Wellington Water

Three Waters Strategy

Wellington Metropolitan Region

FINAL – 2018

Our water, our future

About this Strategy

Why a Three Waters Strategy?

The management of three waters impacts on the daily lives of communities and the quality of our environment. Communities expect safe and reliable water supply for their health and prosperity. They expect their wastewater to drain away and be treated and they expect to be protected from flooding when it rains. They also expect healthy water bodies for recreational, ecological and economic reasons. For Māori, fresh water is taonga that has its own life force or Mauri.

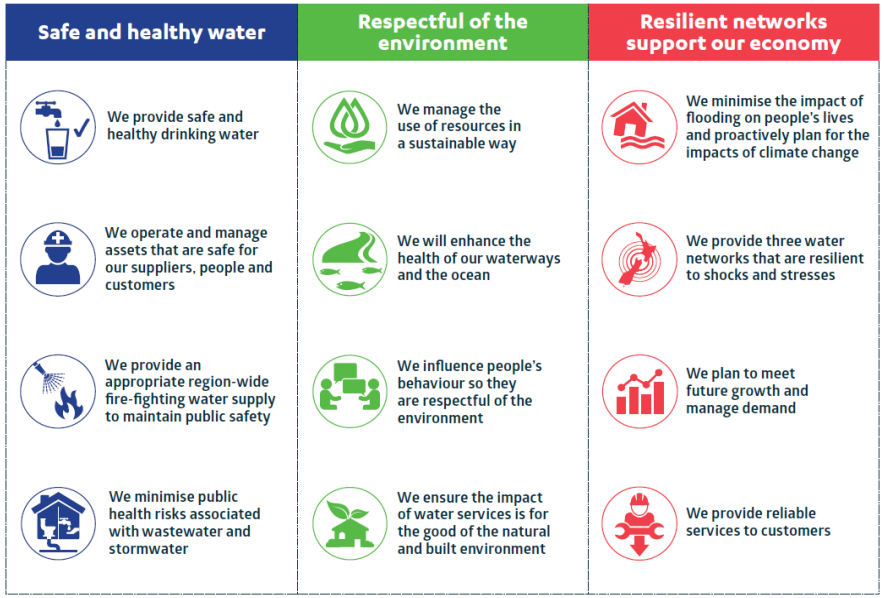
Sustaining current levels of service to the region's customers will become increasingly challenging over the years ahead.

The Wellington Metropolitan Region (the region) is experiencing steady urban growth with population expected to increase by 21% over the next 30 years. At the same time, many of the region's water bodies have reached capacity in terms of acceptable water quality limits. Our communities and three water networks continue to be affected by natural hazards, which over time, will be exacerbated by climate change.

Affordability is becoming increasingly important as a large portion of the region's network comprises aging pipes. Funding new growth assets future maintenance and renewals will become increasingly difficult under the current funding structure. Decision-makers and communities will need to make some difficult trade-offs about what they do and don't fund; particularly if rates rises and debt levels are to be contained. Most of the three water networks are either underground or out of sight and the value of this low profile infrastructure is often not appreciated until it fails.

Supporting growth and prosperity across the region will require us to be smarter about our investment decisions and deliver cost effective and innovative solutions. We need to ensure that the region's three water networks are resilient to future shocks and stresses; and at the same time sensitive to the environment. This Strategy sets the direction and approach required over the next fifty years to help us achieve this. In doing this, it provides the flexibility to deal with both known changes, and what an uncertain future may present us.

Central to this Strategy are Wellington Water's three customer outcomes: safe and healthy water; respectful of the environment; and resilient networks which support our economy. These outcomes (and supporting twelve goals) set the future direction for managing the region's three waters and for galvanising the organisations involved towards a common purpose and approach.



Incorporating a Māori world view

This waiata was written for Wellington Water and articulates a Māori understanding of the relationship between water and the environment which at all levels are woven together within the mauri or life-force that flows through and empowers all things. For this reason water is a taonga not only because of its spiritual and metaphysical properties but also because it supports all life. Understanding water through such a lens highlights the interwoven nature of such a world view.

Understanding that we are an entity responsible for water, which is a taonga for Māori, highlights a need to ensure our planning and investment approach does not directly or indirectly exclude the views and values of our iwi partners. This means going beyond 'consulting', 'including' or 'involving' our iwi partners in the planning process and ensuring that they form a part of our decision making processes.

Ngā Roi o Rangi

Timata i runga ko ngā roi o Rangi
Since time immemorial Rangi's tear drops have fallen

Ka heke tonu ra – ki a Papawhenua
Continuing to permeate mother earth with the infusion of life

Ki ngā tihi hukapapa ona wai e rere
From mountain tops to flowing tributaries

He mouri to te wai, - e kore e mimiti
Life's principle essence, an irreplaceable resource

Mai uta ki tai – rere wai ko te ora
From rivers to the sea flows life

He rawa te taiao, i te ao marama e!
The ecosystem defines one's quality of life

Our future state

Our region treasures its water. Our streams and harbours are healthy, our drinking water is safe and secure, our networks are resilient, our growing cities are water sensitive and we are prepared for a changing climate. Water is at the core of how we plan and grow our cities.

Our communities are engaged and actively involved in decision making.

Safe and healthy water

The region's water sensitive cities deliver livability outcomes, such as safe water, public safety and a healthy environment for all to enjoy.

The efficient use, recovery and self-storage of water safeguards supply to the region's growing population. The use of rain water, and recycling and reuse of grey water from baths, showers and other domestic use, is common practice throughout the region.

Respectful of the environment

The natural environment and engineered systems have been combined to provide clean water, amenity and ecological benefits. Our cities comprise green infrastructure, which is maintained and effective at enhancing water quality in fresh water bodies and coastal environments.

Carbon emissions have been reduced through resource recovery initiatives. Waste water is digested to create nutrients and biogas which is used as cheap, renewable source of energy for the region.

Resilient networks support our economy

Our flexible networks support a vibrant economy; they can withstand and quickly recover from the shocks and stresses of natural events. People, homes and businesses are adapting to our changing climate. Potable water is sourced from multiple locations from across the region. On-site wastewater treatment reduces our reliance on the main network and provides an alternative non-potable source of water.

Future challenges and opportunities

The next fifty years will present multiple challenges and opportunities that will influence the way we manage three waters. Front-footing and adapting to change is an important part of our strategy. Decisions also need to factor in the wider context, considering social, cultural, economic, and environmental trends.

Our journey towards achieving our three outcomes: safe and healthy water, respectful of the environment, and resilient networks will require us to consider the following:

A changing society

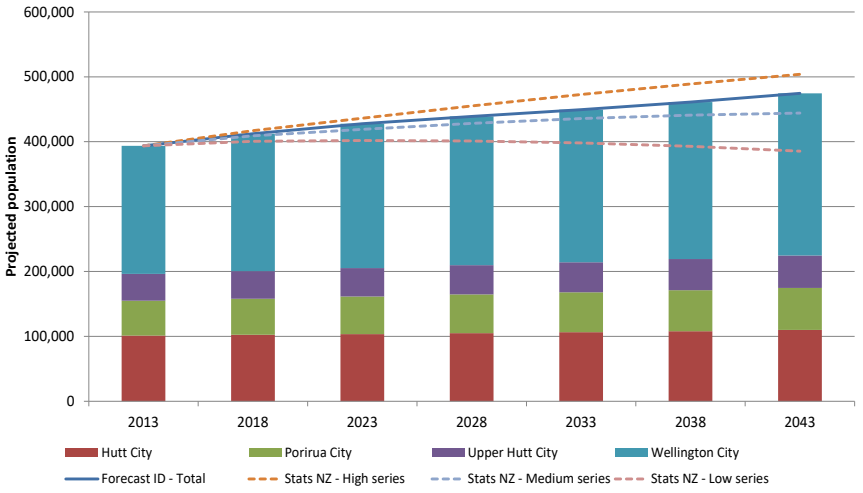
The region's population is growing

Demographic change, and the needs and preferences of particular groups, will affect the way we manage our three waters.

Historically, the Wellington region has experienced relatively slow growth; however this is changing. Population forecasts show that the region's population is expected to grow by around 81,000 over next 30 years. It is predicted that approximately 65% of the combined growth will occur in Wellington City, 11% in each of Upper Hutt and Lower Hutt and 14% in Porirua. It's worth noting that these regional predictions could play out quite differently as a result of a major event, such as an earthquake.

Alongside population growth are other demographic changes which will impact on our cityscape. Our society is getting older. For the Wellington region the percentage of the population 65 and over is expected to increase from 12.5% to around 20% in 2031[1].

As the urban population trends upwards, it is expected that household numbers will grow at a higher rate. However, changing social preferences and an aging population mean that households across the region are also expected to become smaller – i.e. the household occupancy rate is expected to decline on average from 2.8 to 2.6 people per household. This means new dwellings are expected to decrease in size but with greater intensity in terms of city scape.



The capacity of our networks is also impacted by a significant transient population who commute to our city centres for work and other reasons. However, this may change in future as technology influences how we work and where we work from.

[1] Greater Wellington. TN-WTSM 3013 Demographic report

Social preferences are changing

People's social preferences are constantly changing and this is impacting on community expectations and involvement in three waters.

Advances in education and technology have helped empower individuals, and this is leading to increasing demands to participate in decision-making processes. Communities are becoming more concerned about levels of expenditure, environmental outcomes, and hazard events such as flooding, climate change and earthquakes. At the same time there is an increased focus on recreation, aesthetics and the liveability of our cities. Technology is also empowering people to modify their lifestyle and understand the way that they utilise water services (e.g. smart metering).

Our involvement with the community takes many forms – from broadcasting information (e.g. social media); through to a representative customer panel that can express their preferences in an informed way. The future is likely to involve more 'influence' from the community, with customer feedback directly linked to decision making processes. We are already starting this journey through a customer hub, which provides us with a valuable snapshot of customer experience across all three waters.

The region's economy is growing

Along with population increases, the region's economy is growing. In 2015, the Wellington region accounted for 13.5% of all goods and services produced in New Zealand (Gross Domestic Product) – amounting to $32.6 billion. This is an increase of 19.5% over 5 years from 2010 (Stats NZ).

We are fortunate to have a diverse and vibrant regional economy[2]– ranging from government and professional services; screen, digital and information and communication technologies (ICT); design and innovation led manufacturing through to high end food and wine.

Just over 17% of Wellington city's economy is driven by professional, scientific and administrative services (compared to 8.7 per cent for New Zealand). Hutt Valley is the base for a number of specialist manufacturing and distribution industries. For Porirua, employment is relatively higher in the construction, education and health sectors[3].

The levels of service provided by our three waters infrastructure are an important driver of regional economic growth; in particular resilient and reliable networks. Although these growing sectors are generally not water-intensive, some customers require specific needs. The disposal of trade waste, for example, remains an issue in locations with limited wastewater capacity. Wellington Water's Water Supply Resilience Strategy (Towards 80-30-80) will be vital for ensuring the region's industries and businesses are quickly restored following the event of a disaster.

Funding challenges

Councils in the region will face increasing levels of asset renewal and replacement expenditure over the coming years; although the extent of this varies across each council. Affordability is therefore a pressing issue for councils with ageing networks and limited ability to increase revenue.

Funding three waters infrastructure to support new development is also challenging as it involves expensive upfront costs. Because most underground three waters infrastructure lasts around 80 years the payback period is long and returns on investment are low in the initial

[2] The Wellington Regional Strategy (2012)

[3] MBIE (2015). Regional Economic Activity Report

years. This can mean high borrowing and interest costs – particularly if growth is slower than anticipated. Funding growth through development contributions will become increasingly important, to ensure the condition of the remaining network is maintained.

Three waters infrastructure generally has a low profile. By nature, it is designed to be unobtrusive and it is challenging for the community to appreciate the value of these buried pipes and remote treatment plants which are taken for granted.

Alternative funding models and tools could be an effective means addressing some of these affordability issues.

Supporting urban growth within environmental limits

Urban development supports the social and economic well-being of communities. As the region's population increases, there is a need to ensure that new houses and infrastructure services are developed in a sustainable way, which meets aspirations of the community and is sensitive to the environment.

Fresh water quality in the Wellington Metropolitan region is variable. Some of our rivers, flowing out of forested ranges are in excellent health. In contrast, some of our streams and rivers and coastal areas are degraded. These water bodies often contain elevated *E.coli* concentrations, nutrients, poor water clarity, and high levels of heavy metals.

Major contributors to this degradation are wastewater overflows and leakage, and contaminated stormwater run-off. For water supply, most of the region's major rivers are fully allocated, or even over-allocated. This means at normal to low flow there is only just enough water to meet all consented water takes while still remaining within consented levels[4].

Enabling urban growth, while maintaining and improving water quality, will be an important focus looking forward. But there are other challenges at play too. Urban expansion is limited by the availability of suitable land, which means that marginal land, such as steep sections and low lying areas, become options for greenfield development. Affordability is also an issue, with difficult trade-offs required for levels of service across all three waters.

