Report of the Wellington Public Transport Spine Options Hearing Subcommittee

Report agreed by the Hearing Subcommittee on 21 February 2014.

1.0 Introduction

We are pleased to present this report, which we see as a significant milestone in the development of Wellington's public transport system. We are unanimous in our view that a step change is required in Wellington's public transport system in the medium term to meet our shared regional objectives.

We have thoroughly considered the views of all submitters, many strongly held, and have sought additional technical information on a number of issues that were raised with us. It is not possible to resolve all issues in a feasibility study of this nature. Many details will need to be decided in the next stage, but we are confident that the direction we are putting forward is the best option for Wellington City and the region as a whole.

This report outlines the key issues raised through the consultation process and shows how these have been considered and resolved. Our recommendations to the Regional Transport Committee provide a clear way forward for the three partner organisations (Greater Wellington Regional Council (GWRC), Wellington City Council (WCC) and New Zealand Transport Agency (NZTA)) to progress to the implementation phase of this project.

Wellington Public Transport Spine Options Hearing Subcommittee:

Fran Wilde, Chair Greater Wellington Regional Council (Chair)

Celia Wade-Brown, Mayor Wellington City Council

Nick Leggett, Mayor Porirua City Council

Wayne Guppy, Mayor Upper Hutt City Council

Jenny Chetwynd, Regional Director (Central) New Zealand Transport Agency

2.0 Background

First some brief background on the process.

The Wellington Public Transport Spine Study (the study) arose out of the Ngauranga to Airport Corridor Plan, adopted in 2008, which identified the need to investigate options for a high quality public transport spine through central Wellington, as part of a package of overall transport improvements to the state highway, local roads and active modes. The Corridor Plan identified a package of measures to strengthen four key transport elements:

- A high quality and frequency passenger transport spine
- Highly accessible and attractive activity or shopping streets
- A reliable and accessible ring or bypass route for vehicles
- Interconnected and convenient local street, walking, cycling and passenger transport networks.

The study was commissioned jointly by Greater Wellington Regional Council, Wellington City Council and the NZ Transport Agency, and was completed in the period from mid-2011 to mid-2013.

The study forms one part of a wider public transport network planning exercise that will achieve a more efficient and effective public transport system in Wellington City. We are designing a public transport network that:

- goes where people want to go, at the times they want to travel
- provides competitive journey times
- provides value for money
- is easy to understand and use
- is safe, comfortable, and reliable
- provides flexibility, allowing people to change their plans.

The study investigated the feasibility of a large number of different public transport options (both corridors and modes) and progressively narrowed these down to three options – Bus Priority, Bus Rapid Transit, and Light Rail Transit running along a corridor between the Wellington Railway Station, Newtown and Kilbirnie.

After considering the study outcomes at its meeting on 19 June 2013, the Regional Transport Committee identified Bus Rapid Transit as its preferred option and agreed to consult with the community on the three shortlisted options.

Consultation Process

Formal public consultation on the Wellington City Public Transport Spine options commenced on the 24 July and closed on 1 October 2013. Market research was also carried out using three online citizen panels managed on behalf of Wellington City Council and Greater Wellington Regional Council.

A total of 278 submissions were received, 26 from organisations or groups and the remainder from individuals. In addition 514 people also filled in a form to support the themes in the submission by Generation Zero.

Hearing Subcommittee

The Wellington Public Transport Spine Options Hearing Subcommittee was established by the Regional Transport Committee on 18 September 2013. The Subcommittee comprises Cr Fran Wilde - Greater Wellington Regional Council (Chair), Mayor Celia Wade-Brown – Wellington City Council, Mayor Nick Leggett - Porirua City Council, Mayor Wayne Guppy – Upper Hutt City Council, and Jenny Chetwynd – Regional Director, NZ Transport Agency.

The Subcommittee received a full hard copy of all written submissions, as well as full copies of the reports from the Wellington City Council and Greater Wellington online citizen panels. A summary of the feedback received from submissions and the online citizen panel surveys was also provided to the Subcommittee and is available on the GWRC website (www.gw.govt.nz).

The Subcommittee met on the 26 November and the 2 December 2013 to hear 43 oral submissions in relation to the spine options. The Subcommittee reconvened the meeting on 5 February and 21 February 2014 to discuss the issues raised in both the written and oral submissions through the hearings. Additional advice was sought and received from officers and an expert technical advisor. This report forms the record of those deliberations and the recommendation of the Subcommittee to the Regional Transport Committee.

3.0 Key Issues considered by the Subcommittee

A significant number of issues were raised with us in submissions and at the oral hearing. Also, we requested additional information on specific issues from the study consultants, officers from GWRC, WCC and NZTA and an independent technical advisor (Denis Leviny of Opus Australia). We considered this information and agreed on the best option.

This section provides a record of the issues we considered, our understanding of those and how we resolved them. We have organised them into 20 key themes, starting with the broader strategic issues and narrowing down to more specific points. It is important to note at this stage that we found that the issue of which transport mode was right for Wellington to be far less critical than might be assumed from some of the public debate around it. In our view the identification and construction of the core spine corridor and associated priority measures was of far greater importance.

The preferred option that is recommended to the Regional Transport Committee is summarised at the end of this section.

Key Issues

3.1 Study scope and identified problems

Some submitters raised concerns about the scope of the study, some touched on the objectives of the study, and many raised issues similar to the problems that were identified by the study.

The purpose of the study was to assess the feasibility of a high quality public transport system as identified in the Ngauranga to Wellington Airport Corridor Plan (specifically from the Wellington Railway Station to the Wellington Regional Hospital), as part of a package of overall transport improvements to the state highway, local roads and active modes.

Several submitters commented that the study focused on too narrow a geographic area and should have included areas further north (primarily Johnsonville if not the entire public transport network). We consider that the study terms of reference appropriately reflect the recent significant investment made in the region's heavy rail network (through the new Matangi trains and network infrastructure) and that duplication or replacement of the function provided by the heavy rail network should be excluded. The decision to extend the spine to the east (Kilbirnie) was made by the study partners when analysis showed good potential to increase public transport mode share from the eastern suburbs catchment. This aligns well with the desire to extend the spine on to the airport in the future, with the Regional Public Transport Plan, and the targets in the Regional Land Transport Strategy.

The problem definition for the study was established at the beginning of the process and confirmed throughout the study including through testing with reference and stakeholder groups. The problem definition is focused on a future state in 10-30 years' time and includes the following key elements:

- Slower public transport journey times
- Unreliable public transport journey times
- Increased traffic congestion in the strategic and local road network and related environmental impacts
- Constrained economic growth and productivity in Wellington as a result of access constraints
- Diminished returns from current and planned transport investment resulting from the uncertain nature and shape of the public transport system in the longer term.

We also heard from submitters on issues with the current public transport system and their desires for what a future system should deliver. These themes were well-aligned with the problem definition (and the study objectives) and include the need for reliability of journey travel time, faster travel through the CBD, reduced congestion along the Golden Mile, reduced conflict between all transport users and improved access to the CBD to ultimately reinforce the attractiveness of Wellington as a place to live and work. We also noted the importance of the need to provide certainty about where the high quality, high frequency route would be located so as to facilitate investment in development along this corridor.

The Regional Land Transport Strategy (RLTS) places a high priority on increasing public transport patronage, with a key outcome being to increase peak period public transport mode share (Key Outcome 1.1). The study options provide one means by which public transport mode share can be improved, particularly from the southern and eastern suburbs of Wellington City. The modelling completed as part of the PT Spine Study shows that an improvement in mode share can be achieved

as a result of the project, particularly in the eastern and southern suburbs. Whilst this is a positive outcome, we agree that additional measures will be necessary to further boost public transport patronage. One of the reasons for increasing public transport mode share is to reduce the overall emissions from transport and consequent climate change impacts.

Overall we conclude that the study scope and problem statement are appropriate. However we consider that increasing public transport mode share should be added to the objectives, with the resulting objectives of the spine being to:

- Improve access into and out of the Wellington CBD (thus enabling economic growth and productivity)
- Meet future growth in public transport demand as part of the wider transport network
- Increase public transport mode share, particularly at peak periods
- Improve public transport reliability and efficiency
- Improve the safety and resilience of the transport system for all types of users including public transport users, car users, pedestrians and cyclists
- Provide public transport that is affordable for passengers and ratepayers and that is increasingly less reliant on subsidy

3.2 Purpose of the public transport spine

Submitters raised a number of different and contrasting ideas about the purpose of a public transport spine through the city. Some submitters felt that the purpose of the spine was to travel through and join up as many communities as possible along the corridor. Others suggested that faster journey times were most important to enable public transport to compete with private car journeys and that the spine should be focused on this and a further view was that improved reliability was the most important factor for the spine to deliver.

We note that the Wellington City Growth Spine stretches from Johnsonville in the north through to the Wellington Airport in the south. The identified areas of intensification are Johnsonville town centre, the CBD, Adelaide Road, and Kilbirnie town centre.

A crucial role of the public transport spine is to support this growth spine by ensuring public transport is an attractive option between the key destinations along this corridor. Currently, the northern section is well served by the existing high capacity rail system and buses along State Highway 1 and Hutt Road. However, all services are affected by congestion and poor reliability through the Golden Mile/CBD.

A key role of the spine is to provide a central corridor along which services to and from the north, south, east and west flow effectively, minimising overall journey times and maximising reliability in this heavily congested area. This will contribute to increasing public transport mode share.

Services to and from the southern/eastern suburbs could also be significantly improved to be more competitive with car journey times and to achieve the service levels expected of this core part of the public transport network. The spine has an important role in providing reduced journey times between the key intensification areas in the south and east and the CBD. We consider that providing

faster, reliable and more direct journeys is the best way to optimise the whole transport network, including maximising patronage growth for public transport.

There is a trade-off between speed and reliability on the one hand and accessibility on the other. A high number of stops provide higher accessibility but lower speed and less reliability. In order to minimise overall journey times and improve reliability along the core spine there is a need to rationalise stops and use efficient corridors. We believe it is not practical for the core spine corridor to serve all communities and some of these (for example Hataitai Village and Constable Street) will instead continue to be served by complementary local services which will have the benefit of the spine infrastructure once they join the core spine corridor.

We conclude that the primary role of the public transport spine is to support the efficient and effective operation of the Wellington public transport network by:

- Providing a dedicated central city corridor that enables reliable and improved journey times for all public transport services;
- Providing an efficient, reliable and frequent connection between the central city and the key intensification areas in the southern and eastern suburbs;
- Growing public transport mode share, particularly during peak periods.

We believe that this approach will support the Wellington City Growth Spine and the Regional Land Transport Strategy, including reducing overall transport emissions and consequent climate change impacts.

3.3Dedicated public transport corridors

The vast majority of submitters supported the concept of securing a dedicated public transport corridor along the spine. The key rationale was to improve reliability and to provide quicker travel times that would provide an attractive transport option for existing and potential users. Many submitters made the point that Bus Priority could be implemented now in advance of a rapid transit mode option provided the infrastructure was designed to be suitable for adaptation later. Some submitters highlighted the need for careful design of any public transport lanes to: maintain accessibility; minimise impacts on existing town centres; provide for pedestrian movements; and maintain a high standard of visual amenity. A number of submitters highlighted the need to consider the provision of separated cycle lanes at the same time as dedicated public transport lanes.

