He Rautaki Whakahaumaru Wai
Water Security Strategy for the Waikato Region

Waikato
REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

Rārangi kaupapa
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Kōrero whakataki
Executive summary

- Our regional economy and the wellbeing of our people are dependent on the availability of water.
- There is increasing concern among Waikato communities over climate-related reductions in water availability and the implications for freshwater ecosystems, urban and industrial water supply/demand dynamics, ongoing delivery of electricity generation, primary sector productivity and constraints on future growth.
- Waikato Regional Council has developed this draft water security strategy to support conversations on regional and local water security issues and to identify potential solutions.
- We are seeing impacts of a prolonged period of reduced rainfall on water resource supply and an increase in demand in parts of our region. Water available for allocation is approaching, or exceeding, limits in several major catchments.
- Projected effects of climate change are likely to exacerbate constraints on water availability and/or increase demand.
- Analysis of regional water resource state and trends confirms the concerns raised by the Waikato Mayoral Forum and Waikato Regional Council about the scale, severity and impact of water security issues for the Waikato region.
- A collaborative, multi-stakeholder and regional-scale water security management plan is recommended to identify roles and responsibilities in addressing the significant water security challenges facing the region, and to establish partnerships to implement appropriate solutions.
- Some potential solutions are identified, including managing demand, enhancing supply and increasing ecosystem resilience to periods of water deficit, but it is recognised that all options need to be 'on the table' and assessment of options should follow a robust process.
- This strategy also recommends development of a more detailed water accounting system for the Waikato that can provide timely and robust information on water availability and demand (including better information on actual use) to our communities.

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He tīmatanga kōrero
Introduction

Water security has previously been identified as a critical driver for the Waikato region in the ***Waikato Freshwater Strategy*** and is also reflected in Waikato Regional Council's **strategic priorities**. More recently, water security has been identified as a regional priority by the Mayoral Forum and Waikato Regional Council.

Water availability and security is also a priority for central government. The Ministry for Primary Industries has published a national review of water availability and security with the primary goal of identifying risks and opportunities for the food and fibre sector. An important conclusion from the 2021 review is that declining natural availability of water, combined with the need to halt further degradation of our natural waterbodies and operate within environmental limits, pose significant challenges for the availability and security of water for the food and fibre sector and rural communities.

Other regions of New Zealand are also grappling with water security issues. For example, Hawke's Bay Regional Council has initiated a $30 milliion regional water security programme supported by the Government's Provincial Growth Fund. In the Wairarapa, a multi-stakeholder group formed to address climate-related threats to water security has developed the *Wairarapa Water Resilience Strategy.*

Their statement about the scale of the water security challenge is equally appropriate for the Waikato:

"There is no resource more fundamental than fresh water and yet we often don't appreciate its importance until the supply is threatened. Climate change is the primary threat, aided and abetted by our 'traditional' approach towards water: that there are supposedly infinite volumes available and that where there is scarcity, infrastructure solutions will save the day. That will simply not be the case."
- Wairarapa Water Resilience Strategy 2021.

The aim of this document is to establish a roadmap for improved water security in the Waikato, with a clear understanding of the issues, objectives for the region and measures of success.

What is water security?

"Water security is the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human wellbeing and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability."
- UN Water 2013

Within the UN definition, there is an implicit recognition of trying to achieve a balance across multiple, often conflicting, demands. This balancing is a major challenge for water resource managers, as competing interests often make finding sustainable solutions extremely complex and often litigious.

Te Ture Whaimana o te Awa o Waikato and Te Mana o te Wai

The National Policy Statement for Freshwater Management (NPS-FM) provides clear direction on how regional councils must deal with the often conflicting demands of social, cultural, economic and environmental wellbeings, establishing a hierarchy of needs that puts the health and wellbeing of waterbodies and freshwater ecosystems at the top, with the health needs of people (for example, drinking water) second. The ability of people and communities to provide for their social, economic and cultural wellbeing, now and in the future, sits in a third tier (noting that these wellbeings are also influenced by tier 1 and 2 values). The Te Mana o te Wai hierarchy has significant implications for how New Zealand addresses water quantity issues, including allocation (MPI 2021).

The concept of regional visions for fresh water and central importance of Te Mana o te Wai within the NPS-FM is clearly informed by, and builds upon, *Te Ture Whaimana (**The Vision & Strategy for the Waikato-Waipā River**)*. Water resource management within the Waikato catchment must give effect to *Te Ture Whaimana*, a statutory document that takes precedence over other national instruments such as the NPS-FM (where they are divergent).

Te Ture Whaimana highlights four fundamental issues.

1. The degradation of the Waikato River and its catchment has severely compromised Waikato River iwi in their ability to exercise mana whakahaere or conduct their tikanga and kawa.
2. Over time, human activities along the Waikato River and land uses through its catchments have degraded the Waikato River and reduced the relationships and aspirations of communities with the Waikato River.
3. The natural processes of the Waikato River have been altered over time by physical intervention, land use and subsurface hydrological changes. The cumulative effects of these uses have degraded the Waikato River.
4. It will take commitment and time to restore and protect the health and wellbeing of the Waikato River.

This strategy is built within the framework of Te Mana o te Wai and recognises *Te Ture Whaimana* as the pre-eminent guiding document for water resource management in the Waikato catchment. We also recognise that other mana whenua across our region will have objectives and aspirations for the many other catchments that make up our region, and these will also play a critical direction setting role in future water resource management.

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Scope

This draft strategy recognises that water security affects the whole region, so is regional in scale, but considers variation in water security issues across the region's districts and catchments. The primary goal is to describe water security from a quantity perspective but also recognise the interdependencies of water quantity with the broader environment, including water quality.

The strategy is a non-statutory document. It provides recommendations for high level actions that might be undertaken by local government and other stakeholders, with Waikato Regional Council in a co-ordinating role.

Water resource patterns over the last 60 years are considered and the most up-to-date climate data has been used to predict likely climate change impacts out to 2090.

There are multiple strands of work that have come together to inform the development of the water security strategy, including an updated regional climate impact assessment (Li et al. 2021), a State of Environment report (in preparation), research into drought effects in the Waikato (Connolly et al 2021) and a **national water availability and security work programme** led by MPI (2021). Other regions, for example, Wellington, Hawke's Bay and Auckland, have developed their own strategic thinking regarding water availability and security and the Waikato strategy draws heavily from their insights.

The management and governance of water resources is undergoing a fundamental change. For example, implementation of the NPS-FM (2020) will require significant changes in the *Waikato Regional Policy Statement* and *Waikato Regional Plan*, many of which will relate to how we use water resources in the region.

The Three Waters reform driven by central government is likely to change the political and operational landscape for water security in the Waikato region. These changes are uncertain and will take several years to take effect, so these issues of resource management policy and water governance are not considered in the strategy. However, given the Three Waters reforms, Local Government Act and Resource Management Act reforms, the interaction of the strategy with water services entities needs to be given further consideration. This may include revisiting the nature of boundaries, transboundary collaboration, future consenting and regulations.

The strategy does not seek to provide a detailed regional water accounting, neither does it provide recommendations on specific infrastructure projects or policy responses to be undertaken by local government. However, it is expected that these are among several likely actions to follow development of the strategy (see Draft recommendations, page 21).

Transboundary co-operation

The Waikato region is a major exporter of water and water-dependent products (for example, dairy products), but we also import water from catchments outside the region to support hydroelectricity production.

We need to work with neighbouring regions where we share water resources. For example, water from the Waikato catchment (Waikato River at Tūākau and Mangatangi/Mangatāwhiri catchments) is critical for **Auckland region's water security**. In addition to the Auckland municipal takes, water leaves the Waikato River catchment in the north for New Zealand Steel's Glenbrook Mill, which discharges into the Manukau Harbour.

Waikato currently benefits from significant inter-basin transfer from the Manawatu-Whanganui region. Lake Taupō receives an average of 20 per cent annual increase in flow from water collected from the western side of Ruapehu, Ngāuruhoe and Tongariro mountains that originally formed the catchment of the Whanganui River, from the southern side of Mt Ruapehu that originally formed part of the Whangaehu catchment, and from the western side of the Kaimanawa Ranges that historically drained into the Rangitikei catchment via the Moawhango River.