These issues require us to challenge conventional thinking about infrastructure provision and consider more affordable options, which may have multiple benefits. Non-asset solutions such as hydraulic neutrality and on-site systems for reducing wastewater discharges (e.g. grey-water or stormwater recycling) may reduce the pressure on our existing networks while minimising impacts on the environment. Water sensitive urban design solutions such as wetlands will become increasingly important for managing the impacts of stormwater and flooding.

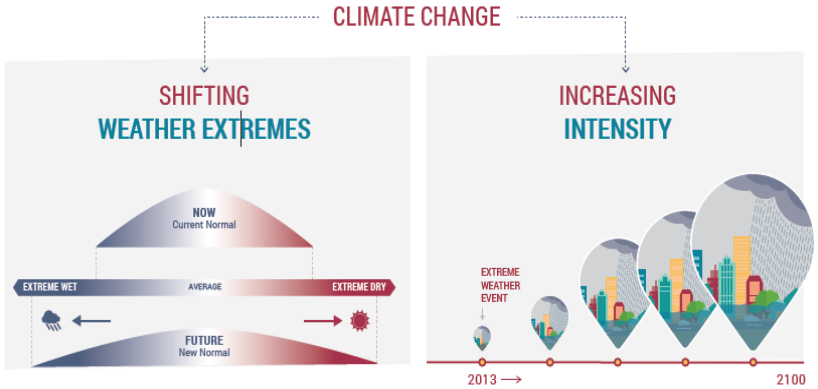
The impacts of climate change will affect three waters

Human activity is increasing the natural level of greenhouse gases in the atmosphere causing an increase in the earth's temperature and the climate to change. The Wellington Region is likely to warm significantly in the future.

[4] Greater Wellington – Air, land and water in the Wellington Region – states and trends. Regional Overview

Research undertaken by NIWA and IPCC projections suggest temperatures in the region are likely to be around 1°C warmer by 2040 and 2°C warmer by 2090 (compared to 1990). New predictions suggest the number of hot days – classified as days above 25 degrees – will jump from six to 26 for Wellington city, which means a similar climate to Sydney. Sea level monitoring in Wellington Harbour shows that relative sea level is currently tracking towards a 0.8m rise by 2090s or ~1m by 2115[5].

As sea level rises, the frequency and severity of flooding in low lying areas will increase significantly – especially during storm surges. Similarly, the risk of erosion, inundation and saltwater intrusion, will increase the need for coastal protection.



As sea level rises, groundwater levels influenced by sea level will also rise. This is the case for the Waiwhetu aquifer. Impacts may include water infiltration to basements, saline intrusion into the aquifer system and increased corrosion of underground pipelines.

[5] 2015, Greater Wellington Climate Change Strategy – reference to 2012 NIWA Sea level Variability and Trends report.

Climate change will impact on river flows, which are likely to be lower in summer and higher in winter; particularly in the west. Lower river flows in summer will raise water temperatures and aggravate water quality problems (e.g. through increased algae growth). Regional droughts and changing rainfall patterns may result in shortages in water supply and greater demand over the summer period. This has significant implications for the region's future water supply, which will require an additional source by 2040 based on current demand projections.

Climate change will also impact on the region's wastewater networks. Beaches may be closed for swimming due to more frequent wastewater overflows. More intense rainfall will also increase landslides, which may temporarily damage networks.

Our networks are vulnerable to the impacts of extreme natural events

The Wellington region is vulnerable to a range of natural disasters. We know it's not a question of *if* an event will strike our region, but *when*. The Kaikoura Earthquake of November 2016 is a stark reminder that significant events can result in serious damage to buildings and infrastructure, while disrupting business and everyday activities.

Our networks cross numerous fault lines, including the Ohariu and Wellington faults, which makes then particularly vulnerable to seismic events. For example, the bulk water supply pipeline from the Te Marua treatment plant to Porirua and Wellington crosses the Wellington Fault at Te Marua, Silverstream and Karori. The vulnerability of the Waterloo bore field and treatment plant to a seismic event, will also impact the supply of potable water. For wastewater too, trunk pipelines cross fault lines and many pipelines sit within landslides or liquefaction zones.

Our networks are also brittle and susceptible to breakage. Forty three percent of water reticulation pipes are made of cast iron and asbestos cement. These pipes are fragile and prone to sudden bursts as they age. Further, 30% of the region's reservoirs are considered to be vulnerable to shocks. We also have low resilience in our wastewater network with 80% of pipes made from asbestos cement, concrete or earthenware, meaning they are likely to break under disruptive forces. This in turn leads to overflows of untreated wastewater to public areas which may result in illness and disease.

We are taking a multipronged approach to mitigating the region's vulnerability to extreme natural events, comprising a combination of short-term and long-term actions. These are discussed later in the Resilient Networks section of the Strategy.

Legislation influences the way we manage three waters

Management of the region's 3-water networks is influenced by a range of statutes and legislative instruments (including regulations) spanning governance, asset management, health and safety and protecting environmental values. The Health Act (1956), Local Government Act (2002); the Resource Management Act (1991); the Health (Drinking Water) Amendment Act (2007) and the Building Act (2004) are particularly relevant to the management of three waters.

The regulatory environment and institutional arrangements for managing three waters are constantly changing; with multiple drivers for these changes. Some of these outlined below.

Legislative drivers of future change

- Increasing community expectations around safe water supply
- Environmental quality and resource scarcity
- Fragmented water governance structure with multiple entities
- Joined up and more efficient service delivery
- Financial incentives and the need to fund the bow wave of renewals
- Housing supply and affordability – supporting high growth
- More robust building standards
- Public health and safety

Protecting Coastal and Freshwater Environments

The National Policy Statement for Freshwater Management (NPS-FM) is becoming an increasingly important consideration for 3-waters investment. The NPS-FM directs regional councils to establish objectives for fresh water in their regional plans. The NPS-FM is being implemented by Greater Wellington through Whaitua processes, which will form catchment-specific chapters in the Natural Resources Plan for the Wellington region. Environmental limits and "objectives" will be set for freshwater management units in sub-catchments in the region.

The New Zealand Coastal Policy Statement also contains provisions to protect coastal environments from land-based discharges.

Providing for Urban Growth

The National Policy Statement on Urban Development Capacity (NPS-UDC) directs local authorities to provide for sufficient development capacity in their resource management plans to support projected demand for housing and business growth. Development capacity is defined as land intended for urban development, which must be supported with infrastructure. The NPS-UDC is a vehicle for achieving greater integration

between landuse and infrastructure planning and is already encouraging greater integration between Wellington Water and its client councils.

Integrating growth and environment

These two regulatory drivers send a clear signal that growth needs to be provided for - but not at the expense of degrading fresh water bodies. An ongoing challenge will be providing infrastructure that supports the region's growth aspirations - but also water quality limits set by our communities.

This will require increased investment in infrastructure and urban design solutions to mitigate the environmental impacts of new developments. Looking forward we have an important role to play in ensuring that planning policies and standards provide for these design solutions.

Protecting water supply

Drinking water is regulated by the Health (Drinking Water) Amendment Act 2007, which requires councils to take all practicable steps to comply with drinking-water standards and to implement a Water Safety plan for drinking-water supply.

The outbreak of gastroenteritis in Havelock North in August 2016 contributed to three deaths and over 5000 people becoming ill. As a consequence, public confidence in the fundamental service of water supply was shaken. Stage 2 of the Havelock North Inquiry, identified more systemic issues and recommended changes to the regulations and institutional arrangements that underpin the supply of safe drinking water. Recommendations included establishing a new water regulator.

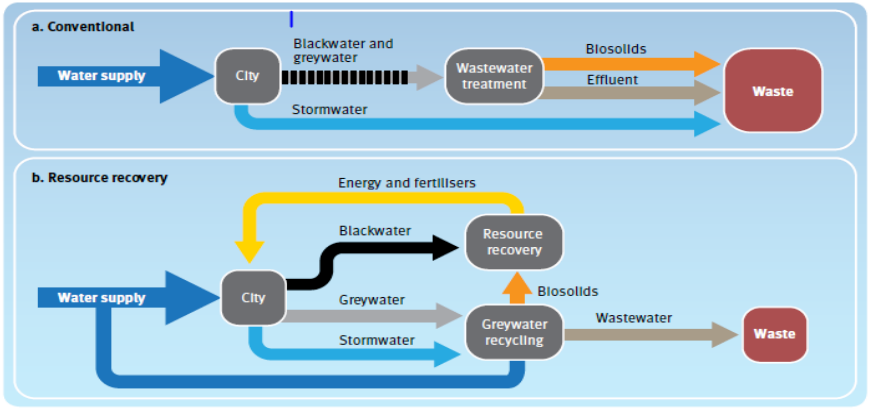
Irrespective of the Inquiry findings, we are taking a proactive approach to protecting public health (as discussed in later in this Strategy).

Technology has a key role to play in achieving our future state

Technology and innovation will continue to provide opportunities to improve services; mitigate environmental impacts and reduce costs. Technology provides exciting opportunities, but also brings challenges around cyber security, and the flexibility of our current systems to adapt.

Many cities across the world are already transitioning towards what we call the "fourth generation" of water infrastructure. This is characterised by improved water efficiency; source control; separation of resources and pollutants at source; improved management and control of flows in the system; and resource recovery of energy, carbon and nutrients[6].

An example of innovation in resource recovery[7]



Adapted from Prosser, IP 2011, *Water: Science and Solutions for Australia*, CSIRO Publishing, p. 86.

[6] WASA; Institute for Sustainable Futures (2017). Urban Water Futures: Trends and Potential Disruptions – Discussion Paper.
[7] Department of Energy and Water Supply (2013) Queensland's water sector: a 30-year strategy - Discussion paper: Shaping our water future

Technology to address environmental challenges

We are particularly interested in the way technology and innovation can help address environmental challenges, and at the same time support a growing population and increased urbanisation. Leveraging these technologies will be integral to achieving our strategy.

Water reuse technologies have been implemented in various locations around the world. For example, The Ground Water Replenishment System operated by the Orange County Water District uses a three step purification process to produce near-distilled-quality water that exceeds all state and federal water standards. This water is pumped into the district's percolation basins where the water naturally filters through sand and gravel to the deep aquifers underground.

Water efficiency gains are being achieved through ultra-efficiency and even waterless technologies. For example, vacuum system technology moves waste along a small pipe using air rather than relying on water.

Water efficiencies are also being achieved through the emerging area of "smart" metering. It provides users with the ability to monitor their consumption patterns and avoid wastage. This could be integral to our demand management strategy, and would pave the way for community consideration of volumetric charging.

The Mackay Regional Council in Australia used smart metering to reduce monthly peaks of water consumption to defer the construction of a water treatment plant and infrastructure upgrade. This has resulted in a 10% reduction in peak demand, a reduction in leakages and greater customer awareness.

Closer to home, Watercare are currently trialling smart meters in Waiuku to help build a better understanding of water flows and usage.

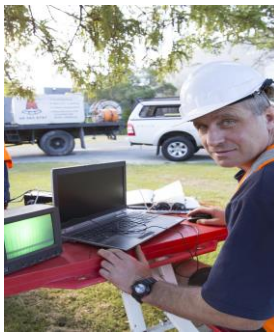
Pipelining and trenchless technology is increasingly become a cost-effective and less disruptive option for renewals, upgrades and new works.

Automation and digital technologies

The use of automated systems to operate mechanical systems more efficiently is helping keep pace with future pressures such as climate change and population growth. Variable speed drives is one example where individual control of pumping rates can reduce overall energy consumption in rising main pumping systems.

The widespread deployment of sensors which capture and transmit 'real time' data has the potential to have a profound impact on water management. Up until now one of the main barriers has been the cost of sensors (including battery replacement and internet connection). However, two recent developments are changing this. The first allows rapid transmission via a long-narrow band, which extends the battery life of sensors from weeks to years. The second is technologies which provide a public platform for connecting sensors and publishing data.

New technologies will also encourage more effective capture of physical asset data, reducing the cycle time between asset installation and asset management.



Information to drive efficiency

We aim to transform our plethora of operational and 'core asset' data into meaningful information to support decision-making. The transformation of source data to useable information is driven by two trends. First, the 'convergence' of operational data (for example, data captured from sensors) with corporate data (such as that related to the region's core assets). Second, automation allows the pace of data collection to increase. Both trends place a greater role on the development of accurate, fast-paced tools that can support three waters decision-making.

Safe and Healthy Water

We provide water services to ensure safe drinking water and work to minimise the public health risks from wastewater and stormwater over time.

A safe and reliable water supply is essential to public health and the social and economic progress of the region. Delivering current levels of service to the metropolitan region requires the abstraction, treatment and delivery of an average 140 million litres of water each day and providing sufficient capacity for fire-fighting supply when required.

Once this water has been used, the untreated wastewater needs to be safely conveyed through reticulated networks then treated and disposed in an appropriate way to minimise risks to human health.