We agree that the provision of dedicated public transport lanes and priority at intersections should be a guiding principle for the implementation of the core spine corridor and is, in fact, more important than the choice of mode (ie Light Rail Transit or bus). As a general principle we believe that dedicated public transport lanes along the entire spine route are desirable to ensure that the reliability of the whole system can be improved and maintained.

We strongly support the early implementation of Bus Priority along the agreed spine corridor, with priority to be given to the Golden Mile and the corridor to the Regional Hospital. We also note that discussions are in progress with NZTA and WCC about the possible provision of Bus Priority lanes through the SH1 corridor (Ruahine Street and Wellington Road).

We considered where public transport lanes should be located within the road reserve - whether at the edge of the carriageway or alongside the median. We noted the advantages of a location away from property access points and on-street parking, as this would minimise disruption and improve reliability, and we agree that the next stage of the study should examine the alternative location options in more detail. This should include, within the same process, consideration of accessibility and the relationship between pedestrians and cyclists facilities. We also agree that this should be considered before any interim Bus Priority lanes are constructed to avoid redundancy.

One option we discussed further was providing tidal flow lanes as an alternative to full-time dedicated lanes. This would have the advantage of requiring less space in corridors where space is constrained. Tidal flow road lanes can change direction to accommodate higher flow volumes in the peak demand direction, whilst vehicles in counter peak direction share with general traffic. Managing the process of changing traffic direction is usually accomplished by some form of intelligent traffic system (ITS) such as overhead lane indicators and/or moveable barriers.

The configuration of tidal flow lanes will depend on the number of lanes in the corridor:

- Two lane roads: the implementation of tidal flow requires use of the entire road corridor for the peak direction traffic (ie two inbound lanes one for cars and one for public transport) which means that the counter peak traffic would need to be redirected via an alternative route. Traffic management of the public transport lane would need to be achieved without the use of road markings given the function of the lanes would change depending on the time of day and the direction of flow.
- Three lane roads: the outside lanes can remain fixed in direction, whilst the middle lane could be reversed to suit the time of day. The centre lane could easily be allocated full time to public transport allowing permanent road markings to be provided (ie only the direction of vehicles using the lane changes during the day). This arrangement would mean that the tidal flow only applies to public transport, not other vehicles.
- Four lane roads: This option results in three lanes in the peak direction and one in the other direction, and implies a requirement for very strong tidal flow demand conditions. Two of the peak direction lanes could be provided for motor vehicles and one for public transport. Traffic management of the public transport lane would need to be achieved without the use of road markings given the function of the lanes would change depending on the time of day.

We received independent advice that tidal lanes would be problematic and costly to achieve for Light Rail Transit as additional tracks and supporting infrastructure would be required. It would be more practical for bus-based options which are more flexible in their operation. We were also advised that sharing lanes in the counter-peak direction may impact on the efficiency of the overall public transport network, as follows:

- *Service reliability impact:* public transport running against the peak direction will be used to form peak trips once reaching their destination. Given counter peak public transport vehicles will be operating in mixed traffic conditions, and the intensity of the traffic volumes will also have increased due to counter peak lanes being reallocated to peak direction traffic, then the propensity for delay to these vehicles is increased. Unpredictable late running in the

counter peak direction has the potential to result in random delays for peak direction public transport vehicles, reducing the reliability of the entire network and/or creating a need for longer dwell times at the ends of route to allow recovery of timetables.

- *Network capacity impact:* Counter peak flow public transport vehicles will generally be poorly patronised, and their operation is largely justified by the need to return peak flow vehicles for their next turn of duty. It is desirable to get these vehicles back in position for their next peak run as quickly as possible, and delay will manifest in reduced peak service frequency, or the need for a larger fleet. The exception to this is if it is only possible for a public transport vehicle to make only one trip per peak period (ie on long or slow routes), in which case it will be returning to the depot and the congestion manifests as higher driver wage costs.

We conclude that:

- The provision of dedicated public transport lanes and priority at intersections should be a target for the implementation of the core spine corridor.
- Detailed design of the core spine corridor from the Wellington Railway Station to the Regional Hospital should be progressed as a high priority, including consideration of how any dedicated public transport lanes will be configured and taking into account the needs of pedestrians, cyclists, general traffic and service vehicles.
- Bus Priority lanes could be implemented in the short term along the core spine corridor, as an interim measure. These should be designed to be suitable for the preferred rapid transit mode at a later date;
- The provision of tidal flow lanes for Light Rail Transit would be problematic and costly to achieve as additional tracks and supporting infrastructure would be required.
- The provision of tidal flow lanes for Bus Rapid Transit has the potential to degrade the service quality and reliability, and could lead to additional capital and/or operating costs for the network.

3.4 Reliability outside of dedicated corridors

Some submitters queried how reliable journeys could be facilitated outside of any dedicated corridors, and how this would impact on the total journey time of passengers.

In a Bus Priority option only part of the corridor is located on dedicated lanes. For Bus Rapid Transit the core spine corridor would provide dedicated lanes, but because the system is designed as an open system some buses would travel to other destinations using shared local roads. Light Rail Transit is a closed system, so passengers travelling beyond the core routes would be required to transfer to feeder bus services at interchange points.

We note that reliability is one of the key objectives of the spine and it is important that services run to schedule, have consistent journey times and provide a vehicle spacing that is as close as possible to the desired two minute headway along the spine section. This approach will help to provide a standardised ‘level of service’ for passengers which will play a major part in selling the benefits of the services as an attractive and viable transport system.

In many suburban areas beyond the core spine, traffic congestion levels are low and buses will experience little delay sharing with general vehicles. In areas where there is a degree of traffic congestion bus reliability can be enhanced through the use of Bus Priority measures.

We were advised there are other secondary measures that could be utilised to manage reliability including:

- Timetables that will allow time for layovers at the end of each run. For example if a bus arrives at its destination late, there is sufficient allowance in the timetable for it to still perform its next turn of duty. However we note that layovers can sometimes require a larger bus fleet and more drivers due to the operational inefficiencies associated with buses not being used intensively.
- Timetables that recognise extended running times at congested times of the day on some parts of the network. However we note that this approach is not optimal.
- Standby buses that can be substituted for a late bus as required, a practice sometimes referred to as transposal.

We note that delays experienced outside of the core spine are more critical for inbound buses than outbound ones because they need to mesh with other buses along the spine to provide a consistent and reliable service frequency.

We conclude that the end-to-end journey time for passengers is important to the overall level of service, and that consideration will need to be given to the need for additional Bus Priority measures to maintain the overall reliability of services.

3.5 Preferred spine corridor location

Submitters proposed a wide range of alternative locations for the spine corridor. These include links complementing, replacing or extending the wider public transport network to the north of Wellington City and beyond; alternative links to the east and onto the Airport; and a variety of alternative routes through the CBD, including Willis Street, Victoria Street, Wakefield Street, Featherston Street and along the Quays. Submitters also presented alternative ideas for how a corridor should be designed into the local street network.

We agreed that consideration of the core spine corridor was of primary importance to the outcome of the study and noted the variety of sub-options already considered through the various stages of the study.

Central City

We noted that it was desirable to have one clear legible corridor for public transport through the city centre, and that this should be located as close as possible to major destinations and users and be safe and attractive. We agreed that the primary spine corridor through the central city should be focused along the Golden Mile, comprising Lambton Quay, Willis Street, Manners Street and Courtenay Place. We did however note that a ‘pinch point’ had been identified around the Old Bank

building on the corner of Willis Street and Lambton Quay, and that there were alternative options to mitigate this which could be considered further at the next stage.

Newtown

We also confirm Kent/Cambridge Terraces, the Basin Reserve, Adelaide Road and Riddiford Street as key parts of the spine corridor providing access to the Regional Hospital and the southern suburbs and note that there were no practical alternatives to this location. The precise alignment around the Basin Reserve will be confirmed as part of the Basin Bridge project.

However a key consideration was whether the core spine corridor should travel on further through Newtown town centre. Advice from the study consultants was that twin dedicated public transport lanes through this area would require the acquisition and demolition of properties and removal of on-street parking, and would have significant detrimental impacts on the community. We agreed that significant property acquisition and associated heritage and community impacts would not be a desirable outcome and should be avoided. We agreed that whilst a number of important services would continue on through Newtown town centre to the Zoo and further destinations, the core spine corridor (and the associated dedicated lanes) would finish around the Regional Hospital (the precise location to be determined through subsequent detailed design). As such only a lower-speed route would be possible through Newtown.

Routes to Kilbirnie and the eastern suburbs

We agree that extending the spine corridor to Kilbirnie was a key objective as this allows the spine to serve the important catchment of the eastern suburbs and the airport. A number of options to achieve this were discussed and considered in terms of:

- the purpose of the spine in providing a reliable and fast corridor to and from the CBD
- ability to provide dedicated public transport lanes
- future patronage numbers
- public transport travel times and their comparison against equivalent car travel times
- cost and ease of construction
- impacts on existing communities (ie parking, property and streetscape)
- safety and resilience.

We considered a single spine corridor through Newtown, along Constable Street and Crawford Road and into Kilbirnie town centre. Whilst in theory concentrated demand onto one corridor is beneficial, in practice this corridor has a number of disadvantages. Firstly journeys for passengers from the eastern suburbs would be longer, less reliable and overall less attractive, particularly when compared to the equivalent car journey. This would be at odds with the purpose of the spine in providing an efficient, reliable and frequent connection to the eastern suburbs. Secondly the study consultants advised that twin public transport lanes through this area would require the acquisition and demolition of at least 13 properties as well as substantial other land take, and the removal of all on-street parking. We agreed that significant property acquisition and associated heritage and community impacts would not be a desirable outcome and should be avoided.

The study consultants advised that the only other practical solution along Constable Street would be to remove all parking on both sides of the street and convert the configuration to three lanes. This would allow the following sub-options:

- Option 1: Central lane to be used exclusively as a tidal flow lane. Through traffic in the outside lanes would be delayed by turning traffic at intersections. Importantly, it is unlikely that provision could be made for stops along the entire length of the street, given the vehicles would be in the middle of the road.
- Option 2: Morning public transport lane in the southern outside lane and evening in the northern outside lane. The management of access would need to be controlled by ITS variable signage because all lanes will change direction or function at different times of the day. This is likely to create significant safety issues because traffic joining the corridor could be confused by the lane allocations. Stops could be accommodated by utilising footpath space, although the passenger waiting areas would be tight and the provision of shelters may not be possible.

Whilst it would be possible to design tidal flow lanes in Constable Street, the degree of disruption to existing land uses and the impact on the general amenity of the street would need to be considered carefully. The preferred option would be for three lanes (with no parking at all) with the tidal flow lanes located adjacent to the kerbs, and with a comprehensive lane management system installed along the length of the street to indicate the current lane use allocations as they change during the day. The safety issues associated with this road management strategy would need to be seriously considered in the light of driver confusion about lane designations at different times of the day.

We consider that this is not a practical option for the core spine corridor. This corridor would however remain an important route for bus services. In the future it may also be advantageous to consider some priority measures along this corridor to assist the reliability of these services.

We examined the potential to run the core spine corridor through Moxham Avenue, Hataitai Village, the bus tunnel, Pirie and Elizabeth Streets. Additional investigations undertaken by the study consultants showed that it would not be practical to provide a complete dedicated corridor through this route without significant property impacts. At least 12 buildings would be directly affected and over 40 properties partly affected. There would also be a significant loss of on-street car parking through Hataitai village centre and residential areas. Along the route there are currently 347 on-street car parking spaces, of which it is estimated up to 210 would be removed. Those in the commercial areas are continuously utilised, whilst those in residential areas have a high degree of utilisation. Many residential properties in this area do not have alternative off-street parking provision.