There are also two areas where groundwater resources are shared with regional neighbours. The Kawa aquifer spans the Northern Waikato/Auckland regional boundary in the vicinity of Pukekohe, a major area of horticulture/vegetable production. Aquifers of the Mamaku Plateau provides sources of springs that flow to both the Waihou River and several Rotorua streams in the Bay of Plenty region.

Water security for the Waikato will need to consider the needs and long-term objectives of our neighbouring regions, as well as New Zealand as a whole.

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Te wero
Our water security challenge

There is increasing concern among Waikato communities over climate-related reductions in water availability and the implications for freshwater ecosystems, urban water supply/demand dynamics, lifeline utilities (for example, electricity generation), primary sector productivity and constraints on future growth. Reducing water security is a symptom of, amongst other things, our changing climate, so any responses to climate change (for example, **Climate Action Roadmap**) need to consider water security, and vice versa.

The evidence base for the scale of the Waikato region's water security challenge is summarised in the sections below.

Warming trends

One of the fundamental climate shifts associated with anthropogenic global warming is increasing air temperature. A warming atmosphere increases evaporation from the global surface and increases the water-holding capacity of the atmosphere.

We are already seeing evidence of a warming trend for Waikato (Li et al 2021). The historical areal average of annual mean temperature for the Waikato region (1973-2020) is 12.9° Celsius, with 17.2° Celsius during summer months, and 8.5° Celsius during winter months. Over the period 1973-2020, annual mean temperature has shown an increasing linear trend of 0.12° Celsius per decade (Figure 1). May, June and July show the strongest warming trends (Li et al. 2021).

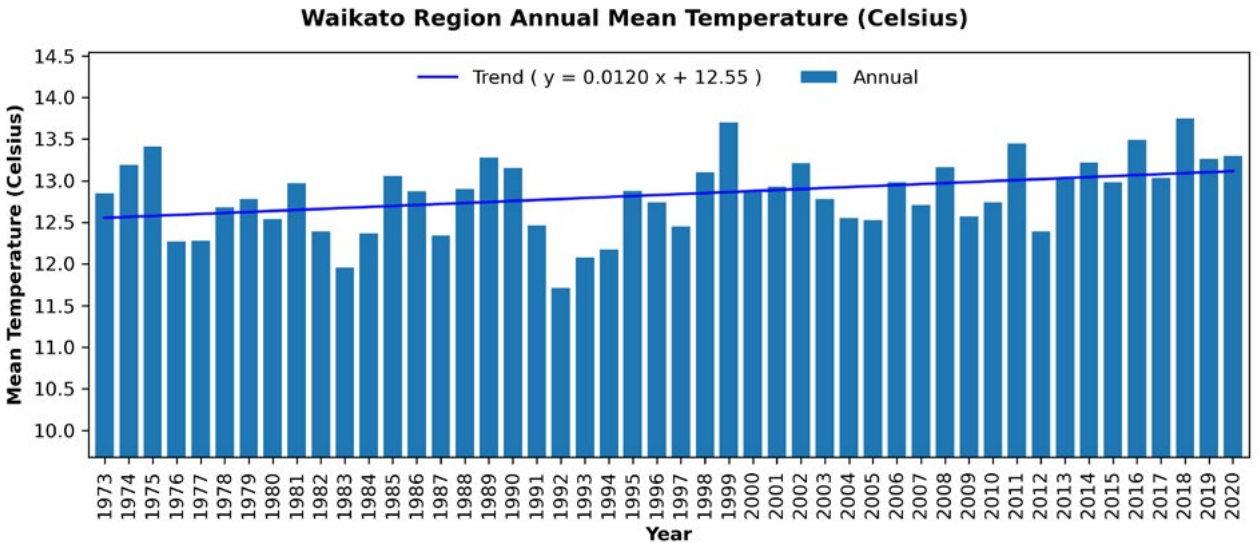

Figure 1: Long-term pattern in annual mean temperature across Waikato region.

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Water resource state and trends

The Waikato region receives approximately 38 billion cubic metres of rainfall per annum[1]. For comparison, Lake Taupō contains around 59 billion cubic metres of water. Of this water supplied via rainfall, nearly 15 billion cubic metres per year runs to the sea.

Lake Taupō is a significant natural storage of surface water for the Waikato River catchment and is managed day-to-day for hydroelectric generation. No similar surface water storage influences the river systems of the Hauraki Plains. This has significant implications for water security, particularly in the Piako River system that also lacks the stabilising effects of deep groundwater discharges from the Mamaku Plateau that are characteristic of the Waihou River.

The Tongariro Power Scheme imports an average 26 cubic metres per second into the Waikato River system (Jenkins & Koh, submitted). This has a beneficial effect on the annual low flow statistics for the Waikato River, with around 40 cubic metres per second added to low flows at the Taupō outlet as a result of the water import and management of lake levels for storage. However, it is important to note this out of catchment contribution is subject to seasonal fluctuation. In dry conditions, the additional volume of imported water reduces due to minimum flow requirements in the current resource consents for the operation of the Tongariro Power Scheme.

There has been an overall declining trend in annual rainfall across the Waikato region over the period from 1960 to 2020, with each decade drier than the one before. There has been a corresponding increase in potential evapotranspiration from the 1990s-2020 (Jenkins & Koh, submitted).

The 1960s and 1970s were wetter than the long-term average (1961 -2020), with a reduction in rainfall in subsequent decades (Figure 2). Since 2000, the reduction in rainfall has been widespread across the region and the driest period has been the last decade (2011-2020). At one of the region's longest rainfall recorders at Ruakura, 2020 was the driest year since records began in 1907.

The Coromandel, lower Waikato and Hauraki subregions experienced the largest declines in annual rainfall over the period 1960-2020, with the upper Waikato showing the greatest decline over the period 1990-2020.

The majority of continuously monitored flow sites showed declining trends in annual low flow (the lowest flow of the year) since 1990s, with up to 50 per cent loss of summer flow over the 30-year period (Jenkins & Koh, submitted). This declining trend in both rainfall and river flow is shown in Figure 3.

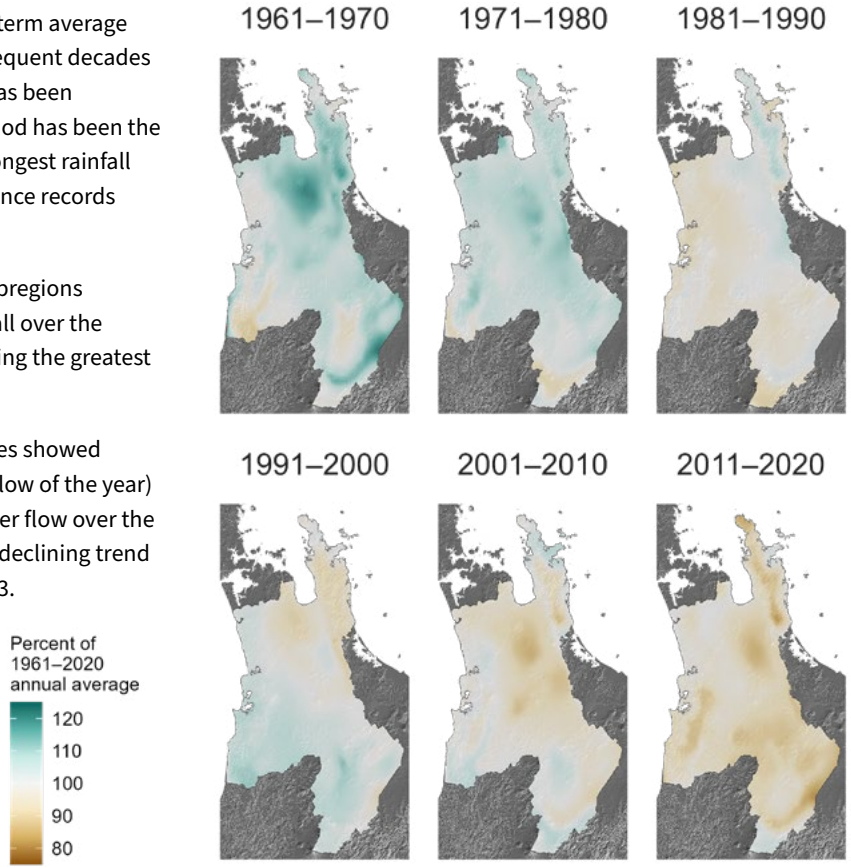

Figure 2: Waikato region decadal rainfall as a percent of the long-term rainfall (1961-2020) using NIWA's Virtual Climate Station dataset.

