



**The  
Aotearoa  
Circle**

**Natural Capital Regional  
Resilience (NCR2)  
for the Bay of Plenty**

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# Opening Statement

## Regional Resilience for the Bay of Plenty

When The Aotearoa Circle first developed a framework for our Natural Capital Regional Resilience workstream, we did so with the understanding that while New Zealand's regions are diverse, they share common vulnerabilities - particularly in the face of climate change and environmental degradation.

Our goal was to explore the critical link between natural capital and regional economic resilience and quantify the value at risk in the coming decades should we fail to act decisively in response to climate change now. The resilience of the Bay of Plenty has never been in doubt. From recovering after floods and frosts to driving innovation and investment in horticulture and agriculture, the region has consistently demonstrated foresight and determination.

So why this focus on the Bay of Plenty? Because it represents a unique ecosystem of interdependent sectors. Sheltered by high country on three sides, it enjoys one of the sunniest and least windy climates in Aotearoa. Its calm, warm waters support a thriving aquaculture sector, and its economy makes a significant contribution to our national GDP. Put simply: when the Bay of Plenty prospers, so does New Zealand.

Another important intent of this work was to understand potential barriers to greater investment in natural capital and what is required to enable this at a local level.

This report, developed by PwC NZ, represents a crucial step in helping the region further understand current risks and barriers but also expected cascading impacts of climate threats across its systems.

It is designed to support a more unified, proactive adaptation local response and that need has arguably never been greater or more urgent.

The Circle and I invite you to not only reflect on the insights and lessons captured in this report, but to turn that reflection into action. By considering how these findings resonate within your own world, sector and region, you can help position New Zealand to be more resilient to the climatic challenges ahead and strengthen its natural resources and buffers.

The Circle has shared this framework with appropriate Ministers, and our recommendation that it be replicated across all regions of New Zealand, has been well received. That's because, as evident in this report, the benefits of taking collective, regional action extends well beyond the borders of the Bay of Plenty. This approach presents an opportunity to leave a more positive and enduring legacy for the decades to come for all New Zealanders.

In the interim, a Champions Group, formed as part of this workstream, will lead collaborative action in the Bay of Plenty following transition of responsibility from the Circle. Our sincere thanks to this group, as well as co-chairs - Simon Limmer, Fiona McTavish and Pā Ropata for your leadership and commitment. Together the foundation has been laid for continued resilience-building and regional collaboration, ensuring the Bay of Plenty strengthens its position as an inspiring, vibrant and thriving economy and home for generations to come.



**Vicki Watson**  
CEO, The Aotearoa Circle

## Co-Chairs' Foreword

The Bay of Plenty is one of Aotearoa New Zealand's natural and economic treasures. Spanning nearly 28,000 square kilometres of land and sea, our region contributes around 6% to the national GDP and is home to over 350,000 people.

From the coastal gems of Waihi Beach, Mount Maunganui, Tauranga, Whakatāne, and Ōpōtiki, to tourism hotspot Rotorua and the natural backdrop of indigenous forests - the region is one of abundance - true to its name.

Our economy has been built on rich and diverse natural capital. We're leaders in food and fibre production - from kiwifruit, citrus, and dairy to seafood - and a growing hub for investment, infrastructure, and innovation. With over 2,000 sunshine hours a year and a temperate climate, it can feel like we have everything we need. And ideally, that's what we'd like to preserve.

But the Natural Capital Regional Resilience (NCR2) project has revealed a sobering truth: unless we act now, nature degradation driven by climate change will have significant and lasting economic impacts. No region is immune - including ours.

Led by PwC NZ on behalf of The Aotearoa Circle and supported by a dedicated group of local Champions and ourselves as Co-Chairs, the NCR2 project assessed the potential impacts of climate-drive nature degradation in our region. Most importantly, it has exposed the deep interdependencies between nature and business - and the risks of ignoring them.

The findings are stark. The work undertaken to inform this report, suggests that, without any mitigation or adaptation efforts, climate-related pressures could reduce the Bay of Plenty's total economic activity by up to \$350M by 2030. If that trajectory continued the potential financial reduction could accumulate up to \$33B by 2090. This would unfold if global progress addressing climate change reverses, and emissions rise year after year reaching 4.1C by 2090.

Cyclone Gabrielle alone caused an estimated \$20 million in damage here alone - and that's just one event. Nature is already being tested by climate change, pests, pollution, and overuse. What this report provides - for the first time - is a clear, regionally specific picture of how deeply our economy and communities rely on nature.

It offers a replicable framework for other regions to follow and makes a compelling case for collective action. As the whakatauki reminds us: *He waka eke noa - we are all in this together.*

But amid the challenges, there is strength. One of the most significant outcomes of this work has been the remarkable commitment of our local Champions. Their willingness to come together - across business, iwi, local government, NGOs, and community shows the power of unified leadership and shared purpose.

It's also highlighted the opportunity to strengthen existing governance structures to drive collective progress.

We've already seen positive examples of adaptation and leadership from within our region. These efforts show that not only are we capable of leading - we already are.

This report is therefore both a wake-up call and a beacon of opportunity. It reinforces the need to work together, to strengthen cross-sector collaboration and to act boldly and decisively for the benefit of our people, our economy, and our natural world.

With the groundwork laid and a clearer path forward, we can now focus on building a more resilient, sustainable Bay of Plenty - a region where our name continues to reflect not just what we have, but what we must protect and pass on.

**Fiona McTavish, Simon Limmer, Pā Ropata**

“

**Without any mitigation or adaptation efforts, climate-related pressures could reduce the Bay of Plenty's total economic activity by up to \$350M by 2030.**

”

### Natural Capital Regional Resilience

#### Co-Chairs



**Fiona McTavish**  
Bay of Plenty Regional Council



**Simon Limmer**  
Indevin Group



**Pā Ropata**  
Tiwaiwaka

**Ka ora te taiao, ka ora te tangata**  
**When our environment is well, our people are well**

# Introduction & Context

## Background

This project integrates climate change and nature to better understand the impacts on natural capital in Te Moana-a-Toitehuatahi the Bay of Plenty (BoP), and its implications for the future resilience and prosperity of the region. Our analysis considers how the potential impact of climate change on nature flows through to a range of social, cultural and economic activities within the region, as a result of their reliance on the ecosystem services provided by nature.

Recognising these interconnections and understanding potential points of fracture as a result of He Huringa Āhurangi (a changing climate) allows us to highlight the key risks that manifest from climate change's impact on nature, and prompts the conversation around adaptive measures.

This project:

- examines the way in which climate change contributes to the degradation of nature
- explores the cascading impacts this degradation has on the Bay of Plenty regional system
- highlights the key threats and opportunities to the region
- recommends a framework for building regional climate resilience and adaptation at regional and local levels.

The foundation of this work has been extensive stakeholder engagement with a range of technical and subject matter experts in the Bay of Plenty region, including business leaders, scientists, conservation leaders and iwi. We also conducted a desktop review of publicly available literature - mainly academic papers and other scientific studies, but also media reports and website articles, both from New Zealand and internationally.

We have also leveraged the findings of climate scenario analysis to inform our conclusions. As our source of future climate information, we adopted NIWA's updated 2024 national climate projections for New Zealand, which comprise three plausible emissions and temperature futures (see Appendix One). These are considered the preferred climate projections in a New Zealand context for assessing impacts at the regional level. New primary research was outside the scope of this work.

## The challenge

Globally 55% of all GDP - approximately US\$58 trillion - is highly or moderately dependent on nature. This is even more the case in New Zealand, where more than 70% of our export earnings are dependent on nature.

New Zealand's natural capital is declining, as a result of human activity. The OECD stated in 2017 that "New Zealand's growth model, largely based on exporting primary products, has started to show its environmental limits, with increased greenhouse gas emissions, diffuse freshwater pollution and threats to biodiversity."

Climate change is exacerbating this issue, with its own impacts on nature and the activities that rely on it. The combination of climate change and declining natural capital means we face the possibility of experiencing compounding climate and nature events.

Any further degradation of nature could have significant adverse impacts on ecosystem services (services provided by nature that activities rely on to function), to the point where regional systems are irrevocably impacted.

The continued prosperity of New Zealand is dependent on our ability to sustain, regenerate and protect our natural capital.

## This work

Natural Capital Regional Resilience is a body of work which has investigated the vulnerability to climate change-driven nature degradation in the BoP at the current point in time. A key objective of this work is to use a systems approach, to investigate the collective impacts of climate change related degradation of nature across relevant economic, social and cultural activities, and the interdependencies between them.

This work included climate scenario analysis and piloted the development of a replicable and scalable methodology for modelling the impact of climate change as a result of the degradation of nature. Additionally, this work recommends a framework for building regional climate resilience and adaptation at regional and local levels. This document summarises the key findings from this body of work.