The consultants also identified that the reliability and travel times of this route would be affected by:

- The high number of direct residential accesses onto the corridor that would result in ‘side friction’;
- The number of bus stops along this route (10) and the relatively short distance between these stops (an average of 200 metres). These would have to be significantly rationalised to achieve desired journey times and meet overall standards for the Bus Rapid Transit network
- The number of intersections through which this route travels (18 in total)
- Limited capacity of the Hataitai bus tunnel to cope with additional bus services if demand were to increase beyond the level projected.

We consider that the only practical outcome through this corridor would be an enhanced Bus Priority outcome (not full Bus Rapid Transit), which would not meet the desired level of service for the overall network. As a result we do not consider this corridor would be able to provide the necessary priority required to be the core spine corridor. Other local bus services will continue to serve this important catchment.

We consider the primary option to be the State Highway 1 corridor through the duplicated Mt Victoria Tunnel, Ruahine Street and Wellington Road. This provides a fast and reliable corridor between the eastern suburbs and the CBD. However we note that further investigation will be required in the next phase of the project to determine whether dedicated public transport lanes should be provided, and whether forecast travel times can be achieved. As a first step we agreed that it would be desirable for NZTA to plan for a designation over this corridor to include provision for dedicated bus lanes.

Seamless rail journeys to and from the north

Some submitters told us that the public transport spine was broken at the Wellington Railway Station, and that people travelling into Wellington City from the north by train should be able to travel seamlessly through the CBD and beyond without needing to interchange.

We note that the purpose of the spine corridor is not to extend rail services from the north further into the CBD. We already have a quality, high capacity heavy rail system which delivers significant numbers of people from north Wellington and the rest of the region into the northern end of the CBD. Most of these people have only a short trip beyond the station (0.9km average) which 90% make by walking or cycling.

We recognise that a seamless service from the north might potentially increase the number of future through-journeys using public transport, possibly at the expense of active modes. However, we note that providing services that continue through and beyond the station would require extending the heavy rail through the city at a significant cost, or alternatively running tram-trains on the heavy rail network. This includes a number of operational issues and cost implications which are discussed separately. Either way, the large number of services and high volumes of passengers arriving at Wellington Railway Station during peak times mean that most people would still be required to transfer in any scenario, as it would be feasible for only a small proportion of those services to continue through.

Therefore we expect that those travelling into Wellington Railway Station by rail from the north will continue to walk to their final destination or transfer to another public transport service. We believe the best approach is to ensure those that want to transfer to another public transport mode are able to do this as easily and pleasantly as possible, and that connecting services are frequent, fast and reliable.

Extended routes

We do note, however, that the Regional Council is proposing to provide through bus services from the north through the CBD and to the eastern and southern suburbs as part of the future public

transport network. This will provide options for those passengers wanting to travel to Te Aro and destinations in the southern and eastern suburbs. The Ngauranga to Airport Corridor Plan already includes proposals to develop Bus Priority lanes on Hutt Road to Ngauranga. These would complement and feed into the core spine corridor.

We agree that it is desirable for services to extend beyond the core spine to service destinations further afield. In a Light Rail Transit mode option this means additional infrastructure (ie rails, power). For bus-based mode options, additional infrastructure is less likely to be required, although the type of vehicles and power source selected will have a bearing on this. We noted that it is likely that bus-based services would be configured around through routes running north-south and west-east to maximise efficiency and service frequency.

Conclusion

We conclude that the core spine corridor should be confirmed as:

- The Golden Mile, along Lambton Quay, Willis Street, Manners Street, and Courtenay Place. The next stage of the study will have to consider the best options around the Old Bank building.
- Kent/Cambridge Terraces, Basin Reserve, Adelaide Road and Riddiford Street to the Regional Hospital, with that the precise location through the Basin Reserve to be determined as part of the Basin Reserve Board of Inquiry process.
- Connecting east to Kilbirnie using the Mt Victoria Tunnel/SH1 corridor, subject to further design indicating that dedicated lanes can be satisfactorily provided.

We also agree that:

- Provision of a route for an extension of the spine corridor through to the Wellington Airport should be future-proofed under all options.
- There will be a continuing need for people to interchange at Wellington Railway Station and the focus should be on continuing to make this transfer as quick and easy as possible.
- The Bus Priority lanes proposed as part of the Ngauranga to Airport Corridor Plan on Hutt Road would support and feed into the core spine corridor and their timing needs to be evaluated alongside other related projects including the Ngauranga to Petone cycleway and the Ngauranga to Aotea improvements to the state highway.
- The core spine corridor does not preclude other bus-based services along other routes, and additional corridor priority measures may be advantageous to assist the reliability of these routes.
- If Bus Rapid Transit is selected, extending bus routes beyond the core spine to service destinations further afield should be considered, including the option of through-routing.
- Further investigation should be carried out as a high priority to confirm whether a designation for additional bus lanes is required on Ruahine Street and Wellington Road.

3.6 Secondary routes

Some submitters were concerned about the introduction of a secondary route for public transport vehicles through the CBD, because of the greater walking distance for passengers and reduced legibility, as well as the need for additional public transport lanes and stop facilities.

We agree that:

- Journey time reliability is one of the key elements of the problem to be addressed by the spine – it continually ranks highly when passengers are asked about what dissuades them from using public transport.
- Reliability is influenced by a number of factors, one of which is the impact of bus-on-bus congestion along the Golden Mile, with currently well over 100 vehicles per hour, in each direction at peak times.
- The study and previous studies acknowledge that an upper limit of around 60 vehicles per hour is desirable to minimise delays.
- Larger capacity vehicles associated with the Bus Rapid Transit and Light Rail Transit options would result in a reduction in vehicles travelling along the Golden Mile. New through-routes proposed as part of the Regional Council's current service procurement process will also reduce the number of vehicles along the Golden Mile. However this may not be enough to achieve the desired target of less than 60 vehicles per hour.
- Proposed changes as part of the Wellington Bus Review include short-running some peak services from the north. This would mean services continuing to run along Lambton Quay, but terminating before Willis Street and returning along the Quays. This will also reduce bus congestion along Willis and Manners Streets.
- The study proposed a secondary route through the CBD for some services - at peak times to further reduce the number of public transport vehicles travelling along the Golden Mile. This route was along Featherston Street and Jervois Quay. This has disadvantages in terms of providing a single legible route and requiring additional infrastructure. An alternative approach is to redesign the network to provide for more feeder bus services.
- There may be potential for additional corridor capacity along the core spine route in some locations, through providing for passing lanes at critical 'bottle-necks' and major stops, or through split stops.

We conclude that in order to deliver a high quality, fast and reliable public transport service, the number of vehicles travelling along the core spine corridor should be targeted at a maximum of around 60 vehicles per hour. Further investigation is required into the alternative means to achieve this, either through a secondary route at peak periods or through enhancing the capacity of the corridors at critical locations, through split stops or through more short-running peak services.

3.7 Public transport priority at intersections

A number of submitters commented on the priority to be assigned to public transport vehicles along the corridor and how this was to be balanced against other modes using the same corridor.

Intersections are one of the key sources of delay for public transport services. Neither the proposed Bus Rapid Transit nor Light Rail Transit systems would operate in a segregated corridor similar to one

along which rail services operate. Both modes would operate through city streets used by a variety of other modes. The feasibility study assumed for the purposes of evaluation that the environment would be as segregated as possible, providing high level of fixed priority at intersections to allow consistent reliability and travel times. However in practice this will depend on balancing the competing needs of all the modes sharing the corridor and the degree of priority that can be delivered.

For example, selective priority at intersections could provide the following options:

- All public transport vehicles have full priority through intersections, maintaining their speed and avoiding delays;
- All public transport vehicles that are running behind schedule have full priority through intersections, maintaining their speed and avoiding delays;
- Public transport vehicles have part priority at intersections, with reduced delays.

The core spine corridor can be split into four key sections. These are described below in relation to the number of signalised intersections, the competing modes and key cross flows.

- *Wellington Station to Courtenay Place (Golden Mile):*

  Two kilometres through the centre of the CBD with a maximum target of up to 60 public transport vehicles per hour per direction, operating at peak times. The Golden Mile is an important pedestrian corridor through the centre of the city, but has low traffic volumes. There are 11 signalised intersections – all with single or double cycle pedestrian phases - and seven pedestrian crossings along the corridor. Major traffic flows cross the corridor at four signalised intersections, Whitmore Street/ Bowen Street, Willis Street/ Boulcott Street, Taranaki Street/ Courtenay Place and Victoria Street/ Manners Mall.

  The current urban environment is designed to provide a high level of connectivity and safety for pedestrians, which may impact on public transport travel times. Provision for public transport vehicles will therefore need to balance improved travel times whilst maintaining pedestrian connectivity and safety.

- *Courtenay Place to Basin Reserve:*

  There are three signalised intersections and one pedestrian crossing (directly to the north of the Basin in both directions) along this 600m corridor. Priority for public transport vehicles turning onto / from the Golden Mile will have to be balanced at the intersection of Courtenay Place / Kent Terraces with the needs of general traffic. The signalised intersection of Vivian Street (SH1) and Kent / Cambridge Terraces is the major intersection along this corridor and demand for general state highway traffic will need to be balanced against priority required for public transport vehicles.

- *Basin Reserve to Newtown:*

Two kilometres between the northern side of the Basin Reserve and the intersection of Constable Street / Riddiford Street. There are eight signalised intersections and two signalised pedestrian crossings along the corridor. The key intersection along this corridor is John Street / Adelaide Road / Riddiford Street. Adequate priority measures for public transport vehicles at this already congested intersection are required in order to provide for the designed travel times.

The ability to provide priority to public transport vehicles at the intersection of Adelaide Road / Basin Reserve will be easier once a solution has been implemented for the Basin Reserve (estimated to be in 2018). Adelaide Road is also an important general traffic and pedestrian route. There are multiple side roads and frontages to commercial units and residential apartment blocks, all of which will require access off Adelaide Road. This is a key area where safe and convenient access needs to be balanced against providing reliable and fast public transport travel times.

- *Basin Reserve to Kilbirnie*

  Two kilometres with five signalised intersections and one zebra crossing. Between the Basin Reserve and Kilbirnie Crescent the corridor will be relatively unconstrained by pedestrian and vehicular traffic, with public transport vehicles running in segregated lanes along this entire stretch apart from through Mt Victoria tunnel where they would mix with general traffic.

  Kilbirnie Crescent is a minor road with residential frontages, access to playing fields and access to Kilbirnie Pool. The needs of recreational users (park and leisure centres) and residents will need to be balanced against providing reliable public transport travel times. The intersection of Kilbirnie Crescent / SH1 is currently being investigated with the aim of providing greater priority to public transport vehicles leaving SH1 or exiting Kilbirnie Crescent onto SH1.

We also received advice from officers that the existing technology used in Wellington, including the Sydney Coordinated Adaptive Traffic System (SCATS) system and Real Time Information (RTI), has the existing capability to deliver priority for public transport vehicles. This can be utilised to request priority for vehicles that are running behind schedule or all vehicles. This system has already been utilised successfully in Perth, Australia, and a trail is planned for Wellington.

We conclude that the corridor should be designed with the aim of providing appropriate priority for public transport vehicles, taking into account the needs of other modes, including pedestrians, cyclists, general traffic and service vehicles at each intersection, and over the network as a whole.

