

Resilience Summary

November 2018

DRAFT

1. INTRODUCTION

Let's Get Wellington Moving (LGWM) is an alliance between Wellington City Council (WCC), Greater Wellington Regional Council (GWRC), and the New Zealand Transport Agency (the Transport Agency). LGWM seeks to deliver an integrated transport system that supports the community's aspirations for how Wellington City will look, feel and function.

This document summarises the context, approach taken, and how LGWM has accounted for resilience. It also includes commentary around resilience trade-offs that are implicit in some key future decisions.

2. RESILIENCE CONTEXT

A challenging topography, highly concentrated economic activity in the CBD and very low infrastructure redundancy makes the NZ capital uniquely vulnerable to a shock event, resulting in economic and social risks for the region and country.

Wellington is vulnerable to natural hazard events, and climate change may increase vulnerability to certain types of events including storms or tsunamis. Wellington is also uniquely vulnerable to seismic events, with a number of known fault lines in and near the region, including the Wellington fault that runs through the northern end of the CBD, and the Hikurangi Subduction zone offshore to the east of the North Island.

The scope of LGWM is just one part of a much larger local, regional, and national resiliency picture. There are a range of resiliency initiatives ongoing within the region including:

- Business case for coordinated resilience investment across all lifeline utilities being led by Wellington Lifelines Group. The LGWM partner organisations are involved in this project
- Community preparedness and planning work being undertaken by Wellington Region Emergency Management Office, who co-ordinate Civil Defence and Emergency Management services on behalf of the nine councils across the Wellington region
- Wellington City Council 100 resilient cities and Resilience Strategy work – includes aspects of social and structural resilience, and preparedness
- Wellington City Council urban growth planning and district plan reviews – focusing growth to areas that are less vulnerable to disruption
- Planning for the accessibility and resilience of the port area as part of a Multi-User Ferry Terminal, including initiatives 'inside the gate'
- NZ Transport Agency regional transport resilience programme business case to improve the resilience of the region's land transport network.

3. LGWM APPROACH TO RESILIENCE

The LGWM area contains several key recovery locations such as the airport, hospital, and Wellington City port areas. It also includes transport links that connect large centres of population and employment locally, regionally, and nationally.

LGWM has focused on the following resilience aspects:

- The resiliency of the transport system in recovering following a large scale natural event
- The resiliency of small scale disruption on the transport system that can arise from both natural and manmade hazards (e.g. breakdown, small slip).

LGWM has also considered the degree to which it can influence transport related emissions that in turn could contribute to climate change. This is documented in the investment objective KPI assessment.

The resilience of the land transport network within the LGWM area is just one aspect of a much larger picture. There are also several resilience aspects that are interrelated to transport resilience that the LGWM partner organisations are involved in. This includes:

- Social resilience
- Preparedness
- Emergency response planning
- Land use planning
- Resilience of vertical infrastructure (e.g. structural resilience, resilience of key recovery centres like the port area)
- Resilience of other horizontal infrastructure (e.g. other lifeline utilities including water, power, communications, and fuel).

3.1. Resilience in the LGWM Strategic Case

Resilience has been embedded across the LGWM strategic case.

Principles and Problem Definition

Using the results from public feedback in 2016 the LGWM team developed 12 urban design and transport principles. One of these strongly related to resilience:

Future proof and resilient – Provide a transport system that is adaptable and future-proofed for urban, transport and freight growth and resilient to natural hazard and climate change.

The LGWM problem definition included a relevant problem statement of:

Vulnerability to disruption from unplanned events

The benefits of addressing this problem were identified as:

A transport system that is adaptable to disruptions and future uncertainty

Similarly, the consequence of not addressing the problem was identified as:

Increase in disrupted journeys for people and freight and slower recovery

Investment Objectives

LGWM developed an investment objective related to resilience of:

A transport system that is adaptable to disruptions and future uncertainty

The KPI that underpins this objective was defined as:

An assessment of the network’s resilience to disruption caused by large-scale natural hazards

There was also recognition that LGWM has a role in influencing smaller scale event disruption, and a corresponding need to monitor it.

Strategic Response

Like safety, Resilience is inherent in all of the strategic response. However, it is most strongly evident in certain parts.