Where does our water come from?

The Wellington Metropolitan region is fortunate to have most of its water sourced from protected catchments. Land upstream of all river abstraction points are owned and managed by Greater Wellington Regional Council. Risks of contamination are kept low through active pest management and controlled access to the catchment area.

The water supply to our four cities comes from three primary sources:

The headwaters of the **Hutt River** (abstracted from an intake at Kaitoke weir, treated at the Te Marua Water Treatment Plant (WTP) and stored in the Macaskill lakes

The **Wainuiomata and Orongorongo catchments** (abstracted from river intakes and treated at the Wainuiomata Water Treatment Plant).

The **Waiwhetu aquifer** (primarily extracted and treated at the Waterloo Water Treatment Plant although there is a standby treatment plant at Gear Island, Petone).

Bulk water sourced from the Hutt, Orongorongo and Wainuiomata rivers is limited by consents which require minimum flows to be maintained so that the ecological health of rivers is sustained. On days where there is excess supply of water available, some is diverted to the Macaskill storage lakes at Te Marua. Stored water is pumped back to the treatment plant when river flows are too low to meet demand or when flow levels require the Kaitoke intake to be turned off during river fresh events.

Water extracted from the Wahiwheu aquifer is also limited by consents which are intended to minimise salt water intrusion risks, as the aquifer extends beneath the harbour.

Providing safe drinking water

Safe drinking water is crucial to public health. To be deemed "safe", drinking water needs to meet the requirements of the Drinking-water Standards for New Zealand 2005 (revised 2008). However, meeting these Standards is only part of the story. The delivery of safe drinking water is also dependent on the security of supply in terms of quality and quantity. We are also aware of customer perceptions of what is considered 'safe' water. This can be driven by aesthetic qualities such as taste, odour and appearance.

In line with international best practice, we use a multi-barrier approach for managing risks of contamination. That means protecting the *source* water from contamination; treatment plant processes; management of distribution system risks; effective monitoring and response; and the protection of water after treatment to prevent re-contamination.

Water supply for firefighting

The protection of peoples' lives and property from the hazards of fire is dependent on an adequate supply of water for fire protection and firefighting. In general terms this means that the design of water supply networks must have adequate water pressures and flows available for in-property fire protection systems and for use by Fire and Emergency NZ personnel. Sufficient water storage is also critical should supply to networks become unavailable.

Our water supply networks are generally adequate for firefighting purposes. However there are localised areas where water pressure and available flows could be improved. Future improvements will be based on improved knowledge of network performance and through dialogue with Fire and Emergency NZ. Changes may involve reconfiguring the water supply network so that firefighting supplies are more accessible to emergency services.

Protecting public health

The region's urban areas are serviced by reticulated wastewater networks, which are designed to protect public health and the environment by transporting contaminated water away from private property without exposing people to harmful pathogens that are contained in human waste.

Stormwater services are also essential to protect public health as rainfall needs to be drained away to prevent damp ground and the various illness that can develop affecting people and property.

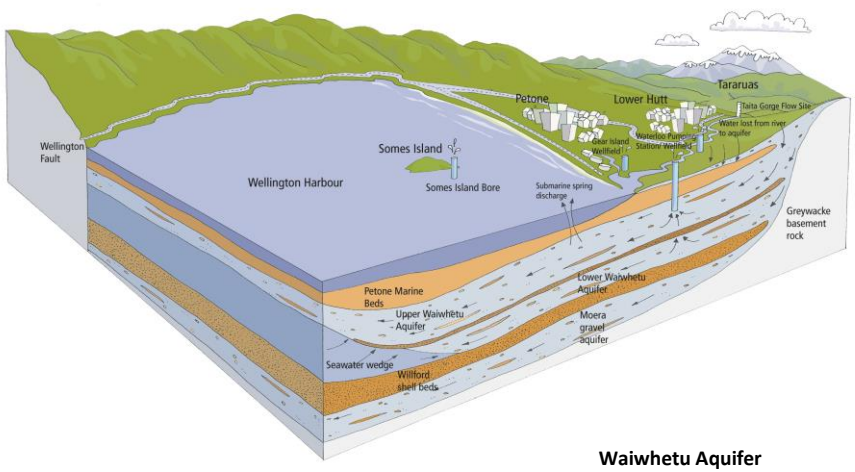
What are our key issues?

Protecting source water - current and future supply

Waiwhetu aquifer

About forty percent of the region's water is sourced from the Waiwhetu aquifer, which sits beneath Lower Hutt and Wellington Harbour. The aquifer is charged from the Hutt River and undergoes a natural filtering process underground that produces high quality water.

Greater Wellington Regional Council (GWRC) is responsible for protecting the aquifer (and source) and does this by regulating water takes, discharge and landuse activities that may adversely impact on quality and supply of water. The National Environmental Standard for Sources of Human Drinking Water require regional councils to protect drinking water sources through water and discharge permits and consent conditions. The Proposed Natural Resources Plan (PNRP) identifies a drinking water protection zone for the aquifer which controls certain discharges to land (e.g. animal effluent).



Waiwhetu Aquifer

As development intensifies in the Hutt Valley region, it will become increasingly important to manage and monitor the effects of landuse activities on the aquifer and the Hutt River that recharges it. Monitoring tests revealed three positive *E.coli* results from assets associated with the aquifer - two of which were taken from the bores. Before December 2016, there had never been a positive *E.coli* result from the aquifer source, which indicates that something has changed within the aquifer; although the source of this contamination has still not been determined.

On-going investigations are increasing our understanding of the aquifer and testing previous assumptions. We need to be responsive as new information comes to hand on the integrity of the aquifer and potential sources of contamination. This may require changes to the way we monitor and respond to aquifer water quality; and changes to landuse controls. Also, depending on what investigations reveal, other forms of treatment may be required.

Emerging contaminants

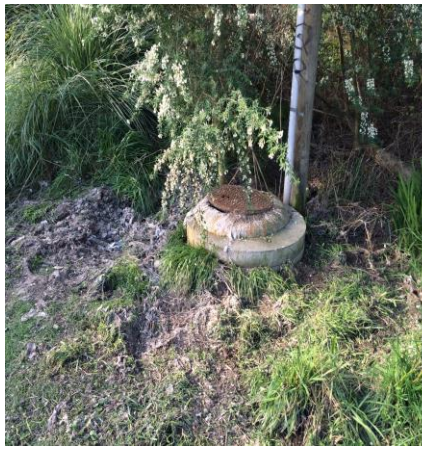
The detection of emerging contaminants (ECs) in aquatic environments could impact on water supply and may require greater focus in the future.

EC's such as pesticides, pharmaceuticals and industrial products have potential to cause adverse ecological and/or human health effects. Primary sources of ECs include wastewater effluent, urban stormwater, landfill leachate, and agricultural and horticultural run-off.

Human health impacts from wastewater and stormwater

During heavy rain events, stormwater, groundwater, and even seawater can enter the wastewater network resulting in overloading the capacity of the wastewater networks and overflow to the environment. These overflows are exacerbated by cross connections where stormwater downpipes are incorrectly connected into the wastewater system and local flooding which can directly enter gully traps.

Wastewater overflows can also occur in dry weather; often from blockages from private household drains and tree roots blocking pipes resulting in overflowing gully traps. These blockages can result in untreated wastewater seeping onto neighboring properties and causing a health risk. Untreated wastewater can also enter the environment by seeping through old and fragile pipes; with detection difficult.



Wastewater overflows are usually controlled by directing the wastewater into the stormwater network or directly to waterways via high level emergency bypass routes. However, in some areas, overloaded networks often result in uncontrolled flows; overflowing through manhole lids and onto land.

The potential public health impacts from blockages and overflows can be significant. As well as impacting on the environment and contaminating kai moana, wastewater overflows can result in disease and gastro-intestinal upsets in people who have direct contact with the contaminated ground surface. Children who inadvertently play in polluted areas are particularly at risk. Although most of our urban streams are not generally used for swimming, high levels of *E. coli* bacteria still indicate a health risk to children playing in or near the water, for example.

Our strategy to achieve safe and healthy water

Managing risk through effective treatment of water supply

We are fortunate that source water supplying the Wainuiomata and Te Marua treatment plants is from protected catchments. This means a reduced risk of contamination from human and animal sources that introduce disease-causing organisms such as *protozoa*, bacteria, and viruses.

However, we can no longer rely only on the natural filtering processes of the Waiwhetu aquifer to provide a safe supply of drinking water. Following the detection of some E.*coli* in the ground water, treatment methods such as chlorination and UV light (for the treatment of protozoa) are now required to ensure customer safety. Ongoing investigations may also reveal the need for different treatments.
We will continue to manage risk through assessing the condition of pipes and storage lakes. In recent years we detected algae living on the bed of the Macaskill lakes that are known to be capable of producing toxins. The response to this included establishing an enhanced monitoring regime and implementing changes to the treatment process at Te Marua WTP to improve the capability of the treatment plant remove cyanotoxins should they be detected in the lake water.

Water safety plans remain an important tool for managing risk and driving operational improvements and investments. We will continue to ensure these plans reflect the best available information and manage public health risk at an appropriate level.

Waterloo Water Treatment Plant

Ensuring on-going precaution through relationships and communication

The Havelock North Inquiry has highlighted the importance of relationships and strong lines of communication between all agencies tasked with delivering a robust multi-barrier approach to potable water supply. For example, there is a need to work collaboratively with GWRC to ensure on-going source protection.

We have established a collaborative working group comprising Regional Public Health, GWRC, and the Wellington region's territorial authorities to take a 'system-wide' approach to supplying the region with safe drinking water. We continue to monitor environmental water quality and provide information to our community to keep them informed of any public health risks.

Minimising the impacts of wastewater leaks and overflows

Addressing these issues will require a combination of asset (pipe renewals) and non-asset solutions. A regional programme of investigations is underway to determine inflow and infiltration, and where possible, the occurrence of cross connections. A network improvement plan is being developed for the Porirua trunk wastewater network that will provide information to identify and prioritise works.

There is potential to achieve improvements through community awareness programmes; particularly to minimise the occurrence of dry weather overflows in private dwellings. Simple messaging relating to not flushing sanitary products including wet wipes, avoiding tree planting over pipes and eliminating cross connections can go a long way in mitigating the occurrence of overflows.

Regulatory measures, such as bylaws, and design measures may also play a role in mitigating overflows. Some design elements include storage at pumping stations (to allow for failure), ensuring gully trap heights are maintained, and understanding when to replace leaking lateral pipes will aid in controlling this inflow and infiltration to a manageable level.

Incremental growth can lead to cumulative pressures with each additional development adding a small amount of impact to already overloaded networks. Structured analysis from the NPS-UDC work will help us understand the likely growth areas and plan for the necessary infrastructure provision in a controlled manner.

Action Plan – Safe and Healthy Water

Strategy	Initiatives	Timing	Goal
Managing risk through effective treatment and supply	Regular monitoring of Macaskill Lakes Project to modify the treatment process and capacity at Te Marua Water Treatment Plant Regional Water Safety Plan	On-going On-going June 2018	
Ensuring on-going precaution through relationships and partnerships	Collaborative working group established comprising Regional Public Health, GWRC, and the region's territorial authorities.	Ongoing	
Minimising the impacts of wastewater leaks and overflows	Future Services Study: Wastewater overflows Inflow and Infiltration reduction works Asset renewals and upgrades Network performance monitoring Community education and training Policies, bylaws and design measures to reduce overflows Wastewater Treatment Plant Upgrades (Porirua, Seaview)	0-3 years Ongoing Ongoing Ongoing Ongoing Ongoing 10-30 yrs	
Water supply for fire-fighting	Improved knowledge of network performance (modelling)	On-going	

Respectful of the Environment

When we provide water services we seek to avoid harm to the natural and built environment and over time enhance it for the benefit of future generations.

The region's water bodies support multiple values

The region's coastal environments and freshwater bodies (including lakes, rivers, streams, and groundwater) support a range of values. The Wellington coastline supports a variety of habitat types, including sandy beaches, rocky shores and over 90 estuaries. These areas support tourism, recreation and food gathering, and are valued for their natural biodiversity.

Although often highly urbanized, the rivers and streams in the Wellington Region have significant recreational and ecological values. Water from these rivers supports surrounding reserves, regional parks and forests which serve as popular sites for swimming and fishing activities, as well as camping, cycling and tramping. The region's rivers and streams provide habitat and food for hundreds of plants and animals, from tiny algae to two metre eels, and to native freshwater fish - many of which migrate between freshwater and the sea.

Māori continue to have a close relationship with water in all its forms, both spiritually and physically. Water is a taonga of huge importance to Iwi and enhancing the health and wellbeing of our waterways is a priority for Iwi. Māori often consider their personal health and the health of the Iwi to be closely linked to the health of their water bodies. For Māori degradation has led to traditional values embedded in their water-bodies being either compromised or lost completely.

How healthy is our water?