3.8 Transfers

A number of submitters considered that the penalty applied to transfers in the study evaluation was too high, that transfers are a necessary part of any public transport system and that people don't mind transferring if good facilities and frequent services are provided. As the need to transfer was

one of the significant dis-benefits of the Light Rail Transit system, submitters believed that a different approach to this issue would improve the viability of this mode option.

We received independent advice that the assumed penalty applied to transfers in the study evaluation was consistent with best practice and reflected the actual and perceived dis-benefit to public transport users. We were advised that the penalty applied was in fact on the low side of the best practice range.

We acknowledge that some transfers are required as part of any efficient public transport system. These should be carefully balanced as they do impact on travel choices. However, the shorter the total trip length the greater the perceived dis-benefit associated with needing to transfer. In Wellington most public transport trips are short (by international standards) and as such the transfer cost is proportionally higher. One of the advantages of the current bus network is that most routes provide direct services to the central city. We note that the Light Rail Transit option would require a large number of people from the southern and eastern suburbs to transfer midway through their trip despite a relatively short overall trip length of less than 10km.

Public perception of transfers indicates clearly that transfers can be perceived negatively. The Wellington Bus Review initial network proposals included a number of suburban interchanges. A significant number of submissions were received (over 6000) with one of the dominant themes being concern over the need to transfer between services and the quality of the interchange facilities.

We conclude that the way transfers were evaluated in the study is acceptable and robustly reflects the impact that these are likely to have on travel choice and public transport patronage. We also consider that improvements will be required to transfer facilities and this is discussed in the next section.

3.9 Interchange facilities

Some submitters considered that the quality and design of any interchange points will be critical to the success of any new rapid transit system.

We agree that the design of key interchanges is very important. These must be safe and attractive facilities, well integrated with adjacent pedestrian facilities/cycle facilities and provide a quality interchange experience. They may also provide good opportunities for development that involves ‘transit oriented design’ with a mix of uses and quality urban design. Stops/stations along the public transport spine must also be of a high quality, providing a level of functionality and amenity that would be expected for a high quality public transport system.

Under a Light Rail Transit option, significant interchange points will be required at each end of the Light Rail Transit route to allow mode transfer for all bus routes operating beyond that point. A number of other intermediate interchange points along the length of the Light Rail Transit route will also be required to allow interchange with bus routes that intersect the Light Rail Transit corridor and that will no longer operate along the Golden Mile.

Under a Bus Rapid Transit scenario, the interchange strategy will be similar. However, the size and functionality of the interchange points at the end of the core spine corridor will be significantly diminished to reflect fewer transfers as a result of the Bus Rapid Transit vehicles being able to operate beyond the limits of the core spine corridor. Depending on the network operating strategy applied, there may or may not be a need for intermediate interchange points in order to provide an alternative to feeder routes joining the core spine corridor.

We received advice that a hierarchy of interchange design should reflect the passenger volumes and function at each location:

- *Interchange Hub:* Located at the ends of the Light Rail Transit route or the core spine corridor, these locations are expected to process large numbers of travellers, particularly under the Light Rail Transit scenario where there are high numbers of forced transfers. Of particular importance will be the identification of a sufficiently large enough parcel of land to accommodate the termination and turnback of buses feeding the spine. The design should accommodate the seamless transfer of people between vehicles, as well as travellers originating their journey from that location during peak periods. Particular attention will need to be paid to weather protection and place-making issues in order to make the interchange an attractive place, both during peak periods when there are large numbers of people present, and during off peak periods when the interchange could be largely empty (eg late at night). Integration of retail and other services could enhance peak period amenity of the facility but it is unlikely that this feature would be available over the full operating period of the network. Therefore security and safety issues will feature highly in the design.
- *Special Interchange Hub – Wellington Station:* Located at the northern end of the spine, this would perform all the functions of an Interchange Hub (described above), but also needs to process high volumes originating from the rail network. The current interchange already provides an 'all weather' interchange, with relatively short walking distances, that compares well against comparable international rail/bus interchange facilities. However there may be opportunities for improvement to this facility.
- *Intermediate Interchange:* Located along the spine, these locations will need to process the interchange between spine and the feeder bus services. They will have some of the features of the Interchange Hub but scaled down. Of particular focus will be issues of safety, security and weather protection because outward-bound trips during off peak periods are likely to involve longer waiting times for passengers due to the lower service frequency of the feeder bus services.

We conclude that interchanges will be an important feature of any public transport solution along the spine and that further work is required to develop a hierarchy of interchange design requirements related to the intended function of each interchange. Issues of safety, security, weather protection and place-making will be important features to incorporate into the functionality requirements of each location. We also conclude that there is potential to investigate a comprehensive 'Transit Oriented Development' as part of the Wellington Railway Station, Kilbirnie and Newtown interchanges.

3.10 Capacity

We noted the following key concerns raised by submitters in relation to capacity:

- Bus Rapid Transit will be "at capacity on day one", in particular on the proposed route to Kilbirnie (via the Mt Victoria Tunnel).
- The capacity of a Bus Rapid Transit system is inadequate to meet future needs, especially if demand outstrips expectations
- The greater capacity of a Light Rail Transit system is more appropriate for Wellington and will future-proof the public transport system.

We received the following advice from officers and the independent technical advisor:

- The Bus Rapid Transit system as modelled for the PTSS evaluation provided 16 vehicles per hour on both the Newtown and Kilbirnie routes, providing capacity of 1600 passengers/hour on each branch and capacity of 3200 passengers/hour in each direction along the Golden Mile. This is sufficient to cope with projected growth up till 2041. It is important to note that this is based on a theoretical network design for the purposes of comparison of options only.
- Whilst the modelling results for the study indicated that during the AM peak, loadings for vehicles on the Kilbirnie branch would be at around 100% volume capacity (VC) from day one, this has been misinterpreted. The modelling simply allocated enough vehicles to meet forecast demand and no more. Additional services can simply be scheduled to provide additional capacity as required.
- There is considerable spare network capacity. The Bus Rapid Transit system could theoretically accommodate 30 vehicles per hour on each branch, nearly double what has been assumed for the evaluation. A final network design and the specification of services would take these factors into account to ensure that there was sufficient capacity to meet demand.
- It is the constraint of the narrow Golden Mile corridor that limits capacity, not Bus Rapid Transit as a system. This is due to the need to limit the number of vehicles using this corridor during the peak period to ensure that buses do not hold up other buses. This same constraint applies to all the modes, and a similar limit on the number of vehicles would apply to Light Rail Transit.
- There are examples of Bus Rapid Transit systems around the world that provide significantly more capacity than would ever be needed in Wellington, including several in Australia. The Brisbane Bus Rapid Transit system has a capacity that is almost 5 times more than what is needed to meet forecast peak demand in Wellington.
- The Golden Mile constraint means that the theoretical capacity of Bus Rapid Transit in Wellington is around 6,000 passengers/hour in each direction, using vehicles with a 100 person capacity. If larger Bus Rapid Transit vehicles were to be used this capacity could be increased. A capacity of 6,000 passengers/hour in each direction is almost double the forecast peak demand levels, and more than sufficient to meet the mode share target for public transport in the Regional Land Transport Strategy.
- It is estimated that a Light Rail Transit system in Wellington would have a capacity of around 10,000 passengers/hour. This is purely because a two car Light Rail Transit tram has a capacity of 180 passengers, compared to the assumed 100 passenger capacity of the Bus

Rapid Transit vehicles. Utilising larger Bus Rapid Transit vehicles on a similar network could achieve a similar capacity.

- The system as modelled for the feasibility study assumed one-way Bus Rapid Transit running with no passing lanes and vehicles that can hold 100 passengers. If needed at some point in the future, increased capacity can be achieved through using passing lanes at key bottlenecks or larger vehicles.
- It is noted that in order to accommodate these theoretical capacities and guarantee travel times and reliability on the Golden Mile, refinement of the network design might be required for either of these modes. This might include interventions such as some direct routes becoming feeder services to interchange locations, the use of a secondary route for some services, split stops, or passing lanes.
- During the AM peak period (7am to 9am), there will be peaks in patronage that occur at the 'peak of the peak'. The Light Rail Transit system with its larger capacity is able to cope easily with peak demand. The Bus Rapid Transit system, through higher-than-average service frequencies at these times, also has the flexibility and capacity to cater for demand during the 'peak of the peak,' whilst still delivering the forecast travel times. At non-peak times when there is less demand, it is likely that the Light Rail Transit system will be significantly underutilised with reduced overall efficiency.

We note that precise estimates of capacity cannot be made until the next phase of the project, when the proposed public transport network is decided, the vehicles are specified, the service scheduling is completed and the additional measures to address capacity on the Golden Mile are investigated and resolved.

Having considered the points raised and the further advice and clarification provided, we conclude that:

- A Bus Rapid Transit option would have sufficient capacity as proposed to cope with forecast demand.
- If patronage were over time to exceed current forecasts then the Bus Rapid Transit option has potential to add additional vehicles to boost capacity, and the theoretical maximum capacity of the system is far in excess of patronage predicted by even the most optimistic growth scenarios.
- A Bus Rapid Transit system provides the flexibility to better match capacity with demand across the whole day.

3.11 Vehicle power source

We heard from a number of submitters that there was a strong preference for the future public transport system to minimise carbon emissions and air pollution by utilising sustainable power sources. Many submitters who preferred Light Rail Transit considered this to be one of its strengths.

We support the desire to use more sustainable power sources and to reduce emissions from public transport vehicles along the spine corridor. This is important for climate change mitigation and public health objectives.

Light Rail Transit vehicles are generally powered by electricity and a considerable proportion of Wellington's electricity is generated using sustainable means. Whilst there is some ongoing development of alternative power sources for Light Rail Transit vehicles (such as solar cell technology), it is reasonable to expect that any Light Rail Transit solution adopted will the driven by electricity drawn from the power grid. The method of delivering electricity to the vehicles has generally been via an overhead contact wire suspended above the tracks, which has some visual impacts. Newer technologies, such as the underground delivery system (first used in Bordeaux), and capacitor charging at points along the route, are offering viable alternatives.

Buses have traditionally been powered by diesel fuel which is a non-renewable resource, although trolley buses, like those already operating in Wellington, utilise electricity from an overhead contact wire in a similar manner to a Light Rail Transit vehicle. The rising price of petro carbon based fuels, along with the debate around their future availability of supply, has generated considerable research into alternative power sources for buses in recent years. There are a large number of options available for bus propulsion which can broadly be categorised as either carbon fuel based or electricity based. There is no 'one size fits all' solution for bus propulsion and the technology that is deployed in Wellington will be the one that responds best to a number of specific local requirements and circumstances.

Some of the options available are:

Carbon Based Options

- **Ethanol Buses:** Ethanol can be produced chemically from ethylene or biologically from the fermentation of various sugars. Despite lower fuel efficiency, the distance travelled by an ethanol bus is typically equal to that of conventional diesel buses due to the use of an enlarged fuel tank. It is necessary to have a source of ethanol production to support the volumes consumed by the buses.
- **Biodiesel buses:** Biodiesel is a relatively clean burning, renewable fuel that is becoming increasingly common. Since biodiesel blends such as B20 can be used in existing diesel engines without modifications, it has a very low capital cost requirement relative to other alternative fuels.
- **Liquefied Petroleum Gas (LPG) Buses:** LPG is a relatively common fuel that has been used successfully for bus fleets internationally. Operational issues associated with using LPG powered buses are generally less challenging than with CNG or LNG.
- **Compressed Natural Gas (CNG) Buses:** CNG is a clean burning fuel that yields considerably lower emissions than conventional diesel. Although the fuel cost of CNG compares favourably with diesel, higher capital and operational costs can limit its applicability. CNG buses are also reported to be only 50-75% as reliable as conventional diesel buses although operators in Perth and Sydney have shown that bus fleets can operate on CNG.
- **Liquefied Natural Gas (LNG) Buses:** LNG is stored at very low temperatures and at relatively low pressure in insulated tanks. The cost of transporting LNG from a production plant to a dispensing site can be relatively high thereby limiting its applicability. LNG has been used in some transport applications internationally and has found acceptance due to its higher energy density when compared with CNG.