# BoP Regional System

## The Bay of Plenty region

This work defines the BoP using the same boundaries as the Bay of Plenty Regional Council (BoPRC). The BoP is on the eastern coast of New Zealand's North Island, and includes the coastline from Waihi beach in the west to Pōtikirua in the east, as well as 18 islands out to the 12 mile nautical boundary. It comprises 12,254km<sup>2</sup> of land and 9,583km<sup>2</sup> of marine area.

The BoP has a diverse natural landscape, including beaches, forests, geothermal areas, mountains such as Mount Maunganui and the Kaimai Range, and an active marine volcano in Whakaari (White Island).

Key ecosystems include native forests, wetlands, frost flats and coastal dunes. Notable species in the region include the North Island brown kiwi, the New Zealand dotterel, and various native plants like the threatened prostrate kanuka, kauri and monoao.

With long sunshine hours and mild year round temperatures, it is the fifth most populous region in New Zealand. As one of the fastest growing regions in NZ, the BoP is home to 335,000 residents, with 37% of the population over 65.

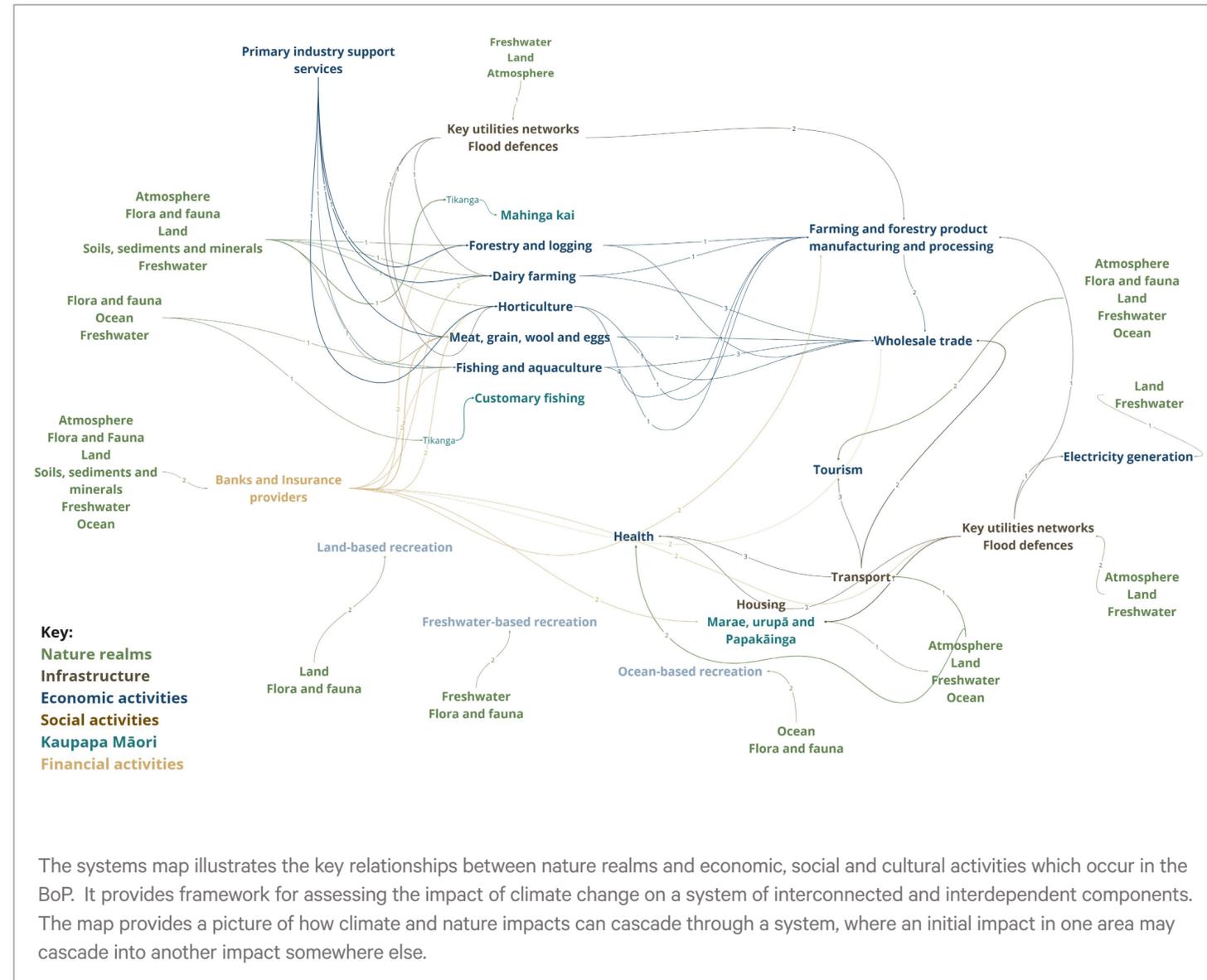
It has a strong tourism sector, with Rotorua in particular home to adventure tourism attractions, depending significantly on Māori culture and economy.

The BoP's fertile land contributes to its collection of primary industries. It is known for producing kiwifruit, avocados, citrus and dairy - e.g. ~80% of all NZ kiwifruit production is in BoP.

Forestry is a prominent industry, with Kaingaroa Forest estate covering approximately 200,000ha.

The region's coastal location also makes it an ideal location for fishing and aquaculture. There are currently three oyster farms and a mussel farm spanning 3,800 ha of open ocean.

The BoP has a significant amount of flood protection and river management infrastructure - including four major river schemes, one drainage scheme, 163 floodgates, and 380km of stopbanks. The Kaituna Catchment Control Scheme covers 1,250km<sup>2</sup>, encompassing coastal areas around East Pāpāmoa and Maketū, through to horticultural areas around Te Puke, and the wider Rotorua area.



## Local iwi and mana whenua

**Te Moana a Toi-te-Huatahi (the BoP) has strong historical significance to Māori**

- Its name commemorates the significant early ancestor of Māori people, and principal ancestor of Ngāti Awa, Toi Te Huatahi, also known as Toikairākau.
- Kāpū-te-rangi pā above Whakatāne was the home of Toi Te Huatahi.
- Kāpū-te-rangi or the Pā of Toi is of major historical significance and is part of the Kōhī Point Scenic Reserve.
- It is home to the sites of the Battles of Te Ranga and of Pukehinahina (Gate Pā), while Mauao (Mount Maunganui) also holds a significant place in Māori culture.

Māori represent a third of the BoP population, and the BoP has the second highest rate of Māori language speakers in the country. There are 35 different iwi groups across the region (the highest of any region in New Zealand), and 260 hapū and 224 marae. Māori have a significant connection to the region's natural landscape, and in pūrākau (stories) such as The legend of Mauao. Around 37% of land tenure is in Māori title, including more than 5000 parcels of Māori land.

The BoP is also the third highest employer of Māori across the country (behind Auckland and Waikato) with 1,347 individual employers in 2020 representing around 12% of all regional employers. Half of the nation's Māori-owned farms are in the Waikato, BoP, and Northland regions.