The health of freshwater bodies

Water quality in the Wellington metropolitan region is variable. Larger rivers, flowing out of forested ranges are in 'excellent' or 'good' health, such as the upper reaches of the Hutt or the Orongorongo River. In contrast streams and rivers of degraded water quality (e.g. fair or poor) are located in largely farming or urban catchments. Water quality is generally good at beaches in the region, but there are some beach sites (e.g. Wellington City, Petone and Porirua) where high levels of pollution are recorded, particularly after heavy rain.

Degraded fresh water bodies include the upper and lower reaches of Porirua stream, the Waiwhetu stream, and the Karori and Kaiwharawhara streams in Wellington City. These streams often contain elevated *E. coli* concentrations, nutrients, and poor water clarity. At times, high levels of heavy metals are found in some urban streams.

The health of the region's coastal areas

For the region's coastal areas, the story is also mixed. Water quality is generally acceptable at beaches throughout the Wellington region. However, Wellington Harbour contains a range of contaminants from urban stormwater such as lead, copper and zinc; these levels are highest in Evans Bay and Lambton Basin – a clear indication that contaminants and toxins from nearby urban stormwater and other uses accumulate in the harbour sediments.

The deeper parts of Porirua Harbour are also impacted by contaminants, and the situation is even worse in the Onepoto arm where heavy metal concentrations are near or above early warning guidelines. Weekly summer monitoring of bacteria levels has shown that Plimmerton (at South Beach), Porirua Harbour (at Rowing Club) regularly breach national recreational water quality guidelines. This is due to faecal contamination from a combination of waterfowl, and sewer or storm water drains.

Polluted urban streams also empty into the sea where they can affect swimming beaches. Some of our popular spots, such as Eastbourne and Petone are graded 'fair' because guidelines are sometimes breached, especially after rainfall. Owhiro Bay (Wellington) and Robinson's Bay (Eastbourne) have been graded 'poor' because of faecal contamination; at least partly due to sewer and stormwater and infrastructure problems.

The region's wastewater networks

Urban areas are serviced by reticulated wastewater networks which dispose of domestic and industrial wastewater from residential and business properties

Most of the pipelines in the wastewater reticulation networks operate by gravity drainage. The reticulation networks discharge into systems of trunk sewers – and then treatment plants. There are four treatment plants in the region - Moa Point, Porirua, Seaview and Western. Treated effluent from the plants is discharged into the coastal marine area.

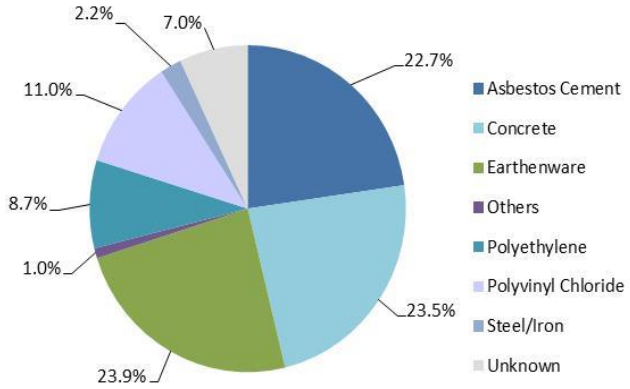
The 24,000 tonnes per annum of solids removed during the treatment process are currently disposed in the regions landfills. Additional treatment and disposal options for these biosolids is being explored to get beneficial use of this potentially valuable resource, however disposal of any human waste based product in New Zealand is complex

2,367 km pipeline

168 pumping stations

4 Treatment plants

Material distribution for wastewater pipes



The region's stormwater networks

The region's stormwater networks comprise pipes and channels which discharge into open drains, watercourses, the harbour and the ocean at many locations across the region. Most pipelines in the stormwater networks operate by gravity drainage. Pump stations provide drainage from localized areas which are too low lying for gravity drainage to be effective. Most of these are located in the Hutt Valley along with one in Kilbirnie. Debris traps tend to filter out solid rubbish from stormwater flows; but stormwater is generally not treated to remove contaminants.

While not formally identified as part of the stormwater network, overland flow paths and storage areas play an important role in managing flow. Stormwater detention dams are used to capture surface run-off and overland flows.

Our consenting regime

Many of our three waters activities require resource consents to comply with Regional Plan and District Plan requirements. These include stormwater network consents; new consents for capital expenditure (capex) projects; wastewater treatment plant (WWTP) upgrades; wastewater overflows, and water permits for bulk water abstraction. Wellington Water currently manages over 200 consents (and conditions), but also has a heavy future schedule of new consents and consent renewals that will be subject to greater rigor.

The Proposed Natural Resources Plan (PNRP) has introduced new and more stringent consent requirements for three waters infrastructure. This includes new consent requirements for stormwater discharges, and a non-complying status for any 'new' discharges of wastewater to freshwater, including historic emergency overflows. A key requirement of the stormwater discharge consent is the establishment of a monitoring regime and the development of stormwater management strategies that target water quality improvements.

Some of the significant consent renewals in the near future include overflow discharges to the Waiwhetu stream from the Seaview WWTP (2018); a renewal of consent to discharge to coastal waters from the Porirua WWTP (2020); Porirua Wastewater network overflows consents; Western Wastewater Treatment Plant bypass (2023); WCC Moa Point WWTP (2035) WCC wastewater network overflows; a new consent for the Omāroro Reservoir; dewatering global consent application (2017).

What are our key issues?

Regular monitoring by GWRC shows that some coastal areas, rivers and streams are adversely affected by discharges from urban land use; in particular stormwater and wastewater overflows, which flow directly into water bodies. Heavy metals and chemicals affect the ecological health of benthic (seabed) communities in the harbour, particularly in close vicinity to stormwater outfall sites.

Aging pipe networks

There are areas within the region's environment that are impacted by the deteriorating condition of our networks; in particular leaking pipes and wastewater overflows. A history of deferred maintenance has created legacy issues across the region, which will require significant investment in the future to maintain and improve current levels of service.

To put this into context, around 55% of the region's wastewater pipes are between 35 and 60 years old; with an expected design life of about 80 years. Theoretically they should have a remaining life of between 20 and 45 years. However considerable lengths of network (around 18%) are likely to need repairing before the end of their usual life date because of the poor quality of materials used for construction during the 1960s and 1970s. We are investigating the renewals that will require repair over the next 20-30 years.

The capacity of our networks

Stormwater networks have historically, been designed to cope with a 1 in 5 or 1 in 10 year storm events. This means networks have been overwhelmed in places as the storm intensity has exceeded the design capacity resulting in private residences and businesses being flooded.

All of the region's wastewater networks are designed to transport wastewater with some allowance for leaks and trade waste flows. However, during periods of heavy rainfall, excessive stormwater can make up the majority of the flow and lead to overflows from the wastewater system. Seawater and groundwater can also enter the wastewater networks, causing overflows to occur.

The end result is contaminated water flowing onto land and into waterways, which impacts on cultural values, human health and the ecological health of the receiving environment.

The region's wastewater treatment plants are also designed to cope with dry weather flows, but in storm events the flows increase significantly. For example, stormwater entering treatment plants can cause variations of more than 300% of the total wastewater volumes on some days. In some cases the peak flows exceed the capacity of the plants, resulting in partially treated wastewater being discharged into the receiving environment. This is a particular issue for the Porirua Wastewater Treatment Plant where the current capacity for dealing with high flows is limited.

As our networks age, this issue will be compounded. It is almost certain that the amount of groundwater entering the wastewater system will increase. Further, the capacity of our networks will also be impacted by climate change through more intense and frequent rainfall events.

Increasing urbanisation and the impacts of stormwater

High performing cities are important to the prosperity of regions and our national economy. Given population forecasts for the region, urban growth is inevitable. This growth needs to occur in a way that maintains, and even enhances the environment for residents to enjoy, and for businesses to prosper.

There are places in the Wellington metropolitan region where urbanisation is contributing to the degradation of water quality through increased stormwater volumes flowing directly into water bodies. Greenfield development in particular, results in sedimentation from vegetation removal and soil compaction, or coverings of impervious surfaces such as roofing, asphalt and concrete. As rainfall runs off over land it picks up sediment, contaminants, petrochemicals and metals such as zinc, copper or lead and carries them through the stormwater network untreated to streams, harbours and beaches.

These contaminants, especially heavy metals, can build up over time in increasing concentrations. For example, research suggests that most of the zinc in our stormwater comes from unpainted or poorly maintained galvanized iron roofs. Some contaminants are historical and are expected to decrease over time – e.g. lead contamination from the historical use of lead additives in petrol. Similarly, modern roofing materials have a very low zinc yield compared to traditional galvanized iron.

The impacts of stormwater are likely to worsen in the near future. Modelling undertaken by Wellington Water shows a correlation between household growth for the region and increases in stormwater volumes; largely because of more impervious surface cover.

Disposing of biosolids

Each year, the region produces around 24,000 tonnes of biosolids (sludge), as a by-product of the wastewater treatment process. The disposal of biosolids is becoming an emerging issue for parts of the region because of the limited capacity of landfills to deal with the waste and the production of carbon emissions from the landfills. Wellington City Council is targeting an 80% reduction in emissions by 2050.

Before leaving the treatment plants, sludge goes through a dewatering process before it is transported to Wellington City Council's Southern Landfill and Spicer's Landfill in Porirua City. For the Hutt Valley, sludge is thermally dried before being disposed of in the Silverstream Landfill.

Dewatered sludge is generally mixed with other waste streams prior to its disposal and this is done on a 'ratio' basis to ensure safe and stable storage. However, this mixing ratio isn't sustainable at the Southern and Spicers landfills as volumes of waste remain static (because of waste reduction measures) against *increasing* volumes of sludge produced from population growth.

One option we are exploring is introducing thermal dryers for the Porirua and Wellington plants, which reduces the volume and produces a "Grade A" product which is safe for beneficial use on forestry land, for example.

Wellington City had a composting plant in operation for about eight years which produced high quality compost from biosolids and green waste, however the lack of a market and odour complaints forced the closure of that operation. We will continue to look for alternative disposal routes for the Porirua and Wellington biosolids in the medium term.

Meeting community aspirations

Water quality regulations are signaling that a 'business as usual approach' to three waters management (e.g. managing the impacts of storm water and wastewater overflows) may no longer deliver the required levels of service from an environmental outcomes and compliance perspective.

The National Policy Statement for Freshwater Management directs regional councils to establish environmental limits or "objectives" in their regional plans, and to take a more integrated approach to managing fresh and coastal water. These objectives (and limits) are being determined through Whaitua committees, which have been established across the region. Wellington Water is currently working with *Te Awarua o Porirua Whaitua* Committee on the objective setting process. The Wellington Harbour-Hutt Valley Whaitua Committee will get underway in early 2018 and will set objectives for that catchment.

The ***Te Awarua o Porirua Whaitua Committee*** is currently developing a "policy package" comprising limits, targets, and methods, as a framework for meeting freshwater objectives.

In cases where limits have been already been exceeded, progress towards meeting long-term targets is required using a range of methods such as regulatory (e.g. limiting land use activities); education, investment (e.g. infrastructure renewals) and integrated catchment management.

Given that wastewater overflows and stormwater have a direct and measurable impact on water quality, the implications for all three waters networks could be significant. The same situation applies to water abstraction, where more stringent limits may be imposed on water takes. For sub-catchments requiring improvements, investment will need to focus not only on remedying legacy issues (e.g. asset condition), but solutions that support sustainable urban growth.

Our strategy for improving environmental outcomes

Reducing stormwater run-off through water sensitive urban design

Changes in impervious surfaces have a direct impact on the amount of stormwater run-off that can cause flooding and exacerbate degradation of receiving environments. Water Sensitive Urban Design (WSUD) is a best practice approach for stormwater management, which is achieved by integrating stormwater management with the ecology of a site; whilst also factoring in urban design and community values.

Water sensitive design (or similar concepts) have been successfully applied throughout the world and are becoming increasingly common practice in New Zealand. Water quality is improved by natural design features that limit stormwater pollutants from entering the network. WSUD can also assist with hydraulic neutrality objectives by minimizing impervious areas and promoting infiltration and rainwater storage.

We are producing concept design guidelines that can be applied at a range of scales from brownfield site-specific developments through to new greenfield developments.

Although WSUD results in a reduction in annual average runoff volume entering the stormwater network, its impact on peak flows during extreme events is limited.

The opportunity to apply water sensitive design to the Wellington metropolitan region may be limited by demonstrable "success stories". However, as our science and engineering matures we are moving towards some successful applications. It will be only a matter of time before the benefits (including financial) are acknowledged and understood by communities. Issues such as the ongoing maintenance of WSUD features need to be worked through to ensure their effectiveness over time.

The use of planning controls to reduce impacts

Over the short term we plan to work with the region's councils to introduce regionally-consistent District Plan provisions, standards and codes of practice designed to help mitigate the impacts of stormwater. This will be achieved by incentivising (or requiring) certain approaches to development, such as hydraulic neutrality, minimum floor levels, setbacks from open streams, and the protection of overland flow paths. These provisions can be set at the policy stage; or as a consent condition.