Electricity Based Options

- **Battery Powered Buses:** Batteries store energy in chemical form in substances that can react to release electrical energy. Electric buses are not commonly deployed as existing technological limitations require time consuming battery recharging after relatively short travel distances, which isn't very practical for route buses which can travel hundreds of kilometres per day. Also the recharge time is extensive. If a bus runs out of power en route then it can be stranded. For this reason, hybrid technology is usually preferred.
- **Hybrid Buses:** Hybrid buses generally comprise both an electric propulsion system and a conventional diesel engine. They operate in a more efficient manner than a standard engine by sharing the energy and power demands of vehicle operations between the conventional engine and the battery-powered (electric) system. Hybrid solutions could also be developed between battery and supercapacitor technology to combine their best elements.
- **Hydrogen Fuel Cell Buses:** Fuel cells combine hydrogen and oxygen in a process to produce electricity, with water and heat as the only by-products. Hydrogen needs to be obtained from other materials which require substantial energy input (thereby producing emissions). The high costs associated with fuel cells and associated infrastructure has limited its use to date.
- **Trolley Bus:** Drawing electricity from overhead wires is a long established technology with hundreds of trolley bus systems in existence throughout the world. A key disadvantage of overhead pick up is that buses can operate only where the overhead cables are provided which limits flexibility to implement new routes quickly and adds to costs which is a particular issue on low demand bus corridors. Overhead wires can be visually intrusive and there are some issues associated with the trolley pole disconnecting from the contact wire. Trolley buses are quieter in operation, and there is much experience with their use in Wellington. This option provides the closest comparison with current Light Rail Transit technology.
- **Online Electric (OLE) Buses:** Buses receive power wirelessly through "Shaped Magnetic Field in Resonance" technology buried in the road and can charge while stationary or being driven eliminating the need for overhead wires. OLE is essentially wireless ground pick up with OLE buses currently being deployed in South Korea after successful trials.
- **Supercapacitor Power Buses:** Capacitors in the bus store electrical charge in two electrodes. The larger the electrodes and the closer they are, the more energy can be stored. Supercapacitors can be charged and discharged in seconds at a depot, or bus stop and can withstand many hundreds of thousands of such charging cycles. This technology is now deployed on Spanish and French trains and hybrid buses all over the world with take up of the technology set to expand as the technology improves.

The Regional Land Transport Strategy recognises system-wide issues of climate change and public health. Ongoing improvement and enhancement of our public transport system is critical to address these issues. Several submitters suggested that the light rail option should be selected on the basis that it was the only one that would effectively address these issues. However, this often appeared to be based on the assumption that the bus-based options would involve the current diesel bus fleet. We note that new buses introduced to the fleet are already required to meet Euro 5 standards and we encourage the exploration of new power technology for any future buses – whether it is hybrid, electric, induction, or other fuel technology – with the associated emission and pollution benefits.

We conclude that it is reasonable to expect that technology will continue to evolve and therefore it should be assumed that a future Bus Rapid Transit system in Wellington will at the time of implementation be operated with a new generation buses that operate on more sustainable power sources. We support this and anticipate that this would be introduced in a staged programme as the existing bus fleet is retired.

3.12 Capital costs

A number of submitters queried the capital costs assessed for the options. Most concerns were raised about the perceived inflation of costs for Light Rail Transit and it was suggested the estimated costs were out of line with international examples and previous estimates for past studies. Specific concerns were raised about the inclusion of costs for a separate Light Rail Transit tunnel (this issue is dealt with separately) and a depot. It was also suggested that the Light Rail Transit option utilise new lightweight technology to minimise the costs associated with track construction.

We noted that the costings are estimates prepared by a specialist international consultancy from the 'bottom-up' and that they were prepared at a feasibility level of accuracy, which is appropriate for this stage of the project. More detailed costings will be required as the project progresses and as additional detailed specifications are available. The estimated costings have been benchmarked against New Zealand and international cost comparisons, and the inclusion of a contingency allowance of 20% is reasonable given the uncertainty of some design elements and ground conditions.

Whilst submitters pointed to some other Light Rail Transit projects in other countries with different costs per kilometre of track, this does not recognise the particular challenges of Wellington or necessarily include the full suite of associated costs for necessary elements such as traffic management, service relocation, design fees and the contingency allowance. In Wellington the introduction of a new Bus Rapid Transit or Light Rail Transit mode would occur through the central city in a narrow, shared corridor that is utilised for a range of different purposes. Many overseas examples have been largely constructed on segregated corridors, such as along redundant rail corridors or motorway corridors. Experience of other recent projects, such as Manners Mall and Memorial Park, which have involved significant changes to inner city streets, have clearly shown the significant costs associated with diversion of underground services. International Light Rail Transit schemes can be quite different due to their different context and type. We also know that the cost of construction is generally higher in New Zealand than many other OECD countries.

We received independent advice on the considerable variation in final costs per kilometre in overseas Light Rail Transit projects, even those within the same country. There is also clear evidence of significant variations between initial estimated costs and actual costs for many such projects. We noted the conclusions from a review of light rail schemes in the UK by the Department for Transport and UK Audit Office (September 2011) which stated that: "Comparisons between the capital costs of light rail projects are difficult to make because no two schemes currently in operation in England are directly comparable. They all have different characteristics."

This UK report compares the capital cost of 11 different Light Rail Transit schemes undertaken between 1987 and 2004. The construction costs of these schemes (in current prices and converted to NZ $) was found to have varied from $12.6 million/km to $94.0 million/km, a considerable range.

It is also important to note that all of these Light Rail Transit projects included part of their route on non-road corridors (ie an existing or disused rail corridor), which would make a significant difference to overall costs. The International Review undertaken as part of the study found a similar range at $12 - $141 million/km. We noted that the study option for Light Rail Transit equates to $59m/km (excluding vehicles and the dedicated tunnel) or $68/km (excluding just the tunnel), which sits well within this range.

A review of the estimated costings for the last comparable study of Light Rail Transit in Wellington, the Ngauranga to Airport Study (Opus 2008), shows an estimated cost of $52 million/kilometre (updated to today's dollars). This is broadly comparable with the estimates for this study.

The estimated cost of a depot for the Light Rail Transit option is around $20million (including additional tracks). This is less than 2% of the total estimated cost of the Light Rail Transit option, and as such is not material to the overall conclusions of the study. No depot has been assumed for Bus Rapid Transit as it is assumed that existing premises will be reused. However even if additional depot space was required and if a similar provisional sum was included to the Bus Rapid Transit option this would add around 8% to the total cost.

We received independent advice on the use of lightweight trams as part of a Light Rail Transit project. In theory this could reduce costs through the use of a lighter track structure and avoiding the need to move underground services.

The weight of a Light Rail Transit vehicle is directly proportional to the size of the vehicle and the materials used in its construction. The weight of the vehicle is important in that it affects axle loading and the force each vehicle applies to the track. Manufacturers choose materials that optimise the trade-offs between the weight of the vehicle, its strength, its design life and the cost. The only viable options for making lighter vehicles (with similar performance characteristics) is to make the vehicles smaller, either in width or length, or use exotic materials at a higher cost.

Conventional tram track is capable of carrying the axle static and dynamic loadings and provides a degree of resilience that minimises ongoing maintenance costs. The mass of the track structure reduces vibration, noise and prevents the track moving under the passage of trams operating at speed, particularly on curves. Lightweight track structure options typically focus towards axle loading of less than 5 tonnes. The track structure is designed to be almost as thin as the road topping and requires a strip of road to be removed to allow the structure to be placed directly onto the existing road bed.

We received independent advice that there are a number of risks and dis-benefits associated with the use of this emerging lightweight tram technology:

- Smaller trams would compromise overall carrying capacity and require additional vehicles, affecting overall congestion levels along the Golden Mile.
- Given the age of Wellington's roads and inconsistency in design standards over the years, there would be a high likelihood that the road bed would need improving to accommodate this type of track structure thus negating some of the purported benefits.

- It is likely to result in added vibration and track movement under the passage of vehicles, and reduced speed limits.
- There are no known examples where these technologies have been applied to a Light Rail Transit system comparable to the one being considered for Wellington and as such this option would carry a significant degree of risk.
- There are likely to be additional operating/maintenance costs for the track and vehicles, which would offset savings in capital costs.

We conclude that the costings provided in the study are sufficiently robust to enable a fair comparison to be made of the options in this feasibility study. We consider that the difference in cost between the Light Rail Transit option and the others was so significant that even with the exclusion of the proposed tunnel or the use of lightweight trams or other adjustments it would not have affected the relativity of the options or the conclusions of the study.

3.13 Separate tunnel for Light Rail Transit through Mt Victoria

We heard from a number of submitters that they perceived the study to be biased against the Light Rail Transit option because it recommended a separate tunnel through Mt Victoria at an additional estimated cost of $380M. These submitters believed that it was both possible and acceptable for light rail vehicles to share a tunnel with general traffic and that there should be no difference between Bus Rapid Transit and Light Rail Transit sharing a lane within the duplicated Mt Victoria tunnel.

We received advice from officers that there are a number of operational, infrastructure, fire-life safety and traffic management issues which would need to be overcome if light rail was to share a lane with general traffic in a new duplicated SH1 Mt Victoria tunnel. These were specific to the light rail option because they related primarily to the operating characteristics, fixed infrastructure, power source and high passenger numbers of that mode.

We were advised that, while it may be possible to address these issues, they are likely to add significant cost and complexity to any SH1 Mt Victoria tunnel duplication project. In addition, widening of the existing SH1 Mt Victoria tunnel portal (which will accommodate two lanes of north-bound traffic in future) may be required due to height clearance requirements for light rail.

Another key consideration is the impact of even a minor traffic incident within the tunnel on the reliability of the entire light rail network. A vehicle breakdown or ‘nose to tail’ accident in the traffic lane shared with the light rail track would effectively bring the entire branch of the light rail system to a halt until the lane could be cleared. By contrast, a bus would have the ability to move into the adjacent lane and continue operating.

For the above reasons, a separate tunnel for light rail is our recommended option. Nevertheless, we acknowledge that a shared light rail/general traffic tunnel does not appear impossible. If the reliability risk around a shared light rail/general traffic lane within the tunnel was considered acceptable, then designing a shared tunnel that would overcome the operational and safety issues may be possible at an increased cost.

We note that even without the cost of a dedicated light rail tunnel the Light Rail Transit option would cost around $560M, almost three times the cost of the Bus Rapid Transit option. Removing the tunnel cost would also result in only a minor improvement to the very low benefit-cost ratio for the Light Rail Transit option, due to the low level of benefits generated by this option.

