WHAKATĀNE
District Council

Tonkin+Taylor

Whakatāne District Climate Change Risk Assessment | Te Pūrongo Aromatawai Tūraru Huringa Āhuarangi o Whakatāne

Prepared for: Whakatāne District Council

Prepared by: Tonkin & Taylor Ltd

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Whakatāne District Climate Change Risk Assessment |
Te Pūrongo Aromatawai Tūraru Huringa Āhuarangi o Whakatāne

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Glossary | Kuputaka

Key term	Definition
Adaptation	Adjustment to actual or expected climate change and its effects. In human systems, adaptation seeks to moderate or avoid harm, or to take opportunities. Intervention may facilitate adjustment[1].
Adaptive capacity	The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences[2].
Climate change	A change in the state of the climate identified (e.g., through statistical tests) by changes or trends in the mean and/or the variability of its properties, and that persists for an extended period, typically decades to centuries. Includes natural internal climate processes or external climate forcings such as variations in solar cycles, volcanic eruptions and persistent anthropogenic changes in the atmosphere or in land use[2].
Element	Elements at risk are the people or systems that are potentially adversely affected by the physical risk, e.g., assets, ecosystems, infrastructure, and taonga[2].
Hazard	The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources[2].
Physical risk	Physical risks are those resulting from climate change hazards, and these can arise from *acute* hazards, such as increasingly extreme weather (e.g., cyclones, droughts, floods) or longer-term (*chronic*) shifts in precipitation, temperature, sea-level rise, and more variable weather patterns (Ministry for the Environment, 2020). Physical risks can also be direct or indirect. Direct risks are those where there is a direct link between a hazard and an element at risk that is exposed and vulnerable. Indirect risks are further removed from a hazard – for example, impacts on mental health and disruptions to supply chains. They result from direct risks elsewhere, which can be local or distant and emphasise the interconnected nature of climate risks within systems.
Risk	The potential for consequences where something of value is at stake and where the outcome is uncertain, recognising the diversity of values. To address the evolving impacts of climate change, it can also be defined as the interplay between hazards, exposure and vulnerability[1].
Sensitivity	Is the degree to which an element at risk is affected, either adversely or beneficially, by climate variability or change. Sensitivity relates to how the element will fare when exposed to a hazard, which is a function of its properties or characteristics[2].
Vulnerability	The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts including sensitivity or susceptibility to harm, and lack of capacity to cope and adapt. Assessing vulnerability is broader than conventional risk assessments; it includes indirect and intangible consequences on the four wellbeings, and adaptive capacity (e.g., communities, whānau, hapū and iwi may be resourceful but may lack the resources, insurance access and mandate or capacity to adapt)[2].

[1] IPCC, 2014. Summary for policymakers. In: Climate change 2014: Impacts, adaptation and vulnerability. Part A: Global and sectoral aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.
[2] Ministry for the Environment, 2021. A guide to local climate change risk assessments.

1.0 Executive Summary | He whakarāpopototanga

This report outlines the approach and outcomes of the first Whakatāne District Council (Council) Climate Change Risk Assessment (CCRA). It was jointly prepared by Council and Tonkin & Taylor Ltd (T+T).

This CCRA will help Council understand how climate change will directly and indirectly impact the District, communities and the Council's assets and operations. This information will be critical to plan for the impact of acute and chronic climate hazards and allow the prioritisation of climate change adaptation actions required to safeguard the wellbeing and resilience of the Whakatāne District and its communities.

The objective for the CCRA project was to identify social, economic, built environment, natural environment and cultural climate change risks and implications for Council and the services they provide, across different timescales and climate change scenarios.

The CCRA followed the approach set out within the *Guide to local climate change risk assessments (Ministry for the Environment, 2021)*.

The CCRA firstly involved undertaking a risk identification exercise that provided a high-level long-list and broad understanding of a wide range of direct and indirect risks that could result from climate change hazards this century, at both a sectoral and community level.

Geospatial analysis was undertaken with existing hazard data (where available) to model how climate and infrastructure exposure may vary across the District. This helped identify and quantify the assets which are potentially most at risk from climate change across key sectors, and in which communities these risks lie.

Subsequently, rating of the risks within the sectoral categories was undertaken, however risks identified at a community level have not yet been rated.

Separately, an extensive community engagement programme was undertaken to ensure local knowledge about local climate risks known to the community was incorporated into the CCRA. The result is a CCRA that combines expert analysis and local knowledge to reflect the real-world complexity of the Whakatāne District.

This project forms part of the Council's climate change adaptation programme of work. The results will be used to inform future engagement with local communities, iwi and / or other external parties on climate change risk and adaptation, and ultimately inform Local Adaptation Plans.

Summaries of significant risks identified throughout the project are listed below, categorised within five domains. Brief commentary is provided where specific community information was gathered.

1.1 Natural Environment

- Coastal ecosystems may be at risk from sea level rise causing habitat loss, "coastal squeeze," and displacement of species like seabirds and saltmarsh plants.
- Marine ecosystems may suffer from rising temperatures, marine heatwaves, and ocean chemistry changes — leading to species stress, die-offs, algal blooms, and food web disruption. Flood-related runoff introduces sediment, nutrients, microplastics, and contaminants into marine and estuarine environments, degrading habitat quality.
- Terrestrial biosecurity may be at risk from higher temperatures and changing humidity increase which may result in the spread and establishment of exotic pests, weeds, and diseases (e.g. myrtle rust, wild ginger, fire ants). Also, erosion and wildfire events expose land that is prone to colonisation by invasive species like pampas and wattle, further degrading ecosystems.

- Marine biosecurity may suffer due to increasing temperature and marine heatwaves as this could result in species migration and invasive marine species that may outcompete natives.
- Freshwater biosecurity may be at risk as warming expands the range and impact of invasive pests in lakes and rivers.

The community engagement programme identified a range of risks relating to the natural environment. These included; water quality and ecological risks for Lake Matahina, Lake Āniwaniwa, Whirinaki and Horomanga rivers (Galatea), and the Rangitaiki River – as a result of increased temperatures, extreme rainfall and drought. Additionally, degradation of wetland ecosystems due to sea level rise and higher temperatures was identified (e.g. Coastlands and Wainui). Lastly, the deterioration of the estuarine ecosystem (due to sedimentation) within Ōhiwa Harbour was identified, which has knock-on impacts for estuarine species and kaimoana.

1.2 Sectors Relying on the Natural Environment

- Estuarine aquaculture and fisheries may suffer from warming waters, reduced oxygen, and biotoxins (e.g. affecting mussels and oysters), which can reduce economic and biological viability.
- Aquaculture and fisheries may be at risk from sedimentation caused by coastal erosion, farming, landslides, and forestry runoff.

The community engagement programme identified a range of risks relating to fisheries and aquaculture. Particular issues were identified within Ōhiwa Harbour where sedimentation is impacting on aquaculture activities. More generally, warming seas and land surface temperatures are directly impacting species such as Snapper, Kōura and Pāua that are important to coastal communities and Māori.

1.3 Built Environment

- Water quality for potable supplies may be at risk from contaminant runoff and erosion from extreme rainfall and flooding.
- Flood defences / stopbanks may underperform due to prolonged dry periods followed by wet conditions, weakening their structural integrity.
- Wastewater infrastructure may be vulnerable to overflow and service failure from inflow during flood events.
- Stormwater systems near coastlines may suffer from groundwater rise and salinity, reducing capacity and increasing maintenance.
- Electricity distribution assets (especially ground-mounted ones) are at risk of damage from flooding.
- Rail infrastructure may be disrupted by debris, landslides, or fallen trees caused by extreme weather events.
- Ports may experience operational delays (and interference with goods handling and storage) from increasing sea level rise and coastal flooding.
- Parks and reserves infrastructure (park roads, bridges, and carparks) may be damaged from increasing landslides (and cause access restrictions).
- Communities and buildings may face structural damage and access issues due to increasing landslides and flooding with flow-on effects for insurance and emergency response.

The community engagement programme identified a range of risks relating to flooding of roads, water supply, wastewater and other critical infrastructure, landslides, wastewater overflows (e.g. Whakatāne, Murupara and Tāneatua treatment ponds), septic tank issues (e.g. Matatā), drought impacting on water availability (e.g. Manawahe) and contamination from closed landfills (e.g. Te Teko).

1.4 Ngā mea hirahira o te ao Māori

Many of these highlighted risks will have unique and significant implications for Māori in the District. Climate risks have potential to impact ancestral lands, water, significant sites, marae, urupā, cultural assets, taonga species, businesses, etc. In turn, these impacts can have a wide range of secondary effects, including on customary practises (tikanga) as well as on spiritual and physical wellbeing. The community engagement programme identified a number of specific locations where important sites (such as Urupa and Marae) were at risk from flooding and erosion. These included Matatā, Te Teko / Te Mahoe, Rūātoki, Waiohau, Wainui, Murupara and Coastlands.

1.5 People, health and communities

Climate change presents a wide range of potential health risks due to higher temperatures, drought, flooding, fire and coastal hazards. Climate change impacts on health can be through direct exposure to hazards or indirect consequences arising from these hazards. These can occur as either acute (e.g., injury from fire or during a storm) or chronic (e.g., long term impacts on wellbeing). The community engagement programme identified a number of specific examples of health risks, including: increased risk of bacterial and pathogen contamination of untreated water supplies due to increasing temperatures, increased disease and mosquito risk during higher temperatures (e.g. Matatā, Minginui and Te Whāiti), wastewater and septic tank overflows (e.g. Edgecumbe, Matatā, Murupara), increased use of agricultural and horticultural sprays (e.g. Poroporo), contaminant leaching from historic wood waste sites (e.g. Whakatāne, Poroporo, Coastlands), bore water contamination from floods (e.g. Rūātoki, Waiohau, Ruatāhuna), increased occurrence of algal blooms in waterways (e.g. Waimana – Nukuhou North), allergen impacts (pollen) from longer growing seasons (e.g. Minginui and Te Whāiti).

2.0 Introduction | Kupu Arataki

Climate change is already impacting Aotearoa-New Zealand and impacts are predicted to increase over time. More frequent and intense weather events—such as storms, floods, droughts, and heatwaves—will likely disrupt both natural systems and the built environment. These changes also carry significant implications for public health, community wellbeing, and the unique relationships Iwi and Māori have with the environment. In the absence of effective climate change adaptation planning, there will be negative impacts on the wellbeing of people and communities, as well as on the Whakatāne District Council (Council) assets, operations and responsibilities.

This Climate Change Risk Assessment (CCRA) was developed to identify and understand the Whakatāne District's exposure to predicted climate-related risks. The assessment aims to build a clear picture of where and how climate change may impact the District, and to lay the groundwork for informed, targeted responses in the years ahead.

2.1 Whakatāne District

The Whakatāne District (the District) stretches from Otamarakau to Ōhope along the coast and inland to Te Urewera and Whirinaki Forest Park, covering 433,000 hectares of urban, rural and coastal areas. It is a growth area of New Zealand and has a population of approximately 37,149 people. The main urban / town centres are Whakatāne, Ōhope and Edgecumbe. Rural settlements include Otakiri, Matatā, Awakeri and Murupara. The District has a long history of Māori settlement with 48% of the population of Māori descent[3]. The District is a mix of coastal, plains and forested areas. Multiple rivers flow through the District including the Tauranga River, Whakatāne River, Rangitāiki River and Tarawera River.

For the purpose of this CCRA, the District has been divided into individual community areas, as shown in Figure 2.1.

[3] https://www.whakatane.govt.nz/sites/www.whakatane.govt.nz/files/documents/2025-07/pre-election-report-2025-web.pdf

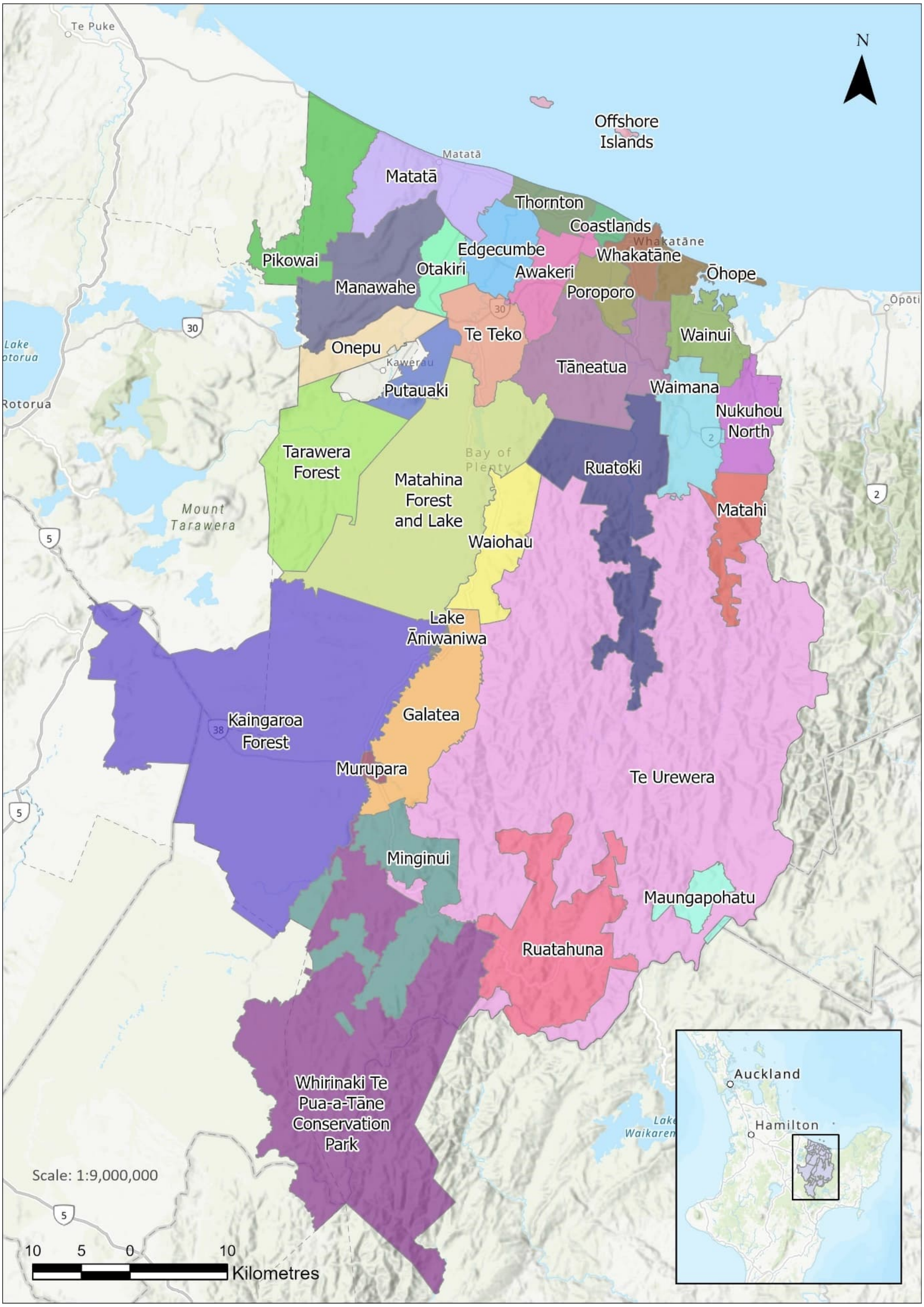

Figure 2.1: Communities in Whakatāne District

2.2 Background and purpose

In 2023, the Bay of Plenty Regional Council (BOPRC) published a detailed CCRA for the region. The purpose of the regional CCRA was to provide a regional overview of current and future climate risks. The associated report included a summary of risks to each District within the region, as well as sector summaries.

To better understand the specific future climate change risks for the District, Council has undertaken this comprehensive District-level CCRA. This risk assessment builds upon the 2023 Bay of Plenty regional CCRA and brings together the Council's and communities' collective understanding of climate risk across all aspects of society, the environment and the economy. This project forms part of the Council's Whakatāne District Climate Change Adaptation programme of work and will help form development of Local Adaptation Plans moving forward.

This objectives of the District CCRA are summarised as follows:

- Describe how the District's climate is changing, and how it may continue to change in the future.
- Provide a specific understanding of climate risks which can assist collective District and regional responses to make Whakatāne communities more resilient to climate change.
- Identify and highlight areas within the District where efforts to manage climate effects need to be focused.
- Identify gaps in the Council's understanding.
- Inform adaptation planning at a range of scales and by a range of parties, and build on existing adaptation planning projects in the District and region.
- Support the development of Local Adaptation Plans for individual communities.
- Help identify targeted action and further projects.

It is noted that this project will also meet Council's reporting requirements under the Climate Change Response (Zero Carbon) Amendment Act 2019. Under this Act, local government is required to report on climate change risks, when requested by the Minister.

2.3 Project scope

As with the Bay of Plenty Regional CCRA, this CCRA process followed best-practice national guidelines and focused on collaboration, transparency, and alignment with the process described in *A Guide to Local Climate Change Risk Assessments (Ministry for the Environment, 2021).*

Importantly, the scope of the project has two main focus areas:

1. Sectoral focus: assessment of risks across 20 sectors across the built, natural, community and primary sector domains.
2. Community focus: identification of specific place-based risks relevant to 27 discrete communities within the District.

2.4 Project structure

As well as the core project team, comprising T+T and Council staff, the team included an expert technical reference group (the Whakatāne District Climate Change Technical Advisory Group) that provided appropriate high-level technical oversight. Risk identification and rating was undertaken using a wide range of subject matter experts, refer Figure 2.2 below.

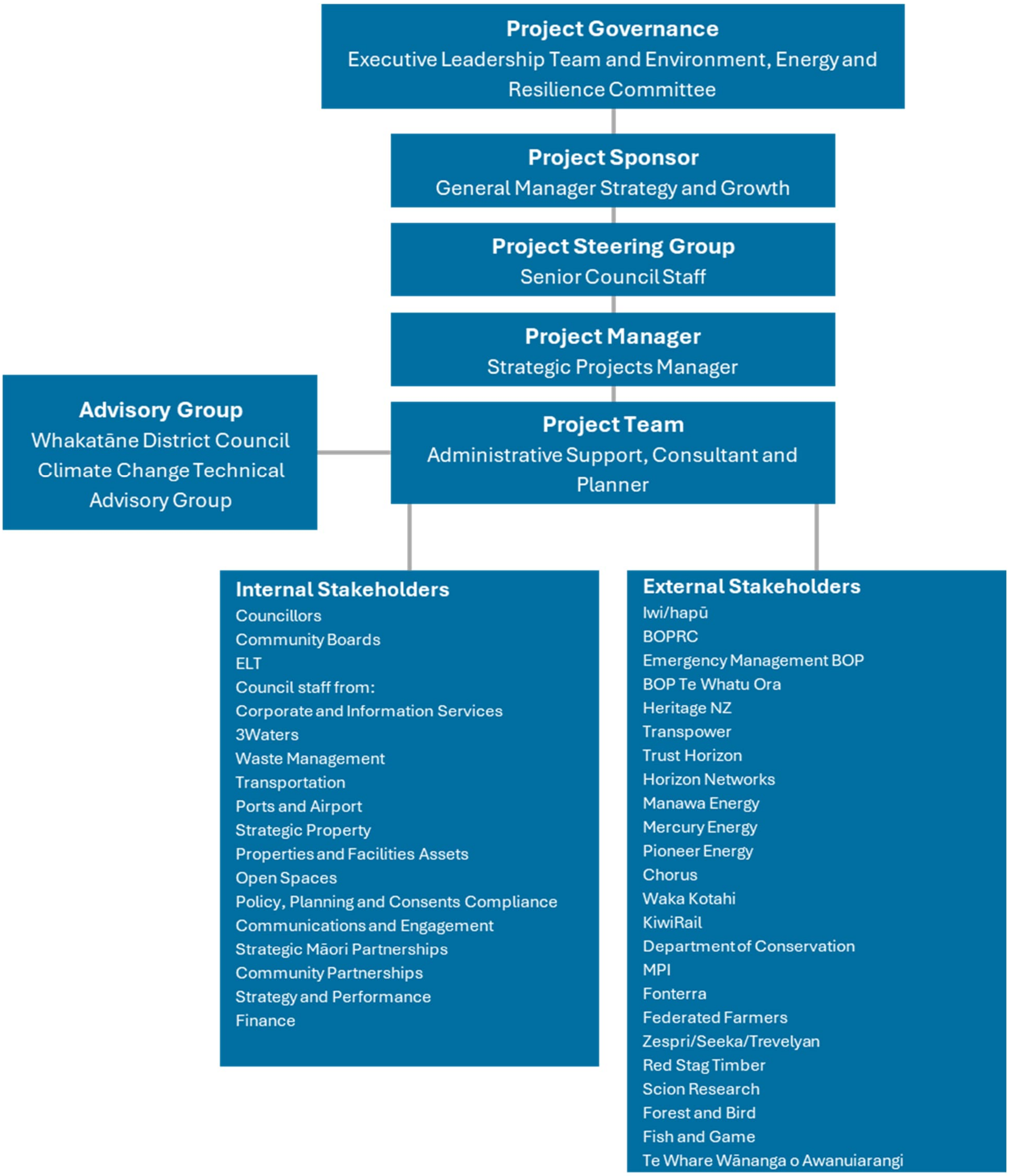

Figure 2.2: Whakatāne CCRA project structure

3.0 Climate context | Te horopaki āhuarangi

3.1 Climate change context

The main driver of climate change relates to emissions of carbon dioxide into the atmosphere, which has been extensively modelled by the Intergovernmental Panel for Climate Change (IPCC). Based on IPCC models and reporting from their fifth assessment report (AR5), four Representative Concentration Pathways (RCPs) were defined, providing greenhouse gas concentration trajectories to the end of the century (Figure 3.1).

The IPCC's sixth assessment report (AR6) introduced the Shared Socio-economic Pathways (SSPs) which are similar to the RCP scenarios; the RCPs effectively set pathways for greenhouse gas concentrations whilst the SSPs outline how global society, demographics and economics might change over the next century, influencing the levels of mitigation that may be achieved. In 2024, four SSPs (SSP1-2.6, SSP2-4.5, SSP3-7.0 and SSP5-8.5) were modelled for Aotearoa New Zealand[4], however, given that BOPRC utilised the AR5 RCPs scenarios and developed down-scaled projections for the region, these same scenarios have been used for this CCRA. The following two scenarios, to describe possible future changes to climate variables and hazards were used:

- The 'Middle of the road scenario' (RCP4.5 or SSP2-4.5) reflects moderate emissions and implementation of current global emissions reduction policy settings. This scenario represents an average rise in global air temperature of 2.7°C by 2100.
- The 'Fossil-fuel intensive scenario' (RCP8.5 or SSP5-8.5) broadly aligns with emissions-reduction practice over the past few decades. It reflects high emissions, limited mitigation measures and no global emissions reduction policy settings. This scenario represents an average rise in global air temperature of 4.4°C by 2100.

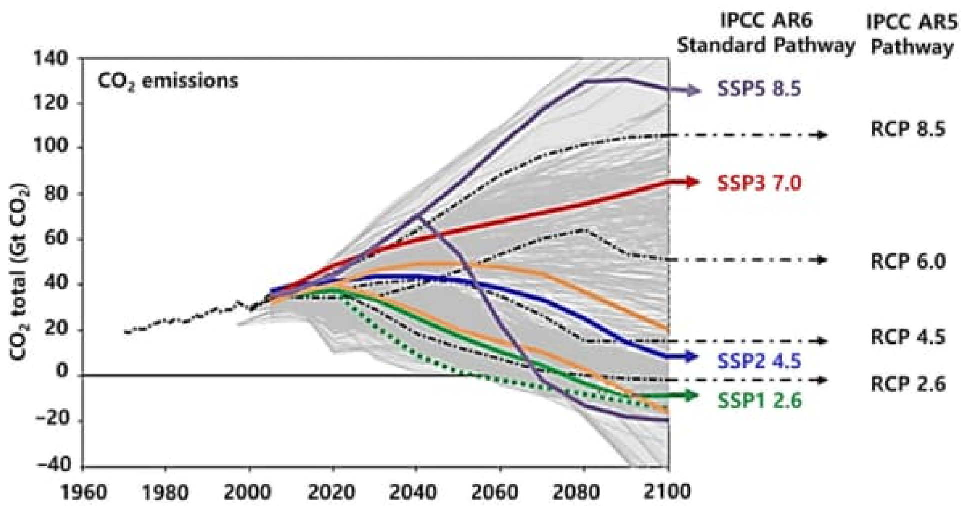

Figure 3.1: Global CO_2 emissions for the 21st century scenarios, sourced from An et al. (2022)[5].

3.1.1.1 Timeframes

Three main timeframes are recommended for assessing risks from climate change. The scenarios focused on short-, medium- and long-term time horizons and for this CCRA, these are defined as:

- Short-term (present-day). The impacts already occurring from climate change are a starting point for considering the urgency of the risks identified.

[4] https://niwa.co.nz/climate-and-weather/updated-national-climate-projections-new-zealand#:~:text=Introduction,Background
[5] Climate change scenarios for New Zealand | NIWA

- Medium-term (~2040). This covers risks out to mid century, and relates to the next few cycles of Council Long-Term Plans. Thirty years is the planning timeframe for local government infrastructure strategies (Local Government Act 2002, section 101B) and asset management plans. It also aligns with the longer terms granted for resource consents (up to 35 years).
- Long-term (~2090). This covers risks to end of century, and may be relevant to many long term decisions (e.g., land-use planning[6]) that Council will make.

3.2 Climate change projections for Whakatāne District

Over the last 30 years, as well as experiencing many small climate events, the Whakatāne District has experienced 21 significant climate events requiring substantive emergency management response (Table 3.1). This is an average of around 1 event every 1.5 years. These events affect communities in deep, often interconnected ways—disrupting health, livelihoods, infrastructure, social cohesion, and long-term resilience.

Table 3.1: Summary of historic events from 1987 to 2017

Year	Location	Climate event
1987	Whakatane, Ōhope and Awakeri	Tornados
1988	District wide	Slips/flooding
1991	Waimana	Flooding
1992	District wide	Flooding
1993	District wide	Severe hailstorm
1996	Ōhope	Coastal inundation and coastal erosion x 2 (Tropical Cyclones Fergus and Drena)
1997	Whakatāne	Flooding
1998	Waimana and Tāneatua	Flooding
1999	Matatā	Flooding
2001	Awakeri	Flooding
2002	Awatapu	Flooding
2003	District wide	Flooding
2004	Ōhope	Coastal erosion, coastal inundation and landslides
2004	Awatapu, Wairaka and Edgecumbe	Flooding
2005	Thornton/Onepū	Tornadoes
2005	Matata, Edgecumbe and Matata	Debris flows, flooding
2009	District wide	Severe hailstorm
2010	Whakatāne and Ōhope	Flooding and landslides
2012	Whakatāne	Flooding
2014	Whakatāne	Flooding
2017	Edgecumbe	Flooding

[6] Bay of Plenty Regional Policy Statement – Policy NH 11B

Climate change projections indicate the frequency and intensity of these events can be expected to increase in the future.