Development Contribution policies can also impose fees on the basis of impervious surfaces and have some influence depending on the relative dis-incentive versus benefit of hard surfaces for any specific case. However, such provisions normally only apply to the non-residential sector.

The NZS4404:2010 'Land Development and Subdivision Infrastructure' has been revised to include specific reference to water sensitive design, stating that solutions that use natural processes and add value to urban environments are the preferred approach to land development and infrastructure design. There may also be an opportunity to better utilise transport routes as overland flow paths.

A step-change for managing biosolids

We need a step change around how we manage wastewater sludge, which takes a holistic view of benefits and costs, e.g. better sludge management can have waste reduction benefits.

The Wellington Regional Biosolids Strategy recommends working towards thermal drying facilities at Porirua and Wellington, and upgrading the existing Hutt Valley thermal dryer in the medium term.

However, this may not be a viable option as thermal drying is a major capital expense and is energy intensive, resulting in emissions. On the other hand the ongoing disposal of biosolids may impact on waste reduction initiatives. This in turn has implications for council policies aimed at reducing waste volumes and their associated carbon emissions.

A sustainable solution for biosolids management needs to be developed within the next ten years, which is championed regionally, environmentally sound, economically viable, and socially accepted. This will be a medium to long term focus for Wellington Water in partnership with our operations contractor and client councils.

Promoting energy efficiency

The growing emphasis on energy efficiency and reducing resources will become an increasingly important issue for the management of three waters. Wellington City Council has reconfirmed its trajectory towards an 80% reduction in city-wide emissions by 2050.

Electricity is a significant proportion of the operating costs for the water supply network. The cost of pumping is the single largest component of power usage.

We have some good examples of energy efficiency measures such as the Wainuiomata mini hydro plant. The mini plant uses high pressure from the Orongorongo water take to drive a turbine and generate electricity. The plant has a capacity of approximately 300 kW - enough to generate sufficient electricity to run the Wainuiomata WTP and export a small excess into the national electricity grid.

Wainuiomata mini hydro plant

Wastewater treatment also represents significant energy consumption for aeration, pumping and UV disinfection. Wastewater treatment plants could potentially focus on purifying water for reclamation, and conserving or producing energy from digestion of biosolids. For example, the co-combustion of sewage sludge with fuels or other types of waste may be a feasible alternative use that could generate income through energy recovery. Approximately 55% of Australia's wastewater treatment plants are capturing biogas and generating bioenergy[8].

We will continue to look at ways to run our systems more efficiently, as well as leveraging new technologies as they become available. Regional and national climate change policies could require sustainable solutions to be implemented over the medium to long term. This will become an increasingly important priority for us over the next ten years.

[8] Beca Consulting (November 2015) – Opportunities for Renewable Energy in the Australian Water Sector - Prepared for Australian Renewable Energy Agency (ARENA)

Community awareness and behaviour change

We want a community that is well-informed and engaged about how their actions may affect our networks and their environment. Community awareness programmes are an important part of our strategy to reduce environmental impacts across all three waters. It involves providing information that our communities can act on by changing their perceptions and behaviours.

Improving water quality and health impacts

Community awareness can help minimise blockages caused by inappropriate items being disposed in the wastewater network, which can result in dry weather overflows. Simple messaging relating to what can be flushed down the toilet, location of tree planting and avoiding cross connections between the stormwater and wastewater networks can go a long way towards mitigating adverse effects. Education and work training programmes aimed at reducing litter and the disposal of contaminants into the stormwater system (e.g. heavy metal concentrations, oils, and detergents) can also be effective.

Ragging at Porirua Treatment Plant

Encouraging water efficiency

There are a range of tools that can be used to encourage efficient water usage. Educational campaigns can help customers understand how they use water and encourage them to reduce their demands on the system, particularly when supply is low. A major reduction of water demand has been the improvement of the efficiency of appliances over the last 20-30 years. For example, it has been possible to bring clothes washing water usage down from an average of 140 litres/wash to under 75 litres/wash.

Other demand management options, such as leak detection and universal metering are discussed in the Resilience section of this Strategy.

Driving a regional approach

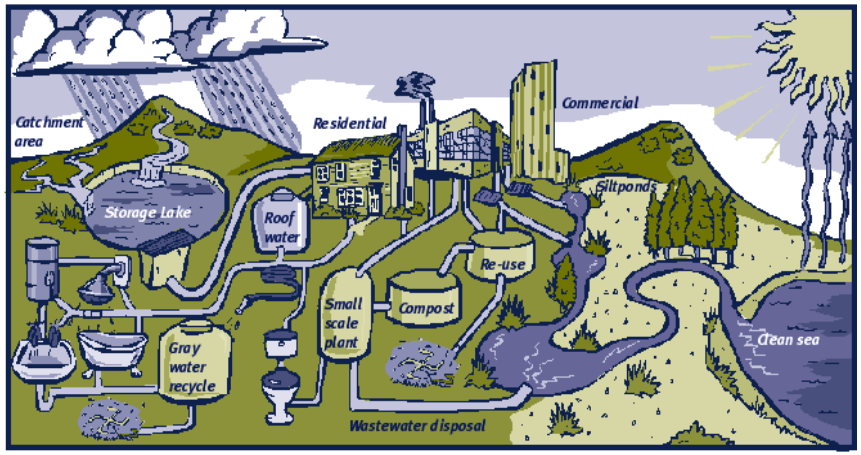
We want to drive a more regionally consistent and coordinated approach to drinking water, stormwater and wastewater education programmes across our councils, so we can maximise benefits to their communities. However, the allocation of community awareness funding from councils and trusts may need to be reconsidered as wastewater only receives a small portion.

Decentralised Wastewater Systems

The conventional approach to urban wastewater management is based on a centralised system that collects and treats a combined flow of most or all of the wastewater elements. For the past 150 years this concept remains the most common and most sought after approach to urban wastewater management throughout the world[9].

Conventional wastewater management is a rigid solution and this lack of flexibility means that it is vulnerable when confronted by future uncertainties. Urban population growth, for example, challenges the design capacity of centralised wastewater treatment facilities.

Decentralised systems prevent infrastructure overload by separating greywater and stormwater and managing human waste at the household and community level. They also offer the advantage of water re-use and energy recovery. Blackwater, for example, can be digested to create biogas which in turn can be used as a cheap, renewable source of energy.



Source: Ministry for the Environment

[9] Sustainable Water Management in the City of the Future: Findings from the Switch Project (2006-11).

Action Plan – Respectful of the Environment

Strategy	Initiatives	Timing	Goal
Reducing stormwater run-off and contaminants	Future Services Study: Stormwater Quality	0-3 yrs	
	Water Sensitive Urban Design Guidelines	2018	
	Work with our client councils to incorporate WSUD Input into spatial and concept plans	0-5 years	
	Implementation of Integrated Catchment Management Plans for Wellington City	on-going	
Planning controls to reduce run-off	Work with our client councils to provide advice on suitable planning controls to mitigate the impacts of stormwater run-off	0-5 yrs	
	Regular monitoring for Global Water Consent	On-going	
A step-change for managing biosolids	Future Service Study: Sludge Management	0-3 yrs	
Promoting energy efficiency	Future Service Study: Carbon reduction	0-3 yrs	
Community awareness and behaviour change	Education and community awareness campaigns across the region	Ongoing	
	Implementation of Stormwater Management Strategies for Wellington City		
Decentralised wastewater systems	No work planned	0-50 yrs	

Resilient Networks that support our Economy

Importance of Resilient networks

Resilient three water networks are vital to the prosperity, well-being and safety of the region's communities.

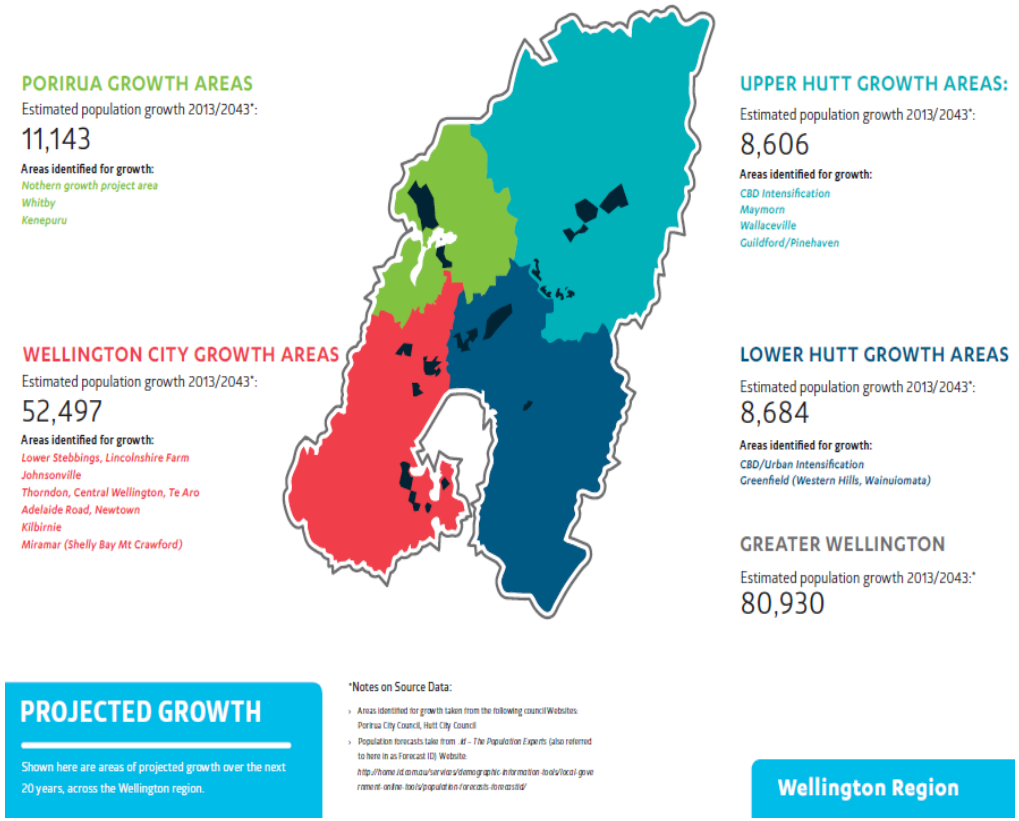
Resilient networks can recover and remain functioning after shock events, such as earthquakes or landslides. Restoring essential services to the region is vital to communities and for sustaining the region's economy. Achieving this resilience is reflected in our goal to provide 80% of our customers, within 30 days of a reasonable seismic event, with at least 80% of their water needs (80-30-80 Strategy).

Resilient networks are also adaptive to on-going stresses such as the impacts of sea level rise, and uncertainties such as social and political change. Minimising the impacts of flooding on people's lives is an important focus for the region as climate change is likely to exacerbate the frequency and severity of flooding events.

Enabling urban growth in the region

As the Wellington metropolitan region experiences increasing rates of urban development and economic growth, we need to ensure that our three waters networks keep pace of this demand.

Significant areas of development will involve intensification in the region's central business district areas and greenfield developments such as Upper Stebbings; the Porirua Northern Growth Area, Pinehaven and Wainuiomata. The diagram below outlines current areas of growth for the region.



Consideration of growth trends and impacts on three waters networks needs to factor in the significant commuter population in the region. For example, the long term impact of the Transmission Gully Motorway project (due to be completed by 2020) is likely to attract commuters from further north, while encouraging greenfield developments in the Porirua northern growth area.

There is a regulatory imperative through the National Policy Statement – Urban Development Capacity (NPS-UDC) to ensure that development capacity over the short term is serviced with infrastructure. Over the medium to long-term (3-30 years) the NPS-UDC requires infrastructure and supporting development to be signalled in long term plans and infrastructure strategies.

What are our key issues?

The capacity of our networks to support urban growth

The region's three waters networks are being placed under increasing pressure from new development. The impacts from infill housing are becoming a significant issue for networks already overloaded during wet weather and a regulatory environment requiring the reduction of overflows over time. For example, additional demand on the stormwater networks they connect to by increasing the amount of impervious areas in the catchment. From this there is a risk that water quality is adversely affected and that higher peak flows may cause flooding.

Historically, investment in three waters has largely focused on network condition - arguably at the expense of capacity or environmental outcomes. For wastewater in particular, we are experiencing capacity issues in areas across the region which is impacting on new developments. There are an increasing number of occurrences where the cumulative demands from our already overloaded networks are resulting in adverse health and environmental impacts – e.g. increasing wet weather wastewater overflows.

Continuing to deliver current levels of service (and improved environmental levels of service), whilst at the same time supporting new growth, will require increased levels of investment. This issue is also compounded by networks already overloaded across the region. Accommodating unanticipated growth needs within our investment envelope requires on-going re-prioritisation which has the potential to impact on current and future levels of service.