## Te ao Māori Perspective

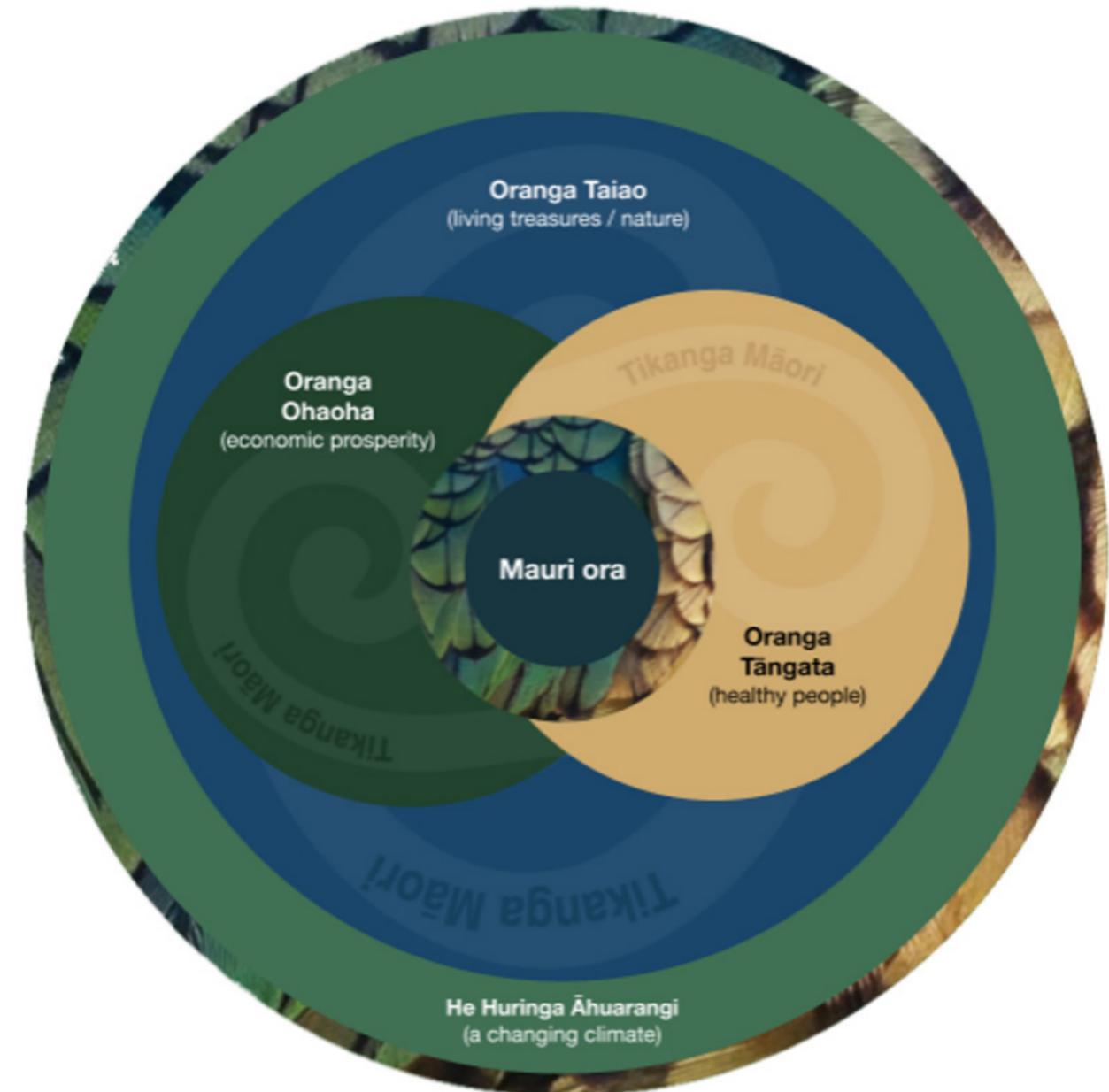
This work seeks to understand how climate change may impact natural capital in the BoP, and its implications on the system or 'regional fabric'. We have created a Te ao Māori Framework that reflects this work from an indigenous perspective. The framework visual essentially represents the systems map in line with Te ao Māori.

In addition to Oranga Taiao (living treasures/nature), the regional fabric is inclusive of Oranga Tāngata (healthy people) and Oranga Ohaoha (economic prosperity). These components are tied together by Tikanga Māori. When these components are in equilibrium, they are considered to be in a state of Mauri ora.

Mauri refers to life force; it is found in the connections which enable life to thrive. Different forms of Mauri can be used to describe the wellbeing or state for a physical object, individual, ecosystem or social group in which this essence is located.

The ultimate goal in any case is to achieve Mauri ora: a state of being, where our life force is in balance, we are alive, well and full of vitality. In terms of the outcomes of project, it can be broken into three phases.

- Mauri tū:** We are aware and observant of our current condition. Here we are looking to use insights, observations and data to translate climate science into nature-related, social, cultural, economic implications for the region to highlight the case for further action and support. Mauri tū is our first phase where we are receptive to our current state to be able to review and analyse current levels of Mauri from these perspectives. [With the end of this work, we have reached Mauri Tū].
- Mauri oho:** After a review and analysis on our current state we are cognisant of our current status and better prepared and conscious of what actions are required to achieve equilibrium. Mauri oho is the awakening phase where we respond accordingly to provide options for adaptability and resilience of a regional system. Here we activate our plan to achieve a state of optimal wellbeing for nature and our communities. The Regional Adaptation Framework will provide the necessary tools and resources to support this awakening phase.
- Mauri ora:** After analysing and activating, we are now in a phase where we can achieve Mauri ora; a state of equilibrium, where nature can thrive, our life force is in balance, and communities are well and full of vitality. Work doesn't finish here though, once we arrive at this phase it's about maintaining this state for future states and generations. We must maintain the equilibrium, so nature and our people continue to prosper.



\*The above translations in te reo Māori encapsulate the metaphorical meanings of concepts. Figurative translations are sometimes used rather than literal translations.

\*\*Mātauranga Māori (traditional knowledge) has been used to inform and enhance the framework, narrative and concepts.

# BoP Vulnerability Matrix



“Our work has identified what’s at stake economically - up to \$33 billion by 2090 if we fail to adapt or act. While some parts of the region are already stepping up to meet the challenges, we now have a clear economic imperative to enable additional action and investment to secure our long-term future.”

**Fiona McTavish**  
Chief Executive, Bay of Plenty Regional Council  
& Co-Chair of NCR2



The matrix featured is a tool to understand the potential vulnerability of sectors and activities in the Bay of Plenty to acute and chronic climate change impacts within the nature realms on which they are dependent. Each nature realm is analysed for both acute impacts, such as extreme weather events, and chronic impacts, like long-term temperature changes. With nature realms across the top and sectors/activities along the side, the matrix assigns a vulnerability rating for each interaction, highlighting the risk of dependencies on ecosystem services crucial for these activities being compromised by the impacts of climate change.

Impacts are not isolated to one activity, however, and can have cascading effects throughout the system. For example, losses in primary production can significantly impact manufacturing and processing sectors, as well as primary industry support services and wholesale trade, which collectively make up a large proportion of employment and GDP within the region. Downstream environmental impacts from primary industries and urban centres can also occur as a result of climate events and a loss of ecosystem services. Pollution and sedimentation of waterways during extreme rainfall events has the potential to disrupt activities dependent upon freshwater downstream and the ocean, such as tourism, oyster farming in estuaries or recreational and customary fishing. Interactions between these vulnerabilities should be further explored through in-depth understanding of cascading and compounding risks and scenario analysis.

Activity	Degree of impact by nature realm											
	Freshwater (ie. heavy rainfall / flooding, water availability)		Ocean (ie. marine heatwaves)		Flora and fauna (ie. pests and disease, biodiversity loss, pollination challenges)		Land (ie. sea level rise)		Soil (ie. drought, soil quality, sediment runoff into ocean and waterways)		Atmosphere (ie. temperature increase, wind)	
	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute
Dairy farming	↓	⚡	—	—	↓	⚡	↓	⚡	↓	⚡	↓	⚡
Sheep and beef farming	↓	⚡	—	—	↓	⚡	↓	⚡	↓	⚡	↓	⚡
Horticulture - Kiwifruit	↓	⚡	—	—	↓	⚡	↓	⚡	↓	⚡	↓	⚡
Horticulture - avocado	↓	⚡	—	—	↓	⚡	↓	⚡	↓	⚡	↑	⚡
Fisheries/aquaculture	↓	⚡	↓	⚡	↓	⚡	—	—	↓	⚡	↓	⚡
Forestry	↓	⚡	—	—	↓	⚡	—	—	↓	⚡	↓	⚡
Primary industry support, manufacturing and processing services	Downstream cascading impacts 1											
Wholesale trade	Cascading impacts downstream from primary industries and primary industries support, manufacturing and processing services impacts											
Tourism	↓	⚡	↓	⚡	↓	⚡	↓	⚡	↓	⚡	↓	⚡
Healthcare services	↓	⚡	—	—	↓	⚡	↓	⚡	↓	⚡	↓	⚡
Electricity generation	—	⚡	—	—	—	—	—	—	—	—	—	⚡
Electricity distribution, three waters, and telecommunications infrastructure	↓	⚡	—	—	—	—	↓	⚡	↓	⚡	↓	⚡
Transport infrastructure	↓	⚡	—	—	—	—	↓	⚡	↓	⚡	↓	⚡
Housing	↓	⚡	—	—	—	—	↓	⚡	—	—	↓	⚡
Marae, Urupā and Papakāinga	↓	⚡	↓	⚡	↓	⚡	↓	⚡	—	—	↓	⚡
Recreation	↓	⚡	↓	⚡	↓	⚡	↓	⚡	—	—	↓	⚡
Mahinga kai and customary fishing	↓	⚡	↓	⚡	↓	⚡	↓	⚡	↓	⚡	↓	⚡
Banks and insurance providers	↓	⚡	↓	⚡	↓	⚡	↓	⚡	↓	⚡	↓	⚡

Chronic negative impact - low  
 Chronic negative impact - medium  
 Chronic negative impact - high  
 Neither positive or negative impact  
 Chronic positive impact - low  
 Acute impact - low  
 Acute impact - medium  
 Acute impact - high

The vulnerability matrix was informed through a desktop review of publicly available literature, including academic studies and scientific reports, which was used to identify key relationships and potential impacts. The initial analysis was also supplemented through interviews with a range of industry and stakeholder participants in the Bay of Plenty region, which helped to validate the findings and uncover additional relevant insights.