1 Land, Air, Water Aotearoa (LAWA) - Water quantity

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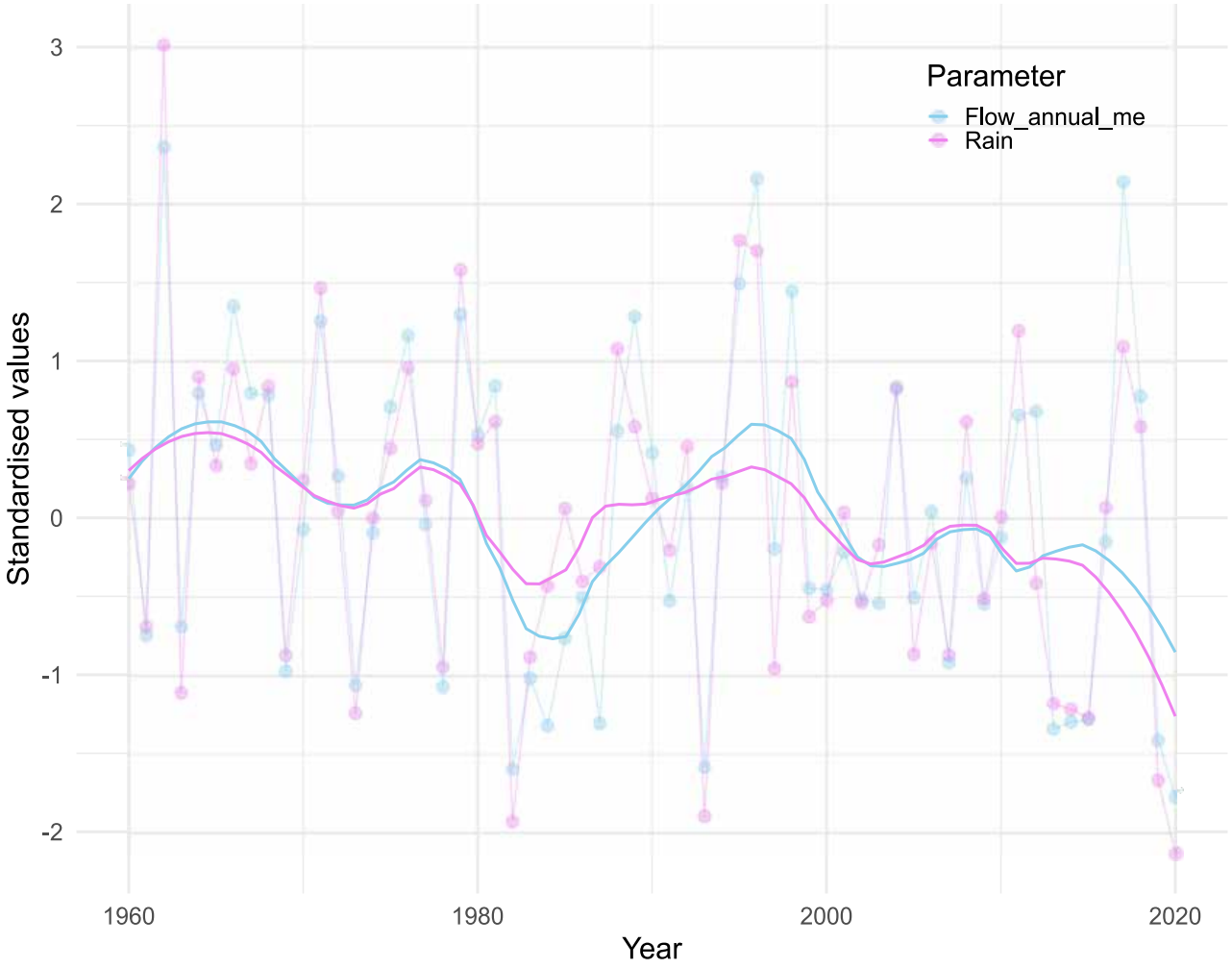
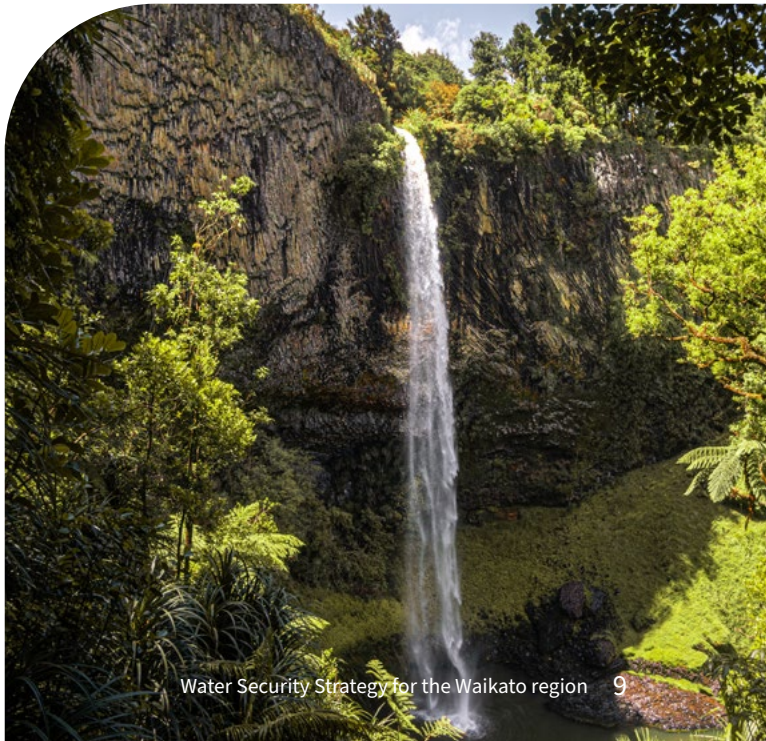


Figure 3: Standardised annual rainfall from all Virtual Climate Station Network (VCSN) stations within the Waikato region and mean standardised annual average river flow from all long-term flow recorders (n = 16). LOESS curves are shown for flow (blue) and rain (pink).

The declining trends could be explained by the combined effect of increases in water use (see *Water demand pressures*) and change in climate. The areas that experienced the largest decline in water quantity availability were Hauraki plain catchments and upper Waikato River. The area that experienced the least summer flow trend impact was the Coromandel area.

Recent changes in summer low flows may have been exacerbated by historic changes in catchment land use. For example, increasing impervious surfaces in urban areas and efficient routing of stormwater can contribute to reduced summer base flows in urban waterways.

We have been highly effective at draining the landscape, changing natural hydrological flow paths, with consequences for groundwater recharge, flood flows and river baseflow conditions.



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Water demand pressures

Water use has been increasing in most Waikato catchments for the period 1968-2021 (Jenkins & Koh, submitted).

Agricultural water takes, including irrigation, are the largest water use and have been since the start of the record (Figure 4). Municipal and industrial takes are also significant, supplying towns and cities in the Waikato region, along with exports of water to Auckland city from several catchments, including the mainstem of the Waikato.

Water is also required to provide essential lifeline utilities, such as electricity generation from the Waikato Power Scheme and the Huntly Power Station, with the Huntly Power Station being of particular importance in dry years to support the security of electricity supply given its generation output and strategic location.