Projected changes in climate for the Bay of Plenty have been developed by NIWA, based on the IPCC AR5 report (2014). Relevant climate projections for the District are summarised in Table 3.2, at 2090, across two climate scenarios.

Table 3.2: Long-term climate projections for RCP 4.5 and RCP 8.5

Climate hazard / variable	RCP 4.5 (2090)	RCP 8.5 (2090)	Sub-district variation
Air temperature	↑ 1-1.5°C	↑ 2.5-3°C	Consistent mean temperature increases within Whakatāne District.
Hot days (>25°)	↑ 20-40 more hot days	↑ 40-90 more hot days	↑ ↑ Most of Whakatāne District is projected to experience large increases in number of hot days, particularly along the Rangitāiki and Tarawera Rivers.
Drought	↑ 80-14 mm of Potential Evaporation Deficit (PED) (coastal) ↑ 60 - 100 mm of PED (inland)	↑ 120-160 mm of PED (coastal & Rangitikei River) ↑ 60 - 120 mm of PED (elevated)	↑ ↑ Coastal Whakatāne District and inland areas surrounding the Rangitāiki River are projected to experience relatively large increases in of PED (which indicates an increased potential for drought).
Frost days	↓ 2-6 days (coastal areas) ↓ ↓ 2-5 days (inland)	↓ 6-8 days (coastal areas) ↓ ↓ 4-30 days (inland)	Inland elevated areas experience the greatest number of frost days at present and are projected to experience the greatest decrease in frost days in future.
Annual rainfall	↑ 0-8% in winter rainfall ↓ 0-10% in spring rainfall	↑ 2-8% in winter rainfall ↓ 4-10% in spring and summertime rainfall	↑ ↑ Winter rainfall increases the most near the coast. ↓ ↓ Summer rainfall decreases the most in inland areas.
Extreme rainfall	↑ 10%	↑ 22%	Present day, 1% AEP, 24hr rainfall depth (HIRDS), is 267mm. This increases to 294mm (RCP 4.5) and 326mm (RCP P8.5)
Sea level rise	↑ 0.55 m	↑ 0.74 m	Vertical land movement (VLM[7]) may influence the effect of sea level rise on coastal areas as follows: Ōtamarākau approx. +2.8 mm/year (uplift); Matatā approx -3 mm/year (subsidence); Whakatāne and Ōhiwa Harbour +/- 1mm/year (neutral)

Note: 1% Annual Exceedance Probability (AEP) event = flooding event that has a 1% chance of occurring in any given year, 2% AEP event = flooding event that has a 2% chance of occurring in any given year.

[7] VLM has the potential to change the effects of sea level rise, with subsidence increasing the depth and bringing forward the timing of sea level rise impacts, and uplift decreasing the effective depth and pushing out the timing of observed sea level changes. VLM rates, sourced from NZSeaRise, have been developed using datasets that are short relative to the duration of this assessment. Precise levelling data for specific sites over extended time periods may provide increased confidence in the rate of vertical land movement over the time periods considered in this assessment.

3.3 Climate change implications for Māori

Climate change is likely to have a significant impact on Māori throughout the District, affecting ancestral lands, water, significant sites, marae, urupā, cultural assets, taonga species, businesses, and in some cases further impacting household income levels.

Nearly 50% of the Whakatāne District population identify as Māori. The Council recognises iwi as Te Tiriti o Waitangi partners and acknowledges the deep whakapapa, mātauranga, and enduring responsibilities that iwi, hapū and whānau hold as tangata whenua and mana whenua. Whakatāne District Council iwi relationships are with Ngāti Awa, Ngāti Mākino, Ngāti Manawa, Ngāti Rangitihi, Ngāi Tūhoe, Tūwharetoa ki Kawerau, Te Whakatōhea and Ngāti Whare. Their perspectives, lived experiences, and aspirations are central to advancing the collective wellbeing and future of our district.

Within the District, several iwi and hapū have already experienced the impacts of climate Change. Going forward, these impacts are expected to increase over time. Given Māori are kaitiaki (guardians) of the taiao (natural world), they will therefore be impacted by risks posed to the natural environment to which they have an innate connection. It was also highlighted that climate change is likely to exacerbate existing inequities/vulnerabilities within communities.

The BOPRC Regional CCRA (2023) summarised a range of risks to Māori which are presented below for reference:

- Māori have a role as Kaitiaki over the natural environment; increased risk to the natural environment places further risk to the capacity of Kaitiaki to be responsive.
- The terrestrial ecosystems are of importance to whānau, hapū, iwi, and businesses, contributing more broadly to the health and wellbeing of the broader ecosystem. This is particularly relevant within and around Māori land holdings.
- The well-being, care, utilisation, and management of freshwater ecosystems is of utmost importance to Māori. Taonga species that are likely to be impacted and that are of importance to Māori include longfin eels, lamprey (piharau, kanakana), īnanga, kōaro, banded kōkopu, the shortfin eel and the freshwater mussel.
- Warming seas and land surface temperatures are directly impacting species such as Snapper, Kōura and Pāua that are important to Māori, and ocean acidification is likely to impact Kina and Mussels. Decline of these species will impact Māori commercial interests and Māori cultural values and customary practices.
- Māori have significant commercial investments in many primary industries. These include in honeybee production from pōhutukawa and mānuka, which are likely to be impacted by climate change. Other commercial interests include kiwifruit, pine forests, and dairy farming.
- Direct links between people and the environment are culturally significant for Māori and climate impacts on the environment may impact Māori wellbeing.
- Potential climate related impacts on Māori enterprise may impact whānau, hapū, and iwi through increased stress and mental health issues for business owners. It may also lead to increasing poverty levels with associated poor health outcomes due to reduced levels of employment opportunity, decreased household income levels, and financial security of iwi businesses and corporations.
- Climate impacts on primary industries and the environment may increase the cost of food and compromise food security. This may drive nutrition deficiency in communities with lower incomes.
- Extreme heat conditions may impact sufferers of chronic diseases, of which Māori are overrepresented. Temperature may also pose increasing health risks to outdoor workers.
- Increasing temperatures may contribute to the establishment of vector-borne and zoonotic diseases. Coastal Māori communities may be particularly vulnerable, as well as the many rural marae that have unreticulated water supplies.

- Reduced ability to undertake customary practises (tikanga) with consequential impacts on spiritual and physical wellbeing.
- Risk to intergenerational knowledge (te reo me ōna tikanga), whakapapa (genealogy), tribal histories and narratives that are linked to the environment.
- Loss of taonga species and the capacity to engage in cultural ways with the environment whether through the gathering of rongoā and/or kai impacts the extent to which people can engage in traditional practices.
- Culturally significant environmental places are at risk including for example wāhi tapu, traditional astronomical sites, traditional wānanga sites and traditional burial sites.

Community engagement meetings with iwi and hapū identified several specific climate risks to Māori of the Whakatāne District. A sample of these risks are:

- Increased risk to wāhi tapu sites, urupā and access from coastal erosion and fluvial inundation.
- Increased risk to urupā and marae from fluvial flooding and erosion.
- Risk to public health and freshwater ecosystems from riverbank erosion of toxic woodwaste site.
- Increased risk to Marae from pluvial flooding.
- Increased risk to water quality, ecology, and mauri of river from fluvial floods containing slash.
- Increasing exposure of kōiwi (skeletal remains) in sand dunes due to coastal erosion.

3.4 Interdependencies / cascading risks

Risks can be direct or indirect and can cascade or create 'knock-on' effects. This is because climate-related hazards do not occur in isolation—and that the impacts of one risk can trigger or amplify others across systems and sectors. Understanding these relationships is essential for building resilience.

Climate change risks can propagate as 'cascades' across physical and human systems, potentially compounding to form many risks across various sectors. Such effects arise because of the links between natural and socio-economic systems as they change, and from feedback loops between them. Cascading risks can have significant implications for community wellbeing, and the management and governance of climate risks (Lawrence et al, 2018). The chain of causality is often described as a 'toppling domino effect', where a sudden shock generates uncontrolled losses down the line of connected systems. Another word for this is 'interdependencies'.

Figure 3.2 illustrates examples of interdependencies that can occur as a result of climate risks. Understanding cascades can help identify potential upstream or downstream impacts, which can provide deeper understanding of impacts and allow for interventions at different levels.

A holistic or systems approach is also consistent with a te ao Māori perspective. This promotes understanding of both dependencies between elements, and cascading impacts.

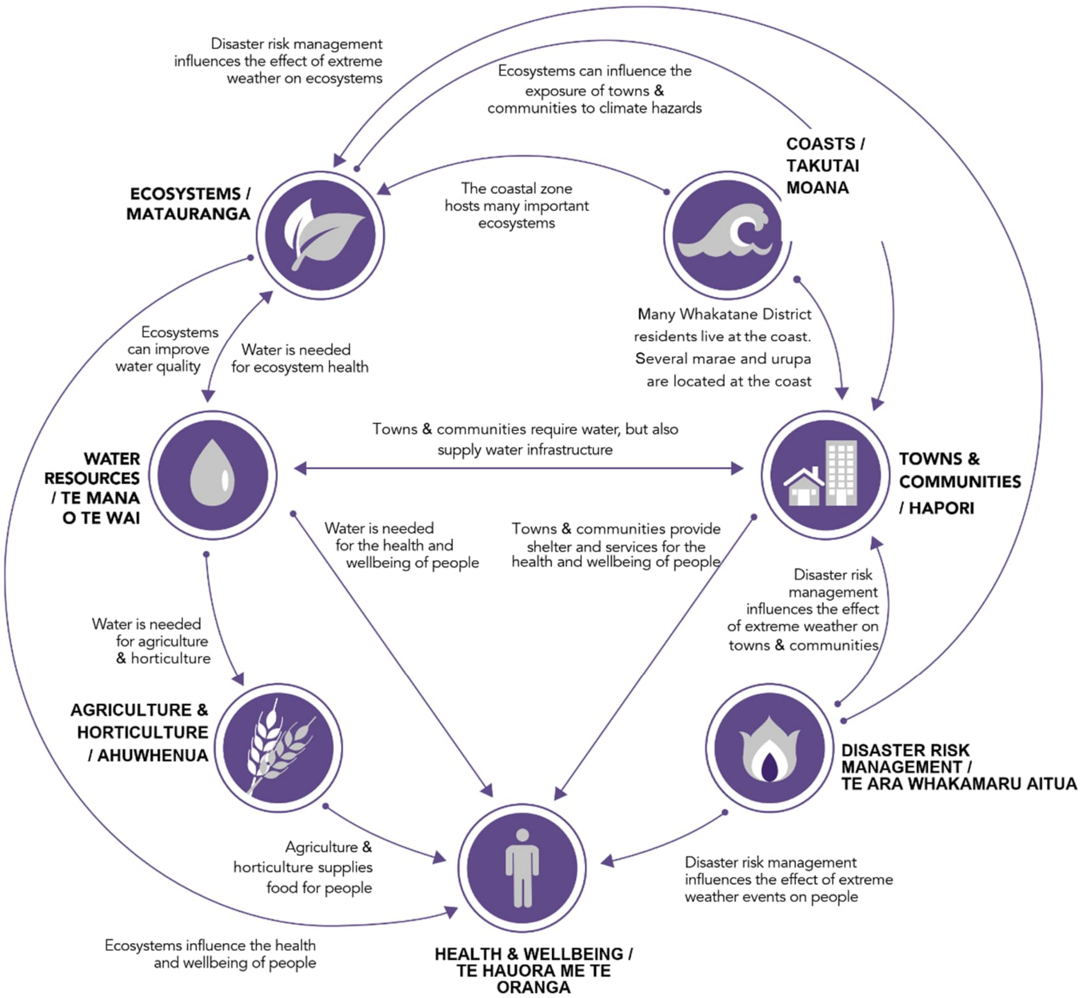

Figure 3.2: Example of interdependencies and cascades that can influence climate risk[8]

[8] Adapted from Australian National Climate Resilience and Adaptation Strategy, 2015

4.0 Method | Te tukanga

The aim of the first phase was to develop a long list of potential climate change risks, drawing on knowledge from across Council and sectors. This was achieved through a desktop study and input from sectoral subject matter experts.

Figure 4.1: Risk assessment method

4.1 Desktop review

For this task, we identified potential risks to elements within agreed sectors, due to a range of specified climate hazards. The BOPRC CCRA (2023) was used as a starting point. Elements at risk are the people or systems that are potentially adversely affected by a climate hazard, e.g. assets, ecosystems, infrastructure, and taonga[9]. The elements were grouped into sectors that, in turn, relate relevant value domains as suggested by the Climate Change Commission for the 2026 NCCRA[10].

These sector categories informed discussions within the workshops and are shown in Table 4.1.

[9] Ministry for the Environment, 2021. A guide to local climate change risk assessments.
[10] https://www.climatecommission.govt.nz/our-work/adaptation/national-climate-change-risk-assessments/2026-national-climate-change-risk-assessment

Table 4.1: Sector level categories

Value domains (NCCRA)	Sectors
Natural environment	Water source and water quality Freshwater ecosystems Terrestrial ecosystems Coastal and marine ecosystems Biosecurity
People, health and communities	Health
Ngā mea hirahira o te ao Māori	Te ao Māori
Sectors relying on the natural environment	Energy* Fisheries Agriculture Horticulture Tourism
Built environment	Energy* 3 Waters Flood management Telecoms Property and open spaces Roads and Rail Airport and Ports Waste management
Economy and financial system	Not covered as part of the assessment
Governance	Additional Council functions

*Energy sector sits within two domains – 'Built environment' and 'Sectors relying on the natural environment' because it depends on physical infrastructure and on natural resources for energy generation.

The climate hazards used were as follows:

- Rainfall and flooding, including increased extreme rainfall and flooding, extreme weather (wind and storms), landslides, and change in variability and seasonality of rainfall.
- Increasing temperature and drought, including higher temperature (including increased hot days), increased fire weather, new pests and diseases and drought.
- Coastal hazards, including coastal erosion, groundwater risk and salinity stress, sea level rise and coastal inundation / flooding, marine heatwaves, and ocean chemistry changes.

Further information on climate hazard projections is provided above in Section 3.1.

4.2 Geospatial exposure assessment

An exposure assessment was undertaken to understand the quantity and spatial distribution of the following risk elements for which spatial datasets were available. Risk elements and the source of data are identified in Table 4.2.

Table 4.2: Element dataset sources for geospatial assessment

Geospatial map element	Data source (year sourced)
Buildings	Provided by Whakatāne District Council (2024)
Marae Land Parcels	
Landuse Categories	
One Network Framework (ONF) Roads	
Waste	
Retaining Walls (RAMM)	
Culverts	
Three Waters points, lines, polygons	Whakatāne District Council Open Data Hub. Extracted 15/01/2025.
Parks and Reserves	Provided by Whakatāne District Council (2025)

Risk elements were assessed for exposure to the following climate-related hazards. Other hazards were not included in the geospatial assessment due to no data being available. Table 4.3 summarises the hazards, data sources and scenarios used.

The assessment was undertaken using spatial software (GIS), where risk elements were overlaid on top of the hazard datasets to quantify their exposure.

This information was then used to inform the hazard exposure ratings within the risk assessment framework, where relevant.

Table 4.3: Hazard dataset sources for geospatial assessment

Hazard	Geospatial dataset source details	Scenarios
River and Surface Flooding*	Rangitāiki pluvial flood model. Note: does not include a freeboard component.	1 in 100 year ARI, RCP 8.5, 2130.
	Whakatāne pluvial flood model.	1 in 100 year ARI rainfall, plus 20yr ARI river flow, ~2130, RCP 6.0.
	Waimana flood data[11] Whakatāne Waimana Floodplain Management Strategy, BOPRC Operations Publication 2008/09.	~1 in 50 year ARI with no climate factors
Coastal Erosion	Hazard data produced by Tonkin + Taylor Ltd, prepared for the Bay of Plenty Regional Council, 2024.	Current P66%; 2080 0.4m SLR P66% VLM; 2080 0.6m SLR P66% VLM; 2130 0.8m SLR P66% VLM; 2130 1.25m P66% VLM.
Landslide	Matata, Whakatāne and Ōhope Landslide Hazard data produced by Tonkin + Taylor, 2013.	
Fire	Legacy records of the Whakatāne Rural Fire Authority	Fire risk levels categorised low - extreme

All dataset information supplied by Council.
*Quantitative flood modelling data was available for the following communities; Awakeri, Thornton, Edgecumbe, Otakiri, Poroporo, Te Teko, Waimana, Whakatāne, Coastlands and Matatā. Flood modelling data was unavailable for the other communities.

[11] Hydraulic Modelling of Waimana River and Floodplain 2005

4.3 Risk identification

The first phase of the CCRA involved a risk identification or risk long-listing exercise, which provided an overview of the potential climate change risks to the Council and the District. Figure 4.2 illustrates the risk assessment and adaptation cycle and shows that this first Phase sits within 'Step 1' of the cycle.

Figure 4.2: The risk assessment and adaptation cycle. Risk identification is undertaken as part of Step 1[12]

The project involved identifying physical risks due to climate change hazards within the Whakatāne District, focusing on the *negative* impacts associated with climate hazards. It is noted that the project did not focus on identifying *opportunities*, nor *transition* risks (associated with the shift to a lower carbon future).

Physical risks are those resulting from climate change hazards, and these can arise from *acute* hazards, such as increasingly extreme weather (e.g., cyclones, droughts, floods) or longer-term (*chronic*) shifts in precipitation, temperature, sea-level rise, and more variable weather patterns[13].

As discussed in Section 3.4, physical risks can also be direct or indirect. Direct risks are those where there is a direct link between a hazard and an element at risk that is exposed and vulnerable. For example, storms and flooding damaging buildings and infrastructure, droughts leading to crop failure, or extreme temperatures causing heat stress.

Indirect risks are further removed from a hazard – for example, impacts on mental health, disruptions to supply chains, migration, social wellbeing, and cohesion. They generally result from direct risks elsewhere, which can be local or distant, and emphasise the interconnected nature of climate risks within systems.

A full day in-person workshop was held on 14 June 2024 and was attended by approximately 80 subject matter experts from across external sectors, Iwi and Council. Attendees were split into groups and worked on identifying risks at a sectoral and community level.

The results of the desktop study and workshop were used to develop the risk identification workbook (long list) containing climate change risks relevant to the Whakatāne District. The workbook was issued to stakeholders to review and validate.

[12] Ministry for the Environment (2021). A guide to local climate change risk assessments.
[13] Ministry for the Environment, 2020. National Climate Change Risk Assessment.

4.4 Detailed risk rating

4.4.1 Overview

Following the identification of risks, these were rated via a series of workshops with subject matter experts. Risk ratings were completed in a consultative manner, with the Council Project team and T+T experts facilitating the workshop and guiding the risk rating process, and subject matter experts deciding on the appropriate risk rating for each of the risk elements. These workshops solely focused on the rating of direct risks.

4.4.2 Risk rating method

The approach to rating risk followed the methodology outlined in the MfE Guide to Local Climate Change Risk Assessments. This uses a qualitative rating of exposure, sensitivity and adaptive capacity (Figure 4.3).

Exposure refers to the presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected by a climate hazard.

Sensitivity refers to the degree to which an element at risk is affected, either adversely or beneficially, by climate variability or change. Sensitivity relates to how the element will fare when exposed to a hazard, which is a function of its properties or characteristics.

Adaptive capacity refers to the ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences. It relates to how easily/efficiently an element at-risk can adapt (autonomously) or be adapted (planned) when exposed to a climate hazard. Again, this is a function of an at-risk element's properties or characteristics.

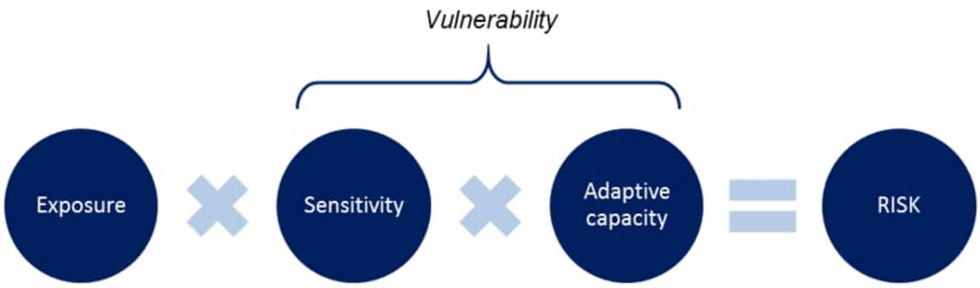

Figure 4.3: Risk equation based on exposure, sensitivity and adaptive capacity

To assign a rating for exposure, sensitivity and adaptative capacity, a set of criteria were used, refer to Appendix A for the criteria and matrices used.

In each of the workshops, these criteria were interpreted qualitatively or quantitatively (where data was available), with the subject matter experts determining the level of exposure, sensitivity and adaptative capacity for each element based on their expert judgement and observations. The exposure rating was completed for three timeframes (present-day, 2050, and 2100), whereas the rating for sensitivity and adaptive capacity did not include a defined temporal component.

4.5 Limitations and exclusions

This CCRA provides sectoral and community-focussed overviews of climate risks. It does not:

- Explore localised or site-specific risk in detail.
- Consider compound risks (e.g. wildfire followed by floods).
- Include emissions reduction or carbon mitigation strategies.
- Include non-climate-related natural hazards.
- Involve adaptation planning or transition planning.

Limitations include:

- Uncertainties in climate models including tipping points (e.g. abrupt ice sheet collapse).
- Limitations of data.
- Value judgements and subjectivity of subject matter experts in rating risks.
- Unfinished engagement with Iwi and hapū which will result in a future addendum to the report.
- Uncertainties around future societal developments (e.g. technology, public policy, disaster risk reduction investment).

5.0 Risk summary | He whakarāpopototanga tūraru

This section presents a brief summary of a selection of the highest rated climate risks, categorised by domain.

Section 6 presents highly-rated sectoral level risks that were identified, and Section 7 presents a summary of the community level risks that were identified.

5.1 Natural Environment

- Coastal ecosystems may be at risk from sea level rise causing habitat loss, "coastal squeeze," and displacement of species like seabirds and saltmarsh plants.
- Marine ecosystems may suffer from rising temperatures, marine heatwaves, and ocean chemistry changes — leading to species stress, die-offs, algal blooms, and food web disruption. Flood-related runoff introduces sediment, nutrients, microplastics, and contaminants into marine and estuarine environments, degrading habitat quality.
- Terrestrial biosecurity may be at risk from higher temperatures and changing humidity increase which may result in the spread and establishment of exotic pests, weeds, and diseases (e.g. myrtle rust, wild ginger, fire ants). Also, erosion and wildfire events expose land that is prone to colonisation by invasive species like pampas and wattle, further degrading ecosystems.
- Marine biosecurity may suffer due to increasing temperature and marine heatwaves as this could result in species migration and invasive marine species that may outcompete natives.
- Freshwater biosecurity may be at risk as warming expands the range and impact of invasive pests in lakes and rivers.

The community engagement programme identified a range of risks relating to the natural environment. These included; water quality and ecological risks for Lake Matahina, Lake Āniwaniwa, Whirinaki and Horomanga rivers (Galatea) and Rangitaiki River – as a result of increased temperatures, extreme rainfall and drought. Additionally, degradation of wetland ecosystems due to sea level rise and higher temperatures was identified (e.g. Coastlands and Wainui). Lastly, the deterioration of the estuarine ecosystem (due to sedimentation) within Ōhiwa Harbour was identified, which has knock-on impacts for estuarine species and kaimoana.

5.2 Sectors Relying on the Natural Environment

- Estuarine aquaculture and fisheries may suffer from warming waters, reduced oxygen, and biotoxins (e.g. affecting mussels and oysters), which can reduce economic and biological viability.
- Aquaculture and fisheries may be at risk from sedimentation caused by coastal erosion, farming, and forestry runoff.

The community engagement programme identified a range of risks relating to fisheries and aquaculture. Particular issues were identified within Ōhiwa Harbour where sedimentation is impacting on aquaculture activities. More generally, warming seas and land surface temperatures are directly impacting species such as Snapper, Kōura and Pāua that are important to coastal communities and Māori.

5.3 Built Environment

- Water quality for potable supplies may be at risk from contaminant runoff and erosion from extreme rainfall and flooding.
- Flood defences / stopbanks may underperform due to prolonged dry followed by wet conditions, weakening their structural integrity.

- Wastewater infrastructure may be vulnerable to overflow and service failure from inflow during flood events.
- Stormwater systems near coastlines may suffer from groundwater rise and salinity, reducing capacity and increasing maintenance.
- Electricity distribution assets (especially ground-mounted ones) are at risk of damage from flooding.
- Rail infrastructure may be disrupted by debris, landslides, or fallen trees caused by extreme weather events.
- Ports may experience operational delays (and interference with goods handling and storage) from increasing sea level rise and coastal flooding.
- Parks and reserves infrastructure (park roads, bridges, and carparks) may be damaged from increasing landslides (and cause access restrictions).
- Communities and buildings may face structural damage and access issues due to increasing landslides, with flow-on effects for insurance and emergency response.

The community engagement programme identified a range of risks relating to flooding of roads, water supply, wastewater and other critical infrastructure, landslides, wastewater overflows (e.g. Edgecumbe, Murupara and Tāneatua treatment ponds), septic tank issues (e.g. Matatā), drought impacting on water availability (e.g. Manawahe) and contamination from closed landfills (e.g. Te Teko).

5.4 Ngā mea hirahira o te ao Māori

As discussed in Section 3.3, many of these highlighted risks will have unique and significant implications for Māori in the District. Climate risks have potential to impact ancestral lands, water, significant sites, marae, urupā, cultural assets, taonga species, businesses, etc. In turn, these impacts can have a wide range of secondary effects, including on customary practises (tikanga) as well as on spiritual and physical wellbeing. The community engagement programme identified a number of specific locations where important sites (such as Urupa and Marae) were at risk from flooding. These included Te Teko / Te Mahoe, Rūātoki, Waiohau, Wainui, Murupara and Coastlands.