# Key regional challenges by nature realm

## Flora and fauna vulnerabilities



All living species including plants, animals, fungi, algae and any type of genetic resource (such as microorganisms, plasmids)

All primary industries are vulnerable to increasing prevalence of pests and diseases. Increasing average temperatures means there is a risk that various pests and diseases become more widespread. The extent to which such pests and diseases could harm crops and animals in the future is subject to some uncertainty. It is also uncertain to what extent such impacts could be mitigated or prevented with biosecurity measures and breeding.

Native flora and fauna are sensitive to changes in temperature.

- The native biodiversity of the BoP is a critical part of what attracts people to live and work in the region. Warmer temperatures may result in northern plant species migrating to the south. This would change the mix of native biodiversity in the BoP, potentially disrupting ecosystems and changing the suitability for certain taonga including native birds; trees; lichens; fungi; insects; fish; and amphibians.
- Warmer temperatures will also change the natural balance of aquatic ecosystems, resulting in negative impacts for fishing, aquaculture and mahinga kai.

### Impacts include:

- Facial eczema harms cows and sheep, affecting agricultural production
- Leafroller species and greenhouse thrips harm avocados
- Fruit flies, stink bugs and mites harm kiwifruit
- Dothistroma Needle Blight harms forestry
- Pacific Oyster Mortality Syndrome (POMS) harms oysters.
- The extent to which such pests and diseases could harm crops and animals in the future is subject to some uncertainty. It is also uncertain to what extent such impacts could be mitigated or prevented with biosecurity measures and breeding.

**Key vulnerability:** Temperature induced pest and disease incursions  
**Chronic:** Warmer temperatures are more favourable conditions for many pest species and diseases to thrive  
**Acute:** Increased risk of outbreaks occurring

**Example:** While not temperature induced, *Pseudomonas syringae* pv. *actinidae* (PSA) was detected in New Zealand in 2010 and cost North Island kiwifruit growers an estimated \$1 billion in production and profitability.



## Atmosphere vulnerabilities

Includes the gaseous medium and its suspended particulate liquids and solids above the land realm, extending to the altitudinal limits of life.

All regional activities rely heavily on the atmosphere providing suitable temperatures and levels of wind and rain. The primary industries are relatively vulnerable to chronic atmospheric changes, while extreme weather events impact the whole system.

Increasing average temperatures is likely to have a number of effects on primary industries.

### Impacts include:

- Reduction in winter chilling hours (total hours below 7°C from May to July) can affect kiwifruit productivity. Crops which require winter chilling may become less suitable for the region.
- Once the temperature is high enough for long enough, animals will suffer from heat stress, which reduces production levels.
- On the positive side, avocados prefer warm sunny conditions. Higher temperatures should (all other things equal) improve avocado yields.
- Linked to increasing temperatures, severe weather events are expected to become more intense in the future. This will have numerous adverse impacts across primary industries in the BoP. For example:
  - Soil and pasture will be damaged, as a result of heavy rain, soil compaction and 'pugging', affecting dairy and sheep and beef farming
  - Avocado trees, forestry trees and kiwifruit vines can all be destroyed as a result of the event, often due to the wind
  - Waterlogged soils can compromise kiwifruit plant health and in extreme events cause plant death
  - Disruptions to the local roading network can restrict support services and remediation work
  - High winds can disrupt and delay wholesale trade activity at the port.

**Key vulnerability:** Extreme weather events  
**Chronic:** Gradual increase in temperature  
**Acute:** Increased risk of extreme high wind events i.e. cyclones

**Example:** Extreme wind events can cause extensive damage to forests and infrastructure. A recent high wind event near Matea caused the loss of 200 ha of plantation forest. Cyclone Gabrielle caused ~\$14.5b of 'known impact' across NZ.



## Freshwater vulnerabilities

All permanent and temporary freshwater bodies as well as saline water bodies that are not directly connected to the oceans.

Warmer temperatures could lead to a degradation of freshwater quality. This would have adverse impacts on recreational activities, commercial and customary fishing.

### Impacts include:

- Rising groundwater levels could lead to increased disease risk.
- More severe heavy rainfall events could lead to river flooding, with direct impacts on a number of activities, as well as indirect impacts via subsequent impacts on soil quality and ocean water quality.
- Increased drought conditions can reduce freshwater supply, leading to shortages and restrictions.

**Key vulnerability:** Heavy rainfall and flooding  
**Chronic:** Gradual increase in rainfall over time  
**Acute:** Greater risk of acute fluvial and pluvial flooding events

**Example:** Flooding, as a result of extreme rainfall is the most common natural hazard in Aotearoa, with a major flood event occurring on average every eight months.

# Key regional challenges by nature realm



## Land vulnerabilities

Land area and the topographical variations of land mass

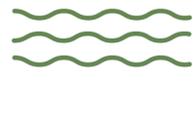
Activities which primarily occur on low-lying land, whether coastal or river-adjacent - such as dairying, horticulture, and some customary fishing activities - are under threat as a result of the impact of sea level rise and heavy rainfall events.

**Impacts include:**

- The inundation of areas of housing and marae through sea level rise and coastal flooding events
- Damage to critical coastal infrastructure including water, energy, telecommunications and roading
- Landslides and other issues may make it difficult to live in particular locations, impacting homes, transport routes, some primary production land and critical infrastructure
- Social disruptions involved with establishing and undertaking managed retreat process including the shifting of marae

**Key vulnerability:** Sea level rise  
**Chronic:** Gradual sea level rise (0.53m by 2090 under Double Up scenario)  
**Acute:** Greater risk of storm surges and coastal flooding events

**Example:** In February 2023, around 50 homes were evacuated across Waihi Beach, Athenree, Maketu and Little Waihi due to coastal flooding risk from Cyclone Gabrielle.



## Ocean vulnerabilities

All connected saline ocean waters characterised by waves, tides and currents.

Marine species in the BoP have become used to specific temperature ranges, ocean acidity, and sea levels. Changes to these historical levels will put the health and local area survival of different species at risk. .

**Impacts include:**

- Shellfish (in particular) and fish will become stressed with higher sea temperatures.
- More acidic ocean will reduce production yields for shellfish.
- Sea level rise will make it challenging to farm Pacific oysters, since they require a specific tidal level, although there are ways to adapt to this.
- Sea level rise, and in particular the associated coastal flooding and groundwater rise, will put other habitats and species near the shoreline at risk.
- More marine heatwaves, driven by higher average temperatures, could result in mass species die-offs.

**Key vulnerability:** Marine heatwaves  
**Chronic:** Gradual sea temperature increase due to GHG concentration  
**Acute:** Marine heatwaves can occur as a result of El Nino events

**Example:** In 2023, New Zealand’s coastal waters were in marine heatwave conditions for 208 days and in the Bay of Plenty, the waters remained in heatwave for the entire year.



## Soil, sediment and mineral vulnerabilities

The unconsolidated mineral or organic material on the immediate surface of the Earth that serves as a natural medium for the growth of land plants. Sediments are particles of rock and other organic material often transported in water or wind to form layers on earth's surface

The primary industries of farming (dairy, and beef and sheep) and horticulture (kiwifruit and avocado) rely heavily on soil, and the quality of it.

**Impacts include:**

- Increasing temperatures are expected to lead to increases in ‘PED’ (i.e. drought), which in turn will reduce water availability and moisture within soils across the BoP.
- This will likely reduce industry production in dairying, sheep and beef farming, kiwifruit and avocado growing.
- Water availability could be mitigated through irrigation, although obtaining consent for substantial irrigation schemes in the BoP may be difficult in the near future and would increase the region’s overall water stress.
- Severe weather events can also cause significant damage to soils, with corresponding effects on economic activities.
- More ocean runoff increases ocean sedimentation, with adverse impacts on shellfish in particular.
- Some low-lying land may become unsuitable for farming and/or horticulture in the future, as a result of coastal flooding, water inundation and soil salinization. Degradation of soil is exacerbated by “pugging” effects from livestock during wet periods .

**Key vulnerability:** Drought  
**Chronic:** Gradual increase in PED accumulation over time exacerbating soil salinization  
**Acute:** Greater risk of acute drought events

**Example:** In 2019, the Western BoP drought came as a result of below average rainfall and back-to-back dry months for the region. From January 1 to March 31, Tauranga had only a third of its average rainfall.