Regional water use relies heavily on surface water take in terms of volume. The peak regional total surface water use is in the order of 900,000 cubic metres per day, whereas the peak regional total ground water use is in the order of 125,000 cubic metres per day.

Water resource pressure can also be indicated by allocation status of waterbodies. Waikato Regional Council operates an automated water allocation accounting system called the Water Allocation Calculator (**WAC**) which updates the water allocation status in around 350 catchments every day. The catchments identified as red in Figure 5 exceed allocation limits (Jenkins & Koh, submitted). The catchments with heaviest allocation pressures are Piako River, Whangamarino River and Pokaiwhenua Stream. Some small headwater catchments also show high allocation pressures. These are typically associated with headwater municipal water takes.

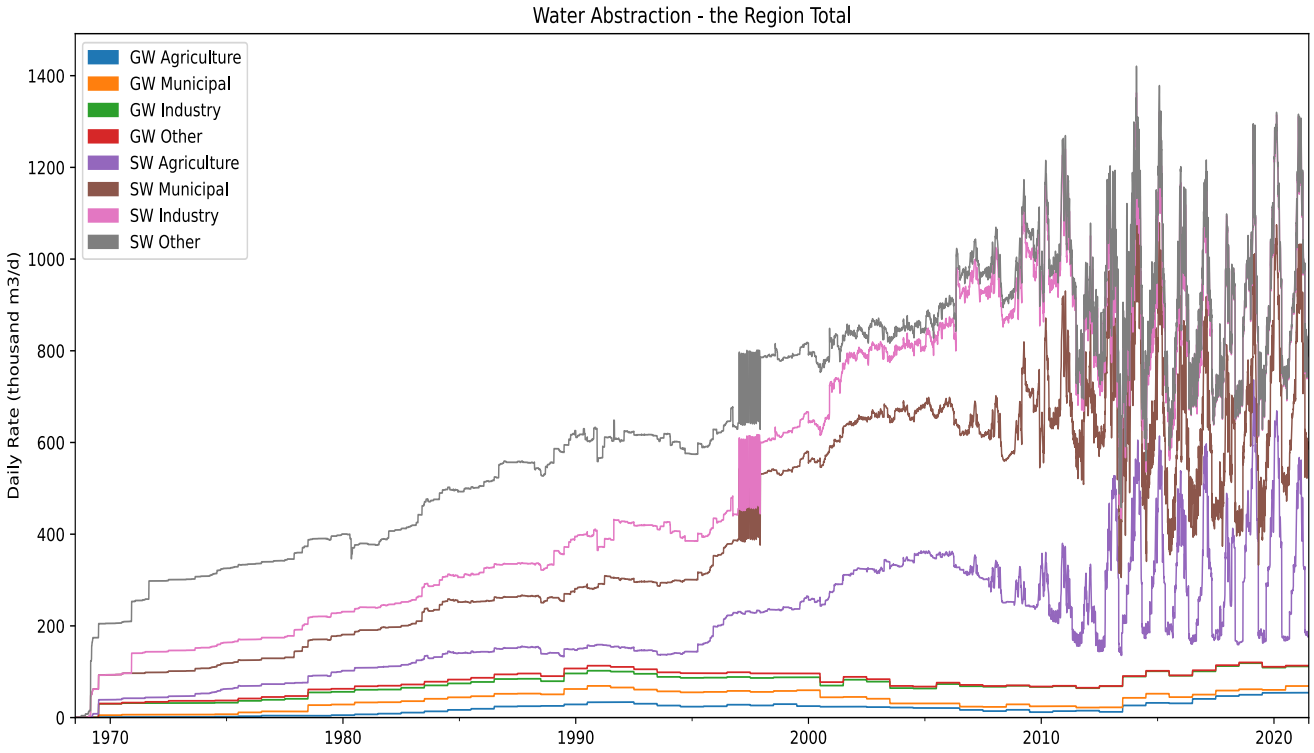

Figure 4: Estimates of total water abstraction show increasing demand across the region 1968-2021. Note: The apparent seasonality of water use at the end of the record is due to improved take data, including from water metering.

It is likely that further resource limits required as part of the NPS-FM (2020) implementation will reduce water availability to improve environmental outcomes. This will increase competition among water users, particularly when considering the hierarchy of uses explicit in the NPS-FM (2020).

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Allocation pressure in summer and winter

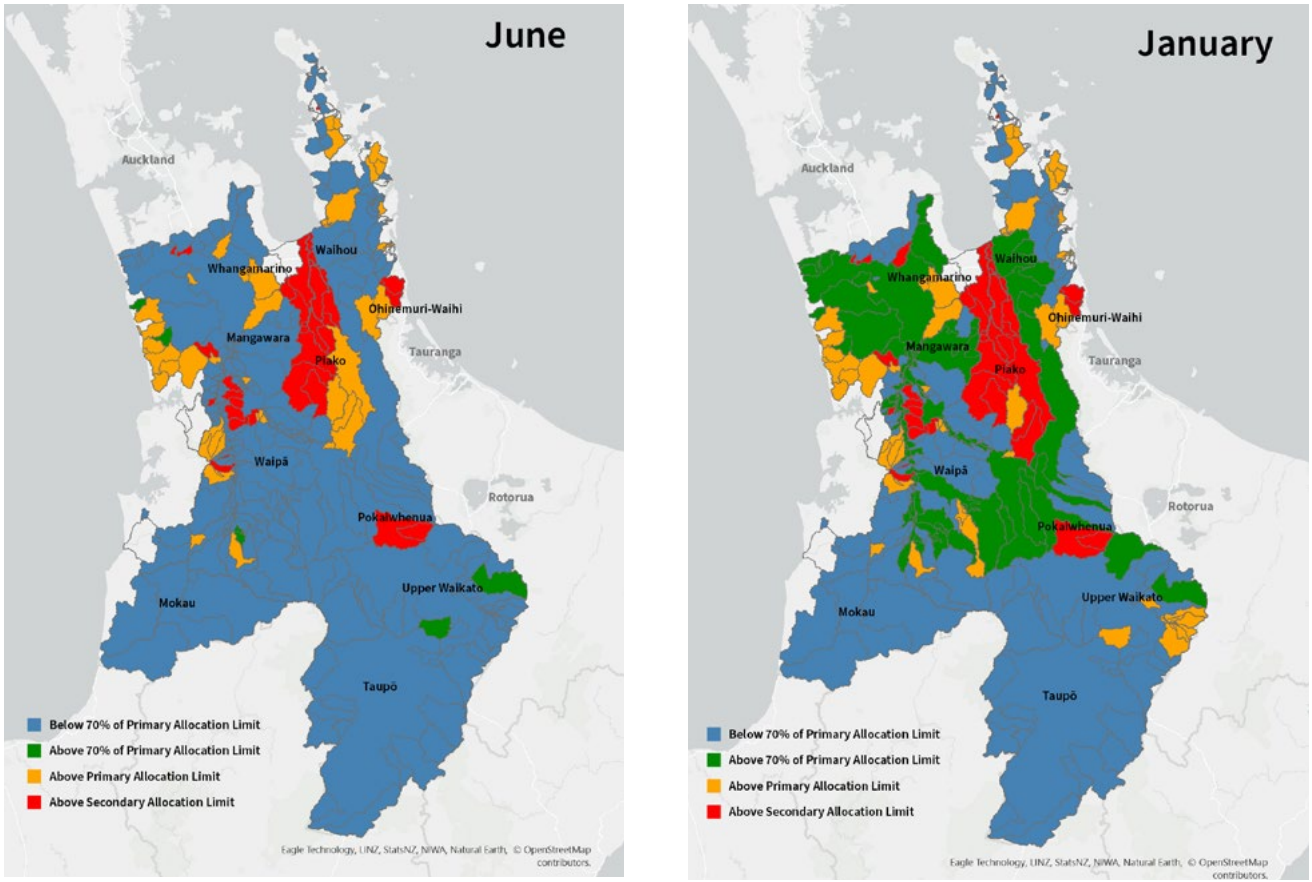

Figure 5: Allocation pressure in summer and winter. The Piako and Whangamarino catchments have very high allocation pressure. The Mōkau, Waihou and Mangawara catchments have low allocation pressure.