5.5 People, health and communities

As discussed in Section 6.6, climate change presents a wide range of potential health risks due to higher temperatures, drought, flooding, fire and coastal hazards. Climate change impacts on health can be through direct exposure to hazards or indirect consequences arising from these hazards. These can occur as either acute (e.g., injury from fire or during a storm) or chronic (e.g., long term impacts on wellbeing). The community engagement programme identified a number of specific examples of health risks, including: increased risk of bacterial and pathogen contamination of untreated water supplies due to increasing temperatures, increased disease and mosquito risk during higher temperatures (e.g. Matatā, Minginui and Te Whāiti), wastewater and septic tank overflows (e.g. Edgecumbe, Matatā, Murupara), increased use of agricultural and horticultural sprays (e.g. Poroporo), contaminant leaching from historic wood waste sites (e.g. Whakatāne, Poroporo), bore water contamination from floods (e.g. Rūātoki, Waiohau, Ruatāhuna), increased occurrence of algal blooms in waterways (e.g. Waimana – Nukuhou North), allergen impacts (pollen) from longer growing seasons (e.g. Minginui and Te Whāiti).

6.0 Sectoral level risks | Ngā tūraru rāngai

This section provides summaries of highly-rated risks across each of the 20 sectors (as listed in Table 4.1). Highly rates risks include those rated either high or very high. The assessment was based on a combination of spatial data (where available) and subject matter expert opinion / anecdotal knowledge.

6.1 Three Waters infrastructure

Three Waters infrastructure includes stormwater, wastewater and water supply. Together, these services manage rainfall runoff (stormwater) in urban areas, manage and treat wastewater, and provide reticulated access to potable water. The District has:

- Stormwater networks in most townships, with a total pipeline length of ~140 km. The majority is located in: Whakatāne (52%), Ōhope (15%), Edgecumbe (11%) and Coastlands (7%).
- Wastewater schemes in seven townships with a total pipeline length of ~250 km. The majority is located in: Whakatāne (50%), Ōhope (20%), Coastlands (13%) and Edgecumbe (9%).
- Water supply networks in most townships, with a total pipeline length of ~620 km. The majority is located in: Whakatāne (23%), Edgecumbe (13%), Te Teko (10%) and Ōhope (8%).[14]

As discussed in Section 4.4, risks were rated by subject matter experts based on an assessment of exposure, sensitivity and adaptive capacity.

Table 6.1 below shows the six highest rated risks (i.e. rated 'high' or 'very high').

Table 6.1: Summary of highest climate risk ratings for Three Waters infrastructure

	Now	RCP4.5 2050	RCP8.5 2050	RCP4.5 2100	RCP8.5 2100
Risk ID 3W8: Risk to stormwater infrastructure due to groundwater rise and/or salinity stress in low lying areas	high	high	high	high	very high
Risk ID 3W5: Risk to wastewater infrastructure due to increased extreme rainfall and flooding	high	high	high	high	very high
Risk ID 3W4: Risk to stormwater infrastructure (catchpits) due to extreme weather	moderate	moderate	moderate	moderate	high
Risk ID 3W6: Risk to water supply infrastructure due to increased extreme rainfall and flooding	moderate	moderate	moderate	moderate	high
Risk ID 3W7: Risk to wastewater infrastructure due to groundwater rise and salinity stress in low lying areas	moderate	moderate	moderate	moderate	high
Risk ID 3W10: Risk to wastewater infrastructure due to sea level rise and coastal flooding	low	moderate	moderate	moderate	high

Legend: ● very low risk, ● low risk, ● moderate risk, ● high risk, ● very high risk

The following sections describe each of the above risks in further detail.

6.1.1 Groundwater rise and / or salinity stress risk to stormwater and wastewater infrastructure (Risk ID 3W8 and Risk ID 3W7)

Increased infiltration by groundwater may reduce the capacity of stormwater infrastructure, increasing flood risk

[14] https://www.whakatane.govt.nz/services/water-services

further in areas that are already highly exposed to flooding. In addition, increased infiltration may increase wear and running costs of pumped stormwater components. Pumps for flood events may be insufficient with higher groundwater levels and higher drain water levels.

Groundwater rise and salinity stress may result in reduced levels of service in wastewater infrastructure and increase the potential for overflows of wastewater. Higher groundwater can also reduce the effectiveness of land-based treatment / dispersal. This will become important should the Council be required to alter its current wastewater disposal options to fresh and salt water environments. High water tables may cause salinity damage or lead to flotation of buried structures. Most areas within the District have water and wastewater pipes made of asbestos cement which can become weakened by the elevated groundwater.

No spatial information is available indicating groundwater levels for the District, therefore the assessment of these risks was based on subject matter expert opinion and anecdotal knowledge.

For the stormwater network, it was considered that at present, risk to groundwater rise and / or salinity stress is 'high' as a large proportion of the network is considered currently exposed (e.g. in Whakatāne, a large number of stormwater pipes are considered exposed given their proximity to the coast, and in known areas of high groundwater). Risk to groundwater rise and salinity stress is expected to increase to 'very high' by 2100, in response to sea level rise.

For wastewater infrastructure, present day risk was also considered 'high' based on knowledge of the networks located in Edgecumbe, Whakatāne, and Tāneatua. Again, this risk is expected to increase to 'very high' by 2100 due to wetter conditions, and additionally for Edgecumbe and Whakatāne, sea level rise.

6.1.2 Increased extreme rainfall and flooding risk to wastewater and water supply infrastructure (Risk ID 3W5 and Risk ID 3W6)

Increased flooding and extreme rainfall can cause increased inflow and infiltration to wastewater networks, causing higher flows to treatment plants and increased likelihood of overflows. This, in turn, can create public health, environmental and regulatory compliance risks, and reduce the overall level of service. Flooding can also cause overloading or damage to pumping stations.

Water supply infrastructure can be damaged or contaminated by increased flooding and extreme rainfall e.g. due to inundation, erosion and sedimentation, causing turbidity and disruption to essential services.

Based on an assessment of exposure using available 1% AEP flood datasets for the District, a significant proportion of wastewater pipes and assets (oxidation ponds and pump stations) are potentially exposed. The implications of this will vary based on nature and duration of inundation, however in general, extreme rainfall and flooding have potential to cause significant impacts on levels of service, public health and on the receiving environment (via untreated discharges).

The subject matter experts consider the current risk is 'high', as extreme rainfall and flooding frequently occurs in Edgecumbe and in other low lying areas e.g. Whakatane, Murupara, Ōhope, Tāneatua. Exposure to this hazard is expected to increase over time due to increased frequency and increased intensity of extreme rainfall.

In terms of risk to water supply intakes, the subject matter experts rated current risk as 'moderate' because the Whakatāne water supply source and treatment plant already experience issues relating to flooding from the Whakatāne River. The Ruatoki intake bore is also highly exposed to flooding and flood-induced erosion (although it has a much smaller supply area). Also, Tahuna road / Te Teko and Tāneatua water supplies have been affected by flooding in the past.

6.1.3 Extreme weather risk to stormwater infrastructure (Risk ID 3W4)

Extreme weather (including high rainfall) can cause blockages, washouts, or erosion around structures (e.g. catchpits) which can cause damage to stormwater networks throughout the District. Windfall and debris can block culverts and catchpits, leading to an increased potential for flooding. Increasing rainfall intensity will mean the capacity of existing networks is reached more frequently, driving increased overland flow, further increasing the potential for flooding.

Risk is currently considered ‘moderate’ due to recent events e.g. the Council has experienced debris in Wainui Te Whara Stream and in small streams in Ōhope which has impacted infrastructure and resulted in damage to pipes. With the expected increase in exposure to extreme weather, the resulting risk to the stormwater infrastructure is expected to be ‘high’ under RCP8.5 at end of century.

6.1.4 Sea level rise and coastal inundation risk to wastewater infrastructure (Risk ID 3W10)

Sea level rise and coastal flooding may pose a significant risk to wastewater infrastructure that is located near the coast due to salinity corrosion and / or increased inflow and infiltration. Gravity wastewater systems will be the most sensitive to coastal inundation due to their reliance on natural land gradients to transport wastewater through underground pipes to treatment facilities or discharge points. Wastewater systems will also become under pressure from groundwater rise (influenced by sea level rise).

6.2 Freshwater ecosystems

Freshwater ecosystems relate to the streams, rivers, and lakes of the District, and include riparian habitats and wetlands. The Whakatāne catchment covers more than 1,100 km^2 and extends 112 km to its upper tributaries. It boasts diverse freshwater ecosystems, including the Whakatāne River and its tributaries. The Waimana catchment covers 440 km^2 extending 77 km from the confluence with the Whakatāne River. The Rangitāiki catchment covers an area of around 3,005 km^2 making it the largest freshwater catchment in the Bay of Plenty. The river is 155 km in length and includes lakes Āniwanawa and Matahina which include hydro dams[15]. The Tarawera River catchment is 984 km^2 in area and 65 km in length and flows from Lake Tarawera to Matatā. These freshwater systems are vital for the region's ecology, water supply, traditional food sources, and of high cultural significance. The Whakatāne River is a major source of water for the town, and the river scheme provides flood defences for communities[16].

Table 6.2 shows the five highest rated risks (i.e. rated 'high' or 'very high') to freshwater ecosystems.

Table 6.2: Summary of highest climate risk ratings for freshwater ecosystems

	Now	RCP4.5	RCP8.5	RCP4.5	RCP8.5
		2050	2050	2100	2100
Risk ID FW3: Risk to wetland ecosystems and species due to dryness and drought	low	moderate	moderate	high	very high
Risk ID FW9: Risk to freshwater ecosystems and species due to sea level rise and increased saline intrusion	moderate	moderate	moderate	high	high
Risk ID FW8: Risk to freshwater ecosystems and species due to dryness and drought	moderate	moderate	moderate	moderate	high
Risk ID FW6: Risk to freshwater ecosystems and species due to increased fire weather	low	moderate	moderate	moderate	high
Risk ID FW7: Risk to freshwater ecosystems and species due to increased fire weather	low	moderate	moderate	moderate	high

Legend: very low risk, low risk, moderate risk, high risk, very high risk

The following sections describe each of the above risks in further detail.

6.2.1 Dryness and drought risk to wetland ecosystems (Risk ID FW3)

Wetland ecosystems may become increasingly vulnerable due to greater variability and seasonality in rainfall, especially with the occurrence of extended dry periods. Reduced baseflows during these times can hinder the natural recovery of streams and wetlands, leading to degradation over time. The loss or decline of wetlands would result in the destruction of habitats for many wetland-dependent species and could drive large-scale changes in plant communities, ultimately reducing biodiversity and altering the ecological balance of these environments.

Presently, risk to wetland ecosystems due to dryness and drought was considered 'low' based on local knowledge of the wetland (noting that sensitivity of a wetland to climate change is strongly affected by the type and size of the wetland) but is expected to increase over time resulting in a 'very high' risk by 2100.

6.2.2 Dryness and drought risk to freshwater ecosystems (Risk ID FW8)

For freshwater ecosystems, dryness and drought may cause periods of low flow or drying of streams and reduced water availability in the wider hydrological cycle (e.g. lower groundwater). Low flows may cause increased nutrient concentration, stress ecosystems and compound the effects of warmer temperatures, which

[15] https://www.boprc.govt.nz/environment/flood-defences/rangitaiki-tarawera-rivers-scheme/
[16] https://www.boprc.govt.nz/environment/flood-defences/whakatane-tauranga-rivers-scheme/

can be damaging to the health of native fish or cause increased species mortality. Changes to flows can impact habitats, and species behaviours (breeding/migration), e.g. margin nesting birds and Galaxiids.

The risk to freshwater ecosystems currently was considered ‘moderate’ but was projected to increase to ‘high’ as climate change drives more frequent and prolonged periods of dryness and drought.

6.2.3 Sea level rise and increased saline intrusion risk to freshwater ecosystems (Risk ID FW9)

The upper limit of the salt wedge (the layer of saltwater that intrudes into an estuary, typically beneath a layer of freshwater) has major implications for; freshwater ecology (e.g., whitebait spawning), the distribution of riparian plants, and the types of benthic invertebrates that can live in the area. Any movement of the salt wedge to upstream areas will result in a potential loss of current whitebait spawning areas, loss of freshwater riparian vegetation (and its possible replacement with saline adapted species), and potential increases in bank erosion as species such as crabs colonise muddy banks that have become exposed to saline water.

Present day risk is considered ‘moderate’ but with the expected increase in sea level rise, it rises to ‘high’ by late century.

6.2.4 Increased fire weather risk to freshwater ecosystems (Risk ID FW6 and Risk ID FW7)

Wildfires can directly damage or destroy freshwater ecosystems, damaging habitats and causing species mortality in smaller waterways and around lake margins. This is mainly due to ash entering the ecosystem. Small streams / rivers in close contact with the surrounding riparian area will be more sensitive to fire than large rivers, where the effects of riparian plants on shade and bank stability decrease.

Subject matter experts considered that, at the moment, Lake Āniwaniwa would be ‘moderately’ sensitive and Lake Matahina would be ‘highly’ sensitive to a fire due to the pine plantations that grow very close to their margins. Both small and large freshwater ecosystems are considered to be at ‘low’ risk now, but increasing to ‘high’ risk by 2100 (RCP 8.5) due to the expected increase in fire weather risk.

6.3 Terrestrial ecosystems

Terrestrial ecosystems are comprised of communities of land-based organisms that are constantly responding to changing processes in the physical environment. For the purposes of this risk assessment, terrestrial ecosystems in the District have been broadly grouped into terrestrial ecosystems (general), native fauna at the coast, native fauna within forests and native flora.

Table 6.3 shows the four highest rated risks (i.e. rated 'high' or 'very high') to terrestrial ecosystems.

Table 6.3: Summary of highest climate risk ratings for terrestrial ecosystems

	Now	RCP4.5 2050	RCP8.5 2050	RCP4.5 2100	RCP8.5 2100
Risk ID TE9: Risk to terrestrial ecosystems and species due to increased fire weather	moderate	moderate	high	high	very high
Risk ID TE1*:* Risk to native fauna at the coast (and wetlands) due to higher temperature	low	moderate	moderate	high	high
Risk ID TE4: Risk to terrestrial ecosystems at the coast due to dryness and drought	moderate	moderate	moderate	high	high
Risk ID TE6: Risk to terrestrial ecosystems and species due to extreme weather	low	moderate	moderate	moderate	high

Legend: ● very low risk, ● low risk, ● moderate risk, ● high risk, ● very high risk

The following sections describe each of the above risks in further detail.

6.3.1 Increased fire weather risk to terrestrial ecosystems and species (Risk ID TE9)

Increased occurrence of wildfire can destroy forests and habitats; reduce forest growth and increase disease; cause loss of native species; and disrupt natural food chains. This can lead to a loss of biodiversity or loss of rare species. Regenerating growth on fire damaged land is often dominated by exotic and invasive species such as privet, wattle and gorse.

Indigenous forest covers a substantial portion of the District (approximately 224,500 hectares or 51%), while exotic forest accounts for a smaller share at 29% (approximately 128,130 hectares)[17]. Late century risk was rated 'very high' given that incidences of fire weather is predicted to increase, and that terrestrial indigenous ecosystems are considered highly sensitive to fire.

6.3.2 Higher temperature risk to native fauna at the coast (and wetlands) (Risk ID TE1)

Higher temperatures may result in heat stress or disruption to critical life stages for native animals. For example, temperatures can impact the breeding incubations for reptiles (tuatara) which can impact the reproductive ability of the species, and can compound other environmental stressors (e.g. pests). Increasing temperatures also favour exotic species, threatening native populations that are highly sensitive to competition such as geckos and skinks.

The risk at the present time was rated as 'low' and was predicted to increase to 'high' by the end of century.

6.3.3 Dryness and drought risk to terrestrial ecosystems at the coast (Risk ID TE4)

Increased dryness and drought may stress coastal native ecosystems and forests due to drying, leading to increased fire risk, increased spreading of diseases e.g. kauri dieback, and increased 'edge effect' (where the

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[17] https://rep.infometrics.co.nz/whakatane-district/environment/landcover

edges of forest die back because of exposure to drying / high winds). Drought-intolerant native species may die off, potentially replaced by invasive, drought-tolerant ones. Changing conditions also may expose prey to more predation, while warmer temperatures could boost pest populations and allow them to spread into new areas. Changing climate may cause key coastal species such as Kohekohe and Pohutukawa to move inland.

It was considered (by subject matter experts) that terrestrial ecosystems are currently exposed to extended dry periods and drought resulting in a present day 'moderate' risk rating, increasing to 'high' by late century.

Current risk was rated as 'moderate' (given current exposure to extended dry periods and drought) and this is predicted to increase to 'high' by end of century.

6.3.4 Extreme weather risk to terrestrial ecosystems and species (Risk ID TE6)

Native trees and forests are considered vulnerable to increased damage from stronger storms and high winds, causing tree fall, loss of branches and foliage. High winds can also strip trees of immature fruit and spread airborne disease (e.g. myrtle rust) which risks the loss of Pohutukawa forest as well as other coastal fringe trees.

Present day risk was rated 'low' but due to projected increased exposure to more extreme ex-tropical cyclones, the risk to terrestrial ecosystems was expected to be 'high' by 2100.

6.4 Coastal and marine ecosystems

Coastal and marine ecosystems include the District's harbours (Whakatāne and Ōhiwa), many estuaries, and numerous islands (Moutohorā /(Whale Island, Whakaari / White Island, and Rurima Islands)[18]. Habitats in and around the harbours and estuaries include freshwater wetlands, saltmarsh, mangroves, seagrass, sand and mud flats, rocky reefs and tidal channels. Sand dunes line the coast, broken by river and harbour mouths, volcanic landforms and rocky headlands.

Table 6.4 shows the six highest rated risks (i.e. rated 'high' or 'very high') to coastal and marine ecosystems.

Table 6.4: Summary of highest climate risk ratings for coastal and marine ecosystems

	Now	RCP4.5 2050	RCP8.5 2050	RCP4.5 2100	RCP8.5 2100
Risk ID C&M5: Risk to marine ecosystems due to runoff from increasing rainfall events and flooding	● very high	● very high	● very high	● very high	● very high
Risk ID C&M4: Risk to marine ecosystems and species due to increasing temperature, marine heatwaves and ocean chemistry changes	● high	● very high	● very high	● very high	● very high
Risk ID C&M1: Risk to shoreline ecosystems and species due to sea level rise, increased coastal flooding and salinity stress	● high	● high	● high	● very high	● very high
Risk ID C&M3: Risk to inshore shallow marine ecosystems and species due to sea level rise	● moderate	● high	● high	● very high	● very high
Risk ID C&M2: Risk to shoreline ecosystems and species due to coastal erosion	● moderate	● moderate	● moderate	● high	● high
Risk ID C&M6: Risk to marine ecosystems and species due to extreme weather (winds and storms)	● moderate	● moderate	● moderate	● moderate	● high

Legend: ● very low risk, ● low risk, ● moderate risk, ● high risk, ● very high risk

The following sections describe each of the above risks in further detail.

6.4.1 Increased extreme rainfall and flooding risk to marine ecosystems (Risk ID C&M5)

Stormwater runoff entering the marine environment can be laden with sediment, nutrients, pesticides, chemicals, organics, pharmaceuticals etc. Micro-plastics, and organic contaminants bound to particles can influence animal uptake. Estuarine and harbour habitats may deteriorate due to reduced salinity during flooding or due to habitat destruction related to erosion and sediment deposition.

At present, the risk was considered to be 'very high' as large rainfall events are already having localised impacts on marine habitats (such as sediment causing large deposition events into estuaries and rocky reef systems, and corresponding losses in biodiversity due to smothering). Climate projections expect rainfall events and flooding will increase significantly in intensity and frequency and hence, the risk was rated as remaining 'very high' for all time horizons.

6.4.2 Marine heatwaves and ocean chemistry changes risk to marine ecosystems and species (Risk ID C&M4)

Marine fish, shellfish, and plant species may experience die-off, heat stress, increased algal blooms, increased migration, increased exotic species, reduced resilience and food web disruption due to increasing temperatures,

[18] https://www.whakatane.com/see-and-do

changing ocean currents, marine heatwaves and ocean chemistry changes. This is important as many of these species have special significance as kai moana.

Monitoring of marine ecosystems and species has already shown sponge losses from heat waves, seagrass bleaching and die-offs, increased prevalence of algal blooms, and impacts to shellfish. On account of this, the present day risk was rated ‘high’. Given that climate projections show temperature to rise, the risk was rated ‘very high’ for all other time horizons.

6.4.3 Sea level rise, coastal flooding and salinity stress risk to shoreline ecosystems and species (Risk ID C&M1)

Sea level rise and coastal flooding may damage coastal species and environments, as ecosystems on the coastal edge are inundated and may have limited space to shift landward. Many species have a limited range of mobility on the coast (e.g. spiders, katipo, geckos and skinks). Seabirds and plant species such as mangroves and saltmarsh are likely to be impacted by this 'coastal squeeze'. Sea level rise may displace these habitats or remove them entirely. Saline intrusion can have profound ecological consequences for wetlands located near the coast, estuaries, or tidal rivers because these ecosystems are highly sensitive to changes in salinity.

Currently, the risk was rated ‘high’ as mapping has identified coastal squeeze for the Nukuhou Saltmarsh at Ōhiwa Harbour[19]. Sea level rise and coastal flooding is due to increase in the future, therefore the risk was rated ‘very high’ by late century.

6.4.4 Sea level rise and coastal flooding risk to inshore shallow marine ecosystems (Risk ID C&M3)

Sea level rise and coastal flooding may damage inshore shallow marine ecosystems and species, for example increasing water depth over submerged habitats, e.g. shellfish or seagrass. Impacts on estuary currents due to changing water levels can impact locations of shellfish beds.

Subject matter experts highlighted that the loss of some subtidal seagrass beds is already evident, due to poor light penetration through water (e.g. as a result of increased sedimentation) which limits their ability to survive and thrive. Therefore, current day risk was rated ‘moderate’. Projected sea level rise will increase depths to outside working species ranges, resulting in further losses and as such, the risk was rated ‘very high’ by late century.

6.4.5 Coastal erosion risk to shoreline ecosystems and species (Risk ID C&M2)

Coastal erosion could lead to a removal of the frontal dune in many locations, particularly if there is limited space for the dune to shift landwards. This would have negative impacts on water quality in the marine environment (from sedimentation), dune ecosystems and coastal settlements.

Present day risk was rated ‘moderate’ as latest beach profiles show erosion from Whakatāne to Ōhiwa, and a mix of erosion and accretion to Otaramakau. The risk of coastal erosion is expected to rise with more frequent and intense storm events and sea level rise, resulting in an increased risk rating (‘high’) by 2100.

6.4.6 Extreme weather (wind and storms) risk to marine ecosystems and species (Risk ID C&M6)

Extreme weather, storms and wind can have significant impacts on intertidal habitats. These forces can cause direct physical damage through erosion, wave action, and hail impact, all of which can alter the structure and stability of these sensitive coastal environments (which occurred to the mangroves in Ōhiwa Harbour). Additionally, strong wave energy and turbulent conditions during storms can dislodge shellfish, such as mussels and clams, from their deeper water habitats and deposit them onto beaches.

Present day risk was rated ‘moderate’ due to the expected increase in extreme weather, by 2100, the risk was rated ‘high’ (RCP 8.5).

[19] https://www.ohiwaharbour.co.nz/post/facing-sea-level-rise-%C5%8Dhiwa-saltmarshes-in-the-spotlight

6.5 Biosecurity

Biosecurity focuses on protecting the District's environment, agriculture, and economy from the harmful effects of pests and diseases. The Bay of Plenty region, including the Whakatāne District, has established a regional biosecurity partnership, the Tauranga Moana Biosecurity Capital, to foster collaboration among different stakeholders.

Table 6.5 shows the five highest rated risks (i.e. rated 'high' or 'very high') to biosecurity.

Table 6.5: Summary of highest climate risk ratings for biosecurity

	Now	RCP4.5 2050	RCP8.5 2050	RCP4.5 2100	RCP8.5 2100
Risk ID B3: Risk to marine biosecurity due to increasing temperature and marine heatwaves	high	very high	very high	very high	very high
Risk ID B1: Risk to terrestrial biosecurity, pests and weeds due to higher temperature, rainfall variability, dryness, and drought	high	high	high	very high	very high
Risk ID B2: Risk to terrestrial biosecurity due to erosion, landslides and wildfire	high	high	high	very high	very high
Risk ID B5: Risk to freshwater biosecurity due to increasing temperature	high	high	high	very high	very high
Risk ID B4: Risk to freshwater biosecurity due to increasing flooding	moderate	moderate	moderate	high	very high

Legend: very low risk, low risk, moderate risk, high risk, very high risk

The following sections describe each of the above risks in further detail.

6.5.1 Higher temperature (including increased hot days) risk to marine biosecurity (Risk ID B3)

Warming marine temperatures are likely to drive increased migration and increased exotic species. Species that have arrived on their own accord are generally undertaking an extension of their range. This may create issues for species that are already found in these locations as they may be out-competed. For 'hitchhiker' pest species there is an ability to reduce their spread; however, there is no control over the natural dispersal of exotic species.

Subject matter experts observed that temperate pest species are already causing issues (e.g. presence of Asian Paddle Crab and Japanese Mantis Shrimp within Ōhiwa Harbour), as such, present day risk was rated 'high' and is expected to increase over time, resulting in a 'very high' risk rating by mid-century.

6.5.2 Higher temperature (including increased hot days) risk to terrestrial biosecurity, pests and weeds (Risk ID B1)

Increased temperatures and changing humidity will create new biosecurity challenges by encouraging migration and allowing establishment of new exotic pests, weeds and diseases currently prevented by NZ's climate (e.g. myrtle rust and other tree diseases). Enhancement of pest species could compromise the resilience of endemic species. Pest species such as privet, wild ginger and wasps have already established and are currently thriving - a warming climate may well increase the already significant impacts of these pests. Additionally, higher temperature could reduce the ability of native forests to naturally regenerate, particularly in areas already under environmental stress. This decline in forest resilience may create opportunities for mammalian pests, such as deer, to inflict irreversible damage by browsing on regenerating seedlings and altering forest structure.

Risk was considered 'high' for the present day (as native species are easily out competed by pest species) increasing to 'very high' by 2100.