We conclude that while the need for a dedicated light rail tunnel through Mt Victoria was not conclusive, it was not the defining factor affecting the competitiveness of the Light Rail Transit option in terms of the total costs and benefits and would not have changed the overall conclusions of the study or our conclusions.

3.14 Tram-Trains

Submitters "Trams-Action" considered that the use of tram-train technology has the potential to extend the existing heavy rail network into the central area and avoid the need for modal interchange at the station. They believed this would improve accessibility to the central area for train users and promote mode shift to public transport in the northern suburbs

Tram trains are a variation on the Light Rail Transit concept in which the vehicles are capable of operating not only along city streets but also on a mixed use heavy rail corridor. The first system of this nature was established in Karlsruhe (Germany) where the vehicles play a valuable role in the city's integrated public transport network. The scheme has been replicated in a small number of other locations, mainly in central Europe.

We received independent advice that on the heavy rail network, tram trains would need to compete for track space with other trains, especially on the Western Corridor, where track capacity is already an issue. The Trams-Action proposal is to run tram trains on this corridor as a service that stops at all stations, whilst the existing trains operate express services. We noted that a mixed stopping and express train operating pattern is already utilised on the heavy rail network. Independent advice was that altering this to include tram-trains was flawed because it will reduce the ability to move people by rail as tram trains cannot carry as many passengers as a train, thus underutilising available track space. One solution is to increase the size of the tram trains but this would lead to significant issues with their operation in Wellington's tight city streets. Another solution is to increase track capacity, however this comes at a considerable cost.

We were advised that in order for a tram train to operate in the heavy rail environment it needs to meet a number of requirements not normally applicable to standard Light Rail Transit vehicles. These generally include:

- Stronger vehicle structural integrity and crash protection
- Dual power supply because heavy rail and Light Rail Transit usually have different requirements
- Consistent wheel gauge for street and heavy rail running, which will restrict Light Rail Transit design to the existing rail gauge
- A compromised wheel/track profile because trams and trains utilise a different standard to optimise ride quality and maintenance/wear
- New platforms at all stations to accommodate low floor tram doorways and issues of lateral clearances for the two different vehicle types. There is unlikely to be sufficient space in

many stations to accommodate additional low-floor platforms. Additional signalling equipment would also be required.

- Possible overhead traction wiring modification to suit tram pantograph operating heights
- Fitting of signalling related equipment such as emergency brakes trips to the trams (preferably vehicle based automatic train protection would be installed on the existing rail network to replace all line-side signals)
- New safety procedures and a higher degree of training for drivers.

One solution that avoids some of these issues is the segregation of tram train operations from heavy rail operation by allocating exclusive periods of track use. This would not be possible in the Wellington context. Whilst each of the above issues could potentially be addressed, there is a significant cost and vehicle weight penalty associated with achieving the requirements and the outcome becomes a compromise between the two different technologies. The process for regulatory change is likely to be lengthy and has the potential to impact on delivery lead times for this technology which is new to New Zealand.

In essence, we understand the tram train option is offered as a solution to avoid the need for interchange between modes at Wellington Station. However it is important to note that even if tram trains are adopted there will still be a need for many passengers to interchange at the Wellington Railway Station because there will still be heavy rail services operating and passengers may wish to transfer to tram trains to travel through the CBD and beyond. Therefore this leads to the requirement to invest in tram trains as well as an improved interchange facility thus adding substantially to the cost of the public transport solution for Wellington.

We note that significant investment has only just been made in a replacement fleet of Matangi train units. We believe it would be considerably cheaper and most cost-effective to provide a better interchange solution than it would be to invest in tram trains.

We conclude that whilst tram trains potentially provide a unique approach to extending the spine and linking it to the heavy rail network, prioritising investment to upgrade passenger facilities to support better interchange between trains and the adopted spine mode at Wellington Station would deliver a more effective outcome for Wellington.

3.15 Mode

There was considerable comment about which mode would be appropriate for the spine. A large number of submitters supported Light Rail Transit as they felt this was a mode that would provide a high capacity system, would be attractive to users and visitors, and would encourage growth in patronage in line with the Regional Land Transport Strategy targets. A number of other submitters preferred a bus based system, either Bus Priority or Bus Rapid Transit, as this provided greater flexibility, was less costly and provided the opportunity to reach a much larger part of the city with direct services. Other submitters proposed an extension of the heavy rail system, a system based around personal rapid transit (pods), and a tram-train system.

As noted earlier, we concluded that the choice of mode was not the most critical decision to be made, and that decisions about the corridor and the priority to be provided on that corridor were in

fact of greater significance. The previous sections have discussed these and other issues, and together they have a significant influence on the mode choice for Wellington.

Whilst we accept that Light Rail Transit would provide an attractive mode that is well proven in other cities, we also acknowledge the particular Wellington context in which such a system would have to operate. The route from Kilbirnie to the Wellington Railway Station is only 6 kilometres in length, which is a short route in which to operate a different mode. The route also lacks strong destinations at both end through which to generate demand, and the 'closed' nature of the system means that forced interchanges would be required at either end for most passengers travelling from further afield, which is unattractive to passengers. We particularly noted the submission from Trams-Action which concurs with this view in stating: "*Light Rail Transit could only be successful if given greater route coverage. The small section chosen with forced interchanges at both ends, would surely doom it to failure even if implementation had occurred, since rail, by its very nature and high capacity is only successful when there are sufficient means to generate traffic.*"

The modelled patronage for the Light Rail Transit option was much lower than for Bus Rapid Transit. This largely reflects the need to interchange, and the unattractiveness of this on a relatively short journey. The answer to this is of course to construct a more extensive Light Rail Transit network. However we consider a more extensive Light Rail Transit network would not be viable in the Wellington context due to insufficient demand to support a high frequency service in the suburbs, as well as the high construction costs.

Overall we consider that given the particular geography of Wellington, the density of population and employment, and the level of forecast demand, Light Rail Transit would not be a suitable mode option for the foreseeable future. This option requires the entire system to be put in place on day 1, at a significant cost. This is likely to result in underutilised capacity. The very low Benefit Cost Ratio (BCR) for this option also points to the difficulty of securing funding for such an option. However if demand were to rise significantly above current forecasts this option could be reconsidered at a later date. As such we consider that the corridors should, where practicable, be designed to accommodate Light Rail Transit, as a future-proofing strategy.

We have separately considered tram-trains and find that this would not be cost-effective solution for Wellington for the foreseeable future, and that investment into improving the interchange at Wellington Railway Station would be a more worthwhile investment.

The study has already, in the Long List and Medium List Evaluation, considered an extension of the heavy rail network, personal rapid transit as well as a number of other mode options. These were not considered to provide cost-effective solutions for Wellington and the further information presented by submitters on these options provided no new information on which to change these conclusions.

This leaves a bus-based solution. We note that the existing bus network is effective in providing direct accessible services to almost 80% of the Wellington population, and that journeys are relatively short (ie less than 30 minutes). Wellington also already has the highest public transport mode share in New Zealand which in part reflects the community's acceptance of bus-based transport as being an attractive option.

We heard from many submitters that progress should be made in the short-term on implementing Bus Priority measures, leading towards the later implementation of a rapid transit solution. We strongly support this, but believe that a step change is required in the public transport system for central Wellington to maximise public transport mode share and address the problems identified at the start of this study. We support the introduction of Bus Rapid Transit as early as possible and want to see a clear system specification developed that can be agreed between the partners, with implementation staged over time. One of the advantages of the Bus Rapid Transit option is the ability to spread the capital cost over a number of years, as priority measures are rolled out on the corridors and new vehicles are purchased when older vehicles are withdrawn from the fleet.

We also agree that if demand grows significantly beyond what is predicted then it would be possible to re-evaluate the business case for Light Rail Transit. We agree that physical infrastructure along the core spine corridor should, where practical, be designed in a manner that does not prohibit the future development of the corridor.

We conclude that the preferred mode is bus-based, with initial Bus Priority measures leading to a staged implementation of Bus Rapid Transit as early as possible.

3.16 Bus Rapid Transit system vision and specification

From listening to submitters it became clear that there is generally a poor understanding about what style of Bus Rapid Transit would be possible and appropriate for Wellington and we believe it is important that a common vision can be projected in order to reduce uncertainty around the recommended Bus Rapid Transit option.

We heard that there are many different forms of Bus Rapid Transit network, ranging from enhanced Bus Priority schemes through to fully segregated networks utilising specialised high capacity vehicles. No two cities are directly comparable, and as such it is not appropriate to model a system based on an international example. Instead we note that a customised solution is being proposed for Wellington that reflects the unique characteristics of our city.

The system being proposed for Wellington has in-road dedicated bus lanes, with prioritisation at road intersections, capable of supporting enhanced buses that can also leave the bus lanes to operate on the wider road network. This system aims to provide reliable rapid transit through the central city where traffic congestion currently impedes bus performance, whilst having the flexibility to reach out into suburban areas to provide a high level of accessibility.

In the Wellington context, with our narrow central city streets, it is not practical to plan for a system with complete segregation, such as is seen in Brisbane or South American cities. There are many different forms of Bus Rapid Transit as outlined in the International Bus Rapid Transit Standard.

We understand that a Bus Rapid Transit scheme would be implemented on a staged basis in order to avoid triggering the investment required to replace all existing buses, some of which are relatively new, and to reflect the incremental provision of priority measures. Therefore the system needs to provide a degree of compatibility between traditional bus operations and the Bus Rapid Transit system, at least during the staged implementation phases.

A number of features and design standards of the future system are as yet unknown, as additional investigation will be required to establish these. However to provide some clarity at this stage, an initial specification for a Bus Rapid Transit network suitable for Wellington is provided below:

Vehicles

- A ***transition from existing buses*** to purpose built vehicles that can maximise the benefits made available by the core spine corridor. This would be timed based on fleet replacement programs and demand levels.
- ***Maximise the capacity of vehicles*** dependent on the route and conditions. The reference design used a 100 person bus.
- ***Steerable axles*** to control the swept path to improve cornering and reduce the risk of the rear of the bus striking people/objects
- ***Low floor height*** vehicles to allow roll-on access from station/stop platforms
- A ***more sustainable power source*** based on emerging technologies that reduces the carbon emissions of the bus fleet. This can be progressively introduced as new solutions become commercially available and reliable
- ***Multiple doors***, recognising that there is a trade-off between the number of doors and vehicle capacity (especially seating)
- ***Left hand side doors only*** to be compatible with street running. This has implications on the design of stop facilities
- ***Auto guidance and self-levelling suspension*** to manage the platform/vehicle interface at stops thus assisting boarding and also preventing platform strikes
- ***Ability to accommodate*** prams and wheelchairs within the vehicle
- ***On-board passenger displays*** and verbal announcements

Stations/Stops

- The **location and number of stops to balance accessibility and efficiency**, including the desire to improve travel times
- The ***length of the stops reflects the density/frequency of bus operation***, and can accommodate multiple buses at once in the central city.
- ***Low height platforms*** compatible with vehicle floor height
- ***Bus guidance system or Kassel curbs*** to achieve accurate docking to manage vehicle platform gap
- ***Platform furniture along*** the core spine corridor including shelter, seating, lighting, safety railing, real time display, tactile tiles. Other selected stops could be built to this standard but other stops would remain at existing standards.

