SECTION 3

Infrastructure Strategy

Te Rautaki Hanganga

INFRASTRUCTURE STRATEGY

APPROACH

This Infrastructure Strategy forms an important part of the 10 Year Plan. The purpose is to identify:

- the significant infrastructure issues for GWRC over the next 30 years
- the principal options for managing those issues
- the implications of those options

The Strategy covers the following assets owned by GWRC:

- bulk water supply
- flood protection
- public transport

The replacement value of GWRC's infrastructure assets for these three asset groups total $1,315m. We are required to include water supply and flood protection infrastructure in this Strategy and have chosen to include our public transport infrastructure because of its importance to infrastructure planning for GWRC. A significant proportion of GWRC's expenditure is on public transport (assets as well as operations). The nature of these assets are that they require long term planning, and the assets form part of a strategic region-wide network.

GWRC assets include water treatment plants, aquifer wells, water distribution pipelines, water storage facilities, pump stations, stopbanks, flood walls, detention dams, rail rolling stock, rail stations, overbridges, subways, bus shelters, and land associated with all three asset groups.

GWRC also owns assets in relation to our network of regional parks, our environmental science activities and harbour management functions. We have chosen not to include these asset groups in this Infrastructure Strategy at this time as they are relatively small in scale compared to other GWRC asset groups and there are no major changes expected in the short to medium term. Their inclusion may be considered for future versions of the Strategy.

GWRC prepares Asset Management Plans (AMPs) for each of the asset groups. AMPs contain more detailed information on the condition, value and performance of our assets. This information is considered to be of a high quality and reliable, and has informed this Infrastructure Strategy.

HEALTH AND SAFETY

GWRC has responsibilities under legislation (such as the Health and Safety in Employment Act 1992) to ensure the safety of our employees, and the general public. GWRC is responsible for infrastructure that has the potential to harm the general public, and to expose staff, contractors and volunteers to hazards.

All efforts are made to identify and eliminate risk for people using or working with our infrastructure. We also use the opportunities of project planning and design to look at how to incorporate further safety aspects. We have operational health and safety plans in place to avoid or minimise risk.

PRINCIPLES

These principles set out our long term approach to managing our infrastructure assets.

Fit for purpose

Provide high quality, cost effective infrastructure

Encourage optimal use of existing infrastructure

Minimise / defer the need for new or replacement infrastructure

Do not defer maintenance

Do not defer renewals

Provide for continuity of service delivery

Resilient

Adapt to change

Deal with significant disruption as a result of natural hazards and financial shocks

Adapt to climate change and sea level rise

Protect what we value

Take responsibility for our natural environment

Protect public safety

Protect public assets

Long term view

Consider the long term implications of decisions

Make a long term commitment to infrastructure funding

Ensure no surprises

Consider intergenerational funding equity

Managed risk

Transparent

Have a low tolerance for financial risk

Comply with legislation

Have a very low tolerance for risk to water supply quality and quantity

Coordinated
Take a regional approach
Co-ordinate infrastructure decisions across GWRC and with other agencies
Integrate management across all networks
Reflect aspirations of the community
Determine levels of service in consultation with the community

WHAT THESE PRINCIPLES MEAN FOR EACH INFRASTRUCTURE ASSET

Public transport

- We provide an effective and efficient integrated public transport network.
- We continue to invest in and improve the public transport network.
- We aim for a high level of continuity of service delivery. We anticipate some disruptions, but very few significant disruptions.

Water supply

- We maintain and operate our water supply system to the highest standard consistent with legislative requirements and community expectations.
- We are ready to provide additional sources of water when they are needed.
- We take the lead in a regional approach to improve resilience.
- We aim for a very high level of continuity of service delivery. We anticipate very few significant disruptions.

Flood protection

- We provide and maintain appropriate flood protection infrastructure.
- We develop approaches to flood risk and environmental management in consultation with the community.
- We maintain a high level of continuity of service delivery. We anticipate very few significant disruptions.

ASSUMPTIONS

The significant forecasting assumptions and risks that sit behind the Infrastructure Strategy are contained in Section Four of this 10 Year Plan. These include both assumptions that are common across asset groups, and those that are specific to asset groups.

SIGNIFICANT INFRASTRUCTURE ISSUES

The significant infrastructure issues for GWRC relate to:

- resilience
- affordability
- community expectations
- population change

RESILIENCE

The issues:

The region's infrastructure is vulnerable to natural hazards including earthquakes, tsunamis, major storms, floods and landslips. These range from high impact, low probability events (such as a major earthquake), to lower impact, high probability events (such as storms). Climate change is expected to increase the frequency and intensity of some of these hazard events.

An earthquake could cause damage to our region's infrastructure. In particular our water supply is critical lifeline infrastructure and needs to be able to be reinstated quickly following an earthquake. A major earthquake could also cause subduction of parts of some flood plains and potentially require stop banks to be raised. Public transport could also be disrupted.

Our flood protection systems both provide protection from natural hazards, but are also vulnerable to damage from hazard events. If flood protection systems are damaged due to natural hazards, then flooding could occur. Climate change is likely to increase the frequency and intensity of storms. This increases the risk of failure of our flood protection systems, which heightens the flood risk to communities along all major rivers in the region.

Climate change is also resulting in rising sea levels, increasing the risks to our coastal infrastructure. This includes parts of our water supply network and public transport system. Although GWRC does not own roads or the rail tracks we rely upon these assets to provide a high quality public transport system in the region. Parts of our flood protection systems are also vulnerable to the potential impacts of rising sea levels, including the ability to discharge storm water. Abstraction from the Waiwhetu aquifer may also need to be reduced over the long term to manage the risk of salt water intrusion from rising sea levels.

Climate change is also likely to result in changing rainfall and wind patterns in the region. Drier summers and wetter winters are anticipated and may increase the need for summer bulk water storage. Severe wind and rain events may also impact on our flood protection systems and disrupt public transport.

Uncertainty surrounding the timing and extent of future climate change impacts makes it difficult to determine the vulnerability of specific infrastructure assets to climate risks over time. How we communicate with the community about potential climate change effects in the context of these uncertainties will be a key factor

in influencing awareness of climate risks and the level of community support for actions to improve long term infrastructure resilience.

Options and implications:

Our options for managing the infrastructure issues relating to resilience revolve around the level of risk that the community is willing to accept. High risk options, such as do nothing, are likely to result in negative public perceptions, and do not represent good asset management practice. Although 'do nothing' would not increase our costs in the short term it will result in a decline in the condition of our assets and the level of service provided over time, and would increase the risk of failure of, or damage to, our infrastructure assets. Thus doing nothing will almost certainly result in increasing costs, possibly significantly, in the longer term.

Improving the resilience of all our assets is a lower risk approach – likely to increase costs in the short term, but may be more acceptable to the community.

Depending on the actual assets involved improving resilience may include physical improvements to the infrastructure itself, back-up plans in the event of infrastructure failure or compromise, building redundancy into the networks, flexibility to meet changes in supply or demand, and/or funds for repairing significant damage.

More research is required to determine the actual impacts of climate change and this will be part of our on-going programme. See Section Four – Significant Assumptions and Risks in this document for assumptions on climate change.

Insurance:

We maintain a material damage business interruption insurance policy for all GWRC above-ground assets (excluding motor vehicles which are separately insured). Our above ground assets are insured on a maximum probable loss basis. This common approach to insurance means that we don't insure 100% of our assets. It is unlikely that all assets would simultaneously be affected by a hazard event. This approach to insurance focuses on the effects of a low probability, high impact event. We provide adequate funding in our annual maintenance budgets to accommodate repairs as a result of smaller, more frequent events. We have a large excess ($20 million for earthquake events) in order to reduce our premium costs. Note that the excess is substantially less for other hazards such as fire.

To meet this excess GWRC has set up a material damage fund. This fund is currently approximately $8.5 million, and earns interest which is added to the fund.

Our underground assets are generally not insured but we have funds set aside for hazard events – either as cash deposits or reserves. The specific funds for our different asset groups are discussed in more detail in Section Three.

AFFORDABILITY

The issues:

We have committed to continue to invest in our regional infrastructure to improve the standard of our assets and to maintain them appropriately, and to build new infrastructure when necessary. Asset maintenance and renewals make up a significant proportion of our expenditure. However, we do not have an open purse for spending. Over time, as our population ages, we are expected to have more and more people on fixed incomes.

The willingness and ability of the community to pay may impact on our long term ability to maintain, upgrade and build new infrastructure. Central government funding also makes a significant contribution to public transport infrastructure, but it is possible that there will be changes to this funding longer term.

Options and implications:

Our principal option to address this issue is to consider the appropriate level of service, as well as the timing of any new projects. Over time, however, reducing overall levels of service is not sustainable as it increases longer-term costs, and potentially increases the risks for some communities. We will not defer maintenance or renewals as this does not reflect our principles for managing our infrastructure assets. We will continue to consult with the community through Long Term Plans in order to achieve the correct balance between long term investment in infrastructure, and shorter term concerns about affordability.

Our debt to revenue ratio needs to be acceptable both to the community and GWRC's lenders. Our Financial Strategy sets out how we intend to fund our capital and operational expenditure long term.

We also work closely with the relevant government funding agencies to help forecast any major changes.

COMMUNITY EXPECTATIONS

The issues:

Over time our communities expect to be flooded less often. This may take the form of requests for protection in currently unprotected locations. Or in currently protected areas communities may desire protection from more events, along with improved environmental outcomes. Communities also expect safe and pleasant drinking water that is available at all times. We are also aware of the increasingly higher levels of performance expectations for our public transport, including expectations that services are on time, are more reliable and provide higher levels of comfort and convenience.

Options and implications:

Our principal option for managing these issues is to continue our discussions with communities over appropriate levels of service. The main vehicles for this are through the 10 year plan process, and key strategic planning documents (for example flood plain management plans, the Regional Public Transport Plan, and the Regional Land Transport Plan.)

In considering changes to levels of service we take into account factors such as costs and benefits, the distribution of costs and benefits both throughout the region and across time, changes in demand, and the social, cultural, economic (including financial) and environmental impacts.

POPULATION CHANGE

The issues:

As set out in our planning assumptions, it is expected that population growth will continue across the region as whole, along with changes in our demographic profile. The pattern of growth varies across the territorial authorities.

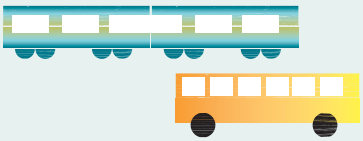
Population growth is likely to increase the demand for public transport long term, and we may reach the point where trains are at capacity. For our water supply assets increased population may mean that at times we are unable to meet the two percent shortfall probability security of supply standard for water. If current population growth and water use continue we will eventually (towards 2045) require new source water storage capacity.

Population growth and / or land use changes are anticipated in particular parts of the region. This is likely to result in pressure to develop areas that are subject to flooding. We may also experience increased, but localised demand for additional public transport services, and new or upgraded water supply infrastructure.

Options and implications:

Our principal options for addressing these issues relate to how to manage and provide for changes in demand. This is a major component of our long term asset management planning regime. We have planning models that help predict the impact of changes in demand – these include the Sustainable Yield Model for water supply, the Wellington Transport Strategic Model for transport planning, and the Wellington Public Transport Model for public transport. We use these models to factor in a number of variables, including population change, to forecast necessary changes in infrastructure.