Transport system attributes:

A transport system that moves more people, goods and services reliably with fewer vehicles, while increasing resilience to incidents, natural events, and disruptive technologies.

Strategic approach:

Intervene in the transport system by significantly increasing the person-carrying capacity of the network

- *Make a step change in public transport capacity, quality and performance*

Our emphasis for transport journeys through and around the periphery of the central area is on:

- *Increasing the resilience and reliability of our transport corridors*

Strategic interventions:

Enable mode shift with key changes to walking, cycling and public transport infrastructure, and land use policies

Relocate general traffic away from the central city to an improved bypass route

4. RESILIENCE WITHIN THE RECOMMENDED PROGRAMME OF INVESTMENT

WSP-Opus were commissioned by LGWM to undertake a review of the RPI, commenting on resilience of mass transit and resilience of the RPI, particularly suggesting issues and opportunities to leverage investment for resilience outcomes. This section presents the summary findings of the commission.

4.1. RPI Resilience Issues and Opportunities

Placeholder for summarising WSP work and resulting KPI assessment.

The issues and opportunities for resilience within the RPI were summarised as shown in the following table.

STRATEGY	INVESTMENT PROPOSAL	ASSOCIATED RESILIENCE ISSUE	COMMENTS
Step change in public transport connection to the north	Increased bus priority on Hutt Road and Thorndon Quay	Hutt Road is vulnerable to closure from failure of retaining walls, slopes and possibly overbridge structures, due to earthquakes and landslides.	Parallel investment in enhancing resilience is important.
	Increased rail network capacity and service	Rail network – Johnsonville line (landslides), NIMT (landslides and bridges), Hutt Valley line (landslides and coastal erosion along Petone to Ngauranga) are vulnerable to closure.	Improving resilience of feeder rail networks is critical to deliver benefits. This will include operational planning to provide alternate transport such as buses where roads are open.
Step change in public transport through Central City	Implementing dual spine PT through central city.	Enhances resilience by adding redundancy, particularly as both Golden Mile (damaged building safety) and the Waterfront Corridor (liquefaction lateral spreading) are vulnerable to earthquake hazards.	PT can also be added or relocated along Thorndon to Basin section of SH1 motorway to improve resilience, because of the vulnerability of the CBD routes to earthquakes.
Step change in public transport through Mass Transit	LRT from Railway Station to Newtown	LRT route along waterfront is vulnerable to liquefaction and lateral spreading. LRT cannot be reassigned (like rubber tyred mass transit) if a section of corridor is closed due to earthquake or other related hazards, see below.	Alternate mass transit or incorporate resilience into LRT corridors. Motorway corridor will be more resilient to earthquakes and sea level rise. Through Newtown, along Hansen Street – south Adelaide Road. would give enhanced resilience (recognise these will be further away from commuters)
	LRT from Newtown to Airport	LRT route through Kilbirnie and Cobham Drive is particularly vulnerable to liquefaction lateral spreading, tsunami and sea level rise.	Alternate route through Rongotai (middle of Kilbirnie – Lyall Bay Isthmus) and below the runway. through an underpass. to the airport and then to Miramar would reduce resilience risks.

Improving bypass route from the North	Southbound widening of SH 1 between Ngauranga and Aotea Quay	Eastern seaboard widening exposes new lanes to earthquake, coastal and sea level risks.	Consider enhancement of resilience or alternate widening on the western side, and alternate alignment for Wellington Fault crossing.
	Second Terrace Tunnel	Enhances redundancy in routine hazards and a secure alternate route not affected by building damage safety hazards in CBD local streets.	Consider design to seismic standards.
Improving bypass route through Te Aro	Lateral spreading in earthquakes.	Enhances resilience through redundancy in routine hazards, and a secure alternate route not affected by building damage, safety hazards in CBD local streets and liquefaction lateral spreading along water front route, in earthquakes.	Design to be resilient to groundwater issues.
Improving bypass route by grade separation at Basin Reserve	Sussex Street extension local road overbridge to grade separate.	The proposed bridge will straddle an area of liquefaction and lateral spreading down the terrace rise and expose SH1 to poor resilience, which is likely to be able to be mitigated through significant investment in ground improvement of the area. The at-grade state highway north – northeast of the Basin will also continue to be vulnerable to liquefaction and flooding given the liquefiable ground and high groundwater pressure. Pedestrian underpass from Cambridge / Kent Terrace corridor under SH1 at grade will be challenging and very difficult to impractical, given poor ground and groundwater conditions - high groundwater, artesian groundwater below and liquefaction hazard.	Consideration could be given to entrance from the west (Sussex Street) or south-east of the Basin Reserve.
Improving bypass route by better access to the east	Second Mt Victoria Tunnel and widening Ruahine Street	Opportunity to provide redundancy and construct tunnel with more resilient approaches (tunnels themselves generally resilient).	Suggest second tunnel allows for resilient approaches.