6.5.3 Erosion, landslides and wildfire risk to terrestrial biosecurity (Risk ID B2)

Coastal and inland erosion, landslides, and wildfires can lead to the exposure of bare land. These disturbed areas are often quickly colonised by exotic and invasive species such as privet, pampas, wattle, and gorse, which are difficult to control and eradicate. The presence of these pest species can further degrade the environment by increasing susceptibility to both erosion and future wildfires, creating a cycle of disturbance and ecological decline.

Presently, risk was considered 'high' and with the expected increase in erosion, landslides and wildfire, the risk will increase to 'very high' by 2100.

6.5.4 Higher temperature (including increased hot days) risk to freshwater biosecurity (Risk ID B5)

Warming lake, river and stream temperatures are likely to create favourable conditions for a wider range of aquatic pest species, enabling them to expand their geographic range and colonise areas previously unsuitable due to cooler water temperatures. As freshwater bodies warm, some pest species may also begin to occupy greater depths, where cooler conditions once limited their survival and spread.

The current risk was rated as 'high' due to the presence of 'hitchhiker' species and accidental introductions, which have facilitated the entry and establishment of pest species in these environments. It is expected to increase to 'very high' by late century (with the expected increase in higher temperature).

6.5.5 Increased extreme rainfall and flooding risk to biosecurity (Risk ID B4)

Increased flooding can significantly contribute to the spread of freshwater and terrestrial pest and weed species by transporting their seeds, larvae, or adult forms to new locations, including areas that are typically isolated under normal conditions. During flood events, flowing water acts as a natural dispersal mechanism, carrying invasive species from upstream or infested areas into previously uncolonised environments such as ponds, wetlands or floodplain lakes.

The most significant known impact of this risk is to primary production land. Currently, the risk was considered 'moderate,' but it is projected to increase to 'very high' by 2100, due to the anticipated rise in the frequency and intensity of flood events, which will further amplify the threat.

6.6 Health

Climate change poses risks to health across the District. Those who reside at the coastal fringe will be the most likely to be exposed to sea level rise and storm surges, and those in low-lying or flood prone areas will be most likely exposed to harm from flooding. Most of the Whakatāne District is projected to experience large increases in the number of hot days, particularly along the Rangitāiki and Tarawera Rivers. These areas may also be exposed to increased fire risk and drought.

Climate change impacts on physical health can be through direct exposure to hazards or indirect consequences arising from climate related impacts across the District. These can occur as either acute (e.g., injury from fire or during a storm) or chronic (e.g., long term impacts on wellbeing).

Table 6.6 shows the six highest rated risks (i.e. rated ‘high’ or ‘very high’) to health.

Table 6.6: Summary of highest rated risks to Health

	Now	RCP4.5	RCP8.5	RCP4.5	RCP8.5
		2050	2050	2100	2100
Risk ID HE4: Risk to community health due to increased extreme rainfall and flooding	moderate	moderate	moderate	high	very high
Risk ID HE1: Risk to community health due to higher temperatures	low	moderate	moderate	high	very high
Risk ID HE3: Risk to community health due to dryness and drought	moderate	moderate	moderate	high	high
Risk ID HE2: Risk to community health due to increased fire weather	moderate	moderate	moderate	moderate	high
Risk ID HE5: Risk to community health due to groundwater rise and salinity stress	moderate	moderate	moderate	moderate	high
Risk ID HE6: Risk to community health due to sea level rise and coastal erosion	low	moderate	moderate	moderate	high

Legend: very low risk, low risk, moderate risk, high risk, very high risk

The following sections describe each of the above risks in further detail.

6.6.1 Increased extreme rainfall and flooding risk to community health (Risk ID HE4)

Increased extreme rainfall can lead to flooding events which can increase the frequency of drowning, injury and waterborne diseases. It can also harm community health through increased water contamination, cause property and livelihood losses, lead to homelessness, reduced access to care (including emergency services), increased stress and psychosocial stress.

Due to past events (e.g. in April 2017, approximately 1,600 people were evacuated from Edgecumbe and surrounding areas when the Rangitāiki River’s stopbank breached), the present day risk was considered ‘moderate’ and with the expected increase in extreme rainfall and flooding, the risk was considered to be ‘very high’ by the end of century (under RCP 8.5).

6.6.2 Higher temperature (including increased hot days) risk to community health (Risk ID HE1)

Higher temperatures can impact health, particularly in kaumātua, ageing and other vulnerable groups. Higher temperatures can increase the frequency of heat related illness such as dehydration, heat stroke, sunburn and respiratory conditions. In addition, higher temperatures can result in water activity related injuries and increased instances of violence. Higher temperatures may also result in increased duration of pollen production (due to a longer growing season), with consequential impacts on allergy sufferers.

The present day risk was considered 'low,' but it is projected to rise to 'very high' by 2100 due to the anticipated increase in higher temperatures.

6.6.3 Dryness and drought risk to community health (Risk ID HE3)

Drought conditions can cause water shortages, leading to serious community impacts such as dehydration, limited access to safe hygiene, increased risk of infectious diseases, and nutritional deficiencies due to reduced food availability. Commercial water users may also face disruptions, which can in turn affect people's health and well-being (e.g. increased costs).

The present day risk was considered 'moderate' with it increasing by 2100 to 'very high' (in line with the expected increase in dryness and drought).

6.6.4 Increased fire weather risk to community health (Risk ID HE2)

There is a direct risk to life from increased fire weather, including the potential for injury or death, as well as respiratory issues caused by smoke and ash exposure. More frequent and intense fire weather events can lead to the loss of homes, placing people at risk of homelessness and negatively affecting mental health and overall wellbeing through increased stress and trauma.

Subject matter experts observed that present day risk was 'moderate' but that exposure to this hazard is likely to increase due to the expansion of plantation forestry and maize cropping near residential areas. As a result, by late century, under RCP 8.5, the risk was rated 'high'.

6.6.5 Groundwater rise and salinity stress in low lying areas risk to community health (Risk ID HE5)

Groundwater rise (that can occur as a result of sea level rise) can lead to dampness around houses which can lead to negative health impacts such as, Rheumatic fever, School sores and Asthma. Rising groundwater levels may also increase mosquito populations, leading to a higher risk of vector-borne diseases.

Communities such as Edgecumbe, Whakatāne, Rangitāiki Plains and other low-lying areas are currently highly exposed to high groundwater, as such present day risk was rated 'moderate'. Exposure to this risk is expected to increase over time and the risk by 2100 (RCP 8.5) was rated 'high'.

6.6.6 Sea level rise and coastal flooding risk to community health (Risk ID HE6)

Sea level rise and coastal flooding can result in contaminated water, resulting in an increase in the risk of injuries, bacterial and viral infections, and waterborne diseases. These impacts may also result in the loss of property, displacement, loss of livelihoods, destruction of food sources (mahinga kai risk) and heightened psychosocial stressors. Property damage due to sea level rise and associated flooding is likely to prompt affected landowners to seek compensation for loss or re-settlement elsewhere, a process which can contribute to increased stress and adverse mental health implications.

At the moment, the risk was considered 'low' but due to the expected increase in sea level rise and coastal flooding, the risk was expected to increase to 'high' by 2100 (RCP 8.5).

6.7 Fisheries

Fisheries play an important role in the Whakatāne District, contributing to the local economy, food security, cultural identity, and recreational lifestyle. Whakatāne's coastal and riverine environments support a diverse range of marine and freshwater species, including snapper, kahawai, whitebait, and eels. In 2024, the agriculture, forestry and fishing sectors combined, contributed 14.3% to the Whakatāne GDP[20]. Ōhiwa Harbour is home to Tio Ōhiwa Oyster Farm (2.2 hectares) which hosts Ōhiwa Harbour cruises and an annual oyster festival.

Table 6.7 shows the six highest rated risks (i.e. rated 'high' or 'very high') to fisheries.

Table 6.7: Summary of highest climate risk ratings for Fisheries

	Now	RCP4.5 2050	RCP8.5 2050	RCP4.5 2100	RCP8.5 2100
Risk ID F3: Risk to aquaculture and fisheries due to sedimentation (rainfall and storm events, causing landslides and erosion, coastal erosion)	high	very high	very high	very high	very high
Risk ID F2*:* Risk to estuarine aquaculture and fisheries due to marine heatwaves and ocean chemistry changes and higher air temperatures.	high	high	high	very high	very high
Risk ID F1: Risk to open ocean aquaculture and fisheries due to marine heatwaves and ocean chemistry changes	moderate	high	high	very high	very high
Risk ID F6: Risk to freshwater sports fisheries (brown and rainbow trout) due to increasing temperature and drought.	moderate	moderate	moderate	high	very high
Risk ID F7: Risk to both egg and adult trout survival due to increased sediment and floods.	moderate	moderate	moderate	moderate	high
Risk ID F4: Risk to aquaculture and fisheries due to sea level rise, coastal flooding and extreme wind and storms.	low	moderate	moderate	moderate	high

Legend: ● very low risk, ● low risk, ● moderate risk, ● high risk, ● very high risk

The following sections describe each of the above risks in further detail.

6.7.1 Sedimentation (due to rainfall and storm events, causing landslides and erosion, coastal erosion) risk to aquaculture and fisheries (Risk ID F3)

Sedimentation of harbours and nearshore environments often results from increased rainfall and storm events that trigger landslides and accelerate coastal erosion. These processes cause large amounts of soil and sediment to be washed into waterways and eventually deposited in coastal zones. Runoff carrying sediment from farming and forestry activities further adds to this sediment load, often containing nutrients, pesticides, and organic matter that can degrade water quality. The accumulation of sediment can smother sensitive marine habitats such as seagrass beds, coral reefs, and shellfish beds, reducing their ability to provide shelter, food, and breeding grounds for marine life.

Subject matter experts considered that, sedimentation is the biggest issue for Ōhiwa Harbour – primarily generated through farming and forestry activities. Exposure to sedimentation is also dependent on the contributing catchment. Some catchments in the District are 'cleaner' than other. Both Ōhiwa Harbour and the Whakatāne Harbour receive large volumes of sediment due to landslides in the headwaters of the catchment

[20] https://rep.infometrics.co.nz/whakatane-district/economy/industry-diversity

during storm events. As such, the present day risk was rated 'high' but was expected to increase to 'very high' from mid-century.

6.7.2 Marine heatwaves and ocean chemistry changes, and higher air temperatures risk to estuarine aquaculture and fisheries (Risk ID F2)

Marine heatwaves and changes in ocean chemistry may raise water temperatures beyond the optimal range for aquaculture and fisheries, leading to lower dissolved oxygen levels and shifts in oceanographic patterns. This can lead to reduced economic and biological viability of estuarine aquaculture. It may also lead to the collapse of food webs and estuarine productivity, with consequences for aquaculture and fisheries. Rising water temperatures can trigger the production of biotoxins, which may affect mussels, oysters, and invertebrates such as crabs.

It was determined that biotoxin levels (influenced by temperature) are currently a concern. As a result, the present-day risk was rated as 'high' and is expected to escalate over time, reaching a 'very high' risk rating by 2100.

6.7.3 Marine heatwaves and ocean chemistry changes risk to open ocean aquaculture and fisheries (Risk ID F1)

Marine heatwaves and ocean chemistry changes may raise water temperatures beyond the optimal range for aquaculture and fisheries, leading to lower dissolved oxygen levels and shifts in oceanographic patterns. This can lead to reduced economic and biological viability of coastal aquaculture. It may also lead to the collapse of food webs, and collapse of coastal productivity, with consequences for aquaculture and fisheries. Rising water temperatures can trigger the production of biotoxins, which may affect mussels, oysters, and invertebrates such as crayfish.

Compared to estuarine aquaculture and fisheries, the risk to ocean aquaculture and fisheries was rated as 'moderate' but is also projected to increase over time, becoming a 'very high' risk in 2100.

6.7.4 Increasing temperature and drought risk to freshwater sports fisheries (brown and rainbow trout) (Risk ID F6)

Drought can lead to low or completely dry stream flows, particularly in smaller streams, resulting in higher water temperatures and lower oxygen levels, potentially impacting trout survivability. High temperatures and periods of stable flow can also contribute to algal blooms in unshaded, gravel bed rivers, which would alter habitat for trout, and their food. Cyanobacterial blooms may also occur in lakes, rivers and streams, with potential toxic effects to trout health.

An increase in temperature of up to 3°C is expected to significantly impact trout, particularly in small headwater streams, many of which serve as important spawning habitats. As such, the present day risk was rated 'moderate' and due to the expected degree of warming and likelihood of droughts, the risk in 2100 (under RCP 8.5) was expected to increase to 'very high'.

6.7.5 Increased flooding and sedimentation risk to both egg and adult trout survival (Risk ID F7)

Flooding can impact trout by physically injuring or displacing them and by damaging their habitat (especially during spawning) and food sources. Smaller trout are likely more vulnerable than larger ones, as the latter tend to be stronger swimmers. Any increases in flood frequency may lead to increased sedimentation and erosion of stream beds which could affect spawning success, as well as overall food availability and reduced predation efficiency.

Due to the history of flooding events in the District, the present day risk was rated 'moderate'. As flooding events are expected to increase over time, the risk was rated 'very high' under RCP 8.5 by 2100.

6.7.6 Sea level rise, coastal flooding and extreme wind and storms risk to aquaculture and fisheries (Risk ID F4)

Sea level rise, coastal flooding and extreme wind and storms may damage aquaculture and fisheries related facilities or infrastructure, disrupting operations and hindering the normal functioning of related businesses in coastal areas. (e.g. impact on Māori aquaculture ventures, in-water and shore infrastructure).

Damage has been recorded in the past five years, therefore the present day risk was rated 'moderate' with it increasing to 'high' under RCP 8.5 by late century (in line with increasing sea level rise, coastal flooding and extreme wind).

6.8 Agriculture

Combined with forestry and fishing, agriculture (mostly dairy and beef) is the largest industry in the Whakatāne District and contributing 14.3% to its GDP in 2024. The dairy industry alone is worth some $300 million[21] to the District economy and in 2024, the number of cows in the District increased by 1.3% over the year, compared with an increase of 0.6% in New Zealand[22,23]. Agricultural land in the District covers an area of approximately 77,000 hectares, refer Figure 6.1.

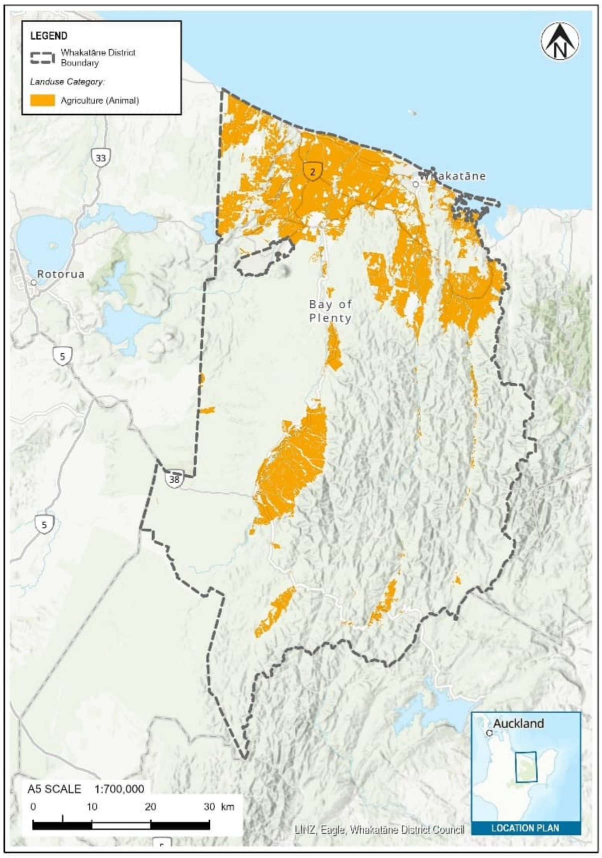

Figure 6.1: Location of agricultural (animal) land in the District

Table 6.8 shows the five highest rated risks (i.e. rated 'high' or 'very high') to agriculture.

Table 6.8: Summary of highest climate risk ratings for Agriculture

	Now	RCP4.5 2050	RCP8.5 2050	RCP4.5 2100	RCP8.5 2100
Risk ID A4: Risk to agriculture / livestock due to dryness and drought	🟢	🟡	🟡	🟠	🔴
Risk ID A8*:* Risk to agriculture / livestock due to increased fire weather	🟢	🟡	🟡	🟠	🔴
Risk ID A1*:* Risk to agriculture / livestock due to increased extreme rainfall and flooding	🟡	🟡	🟡	🟡	🟠

21 www.dairynz.co.nz/media/0oibxesz/solid-foundations-4-september-2023.pdf
22 https://www.whakatane.com/live-and-work/work-here/agribusiness
23 https://rep.infometrics.co.nz/whakatane-district/economy/industry-diversity?compare=new-zealand

	Now	RCP4.5 2050	RCP8.5 2050	RCP4.5 2100	RCP8.5 2100
Risk ID A9: Risk to agriculture / livestock due to increased pests and diseases	moderate	moderate	moderate	moderate	high
Risk ID A5: Risk to agriculture / livestock due to higher temperature (including increased hot days)	low	moderate	moderate	moderate	high

Legend: very low risk, low risk, moderate risk, high risk, very high risk

The following sections describe each of the above risks in further detail.

6.8.1 Drought and dryness risk to agriculture / livestock (Risk ID A4)

Increasing drought conditions will put pressure on water availability for agricultural businesses affecting multiple aspects of farm operations. Reduced rainfall and lower river and groundwater levels can limit the availability of water for stock drinking needs, irrigation of crops and pasture, and the production of feed for animals. This can lead to lower productivity, increased costs, and greater competition for already scarce water resources. In response to these pressures, regulatory authorities may impose stricter controls on water abstraction, including restrictions during dry periods, allocation limits, and prioritisation of certain water uses. Such measures could further constrain farm operations and increase the need for adaptation measures such as on-farm water storage, efficiency improvements, or shifts in land use.

Subject matter experts considered that across the District, the present day risk is potentially 'low' (but noting in the Rangitāiki and Tarawera catchments where irrigation is necessary due to soil type, there is a moderate exposure). With the expected increase in drought conditions, the risk under an RCP 8.5 scenario was rated 'very high'.

6.8.2 Increased fire weather risk to agriculture / livestock (Risk ID A8)

Fire can cause extensive damage to farms and agricultural infrastructure, including fences, sheds, equipment, livestock, and crops. The risk is heightened by the increasing integration of forestry with livestock systems, where the proximity of flammable vegetation such as plantation forests or shelterbelts can significantly increase exposure to fire-prone conditions to pasture.

The present day risk was considered 'low', but it is projected to increase to 'very high' by 2100 (RCP 8.5) due to the expected increase in fire weather.

6.8.3 Increased extreme rainfall and flooding risk to agriculture / livestock (Risk ID A1)

Increased flooding frequency may cause damage to pasture condition, leading to reduced productivity and yield. Extreme rainfall can increase erosion and cause slips, causing sediment deposition on pastures - this buries / kills grass and has low fertility.

Flooding may also cause nutrients to be washed from the land (nutrient leaching) and can also lead to stock being washed away, which can result in increased costs to farmers.

Present day risk was rated 'moderate' (reflecting the District's history of flood events) and is projected to escalate to 'high' by 2100 (under RCP 8.5) as flood frequency increases.

6.8.4 Increased pests and diseases risk to agriculture / livestock (Risk ID A9)

Increased incidence of pests and diseases (as a result of increased temperatures) poses a significant threat to both crop production and livestock health by undermining productivity, raising costs, and compromising food security. Livestock exposed to emerging or re-emerging diseases (e.g., parasites, tics, filaria and facial eczema) suffer from reduced growth rates, lower milk or egg production, reproductive failures, and increased mortality.

More aggressive pests and pathogens, whether it is insects, fungi, bacteria, or viruses, can devastate crops, forcing repeated chemical controls that raise costs, harm beneficial species, generate risk resistance, increase health and safety risks. Even small outbreaks can sharply cut yields and revenues.

Present day risk was rated 'moderate' as invasive weed species are already impacting farming operations such as low quality summer pasture species (bristle grass) and plants like Californian Thistle and Privet. Exposure and risk is projected to increase over time, resulting in a risk rating of 'high' by 2100 (under RCP 8.5).

6.8.5 Higher temperature (including increased hot days) risk to agriculture / livestock (Risk ID A5)

Livestock farming is sensitive to high temperatures, which can cause animal welfare issues relating to heat stress and loss of production. Higher temperatures may require increased planting of trees on farms, or erection of shelters such as herd homes. It may also make the movement of stock difficult. Increased temperatures can also lead to increased use / need for irrigation which can deplete water sources.

Currently, risk was considered 'low' but as temperatures are expected to increase over time, the risk is expected to be 'high' by late century, under RCP 8.5.

6.9 Horticulture

Fertile soils in the District support a variety of horticulture activities, including kiwifruit, citrus and avocado orchards and berry fruit, spanning an area of approximately 6,200 hectares (refer Figure 6.2). These activities open many employment opportunities with significant seasonal and casual work, such as picking and packing fruit.

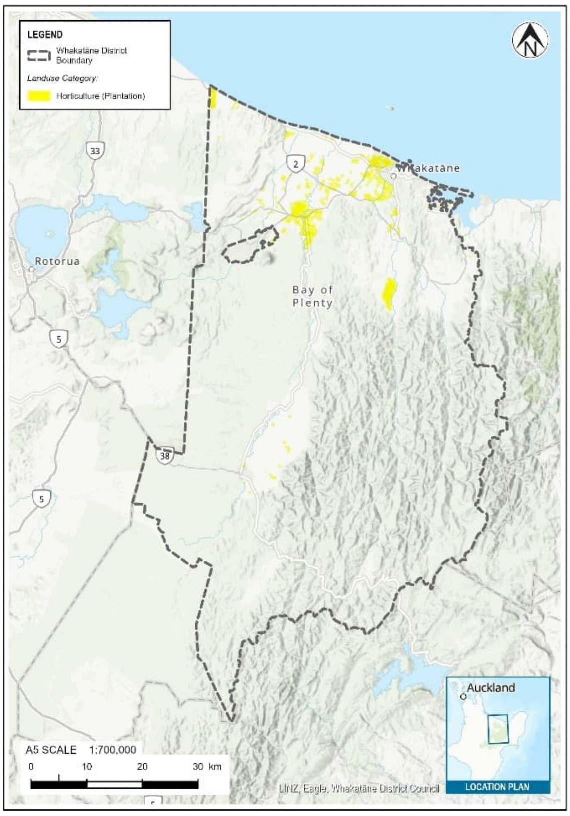

Figure 6.2: Location of horticulture land in the District

Table 6.9 shows the eight highest rated risks (i.e. rated 'high' or 'very high') to horticulture.

Table 6.9: Summary of highest climate risk ratings to Horticulture

	Now	RCP4.5 2050	RCP8.5 2050	RCP4.5 2100	RCP8.5 2100
Risk ID H3: Risk to horticulture due to pests and disease (fruit fly)	Yellow	Orange	Orange	Red	Red
Risk ID H5*:* Risk to horticulture / productivity of the land due to dryness and drought	Yellow	Yellow	Yellow	Orange	Red
Risk ID H1*:* Risk to kiwifruit growing due to decreased winter chill	Yellow	Orange	Orange	Orange	Orange
Risk ID H10: Risk to horticulture / productivity of the land due to increased extreme rainfall and flooding	Yellow	Yellow	Yellow	Orange	Orange
Risk ID H11: Risk to horticulture / productivity of the land due to groundwater rise and salinity stress in low lying areas	Green	Yellow	Yellow	Orange	Orange
Risk ID H2: Risk to horticulture due to pests and disease (thrips)	Yellow	Yellow	Yellow	Yellow	Orange

	Now	RCP4.5 2050	RCP8.5 2050	RCP4.5 2100	RCP8.5 2100
Risk ID H6: Risk to horticulture / productivity of the land due to extreme weather (wind and storms)	🟡	🟡	🟡	🟡	🟠
Risk ID H9: Risk to horticulture / productivity of the land due to increased extreme rainfall and flooding	🟡	🟡	🟡	🟡	🟠

Legend: 🔵 very low risk, 🟢 low risk, 🟡 moderate risk, 🟠 high risk, 🔴 very high risk

The following sections describe each of the above risks in further detail.

6.9.1 Pests and disease (fruit fly) risk to horticulture (Risk ID H3)

Increased temperature can cause the prevalence of pests and disease, and may contribute to the introduction of new, exotic pests or diseases. The presence of fruit flies, for example, can severely impact operations and shut down an entire District or region.

Although the risk was currently considered ‘low’, it is expected to increase over time, and given that horticultural operations are highly sensitivity to exotic pests and diseases (especially fruit flies), the risk was deemed ‘very high’ by end of century.

6.9.2 Dryness and drought risk to horticulture / productivity of the land (Risk ID H5)

Drought conditions can cause soil to dry out, lead to damage or death of trees and vines (particularly shallow-rooted crops) and cause loss of biodiversity in soils. Lack of water availability may also result in loss of production and / or reduced fruit size.

At the present time, risk was considered ‘moderate’, and as the majority of avocado orchards in the District are not irrigated (so therefore are highly sensitivity to the hazard), the risk was rated ‘very high’ by late century (RCP 8.5).

6.9.3 Decreased winter chill risk to kiwifruit (Risk ID H1)

A reduction in low temperatures (not necessarily frosts) may impact the natural triggers for kiwifruit budding, potentially reducing yields or driving continued reliance on artificial budding treatment. Over time, there is a risk that the use of this technology may be restricted, or not accepted by export markets. Additionally, if kiwifruit production shifts to cooler regions in response, there may be flow-on impacts to the avocado industry, which relies on the same infrastructure and packhouses. A reduction in winter chill can also lead to increased pest pressure, as milder conditions allow more pests to survive and reproduce year-round.

Risk was currently considered ‘moderate‘, as decreased winter chill is already impacting kiwifruit orchards across the District, and it is expected that this will increase. As a result, risk was expected to increase to ‘high’ by mid-century.

6.9.4 Increased extreme rainfall and flooding risk to horticulture / productivity of the land (Risk ID H10)

Extreme rainfall and flooding can lead to significant nutrient runoff and contaminant leaching from horticultural land. When soils become saturated, excess water can wash away valuable nutrients (e.g. nitrogen and phosphorus) before crops have a chance to absorb them. This not only reduces soil fertility but also forces farmers to apply additional fertiliser to maintain yields, creating potentially adverse downstream environmental impacts (such as eutrophication and water quality degradation).

Present day risk was rated ‘moderate’ (as leaching of nitrogen already occurs in heavy rainfall events) and is expected to increase over time. The end of century risk was rated ‘high’.