MANAGING THE GREATER WELLINGTON REGIONAL COUNCIL'S INFRASTRUCTURE ASSETS



PUBLIC TRANSPORT

Our long term approach for managing GWRC's public transport assets is to continue to provide new and upgraded rail rolling stock, to upgrade other rail infrastructure, and to maintain and improve bus infrastructure. We aim to provide a modern, effective and efficient integrated public transport network.

RENEWING OR REPLACING EXISTING ASSETS

GWRC owns public transport assets across the region with a replacement value of $452.5 million.

Summary of asset types (optimised replacement costs $000)

BUS ASSETS	
Shelters	**5,510**
Signage	**2,184**
Real time information equipment	**1,963**
RAIL INFRASTRUCTURE ASSETS	
Station buildings	**21,145**
Station structures	**24,621**
Facilities	**1,284**
Shelters	**3,917**
Access	**2,508**
Parking	**6,422**
CCTV	**1,830**

Summary of asset types (optimised replacement costs $000)		
	Rail Depot Building	**17,507**
	Signage	**622**
	Lighting	**6,930**

The first set of Matangi trains were purchased new during 2010-13 and are due to be replaced around 2041 to 2043, which is towards the end of this Infrastructure Strategy. A programme of scheduled maintenance is in place. For more detail please refer to the asset management plan. We will also be purchasing additional Matangi trains during 2015/16 which will enable us to progressively withdraw from service the older Ganz-Mavag units.

The SE and SW carriages which operate on the Wairarapa line were manufactured from old British carriages during 2007-09. The SE type carriages are estimated to reach the end of their current life around 2016, so replacement or a re-life refurbishment needs to be considered for these six carriages. The SW type carriages also require a mid-life refurbishment around 2016-21 with ultimate replacement scheduled around 2032. As a result, a business case and decision is required whether to undertake the carriage refurbishment in 2016-21, or replace the fleet with more efficient Diesel Multiple Units (DMUs). More detail is provided in the asset management plan.

Rail infrastructure assets, including station buildings, shelters and structures (such as overbridges and subways) and car parks have a current book value of approximately $51.5 million. This includes all 47 stations in the region, excepting the Wellington Central Railway Station which is owned by KiwiRail. KiwiRail also owns all of the platforms[1]. GWRC has undertaken an assessment of the condition of station buildings and structures and has put in place a programme for renewals and replacements. Renewals have been prioritised primarily based on safety aspects and asset condition. Many of the rail stations also require upgrading to reflect increasing customer expectations and technological change.

Bus and ferry infrastructure assets, including shelters, signage, and the real time information system, have a current value of approximately $9.7m[2]. Bus shelter replacements are prioritised using a combination of data relating to the condition of the existing shelter, performance and aesthetics. We use GWRC's bus infrastructure prioritisation tool to do this. Those bus shelters that are assessed as in very poor condition are given top priority for replacement.

CHANGES IN DEMAND

The key drivers for changes in demand for public transport services are likely to be:

- Changes in the size and nature of the region's population which can be directly linked to demand for travel in general. See Section Four for our demographics planning assumptions. A growing population increases the

1 Refer to KiwiRail's Wellington Network Management Plan (2013) for KiwiRail owned infrastructure assets in the region.

2 As per the GWRC Annual Report 2013/14 pg. 57

demand for public transport, as does an aging population, and increased growth along transport corridors. More inner city residents impacts the demand for public transport

- Economic growth (or decline) which can influence the need to travel, car ownership, mobility choices, and congestion. Increasing car ownership decreases the demand for public transport. Increasing costs of fuel and inner city parking increase demand. Increased congestion would also increase demand. The price of public transport over other modes also impacts on demand
- Community awareness of sustainability which can influence the emphasis individuals place on using public transport as opposed to private vehicles. Increasing awareness results in increasing demand for public transport. Changing lifestyles, such as decreasing numbers of younger people with driving licences can also increase demand for public transport
- The quality and performance of our public transport system. Improvements in reliability, comparative travel time with other modes, convenience, access to information, quality of vehicles, service frequency, perceptions of safety, and capacity all increase the demand for public transport services
- Alternatives to public transport. Roading improvements and reduced congestion reduce the demand for public transport.

We use the Wellington Transport Strategy Model and the Wellington Public Transport Model to forecast growth and demand for public transport. The models can accommodate variables such as demographics, employment, transport costs, infrastructure and the transport network. For the purposes of this Infrastructure Strategy we have assumed a continued increase in passenger numbers, particularly for rail. The Regional Public Transport Plan sets out GWRC's ongoing commitment to growing public transport patronage, particularly at peak times. We will do this by improving our public transport network so that services:

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

A number of infrastructure projects are planned to enable us to provide for increased patronage. These include introducing integrated fares and ticketing, and expanding the Matangi train fleet.

CHANGES IN LEVELS OF SERVICE

We are aiming to increase the level of service of our public transport system. Initiatives include improving the frequency of train services to 15 minutes during peak times, introducing integrated fares and ticketing, providing additional bus shelters, providing additional park and ride space, extending CCTV coverage, and replacing the Ganz-Mavag fleet with additional Matangi trains.

PUBLIC HEALTH

The region's public transport system has a positive impact on public health by reducing transport emissions, and by encouraging the use of active modes to transit to train stations and bus stops. Public transport generates lower emissions (per passenger kilometres travelled) then than private car. Actives modes such as cycling and walking create no emissions.

Physical inactivity is a significant issue affecting the health of communities in the region and nationally. Opportunities to engage in physical activity as part of a trip or daily commute can have important health and wellbeing benefits for the individual.

Diesel emissions are believed to have adverse human health effects when their concentrations in air exceed guidelines. Monitoring of particulates in Wellington CBD indicates that concentrations were well within national standards and have been at 'acceptable' levels or better throughout the monitoring period. Particulate concentrations have exceeded the national standard only on one day throughout the entire eight year monitoring period from 2005-2012[1].

Despite this, we aim to improve the quality of the bus fleet by transitioning towards a fully electric fleet in the future.

We aim to ensure that our public transport infrastructure and facilities are safe. Over the life of the Infrastructure Strategy we are also aiming to improve the safety of the public transport system for customers, workers and the general public.

ENVIRONMENTAL OUTCOMES

Overall our public transport system improves environmental outcomes. In the Wellington region 35 million public transport trips are made annually which would otherwise have required private vehicles and additional road infrastructure. This directly contributes to reducing carbon and other harmful emissions and decreases traffic congestion particularly in peak times. Public transport also assists in enabling efficient land use, and a compact well-designed, and sustainable urban environment.

We also aim to reduce any adverse effects of providing, maintaining and operating public transport assets. For example we manage the storm water run-off from sealed carparks.

RESILIENCE TO NATURAL HAZARDS

With a variety of public transport assets located throughout the region it is important to build in resilience to natural hazards wherever possible. We do this through maintaining our assets and those they rely on to a high standard, and alternative route planning. We operate a reserve fund for any major loss or damage to public transport infrastructure as a result of natural hazards.

Our public transport assets (excluding trains) are also included in the GWRC's material damage business interruption insurance policy. This insurance is on a maximum probable loss basis which means that 100% of the assets are not insured. Any difference is covered by the GWRC's material damage reserve fund, or by borrowing. We may also be eligible for government funding for any additional difference.

Our trains are insured separately, also on a maximum probable loss basis. Any shortfall would be met by borrowing.

1 GWRC, 2012/13 Annual Monitoring Report on the RLTS

WATER SUPPLY

Our long term approach for managing GWRC's water supply assets is to maintain and operate the existing system to a high standard consistent with legislative requirements and community expectations for an essential service, and to be ready to provide additional sources of supply when these are needed. There are no proposed changes to the current level of service, other than improving the supply of water in an emergency.

RENEWING OR REPLACING EXISTING ASSETS

GWRC owns and manages bulk water supply assets with a replacement value of over $800 million summarised below.

Summary of asset types (replacement costs $000)

Distribution pipelines and valves	Water treatment plants	Tunnels	Water storages	Pump stations	Roads and bridges	Raw water intakes	Aquifer wells
379,016	**164,235**	**117,283**	**90,826**	**35,143**	**10,410**	**7,295**	**5,728**

GWRC's bulk water supply assets include our four treatment plants at Wainuiomata, Te Marua, Waterloo and Gear Island, the twin Stuart Macaskill storage lakes in Te Marua, the Waiwhetu aquifer wellfield, and the seven river intakes. A significant proportion of the bulk water supply assets have very high replacement costs and long economic lives. This generates capital expenditure profiles with significant peaks followed by long periods where relatively low investment is required.

We have in place a programme for renewing or replacing existing water supply assets when they reach the end of their economic life. However for some of these assets their long life and extremely high replacement values means that they are likely to be maintained in perpetuity. Examples include the Stuart Macaskill lakes, and a number of tunnels at the water sources and in the distribution system. Decisions on renewing or replacing these assets are well outside the timeframe of this Infrastructure Strategy.

The eleven aquifer wells at Waterloo and Gear Island are reaching the end of their economic lives. A total of $8 million has been allocated for replacement of the wells over the next 20 years. Investigations are in progress to ensure replacement occurs at the right time to maximise the economic life while maintaining the risk of failure within acceptable levels.

Replacement of the Kaitoke trunk main will be a significant renewal project in the medium term. The pipeline will require replacement in the mid to late 2040s. This may be just outside the timeframe for this Infrastructure Strategy; however it is appropriate to note that the potential impact on debt forecasts may be as high as $150 million. GWRC is investing in techniques to extend the economic life of the pipeline as much as practicable. Operations and maintenance activities over the next 30 years will need to be adjusted to manage the end of life process. Additional details will be included in future infrastructure strategies.

RESILIENCE TO NATURAL HAZARDS

Building resilience into our water supply assets is vital as water supply is an essential service. We must provide a secure system that is resilient to natural hazards, and can be reinstated (or alternatives activated) quickly following any hazard event.

The major risk to our water supply assets is from a significant earthquake, particularly one that involves movement of the Wellington Fault. Other hazards include major rain events, droughts, fires, and electricity failure of over two days' duration.

GWRC has developed a risk based methodology for assessing the benefits of proposed resilience improvements to its water supply assets. This is used to assess existing assets and form the basis of planned improvements. We plan to carry out a major infrastructure risk assessment every ten years (the latest was in 2013/14). The major resilience improvements focus on our strategy for supply of emergency water.

Our above-ground water supply assets are also included in the GWRC's material damage business interruption insurance policy. This insurance is on a maximum probable loss basis which means that 100% of the assets are not insured. The excess for this insurance is presently $20 million and any short fall will need to be covered by borrowing. Our below ground assets are also covered via a maximum probable loss approach. A fund has been established to meet this loss with annual contributions which attempt to keep pace with rising replacement costs. The fund is presently sitting at $20 million. The gap between this and the maximum probable loss may be covered by a mix of insurance, borrowing and government assistance.

EMERGENCY WATER SUPPLY

Restoring the supply of water to the four cities following a major natural hazard event such as an earthquake involving the Wellington Fault, will be challenging. The trunk mains cross the Wellington fault at five locations and some sections may be subject to damage from liquefaction and land movement. Severe disruption is practically unavoidable in these areas.

In addition to direct damage from fault movement, it is estimated that up to 100 breaks could occur in the bulk supply network. Many more would occur in the water supply reticulation owned by the city councils. It is estimated that it could take up to 70 days to restore a bulk supply to the eastern Wellington suburbs. At least 100 million litres of water will be required to meet the emergency needs of people in Wellington City. Restoring supply to Porirua City and Wellington's northern suburbs will also take a considerable amount of time.