Dedicated lanes

- Selected ***Bus Priority measures as a first step*** towards the creation of the Bus Rapid Transit system, with sections of the core spine corridor constructed progressively as funding is available
- An ***'open' system*** on which buses can leave and join the core spine corridor at designated points to access wider suburban catchment areas

- A ***single lane in each direction*** for the core spine corridor, with the design providing for buses leaving the dedicated lanes and entering the general traffic lanes at any point should an unexpected obstruction be confronted.
- ***Dedicated lanes for buses as a guiding principle***. Further consideration would be needed on whether taxis should be allowed to also use these lanes
- Vertical and horizontal design standards to allow for ***Light Rail Transit compatibility*** where practical, to leave open the option of a transition of mode at some time in the future
- ***Recognition of cycling requirements*** where it is anticipated that Bus Rapid Transit will share a corridor. Where possible this should be by physical separation of the modes
- ***Bus Priority for at-grade intersections*** achieved through traffic light control.

Miscellaneous

- ***New integrated ticketing system*** with a preference for off vehicle ticket sales and on-board validation

We conclude that a vision for the future Bus Rapid Transit system, based on the above, should be developed and shared with the community as a matter of priority.

3.17 Service procurement and staging

A significant number of submitters suggested that Bus Priority could be implemented in the short term as an initial step, leading towards a rapid transit system in the medium to longer term. There was also some suggestion that Bus Rapid Transit could be implemented as an initial step but the corridors designed for Light Rail Transit, which could be implemented at a future date if demand was sufficient.

We further considered how the delivery of any option should be staged. This includes consideration of the statutory procurement process that Greater Wellington Regional Council (GWRC) is currently starting for the delivery of new public transport services under the Public Transport Operating Model (PTOM) process prescribed in the Land Transport Management Act and NZ Transport Agency procedures.

The PTOM process has had to be started in advance of the decision on the study's outcome, to meet contracting deadlines. GWRC has developed initial proposals for how Wellington City will be divided into 8 'units' under PTOM. This has been done on the basis of the Regional Transport Committee's interim decision that Bus Rapid Transit was the preferred option. As the Subcommittee is recommending Bus Rapid Transit these assumptions are consistent. If, however, the Regional Transport Committee were to decide on a Light Rail Transit option in its final decision, the PTOM contracting process can be reviewed, albeit with a requirement to extend the current contracts to provide additional time.

The current draft units under PTOM provide for two key through-routes (north-south and east-west) as well as a number of other routes. These rely on a spine corridor through the central city. It also assumes a replacement of the current trolley bus network, to allow for services to provide more efficient through-routes that are not possible with the fixed constraints of the current trolley bus

network. It is noted that this is consistent with the recommended option for Bus Rapid Transit which is designed as an 'open' system that allows buses to travel to destinations outside the core routes.

The draft PTOM proposals have been sent to registered operators for feedback in accordance with the procedures in the Land Transport Management Act. They will be formalised as part of the new Regional Public Transport Plan, which Greater Wellington Regional Council needs to adopt before July 2014. The formal procurement process will then proceed and is expected to result in new service contracts with operators before June 2017, when all existing contracts expire. The contracts may have a life of up to 12 years, which therefore extends into the period in which the study options are envisaged to be operational.

We discussed whether it was practical to propose a staged implementation of the spine, starting with Bus Priority, then leading to Bus Rapid Transit, and possibly even leading to an eventual future of Light Rail Transit, if circumstances changed. We heard from submitters and officers that Bus Priority and Bus Rapid Transit are essentially different ends of the same spectrum. The highest specification of Bus Rapid Transit would involve high capacity, high frequency services running on segregated corridors, supported by off-bus infrastructure and information. Bus Priority can involve all these same elements but at a lower specification.

We also heard that, whilst it was possible for the public transport corridors to be designed to be compatible with a future Light Rail Transit system in terms of their basic dimensions, converting a Bus Rapid Transit system to Light Rail Transit would cause considerable disruption to the public transport network for a significant length of time.

We conclude that:

- Bus Priority measures could and should be implemented in the short term (ensuring that any works are compatible with the longer-term future option)
- A decision on the preferred modal option and system specification needs to be made as soon as possible to feed into the PTOM procurement process and contracts that will be issued before 2017
- A Bus Rapid Transit system could be implemented in a staged delivery, with new bus vehicles being progressively introduced
- The corridors should be designed to be compatible with Light Rail Transit, if that mode was introduced at some future date due to changed circumstances.

3.18 Impacts on general traffic and parking

We noted the strong support for providing dedicated public transport lanes and improving reliability and travel times. The Citizens Panel surveys highlighted the strong support for the trade-offs required to provide this additional priority for public transport. We also heard from submitters concerned about restrictions on general vehicles and the removal of parking, as well as suggestions for alternative traffic flow arrangements along some streets including Victoria Street, Willis Street, Lambton Quay, and Wakefield Street.

We understand that the study adopted a general philosophy of providing dedicated public transport lanes along the core spine corridor between Kilbirnie, Newtown, the Basin Reserve and Wellington Railway Station to avoid conflicts between public transport and general traffic which slow travel times and reduce reliability. We support this principle.

In most cases this can be accommodated within the road reserve without impacting general traffic lanes. However in some narrow sections of the spine route there is insufficient space to provide for both dedicated public transport lanes and general traffic. The study proposes restrictions on general traffic along the following sections of the Golden Mile in business hours:

Courtenay Place between Kent / Cambridge Terrace and Taranaki Street

Traffic turning right down Cuba Street off Manners Mall

Willis Street between Boulcott Street and the BNZ Centre

Lambton Quay from Old Bank Building to Panama Street (in both directions)

Current general traffic volumes along Courtenay Place and Lambton Quay are low. The impact on the surrounding local road network of restricting general traffic from these sections was modelled as part of the study and indicated that the impact would not be significant. However this would require further investigation as part of the next phase of the project, including consideration of access for service vehicles to businesses along these streets.

Willis Street is more heavily used as a route between Brooklyn / Aro Valley, the CBD and beyond. The effects on the network of restricting general traffic from Willis Street between Boulcott Street and BNZ would require further detailed investigation alongside alternatives such as a one-way gyratory system along Willis Street and Victoria Street

Providing dedicated public transport lanes will also require the removal of on-street parking along some of the key corridors. This may impact on businesses and nearby residential properties.

We acknowledge the concern of retailers and businesses in the central city about the loss of car parking. A stocktake of current parking spaces along the corridor revealed however, that there are few car parks directly affected by the proposed dedicated public transport lanes. Along Lambton Quay, Willis Street and Manners Street there are no public car parking spaces likely to be affected. However a number of loading zones would potentially be affected and the continued operation or relocation of these would need to further considered. Along Courtenay Place there are a number of public parking spaces that might be affected depending on the placement of the dedicated lanes within the existing carriageway. We did however note the strong support indicated in the submissions and citizens panel surveys for this trade-off and support this as a necessary step.

We conclude that:

- Additional priority will be required for public transport to achieve improved reliability and travel times, and this will need to be implemented as a deliberate policy. This may result in some dis-benefits to general vehicles and on-street parking
- Segregating public transport vehicles from general traffic along the core spine corridor during business hours is of critical importance if improved travel times and reliability are to be achieved and some on-street car parking will have to be lost to achieve this
- Removing general traffic from parts of the Golden Mile could be achieved without significant impacts on the surrounding road network and connectivity, although we note this will require further evaluation

- There could be minimal impacts on the public car parking spaces along the Golden Mile, apart from Courtenay Place, where further design work is required to assess the potential impacts
- Further investigation may be needed of impacts on service vehicle access.

3.19 Pedestrians and cyclists

Submitters raised a number of issues relating to pedestrians and cyclists including:

- Need for consideration of pedestrian safety, particularly through Golden Mile.
- Importance of pedestrian amenity (eg noise, air quality) and high quality stations/interchanges.
- Need for safe and attractive provision for cyclists along many of the same corridors as the public transport spine.
- Need for cycling and public transport integration – such as cycle parking at stops/interchanges and taking cycles on public transport vehicles.
- Need for accessible public transport facilities and vehicles.
- The health impacts of vehicle emissions on pedestrians.

We discussed these issues and agreed the following:

Pedestrians

Whichever option is progressed, the detailed design will need to take account of the provision for pedestrians and cyclists.

We noted the view that a key factor influencing pedestrian safety is public transport movement that is 'predictable'. Both the Light Rail Transit and Bus Rapid Transit options would provide a clearly identified public transport 'lane' to assist with this. A lesser number of vehicles, and reduced queuing, to avoid the 'wall of buses' will assist with improved visibility and consequently safer crossing for pedestrians.

Other factors such as the design/shape of the vehicle, the travel speed through the Golden Mile, the ability for vehicles to stop quickly, the addition of warning sounds to vehicles (like a bell), can all be considered as part of the system design and are not unique to one mode option or other.

Central running public transport lanes are proposed along parts of the spine and these could provide a safer environment for pedestrians crossing the road. This will however require adequate platform widths (for passengers waiting or alighting) and good crossing facilities to the adjacent footpath.

The health impacts of the different vehicle options have not been considered in detail at this point. To provide a useful and reliable evaluation, further details on vehicle type, power source, the detailed design of the network, and the forecast vehicle kilometres would need to be better defined. This is an evaluation that can be carried out as part of the next phase of the project. It is noted however that a wider Health Impact Assessment was undertaken as part of the development of the regional Land Transport Strategy, and that this supported the further development of public transport to minimise health impacts.

Cycling

The study already indicates separate cycle lanes along parts of the core spine corridor, where space allows. However cycle lanes are not shown through the Golden Mile. We understand that this is

based on the current Wellington City Council approach - that cycle trips within the CBD are dispersed and consequently a specific priority cycle route does not need to be identified. We also note that there are some space constraints along parts of the Golden Mile where separate cycle lanes may not be practical.

The next stage of the project will need to consider how cyclists can be best catered for along the entire spine corridor in conjunction with the City Council's overall plans for cycle lanes and other improvements. There are a range and mix of potential solutions including dedicated cycle lanes, wider shared lanes, or cycle facilities on adjacent routes.

All options have the potential to provide better integration of cycling with public transport and future work around the specification of vehicles and the design of interchanges should take account of this.

3.20 Resilience

Some submitters raised the issue of the resilience of the future public transport system in terms of general reliability and in response to disasters, accidents and planned events.

In terms of general reliability, both bus and light rail system are well-proven across the world. However there can be reliability issues with emerging technology for both these modes and it is important that appropriate trials are undertaken before introducing new technologies into the core system.

Resilience to emergencies and events was considered as part of the Medium List Evaluation of options. There are two scenarios that were examined: the ability to run a service after a major emergency such as an earthquake; and the ability to run an alternative service as part of a planned event, such as a street party that required closure of the road.

Most bus vehicles (with the exception of electric vehicles that rely on overhead wires or underground charging) can easily be re-routed to alternative routes if necessary. In a major disaster the ability to run a bus-based service would depend on the availability of serviceable roads. After the Great Eastern Japanese earthquake in 2011, all highways were able to be re-opened within 14 days. In Wellington, after a major earthquake, it is expected that some roads may be unavailable for longer than this.

Rail-based systems, including Light Rail Transit, are much less flexible, as they run on fixed rails with fixed power sources. This means that Light Rail Transit would not be able to be adaptable for planned events, and the service would instead have to be suspended. Wellington has a reasonable number of major events along the Golden Mile that involve road closures, including street fairs and parades, Santa Parade, university graduation parades, film openings, as well as protest marches. There are also major events elsewhere like the Newtown Fair. During these events a Light Rail Transit system would not be able to operate. This would have implications for the entire Light Rail Transit network.