6.9.5 Groundwater rise and salinity stress risk to low lying areas of horticulture / productivity of the land (Risk ID H11)

Sea water intrusion through groundwater levels can pose serious risks to horticultural production, particularly in low-lying coastal areas. As sea levels rise, saltwater can infiltrate freshwater aquifers, leading to increased salinity in the soil and irrigation water. This salinity stress can reduce soil fertility by altering nutrient availability, damaging soil structure, and impairing plant nutrient uptake. Many horticultural crops are sensitive to elevated salt levels, which can result in stunted growth, leaf burn, lower yields, and in severe cases, total crop failure.

In addition to salinity, higher groundwater tables can lead to poor soil drainage. Waterlogged soils deprive plant roots of oxygen, increasing the risk of root asphyxiation and making crops more susceptible to root diseases such as phytophthora and pythium.

Frost protection may be compromised for farms that rely on groundwater or surface water (such as rivers), as reduced water availability or restrictions during dry periods can limit their ability to operate irrigation-based frost control systems.

Present day risk was rated ‘low’, but exposure is expected to increase over time and by late century, the risk is rated ‘high’.

6.9.6 Pests and disease risk to horticulture (Risk ID H2)

Increased temperature can cause the prevalence of pests and disease, and may contribute to the introduction of new, exotic pests or diseases. Thrips can reduce yield and/or the aesthetic or economic value of plants directly by causing feeding and egg-laying injury, and indirectly by transmitting plant-damaging viruses to their hosts.

Risk was currently considered ‘moderate’ (as thrips are already known to affect horticultural production) and it is expected to increase over time. The risk is deemed ‘high’ by end of century (under RCP 8.5).

6.9.7 Extreme weather (wind and storms) risk to horticulture / productivity of the land (Risk ID H6)

Extreme wind (including ex-tropical cyclones) can damage a wide range of crops such as kiwifruit and avocado often necessitating stronger windbreaks and shelter belts. Wind damage can bruise or dislodge fruit, reducing yield and overall crop productivity. Additionally, extreme weather can disrupt pollination further impacting crop quality and yield.

Currently, risk was considered ‘moderate’ and is expected to increase over time. The end of century risk for RCP 8.5, was rated ‘high’.

6.9.8 Increased extreme rainfall and flooding risk to horticulture / productivity of the land (crop loss) (Risk ID H9)

Increased frequency of river flooding may cause loss of crops, reduced productivity and yield. It may also lead to tree and vine death. Ponding and lack of drainage leads to asphyxiation of plants which kills trees and vines.

Risk at the present time was considered ‘moderate’ and it is expected to increase over time. The risk by 2100 was deemed ‘high’ (RCP 8.5).

6.10 Forestry

Indigenous forest covers a substantial portion of the District (approximately 224,500 hectares or 51%), while exotic forest accounts for a smaller share at 29% (approximately 128,130 hectares)[24], refer Figure 6.3.

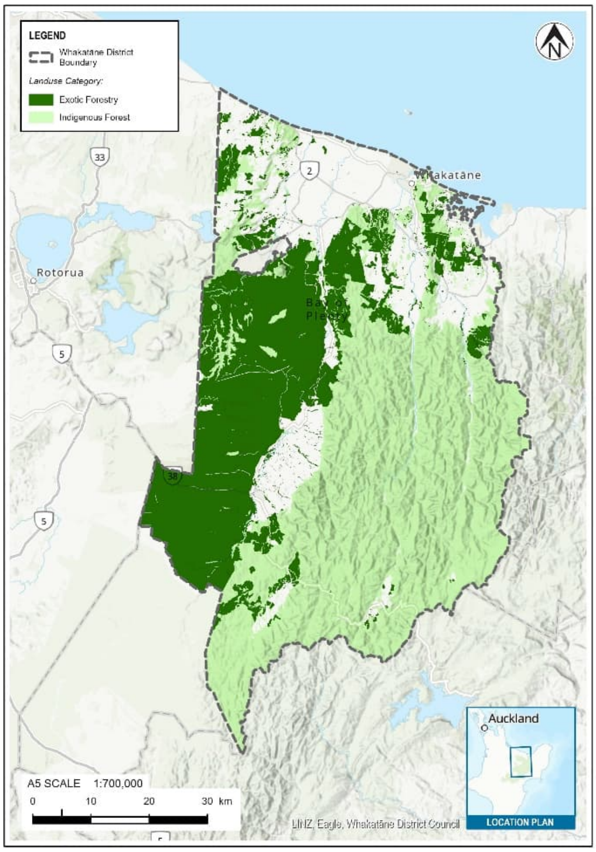

Figure 6.3: Forestry locations within the District

Table 6.10 shows the three highest rated risks (i.e. rated 'high' or 'very high') to forestry.

Table 6.10: Summary of highest climate risk ratings for forestry

	Now	RCP4.5 2050	RCP8.5 2050	RCP4.5 2100	RCP8.5 2100
Risk ID F7: Risk to forestry due to pests and diseases	moderate risk	moderate risk	high risk	high risk	very high risk
Risk ID F3: Risk to forestry due to extreme weather (wind and storms)	moderate risk	high risk	high risk	high risk	high risk
Risk ID F1: Risk to forestry due to increased fire weather	moderate risk	moderate risk	high risk	high risk	high risk

Legend: very low risk, low risk, moderate risk, high risk, very high risk

The following sections describe each of the above risks in further detail.

[24] https://rep.infometrics.co.nz/whakatane-district/environment/landcover

6.10.1 Pests and disease risk to forestry (Risk ID F7)

An increased prevalence of weeds, pests, and diseases poses a growing threat to forestry productivity and profitability. Warmer temperatures, changing rainfall patterns, and milder winters create more favourable conditions for a broader range of pests and pathogens to survive, reproduce, and expand into new areas.

Current risk was rated 'moderate' and is expected to increase over time. Risk was rated 'very high' by late century (under RCP 8.5).

6.10.2 Extreme weather (wind and storms) to forestry (Risk ID F3)

Wind events can result in significant damage to forestry, impacting both the trees and associated infrastructure. High winds can break or uproot trees, damage roads and equipment, and restrict access for forestry operations. In cases where trees are not merchantable, they can often end up as forestry slash, which, on steep land, can have downstream impacts such as erosion, debris flows, and increased sedimentation in waterways.

Extreme weather events have occurred in the last five years therefore, this risk was rated 'moderate' for present day and it is expected to increase over the long term as the frequency of these events increase. By mid-century the risk was rated 'high'.

6.10.3 Increased fire weather risk to forestry (Risk ID F1)

Increased fire weather conditions, which include factors like temperature, humidity, wind, and dryness that influence wildfire risk, may damage and destroy crops within plantation forestry and cause damage to facilities. The increasing occurrence of extreme fire risk may limit access to commercial forests for operations, potentially compromising the effectiveness of pest control.

Present day risk was rated 'moderate' due to numerous possible locations for fires to be lit. On account of fire weather conditions expecting to increase, the risk at the end of century was rated 'high'.

6.11 Tourism

Total tourism expenditure was approximately $161 million in Whakatane District during the year to March 2025[25]. Over 1,200 people in the District are employed in the tourism sector[26].

Table 6.11 shows the three highest rated risks (i.e. rated 'high' or 'very high') to tourism.

Table 6.11: Summary of highest climate risk ratings to Tourism

	Now	RCP4.5 2050	RCP8.5 2050	RCP4.5 2100	RCP8.5 2100
Risk ID T1: Risk to tourism due to higher temperature	low risk	moderate risk	moderate risk	high risk	very high risk
Risk ID T3: Risk to tourism due to increased extreme rainfall and flooding	moderate risk	moderate risk	moderate risk	high risk	very high risk
Risk ID T4: Risk to tourism due to coastal erosion	very low risk	low risk	low risk	moderate risk	high risk

Legend: very low risk, low risk, moderate risk, high risk, very high risk

The following sections describe each of the above risks in further detail.

6.11.1 Higher temperature risk to tourism (Risk ID T1)

Rising temperatures may lead to declining water quality, the spread of invasive species, and negative impacts on biodiversity, all of which can affect the appeal and sustainability of tourism in natural areas.

Risk was currently considered 'low' and is expected to increase over time. Note: the District is already experiencing some concerns due to higher temperatures in specific areas – e.g. at beaches with sea lice and jellyfish and water quality in lake / rivers have been affected by algal blooms and invasive species (such as Asian Clam).

As temperatures are expected to continue rising over time, the risk by 2100 (RCP 8.5) is considered 'very high'.

6.11.2 Increased extreme rainfall and flooding risk to tourism (Risk ID T3)

Increased extreme rainfall and flooding may result in broader impacts on the natural environment potentially impacting the tourism industry in general e.g. bad weather reduces potential for camping and reduces numbers of visitors to the District.

Risk was currently considered 'moderate' due to past events. e.g. Lake Rotoma was recently affected for the majority of the season with no boating activity due to high rainfall. Following significant rainfall in 2023, a section of the Ngā Tapuwae o Toi walkway has been unusable (and is awaiting repair) after a large slip caused extensive damage to the track. By 2100, under RCP 8.5, the risk was rated 'very high'.

6.11.3 Coastal erosion risk to tourism (Risk ID T4)

Coastal erosion may impact tourism operators who rely on coastal areas such as walkways and campsites, as the areas may become inoperable due to damage, perceptions of safety, and natural beauty decline. These issues can affect the desirability of visiting.

Risk was rated 'very low' for the present day as past events have not been a major issue. However, many campsites along the beach are in the coastal erosion zone and exposure is projected to increase over time, resulting in a risk rating (for 2100) of 'high'.

[25] Quarterly Economic Monitor | Whakatane District | Tourism expenditure
[26] https://www.whakatane.govt.nz/about-council/news/summer-tourism-provide-boost-local-businesses

6.12 Water source and water quality

Healthy and abundant water is a fundamental aspect of wellbeing. The District's natural environment, communities, Iwi/Māori, primary industries and other economic activities require clean water to sustain them. All water for the Whakatāne and Ōhope urban areas is pumped from the Whakatāne River, water for the other areas is provided via springs and bores[27].

Table 6.12 shows the three highest rated risks (i.e. rated 'high' or 'very high') to water source and water quality.

Table 6.12: Summary of highest climate risk ratings to water source and water quality

	Now	RCP4.5 2050	RCP8.5 2050	RCP4.5 2100	RCP8.5 2100
Risk ID WS6: Risk to water quality for potable supplies due to increased extreme rainfall and flooding	high	high	high	very high	very high
Risk ID WS2: Risk to water availability (groundwater and surface water) for primary production due to dryness and drought	moderate	high	high	very high	very high
Risk ID WS1: Risk to water availability (groundwater and surface water) for potable use due to dryness and drought	moderate	moderate	moderate	high	high

Legend: very low risk, low risk, moderate risk, high risk, very high risk

The following sections describe each of the above risks in further detail.

6.12.1 Increased extreme rainfall and flooding risk to water quality for potable supplies (Risk ID WS6)

More frequent extreme rainfall and flooding can increase runoff from agricultural and urban areas, transporting contaminants into rivers, lakes, and other receiving environments. These events can also accelerate erosion, carrying soil and nutrients into waterways, raising turbidity levels, and degrading overall water quality and ecosystem health.

Present day risk was rated 'high' due to the District's history of frequent flooding due to extreme rainfall, with such events projected to become more frequent over time. The level of risk by 2100 was rated 'very high'.

6.12.2 Dryness and drought risk to water availability for primary production (Risk ID WS2)

Increased occurrence of drought may compromise water availability for primary production. Increasing temperatures may drive increased demand for water, which is likely to coincide with reduced water availability due to drought and rainfall variability. A greater proportion of rainfall and runoff generated in fewer, more intense storms coupled with high evaporation may lead to lower groundwater recharge.

Risk was rated 'moderate' due to past reports of some shallow bores, springs and streams drying up during summer, an occurrence not previously observed in those areas. As dryness and drought is expected to increase over time, the risk by 2100 was rated 'very high'.

6.12.3 Dryness and drought risk to water availability & potable use (Risk ID WS1)

Increased occurrence of dryness and drought may compromise potable water supply security. Increasing temperatures may drive increased demand for water, which is likely to coincide with reduced water availability due to drought and rainfall variability. A greater proportion of rainfall and runoff generated in fewer, more intense storms coupled with high evaporation may lead to lower groundwater recharge. Changes in variability

[27] https://www.whakatane.govt.nz/services/water-services/water/water-supply

and seasonality of rainfall may result in reduced potable water availability due to less recharge of water storage, less recharge of groundwater aquifers and reduced river flows.

Risk was rated 'moderate' due to past reports of some shallow bores, springs and streams drying up during summer, an occurrence not previously observed in those areas. As dryness and drought is expected to increase over time, the risk by 2100 was rated 'high'.

6.13 Flood Management

Certain areas of the Whakatāne District are more susceptible to flooding due to their location on flood plains and the surrounding topography. Multiple rivers that have large catchments flow through the District increasing flood risk to communities located on the flood plains.

In April 2017, Cyclone Debbie struck the Eastern Bay of Plenty. Following heavy rainfall, the Rangitāiki river burst the stop bank at Edgecumbe and flooded the town. The Bay of Plenty Regional Council (BOPRC) had multiple sites that needed to be repaired as a result of the event. In May 2023, BOPRC was served with two legal claims in relation to the flood. The litigation is ongoing with the BOPRC facing potential legal costs of up to $7 million for defending claims[28].

A core function of BOPRC is to provide flood protection to the District. In 2025, BOPRC completed the Rangitāiki river spillway, a major project intended to reduce river flow volume in the main channel before the town of Edgecumbe thereby improving the level of flood protection to the town[29]. In February 2024, BOPRC began upgrading flood defences (stopbanks and floodwalls) along the Whakatāne CBD stretches of the Ōhinemataroa river. Stage one of the project (improvement of the flood defences from McAlister Street Pump Station to the Whakatāne iSite) was completed in December 2024. Stage two began in February 2025 (the area from the Whakatāne iSite through to the end of Quay Street) and involves removing the existing floodwall and creating a new, higher one. Stages three and four (upgrade flood defences from the end of Quay St to the end of the Muriwai Playground and alongside the Wairere Stream) are scheduled to start in late 2025[30].

The Rangitāiki-Tarawera Rivers Scheme (managed by BOPRC) covers the Rangitāiki River with a 3,005 km^2 catchment and the Tarawera River with a 984 km^2 catchment.

Table 6.13 shows the seven highest rated risks (i.e. rated 'high' or 'very high') to flood management.

Table 6.13: Summary of highest climate risk ratings for flood management

	Now	RCP4.5	RCP8.5	RCP4.5	RCP8.5
		2050	2050	2100	2100
Risk ID FM4: Risk to flood defences / stopbanks due to changes in variability and seasonality of rainfall	High	High	High	Very high	Very high
Risk ID FM6: Risk to coastal properties and buildings due to sea level rise and coastal flooding	Moderate	High	High	Very high	Very high
Risk ID FM7: Risk to properties and buildings due to increased extreme rainfall and flooding	Moderate	High	High	High	Very high
Risk ID FM3: Risk to flood defences / stop bank level of service due to increased extreme rainfall and flooding	Moderate	Moderate	Moderate	High	Very high
Risk ID FM1: Risk to flood defences / stop bank integrity due to increased extreme rainfall and flooding	Moderate	Moderate	Moderate	Moderate	High
Risk ID FM5: Risk to coastal defences and coastal flood protection due to coastal erosion	Moderate	Moderate	Moderate	Moderate	High
Risk ID FM8: Risk to properties and buildings due to groundwater rise and salinity stress in low lying areas	Moderate	Moderate	Moderate	Moderate	High

Legend: very low risk, low risk, moderate risk, high risk, very high risk

The following sections describe each of the above risks in further detail.

[28] https://www.rnz.co.nz/news/national/539031/7-million-pegged-for-edgecumbe-flood-litigation
[29] https://www.boprc.govt.nz/environment/flood-defences/rangitaiki-tarawera-rivers-scheme/rangitaiki-floodway-and-spillway/
[30] https://www.boprc.govt.nz/future-proof/

6.13.1 Changes in variability and seasonality of rainfall risk to flood defences / stopbanks (Risk ID FM4)

Increased dry periods followed by intense rainfall can reduce stopbank performance. This is due to drying-related damage (e.g. from burrowing animals like rabbits) and increased catchment runoff after extended dry conditions.

The risk was rated 'high' for present day (due to the damage already experienced) and is expected to increase over time. As a result of this, risk was rated 'very high' by 2100.

6.13.2 Sea level rise and coastal flooding risk to coastal properties and buildings (Risk ID FM6)

Sea level rise may reduce the effectiveness of coastal protection structures and may increase the exposure of coastal settlements to coastal inundation. Sea level rise may also cause rivers to change or jump course in flat coastal areas, making existing flood protection structures ineffective. Sea level rise alters the hydraulic interaction between coastal and inland waterbodies. Elevated tailwater conditions can worsen flooding, reduce the level of service provided by stopbanks, trigger hydraulic phenomena such as tidal bores, and potentially cause rivers to change or shift course in low-lying coastal areas.

Sea level rise and coastal flooding risk for the present day was rated 'moderate' but it is expected to rise and the risk at end of century was deemed 'very high'.

6.13.3 Increased extreme rainfall and flooding risk to properties and buildings (Risk ID FM7)

Settlements, communities, commercial centres and residential areas are at risk of damage from increasing flooding, particularly in low lying areas, downstream of lakes and adjacent to rivers. This may be because of failure of flood management schemes or undercapacity / failure of stormwater systems. Isolated communities are particularly vulnerable and are also likely to have related loss of access routes and disruption to emergency services. Direct and related damages to buildings may cause significant financial implications for individuals, communities, the Council etc including impacts on insurance premiums or insurability.

Currently, risk was rated 'moderate' because Whakatāne and Edgecumbe are protected by their own flood protection schemes (note: the exposure rating was based on Risk ID FM3, see below). On account of extreme rainfall and flooding due to increase over time, the risk rating in 2100 was deemed 'very high' (under RCP 8.5).

6.13.4 Increased extreme rainfall and flood risk to flood defences / stopbank level of service (Risk ID FM3)

The design capacity of stopbanks and flood management schemes may not be sufficient for increasing peak flows related to increased extreme rainfall events. Related changes in erosion and sediment transport may drive changes to riverbed dynamics (geomorphology) and require increased maintenance or further intervention. Changing downstream tailwater conditions and increasing coastal inundation will also change combined probability assessments of concurrent (coastal and riverine) flooding events.

Present day risk was rated 'moderate' because in 2017, the Rangitāiki flood protection scheme was exposed to a 100-year event (Cyclone Debbie) that involved flooding of Edgecumbe township and surrounding area. Projected increases in rainfall intensity means we may experience a 25% increase in peak flood flow under RCP 8.5 by late century, meaning the associated risk rating is 'very high'.

6.13.5 Increased extreme rainfall and flood risk to flood defences / stop bank integrity (Risk ID FM1)

Increased flooding may compromise stopbank integrity, and if failure occurs, the consequences can be severe, including damage to property, reduced community resilience, and risk to life. The structural condition of many older stopbanks is uncertain, increasing the likelihood of uncontrolled breach scenarios occurring.

Present day risk was rated as 'moderate' and is projected to increase over time. Under RCP 8.5 by late century, the associated risk was rated 'high'.

6.13.6 Coastal erosion risk to coastal defences and coastal flood protection (Risk ID FM5)

Sea level rise and increasing intensity of extreme events will increase coastal erosion. This may cause damage to coastal defences (including dunes), coastal flood protection and contribute to a reduced level of service. Changing coastal dynamics may influence coastal bathymetry and sandbar formation, resulting in further impacts on coastal protection structures.

Current risk was rated ‘moderate’ because dunes are already exposed to increasing erosion and this is expected to increase over time. Risk by late century, under RCP 8.5, was deemed ‘high’.

6.13.7 Groundwater rise and salinity stress in low lying areas risk to properties and buildings (Risk ID FM8)

High groundwater and salinity stress may damage building foundations and may reduce their lifespan or performance. High groundwater may also increase dampness in properties causing damage to buildings and health impacts on the residents. Increasing groundwater levels, due to sea level rise, can affect developments in low-lying areas and can create geotechnical instabilities including increasing liquefaction risk.

The current day risk was rated ‘moderate’, as certain areas including Edgecumbe, Whakatāne, Rangitāiki Plains and other low-lying areas are exposed to high groundwater at present, which will increase over time. Under RCP 8.5 by late century, the associated risk was rated ‘high’.

6.14 Telecommunications

Telecommunications is a critical infrastructure sector because it supports economic activity, social connectivity and emergency response across the District. Reliable communication networks support local businesses, education, and access to health and government services. In a region with both urban and rural communities, strong telecommunications are vital for resilience, safety, and equitable access to essential services.

In collaboration with subject matter experts, a list of risks were identified and rated although none were rated as 'high' or very high'. Risks identified included:

- Risk to telecommunications infrastructure due to extreme weather (wind and storms) (TEL1)
- Risk to cell towers including cabinets due to increased extreme rainfall and flooding (TEL3)
- Risk to cell towers including cabinets due to sea level rise and coastal flooding (TEL5)
- Risk to fibre due to increased fire weather (TEL8).

It was considered that, if damage was to occur, repairs could be carried out relatively easily as long as vehicle access is available.

6.15 Energy

Energy is a critical infrastructure sector that underpins both local communities and the wider District economy. In the DIstrict, renewable electricity generation is primarily from hydro, geothermal and solar sources. Hydroelectricty is sourced from the Āniwaniwa and Matahina dams located on the Rangitāiki river. The Kawerau geothermal field sits in both the Whakatāne and Kawerau districts. The system covers an area of about 35 km^2 and is bisected by Tarawera River[31]. Lodestone Energy's Edgecumbe Solar Farm consists of approximately 60,000 solar panels across an area spanning 50 hectares[32].

Table 6.14 shows the three highest rated risks (i.e. rated 'high' or 'very high') for energy.

Table 6.14: Summary of highest climate risk ratings for energy

	Now	RCP4.5	RCP8.5	RCP4.5	RCP8.5
		2050	2050	2100	2100
Risk ID EN2: Risk to distribution (ground mounted assets) due to increased extreme rainfall and flooding	high risk	high risk	high risk	high risk	very high risk
Risk ID EN1*:* Risk to distribution due to extreme weather (wind and storms)	moderate risk	moderate risk	moderate risk	moderate risk	high risk
Risk ID EN3*:* Risk to distribution (ground mounted assets) due to sea level rise and coastal flooding	low risk	moderate risk	moderate risk	high risk	high risk

Legend: ● very low risk, ● low risk, ● moderate risk, ● high risk, ● very high risk

The following sections describe each of the above risks in further detail.

6.15.1 Increased extreme rainfall and flooding risk to distribution (ground mounted assets) (Risk ID EN2)

Distribution infrastructure that is ground mounted, such as transformers, substations, switchgear, and underground cables, is at risk of damage from flooding. Potential damage includes: water ingress, short circuits and structural damage (i.e. flooding can undermine the foundations or support structures of ground-mounted assets). Flooding can also result in operational risks e.g., service interruptions or safety hazards.

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31 https://www.nzgeothermal.org.nz/geothermal-in-nz/nz-geothermal-fields/kawerau/
32 https://www.whakatane.info/sites/www.whakatane.info/files/pics/lodestone_energys_edgecumbe_solar_farm_fact_sheet.pdf

Subject matter experts rated the current risk to this hazard as ‘high’ given significant exposure across the District. As extreme rainfall and flooding is due to increase over time, the risk rating at 2100 (under RCP 8.5) was deemed ‘very high’.

6.15.2 Extreme weather (wind and storms) risk to distribution (Risk ID EN1)

Above ground electricity networks and infrastructure are at risk from extreme weather, particularly wind. Lines can be damaged from high winds or tree fall. Centralised electricity supply can mean that there is widespread disruption during power outages. This is particularly problematic for isolated communities (due to food shortages, lack of communications, electricity dependent healthcare) and community facilities such as marae that operate as emergency shelters.

Extreme weather events causing major outages have occurred during the past five years (in 2021 and 2022), therefore present day risk was rated ‘moderate’. Extreme weather events are projected to increase over time therefore, the risk rating at was deemed ‘high’ (under RCP 8.5).

6.15.3 Sea level rise and coastal flooding risk due to distribution (ground mounted assets) (Risk ID EN3)

Distribution infrastructure (ground mounted assets) is at risk of damage from coastal flooding due to a combination of floodwater characteristics, location exposure, and long-term environmental effects. Saltwater can penetrate equipment seals, corrode conductors, and degrade insulation, leading to long-term failure even after the water recedes. Erosion from coastal flooding can undermine the ground beneath substations, transformers, and underground cables.

At present, exposure of transformers and RMU’s was considered low, therefore risk was rated ‘low’. This is expected to increase over time and the risk for 2100 was rated ‘high’.

6.16 Roads and rail

Roads are one of the most critical infrastructure sectors, supporting both local communities and the broader District economy. They provide critical corridors for supply chains and services and allow access to many remote communities and marae within the District.

The District does not have an operating passenger train service, but rail plays a significant freight role transporting logs, wood pulp, paper and cardboard, fertiliser and steel from Murupara and Kawerau (57 km) to the Port of Tauranga.

Table 6.15 shows the seven highest rated risks (i.e. rated 'high' or 'very high') to roads and rail.

Table 6.15: Summary of highest climate risk ratings for roads and rail

	Now	RCP4.5	RCP8.5	RCP4.5	RCP8.5
		2050	2050	2100	2100
Risk ID R10: Risk to rail infrastructure due to extreme weather (wind and storms)	high	high	high	very high	very high
Risk ID R13: Risk to rail infrastructure due to increasing landslides	high	high	high	very high	very high
Risk ID R14: Risk to rail infrastructure due to increased fire weather	low	moderate	moderate	high	very high
Risk ID R8: Risk to rail infrastructure due to sea level rise and coastal flooding	moderate	high	high	high	high
Risk ID R4: Risk to transport infrastructure due to increased extreme rainfall and flooding	low	moderate	moderate	high	high
Risk ID R5: Risk to transport infrastructure due to increasing landslides	low	moderate	moderate	high	high
Risk ID R9: Risk to rail infrastructure due to increased extreme rainfall and flooding	low	moderate	moderate	moderate	high

Legend: very low risk, low risk, moderate risk, high risk, very high risk

The following sections describe each of the above risks in further detail.