GWRC has investigated three options for meeting emergency water requirements:

The desalination option was found to be expensive for a small scale plant ($70 to $125 million for 10Ml/d capacity), and not well suited to being started at short notice. For these reasons we have not pursued this option further.

Construction of a resilient pipeline across Wellington Harbour has also been considered. This would provide a supply to Wellington City while repairs were completed on the main pipelines supplying Wellington. A number of potential routes and pipe sizes have been reviewed and a comprehensive sea bed survey completed. A small pipe (250mm) would provide a minimum emergency supply of 20 L/p/d and cost $72 million. A larger pipe (550mm) would cost $92 million and would provide additional capacity for a limited amount of non-emergency consumption. The larger pipe is the preferred option because of the significant additional, operational, social and economic benefits. Construction is proposed for between 2015 and 2020.

The option to store emergency water in Wellington City has been investigated as an alternative to the cross harbour pipeline for supply to central Wellington and the eastern and southern suburbs. Up to five large storage reservoirs would be required at various locations. The additional storage sites would provide the necessary emergency water supply but at a higher cost than the cross harbour pipeline option and with significantly greater impacts. We have not pursued this further.

GWRC has also considered a number of potential sites for storage of emergency water for supply to Porirua and Wellington's northern suburbs. The most promising is a site near the north end of Takapu Road. A total of $20 million is proposed for construction of a 200ML lake from 2020 (investigations, design and land purchase from 2018). An additional $32 million is needed for resilience upgrades to the pipeline from the proposed storage to Wellington and Porirua cities.

It should be noted that the above projects will provide bulk water to key locations. Earthquake damage to city reticulation will prevent this water being easily distributed to the community and further work is required to identify options that will ensure access to water for all.

SUPPLY CAPACITY AND CHANGES IN DEMAND

The key drivers for changes in demand for bulk water are population growth and water consumption trends. GWRC uses a model called the Sustainable Yield Model as a strategic planning tool to predict demand and assess the ability of the bulk water supply system to meet agreed levels of service.

The population served by GWRC's bulk water supply is growing and expected to continue to grow (see planning assumptions Section Four). However, consumption per person has been declining so despite a growing population, the actual demand for water has shown a downward trend in recent years (particularly since 2006). There are potentially a number of factors affecting this trend including reduced leakage in the city reticulation systems, changing consumer attitudes to water conservation and an improvement in the water efficiency of household appliances.

Based on the Sustainable Yield Model a new water supply source will be required within the life of this Infrastructure Strategy – in approximately 2036.

We have already undertaken considerable work on investigating possible options for new water sources. These include various on-river storage options (dams), and three off-river storage lakes. The new source options being considered provide different levels of benefit with respect to emergency supply following natural

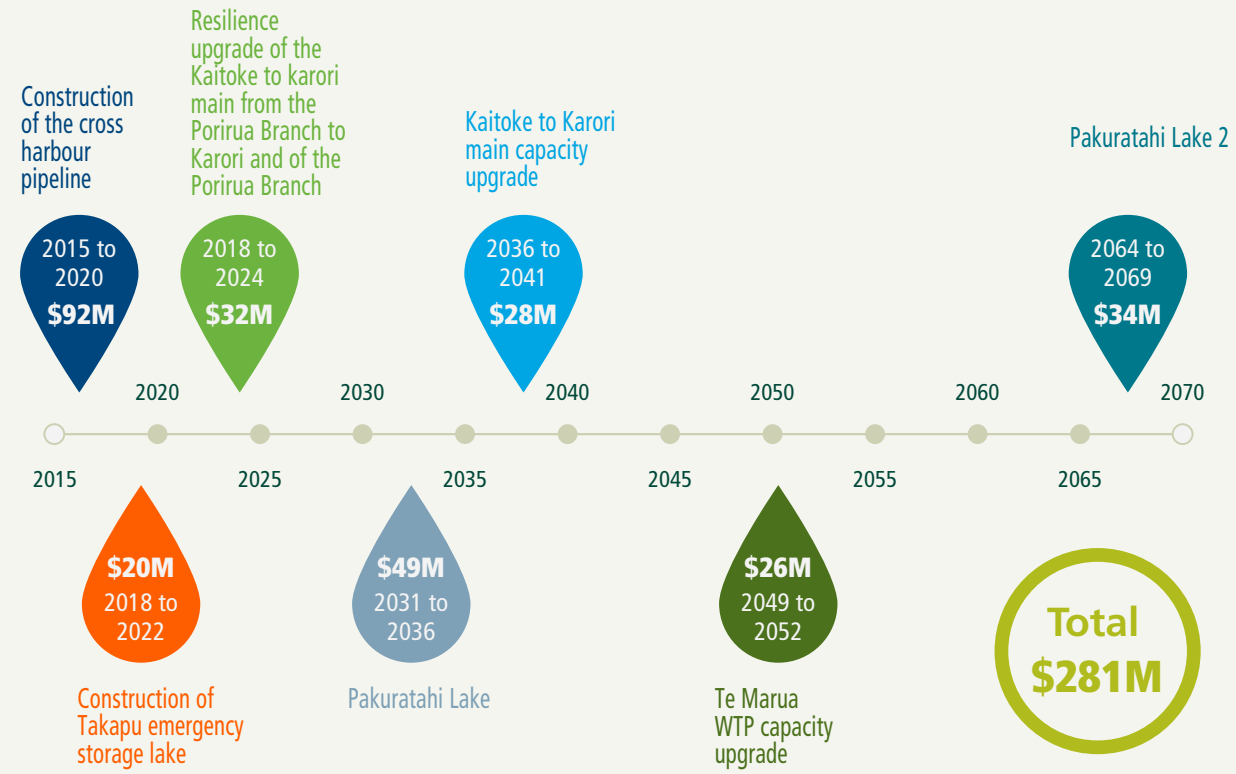
hazard events – particularly movement of the Wellington fault. Options for new sources are therefore being considered in combination with emergency water supplies as discussed above.

The most likely scenario for developing a new water source in combination with improvements to emergency water supply includes constructing two new storage lakes near the Pakuratahi River, increasing the capacity of the Kaitoke main and Te Marua water treatment plant, building a new emergency water storage lake at Takapu Road, improving the resilience of the Kaitoke pipeline, and constructing a cross harbour pipeline from Point Howard to central Wellington. The estimated capital costs of this scenario are set out in the table below.

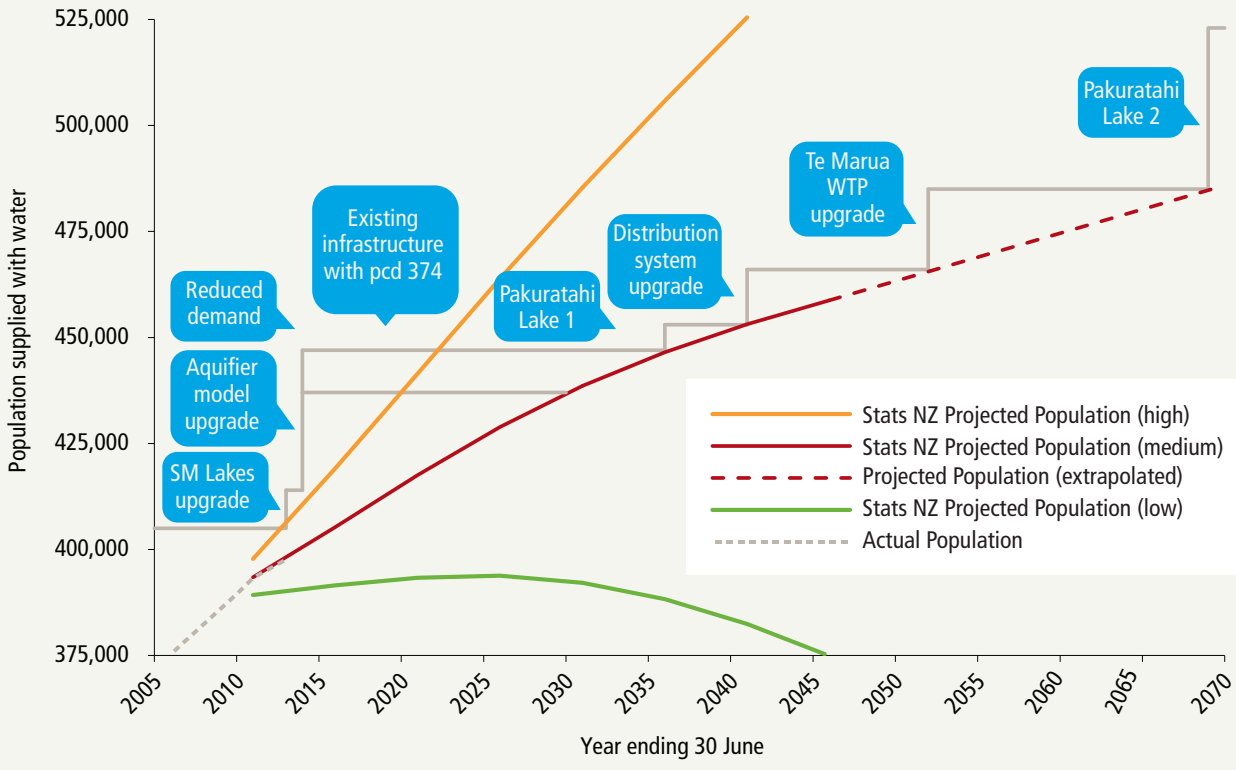
Most likely development scenario for new sources and emergency supply

Description of work or project	Timing	Capital Cost
Construction of the cross harbour pipeline	2015 to 2020	$92M
Construction of Takapu emergency storage lake	2018 to 2022	$20M
Resilience upgrade of the Kaitoke to Karori main from the Porirua Branch to Karori main from the Porirua Branch to Karori and of the Porirua Branch	2018 to 2024	$32M
Pakuratahi Lake 1	2031 to 2036	$49M
Kaitoke to Karori main capacity upgrade	2036 to 2041	$28M
Te Marua WTP capacity upgrade	2049 to 2052	$26M
Pakuratahi Lake 2	2064 to 2069	$34M
Total		**$281M**

Phasing of most likely development scenario



Development strategy for new water source



CHANGES IN LEVELS OF SERVICE

GWRC aims to provide water that is safe and pleasant to drink as well as providing a continuous and secure water supply. The levels of service are required by legislation or set through the 10 year plan process in consultation with the community. Our proposed emergency water supply projects will dramatically improve our level of service following a major earthquake. Based on current studies 150,000 people will be without water for 20 days, 80,000 for 40 days and 20,000 for 70 days. The proposed emergency water projects are designed to provide 20 litres per person per day from day one.

CLIMATE CHANGE AND SEA LEVEL RISE

The effect of climate change on water source availability is assessed using the Sustainable Yield Model. The information is used to determine the timing and optimal storage volumes for future development options.

Sea level rise as a result of climate change may impact on the ability of GWRC to meet the target levels of service in the longer term. To address this issue GWRC recently completed a project to examine the impact of sea level rise in the range of 0.8 to 1.5m on abstraction from the Waiwhetu aquifer. The analysis concludes that under dry conditions abstraction rates from the aquifer may need to be reduced more than previously thought in order to maintain sufficient pressure in the aquifer and prevent the possibility of salt water intrusion. The impact of this information is currently being incorporated into our Sustainable Yield Model.

Climate change and sea level rise is not expected to have a significant impact on the bulk water supply until beyond the planning horizon of the Infrastructure Strategy. Long term mitigation of the adverse effects will be provided by adjusting the timing of source development options to meet predicted demand.