# Existing adaptation efforts

## What is adaptation

The BoP, like many regions worldwide, is already witnessing the impacts of climate change, including rising average temperatures, shifting seasonal patterns, and an increase in extreme weather events. These changes underscore a critical reality:

**the longer we delay adaptation efforts, the more challenging and costly it will become to address the consequences of climate change.**

Adaptation requires adjusting ecological, social, and economic systems. Transformative changes are required to mitigate damages or capitalise on new opportunities that address climate-related changes. For the Bay of Plenty, this means developing tailored strategies to meet regional challenges. The following examples illustrate how the region is already adapting to climate and nature impacts. These adaptation solutions can also provide co-benefits across multiple nature realms and respond to multiple climate impacts.



## Zespri: Adaptation in practice

In 2022, Zespri published its Climate Change Adaptation Plan, responding comprehensively to the risks and opportunities identified in its Climate Change Risks and Opportunities Report. The plan prioritises key actions needed to adapt to climate change and establishes a framework for the kiwifruit industry's long-term resilience.

### Existing Adaptation Actions

Adaptation actions are already being implemented across the Bay of Plenty's kiwifruit industry, demonstrating proactive measures to address climate-related challenges. Some growers use agrichemicals to simulate frost conditions, promoting earlier flowering and ensuring consistent production. Hydrogen cyanamide (HiCane) is applied in warmer winter regions to mimic cold conditions, fostering flower production and improving yield quality. As winters continue to warm, this tool - or its future alternatives - will remain critical for growers adapting to changing climates.

Zespri orchards employ various methods to protect young stems and fruit while improving soil health. Poplar and willow trees, alongside plastic or polythene netting, provide shelter and prevent erosion. Cover crops planted between vines mitigate extreme weather impacts, enhance soil health, and suppress weeds. Organic materials such as wood chips are applied around plant bases to conserve soil moisture, moderate temperature fluctuations, and reduce erosion. Research has shown that dual mulching treatments significantly increase kiwifruit yields compared to non-mulched orchards.

### Goals for Climate Adaptation

The Climate Change Adaptation Plan identifies three primary goals to ensure the resilience and profitability of the kiwifruit industry.

The first goal, Future-Proof Growing and Breeding, focuses on supporting growers in adopting climate-resilient practices, including efficient water use and pest management. It also emphasises the development of a grower network to share knowledge and promote sustainability, resilience, and ecosystem services. Breeding programmes aim to develop cultivars and rootstock that meet performance criteria such as drought and pest tolerance, nutrient efficiency, and adaptability to low winter chill conditions. Research efforts advance understanding of climate change impacts on kiwifruit ecosystems, covering topics like weather event resilience, water security, biodiversity, and pollination.

The second goal, Maintain Fruit Quality and Manage Supply, addresses fruit quality challenges through initiatives like the Taste Zespri programme, which enhances taste consistency and aligns with market expectations. The industry monitors climate impacts on growing seasons in New Zealand and other regions to adapt supply chains effectively. Investments in advanced technologies enable accurate orchard production forecasting, aiding supply chain planning and ensuring quality management.

The third goal, Protect Industry Profitability, focuses on collaborating with research institutions to assess productivity impacts under different climate scenarios and developing pathways to net-zero emissions. Efforts include exploring

future fuels and shipping technologies to reduce supply chain emissions. Additionally, Zespri conducts research on the value of environmental sustainability in global markets to inform strategic investments and ensure regulatory compliance.

### Leading Through Adaptation

Zespri's initiatives showcase a commitment to sustainable practices, ensuring that the kiwifruit industry can thrive in a rapidly changing climate. By aligning with broader regional adaptation efforts and leveraging innovation, Zespri will continue to strengthen resilience while supporting the economic and ecological wellbeing of the Bay of Plenty.

### Growers Leading Through Mitigation

Kiwifruit growers are actively mitigating key climate risks to support long-term kiwifruit resilience. To address reduced winter chill and rising summer temperatures, growers use budbreak enhancers including agrichemicals, canopy and sward management, precision irrigation, and shelter systems that enable airflow. Soil health is being strengthened through enhancements including improved drainage, and organic mulches to reduce the risk of waterlogging and heat stress on vines. To protect against extreme wind and frost, orchards employ evergreen and deciduous shelter trees, artificial cloth and internal shelters, overhead artificial shelter, frost fans, and water-based frost protection systems. These integrated approaches reduce risk exposure to the impacts increasing climate variability now, and into the future.

## Existing adaptation efforts



### Pukekauri Farm: Spotlight on regenerative farming practices

John and Rick Burke, brothers and co-owners of Pukekauri Farm, have been carrying out environmental restoration work on their farm for over 20 years, applying regenerative practices which preserve and restore awa health and Te Rereatukahia Estuary in Tauranga Moana. They protect freshwater sources and biodiversity on their farms where they can, including through strategic land use change.

Despite up to 25% of the farm retired from pastoral farming in order to improve environmental outcomes, John Burke states he is making as much, if not more total profit from the pastoral enterprise. Burke now describes the farm as a ‘multi enterprise’ farm with both Carbon and Forestry revenue.

Wai Kōkopu, a community-led programme to replenish and preserve the Waihi estuary, has a website which shines a spotlight on “lighthouse farms” in the catchment. These are farms like the Burkes’ which are leading the way in terms of innovative and regenerative farming practices. Burke stresses the need to work in catchment groups to assess drivers holistically, which may include existing environmental issues, climate change, erosion and misplaced land-use, such as the low-lying dairy flats already below sea-level in the catchment.



### Maketū community: Spotlight on community-led adaptation

The community of Maketū have been led by local iwi, Te Rūnanga o Ngāti Whakaue ki Maketū, in the development of The Maketu Climate Change Adaptation Plan (He Toka Tū Moana Mō Maketu). The adaptation plan was developed in 2022 and won the New Zealand Planning Institute (NZPI) Best Practice Award.

Over the past decade the Maketū community have experienced:

- Frequent coastal flooding of Whakaue Marae following subtropical storms
- Large swells in 2019 which caused a landslide that caused koiwi (human remains) to tumble from the cliff top urupā at Ōkurei to the beach below.
- Sedimentation in Maketu estuary burying pipi and seagrass and restricting iwi access to mahinga kai.

Maketu iwi emphasise the value in iwi led adaptation plans that begin with hui and open korero about climate change. They also highlight the importance of recognising Māori values in addressing climate change. Examples of these are:

**Kaitiakitanga:** Safeguarding our future. Māori hold a deep sorrow that they haven’t been able to care for the environment due to climate change.

**Kotahitanga:** We have to work together.

According to iwi, one of the most valuable things that came from the Maketū Climate Change Adaptation Plan is a community which is proficient in climate literacy, from the youngest to eldest members of the community. This has enabled the community to be united in looking to the future in a practical way. They have plans underway to build another papakāinga on the hill nearby.



### Whakatōhea Mussels: Spotlight on climate resilient aquaculture

Whakatōhea is an indigenous Māori iwi centered aquaculture venture in the Eastern Bay of Plenty. It was the world's first Open Ocean Greenshell™ Mussel Farm and is located just over 8.5 km off the coastline of Ōpōtiki.

The farm expands across over 3800 hectares of nutrient rich, clear, and open ocean water space. Because of this, the farm is less susceptible to land based impacts commonly seen in harbour environments.

While there is some exposure to marine heat waves, the magnitude of these events in the deeper waters in which the farm resides, are far less than the shallow water environments of harbour environments where mussel farms are traditionally located. As a result, the resilience of the venture is far higher than most, providing a demonstrated pathway forward for expansion of the aquaculture sector in the bay.

## Other adaptation responses implemented by the Bay of Plenty include:

Community and iwi-led conservation initiatives, such as:

- the Aongatete Forest Project, focused on restoring native biodiversity to the Kaimai Mamaku area using pest control
- the Manawahe Eco Trust, facilitating community interest in preserving the Manawahe Ecological Corridor
- Kahoroa Kōkako Trust, focussing on protecting the local population of kōkako

These initiatives are examples of kaitiakitanga and collective action for the long term preservation of natural areas and they play an important role in retaining natural attractions for domestic and international tourism. Large areas of native and exotic vegetation, especially once mature, can act as a fire break.

- The development of a spat hatchery in Opotiki to ensure consistent supply of spat to the growing industry in the BoP.
- Emerging research suggests there is the potential to breed New Zealand green-lipped mussels that have higher resilience to heat stress.
- Utilising floating or ‘flip’ crates that hold oyster crates clear of the water to allow nature to control biofouling without the use of chemicals or pressure washing.
- The exploration of genetic resistance and destocking in the forestry industry. For example, Timberlands is considering species diversification by introducing species like eucalyptus to reduce long-term pest and disease risks.