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Likely impacts of climate change

An assessment of climate change effects on the Waikato region was carried out by Li et al. (2021). The report utilised the CMIP6 data and **IPCC Sixth Assessment scenarios**. There was a specific focus on water security issues.

The average annual mean temperature of the Waikato is expected to rise over the examined time slices of 2050, 2070 and 2090, increasing 3.2° Celsius in 2090 applying a 'worst-case' IPCC scenario compared to the baseline (2005 is the central year of 1985-2014 set in the IPCC AR6 report). Seasonally, the average temperature of the summer months is projected to increase more rapidly than other seasons. The greatest temperature increases occur in southeast districts (such as Taupō), decreasing towards the northwest corner of the region.

While projected annual mean precipitation changes are relatively small, daily extreme precipitation is projected to increase out to 2090 across modelled scenarios for the Waikato. The rate of change increases over time between 2050, 2070 and 2090. The most extreme precipitation intensity tends to occur in the Coromandel district.

Projected effects of climate change are likely to exacerbate constraints on water availability, with projected increases in temperature and drought intensity and changes in regional rainfall patterns (Li et al. 2021).

Annual runoff is expected to increase out to 2090. Seasonally, runoff mostly declines in the spring months. Generally, the region's northwestern area is expected to receive the greatest increase in runoff, while the eastern edge may experience minor changes.

Potential evapotranspiration deficit (PED) increases into 2090. As expected, the additional area where the PED exceeds 200 millimetres is far greater than that exceeding 400 millimetres. Districts with the highest area with a PED larger than 200 millimetres and 400 millimetres include the Hauraki and Waikato districts.

Evidence from the modelling study of Li et al (2021) indicates a high likelihood that water supplies will become increasingly constrained in the Waikato under climate change scenarios, particularly in the spring and summer months. This highlights the increasing challenge for regional water security, with the heart of the problem being the annual peak water deficit period (summer-autumn) that is likely to intensify and even expand with climate change and increasing demand.

The *Wairarapa Water Resilience Strategy* highlighted five aspects of climate change "shock" that collectively generate a significant impact on the community and economy.

1. **Water deficit** – the gap between supply and demand is increasing due to less rainfall and increased evaporation.
2. **Restrictions at low flows** – maintaining or improving ecological flows in rivers and restrictions on groundwater users will significantly reduce water that is available for abstraction in the hot, dry summer water deficit period.
3. **Accommodating growth** – there is already demand pressure on fresh water and continued regional growth will exacerbate these pressures.
4. **Loss of mauri** – mauri is likely to be further degraded and restoration and protection of the mauri of the water is likely to require more water directed to the environment.
5. **Infrastructure challenges** – local authorities are already facing a hefty bill for the upgrade of ageing water infrastructure meaning that less public capital funds may be available for investing in other resilience priorities.

"Shock" may also include the reality of reduced access to water for those who may have had long-term water consents. This may be particularly evident in catchments that are already over-allocated and require actions to reduce that over-allocation, as required by the NPS-FM (2020). Dealing with these shocks will require consideration of alternative water sources and greater water use efficiency requirements, with consent conditions being one avenue to drive these actions.

Another aspect of climate shock of particular importance to the Waikato region is effects on New Zealand's hydroelectricity generation (Tongariro and Waikato power schemes) and water-dependent generation (for example, Huntly Power Station).

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Growth projections for the Waikato region

Waikato Regional Council uses the Waikato Integrated Scenario Explorer (WISE) model to inform regional planning processes. In the most recent application of the WISE model, Fenton et al. (2021) explored a range of growth scenarios out to 2068.

The regional population is projected to grow by 17 per cent by 2035 (up from 475,601 in 2018 to 554,328 in 2035) and could grow a further 21 per cent by 2065 (669,852 people) under a reference scenario (medium population and medium economic growth projections). This growth is not evenly spread, with some districts likely to experience significant growth (for example, Waikato district), whereas others may experience limited growth (for example, Waitomo district) (Figure 6, Table 1). It is our understanding that potential constraints on growth associated with restricted access to water have not been factored into these projections.

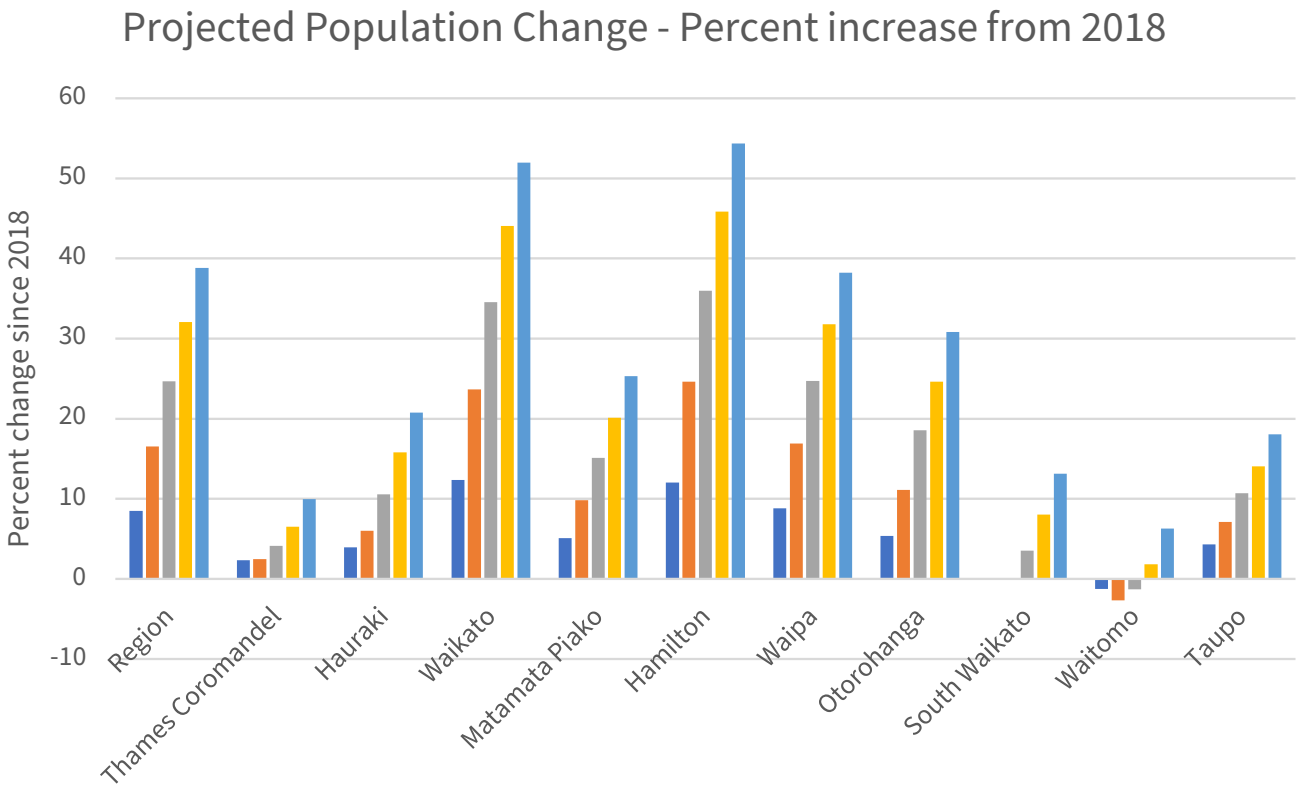

Figure 6: Percentage change in populations from 2018 base.

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	2018	2025	2035	2045	2055	2065
Territorial Authority						
Thames Coromandel	30700	31411	31455	31973	32702	33755
Hauraki	20600	21412	21840	22778	23852	24873
Waikato	78200	87859	96710	105229	112668	118852
Matamata Piako	35300	37103	38770	40638	42394	44234
Hamilton	168600	188877	210135	229217	245952	260263
Waipa	55000	59844	64303	68584	72487	76023
Otorohanga	10500	11062	11665	12447	13084	13738
South Waikato	24900	24877	24883	25773	26895	28169
Waitomo	9580	9462	9323	9454	9753	10182
Taupo	38400	40062	41136	42515	43799	45330
Rotorua*	3822	3960	4108	4307	4512	4741
Region	475602	515929	554328	592915	628098	660160

Table 1: Summary of projected population changes by district and region.