PUBLIC HEALTH

The availability of safe drinking water is a fundamental requirement for public health and GWRC is committed to providing safe and secure drinking water at all times. For our water treatment plants at Te Marua, Wainuiomata, and Gear Island, and for the wholesale distribution system we aim for, and consistently achieve, an A1 grading under the Ministry of Health's grading system. For the Waterloo treatment plant we aim for, and consistently achieve, a B grade. This is the highest possible grading for this facility due to Hutt City Council's policy not to use chlorine.[1]

1 Quality standards for drinking water are set by the Ministry of Health (MoH), through the Drinking Water Standards for New Zealand. Each year the Ministry publishes a grading for every public water supply. Gradings are based on the drinking water standards and indicate how safe each water supply is from contamination.
The MoH grading system has two parts:
- A grading for the source of water and the treatment plant ("A1" to "E"). This relates to the measures taken to limit contamination of the water source and to remove any contamination that is present, by treatment. It is a rating of how safe the water is after treatment, but before it enters the distribution system.
- A grading for the distribution system ("a1" to "e"). This is based on the risk of water becoming contaminated within the local supply pipes, and the procedures in place to minimise the risk of unsafe water to consumers

ENVIRONMENTAL OUTCOMES

Providing, maintaining and operating water supply assets can have adverse effects on the environment. Adverse effects include:

- changes in the natural river environment and consequent impacts on recreation, biodiversity and landscape values.
- the impacts of discharges of water treatment waste products.

In order to mitigate or reduce these effects GWRC has a number of measures in place such as maintaining ISO 14001 accreditation and continuously improving and optimising operational practices. There are also conditions on our resource consents to take water aimed at mitigating and reducing these effects including maintaining minimum river flows and minimum aquifer levels.

Water distribution also uses a significant amount of electricity. We are increasing our use of renewable energy where this is practical and cost-effective. We have implemented three grid connected mini-hydrogeneration schemes and are investigating the feasibility of others. The schemes have been installed at our Wainuiomata and Te Marua treatment plants, and on the inlet to a service reservoir in Porirua. Other renewable energy sources will be reviewed for remaining power needs.

FLOOD PROTECTION

Our long term approach (over the 30 year life of the Infrastructure Strategy) for managing GWRC's flood protection assets is to maintain existing assets in perpetuity and to build new assets in accordance with GWRC's Floodplain Management Plans. In addition to managing our assets we also advise people and communities about flood risk.

Flood Management Plans are our key planning tool that set out how we manage flood risk on individual rivers and floodplains. The plans are comprehensive and involve extensive information gathering, consultation and discussion with the affected local communities, councils and mana whenua. The outcome of the floodplain management plan process is a document that guides how a floodplain and catchment should be managed to;

- Minimise risks to life, health and safety
- Reduce severity of flood damage
- Promote sustainable use of flood and erosion prone land
- Promote sustainable development of the wider catchment
- Use planning and community preparedness to ensure sustainable land use
- Identify options to manage the flood risk.

RENEWING OR REPLACING EXISTING ASSETS

GWRC's flood protection assets across the region have a replacement value of $262.8 million.

Summary of asset types (total replacement value $000)	
Flood protection infrastructure assets	262,820
Land, buildings, plant and machinery	23,689

They include stopbanks, outlet structures (culverts and pipes), berms, edge protection material and structures, debris arrestors, detention dams, barrage gates, flood walls and land within river corridors. Flood protection assets are located in the Hutt, Otaki, Waikanae, Wainuiomata, Porirua and Ruamahanga catchments.

All existing assets will continue to be maintained in perpetuity (including renewals or replacements when necessary) in order to provide the various levels of service set out in the Floodplain Management Plans (FMPs). We have FMPs in place for the Hutt River (2001), Otaki River (1998), and the Waikanae River (1996). In addition the Waitohu Stream Study also fulfils all the requirements of a FMP. For the Porirua Stream we do not have a formal FMP but all the elements have been completed separately.

FMPs are under development for the Te Kāuru (Upper Ruamahanga River), the Waiohine River, the Pinehaven Stream, and the Waiwhetu Stream. A FMP will also be developed within the next ten years for the Lower Ruamahanga River.

We also have infrastructural assets along the Wainuiomata River but there are currently no plans to progress a FMP.

In addition to maintaining existing assets there are a number of major projects underway or planned to renew or replace existing assets. Details can be found in the flood protection chapter (Section Five).

CHANGES IN DEMAND

New development in areas that are subject to flooding is not supported and there are no plans to provide new flood protection assets in such areas. Avoiding the flood hazard by not building in high hazards areas is the most effective way of managing flood risk in the long term.

The key drivers for changes in demand for flood protection services are likely to be:

- An increase in our knowledge and understanding of the potential for flood damage, including our knowledge of climate change impacts (such as changing rainfall patterns and sea level rise)
- Changes in community expectations. The demand for protection from flooding continues to increase in both the extent of the protection and the level of service provided along with improved environmental outcomes, in currently protected areas, and in other areas
- Where existing approved development is subject to an unacceptable degree of flood risk then construction of new infrastructure will be considered. In all other circumstances reliance will be placed on either avoidance or alternative non-structural measures
- The process for discussing and agreeing on our approach to managing flood hazards is primarily through the process of preparing and reviewing flood plain management plans. The context in which we undertake flood plain management planning is to firstly identify the nature and extent of the flood hazard, and secondly to avoid development in flood prone areas. We are considering investigations in six additional areas long term. These areas are Carterton, Paraparaumu, Featherston, Martinborough, Pukerua Bay, and Whareama. A further three areas may require investigation in advance of development pressure from large infrastructure projects. These are Judgeford, Te Horo and Mangaone.

CHANGES IN LEVELS OF SERVICE

GWRC is committed to providing and maintaining an agreed level of flood protection to existing communities.

The levels of service are set through the FMP process in consultation with the community. In general, within areas subject to flood risk, the following standards apply[1]:

- Where required to protect existing residential development, stopbanks are constructed to achieve a minimum 1 in 100 year standard
- Where required in a rural context, stopbanks are constructed to a 1 in 20 year standard to protect land use from frequent flooding events.

There are no planned decreases to this level of service. However, as noted climate change may impact on the ability of GWRC to meet these levels of service long

1 However this does not imply that infrastructure will be built without taking into account our drivers for change.

term. In some circumstances managed retreat may be the most appropriate response.

PUBLIC HEALTH

In maintaining existing flood protection assets and considering new assets, improving public health and safety is very important for GWRC. Through the provision of adequate flood protection, and information and advice about how to prepare and respond to floods we aim to minimise loss of life due to flood events, improve resilience and to promote safer communities. In order to do this GWRC seeks to improve resilience by firstly having a policy of avoiding new developments in areas subject to flooding[1], and secondly by prioritising the building of new or upgraded infrastructure for existing development.

ENVIRONMENTAL OUTCOMES

Providing, maintaining and operating flood protection assets can have adverse effects on the environment. Adverse effects might include:

- Sediment from river erosion and run-off entering streams and coastal waters during construction and maintenance.
- Changes in the natural river environment and consequent impacts on recreation, biodiversity and landscape values.

In order to address these issues GWRC takes measures to minimise the impacts of river control works on the natural form and function of rivers and streams through an adaptive management framework (we monitor our work, review our practices, and implement changes). A Code of Practice guides how all our flood protection works are carried out.

GWRC have also prepared environmental strategies for the major rivers in the west of the region (Hutt, Otaki and Waikanae). New environmental strategies will be prepared for those areas where FMPs are being developed.

RESILIENCE TO NATURAL HAZARDS

Building resilience into our flood protection infrastructure is very important to GWRC as it is these assets that help protect our communities from significant risks. The major natural hazards relating to our flood protection assets are damage from major earthquakes and damage from floods.

Major earthquakes could result in cracking and slumping of stopbanks, foundation settlement and cracking of concrete structures, cracking of river berms, and slumping of rock edge protections. Flood protection assets on land subject to liquefaction may also be damaged.

Assets located within fault zones would likely be completely destroyed by the rupture of those faults. For example, Hutt River assets located in the Wellington fault zone. It is also possible that a Wellington fault movement could cause major subsidence in the lower Hutt Valley reducing the capacity of the flood defences. We rely on self-insurance to pay for the repair or rebuild of assets following an earthquake event.

1 Refer to policy 29 in the Regional Policy Statement.

Flood events themselves also have the potential to damage our flood protection assets and deposit large quantities of gravel in lower reaches of rivers. Flood events with a return period of up to five years may cause some damage to assets. We provide adequate funding in our annual maintenance budgets to accommodate such repairs. For flood events between 5-25 years, top up funding is available, if necessary, from the Flood Contingency Reserve.

Larger floods (between 25-40 year return period) may cause considerable damage to assets. To cover these situations GWRC has a Major Flood Protection Recovery Fund. Where damage exceeds the balance of either or both funds, borrowing may be necessary to carry out the repairs.

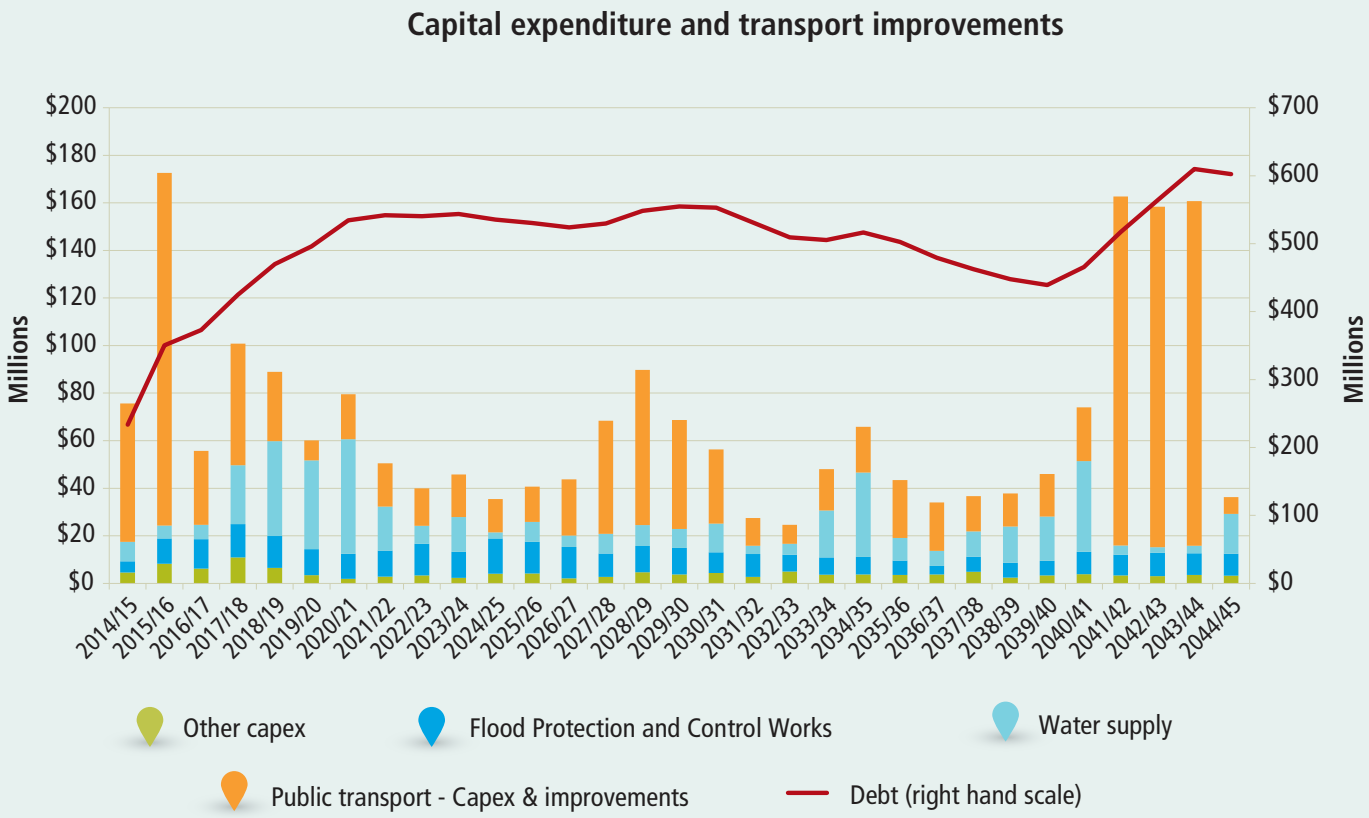
Floods with a return period in excess of 40 years may be eligible for some government funding otherwise damage would be funded by borrowing. GWRC also maintains insurance for some physical assets such as barrage gates and large concrete structures.