6.16.1 Extreme weather (wind and storms) risk to rail infrastructure (Risk ID R10)

High winds can impact signalling equipment, and third-party debris can cause damage and disruptions on the network particularly tree fall which can close the track or de-rail trains.

Currently, the risk was rated 'high' as approximately 25-50% of the Murupara rail line was estimated as being exposed. The rail line experiences tree falls across the track at least once a year. By 2100, the risk was rated 'very high'.

6.16.2 Increasing landslides risk to rail infrastructure (Risk ID R13)

Landslides can severely damage or destroy rail tracks by displacing or burying sections of the track with soil, rocks, and debris. The force of a landslide can deform the track structure, wash away the ballast and subgrade, or lead to misalignment and instability, making the rail line unsafe or inoperable.

There was a major slip in 2022 / 2023 and, given the nature of the geology, current exposure was considered significant. As such, the present day risk was rated 'high'. Murupara is especially impacted due to its geology (volcanic ash) meaning any cuttings (for rail clearance) are unstable and susceptible to landslides. Risk to landslides is expected to increase over time and the associated risk for late century was deemed 'very high'.

6.16.3 Increased fire weather risk to rail infrastructure (Risk ID R14)

Increased fire weather—marked by hot, dry, and windy conditions—makes vegetation highly flammable, increasing the risk of wildfires. Trains may emit sparks through braking, wheel friction, or maintenance activities, and when these sparks land on dry vegetation near tracks, they may ignite fires. The combination of mechanical spark sources and fire-prone environments makes railway corridors particularly vulnerable during fire weather.

Currently, the exposure was rated 'low', but it is expected to increase over time due to the forested nature of the catchment through which the rail line passes. By 2100, under RCP 8.5, the risk was rated 'very high'.

6.16.4 Sea level rise and coastal flooding risk to rail infrastructure (Risk ID R8)

Rail corridors near the coastal edge may be exposed to sea level rise and flooding. As sea levels rise, low-lying rail infrastructure, including tracks, bridges, and signalling systems, may be inundated more frequently, especially during storm surges or king tides. This flooding can erode track foundations, corrode metal components, and undermine structural integrity, leading to unsafe conditions and service disruptions.

At present, risk was considered 'moderate' given that approximately 25% of railway infrastructure is located along the coast (area north of the road of the road). By mid-century it was expected that the risk would increase to 'high'.

6.16.5 Increased extreme rainfall and flooding risk to road infrastructure (Risk ID R4)

Increased extreme rainfall and flooding can cause damage to roads and close/disrupt transport links. Rural communities are particularly vulnerable to being cut off during flooding.

Based on current data, risk was considered 'low' but increasing frequency and severity of extreme events will increase exposure over time. At the end of century, the risk was rated 'high'.

6.16.6 Increasing landslides risk to transport infrastructure (Risk ID R5)

The increasing frequency and intensity of landslides, driven by factors such as extreme rainfall, soil saturation, and land instability, may cause damage or loss of roads. Roads built through steep terrain are particularly vulnerable, as gravity-driven movements of earth and rock can undermine road foundations, block access routes, or cause complete structural failure. Rural communities with limited access routes may have access routes cut off.

Based on current data, risk was considered 'low'. At present, slips are a common occurrence; however, only around two to three slips per year are severe enough to result in road closures. As exposure is due to increase by 2100, the risk at that time was rated 'high'.

6.16.7 Extreme rainfall and flooding risk to rail infrastructure (Risk ID R9)

Increased extreme rainfall and flooding can overwhelm drainage systems along rail corridors in low lying areas, causing track inundation, erosion of embankments, and washouts where the ground beneath the tracks is swept away. This can lead to track misalignment, signal failures, and even derailments, severely disrupting rail operations and endangering safety.

Currently, the risk was rated 'low' because, although parts of the rail corridor lie within a floodplain, only certain sections have been flooded historically (estimated 5-10%). This has mainly been due to bridge closures when river levels are high e.g., track closure occurred last year at the Awakaponga Station bridge. As exposure is due to increase by 2100, the risk was rated 'high' (under RCP 8.5).

6.17 Airport and ports

Communities rely on airports and ports to provide connection, access, and freight routes. Whakatāne Airport offers flights to Auckland (via Air Chathams), and Gisborne, Napier and Hamilton are serviced by Sunair. In 2022, Whakatāne Airport recorded approximately 15,800 passengers, with projections indicating this number will double to around 31,300 by 2033[33].

Port Ōhope and Whakatāne harbours / ports support commercial and recreational fishing, tourism, and marine transport, providing a gateway to the ocean and offshore attractions like Moutohora / Whale Island and Whakaari / White Island. The harbour also plays a key role in local livelihoods, with charter operations, boat maintenance services, and aquaculture relying on access to safe and functional port facilities.

Table 6.16 shows the six highest rated risks (i.e. rated 'high' or 'very high') to airport and ports.

Table 6.16: Summary of highest climate risk ratings for airport and ports

	Now	RCP4.5	RCP8.5	RCP4.5	RCP8.5
		2050	2050	2100	2100
Risk ID AP2: Risk to airport due to extreme weather (wind and storms)	moderate	moderate	moderate	high	very high
Risk ID AP13: Risk to port operations due to increased extreme rainfall and flooding	moderate	moderate	moderate	high	very high
Risk ID AP14: Risk to port operations due to sea level rise and coastal flooding	high	high	high	high	high
Risk ID AP5: Risk to airport due to sea level rise and coastal flooding	low	moderate	moderate	moderate	high
Risk ID AP7: Risk to ports due to sea level rise and coastal flooding	low	moderate	moderate	moderate	high
Risk ID AP11: Risk to port and associated buildings due to increased extreme rainfall and flooding	low	moderate	moderate	moderate	high

Legend: very low risk, low risk, moderate risk, high risk, very high risk

The following sections describe each of the above risks in further detail.

6.17.1 Extreme weather (wind and storms) risk to airport operations (Risk ID AP2)

Extreme weather (wind and storms) may prevent air services from operating. This would interrupt air traffic, causing reduced accessibility and freight disruption. Fog, wind direction, and lightning strike are other considerations that have high impact on flight operations.

Present day risk was rated 'moderate' as severe weather disrupts flights relatively regularly and this is expected to increase. Often the airport may be open, but airlines do not fly due to wind, visibility, etc or must divert to alternative airports. Under RCP 8.5 scenario, late century risk was rated 'very high'.

6.17.2 Extreme rainfall and flooding risk to port operations (Risk ID AP13)

Extreme rainfall and flooding may disrupt port operations and interfere with goods handling and storage, including posing a safety risk. Increased frequency and intensity of rainfall events may lead to more frequent and severe disruptions to port operations, particularly affecting goods handling, storage, and logistics. In

[33] https://www.whakatane.govt.nz/sites/www.whakatane.govt.nz/files/2024-12/appendix_2-20230411_whk_schedule_movements_final_report_apr_2023_updated_11apr.pdf

summer, lower river flows will result in increased build-up of silt and less frequent flushing thereby requiring an increased demand on dredging of the inner-harbour and Whakatāne river entrance.

The current level of risk was considered 'moderate' due to the history of flooding events in the District. By late century, the risk was rated 'very high' (under RCP 8.5).

6.17.3 Sea level rise and coastal flooding risk to port operations (Risk ID AP14)

Sea level rise and coastal flooding pose significant risks to port operations, particularly in low-lying areas like Port Ōhope and the Whakatāne Harbour. As sea levels rise, the frequency and severity of tidal inundation and storm surge events are expected to increase, threatening the functionality and safety of port infrastructure.

The current risk was rated as 'high' (due to the location and elevation) and is projected to remain at that level through to the late century.

6.17.4 Sea level rise and coastal flooding risk to airport (AP5)

Increasing sea level rise may affect Whakatāne airport (located approximately 0.8 km inland from the coast) as it could lead to direct damage to the runway substrate, resulting in interruption to air traffic, reduced accessibility and freight disruption.

Present day risk was considered 'low' as airport facilities are not currently exposed, however access to the airport may be disrupted during significant flood events, which may occur with increasing frequency in the future. Under RCP 8.5 scenario, late century risk was rated 'high'.

6.17.5 Sea level rise and coastal flooding risk to ports (AP7)

Sea level rise and coastal flooding may cause loss of access to, and usability of, ports and related coastal infrastructure. Additionally, changes in tidal dynamics and sediment transport can result in increased silt accumulation within harbour entrances and navigation channels. This build-up may necessitate more frequent dredging and maintenance.

Risk was rated 'low' for present day, but data shows an increasing level of sea level rise which will impact port assets.

Of the two ports, the Whakatāne port is considered to be the most vulnerable. The impact of increasing sea level rise on the maintenance of the two harbour entrances is highly uncertain. By late century, the risk was rated 'high' (under RCP 8.5).

6.17.6 Increased extreme rainfall and flooding risk to ports and associated buildings (AP11)

Increasing rainfall and fluvial flooding may cause increasing flooding of the port and associated buildings. This can inundate critical infrastructure such as warehouses, administrative buildings, access roads, and electrical systems, disrupting daily operations and posing safety risks to personnel and equipment.

Risk was currently considered 'low', however the frequency of storm events is expected to increase over time. Of the two ports, the Whakatāne port is considered to be the most vulnerable. Under RCP 8.5 scenario, late century risk was rated 'high'.

6.18 Waste management

Waste management in the District includes a range of services and facilities including kerbside services (refuse, recycling and greenwaste), two resource recovery centres, landfills[34] (closed) and one greenwaste composting facility[35]. Communities rely on collection and management of waste along with waste minimisation and resource recovery practices.

Table 6.17 shows the ten highest rated risks (i.e. rated 'high' or 'very high') to waste management.

Table 6.17: Summary of highest climate risk ratings for waste management

	Now	RCP4.5 2050	RCP8.5 2050	RCP4.5 2100	RCP8.5 2100
Risk ID WM8: Risk to waste operations due to increased extreme rainfall and flooding	🟡	🟡	🟡	🟠	🔴
Risk ID WM9: Risk to waste management facilities due to dryness and drought	🟡	🟡	🟡	🟠	🟠
Risk ID WM10: Risk to waste management facilities due to increased extreme rainfall and flooding	🟡	🟡	🟡	🟠	🟠
Risk ID WM3: Risk to landfills due to increased extreme rainfall and flooding	🟡	🟡	🟡	🟡	🟠
Risk ID WM4: Risk to refuse transfer stations and composting site due to higher temperature (including increased hot days)	🟡	🟡	🟡	🟡	🟠
Risk ID WM7: Risk to waste operations due to extreme weather (wind and storms)	🟡	🟡	🟡	🟡	🟠
Risk ID WM13: Risk to landfills due to increasing landslides	🟡	🟡	🟡	🟡	🟠
Risk ID WM5: Risk to refuse transfer stations and composting site due to increased fire weather	🟢	🟡	🟡	🟡	🟠
Risk ID WM14: Risk to contracted staff due to higher temperature (including increased hot days)	🟢	🟡	🟡	🟡	🟠
Risk ID WM11: Risk to landfills due to groundwater rise and / or salinity stress in low lying areas	🟢	🟢	🟢	🟡	🟠

Legend: 🔵 very low risk, 🟢 low risk, 🟡 moderate risk, 🟠 high risk, 🔴 very high risk

6.18.1 Increased extreme rainfall and flooding risk to waste operations (Risk ID WM8)

Increased extreme rainfall and flooding events can lead to a surge in waste volumes within communities, primarily due to damage to homes, businesses, and infrastructure. This may also result in disruptions to normal service operations.

The current risk was considered 'moderate' because several extreme rainfall and flooding events have occurred in the District over the last 20 years. Given that extreme rainfall and flooding is expected to increase over time, the risk was rated 'very high' by 2100 under RCP 8.5.

[34] Includes contaminated woodwaste sites

[35] https://www.whakatane.govt.nz/documents/council-plans/waste-management-and-minimisation-plan

6.18.2 Dryness and drought risk to waste management facilities (Risk ID WM9)

Dry conditions and drought may lead to an increase in dust generation at waste management facilities. Drought may also contribute to a rise in pest species, pathogens / bacteria, unpleasant odours, and increased seagull activity at the facilities. Additionally, the condition of collected food scraps may deteriorate more rapidly.

Currently, dust is a management challenge at the Keepa Road Greenwaste composting facility. As conditions become drier, increased biological activity is likely to lead to stronger unpleasant odours at the resource recovery centres. These facilities already experience issues with pest species such as wasps, rats, and flies, and such infestations are expected to become significantly more severe. As such, the present day risk was rated 'moderate' and by 2100, this is expected to increase to 'very high'.

6.18.3 Increased extreme rainfall and flooding risk to waste management facilities (Risk ID WM10)

Flooding may cause damage to facilities or disperse waste. Extreme rainfall and flooding events may also generate additional waste in the community due to property damage e.g. 2017 Edgecumbe flood led to a significant increase in waste volumes. As increased rainfall events become more frequent, managing stormwater discharge will become increasingly challenging. Flooded waste management facilities may also disrupt or postpone the normal waste service.

Present day risk was rated 'moderate' as transfer stations are already susceptible to flooding. As increased rainfall events are expected to become more frequent, the 2100 risk was rated 'high'.

6.18.4 Increased extreme rainfall and flooding risk to closed landfills (Risk ID WM3)

Erosion of landfill caps during extreme rainfall and flooding events may compromise landfill performance and reduce the effectiveness of leachate management systems.

Current risk was considered 'moderate' as data indicates that a number of closed landfills may be exposed to flooding. Previously, Te Teko and Burma Road landfills have been affected by rainfall during storm events which resulted in erosion of caps. These weather events are likely to increase over time and by 2100, the risk was rated 'high' (under RCP 8.5).

6.18.5 Higher temperature (including increased hot days) risk to refuse transfer stations and composting site (Risk ID WM4)

Higher temperatures may increase the likelihood of unpleasant odours and dust generation near the three sites. In addition, microbial activity in compost may overheat piles, potentially leading to deterioration of organic waste (causing increased leachate generation and potential contamination).

The current risk was assessed as 'moderate' due to existing odour complaints received by the Council and the issuance of abatement notices. Higher temperatures are expected to increase and as such, the risk by 2100 was rated 'high' (under RCP 8.5).

6.18.6 Extreme weather (wind and storms) risk to waste operations (Risk ID WM7)

Strong winds frequently cause litter to be blown around waste facilities, bins to be knocked over, and the scatter of rubbish along streets and onto nearby properties. It can result in damaged or lost bins, and in some cases, cause damage to property and vehicles.

Disruption to services happens at least once a year, therefore present day risk was considered 'moderate'. Due to extreme weather events expecting to increase over time, the risk by 2100 was rated 'high' (RCP 8.5).

6.18.7 Increased landslide risk to landfills (Risk ID WM13)

Landfills are at risk of damage or loss of assets due to landslides. Landslides can compromise the structural integrity of landfill, disrupt containment systems, and expose materials. The movement of waste material during a landslide can also damage on-site infrastructure, including leachate management systems, gas collection networks, and access roads.

Previously, Matatā landfill experienced debris flow and Te Teko closed landfill cap was subject to slope instability due to extreme weather. As such, present day risk was rated 'moderate' but by 2100, the risk was expected to increase to 'high' (under RCP 8.5).

6.18.8 Increased fire weather risk to refuse transfer stations and composting site (Risk ID WM5)

Increased fire weather may elevate the risk of fires starting on the sites, due to presence of certain flammable materials, e.g. green waste, compost and certain recycling items (e.g. lithium-ion batteries and gas cannisters).

The current risk was considered 'low', as there have been only a few incidents involving specific flammable materials. The risk by 2100 was rated 'high' (RCP 8.5). It was noted that the risk to composting sites is considered higher (due to the presence of organic materials that can ignite under hot, dry conditions) and that capped landfills were considered to have a lower fire risk (as the sealed cover prevents oxygen from entering and fuelling combustion within the waste).

6.18.9 Higher temperature (including increased hot days) risk to contracted staff (Risk ID WM14)

Increasing temperatures across the District will increase the number and frequency of hot days. Staff exposed to prolonged periods of high heat, such as those working at landfills, kerbside collections, composting facilities and transfer stations may be at increased risk of heat-related illnesses, including heat exhaustion and heat stroke.

Present day risk was rated 'low' but as temperatures are due to increase over time, the risk by 2100 (under RCP 8.5) was rated 'high'.

6.18.10 Groundwater rise and / or salinity stress in low lying areas risk to landfills (Risk ID WM11)

Groundwater rise, particularly in coastal environments, poses a significant risk to the integrity and environmental performance of landfills and greenwaste composting sites. As groundwater levels rise, they can infiltrate older or poorly sealed landfills, saturating waste materials and generating increased volumes of leachate, a potentially contaminated liquid that can escape into surrounding soil and water bodies if not properly contained.

Council has one closed landfill (Matatā) that could be exposed, as such, current day risk was rated 'low'. As groundwater rise is expected to increase over time, risk by 2100 (under RCP 8.5) was rated 'high'.

6.19 Property and open spaces

The District is home to a number of beautiful parks, gardens and reserves which offer both locals and visitors spaces to relax, explore, and enjoy the natural environment. These places are vital assets that support the social, cultural, and environmental health of the community.

Table 6.18 shows the 12 highest rated risks (i.e. rated 'high' or 'very high') to property and open spaces.

Table 6.18: Summary of highest climate risk ratings for property and open spaces

	Now	RCP4.5	RCP8.5	RCP4.5	RCP8.5
		2050	2050	2100	2100
Risk ID POS26: Risk to communities and buildings due to increasing landslides	high risk	high risk	high risk	very high risk	very high risk
Risk ID POS7*:* Risk to park roads, paths, bridges and carparks due to increase in landslides	high risk	high risk	high risk	high risk	very high risk
Risk ID POS24*:* Risk to communities and buildings due increased extreme rainfall and flooding	moderate risk	moderate risk	high risk	high risk	very high risk
Risk ID POS3*:* Risk to Council owned land or buildings from increasing intensity and frequency of sea level rise and coastal flooding	moderate risk	high risk	high risk	high risk	very high risk
Risk ID POS2*:* Risk to Council owned camping grounds (e.g. Pikowai, Thornton Beach Holiday park land, not the buildings) from increasing intensity and frequency of sea level rise and coastal flooding	very low risk	moderate risk	moderate risk	high risk	very high risk
Risk ID POS12*:* Risk to parks structures, play spaces, monuments and artworks due to extreme weather (wind and storms)	moderate risk	moderate risk	moderate risk	high risk	high risk
Risk ID POS18*:* Risk to Council owned property (including museum, culture and community zone) due to increased extreme rainfall and flooding	moderate risk	moderate risk	moderate risk	high risk	high risk
Risk ID POS19*:* Risk to commercial and industrial property due to increased extreme rainfall and flooding	moderate risk	moderate risk	moderate risk	high risk	high risk
Risk ID POS21*:* Risk to cemeteries due to groundwater rise	moderate risk	moderate risk	moderate risk	high risk	high risk
Risk ID POS22*:* Risk to education facilities (e.g. primary, secondary schools and wananga) due to increased extreme rainfall and flooding	moderate risk	moderate risk	moderate risk	moderate risk	high risk
Risk ID POS5*:* Risk to parks soft assets (trees, turf and gardens) due to higher temperature	low risk	moderate risk	moderate risk	moderate risk	high risk
Risk ID POS6*:* Risk to Council public spaces and increased costs due to higher temperature	low risk	moderate risk	moderate risk	moderate risk	high risk

Legend: ● very low risk, ● low risk, ● moderate risk, ● high risk, ● very high risk

6.19.1 Increasing landslides risk to communities and buildings (RISK ID POS26)

Properties near escarpments are at risk of damage from increasing frequency of landslides due to more frequent extreme rainfall events. Rural communities are particularly vulnerable to being isolated through loss of access routes and disruption to emergency services. Direct and related damages to buildings may cause significant financial implications for individuals, communities, the Council etc including impacts on insurance premiums or insurability.

Given the common occurrence of landslides every year, the present day risk was rated 'high' but is expected to increase over time, resulting in a 'very high' risk by late century.

6.19.2 Increasing landslides risk to park roads, paths, bridges and carpark (POS7)

An increase in landslides may cause direct physical damage to park infrastructure such as roads, paths, bridges, and carparks, potentially leading to restricted access or closure.

The risk is currently rated 'high' due to the regular occurrence of landslides, which are expected to become more frequent as storm events increase in intensity and frequency. By 2100 the risk was rated 'very high' (under RCP 8.5).

6.19.3 Increased extreme rainfall and flooding risk to communities and buildings (POS24)

Residential areas are at risk of damage from increasing flooding, particularly in low lying areas, downstream of lakes and adjacent to rivers and streams. This may be because of failure of flood management schemes or undercapacity / failure of stormwater systems. Isolated communities are particularly vulnerable and are also likely to have related loss of access routes and disruption to emergency services.

Present day risk was rated 'moderate' (due to historical flood events) and by 2100 (under RCP 8.5) the risk was rated 'very high'.

6.19.4 Increasing intensity and frequency of sea level rise and coastal flooding risk to Council owned land or buildings (POS3)

Sea level rise and coastal flooding may result in flooding of ex-Harbour Board land area (derived from harbour or riverbed reclamation) and other commercial property. These areas are particularly vulnerable due to their low elevation and proximity to the coastline. As sea levels continue to rise and storms become more frequent, the risk of tidal and storm surge-related flooding increases. This can result in the regular or permanent flooding of land, damage to infrastructure, and disruption to access and services.

Note: BOPRC is in the process of improving flood defences along the lower Whakatāne River including the Wairere Stream to protect the Whakatāne central business District which should reduce exposure once completed.

At present, a significant number of Council land / buildings may be exposed and therefore the risk was rated 'moderate' and is expected to increase to 'very high' by 2100 (under RCP 8.5).

6.19.5 Increasing intensity and frequency of sea level rise and coastal flooding risk to Council owned camping grounds (e.g. Pikowai, Thornton Beach Holiday park land, not the buildings) (POS2)

Sea level rise and coastal flooding may render holiday park land unusable, either through regular inundation, erosion, or saltwater intrusion, making it unsuitable for continued operation or development. Areas that may be impacted included Thornton Beach Holiday Park, Murphys Holiday Camp and Pikowai (some of it is Council owned land and infrastructure, and some is KiwiRail owned land).

The risk at present was considered 'very low' but is expected to increase over time resulting in 'very high' by 2100 (under RCP 8.5).

6.19.6 Extreme weather (wind and storms) risk to parks structures, play spaces, monuments and artworks (POS12)

Extreme weather events, including strong winds and intense storms, pose a significant risk to park infrastructure such as shelters, playground equipment, seating, signage, monuments, and public artworks. High winds can cause physical damage by toppling trees or branches onto structures, lifting unsecured equipment, and damaging roofing or shade coverings. Storms may lead to flooding, water damage, or accelerated wear and corrosion of materials, particularly for installations made from wood, metal, or fabric.

The risk was rated as 'moderate' for present day due to the high susceptibility of trees to damage during storm events. As extreme weather is expected to become more frequent, the risk was rated 'very high' by 2100.

6.19.7 Increased extreme rainfall and flooding risk to Council owned property (POS18)

Increased extreme rainfall and flooding can cause significant damage to Council owned properties, including administrative buildings, community centres, libraries, and cultural facilities such as museums. This damage may include water ingress, structural compromise, electrical failures, and mould or mildew growth, all of which can require extensive repairs and render buildings temporarily or permanently unusable. In the case of museums and cultural facilities, flooding poses a particular threat to valuable and often irreplaceable collections.

Currently, risk was rated 'moderate' as flooding has occurred in the past to some Council owned properties. The long-term risk (at 2100) was rated 'high', reflecting the projected increase in the frequency of these events over time.

6.19.8 Increased extreme rainfall and flooding risk to commercial and industrial property (POS19)

Increased extreme rainfall and flooding result in substantial damage to commercial and industrial properties which can disrupt the operations and or access to the properties. Floodwaters can infiltrate buildings, damaging structural components, electrical systems, machinery, inventory, and stored goods. Prolonged exposure to moisture can also lead to issues such as mould, corrosion, and foundation instability, further escalating repair and recovery costs.

Data shows that a large proportion of industrial / commercial properties are currently exposed to flooding, and as such, the present day risk was rated 'moderate'. With these events expected to increase in frequency, the risk by 2100 was rated 'high'.

6.19.9 Groundwater rise risk to cemeteries (POS21)

Rising groundwater levels can lead to the flotation of caskets, particularly in double-depth burials where one casket is placed above another. This may result in a shift to single-depth burials only, significantly reducing overall cemetery capacity. In more severe cases, high groundwater levels could render burial plots unusable altogether, compromising the ability to conduct burials in affected areas.

Risk was rated 'moderate' as cemeteries at Tāneatua and Waimana currently have high water tables and over the long term this will increase as the water table rises even higher. By 2100, the risk was rated 'high'.

6.19.10 Increased extreme rainfall and flooding risk to education (POS22)

Increased extreme rainfall and flooding can cause significant damage to education facilities. Flooding can lead to water intrusion into classrooms, libraries, laboratories, and administrative buildings, resulting in damage to structural elements, furniture, learning materials, and digital equipment. Prolonged damp conditions can also lead to mould growth and poor indoor air quality, posing health risks to students and staff. These impacts can severely disrupt the delivery of education by forcing temporary closures, reducing access to classrooms and essential resources, and displacing students and staff.

The present day risk was rated as 'moderate' and, given that extreme rainfall and flooding is expected to increase, the level of risk at 2100 was rated 'high' (under RCP 8.5).

6.19.11 Higher temperature risk to parks soft assets (trees, turf and gardens) (POS5)

Warmer conditions can create favourable environments for pests and plant diseases that were previously less common, leading to higher vulnerability and maintenance needs. Prolonged periods of high temperatures can also lead to heat stress, causing wilting, leaf scorch, and even the death of sensitive plant species. Trees and turf may struggle to maintain hydration, especially during drought conditions. As a result, the timing of planting seasons and the selection of tree and plant species may need to be adjusted to suit changing climate conditions.

Currently, risk was rated 'low' as its being noted that some plants, such as tulips, are failing to grow due to changing ground conditions. Exposure is expected to increase over time and therefore, by 2100, the risk was rated 'high' (under RCP 8.5).

6.19.12 Higher temperatures risk to Council public spaces and increased costs (POS6)

Higher temperatures may lead to increased costs associated with the maintenance and management of public spaces. As temperatures rise and dry periods become more prolonged, there is a greater need for frequent irrigation to maintain the health and appearance of turf, gardens, and other green assets. In addition to irrigation demands, higher temperatures can alter the types and prevalence of pests, weeds, and plant diseases. This may require more frequent or intensive use of pesticides, herbicides, and other control measures. To ensure public comfort and safety, especially during heatwaves, there may also be increased pressure to install and maintain additional shade structures, such as trees, shelters, or artificial coverings, in parks, playgrounds, and recreational areas.