Ensuring security of water supply

The water supply system for the region's four cities is primarily 'run of the river'. It relies on river flows, supplemented by an aquifer source and some lake storage backup. Available water exceeds water consumption for most of each year. However, dry spring and summer conditions can raise potentially serious water shortage concerns. Looking forward, this could be exacerbated by climate change.

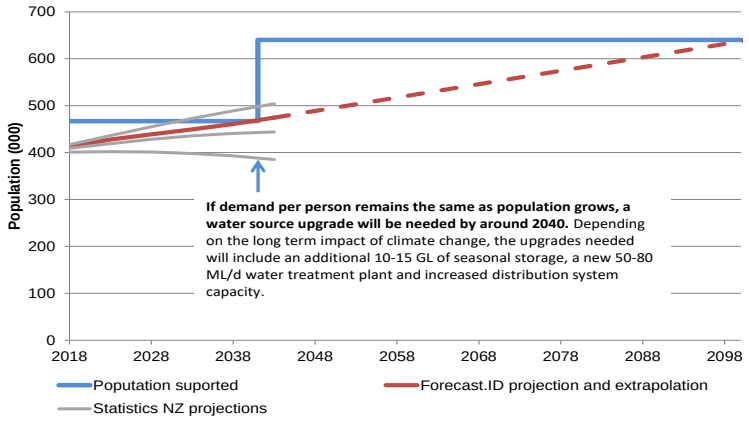
There is also a need to maintain operational resilience, in the event that one plant is off-line.

The region's catchments are over-allocated

All current water take consents, including the Waterloo and Gear Island wellfields, are from sources that are identified as over-allocated in GWRC's proposed Natural Resources Plan (e.g. Hutt, Wainuiomata and Orongorongo rivers). That means it would be extremely difficult to secure new consents for additional water takes. These limits also apply to other catchments earmarked for future use. Also impacting on future supply will be the outcomes from the Wellington Harbour and Hutt Valley Whaitua, who are yet to determine limits for future water flows. More stringent limits could impact on future water takes when consents expire from 2030-2037, further supporting a strategic case for demand management.

Meeting future demand for water supply

The regional demand model used by Wellington Water (Sustainable Yield Model) shows that levels of service, based on current rates of abstraction, is likely to meet projected demand for the next twenty years. However, projected population growth and demand, coupled with estimated climate change impacts (sea level rise of 0.8 and 1.5m) shows that a water source and treatment upgrade will be required by 2040.



Two issues (not factored into the model) which could impact future supply are restrictions on water take consents and unanticipated natural events, such as seismic disruptions or toxic algae. More specifically, limits set by the Wellington Harbour and Hutt Valley Whaitua could require a reduction in water abstraction to meet objectives under the NPS-FW.

Managing the impacts of climate change and flooding

Climate change is a significant and uninsurable challenge facing our drainage networks and the communities they serve. For stormwater management, the issue is that much of the existing networks and urban development has not been designed to take account of climate change. There is therefore a very real risk that the forecast sea level rise and increasing storm intensities will cause more frequent flooding and potentially affect the habitability of some low-lying areas. The effects of rising temperatures and more frequent and intense storms are in fact a current reality, and some forecasts present potentially catastrophic future scenarios.

Rising sea levels will impact the ability of stormwater to freely discharge into coastal receiving waters. This will in turn cause stormwater to "back-up" and potentially flood areas upstream of existing outfalls. Sea level rise is also likely to exacerbate coastal erosion caused by storm surge, causing increasing damage to low lying and coastal areas. This would result in some low lying areas and properties being increasingly subject to flooding and ultimately may require capital investment to protect properties or the decision made to "retreat" from areas which are too expensive to protect.

Much of the cost of adaptation to the increase in extreme rainfall and higher sea levels can be reduced and deferred by taking action now. This requires planning the renewal and growth of our communities with consideration of these risks.

Flooding at Waiwhetu, Lower Hutt

Climate change is also expected to affect the seasonal distribution of rainfall in the Wellington Region. Over the remainder of the century the need for bulk water storage is expected to increase as we experience progressively drier summers and wetter winters.

Over the next century, we are expecting a rise in sea level of up to 1m. Supply from the Waiwhetu aquifer will need to be reduced in the long-term to offset and manage the increased risk of saline intrusion.

Aquifer levels at the foreshore are predicted to 'lift' about 30% because of the confined and pressurised nature of the offshore aquifer. This could result in a 15% reduction in water supply for a 0.75m sea level rise[10]. Given that Waiwhetu aquifer currently supplies about 40% of the region's water, source development will be an important part of our future strategy.

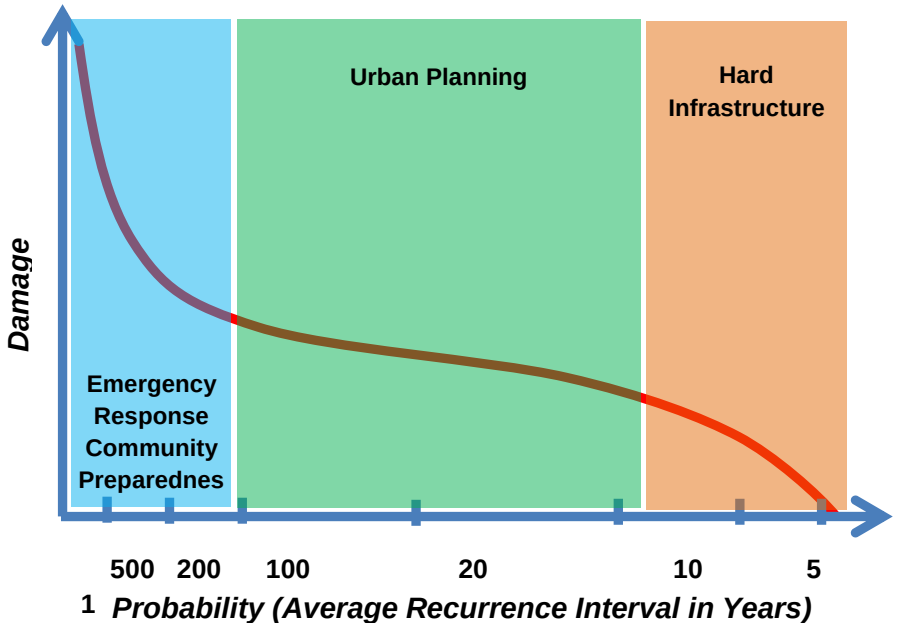
Modelling is used to evaluate risks associated with saline intrusion and to assess the potential impacts of sea level rise on the aquifer.

[10] Greater Wellington (2014) – Lower Hutt Model Revision (HAM3): Sustainable Management of the Waiwhetu Aquifer - Report prepared by Mark Gyropi, Earth and Mind.

Managing the impacts of flooding

Flooding is one of the most costly natural hazards in New Zealand. Its impacts on households and communities can be severe and long lasting. Managing urban flood hazards involves an integrated combination of infrastructure, urban planning, community preparedness and emergency response. In the historical development of the Wellington metropolitan region stormwater pipes have been implemented to convey regular rainfall events and are typically unable to convey flood flows. To avoid costly damages in extreme rainfall our cities have relied on overland flow paths and buildings with elevated floor levels.

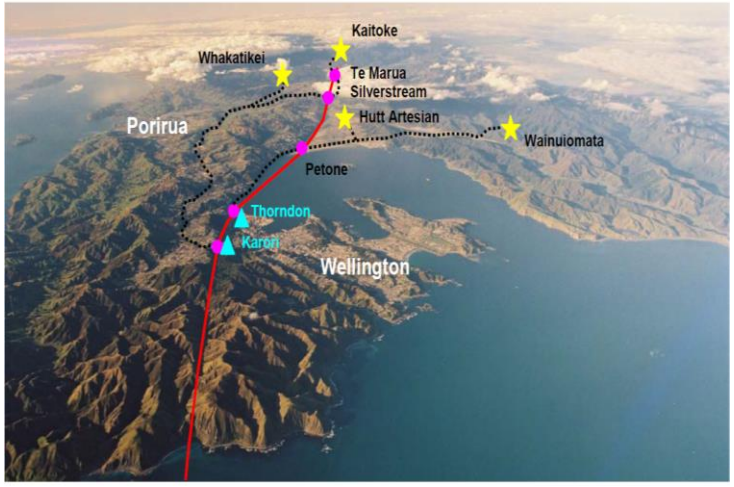
Indicative Flood Risk Profile and the Broad Categories of How the Risk is Managed (source Wellington Water)



Flooding risk in our cities is increasing as a result of the changing landuse, forms of building construction, climate change, growth and the loss of connectedness and understanding of the natural drainage systems as our cities expand and intensify. To continue to effectively manage flood risks into the future will require our cities to rethink and innovate our current approaches with a strong emphasis on reducing our dependence on pipe infrastructure.

Managing the impacts of extreme events

Due to our geology and water source locations, the Wellington region is vulnerable to extreme events, in particular earthquakes and tsunami. The region's water supply network crosses numerous seismic fault lines from catchments to tap. Should a significant event occur, it could take up to 100 days or more to repair the network in parts of the region (e.g. Wellington Eastern and Southern Suburbs).



Bulk water network – several crossings over the fault

Some of our water networks were developed over 100 years ago, which means there is variation in resilience depending on material type and age. This makes it difficult to predict levels of damage in a natural hazard event. A significant proportion (over 40%) of all are made from cast iron and asbestos cement, which means they are fragile and vulnerable to damage in a seismic event.

The geographical and dispersed nature of the Wellington metropolitan area and its population centres mean that significant time, resources and investment will be required to fully repair the entire metropolitan network due to road closures, poor ground condition and other related infrastructure issues.

Our fragile wastewater network

Our existing wastewater service is not well placed to meet the challenges from a significant natural event. Each day the region processes about 150, 000m^3 of wastewater (about 60 Olympic swimming pools worth). In the wake of a major earthquake it's likely we would see a failure in pipes and pumps, resulting in raw wastewater discharging directly into the environment. Further, many people would not be able to use their toilets and wastewater systems, resulting in school and business closures. Very soon thereafter, the region would see its health risks spike, such as outbreaks of cholera. This issue is compounded in the Wellington region because hygiene is further compromised by delays in resuming the supply of potable water.

Wastewater resilience is not only compromised by our fragile pipe network, but through a general lack of community awareness and preparedness. For example, advice about how to hygienically dispose of human waste or how to build a pit latrine.

Our strategy for improving resilience

Enabling growth through timely infrastructure provision

Given that we are operating in a world of limited funding and difficult investment trade-offs, we need to be smarter and more efficient about the way we support future growth. Better integration and alignment, along with a more systematic approach to modelling, is setting us in the right direction. The NPS-UDC is an important driver for achieving this alignment across the region and ensuring future growth is factored into long-term investment planning.

The dynamic and changing environment within which we manage three waters means that we need to revisit assumptions and forecasts as new information (e.g. monitoring) comes to hand.

Our best advice will be underpinned by systematic and comprehensive modelling undertaken on a catchment basis so that cumulative impacts and interrelationships can be identified and factored into future planning decisions. Wellington Water has a long-term modelling plan in place which will provide a more robust platform from which to determine capacity issues and constraints, which in turn will be prioritised in Wellington Water's Three Waters Service Plan.

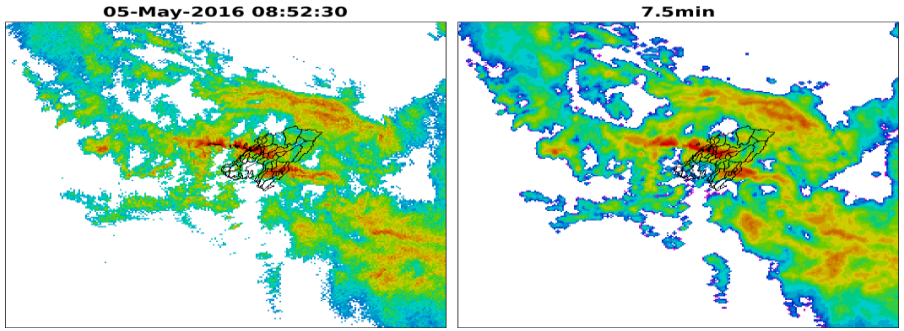
Condition of our networks has been a key driver behind investment and management of our pipe networks. In order to accommodate growth, network *capacity* is rapidly becoming the primary focus of the region's capex programme.

Looking forward, it is important that our infrastructure solutions are linked to the broader catchment objectives, set through the Whaitua processes. By applying a 'systems' lens to three waters management, we can ensure the necessary inter-connections are made across jurisdictional boundaries.

Reducing the impacts of flooding through soft and hard infrastructure

Underpinning our future investment strategy is the need to better understand the limitations of our networks so that improvements can be planned on the basis of risk and the achievement of service standards. Hydraulic modelling is an important tool for understanding the "capacity" of our pipe networks. Although complex and costly to develop they not only assess the potential impacts of flooding but determine the effectiveness of proposed mitigation options.