INFRASTRUCTURE INVESTMENT PROGRAMME

GWRC owns other assets as well as the three most significant sectors included in this strategy.

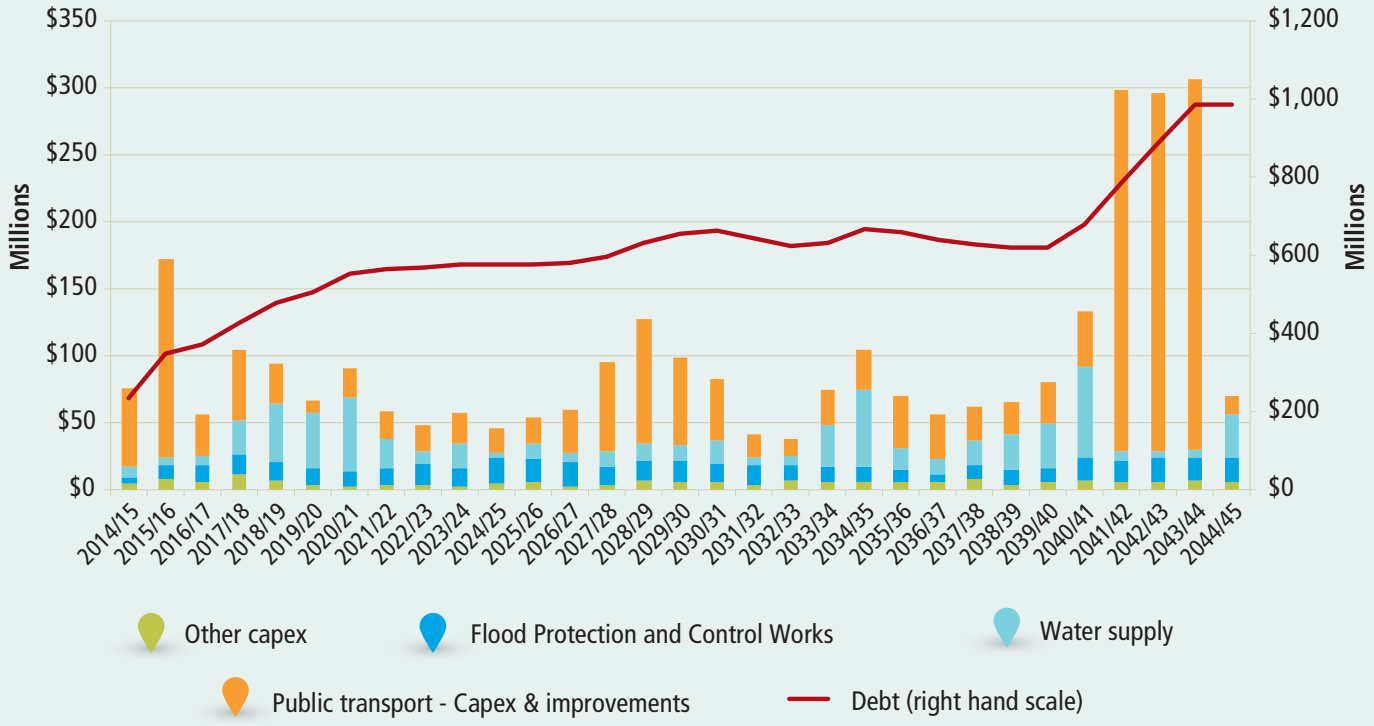
In total GWRC expects to spend over $750 million on new or replacement infrastructure over the life of the Infrastructure Strategy.

The graph below shows the capital expenditure and debt over the 30 years from 2015/16 in 2015/16 dollars. This allows us to look at the underlying changes across all of GWRC on a like for like basis. The peaks represent large investment that we need to manage from both an affordability perspective and with our organisational ability to manage the workload.



In this second graph we have included the impact of inflation. As can been seen the tables are different. The peaks in capital expenditure, and therefore debt, are higher. In the Financial Strategy we use inflated numbers to provide for the relative change in future costs. From an affordability perspective the inflationary increases will to some extent be offset by both the real and inflationary changes to people's incomes.

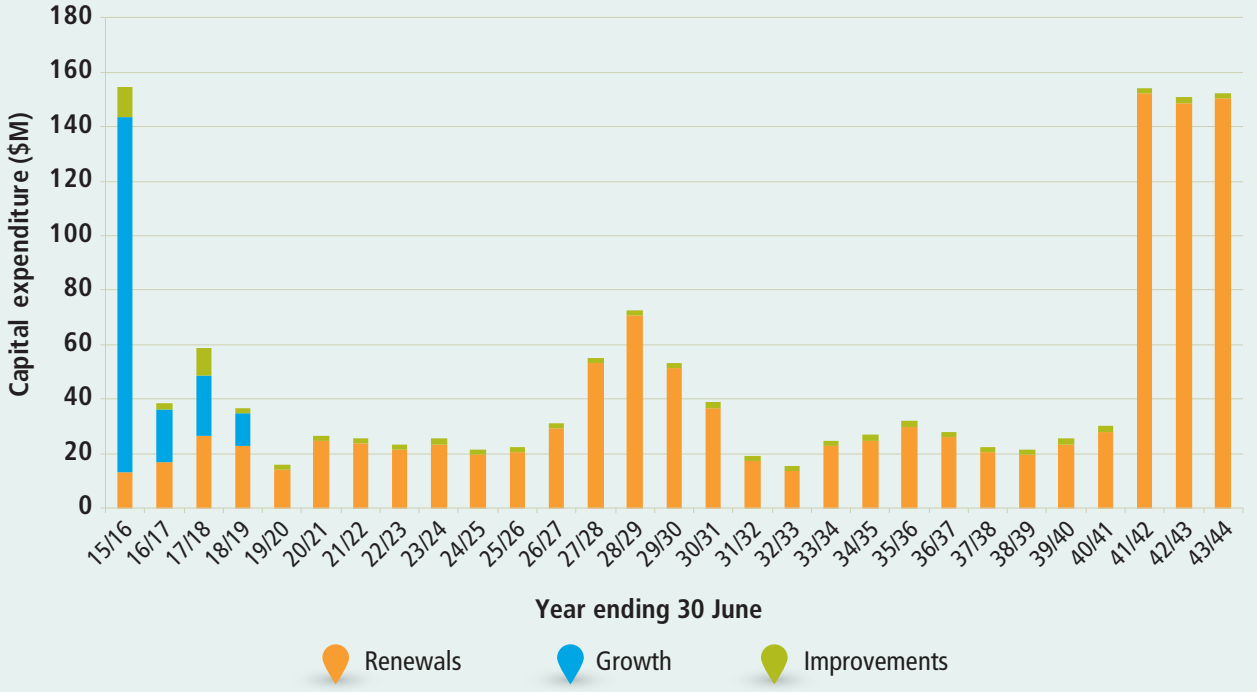
Capital expenditure and transport improvements and debt (inflated $)