Risk was rated 'low' at the moment but is expected to increase over time (with increasing temperatures). By late century the risk was rated 'high' (under RCP 8.5).

6.20 Additional Council functions

In addition to core infrastructure and asset risks, this sector considered several other Council functions which may be potentially at risk during climate change events, particularly in terms of impacts to staff safety, service delivery, and community engagement.

In collaboration with Subject matter experts, a list of risks was developed but not rated. Risks identified included:

- Risk to Emergency response team due to need to provide additional services to the public during increased extreme rainfall and flooding / or other events (C1)
- Risk to Council with increased monitoring required regarding unconsented structures due to coastal erosion (C4)
- Risk to Council in maintaining and providing accurate information due to an increase in extreme rainfall and flooding (C5)
- Risk to Council staff because of increased workload due to extreme weather events (C7).

7.0 Community level risks | Ngā tūraru hapori

Natural hazard events are inherently tied to specific locations, which requires adaptation planning to be locally-focused and place-based. To ensure that this CCRA delivers meaningful and usable outcomes for local communities, a comprehensive community engagement programme was undertaken. This aimed to incorporate local knowledge of climate risks to reflect the real-world complexity of the Whakatāne District.

The Whakatāne District has four Community Boards: Whakatāne-Ōhope, Rangitāiki, Tāneatua, and Murupara. For the purposes of this CCRA, the four Community Board areas were divided into 27 geographical community areas (refer Figure 7.1) to enable more localised engagement and reporting. The community areas also enable reporting by Māori Wards and by Rohe. The Community Boards and community areas are summarised below (Table 7.1).

Table 7.1: Community Boards and associated community areas

Community Board	Community area	Community Board	Community area
Whakatāne-Ōhope	Whakatāne	Tāneatua	Tāneatua
	Ōhope		Rūātoki
	Coastlands		Waimana/Nukuhou North
Rangitaiki	Pikowai		Matahī
	Thornton		Wainui
	Matatā	Murupara	Lake Matahina
	Manawahe		Waiōhau
	Otakiri		Lake Āniwanawa
	Edgecumbe		Galatea
	Onepū		Kāingaroa Forest
	Te Teko/Te Mahoe		Murupara
	Awakeri		Minginui/Te Whāiti
	Poroporo		Ruatahuna
			Te Urewera

The community summaries section altered slightly the areas that were used for the sectoral analysis (Section 4.2). This was done to better enable focused community engagement and future adaptation planning which is inherently local. Changes included separating Pikowai from Matatā, and Lake Āniwanawa from Galatea. Also, excluded from summary reporting due to the limited number of risks identified were:

- Moutohorā and Rūrima islands (sea level rise and landslide risks)
- Putauaki (fire risk)
- Whirinaki Te-Pua-a-Tāne Conservation Park and Tarawera Forest (risk to waterways from forestry slash, erosion and sedimentation from high intensity rainfall)
- Maungapohatu (no risks identified).

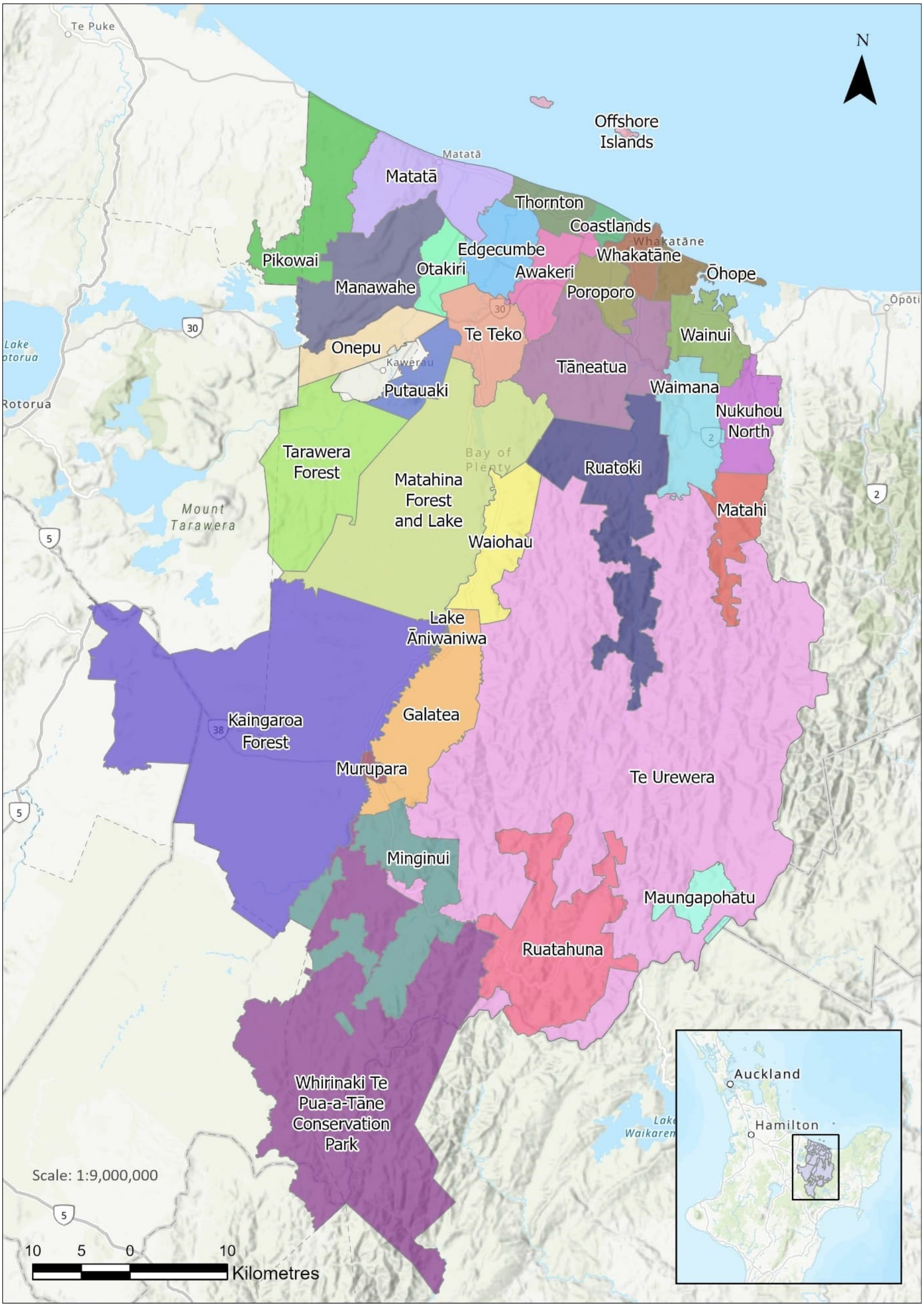

Figure 7.1: Map of communities

A total of 52 engagement sessions were held with community groups, Iwi and hapū. These sessions resulted in more than 500 place-based climate risks being identified by 800+ residents. The identified risks were recorded manually on large community maps before being geospatially plotted in Arc GIS Instant App to enable analysis of the data. A data dictionary, structured to align with the 2026 National Climate Change Risk Assessment, was developed to record the risks in the Instant App. This section provides summaries of the climate risks identified for the community areas (refer Appendix B for the complete list).

7.1 Whakatāne-Ōhope Community Board

7.1.1 Whakatāne community

For the purposes of this climate change risk assessment, the geographical extent of the Whakatāne area is defined as outlined in Figure 7.2.

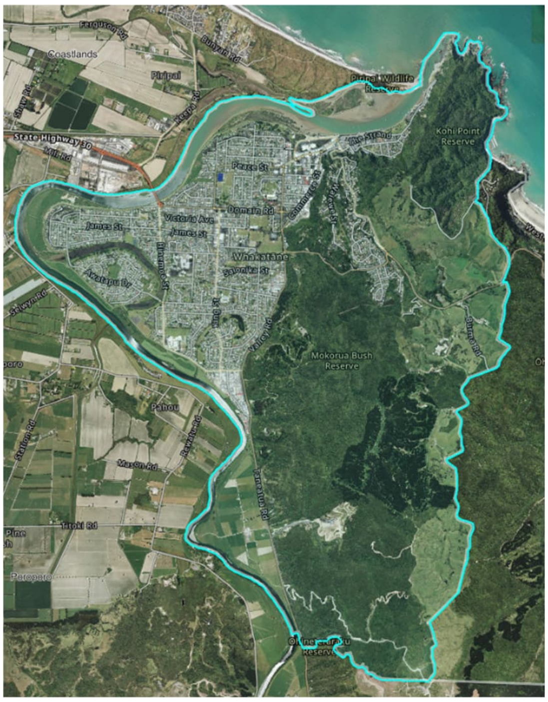

Figure 7.2: Whakatāne community

In addition to the climate risks discussed in the sector analyses, 57 Whakatāne-specific climate risks were identified through a combination of workshops and community meetings. Details on the nature and location of these risks are detailed in Figure B1 of Appendix B.

Relevant climate hazards identified by the community include flooding, coastal inundation, increased storm events, landslides, sea level rise, increasing temperature, changes in seasonality, and fire.

The climate risks identified have been condensed and summarised as follows:

- Fluvial/river flooding impacting Port activities (e.g. boat ramp and wharf structures, increased frequency of moving boats moored in the river to shelter), estuarine ecosystems, infrastructural assets (e.g. Whakatāne Bridge, sewer main under the riverbed), low-lying residential, commercial and industrial properties, Council reserves and Open Spaces assets, the roading network, and primary production land to the south of the town.
- Pluvial/surface flooding overwhelming the stormwater network capacity resulting in flooding of low-lying residential, commercial and industrial properties, Council reserves and Open Spaces assets, the roading network, as well as causing increased leachate discharge from closed landfills.

- Increased storm events impacting on navigability of the harbour entrance, damage to buildings and infrastructure, Council reserves and Open Spaces assets, and the roading network.
- Landslides damaging buildings and infrastructure including Council reserves and Open Spaces assets, and the roading network.
- Sea level rise impacting natural ecosystems, Whakatāne Port structures, sedimentation rates within the Whakatāne Harbour basin, the Whakatāne Water Supply, and the level of liquefaction risk to the town.
- Increasing temperatures and more frequent periods of continuous hot days will result in increased public health risks from algal blooms and exotic pests such as mosquitoes. In combination with changes in seasonality, longer growing seasons will result in increased duration of allergenic pollen production with consequential impacts on allergy sufferers. Odour generation from organic waste facilities is also likely to increase.
- Dryer, warmer summers will increase fire risk.

7.1.2 Ōhope community

For the purposes of this climate change risk assessment, the geographical extent of the Ōhope area is defined as outlined in Figure 7.3.

Figure 7.3: Ōhope community

In addition to the climate risks discussed in the sector analyses, 26 Ōhope-specific climate risks were identified through a combination of workshops and community meetings. Details on the nature and location of these risks are detailed in Figure B2 of Appendix B.

Climate hazards identified by the community for Ōhope include coastal erosion, coastal inundation, estuarine inundation, estuarine erosion, increased storm events, landslides, flooding, and sea level rise.

The identified climate risks include:

- Coastal erosion, and coastal inundation, especially in combination with rising ground water levels due to sea level rise, of coastal dunes, residential properties, Ōhope Top 10 Holiday Park, Mahy Reserve, Open Spaces reserves and assets, Three Waters infrastructure, and the local roading network.
- Estuarine erosion, and estuarine inundation, especially in combination with rising ground water levels due to sea level rise, of estuarine ecosystems, estuarine dunes and cliffs, the Port Ōhope Wharf, Port Ōhope boat ramp, Te Tio Ōhiwa/Ōhiwa Oyster Farm, residential and lifestyle properties, Open Spaces reserves and assets, Three Waters infrastructure, and the local roading network.

- Increased storm events impacting on navigability of the harbour entrance, damage to buildings and infrastructure, Council reserves and Open Spaces assets, and the roading network.
- Landslides damaging buildings and infrastructure including Council reserves and Open Spaces assets (e.g. Ngā Tapuwae o Toi trail), and the roading network.
- Fluvial and pluvial flooding of primary production land, residential, commercial and lifestyle properties, especially if in combination with coastal storms and/or high tide.

7.1.3 Coastlands community

For the purposes of this climate change risk assessment, the geographical extent of the Coastlands area is defined as outlined in Figure 7.4.

Figure 7.4: Coastlands community

In addition to the climate risks discussed in the sector analyses, 57 Coastlands-specific climate risks were identified through a combination of workshops and community meetings. Details on the nature and location of these risks are detailed in Figure B3 of Appendix B.

Climate hazards identified by the community for Coastlands include coastal erosion, coastal inundation, flooding, ground water rise due to sea level rise, increasing temperature, and fire.

The identified climate risks include:

- Coastal erosion and coastal inundation, especially in combination with rising ground water levels due to sea level rise, of coastal dunes, wāhi tapu sites, Urupā, low-lying primary production land, and the local road network.
- Estuarine erosion, and estuarine inundation, especially in combination with rising ground water levels due to sea level rise, of estuarine margins including wetlands and salt marsh impacting on biodiversity and ecology, and erosion of stream and canal banks and flood protection assets (e.g. Opihi contaminated woodwaste site, Opihi floodgate).
- Fluvial and pluvial flooding of marae, residential and lifestyle properties, Whakatāne oxidation ponds, and primary production land, Coastlands' purpose-designed ground soakage zones, and the local road network.
- Increasing temperatures, dryness and drought increases the fire risk to residential properties, Urupā, Whenua Māori land, from scrubland and dry standing maize.

- Increasing temperatures and more frequent periods of continuous hot days will also result in increased public health risks from algal blooms and exotic pests such as mosquitoes. In combination with changes in seasonality, longer growing seasons will result in increased duration of allergenic pollen production (due to a longer growing season) with consequential impacts on allergy sufferers. Odour generation from the Whakatāne Oxidation Ponds is also likely to increase.

7.2 Rangitaiki Community Board

7.2.1 Pikowai community

For the purposes of this climate change risk assessment, the geographical extent of the Pikowai area is defined as outlined in Figure 7.5.

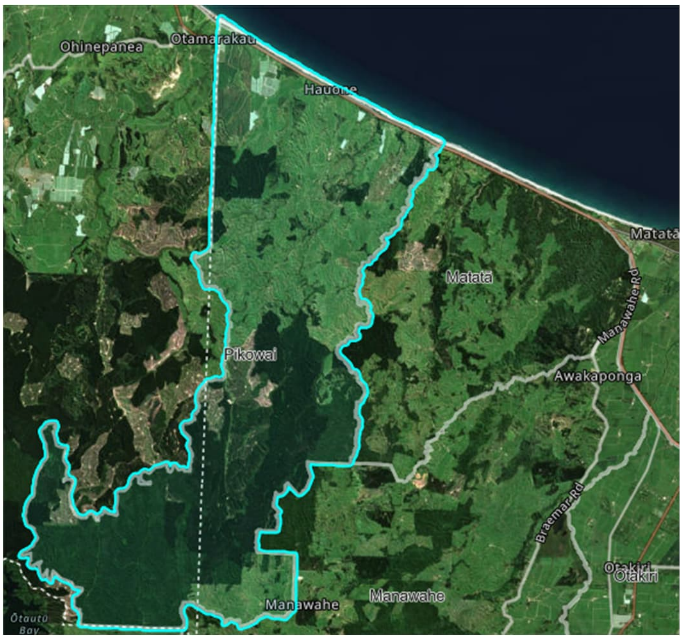

Figure 7.5: Pikowai community

In addition to the climate risks discussed in the sector analyses, 18 Pikowai-specific climate risks were identified through a combination of workshops and community meetings. Details on the nature and location of these risks are detailed in Figure B4 of Appendix B.

Climate hazards identified by the community for Pikowai include coastal erosion, coastal inundation, increased storm events, landslides, flooding, ground water rise due to sea level rise, and fire.

The identified climate risks include:

- Coastal inundation, especially in combination with rising ground water levels due to sea level rise, of coastal dunes, road and rail networks, two camping grounds (Pikowai and Ōtamarākau) and low-lying primary production land.
- Coastal erosion impacting coastal dunes (resulting in exposure of skeletal remains from warriors killed in the Battle of Kaokaoroa), road and rail networks, and the two camping grounds.
- Fluvial and pluvial flooding of primary production land, especially if in combination with coastal storms and/or high tide.
- Landslides forcing closures of State Highway 2, local roads, and the Kawerau to Mount Maunganui rail network.
- Fire risk to exotic forestry plantations.

7.2.2 Matatā community

For the purposes of this climate change risk assessment, the geographical extent of the Matatā area is defined as outlined in Figure 7.6.

Figure 7.6: Matatā community

In addition to the climate risks discussed in the sector analyses, 43 Matatā-specific climate risks were identified through a combination of workshops and community meetings with members of the Matatā community. Details on the nature and location of these risks are detailed in Figure B5 of Appendix B.

Climate hazards identified by the community for Matatā include increased storm events, flooding, landslides, ground water rise due to sea level rise, coastal erosion, coastal inundation, fire, and increasing temperature.

The identified climate risks include:

- Landslide (including debris flows) damage to residential properties, the rail network, local roads and the State Highway, Te Kaokaoroa Reserve, the Manawahe Sun Club, and primary production land.
- Fluvial and pluvial flooding of primary production land, Te Kaokaoroa Reserve, rail and State Highway networks, Te Awa a Atua Nohoanga site, Urupā, access to the DOC Camping Ground.
- Coastal erosion, and coastal inundation in combination with rising ground water levels due to sea level rise, impacting coastal dunes, road and rail networks, primary production land, the DOC Camping Ground, Te Awa a Atua Nohoanga site, Urupā, and the Tarawera River entrance.
- Public health risks from failed onsite effluent treatment systems due to high and rising ground water and more frequent high intensity rainfall events was also identified as climate risks of concern.

Risks relating to the other climate hazards include:

- Debris flow and debris flood risks to residential properties and the closed Matatā landfill due to more frequent high intensity rainfall events
- Increasing salinisation of ground water impacting pasture quality, and
- Electricity outages from lines arcing as a consequence of tree fall or strong winds due to increased storminess.

7.2.3 Thornton community

For the purposes of this climate change risk assessment, the geographical extent of the Thornton area was defined as outlined in Figure 7.7.

Figure 7.7: Thornton community

In addition to the climate risks discussed in the sector analyses, 12 Thornton-specific climate risks were identified through a combination of workshops and community meetings with members of the Thornton community. Details on the nature and location of these risks are detailed in Figure B6 of Appendix B.

Climate hazards identified by the community for Thornton include flooding, ground water rise due to sea level rise, coastal erosion, coastal inundation, wildfire risk, and increased storm events.

Flooding from high intensity rainfall events or in combination with rising ground water levels due to sea level rise feature in 7 of the 13 climate risks identified. These include potential flood damage to:

- rural homes and other buildings (flood-impacted buildings, health and wellbeing of people).
- primary production land (surface flooding and silt deposition).
- the roading network including entranceways into private properties (reduced/no access).
- rural lifestyle properties (especially on-site effluent treatment systems).

Risks relating to the other climate hazards include:

- disruption to flight services at Whakatāne airport due to more frequent storm events.
- increased fire risk to rural properties, Thornton Holiday Park, Whakatāne airport, the Whakatāne Golf Club, due to rising temperatures, dryness and more frequent drought conditions.
- increasing sedimentation of the Thornton harbour and river entrance due to sea level rise.
- increasing risk of coastal erosion and coastal inundation to Thornton Beach Holiday Park due to a combination of sea level rise and more frequent storm events.

7.2.4 Manawahe community

For the purposes of this climate change risk assessment, the geographical extent of the Manawahe area is defined as outlined in Figure 7.8.

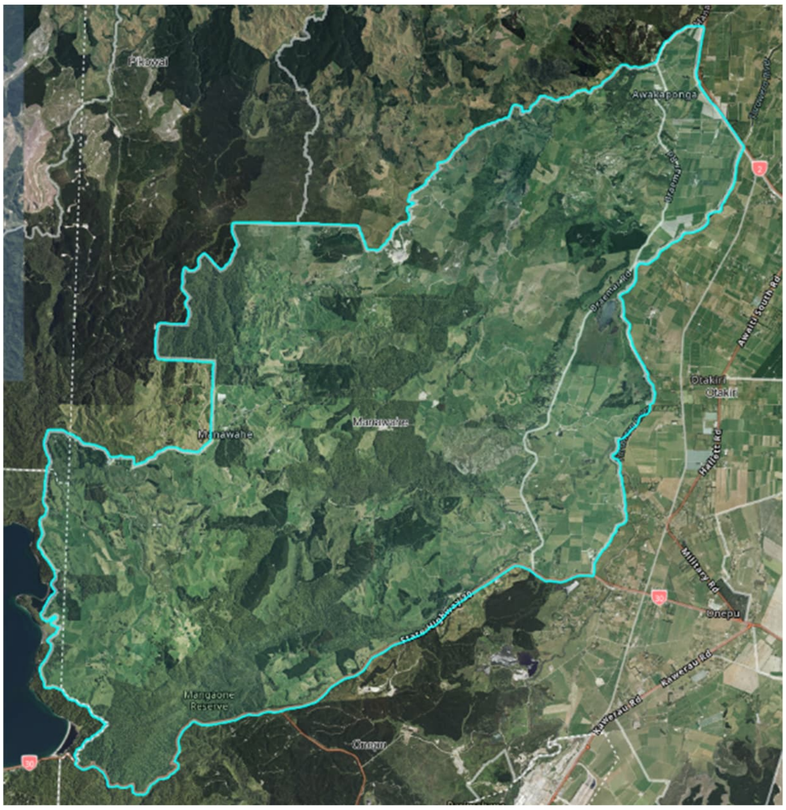

Figure 7.8: Manawahe community

In addition to the climate risks discussed in the sector analyses, 25 Manawahe-specific climate risks were identified through a combination of workshops and community meetings. Details on the nature and location of these risks are detailed in Figure B7 of Appendix B.

Climate hazards identified by the community for Manawahe include landslides, pluvial flooding, increasing temperature, increased storm events, and fire.

The identified climate risks include:

- Landslide risk to local roads, Braemar Springs water supply source and reservoir, including the access track to the reservoir.
- Pluvial and fluvial flooding of primary production land, local roads, including streambank erosion to Braemar Springs Three Waters infrastructure. Increased sedimentation of the Karaponga Dam from more frequent high intensity rainfall events will impact on the Dam's generating capability.
- Increased risk to current land use activities due to increasing temperature, more heatwaves and drought.
- Changing landuse patterns from pastoral farming to plantation forestry result in increased fire risk to rural properties under increasing temperature, dryness and drought conditions.
- Increased storms are likely to cause increased power outages due to tree fall and/or arcing power lines.

7.2.5 Otakiri community

For the purposes of this climate change risk assessment, the geographical extent of the Otakiri area is defined as outlined in Figure 7.9.

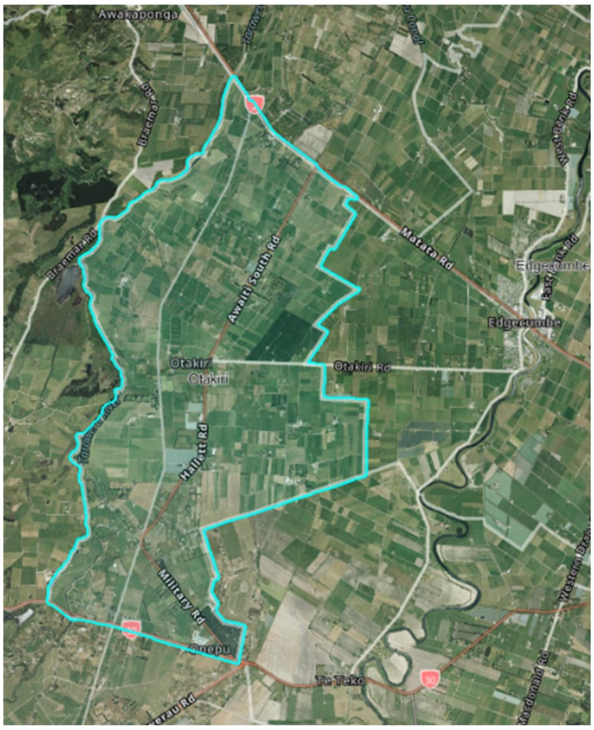

Figure 7.9: Otakiri community

In addition to the climate risks discussed in the sector analyses, seven Otakiri-specific climate risks were identified through a combination of workshops and community meetings. Details on the nature and location of these risks are detailed in Figure B8 of Appendix B.

Climate hazards identified by the community for Otakiri include increasing temperature, increased storm events, pluvial flooding, and fire.

Flooding from high intensity rainfall events is the dominant climate hazard featuring in 5 of the 7 climate risks identified. The identified flood risks include flood damage to:

- Residential and rural properties (flood-impacted buildings, on-site effluent treatment systems, health and wellbeing of people)
- Otakiri Primary School grounds
- Primary production land (surface flooding and fluctuating ground water levels)
- Shallow bores
- The roading network

Increasing temperature, fewer frost days, increases in dryness and drought, and changes in seasonality were identified as risks to crop yield for kiwifruit orchards and to dairying, especially for those farms that require pasture and crop irrigation due to soil type if freshwater abstraction limits were to be constrained.

7.2.6 Edgecumbe community

For the purposes of this climate change risk assessment, the geographical extent of the Edgecumbe area is defined as outlined in Figure 7.10.

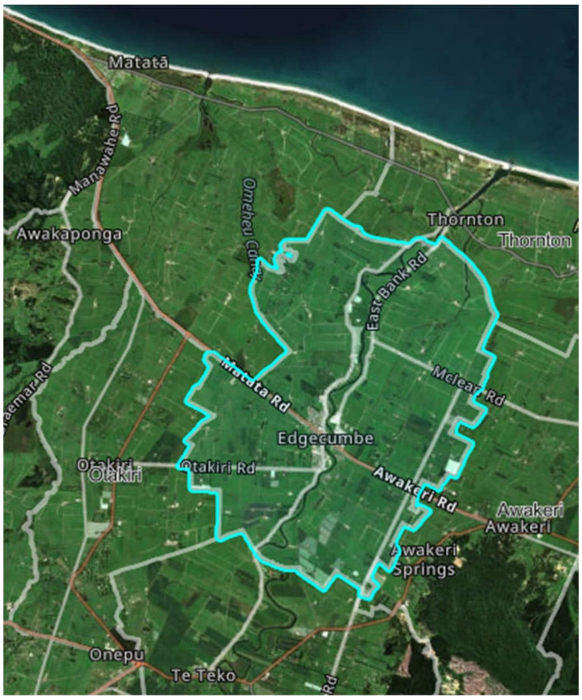

Figure 7.10: Edgecumbe community

In addition to the climate risks discussed in the sector analyses, 12 Edgecumbe-specific climate risks were identified through a combination of workshops and community meetings with members of the Edgecumbe community. Details on the nature and location of these risks are detailed in Figure B9 of Appendix B.