We also need to empower communities to increase their resilience and develop our flood response by leveraging new technologies such as Nowcast Flood Forecasting. More sophisticated models also include data on groundwater table and soil moisture, which creates a more accurate prediction of flood events.



Nowcast Flood Forecasting

An effective way of managing the impacts of flooding is through widespread application of planning measures that will over time raise the resilience of our communities. These include measures such as hydraulic neutrality policy, water sensitive design guidelines, designated overland flow paths, controlling landuses and flood hazard maps that can withstand scrutiny and legal challenge.

We have developed guidelines on applying hydraulic neutrality principles, which form part of the Regional Standard for Water Services. However, the inclusion of these provisions in planning documents within councils across the region is fairly limited, so there is scope for change.

Storage tanks to achieve hydraulic neutrality

Asset solutions such as pumps and renewals and replacement remain part of our future strategy; particularly in developed areas, which flood frequently. However, the economic viability of infrastructure solutions will become an increasingly important consideration. There may be a need to look for alternative solutions like storage in parks and reserves as more affordable asset solutions.

An effective way of mitigating the impacts of flooding is through resilient building solutions, such as raising floor levels and flood resistant buildings. New Zealand's residential buildings are not well suited to this type of approach. We know from the UK experience that these types of solutions can take time to implement. Discussions with the building sector and research entities such as BRANZ could set us in the right direction.

Source development for potable water

As mentioned, source upgrades are predicted to be required beyond 2040, and by the end of this century. This is likely to include additional seasonal storage, a new water treatment plant, and a significant increase in bulk transfer capacity. There has been considerable investment into investigating possible options for new water sources as well as upgrading existing assets. Three potential on-river storage dam sites have been identified, along with investigation into a third storage lake at Kaitoke.

The information needed to predict future demand changes regularly. If demand for water increases in the future then eventually consumption will exceed capacity and new sources will be required. The lead time for developing a new source can be as much as 10 years, so infrastructure planning needs to have an appropriate horizon and be constantly reviewed.

From a planning and investment perspective, works need to be initiated by 2030 at the latest to meet the projected demand shortfall of 2040. There is, however, potential for capital expenditure to be deferred on the basis of increasing efforts into demand management. Modelling tells us that effective demand-management initiatives could defer expenditure for up to 10 years, which has a net present value benefit of $2,000 000 per year deferred over the next 28 years.

Effective demand reduction could also support the case for water take consent renewals that will be required in the mid-2030's. The reasonable

and efficient water use requirement in the proposed Natural Resources Plan provides an indication that consent renewal may be impacted unless we can demonstrate water consumption is reasonable and being managed effectively.

Reducing demand for potable water

Demand per capita for water in the Wellington region has been trending downwards over the last 25 years. The factors contributing to this decline in demand are varied, but include the gradual uptake of conservation measures such as water efficient household fittings and appliances, increased community awareness, and water use restrictions imposed through policies and bylaws.

Leak detection, infrastructure replacement programmes, on-site storage, along with better management of reticulation systems remain an important part of demand management. Further, trends such as reduction in garden sizes through infill housing and apartment developments, and a decline in water-intensive industries all play their part in reducing demand.

Looking forward, it's likely that some of the factors contributing this long-term decline in per capita demand will continue, although since 2016 there has been a flattening of this downward trend which suggests that future efficiencies may be at the margins. However, demand reduction should remain an important focus in the future – not just from an environmental outcomes perspective but as a means of deferring capital investment in source development.

We know that pipe leakage will remain a significant issue – not just because of our aging infrastructure, but because we don't fully understand the extent of the problem right now. Investigations and pipe renewals therefore need to be factored into long-term planning decisions.

An increased focus on understanding the drivers and incentives which lead to water conservation may result in future reductions. As we experience demographic change, we need to stay connected to our customer to ensure conservation measures are targeted. The introduction of water metering as a means of encouraging efficient use and leak detection remains untested in the Wellington metropolitan region. This decision may need to be revisited in the future if we want to defer source development expenditure.

Looking forward, the harvesting of rainwater and stormwater for non-drinking uses (e.g. irrigation) could play an important role in reducing demand.

Water supply resilience

The 80-30-80 strategy[11] is the foundation of resilience planning and has been endorsed by all five of our client councils. The activities that make up the Strategy include, strengthening household resilience, providing alternative sources and implementing large network improvements over the next 30 years.

[11] 80-30-80 is the long term goal to provide 80% of our customers, within 30 days of a reasonable seismic event, with at least 80% of their water needs.

Following the Kaikoura earthquake, the Community Infrastructure Resilience (CIR) programme was quickly initiated to deliver on the short term goals of the 80-30-80 strategy. The programme aims to provide 20 litres per person per day of drinking water within eight days of a major shock event. This works on the assumption that individual households will look after their own water supply needs for the first seven days and the initiative supplies 20 litres per person per day within 500-1000m from every house across from day eight. Activities supporting this programme include the construction of bores, provision of water storage bladders, desalination and stream water extraction sites.

Our response to household resilience for day one to seven is to raise awareness of the need for each household in the region to be self-sufficient by storing the equivalent of 20 litres per person per day (140 litres).

Water supply resilience will also be addressed through medium to long term initiatives involving capital works and on-going education and awareness programmes to raise awareness of the need for personal water storage. Major capital works include new and upgraded reservoirs (e.g. Omāroro), new and upgraded bulk water mains are expected to be completed over the next ten years.

Our exploratory harbour bores in Wellington Harbour are helping us understand the geology of the Waiwhetu Aquifer. This information will determine whether it is viable to extract water to supply Wellington city with an alternative water supply for daily water needs as well as post major shocks to the network. If not viable, an alternative supply route to the Eastern suburbs may be required.

Exploratory Harbour Bore – Welllington Harbour, East of Miramar Peninsula

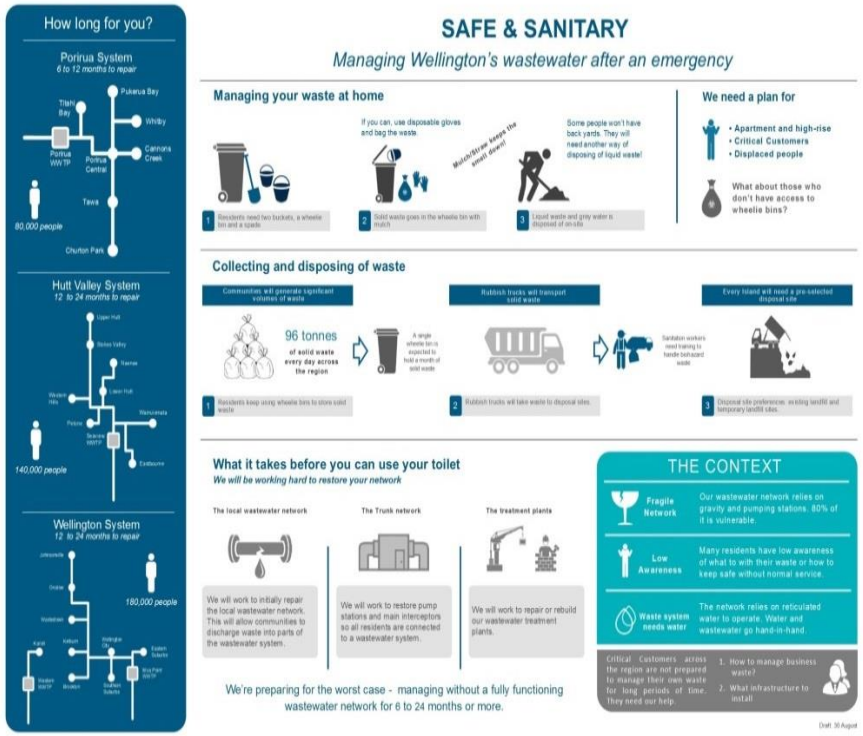
Wastewater resilience

Compared to our water supply resilience programme, our short-term response to wastewater resilience is not well advanced. A strategic case has been developed, which outlines three core areas of focus. The first relates to developing stronger and more resilient networks. This includes developing a better understanding of our networks, smarter asset management tools (e.g. clustering), regulatory options, and identifying funding pathways. The second area involves developing coordinated response plans, involving both government agencies and utility operators.

And finally, there is a need to better understand community needs and preparedness.

A wastewater resilience strategy is currently being developed, which outlines a self-sufficiency approach for alternative sanitation while the water supply network is being restored.

Work to improve our operational resilience planning, understanding the critical potential failures and improving contingency plans for those locations will be undertaken in the next few years.



Action Plan - Resilient Networks

Strategy	Initiatives	Timing	Goal
Enabling sustainable urban growth	Region-wide modelling programme to determine capacity constraints	0-3 yrs	
	Future Services Study: Supporting Urban Growth	0-6 yrs	
Reducing the impacts of flooding	Future Services Study: Stormwater Flooding	0-3 yrs	
	Region-wide modelling programme to understand limitations of networks	0-3 yrs	
	Leveraging new technologies such as Nowcast Forecasting to develop flood responses	ongoing	
	Planning measures to reduce reliance on hard infrastructure solutions.	ongoing	
	Asset solutions, such as pumps and renewals	ongoing	
Source development for potable water	Future Service Study: Sustainable water supply	0-3 years	
Reducing demand	Leak detection and replacement programmes	on-going	
	Promoting water conservation	ongoing	
Water supply resilience	Future Services Study: Resilience	0-3 yrs	
	Implement Community Infrastructure Resilience Programme	June 2018	
	New and upgraded reservoirs	0-10 yrs	
	Upgraded bulk water mains	0-5 yrs	
	Harbour Bore and Cross Harbour Pipeline	0-5 yrs	
Wastewater resilience	Future Services Study: resilience	0-3 yrs	
	Strategic work programme includes: better information, coordinated response plans, self-sufficiency, operational response.	med-term 0-10 yrs	

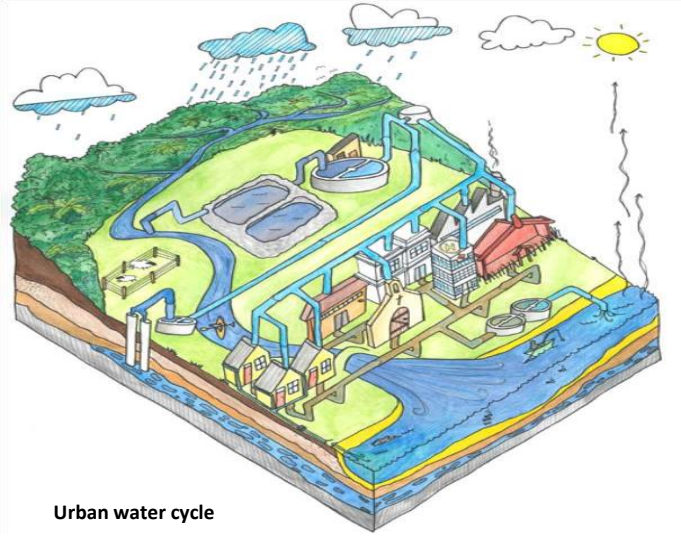
Our Approach

Achieving a water sensitive and resilient region will require us to think differently about the way we provide three water services. We will adapt and respond to future challenges by thinking about three waters as part of a broader "system". This will allow us to better understand the inter-relationships between those involved in delivering service outcomes, our customers, and the broader socio-political environment within which we operate. Our approach to achieving this encompasses three strands:

- **Integrated management**
- **Achieving outcomes through others**
- **Planning and investment based on evidence**

Integrated management

A future integrated approach for three waters management is encapsulated in the concept of Integrated Urban Catchment Management (IUCM) which has emerged across the world over the past 25 years. It considers all parts of the water cycle – natural and constructed – as an integrated system. It also factors in the interaction of three waters infrastructure with land use planning and social, environmental, legislative and economic considerations.



Urban water cycle

Integrated management requires us to think about the broad range of opportunities and outcomes that we can achieve through three waters infrastructure. For example, rather than thinking about stormwater infrastructure as a means of controlling drainage, other outcomes may include amenity, recreation, health protection, aquifer recharging, flood protection and so on.

What are we currently doing?

We will achieve integration through a 'systems thinking' lens which understands the inter-connections between three waters, our natural and physical environment and the broader social and economic environment in which we operate – with communities at the core.

We are currently involved in two initiatives which adopt an integrated approach to three waters management – Integrated Catchment Management Plans (which will become Stormwater Management Strategies under the future service studies) and the Whaitua Committees.

Integrated catchment management

Integrated catchment management is a key non-asset solution which is being applied across the region. The stage two Integrated Catchment Management Plan for Lambton Harbour is an example. Integrated catchment planning applies a holistic, strategy led approach, combining research with monitoring and modelling to identify water quality and quantity issues and possible treatment and management options. This includes the interaction of wastewater with stormwater.

The management of contaminants and their effects on the environment is a shared responsibility between the community and public agencies such as utility providers and consenting authorities. The integrated catchment management approach reflects this, taking a wider view of pollutant sources, effects and controls.