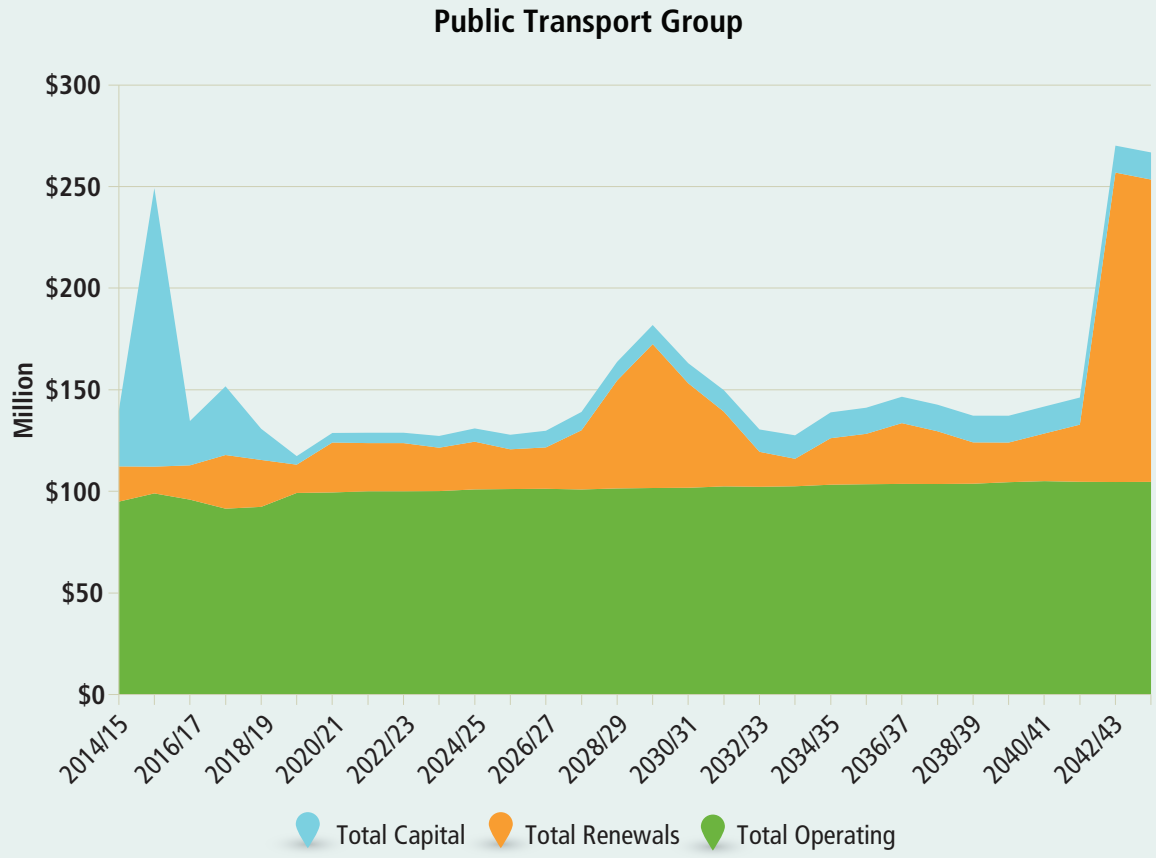
PUBLIC TRANSPORT

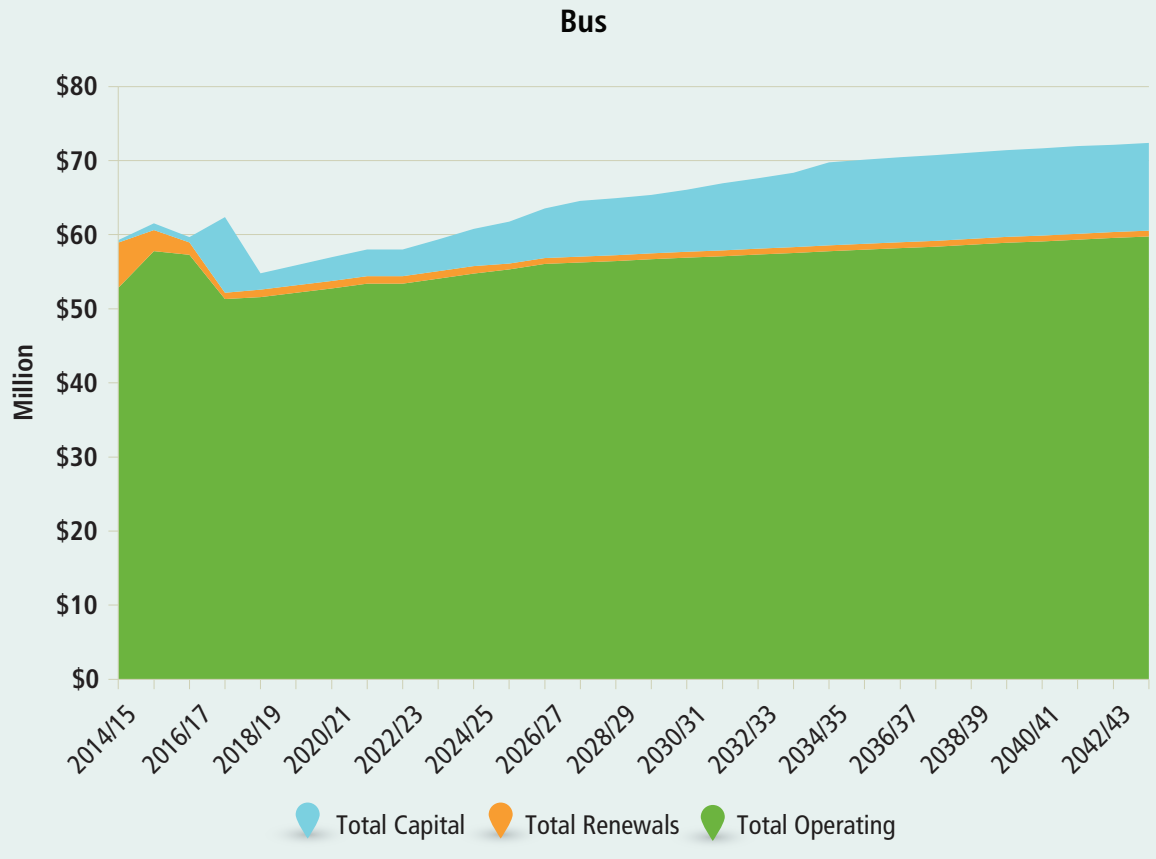
Estimates of capital and operating expenditure

The indicative estimates of the projected capital and operating expenditures for public transport infrastructure assets are shown in the following graph.

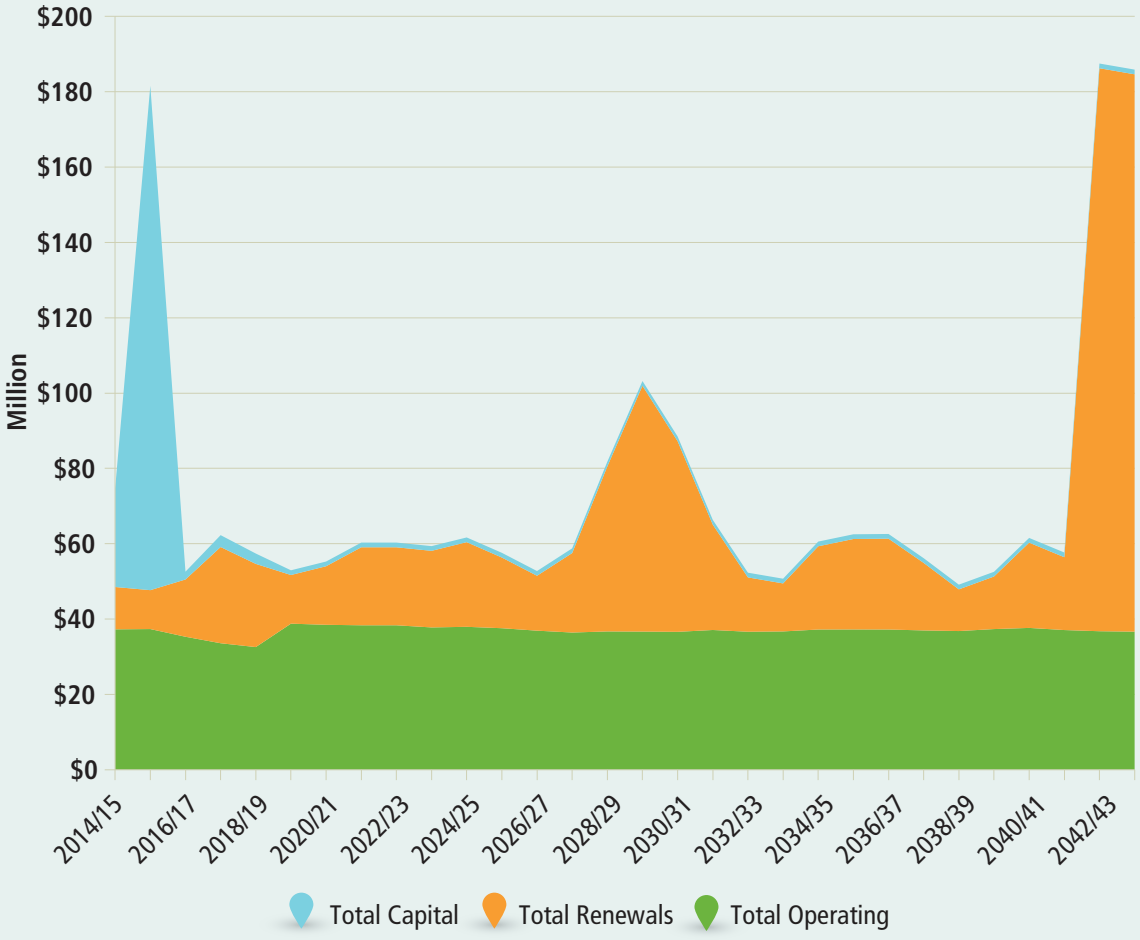


The following graph splits capital expenditure into renewals, growth and improvements:

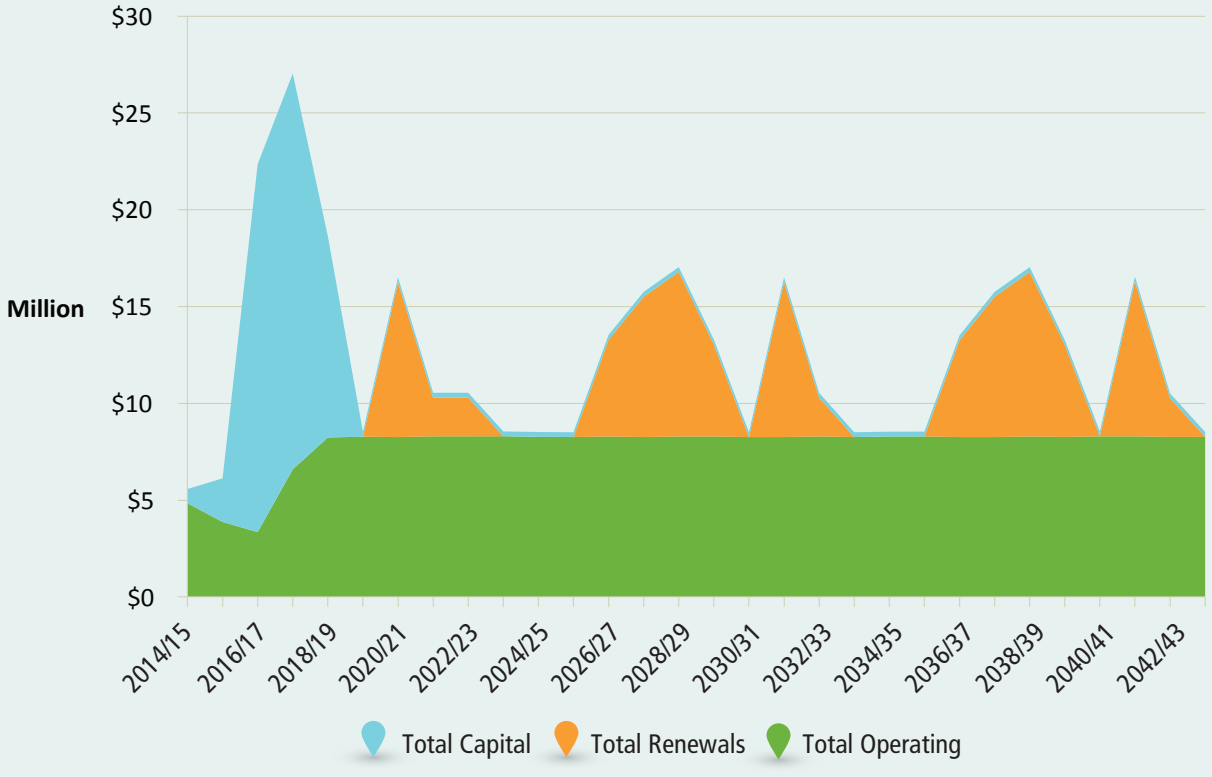




Rail



General



SIGNIFICANT CAPITAL EXPENDITURE DECISIONS

Our significant decisions about capital expenditure for our public transport assets required over the next 30 years are set out below. This includes when we expect to make those decisions, what principal options we expect to have to consider, and the approximate scale or extent of the costs associated with the decision.