Several of these resilience issues present an opportunity to tailor the solution through more detail investigation and design phases so that resilience outcomes can be achieved.

The summary highlighted the importance of land use planning and the dis-benefits from focused growth in vulnerable areas, and presented complementary initiatives that could further reduce resilience risks within the study area. The study also presented some commentary on mass transit route and mode choices.

4.2. Resilience of Mass Transit and Technology Options

4.2.1. Role of mass transit in transport system resilience

Following a large event, mass transit may be disrupted by liquefaction and adjacent building risk. Demand for a mass transit system is likely to be reduced due to widespread CBD damage.

For moderate events, road closure can result from adjacent building risks. Demand for mass transit would be high as multiple parts of the transport system would be affected.

For smaller and isolated disruption events, the high people carrying capacity of mass transit would help minimise economic impacts and offer alternatives by providing network redundancy. For example, the 2007

closure of two sections of the San Francisco MacArthur Maze interchange resulted in increased use of the parallel Bay Area Rapid Transit.

4.2.2. Mass transit route choice – Waterfront/Featherston St/Golden Mile

It is recognised that the liquefaction risk is greater along the waterfront route and the building damage safety risk is greater along the Golden Mile / Featherston Street routes. The liquefaction and associated lateral spreading is likely to cause severe damage only in large earthquakes with a long recurrence interval, and in such earthquakes the demand for LRT systems would be less because of the widespread damage to the CBD. Damage to the tracks from liquefaction and lateral spreading can be limited by design measures (ground improvement, and more resilient track foundations). However, building damage related road corridor closures can occur in relatively moderate earthquakes, as illustrated by building damage in the distant Kaikōura earthquake, and hence can occur in moderate return period earthquakes. Even localised building damage related closures could close the LRT operation.

Repair of an LRT route would not only require consideration of the track and trackform structures where the vehicles operate, but also the supporting infrastructure including any overhead line / traction power equipment, stops, and signalling / communication equipment. All of these must be in safe working order prior to the LRT system resuming operations. The depot and stabling will need to be carefully located and designed to enhance its resilience, so that parked vehicles are secure and in safe working order prior to any resumption of services.

Therefore, an LRT system along the Golden Mile or Featherston Street – Victoria Street will have a lower level of resilience in being able to operate, because of the uncontrollable building damage related closures, than a well-designed LRT system on the water front, designed to minimise damage from lateral spreading.

4.2.3. Rail and tyre based resilience

After an earthquake causing liquefaction and lateral spreading, a rubber tyre based system may be able to resume operations after localised repairs of the road or rerouted.

A fixed guideway system such as LRT which operates on a fixed structural track form might take much longer to repair, depending upon the design of the structure. Repair times could potentially be reduced where ballasted tracks are used, however, this is not likely to be a viable option for an LRT operation within an urban city environment with shared users.

Any mass-transit systems will be equally affected by failure of structures and safety hazards associated with damaged buildings.

Rubber tyre based mass-transit systems can also potentially be rerouted to (temporarily) operate along alternative corridors such as the SH1 Wellington Urban Motorway and Karo Drive, whereas a fixed guideway option such as LRT does not have this flexibility.

5. WIDER RESILIENCE INVESTMENT

As previously mentioned, transport system resilience is just one part of a larger picture. Thinking holistically means considering the resilience of the city and region as a whole (including non-transport infrastructure, and social and organisational preparedness). Consideration at the level of moving earth, moving sea, and societal change will be necessary in order to target investment across the board to make 'Wellington Safe Enough to Stay'.