## Planning Ahead

The SmartGrowth Strategy 2024 -2074 is now in play, with future growth areas planned across the Western, Eastern, Northern and Central corridors to accommodate a growing population. A key transformational shift for this plan is to restore and enhance eco-systems for future generations, with key growth directives to:

- Maintain and restore a range of ecosystems to a healthy functioning state
- Protect cultural and heritage values at risk from coastal erosion
- Implement a precautionary approach to development in ‘go-carefully’ defined areas
- Enhance coastal, terrestrial, and freshwater ecosystems to improve carbon storage and climate resilience
- Prioritise NbS and water sensitive urban design are prioritised and used in urban areas.



## Existing NbS adaptation efforts

Nature-based Solutions (NbS) are strategies that harness the power of nature to address societal challenges, such as climate change, biodiversity loss, and water security, while also offering environmental, social, and economic benefits. These solutions are inspired and supported by natural processes and ecosystems. The following case studies in the Bay of Plenty showcase how a range of nature-based solutions are being implemented to improve ecological resilience and community well-being. These solutions, while directly focusing on issues such as improving ecosystem health, reducing disaster risk, and preserving cultural heritage, also provide wider benefits by enhancing biodiversity, supporting sustainable development, and strengthening community ties and engagement. They illustrate a holistic approach where environmental and societal gains go hand in hand.

### Coast Care

The Coast Care programme involves partnership between the local community and others including iwi, district councils, regional councils, Department of Conservation and other organisations, all working together to protect and restore a region's beaches. It engages local volunteers in restoring and protecting coastal dune systems. Key activities in the BoP include planting native vegetation to stabilize dunes and prevent erosion, educating the community about coastal ecosystem importance, and maintaining dune health through monitoring and invasive species removal. This community-driven initiative creates resilience by enhancing ecological health, supporting biodiversity, and protecting infrastructure from erosion and extreme weather. By fostering environmental stewardship, Coast Care ensures sustainable coastal management for future generations.



### Waihi estuary restoration

Wai Kōkopu and Te Wahapū o Waihi (a collective of five iwi from the Waihi Estuary catchment) are some of the many local groups working toward the development of healthy, diverse, and interconnected habitats and ecosystems within the Waihi Estuary Catchment through several specific projects. Key initiatives include the rehabilitation of estuarine areas, planning for riparian corridors, and the restoration and establishment of riparian zones, wetlands, and forests. This work is already helping make the area more resilient as restoring these habitats enhances biodiversity, improving ecosystem resilience to climate impacts. Estuaries also act as natural buffers against storm surges and coastal flooding. The roots of plants in estuaries help stabilise the soil and prevent erosion.



### Motiti Protection Area

The Motiti Protection Area, made up of three areas surrounding the Motiti islands, is in place to protect the long-term sustainability and cultural significance of the offshore reef systems. By introducing rules preventing the taking of marine life from the areas, as well as limiting anchoring in the areas, the initiative aims to foster a healthier, more diverse marine ecosystem. Ongoing monitoring is in place to ensure that the protections are working and to understand any changes that are occurring. This approach exemplifies a proactive strategy in marine management, balancing conservation efforts with understanding of cultural values, and ensuring the resilience of ocean ecosystems in the face of environmental changes.



### The Kaimai Mamaku Restoration Project (KMRP)

The KMRP is an initiative to bring a variety of projects, communities, investors and stakeholders together to work together to maintain and restore the Kaimai Mamaku and its catchments. The Kaimai Mamaku forest is crucial in stabilising steep soils and regulating water flow. The collection of restoration projects aim to help build resilience for the wider region through improving the health of the forest to reduce the risk of erosion and flooding and normalise sediment movement in waterways.

### Awatarariki Managed Retreat programme

The Whakatāne District Council, in agreement with BoPRC and the Department of Internal Affairs, have introduced the Awatarariki Managed Retreat programme to aid residents to relocate from properties that are at risk of future debris flow events from the Awatarariki Stream catchment. By offering voluntary property buyouts at fair, market value prices, the programme enhances community safety by assisting residents to move to safer locations. In the future, the programme aims to work closely with the community regarding the potential use of the vacated land, such as establishing environmental and disaster protection zones to support.



# Possible solution pathways

The following four pages present the outcomes of a collaborative workshop with the Champions Group, which brought together key stakeholders to identify systemic, landscape-scale responses to address the most significant climate change impacts on the region's natural systems. These proposed solution pathways are designed to establish coordinated governance and enable the development of a cohesive, region-wide adaptation strategy that builds on existing efforts. By taking this holistic, systems-level approach, the aim is to empower leaders in the BoP from a range of sectors to shape a resilient future for the Bay of Plenty in the face of climate change.

## Adaptive land use change | Sea level rise

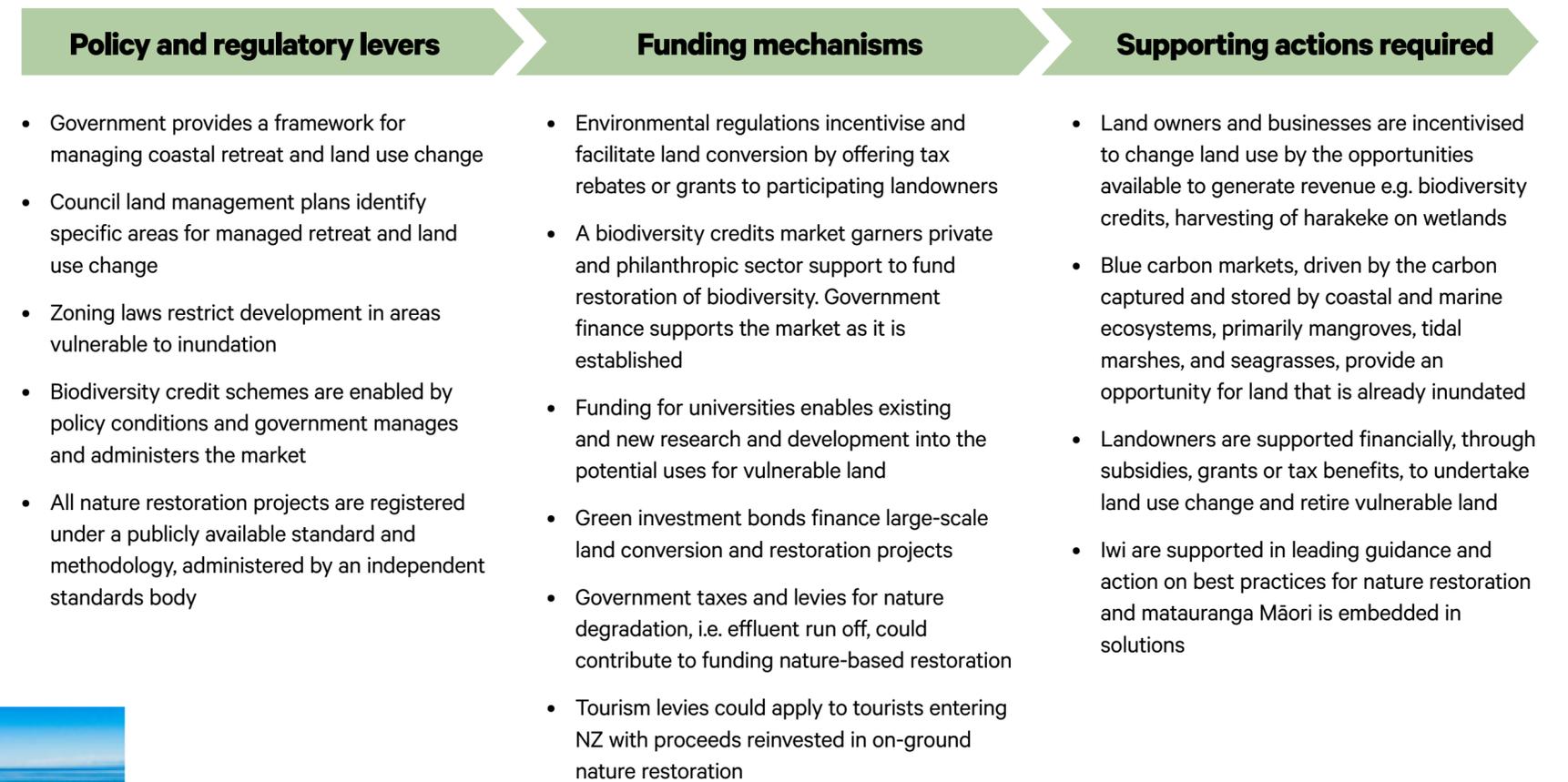
Adapting land use in vulnerable coastal areas could bring renewed value to the region. By concentrating on **nature restoration** and the establishment of **natural buffers**, such as wetlands and mangroves, storm surges can be effectively absorbed, and coastal erosion mitigated, creating a robust first line of defense against rising sea levels. **Managed retreat** strategies, which involve relocating infrastructure and communities away from high-risk areas, further enhance resilience. **Innovative urban planning** plays a crucial role by integrating these approaches and designing towns and cities that incorporate green spaces and elevated structures to withstand climate impacts. Additionally, **alternative markets**, such as biodiversity credit schemes and innovative new products, incentivise conservation and restoration efforts while offering economic benefits that align with environmental objectives.