Significant decision required	Timing	Principal options	Costs
Replacement of our Matangi EMU fleet	2041 to 2043	Before making this decision we will consider other options such as refurbishing the fleet to extend its life, or partial replacement	$410 million
Matangi EMU fleet scheduled mid-life refurbishment	2025 and 2032	No reasonable alternative	$24.4 million
Refurbishment of the Wairarapa carriage fleet	between 2016 and 2021	We are currently assessing whether it would be more cost effective to purchase new DMUs at this time instead. This would bring forward the spending we proposed for replacing the DMUs during 2027 to 2030 at a cost of $90 million.	$12.3 million
Install integrated ticketing	2014-2018	The projected life of the integrated ticketing system is ten years. Before this a decision will be required about whether to replace or renew the system.	$51 million
Real Time Information System replacement or renewal	2024	Before 2024 a decision will be required about whether to replace or renew.	$10 million

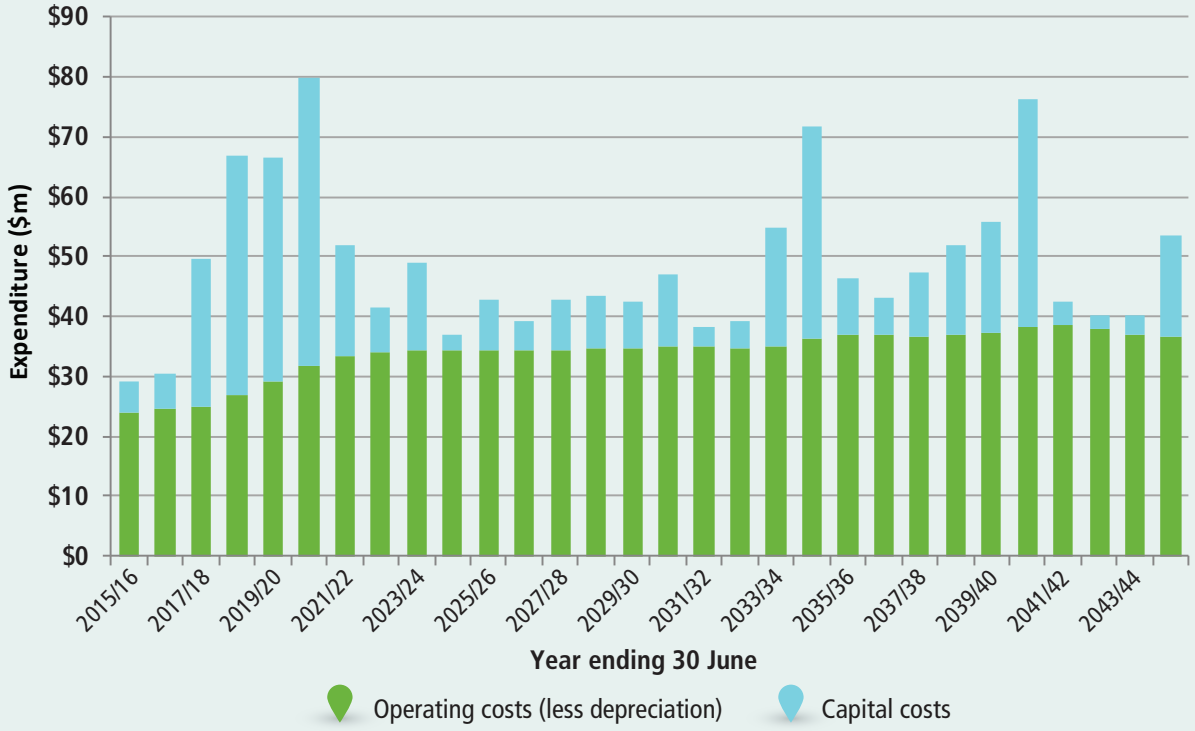
We aim to increase public transport patronage. Demand for public transport is influenced by a number of factors. These are summarised in the table below. GWRC will continue to provide broadly the current service level for public transport assets with some minor, progressive improvements to asset quality, condition and accessibility.

FACTORS AFFECTING DEMAND FOR PUBLIC TRANSPORT

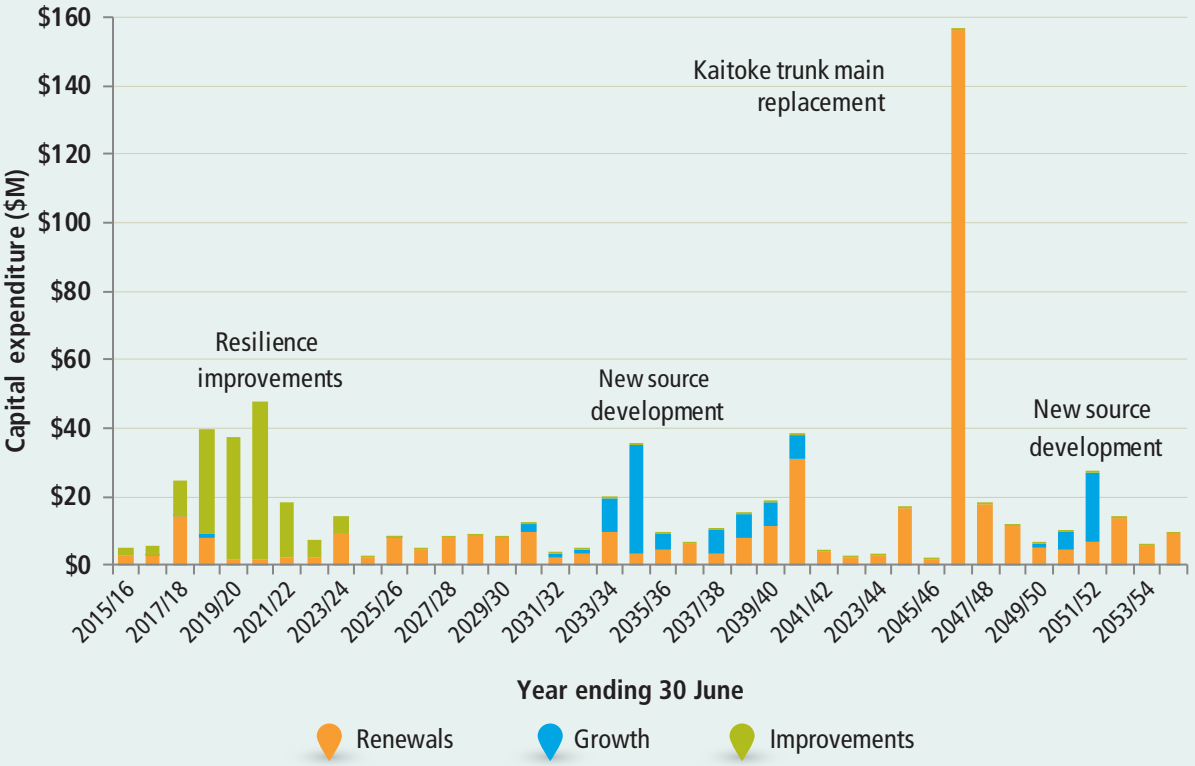
	Growth/demand trend	Impact on public transport	
Internal demand drivers	**Service levels**		
	Overall levels of service provided are progressively improving	Encourages the use of public transport. Key areas to further assess for improvement are: increased car parking facilities; increased quality of infrastructure and safety/security provision; travel convenience including interchange facilities and cyclist provisions; real time information; service capacity; and integrated ticketing	
	Fare increases above the rate of inflation	Fare increases have the effect of damping demand.	
External demand drivers	**Population and demographics**		
	Increasing population, particularly in Wellington City and the Kapiti Coast Increasing inner-city dwellings	Increases demand for public transport, especially with associated increasing congestion. Offsets private vehicular ownership growth trend with greater reliance placed on public transport and other modes of travel.	
	Aging population	Limits peak-time travel growth but with free off-peak travel has the potential to increase off-peak use.	
	Economic growth		
	Modest economic growth in Wellington	Some additional pressure for moving people.	
	Car ownership		
	Increasing car ownership levels	Overall this decreases demand for public transport and other modes of travel.	
	Increasing fuel prices and innovation	Increases result in increased use of public transport and other modes of travel. This may be offset with the introduction of technological advances, such as electric vehicles and ability to work from home.	
	Inner-city parking	Continued perception that inner city parking is difficult to find and expensive will continue to encourage use of public transport.	
	Road congestion	In recent years road congestion levels have remained fairly static. Increased travel demand to be offset by planned roading improvements resulting in little impact on PT demand.	
	Environmental sustainability		
	Increasing awareness of the importance of environmental sustainability	Increased willingness to use public transport and other modes of travel.	

ESTIMATES OF CAPITAL AND OPERATING EXPENDITURE

The estimates of the projected capital and operating expenditures for water supply infrastructure assets is shown in the following graph. This graph shows a 40 year timeframe to capture the anticipated capital expenditure associated with major renewals work needed just outside the 30 year horizon of this Strategy.



The breakdown of capital expenditure by investment driver is given in the following graph. This shows significant investment in proposed resilience improvements in the early stages of this Infrastructure Strategy, followed by new source development in the mid-2030s and major renewals work in the late 2040s.



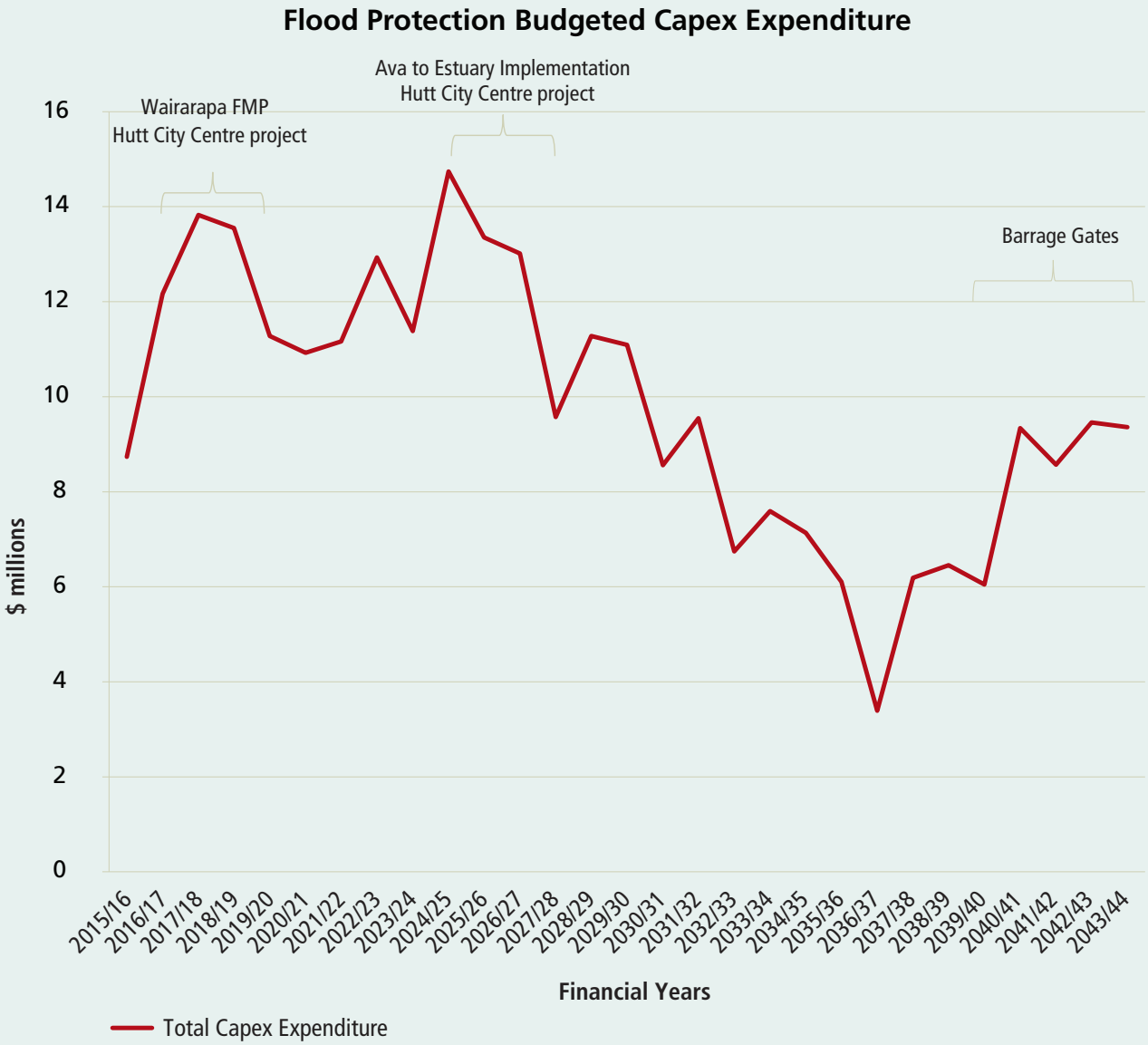
SIGNIFICANT CAPITAL EXPENDITURE DECISIONS