Whaitua committees

We are actively engaging with the Whaitua Committees in the region by contributing information and advice relating to three waters infrastructure. As the whaitua process is responsible for determining future plan provisions for freshwater management, it is critical that we assist in the development of workable outcomes. A 'whole of catchment approach' will require us to collaborate with multiple parties to establish shared objectives and to ensure uses and activities are working towards the same goals.

Future areas of focus

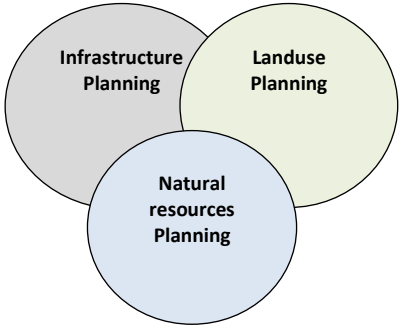
Water sensitive urban design

Communities are becoming increasingly concerned about environmental quality and this is reflected in regulatory initiatives such as the NPS-FW and Natural Resources Plan. We are also facing pressures around resource scarcity; our catchments are over-allocated. Integrated catchment management will be a critical tool that will manage the impacts of land-use and discharges through design solutions.

Our focus will be on promoting and demonstrating the benefits of WSUD solutions as a means of integrating water cycle management into urban planning and design. Multiple outcomes can be achieved through WSUD solutions, such as improved water quality, aquifer recharging, amenity, and resilient and adaptive solutions to manage the impacts of climate change.

Integrating landuse, infrastructure and natural resource planning

Collaboration between agencies is needed to encourage an 'urban water cycle' approach for the management of three waters. The levels of service we provide for three waters infrastructure is inextricably linked to land use planning and regional (natural resource) planning. Reinforcing and growing this connection is vital to achieving our three customer outcomes; safe and healthy water, respectful of the environment, and resilient networks which support our economy.



We are working collaboratively with our client councils and other agencies across the region on two initiatives. The first is the National Policy Statement for Urban Development Capacity, and implementing the Regional Hazards Management Strategy. Regional Spatial Planning has the potential to be important tool to achieve this integration.

Achieving outcomes through others

Just as it is essential to recognize and manage resources in an interconnected way, it is also vital to involve people in a meaningful way. Our three outcomes cannot be achieved through network investment alone, but through involvement and engagement with the wider community and other agencies.

For example, our 80-30-80 water supply resilience strategy assumes that individual households will look after their own water supply needs for the first seven days, with agencies providing water from day eight. Yet, a recent survey revealed that most individuals have significantly less than the recommended amount of water stored.

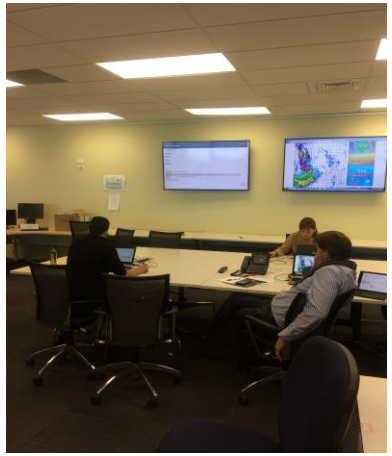
Managing future demand for potable water through water efficiency initiatives is another area that that will require influencing and changing the behavior of the community. Further on-site infrastructure solutions, such as water sensitive design and hydraulic neutrality are an important means of managing impacts on the environment and mitigating the impacts of flooding.

Our strategy over the next 50 years will involve a combination of understanding our customer better; influencing the community and creating behavior changes; and mitigating impacts through both asset and non-asset design solutions.

Understanding our customers

Our customers have a valuable contribution to make in terms of the decisions we make and how we prioritise investments. Investment decisions are not exclusively technical or economic but frequently reflect customer values judgments and complex trade-offs – particularly around levels of service.

Although Wellington Water doesn't have a direct relationship with its customers, we are increasing our knowledge of customer needs through a customer governance group and a newly formed customer hub. The intelligence collected through these initiatives will, over time, enhance our ability to deliver improved services to our customers as well as providing valuable input into investment decisions.



We have undertaken a customer survey to tell us more about perceptions and attitudes towards our water services. Although there is a lack of knowledge about Wellington Water per se, the public are generally satisfied with the services provided. We know that 'providing safe and healthy water' is the most important outcome for our community, followed by avoiding harm to the natural environment, and creating resilient networks.

Empowering communities

We have limited ability to deliver better outcomes through traditional asset-based solutions. By encouraging and activating individuals, households, neighbourhoods and communities to raise their awareness of the three waters, and make changes in their behaviour, those outcomes are likely to be achieved sooner and at lower cost.

Backed by a body of research into social psychology and behavioural science, we will look to empower the community to make desired changes and build support to assist others. We are encouraging individual responsibility through water conservation and efficiency, greater levels of resilience through household self-sufficiency and awareness of blockage or pollution causing substances entering the wastewater and stormwater networks.

This will be done by striking a balance between incentives and losses, making sure we're the right messenger with a salient message and that our commitment to empowering others is clear.

Collaboration and Partnering

There may be an opportunity to manage stormwater/overland flow on public land (e.g. roads) through water sensitive design solutions. Road construction and improvements can be designed in accordance with WSUD principles – e.g. road layouts can be designed to retain existing landforms and drainage patterns wherever possible, and impervious surface percentage can be minimised. Auckland Transport has developed a Code of Practice for Road Drainage, which incorporates WSUD principles.

Many design solutions discussed in this strategy are still not common practice in the private sector. This presents an opportunity for Wellington Water and its client councils to work with land developers on viable and affordable solutions to help mitigate the impacts from urban growth.

Iwi partnership agreements

The development of partnership arrangements is crucial to achieving a participatory approach of Māori values and principles in Wellington Water's planning and decision making processes. The challenge for Wellington Water and our iwi partners moving forward is to understand the imbued differences and to contemplate how a 'co-existence' framework based on shared values and mutually desired outcomes for water may be meaningfully implemented.

Planning and investment based on evidence

Quality data and information is pivotal to understanding the performance and capacity of our assets and driving optimal investment decisions. We are continuously building and refining our information base by integrating new and existing asset information from all five councils. We also generate data and information through modelling the capacity of our networks, and capturing real-time operational data through our monitoring systems. Collectively this information steers our strategic and operational decision making.

However, investment decisions relating to our three water networks are becoming increasingly complex, with multiple issues to take into account and difficult trade-offs. Fragile and aging networks, coupled with a limited funding base means we have to be smarter about our investment decisions. Addressing this complexity will require evidence from multiple sources; not just asset data - but social, economic and environmental sources. Our technology strategy hinges on creating tools that transform data into accurate and user friendly decision support tools (e.g. GIS, Dashboards).

What we are currently doing?

Smart investment

We are committed to helping councils make well-informed investment decisions across their Three water services. We have called this our "Smart Investment" decision making approach that ensures investment is aligned to the performance of our 12 service goals and the aspirations of our client councils and communities.

Understanding the capacity and performance of our networks

Hydraulic modeling is an important tool which helps us understand the capacity and performance of our networks. Modelling information supports operational and strategic decisions ranging from the capacity of existing infrastructure to support urban development through to priorities for future upgrades.

Demand management is informed by the Sustainable Yield Model, which looks at the interactions between water supply and demand factors, and climate change trends.

Monitoring our networks

We monitor the performance of the region's assets through range of mechanisms, such as Supervisory Control and Data Acquisition (SCADA) monitoring, incident reports (e.g. blockages and overflows); feedback from operations contractors; customer feedback; performance testing; and network modelling. Performance monitoring assesses whether Wellington Water has achieved its service goals and associated levels of service.

Another increasingly important part of our monitoring regime focuses on water quality and regulatory requirements. A new global stormwater consent requires us to monitor stormwater discharges and investigate where there are acute effects on water quality. This will provide us with the information to improve the quality of discharges in the future.

Managing data and information

Wellington Water manages data and information on behalf of councils. Our focus is to manage the provision of accurate data (i.e., 'clean' and 'complete') that is accessible for users as information to support their decision-making.

Various programmes are underway to support this, with a focus on solutions that integrate and share data across client councils and provide tools (such as a Data Warehouse) that makes sense of data for users.

We have worked to create a set of national metadata standards for three waters. This has enabled us to standardise data from different councils in tools like the Data Warehouse, and will inform future programmes on simplifying the IT tools that store data.

Integrating multiple sources of information

Our ability to predict future performance and interactions between three water networks needs to improve to increase the confidence in funding projections. This means gaining a better understanding of the broader "system" – after we have worked on standardizing current data sets – and start integrating other sources of information.

The vulnerability of many cities to various 'system failures' has undoubtedly increased. The interlinkage between energy supply, the transport sector, IT systems and the water sector infrastructure is strong. For example, flood protection is not only determined by the physical infrastructure, but also by the reliability of the underlying IT system. Similarly, a disruption of power can cause sewer overflows as pumps fail to operate.

Our investment story

This Strategy sets out the future direction for three waters over the next 50 years. Our planning and investment decisions will steer us towards our desired future state – a resilient and water sensitive region, where communities prosper.

Our actions combine both asset and non-asset solutions. Some of the key principles driving future investment choices are affordability, adaptable to long term change, flexibility to overcome shock events and resource efficiency and recovery. Our future investments will also result in multiple outcomes, rather than being a single infrastructure solution. These outcomes, for example, may include resilience, water quality, amenity, and so on.

Achieving our Strategy will require a shift in thinking from a 'business as usual' conventional approach towards innovative design solutions which embrace new technologies. It may take decades before communities fully realise the benefits of new approaches, so our journey will be incremental. However, it is important that we don't lose sight of our end state, and take advantage of opportunities as they arise.

We can avoid risks of over-capitalisation and significant upfront costs by investing in solutions which are adaptive and scalable.

The future challenges and opportunities outlined in the Strategy will influence future investment decisions. We need to be in a position to front-foot many of these challenges, while responding to unforeseen events. That requires us to constantly review our Strategy and investment priorities as new information comes to hand.

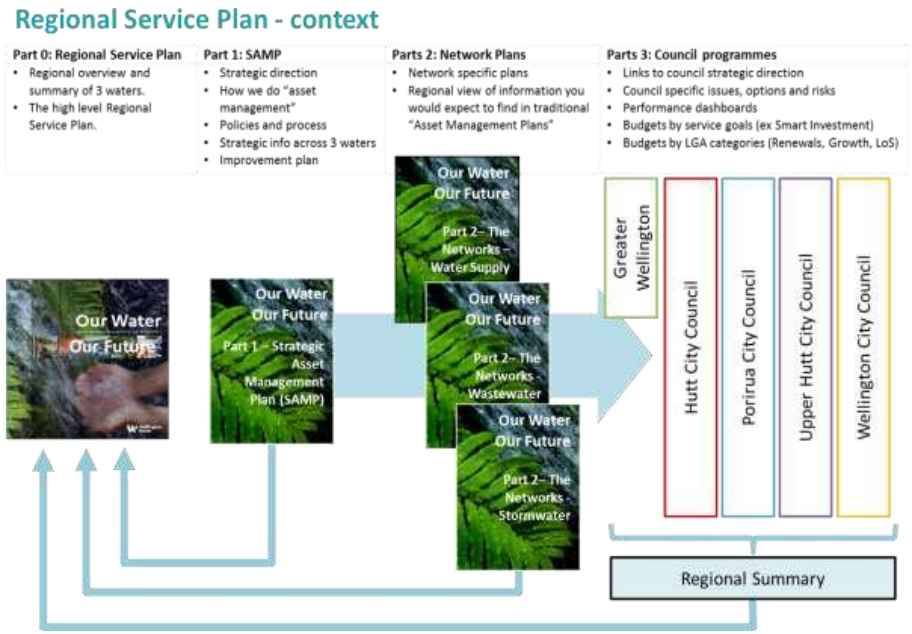
Our investment decisions will be informed by a growing body of knowledge which factors in multiple sources of information. Our Smart Investment approach will ensure decisions are linked to council priorities and aligned to our three company outcomes and service goals.

Finally, by thinking about three waters as an integrated system we can better target our investment decisions, and work towards achieving multiple outcomes.

Relationship with Regional Services Plan

This Strategy forms the front end of the Regional Services Plan (Asset Management Plan) and provides the overarching "strategic story", including challenges and priorities and what's required over the next 50 years to deliver desired levels of customer service.

The Regional Services Plan and its associated documents will provide the next layer of detail, including Network Plans (Asset Management Plans) for each of the three waters and individual Council programmes.



Measuring progress

We have developed key result areas (KRAs) that underlie each of our three outcomes and 12 service goals. Measures and targets for these KRAs have been derived from Council long-term plans and are reported through our Statement of Intent (Annual and Half-Yearly Annual Reports).

Our Smart Investment process uses the same performance framework, and includes measure and targets to assess how effective our investments have been in achieving our service goals and outcomes. Performance is reported on quarterly through quarterly dashboards.