Population growth within the Waikato region will alter future demand for water with those rapidly expanding populations (Hamilton city, Waikato and Waipā districts) needing to become ever more efficient with water use.

Future Proof is a joint project set up to consider how the high growth sub-region (Hamilton city, Waipā district and Waikato district) should develop into the future. The partners work together to consider the important issues that affect us now and over the next 30 years, with the aim of managing growth in a coordinated way.

Future Proof recently completed a water source assessment (Lutra 2022). The aim was to evaluate current water demand, available water sources, prepare a high-level supply-demand balance over a 100-year timeline for the sub-region and evaluate the potential effectiveness of policy and infrastructure initiatives in reducing impacts on the Waikato River over time, thereby helping give effect to Te Ture Waimana.

A major conclusion from the assessment was:

"The awa as it is currently managed will not be able to meet water demand for the sub-region in the long-term without significant demand reduction. This is also true for the different water savings scenarios in future drought conditions. Demand reductions, source diversification and supply resilience are required. Reducing household demand by 30 per cent and reducing the leakage rate of the networks to 5 per cent would see the overall system demand stay almost constant in 100 years, at similar levels to the current demand."

Recommendations included:

- proactive employment of water demand measures across the sub-region, including full water metering, progressive billing and extremely proactive leakage reduction and maintenance programmes
- significant reduction in network leakage
- education and socialisation of using purified wastewater
- evaluation of reservoirs to increase supply resilience in the long-term.

Future development proposals will need to address increased demand for water within the context of reducing availability. For example, it may be necessary to require large developments to include their own water capture and storage supply to feed and service the increased water demand, while also meeting environmental limits.

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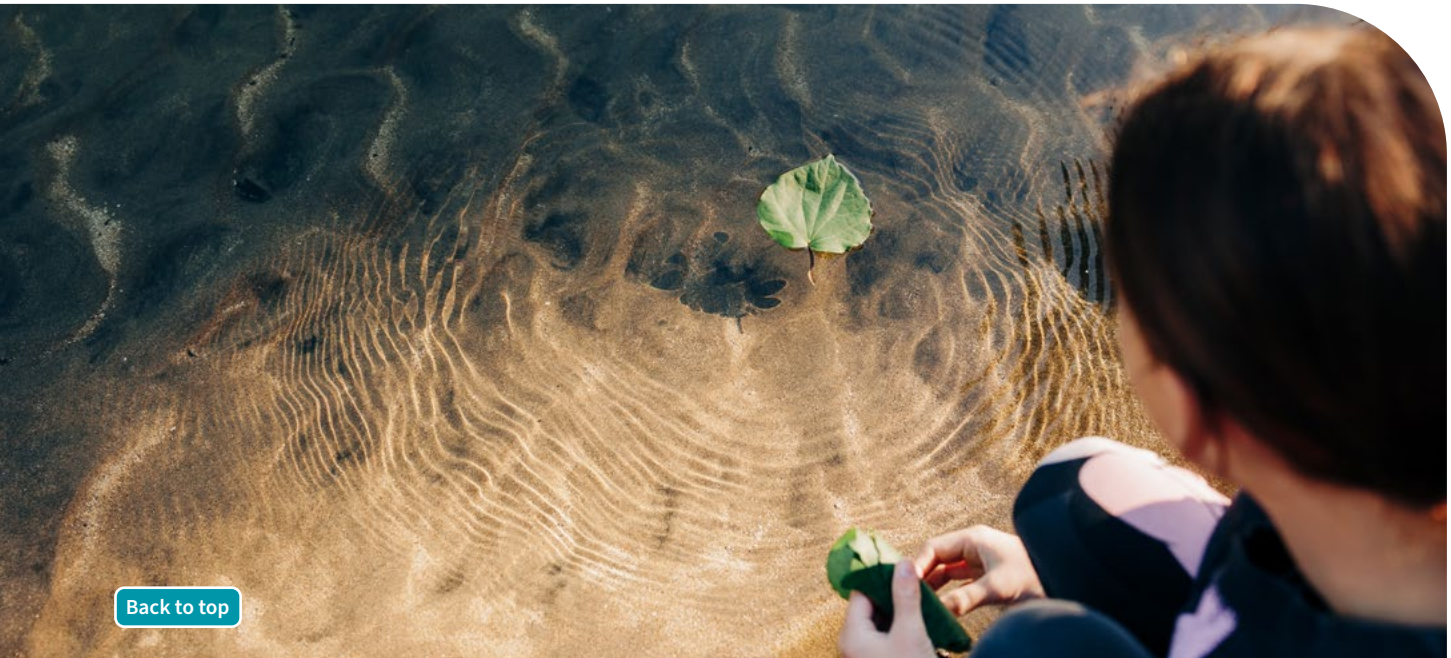
Individual councils are also involved in water security planning. In response to projected future growth, Waikato District Council updated its ***Water Demand Management Plan*** in 2021. The management plan provides a valuable summary of water demand growth to 2016 and highlights several challenges for the district in meeting that demand through existing water supply arrangements. The mid-Waikato (for example, Te Kauwhata) is likely to experience significant growth in water demand by 2061 (from 3500 to 13,000 cubic metres per day), with existing supply agreements expiring/expired and the current water treatment capacity likely to be exceeded in 2023. The management plan incorporates a detailed action plan, including preparation of a rainwater tank strategy, universal metering (already implemented) and leakage reduction projects.

In 2015, Auckland received 60 per cent of its annual water supply from the Waikato catchment – 37 per cent came from the Mangatangi and Mangatāwhiri dams and a further 23 per cent from the Waikato River.

As a major user of water sourced from the Waikato region, Auckland City growth projections and their responses to water security are important components of a *Waikato Region Water Security Strategy*.

Auckland Council recently released the ***Auckland Water Strategy (2022-2050)***. The Waikato River will continue to play a vital role in Auckland's water supply. The Auckland strategy has set water security targets for demand-reduction measures (for example, reduced per person per day consumption) and increased use of alternative sources (for example, rainwater collection and recycled water use). Through these measures, Auckland will balance its reliance on the river with its growth over time.



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He rautaki whakahaumaru wai
A water security strategy for Waikato

The water security challenges for the Waikato region were identified in the previous section. The purpose of this next section is to lay out elements of a strategy for addressing these regional challenges.

Objectives

As a first step, we need to identify a set of regional objectives for water security. In considering how to frame these objectives, it is useful to highlight existing objectives provided in *Te Ture Whaimana* that relate directly to water resources in the Waikato catchment.

- The adoption of a precautionary approach towards decisions that may result in significant adverse effects on the Waikato River, and in particular those effects that threaten serious or irreversible damage to the Waikato River.
- The recognition and avoidance of adverse cumulative effects, and potential cumulative effects, of activities undertaken both on the Waikato River and within its catchments on the health and wellbeing of the Waikato River.
- The recognition that the Waikato River is degraded and should not be required to absorb further degradation as a result of human activities.
- The requirements under the NPS-FM (2020) to phase out all over-allocation of water and avoid future over-allocation also need to be considered in setting objectives.

An example of specific water security objectives is presented in Figure 9. It is sourced from the community initiated *Wairarapa Water Resilience Strategy* (2021), but should also resonate well with Waikato communities, so can be considered a useful place to start conversations here.