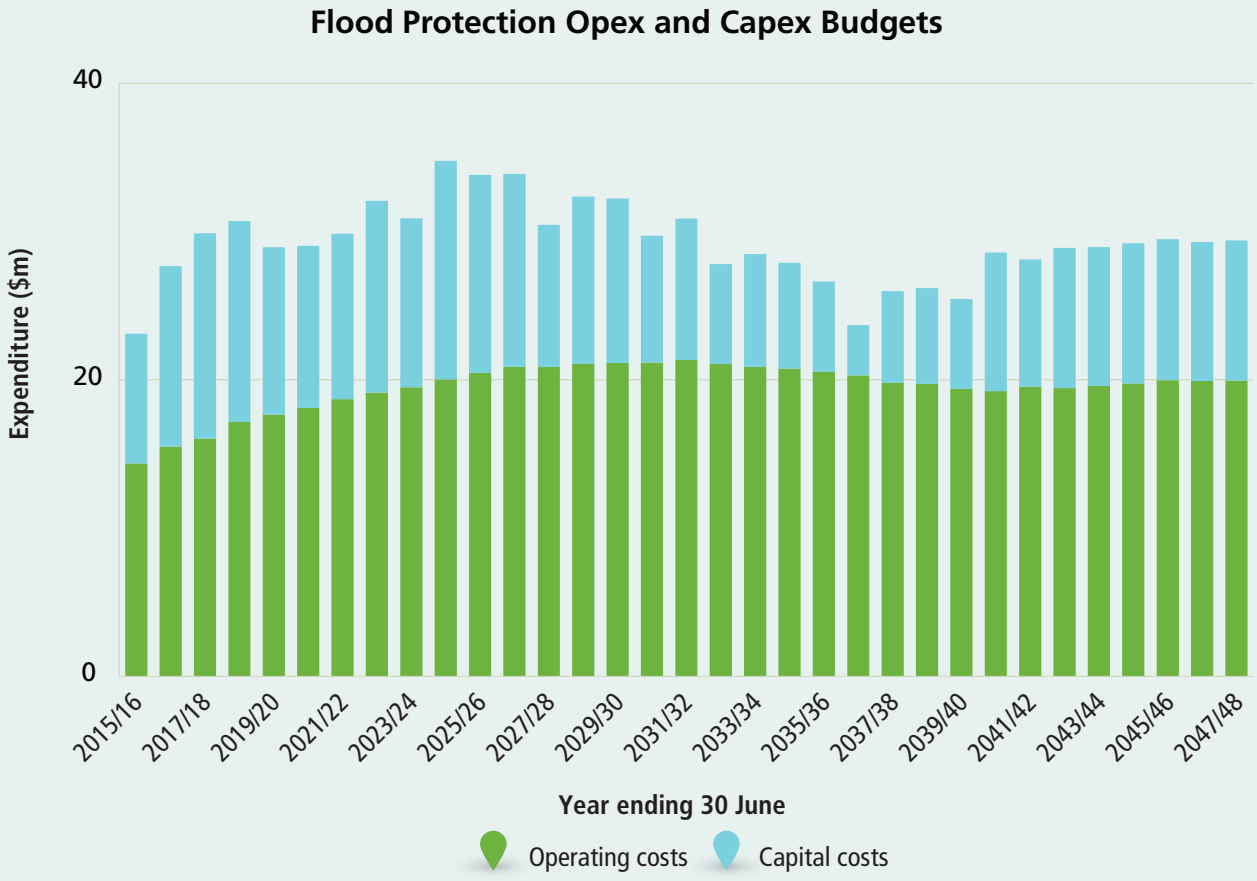
The following table sets out the significant decisions about capital expenditure for our water supply assets required over the next 30 years, including when we expect to make those decisions, what principal options we expect to have to consider, and the approximate scale or extent of the costs associated with the decision.

Significant decision required	Timing	Principal options	Costs
Construction of a resilient cross harbour pipeline for central Wellington and the eastern suburbs to meet the shortfall in bulk water supply following a Wellington Fault earthquake.	Construction proposed for 2015-21, with decision to proceed needed as part of adopting the 2015/25 LTP.	Resilient cross harbour pipeline with two pipe size options. Small 250mm pipe providing a minimum emergency supply of 20 L/p/d and costing $72m, or a larger (preferred) 550mm pipe that would provide additional non-emergency operational, social and economic benefits, and costing $92m.	$92m (preferred cross harbour pipeline with 550mm pipe).
Construction of the Takapu emergency storage lake for supply to Porirua and Wellington's northern suburbs (through to Karori) following a Wellington Fault earthquake.	Construction from 2020, with decision to proceed needed as part of adopting the 2015/25 LTP.	Various sites considered.	$20m plus $32m for associated pipeline resilience upgrades
Construction of Pakuratahi Lake 1 off-river storage and Kaitoke to Karori trunk main capacity upgrades.	Staged between 2035 and 2041 to meet predicted growth in demand, with decision to proceed needed by around 2030.	Various dam and off-river storage options have been considered in combination with proposed resilience improvements. The Pakuratahi Lake off-river storage option is preferred because GWRC owns the land (purchased in 2014), and because the environmental impacts associated with constructing off-river storage are significantly less than with a dam constructed on a river.	$77m
(Section Five provides a breakdown of costs).			
Replacement of the Kaitoke trunk main	Require replacement mid to late 2040s	Optimal replacement strategy to be developed over the next 10-20 years (e.g. replaced in full, staged replacement or early interventions to extend the economic life in some areas). See below for more discussion.	Up to $150m
Replacement of the eleven Waterloo and Gear Island wells	Require replacement progressively between now and early 2030s	Ongoing investigations and staged replacement over the next 20 years to extend the economic life of each well as much as possible while maintaining the risk of failure with acceptable levels.	$8m

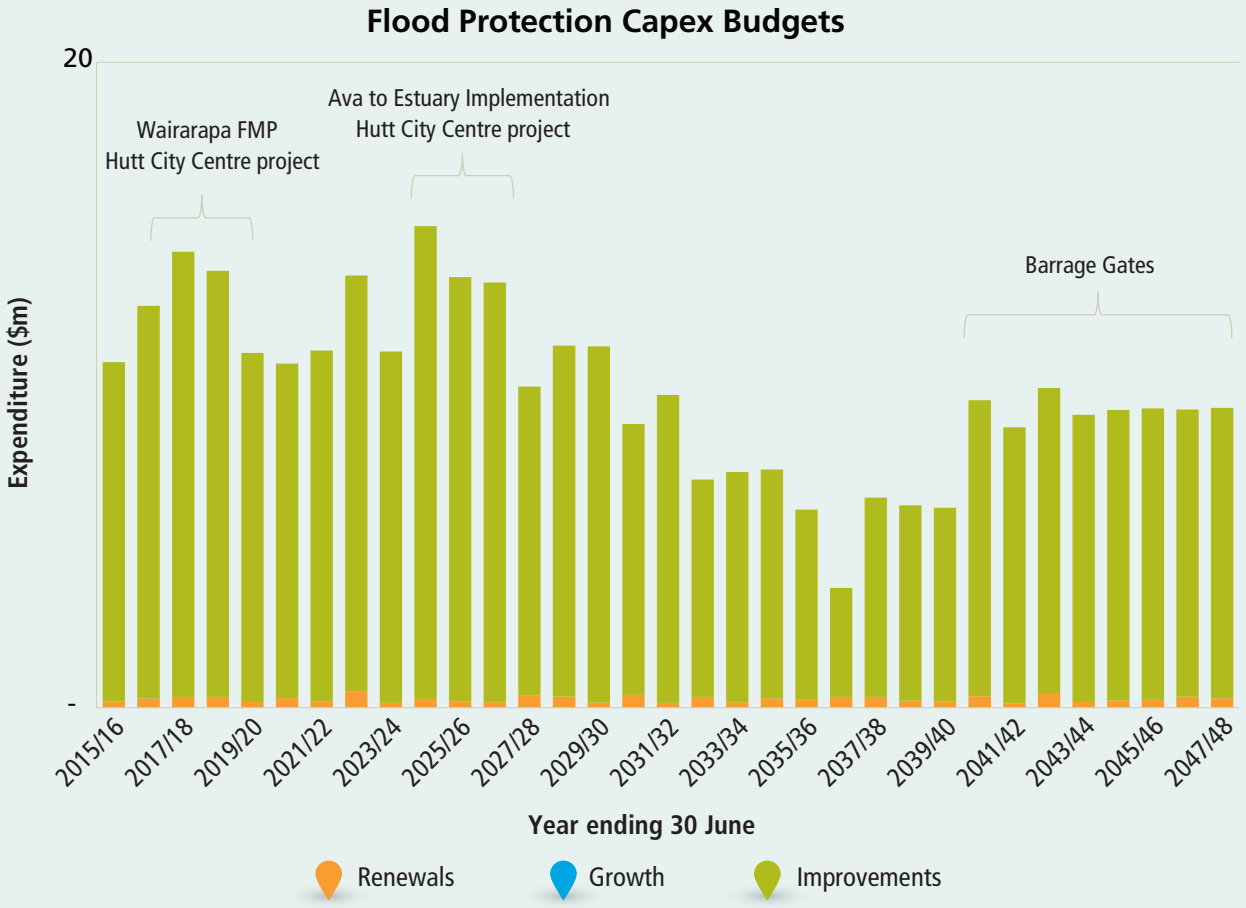
ESTIMATES OF CAPITAL AND OPERATING EXPENDITURE

The indicative estimates of the projected capital and operating expenditures for flood protection infrastructure assets are shown in the following graphs.




Flood Protection Opex and Capex Budgets
40
20
0
Expenditure ($m)
2015/16
2017/18
2019/20
2021/22
2023/24
2025/26
2027/28
2029/30
2031/32
2033/34
2035/36
2037/38
2039/40
2041/42
2043/44
2045/46
2047/48
Year ending 30 June
Operating costs
Capital costs

The following graph splits capital expenditure into renewals, improvement. Capital expenditure is influenced by a number of larger projects but remains constant over time given the nature of the business.



SIGNIFICANT CAPITAL EXPENDITURE DECISIONS

Our significant decisions about capital expenditure for our flood protection assets required over the next 30 years are set out below. This includes when we expect to make those decisions, what principal options we expect to have to consider, and the approximate scale or extent of the costs associated with the decision.

Significant decision required	Timing	Principal options	Costs
Hutt City Centre upgrade project	2015/16 for a decision	A range of options for construction of replacement stopbanks are being considered. Each of these results in a different level of service and resultant flood risk over the short and long term. There are no planned decreases to this level of service.	Up to $80 million
Lower Wairarapa Valley Development Scheme renewal	2017-20	A range of options are being considered for works to maintain existing levels of service, there are no planned decreases to this level of service.	Up to $50 million
Te Kāuru (Upper Ruamahanga) implementing floodplain management plan	2018-2034	Options under development but expected to include new stopbanks and channel works in the Waipoua River to protection Masterton	Up to $10 million
Development of new floodplain management plans for Upper Ruamahanga, Waiohine, Waiwhetu, Pinehaven, Mangaroa, Lower Valley Development Scheme, and Wainuiomata catchments	2016-2035	Capital funded floodplain management plans	Up to $30 million