Following a major disaster, rail-based system such as Light Rail Transit would be required to be suspended whilst a check was carried out on both the rails and the power systems. This occurred recently on the heavy rail network after the earthquakes affecting Wellington in 2012, where the entire network was shut down for up to a day. Any damage would have to be repaired before the network could become operational again. After the Great Eastern Japanese earthquake in 2011, it took approximately 40 days to resume rail services. In Wellington, after a major earthquake, it is expected that parts of the rail network may be unavailable for longer than this.

We conclude that the bus-based options are more flexible in being able to adapt to both expected events and unexpected emergencies.

3.21 Summary of recommended option

Taking account of the issues outlined above we recommend the following option:

- A core spine corridor with dedicated public transport lanes and other priority measures running from Wellington Railway Station along the Golden Mile, along Kent/Cambridge Terraces to the Basin Reserve, along Adelaide Road to the Regional Hospital, and through the duplicated SH1 Mt Victoria Tunnel and along Ruahine street, Wellington Road, and Kilbirnie Crescent to Kilbirnie town centre.

- An open system which is designed to allow vehicles to leave the dedicated corridors and provide services to a wider catchment area.

- A progressive pathway from Bus Priority to Bus Rapid Transit, with the phased introduction of higher capacity low-floor vehicles using a sustainable power source.

- Infrastructure to support improved reliability, travel times and quality, including: signal priority at intersections; improved stop facilities; improved docking systems; improved customer information provision; and off-board ticketing.

- Improved or new interchange facilities at the Wellington Central Railway Station, Kilbirnie town centre and the Regional Hospital.

- Restrictions on general traffic access and parking where necessary to achieve dedicated public transport lanes.

4.0 Next Steps

Implementation

We support a staged approach to the implementation of the recommended option. It is anticipated that this will involve early implementation of Bus Priority measures (compatible with Bus Rapid Transit) and a high priority given to protecting corridors and progressing the detailed design of dedicated public transport lanes within the road corridor, along the length of the core spine.

Further work on such issues as: network design, interchanges, vehicle specification and ticketing will also be required to inform the future implementation of a Bus Rapid Transit corridor. We note that the network planning currently underway as part of the Wellington Bus Review and the service and vehicle procurement process underway as part of the Public Transport Operating Model will incorporate the findings of the PT Spine Study and deliver them on the ground.

All three study partners – Wellington City Council, Greater Wellington Regional Council and NZ Transport Agency – will need to work closely together to progress the different aspects of the implementing the preferred public transport spine option in a coordinated way, and a strong governance and management structure will be central to the success of the implementation. The key responsibilities of the partners include:

> **Wellington City Council:** road controlling authority (local roads); corridor design (local roads); interchange specification and design; traffic signals; funding.
>
> **Greater Wellington Regional Council:** public transport network design, vehicle specification; service procurement; ticketing systems, funding.
>
> **NZ Transport Agency:** road controlling authority (state highways); corridor design (state highways); investor in public transport services and infrastructure, local roads and State highways from National Land Transport Fund.

Funding

The next step in this project requires further detailed investigation, design and obtaining of necessary approvals. This will require funding from all three partners to progress.

Funding for construction has not yet been allocated, and this will be a consideration as part of the forthcoming Long Term Plan and Regional Land Transport Plan processes. Funding from the National Land Transport Fund will require a robust business case to be prepared.

Statutory Plans

There are a number of statutory documents and plans in which the decision on the recommended option will have to be brought through to enable its implementation. These include the following:

Statutory Plan or Process	Responsible Organisation	Timeframe	PT Spine Implementation
Annual Plan 2014/15	GWRC WCC	Draft plan Feb 2014 Adoption July	• Funding of GWRC activities • Funding of WCC activities

		2014	
Long Term Plan 2015-2025	GWRC WCC	Draft budget Sept 2014 Draft plan Feb 2015 Adoption July 2015	• Funding of GWRC activities • Funding of WCC activities
Wellington City District Plan	WCC	Rolling review	• Designation of corridor (if required)
Wellington Regional Land Transport Plan	RTC/GWRC	Draft plan Feb 2015 Adoption July 2015	• Inclusion of implementation in regional priorities for NLTF funding • Amendment of Ngauranga to Airport Corridor Strategy to reflect preferred option
Wellington Public Transport Plan	GWRC	Draft plan Mar 2014 Adoption July 2014	• Service network design and standards • Procurement units and process
National Land Transport Plan	NZTA	Adoption June 2015	• Inclusion of project implementation

Supporting policy interventions

The study evaluation was based on the future land use pattern expected as a result of the Wellington Growth Spine. This provides for a concentration of growth in key centres along the spine from Johnsonville, through the CBD, along Adelaide Road to Kilbirnie. This policy approach underpins the proposed investment in public transport infrastructure and it is essential that this approach is maintained or strengthened. Additional trips generated by new residents or businesses located along the catchment of the core spine corridor will maximise the efficiency and effectiveness of the public transport network.

The study also identified the importance of actively managing commuter parking in the CBD to growing future public transport mode share. Commuters deciding which mode to use to travel to the CBD will take into account the availability and cost of parking. Tests showed that capping parking provision or raising costs have a corresponding increase in public transport mode share. The Alternative Funding Study examined a number of mechanisms that could be used to achieve this, as well as to generate additional funding to help support investment in public transport. This issue requires further investigation as a key measure to further increase public transport mode share.

Wellington City Council, Greater Wellington Regional Council and NZ Transport Agency have been developing a Network Operating Framework, to assist decision-making in allocating priority to different modes along central city streets. This will be an important tool in allocating signal priority

at intersections, and in allocating road space for public transport, cycling, pedestrians, general vehicles and freight.

5.0 Recommendations

1. ***The Wellington Public Transport Spine Options Hearings Subcommittee recommends that the Regional Transport Committee:***

   a. ***Notes that the Public Transport Spine development is an action arising out of the integrated multi-modal Ngauranga to Airport Corridor Plan and sits alongside improvements to the strategic road network and actions to encourage active modes.***

   b. ***Notes that the recommended option will be incorporated into a wider network planning exercise and procurement process that will result in a new integrated public transport network for Wellington City.***

   c. ***Confirms that the purpose of the Public Transport Spine is to support the efficient and effective operation of the wider public transport network by:***
      i. ***Providing a dedicated central city corridor that enables reliable and improved journey times for all public transport service;***
      ii. ***Providing an efficient, reliable and frequent connection between the central city and the southern and eastern suburbs;***
      iii. ***Growing public transport mode share.***

   d. ***Notes that corridor options are constrained by the existing urban form and environment.***

   e. ***Agrees that the core spine corridor within which dedicated lanes and other priority measures should be applied runs from Wellington Railway Station along the Golden Mile[1], along Kent/Cambridge Terraces to the Basin Reserve, branching into two:***

      i. ***Along Adelaide Road and Riddiford Street to the Regional Hospital, and***

      ii. ***Through the duplicated SH1 Mt Victoria Tunnel and along Ruahine Street, Wellington Road and Kilbirnie Crescent to Kilbirnie town centre.***

   f. ***Agrees that Bus Rapid Transit is the preferred option for the Wellington public transport spine.***

   g. ***Agrees that a pathway should be planned to progress from Bus Priority through to Bus Rapid Transit, noting that there are opportunities to develop interim Bus Priority measures in the shorter term that are compatible with the longer term solution.***

   h. ***Notes that full implementation of Bus Rapid Transit will require corridor designation and protection, vehicle and service procurement and physical changes to the road corridor all of which can be sequenced in phases.***

   i. ***Agrees that designation and other protection mechanisms should be advanced over the entire corridor as a high priority in the short term.***

[1] The Golden Mile runs along Lambton Quay, Willis Street, Manners Street, and Courtenay Place

j. Notes that further investigation will be carried out as a high priority to confirm whether a designation for additional bus lanes is required on Ruahine Street and Wellington Road.

k. Agrees that the initial priority for implementation should be the corridor through the Golden Mile and onto the Regional Hospital.

l. Agrees that an extension of the spine corridor through to the Wellington Airport should be future-proofed.

m. Notes that it is desirable for Bus Rapid Transit services to extend beyond the core spine to service destinations further afield, and that additional priority measures on these corridors would be advantageous.

n. Notes that the existing technology within the Real Time Information and SCATS systems, is able to facilitate assigned priority to public transport vehicles at signalised intersections.

o. Agrees that physical infrastructure along the core spine corridor should, where practical, be designed in a manner that does not prohibit the future transport development of the corridor, including for Light Rail Transit.

p. Notes that the next phase of the project will need to include further investigation of outstanding issues, detailed design of the corridors, network planning and design, vehicle specification and the development of a detailed business case.

2. The Wellington Public Transport Spine Options Hearings Subcommittee recommends that the Regional Transport Committee request Wellington City Council, Greater Wellington Regional Council and NZ Transport Agency to:

a. Continue collaborative working, through an agreed governance and joint project management structure to oversee the work programmes and specific actions identified.

b. Progress detailed planning and design of the Bus Rapid Transit option as a matter of urgency, to enable other related transport and urban design projects along the corridor to be progressed and to enable its implementation to be included in the Regional Land Transport Plan 2015-2021, with implementation works to be completed before the end of this period.

c. Provide appropriate priority for public transport vehicles at all intersections along the core spine corridor, taking into account the needs of other modes, including pedestrians, cyclists, general traffic, freight, emergency and service vehicles.

d. Progress detailed design for the core spine corridor from the Wellington Railway Station to the Regional Hospital as the high priority, including consideration of how any dedicated public transport lanes will be configured and taking into account the needs of pedestrians, cyclists, general traffic and service vehicles.

3. ***The Wellington Public Transport Spine Options Hearings Subcommittee recommends that the Regional Transport Committee request Wellington City Council and Greater Wellington Regional Council to:***

    a. ***Assess the suitability of the street environment and the requirements for new stop facilities for the proposed vehicle types, including any higher capacity vehicles, and to meet agreed standards for the Bus Rapid Transit system.***

    b. ***Assess the need for and, where required, design and implement, new or improved interchange facilities at key locations including Wellington Railway Station, Kilbirnie town centre and Wellington Regional Hospital.***

    c. ***Undertake further investigations into the best means to achieve the target of a maximum of 60 buses per hour per direction travelling along the Golden Mile spine corridor, including through a secondary route at peak periods, enhancing the capacity of the corridors at critical locations or more short-running peak services.***

4. ***The Wellington Public Transport Spine Options Hearings Subcommittee recommends that the Regional Transport Committee request Wellington City Council to:***

    a. ***Reinforce the policy approach of aligning residential and economic growth at key nodes and along the Growth Spine with the planned public transport investment along the core spine corridor.***

    b. ***Review options to manage commuter parking provision in the central city to grow public transport mode share.***

5. ***The Wellington Public Transport Spine Options Hearings Subcommittee recommends that the Regional Transport Committee request Greater Wellington Regional Council to:***

    a. ***Investigate and procure suitable vehicles for a future Bus Rapid Transit system in a phased programme, including consideration of higher capacity vehicles and vehicle power sources that seek to minimise carbon emissions and air pollution.***

    b. ***Prioritise the implementation of integrated ticketing and investigate options for off-board ticketing through the Integrated Fares and Ticketing project.***

6. ***The Wellington Public Transport Spine Options Hearings Subcommittee recommends that the Regional Transport Committee request NZ Transport Agency to:***

    a. ***Implement priority measures for buses as an integral component of the Basin Reserve and Mount Victoria Tunnel Duplication projects.***