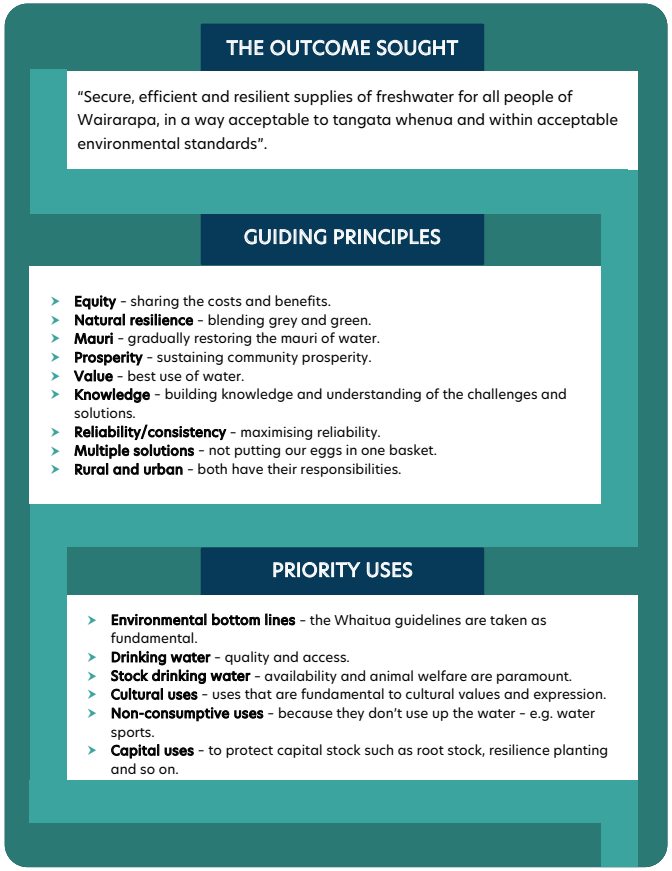

Figure 9: Objectives of the Wairarapa Water Resilience Strategy.

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Also as a starting point for conversations, we provide a set of objectives below prior to consultation with stakeholders and iwi partners.

To enhance regional water security we need to:

- recognise the intrinsic needs of freshwater ecosystems and give effect to *Te Ture Whaimana* and Te Mana o te Wai by ensuring our aquatic ecosystems are resilient to periods of water deficit
- develop our understanding of water demand patterns and the critical role our water resources play in the local and national economy
- recognise the increasing constraints on water availability at certain times and locations across our region and consider current and future water demands using a climate change lens
- shift our collective thinking from one of operating in a water-rich environment, to operating in an increasingly water-constrained environment
- recognise that future growth in some areas will be constrained by water availability and begin to make 'headroom' now to enable appropriate future growth (see Lutra 2022)
- improve our understanding of how water moves through the landscape and how we can most efficiently retain water in the landscape for longer.

High level outcome statements

There is a series of high-level long term strategic outcomes or impacts that the strategy is trying to achieve. These include:

- making water security a community wide concern and priority
- giving effect to the requirements of *Te Ture Whaimana* and Te Mana o Te Wai
- reducing the duration and severity of water deficit periods (summer-autumn) by improving management of supply and demand
- harnessing and holding in the environment/ecosystem, significant quantities of water from periodic "freshes" and rainfall events
- slowing water down throughout the catchment, including improving moisture retention in soils
- strategic protection from adverse climate effects of nature-based assets (such as planting) that provide a range of ecosystem services
- river ecosystems are buffered from the effects of climate change, such as increasing temperatures
- the importance of high flows for ecosystems is recognised and provided for, along with the need to provide connectivity for native fish migration
- ensuring water security supports the ongoing delivery of essential infrastructure, lifeline utilities and agricultural production.

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A conceptual model of water security

The heart of the water security challenge is that the water deficit period on average experienced in summer and autumn will intensify and lengthen with climate change and increasing demand.

Understanding and developing strategies to build community resilience during this water deficit period is central to water security.

Water consumption tends to increase significantly during late spring and early summer (Figure 10), while water availability decreases. This is particularly the case for surface water, whereas groundwater levels tend to have greater lags.

The magnitude and severity of the water deficit period varies across the region. Inter-annual climate variability also influences the scale and impact of the water deficit and climate change is likely to increase water deficit impacts in most parts of the region.

Management of water availability and demand should consider the shoulder periods as well. Enhancing water availability and reducing demand curves during the shoulders, particularly in the spring, could reduce both the length of time spent in water deficit and the severity of the deficit.

Seasonality is important for water use. Most of the region's surface waters are at or near full allocation during the summer with less allocation stress during the cooler winter months. For different reasons, the Lake Taupō and Karāpiro catchments (hydroelectric generation) and the Piako/Waitoa catchment (cumulative effects of permitted activity takes associated with pastoral farming) surface water systems are fully allocated all year round.

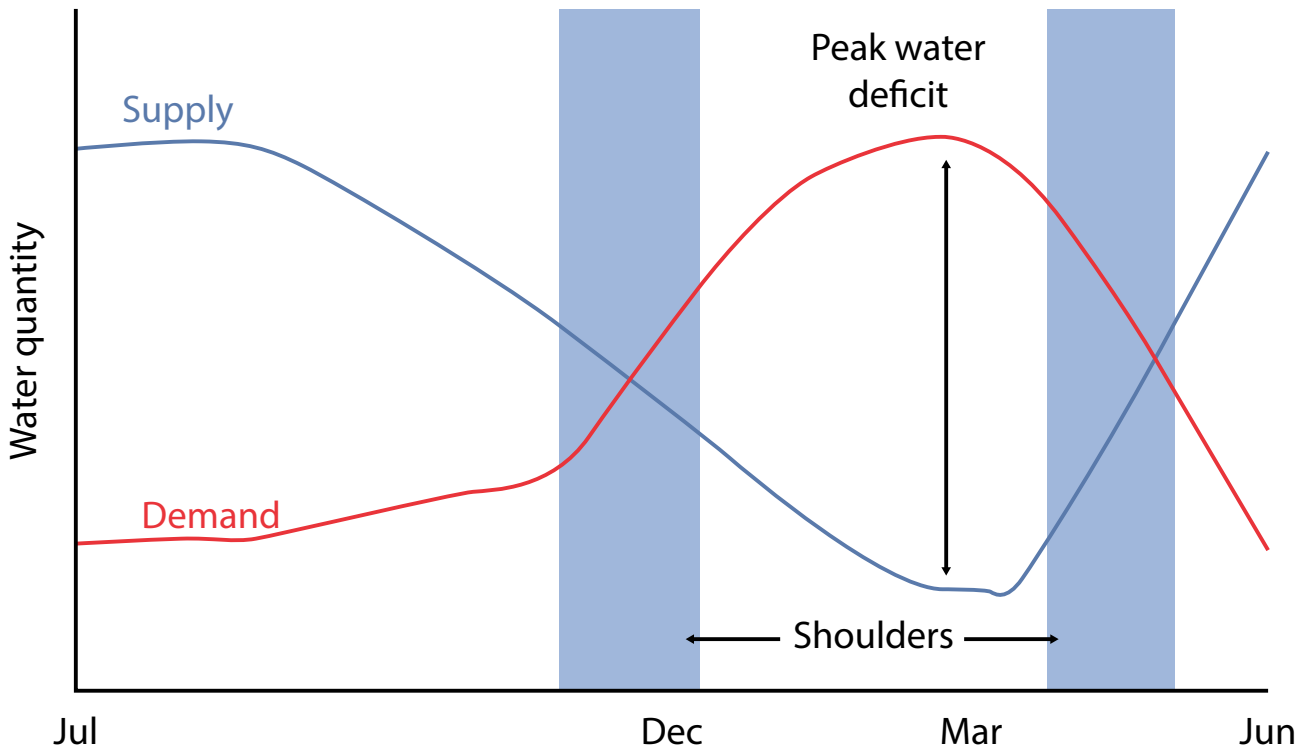

Figure 10: Conceptual model of annual pattern of water availability (supply) and consumption (demand) leading to peak water deficit in summer.

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Potential solutions

Waikato Regional Council has recently completed the first phase of an 'adapting to drought' programme. Connolly et al (2021) provide a detailed conceptual model of the Waikato water system and identify the following specific questions for further drought adaptation investigations.