It is worth noting that these different resilience aspects have many inter-dependencies, particularly following large scale events. As a result, improving transport system resilience will improve the ability for other lifelines to recover, further enabling the transport system to recover. For example, having limited road capacity immediately following an event may enable repair crews to restore power and communications infrastructure necessary for mass transit operation.

5.1. Non-infrastructure Resilience

Both Wellington Region Emergency Management Office (WREMO) and WCC undertake social and organisational preparedness work.

Some WREMO led initiatives include tsunami blue lines, community emergency hubs and response plans, emergency compost toilets, the International Centre of Excellence in Emergency Management, and use of social media for spreading warning and information updates and preparedness information. The Ministry of Civil Defence and Emergency Management also undertake national preparedness initiatives such as the shake out earthquake drills and emergency mobile alert system.

The WCC Wellington Resilience Strategy contains several programmes that include non-infrastructure resilience interventions:

- Making information on all aspects of living in Wellington easily accessible
- Raising awareness about the potential effects of climate change and sea level rise, and developing an adaptation plan that emphasises the need for future decisions to be made
- Developing a framework for successful recovery from any disruption
- Supporting initiatives that contribute to Wellington homes forming the cornerstone of the city's resilience
- Ensuring that Wellingtonians always have access to water services, in a way that enhances the natural environment
- Working with infrastructure owners to ensure flexibility and robustness of transport and energy services in Wellington.

5.2. Lifelines Infrastructure Resilience Investment

Wellington lifelines group are currently leading the development of a business case for coordinated resilience investment across lifeline utilities including roads, fuel, sea ports, electricity, water, rail, telecommunications and gas. Part of the work is understanding the interdependencies between investments in different utilities and capturing the benefits of making these investments in a coordinated manner.

This ongoing work has reinforced the importance of coordinated investment creating improved outcomes, and transport and fuel as enablers for restoration after an event.

5.3. Wider infrastructure investment

This subsection summarises some of the planned and committed improvements in infrastructure resilience within the LGWM area.

Electricity Network

Wellington Electricity is currently investing \$34 after the Government tweaked policy to allow resilience to be priced into line charges. This funding covers emergency hardware, mobile substations, switchboards, critical spares and enhanced communication systems into the region, along with earthquake strengthening substations. Transpower is also looking at resilience investments.

Water, Waste Water and Stormwater

There is significant investment in water resilience within Wellington City including:

- \$35m on the Omaroro reservoir (PoW Park) to ensure water supply to the hospital and neighbouring suburbs
- Linking this to a new reservoir at Bell Road, \$21m
- Already commenced spending \$8.5m upgrading Kilbirnie's stormwater as we start to feel the effects of a changing climate
- Planning new reservoirs in Horokiwi and Upper Stebbings Valley - \$11m each
- The Tawa stormwater system has \$18.5 allocated to improve the resilience to flooding
- In the central City planning to spend \$1m for in Dixon Street and \$8m across the CBD to improve the sewerage system

- Allocated \$3m as part of a \$12m regional initiative for alternative community water supply stations
- Forward work of \$267.5m in upgrades and renewals over the next ten years. Each time we do this, we look to grow our resilience through planning system redundancy and upgrading to more resilient materials.

Buildings

Central Government has recently put in place regulatory changes around earthquake prone buildings; WCC are currently enacting these changes which will see hundreds of millions spent on vertical infrastructure. Private building owners are investing significant sums to secure unreinforced masonry while retaining heritage qualities. In addition, WCC are progressing the following public structural improvements:

- Allocated \$500k for the Opera House and around \$13m for the St James
- Intend to spend \$90m on the Town Hall
- Allocated \$1m of a total \$3m funding support to secure the worst unreinforced masonry buildings.

Wider Transport

Centreport continues to build back better and more resilient than before the Kaikoura earthquake, with forward planning keenly aware of resilience issues.

Transmission Gully is now well advanced and NZTA is starting to investigate and consider other opportunities to improve resilience such as the Petone to Grenada Link Road.

Wellington City Council Resilience

WCC has a Resilience Office with around a dozen staff growing City resilience.

Resilience is one of the key planks of the Long Term Plan.

WCC are looking to build resilience into every aspect of the City's operations, and have recently won awards for use of GIS for resilience.

Many lessons have been learned from the Kaikoura earthquake, and WCC are unashamedly taking advantage of that event to build resilience.