### Secondary benefits:

- **Mahinga kai** - healthy wetlands and estuaries sustain traditional food sources like shellfish
- **Native flora and fauna** - restores habitats for native plant and animal species, leading to increased biodiversity
- **Tourism** - enhanced natural scenery and biodiversity can draw more visitors and improve visitor experience
- **Recreation** - restored areas for recreational activities such as fishing/ gathering, kayaking and hiking
- **Transport** - restored wetlands act as buffers, protecting transport infrastructure from storm surges and erosion
- **Pollination** - restored nature supports native pollinators critical for agricultural land and food production
- **Human health** - plants, trees and biodiverse ecosystems improve air and water quality for the community.

### System nodes directly engaged in response:

#### Agriculture - Horticulture - Iwi - Urban communities - Rural communities



# Possible solution pathways

## Innovative water management practices | Drought

Changing water management practices can respond to drought impacts in both urban and agricultural settings. **Decentralised water storage** systems, such as rainwater harvesting and the expansion of local reservoirs, can capture and store rainwater for potable uses, reducing demand on central water supplies. **Grey water reticulation** systems allow for the reuse of household water from sinks, showers and laundries for irrigation further conserving potable water. In agricultural settings, **dryland management** strategies focus on enhancing soil health through practices like agroforestry, cover cropping, maintaining rooting depths and enhancing organic matter content to increasing resilience. **Nature restoration** works in tandem with dryland management as wetlands and **riparian planting** zones can improve water retention, reduce heat and evaporation.

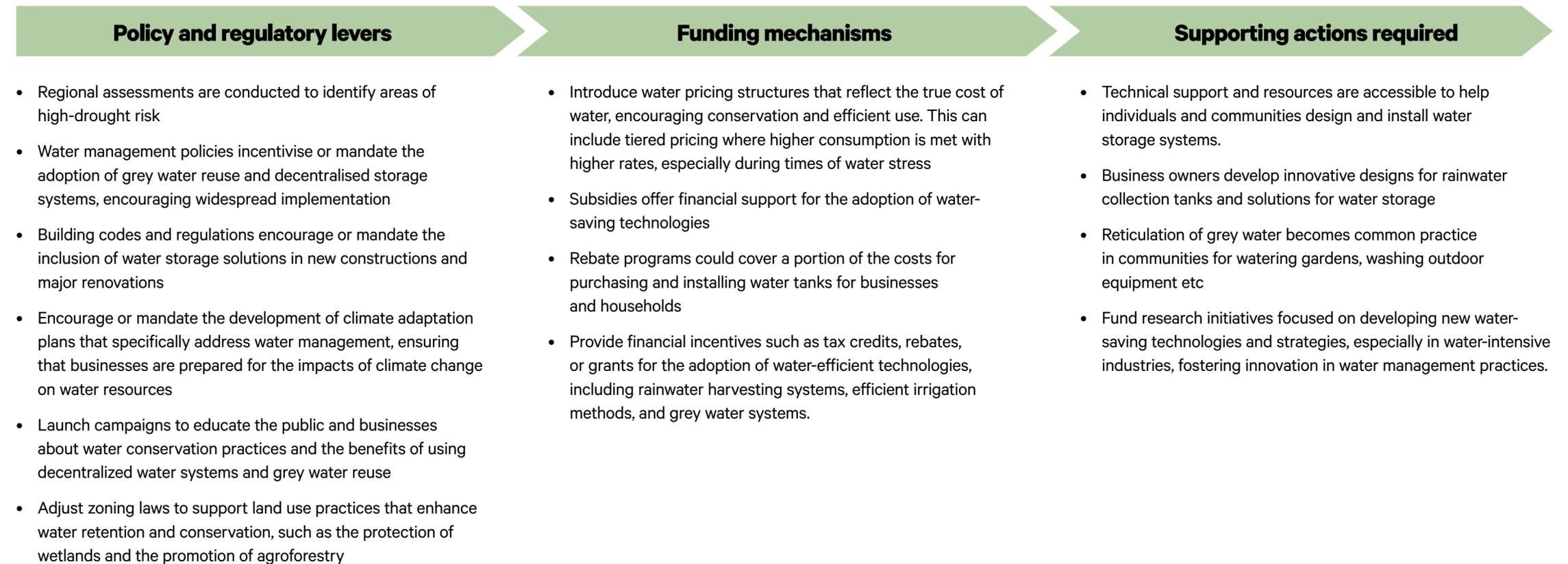
### Secondary benefits:

- **Improved soil health** - dryland management practices can involve incorporating a wider variation of plant species, which enhance soil structure and fertility by supporting diverse microorganisms and reduce the need for synthetic fertilisers.
- **Erosion prevention** - dryland management maintains pasture root systems which prevents erosion and improves water retention.
- **Health** - more certainty and reliability around access to water
- **Manufacturing** - upstream agricultural practices remain productive as water scarcity is addressed, manufacturing processes can continue uninterrupted
- **Wholesale trade** - reduced volatility in agricultural markets as drought conditions are managed more effectively, exports of agricultural products remain stable



### System nodes directly engaged in response:

#### Agriculture - Horticulture - Iwi - Urban communities - Rural communities



# Possible solution pathways

## Ecosystem-based fisheries management | Sea Temperature Increase

Ecosystem-based fisheries management (EBFM) emphasises practices that benefit the entire marine ecosystems rather than concentrating on individual species. It can involve implementing **adaptive catch management**, adjusting catch limits and fishing practices in response to changing fish populations and distributions due to warming waters. The exploration of **alternative markets** for underutilised or newly abundant species that thrive in warmer temperatures can support this, providing economic opportunities and reduced pressure on traditional fish stocks. The adoption of **mātauranga māori approaches** to coastal and marine management could complement EBFM by incorporating traditional ecological knowledge and holistic, community-based stewardship of natural resources. **Investment in biosecurity** can also reduce the incidence of other pests and diseases which threaten existing ecosystems, while the establishment of reserves or 'no-take zones' promotes sustainable fisheries by allowing ecosystems to recover and thrive without human interference. Embracing an ecosystem-based approach to aquaculture development can also yield benefits for marine environments. The strategic cultivation of species like mussels in open ocean settings not only provides economic opportunities, but can also actively contribute to ecosystem restoration by adding habitat complexity and removing excess nutrients, helping to revitalise degraded marine environments.

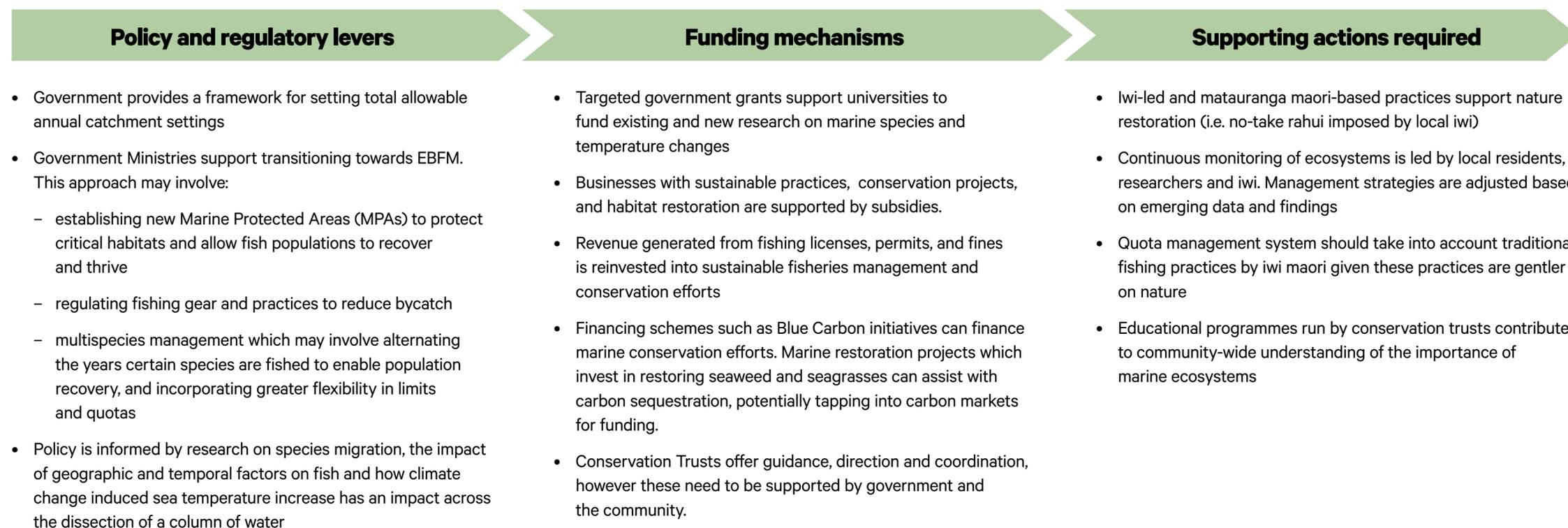
### Secondary benefits:

- **Mahinga kai** - traditional food sources sensitive to temperature change can continue to be eaten and cultural practices associated with gathering can continue
- **Marine ecosystems** - reducing overharvesting of species helps preserve species critical for maintaining ecosystem function
- **Biodiversity** - indigenous biodiversity is preserved, maintaining ecosystem resilience
- **Tourism** - adaptive catch management also contributes to protecting marine species and marine environments which improves diving, snorkelling and fishing in NZ



### System nodes directly engaged in response:

#### Commercial fishing and aquaculture - Iwi - Recreational Fishing and Aquaculture



# Possible solution pathways

## Re-earthing rivers | Heavy rainfall and flooding

Re-earthing rivers is an example of **nature restoration**. It includes restoring floodplains so rivers can overflow naturally, spreading excess water over a larger area. This reduces the water volume moving downstream and lowers the risk of flooding in urban areas. **Riparian planting** along riverbanks slows water flow and promotes sediment deposition, reducing erosion risk and acts as a **nature buffer** during overflow periods. This approach also involves **managed retreat** away from river-adjacent land to make space for floodplain restoration. **Innovative and resilient urban planning** can help minimise disruption to urban communities.

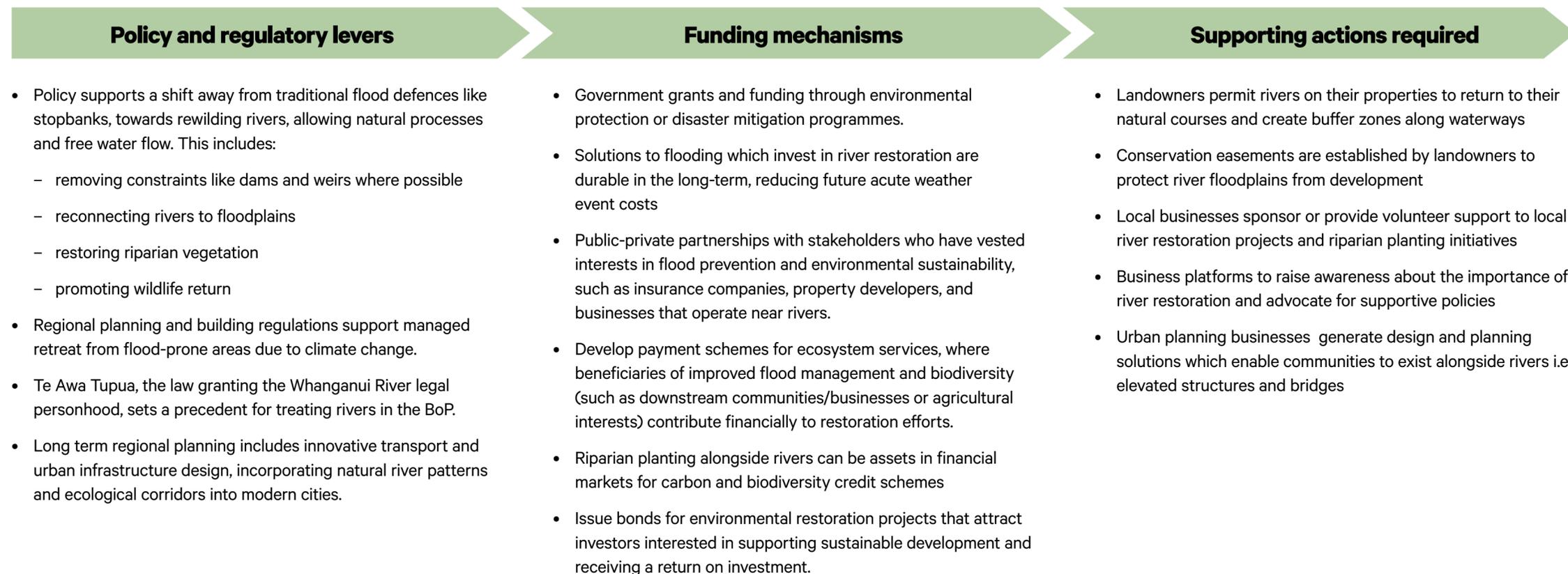
### Secondary benefits:

- **Regional ecosystems** - restoring a river requires preservation efforts from the source to the sea, protecting habitats for native plant and animal species and increasing ecosystem resilience
- **Urban infrastructure protected by flood defences** - when flood defences are breached, heavy rainfall events can damage community infrastructure. Managed retreat from high risk areas and returning rivers to their natural plains enables water flow to be more effectively managed
- **Water supply** - riparian planting assists with natural filtration of water, contributing to cleaner drinking water supply
- **Aquaculture** - floods can transfer sediment out to sea, negatively impacting aquaculture. Preventing the scale of fluvial flooding through river restoration minimises this risk, especially in estuarine environments



### System nodes directly engaged in response:

#### Agriculture - Horticulture - Iwi - Urban communities - Rural communities



# Closing summary

## Call to action

The findings of our analysis illustrate that climate change-induced nature degradation poses a number of significant risks to the economic, social, and cultural activities that define the Bay of Plenty community. These activities are deeply dependent upon the health of our natural ecosystems, which span across the six nature realms considered, underscoring the urgent need for targeted and multi-sectoral adaptation efforts.

The time to act is now. Delaying adaptation strategies will only heighten the challenges and costs associated with climate-related impacts. We must proactively transform our ecological, social, and economic frameworks to mitigate potential damages and seize new opportunities offered by climate change. Tailored adaptation strategies, informed by the best available science and traditional Māori knowledge, are essential for safeguarding the future resilience of the Bay of Plenty. A well planned and coordinated response could yield significant opportunities for the region.

At the heart of these efforts is the principle of Kotahitanga—working together. Every community and sector within the BoP has a crucial role to play. Context-specific solutions are required, including flood defence enhancements, early warning systems for extreme weather, drought-resistant agricultural practices, and policy revisions. Collaboration among local iwi, community groups, businesses, civil society, and regional organisations is vital to harness the collective knowledge and resources necessary for effective adaptation. The establishment of the Champions Group in this project is an example of the collaboration and governance required to progress system-wide change for the region.

Let us embrace nature-based solutions as a cornerstone of our regional adaptation efforts. By protecting, sustainably managing, and restoring our ecosystems, we can address climate challenges and enhance disaster risk reduction. A well planned and coordinated response in this regard has the potential to create opportunities for the region while also addressing key challenges.

Together, we can build a resilient and thriving Bay of Plenty, ensuring the prosperity of our communities today and for generations to come. Let this report serve as a catalyst for robust dialogue and decisive actions that secure our region's future in the face of climate and nature-related impacts, fostering a sustainable and vibrant Bay of Plenty for all. Through Kotahitanga, we can achieve the unity needed to tackle these challenges and create lasting positive change.

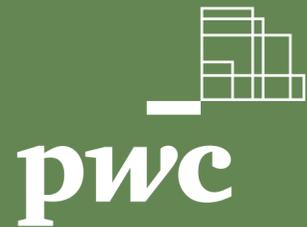


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The Aotearoa Circle is a public private partnership, whose purpose is to restore natural capital in New Zealand. Together we recognise nature is critical to our current, and future, economic success.

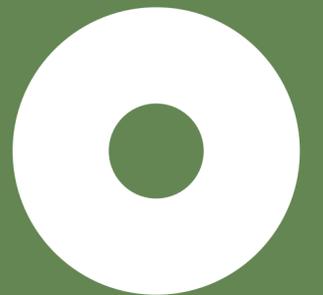
Our purpose is to restore natural capital for future generations to realise enduring prosperity for New Zealand.

We are an apolitical organisation, using our convening capability **to tackle difficult and complex work** that is better done together. We aim to work **quickly, efficiently and cost effectively**, delivering solutions that will achieve buy-in from all parties. We work at a **systems level**. Our partnership model lets us design robust and lasting solutions with key stakeholders involved from the start.

“We know what is happening, we know what we must do – now, we must simply do it.”

Sir Rob Fenwick

You can find out more about The Aotearoa Circle, the evolution of this workstream, and other sector workstreams on our website: <https://www.theaotearoacircle.nz/>



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**The  
Aotearoa  
Circle**

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**Mā te Kaitiakitanga  
ko te Tōnuitanga**  
Prosperity Through  
Guardianship