- **Soil soakage rate** – How might farm management practices enhance the soil soakage rate? (For example, increasing organic matter, reducing compaction.)
- **Evaporation rate** – How might groundcover be maintained/established so that soil evaporation rate is reduced?
- **Soil-groundwater recharge rate** – What soil characteristics enhance retention of moisture in soils?
- **Plant absorption rate** – What plants/crops may still be productive in sustained low soil moisture situations?
- **Overland flow rate** – Can land management practices encourage soakage rather than runoff?
- **Irrigation rate** – How might irrigation demand be reduced through technology?
- **Built storage** – What types of storage might be feasible?

It is important that all solutions are considered for improving water security and there is a robust process for considering options. The following suite of potential solutions is not exhaustive but does serve to provide a framework for considering options. Potential solutions can be separated into three approaches, as follows.

Managing demand

To manage or temper demand by doing more with less (for example, urban water efficiency) or changing to lower water use land uses and management practices.

- Promoting water use that more closely matches water supply patterns to reduce pressure during times, or in specific locations where allocation limits are met or exceeded.
- Modifying land use or management practices towards lower water using 'crops', deeper rooting and more resilient plants.
- Educating regional communities about wise water use to reduce the currently very high per capita consumption.
- Investigating pricing and/or policy options to influence water use behaviour.
- Requiring water suppliers to audit their supply networks for leak detection.

Enhancing supply

To enhance supply by retaining water in the total Waikato ecosystem from periods of water surplus (primarily winter) to the deficit period (summer-autumn) through as many means as possible.

- Slowing flood flows in rivers, lakes and streams – holding/retaining water in the catchment for longer (for example, in offline storage).
- Sequestering water into groundwater and/or surface storage such as reservoirs and tanks for later use.
- Better soil management to restore rain infiltration and moisture retention in the root zone.

Improving ecosystem resilience

Increasing resilience of natural ecosystems to increasing periods of water deficit.

- Look for opportunities to improve resilience of freshwater ecosystems to reduced flows, such as shading to reduce temperature-related stress when flows drop, or infiltration and storage options that increase supply of cool, clean water.
- Reduce other pressures on aquatic ecosystems so they can better tolerate stressors related to reduced flow, such as reduced wastewater discharge.
- The importance of high flows for ecosystems is recognised and provided for, along with the connectivity of fish migration pathways.
- In their national assessment of water availability and security, MPI (2021) identified three high level considerations that inform water security solutions:
- There is a need for multi-benefit infrastructure that supports a range of needs such as ecosystem health and drinking water while also enabling a sustainable food and fibre sector
- There is a need for dynamic adaptation pathway planning, flexible investment and governance structures and new investment models around multi-purpose storage as water needs and priorities of use vary over time.
- Any further investment in water availability and security made by government should use Te Mana o Te Wai as the guiding framework and focus on the use of multiple purpose/multiple benefits models.

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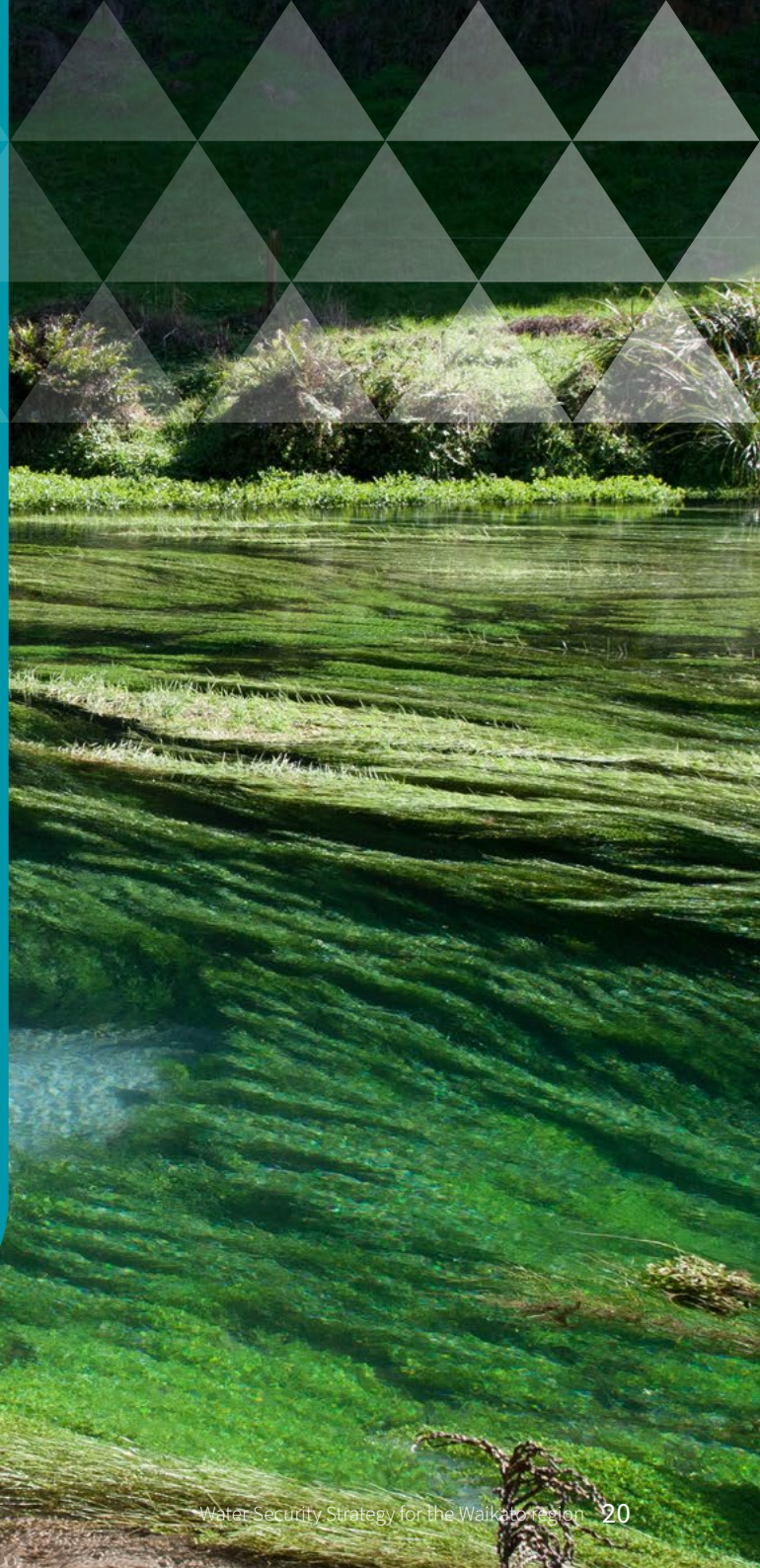
Ngā tūtohunga
Draft recommendations

1. By 2025, develop a multi-agency regional water security management plan that identifies actions, roles and responsibilities and considers the following:

- continual tracking and open reporting of the regional water balance (demand vs supply)
- identifying critical future points for water demand across the region (for example, renewals of significant consents) and developing proactive planning responses
- aligning water security with climate change responses (Climate Action Roadmap)
- developing a list of priority uses for the Waikato region that includes provision for essential lifeline utilities
- developing a land use adaptation programme (for example, developed as part of a legislated regional spatial strategy)
- developing a schedule of 'innovative' water security solutions and initiating a programme of trials to test these solutions with partner and stakeholder involvement
- identifying opportunities to enhance natural attenuation and supporting a coordinated package of natural attenuation initiatives with a shared cost approach across public and private sector stakeholders
- rainwater harvesting initiatives while also taking into account the implications of harvesting on catchment hydrology
- identifying options for auditing large water takes for leak detection
- ensuring options for storage at a range of scales are integrated into regional water security and a 'watching brief' is kept on any large and medium scale constructed water storage project proposals.

2. Review the current water allocation system, and consider methods to address over-allocation as part of the regional plan review that will give effect to the NPS-FM (2020).

3. Align Waikato Regional Council work programmes with the water security strategy and use the management plan to target specific work programmes in the 2024-34 LTP, with clear KPIs for staff and senior management.



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