Flooding from high intensity rainfall events is the dominant climate hazard featuring in 11 of the 12 climate risks identified. The identified flood risks include flood damage to:

- Residential, commercial and industrial properties (flood-impacted buildings, health and wellbeing of people)
- Primary production land (surface flooding and silt deposition)
- Rural lifestyle properties (especially on-site effluent treatment systems)
- Electricity infrastructure
- Papa Taonga Reserve and adjacent footpath (public access)
- The Edgecumbe oxidation ponds (public health effects and environmental contamination of the Omeheu Canal and adjacent pastoral land).

The other climate risk identified by community members was wind and hail damage to solar farm infrastructure due to extreme weather events occurring more frequently in the future.

7.2.7 Onepū community

For the purposes of this climate change risk assessment, the geographical extent of the Onepū area is defined as outlined in Figure 7.11.

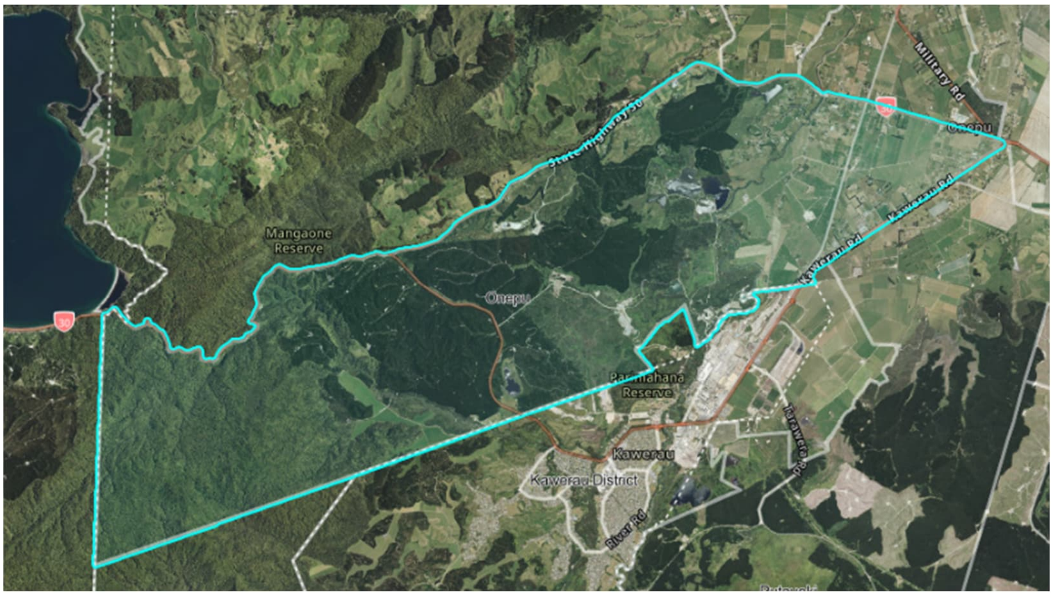

Figure 7.11: Onepū community

In addition to the climate risks discussed in the sector analyses, four Onepū-specific climate risks were identified through a combination of workshops and community meetings. Details on the nature and location of these risks are detailed in Figure B10 of Appendix B.

Climate hazards identified by the community for Onepū include pluvial flooding, landslides, and fire.

The identified climate risks include:

- Pluvial flooding of marae, residential and lifestyle properties, primary production land, the local road network and State Highway 30.
- Landslides from high intensity rainfall events frequently occur on SH30 blocking the road. This risk has been recorded under the Community report for Manawahe.
- Increasing temperatures, dryness and drought increase the fire risk to rural lifestyle properties and plantation forestry.

Increasing temperatures and more frequent periods of continuous hot days will also result in increased public health risks from algal blooms and exotic pests such as mosquitoes. In combination with changes in seasonality, longer growing seasons will result in increased duration of allergenic pollen production (due to a longer growing season) with consequential impacts on allergy sufferers.

7.2.8 Te Teko and Te Mahoe community

For the purposes of this climate change risk assessment, the geographical extent of the Te Teko and Te Mahoe area is defined as outlined in Figure 7.12.

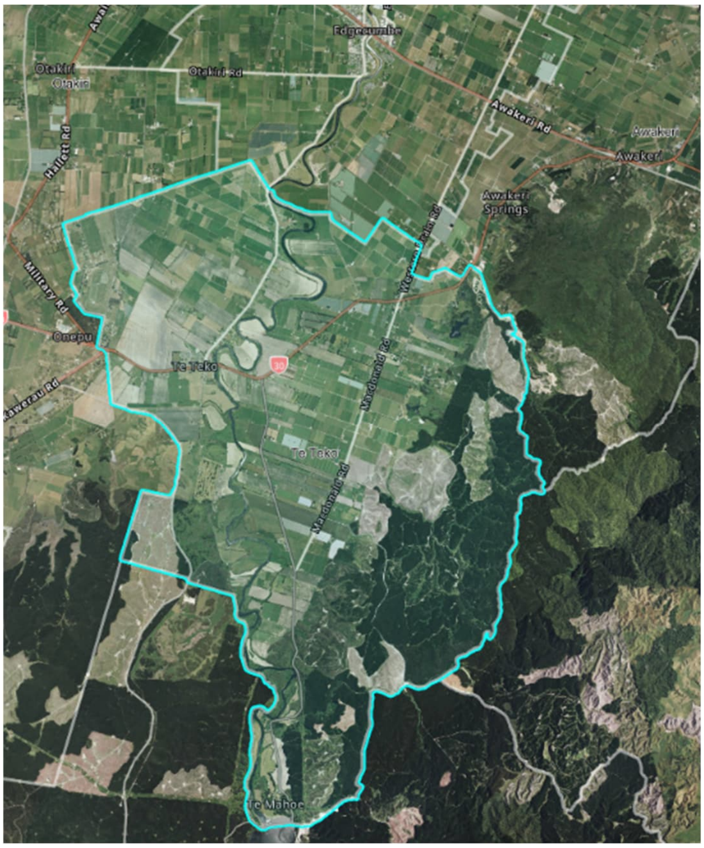

Figure 7.12: Te Teko and Te Mahoe community

In addition to the climate risks discussed in the sector analyses, 22 Te Teko and Te Mahoe-specific climate risks were identified through a combination of workshops and community meetings. Details on the nature and location of these risks are detailed in Figure B11 of Appendix B.

Climate hazards identified by the community for Te Teko and Te Mahoe include pluvial and fluvial flooding, riverbank erosion, increased storm events, landslides, increasing temperature, changing seasonality, and fire.

Pluvial and fluvial flooding (including riverbank erosion) from high intensity rainfall events are the dominant climate hazards featuring in 15 of the 22 climate risks identified. The identified flood risks include potential flood damage to:

- Flood protection structures, e.g. stopbanks
- Residential, commercial, and rural properties including several marae, Te Kura o Te Teko, Te Teko Hall, and Racecourse Park (flood-impacted buildings, on-site effluent treatment systems, health and wellbeing of people)
- Primary production land (surface flooding and silt deposition)
- Urupā
- Paul Road water supply
- The roading network

Increasing temperature, fewer frost days, increases in dryness and drought, and changes in seasonality were identified as risks to crop yield for horticulture and to dairying, especially for those farms that require pasture and crop irrigation due to soil type if freshwater abstraction limits were to be constrained.

Increasing temperatures, dryness and drought also increases the fire risk to plantation forestry and seasonal fire risk to residential properties from dry standing maize. In combination with changes in seasonality, longer growing seasons will result in increased duration of allergenic pollen production (due to a longer growing season) with consequential impacts on allergy sufferers.

Community isolation for Te Mahoe residents due to landslides closing Galatea Road was also identified as a climate risk of concern.

7.2.9 Awakeri community

For the purposes of this climate change risk assessment, the geographical extent of the Awakeri area is defined as outlined in Figure 7.13.

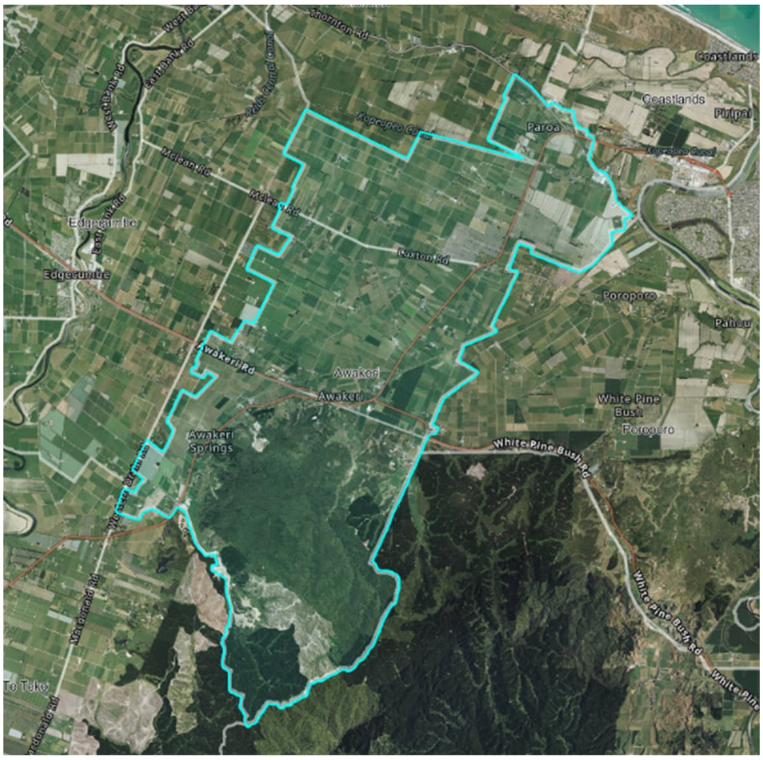

Figure 7.13: Awakeri community

In addition to the climate risks discussed in the sector analyses, 15 Awakeri-specific climate risks were identified through a combination of workshops and community meetings. Details on the nature and location of these risks are detailed in Figure B12 of Appendix B.

Climate hazards identified by the community for Awakeri include pluvial flooding, increasing temperatures, and fire.

Flooding from high intensity rainfall events is the dominant climate hazard featuring in 5 of the 7 climate risks identified. The identified flood risks include flood damage to:

- Residential and rural properties (flood-impacted buildings, on-site effluent treatment systems, health and wellbeing of people)
- Te Kura o Te Paroa
- Primary production land (surface flooding and fluctuating ground water levels)

Increased leachate from legacy contaminated woodwaste sites was also identified as a climate risk.

Fire risks identified included seasonal fire risk from dry standing maize, and increased fire risk to plantation forestry and native fauna (including kiwi) from increasing temperatures, dryness and drought.

7.2.10 Poroporo community

For the purposes of this climate change risk assessment, the geographical extent of the Poroporo area is defined as outlined in Figure 7.14.

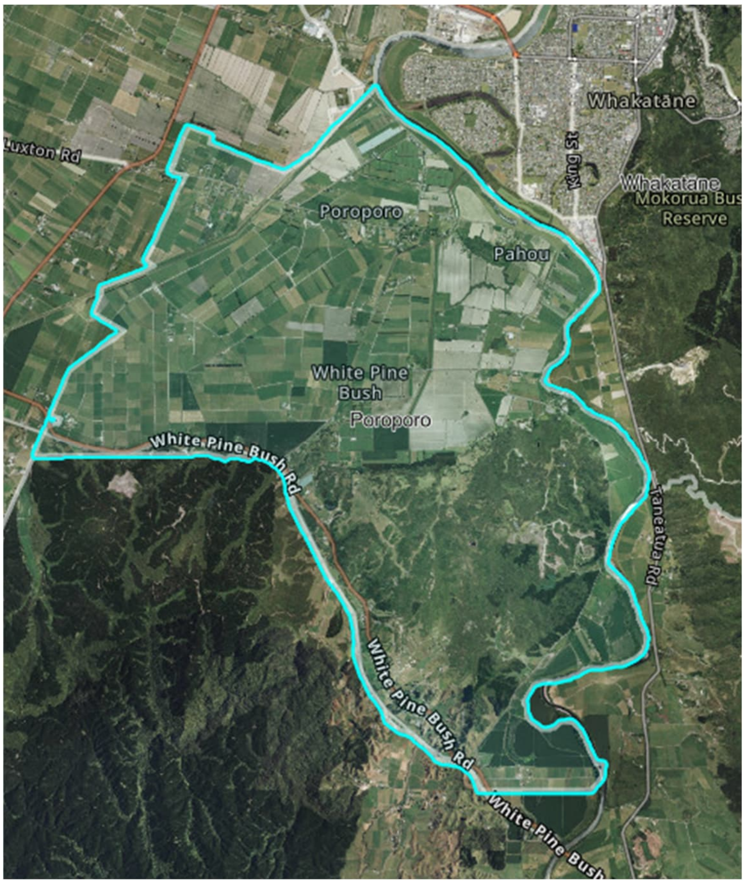

Figure 7.14: Poroporo community

In addition to the climate risks discussed in the sector analyses, 23 Poroporo-specific climate risks were identified through a combination of workshops and community meetings. Details on the nature and location of these risks are detailed in Figure B13 of Appendix B.

Climate hazards identified by the community for Poroporo include pluvial and fluvial flooding, stopbank erosion, landslides, increasing temperature, changing seasonality, ground water rise, and fire.

Pluvial and fluvial flooding (including stopbank erosion) from high intensity rainfall events are the dominant climate hazards featuring in 15 of the 23 climate risks identified. The identified flood risks include potential flood damage to:

- Flood protection structures, e.g. stopbanks
- Stream beds and stream banks (e.g. Waioho Stream)
- Low lying land containing rural residential properties, marae, and Poroporo Sports Club (flood-impacted buildings, on-site effluent treatment systems, health and wellbeing of people)

- Primary production land (surface flooding and silt deposition)
- The roading network

Increased leachate run-off from legacy contaminated woodwaste sites was also identified as a climate risk, particularly for those sites close to the Whakatāne River as the river is the source of the Whakatāne water supply.

Landslides to White Pine Bush Road and Rewatu Road due to high intensity rainfall events already occur. The frequency of these landslides is likely to increase in the future which in turn increases their risk.

Increased fire risks to cropping land due to rising temperatures and increased dryness and drought were also identified as potential climate risks.

7.3 Tāneatua Community Board

7.3.1 Tāneatua community

For the purposes of this climate change risk assessment, the geographical extent of the Tāneatua area is defined as outlined in Figure 7.15.

Figure 7.15: Tāneatua community

In addition to the climate risks discussed in the sector analyses, 29 Tāneatua-specific climate risks were identified through a combination of workshops and community meetings. Details on the nature and location of these risks are detailed in Figure B14 of Appendix B.

Climate hazards identified by the community for Tāneatua include flooding, erosion, increased storm events, landslides, flooding, ground water rise due to sea level rise, and fire.

Fluvial flooding from high intensity rainfall events is the dominant climate risk featuring in 20 of the 29 climate risks identified. The identified fluvial flood risks include flood damage to:

- Residential and rural properties (flood-impacted buildings, on-site effluent treatment systems, health and wellbeing of people)

- Primary production land (surface flooding and sedimentation)
- Three Waters Infrastructure (water supply as well as the Tāneatua Oxidation Ponds)
- The local roading network and State Highway 2 (including bridges) resulting in community isolation
- The closed landfill adjacent to the Pekatahi Bridge
- Flood protection systems (erosion of stopbanks and riverbanks)

Fluvial flooding is already causing aggradation of riverbeds raising the level of fluvial flood risk to low-lying rural and residential properties. Pluvial flood risks were identified to residential and rural properties, primary production land and the roading network.

Increased intensity and frequency of high intensity rainfall events will also result in more frequent damaging landslides to buildings and infrastructure, and increase the frequency of community isolation.

7.3.2 Rūātoki community

For the purposes of this climate change risk assessment, the geographical extent of the Rūātoki area is defined as outlined in Figure 7.16.

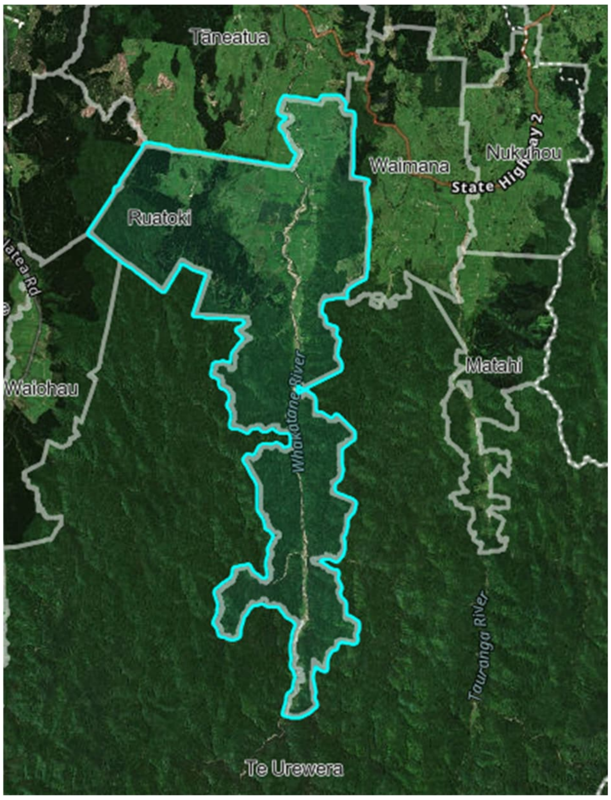

Figure 7.16: Rūātoki community

In addition to the climate risks discussed in the sector analyses, 16 Rūātoki-specific climate risks were identified through a combination of workshops and community meetings. Details on the nature and location of these risks are detailed in Figure B15 of Appendix B.

Climate hazards identified by the community for Rūātoki include flooding, erosion, increased temperature, and fire.

Fluvial flooding from high intensity rainfall events is the dominant climate risk featuring in 13 of the 16 climate risks identified. The identified fluvial flood risks include flood damage to:

- Marae and Urupā
- Rural properties (flood-impacted buildings, on-site effluent treatment systems, health and wellbeing of people)
- Primary production land (surface flooding and sedimentation)
- Three Waters Infrastructure (especially the Rūātoki water supply)
- The local roading network(including the Ohutu Road bridge) resulting in community isolation
- Riverbanks

Fluvial flooding is already causing aggradation of riverbeds elevating the level of fluvial flood risk to low-lying rural and residential properties.

Community isolation from pluvial flooding of rural properties and the roading network was also identified.

Other climate risks identified include:

- Public health risk from contamination of the public water supply during flood events.
- Risk to the mauri of Te Urewera from introduced exotic pest species and drought due to increased temperatures, more frequent periods of continuous hot days, dryness and drought.
- Fire risk to plantation and native forests due to increased temperatures, more frequent periods of continuous hot days, dryness and drought.

7.3.3 Waimana and Nukuhou-North communities

For the purposes of this climate change risk assessment, the geographical extent of the Waimana and Nukuhou-North areas is defined as outlined in Figure 7.17.

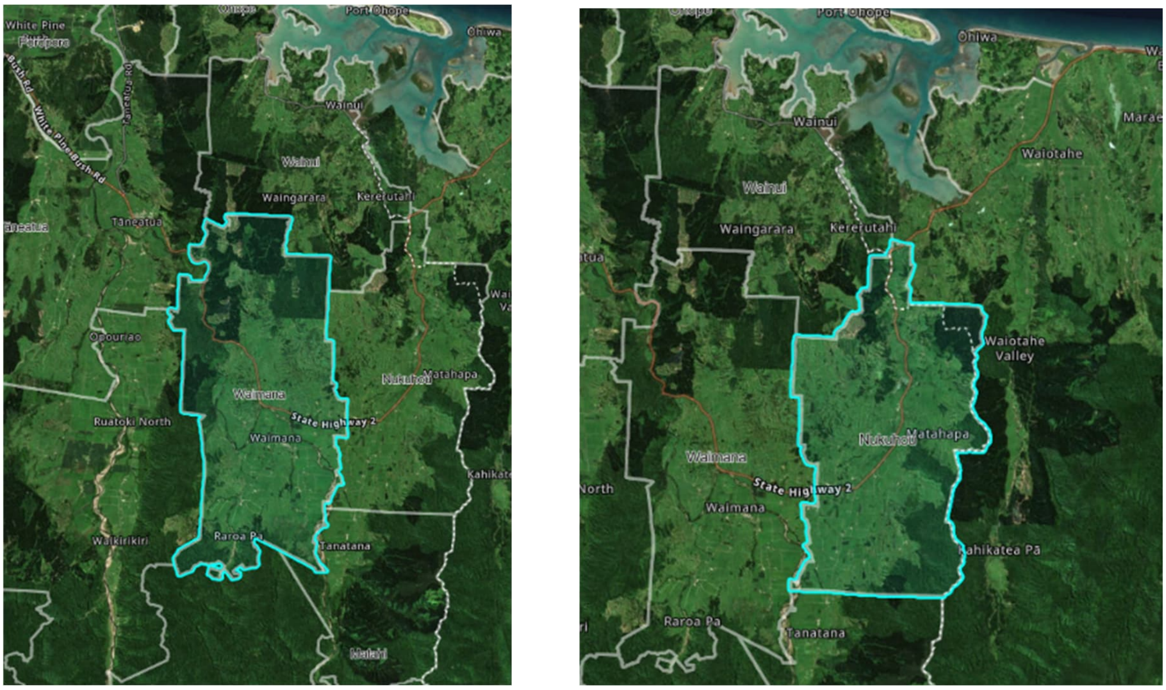

Figure 7.17: Waimana and Nukuhou-North communities

In addition to the climate risks discussed in the sector analyses, 15 Waimana and two Nukuhou-North-specific climate risks were identified through a combination of workshops and community meetings. Details on the location and content of these climate risks are detailed in Figures B16 of Appendix B.

Climate hazards identified by the community for Waimana and Nukuhou-North include landslides, flooding, erosion, increasing temperature, and fire.

Fluvial flooding from high intensity rainfall events is the dominant climate risk featuring in 9 of the 15 climate risks identified. Identified fluvial flood risks include flood damage to:

- Primary production land (surface flooding and sedimentation)
- The Waimana water supply pump station (inundation, also identified as a pluvial flood risk)
- Local roads and State Highway 2 resulting in community isolation
- Riverbanks (erosion)
- Electricity infrastructure

Forestry slash impacting waterways and the roading networks was also identified as a fluvial flood risk.

Other climate risks identified include:

- Increasing temperatures and more frequent periods of continuous hot days will also result in increased public health risks from algal blooms and exotic pests such as mosquitoes. In combination with changes in seasonality, longer growing seasons will result in increased duration of allergenic pollen production (due to a longer growing season) with consequential impacts on allergy sufferers.
- Fire risk to plantation and native forests, and houses in close proximity to those forests, due to increased temperature, more frequent periods of continuous hot days, dryness and drought.

7.3.4 Matahi community

For the purposes of this climate change risk assessment, the geographical extent of the Matahi area is defined as outlined in Figure 7.18.

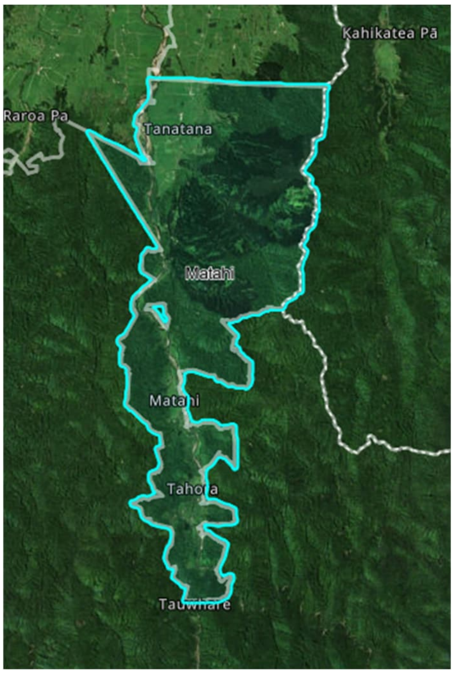

Figure 7.18: Matahi community

In addition to the climate risks discussed in the sector analyses, four Matahi-specific climate risks were identified through a combination of workshops and community meetings. Details on the nature and location of these risks are detailed in Figure B17 of Appendix B.

Climate hazards identified by the community for Matahi include flooding and fire.

The climate risks identified were:

- Fluvial flooding of primary production land due to aggradation of the Tauranga River bed due to a reduction in shingle extraction.
- Riverbank erosion during fluvial flood events.
- Fire risk to plantation and native forestry due to increased temperature, dryness and drought.

7.3.5 Wainui community

For the purposes of this climate change risk assessment, the geographical extent of the Wainui area is defined as outlined in Figure 7.19.

Figure 7.19: Wainui community

In addition to the climate risks discussed in the sector analyses, 22 Wainui-specific climate risks were identified through a combination of workshops and community meetings. Details on the nature and location of these risks are detailed in Figure B18 of Appendix B.

Climate hazards identified by the community for Wainui include estuarine inundation and erosion, flooding, landslides, increasing temperature, sea level rise, and fire.

The climate risks identified include:

- Fluvial and pluvial flooding of the local road network and primary production land.
- Coastal erosion and coastal inundation of the local road network and primary production land from storm events.
- Ecological degradation of Ōhiwa Harbour ecosystems including kaimoana due to sedimentation as a consequence of upper catchment landslides during high intensity rainfall events.
- Ecological degradation of wetland ecosystems, salt marsh and native flora and fauna due to sea level rise, increased salinity, and higher water temperatures.
- Changes to existing pastoral farming on low-lying land as a consequence of rising groundwater due to sea level rise.
- Landslide risk to rural properties and the road network.
- Fire risk to plantation and native forestry and to estuarine salt marsh due to increased temperature, dryness and drought.

7.4 Murupara Community Board

7.4.1 Lake Matahina community

For the purposes of this climate change risk assessment, the geographical extent of the Lake Matahina area is defined as outlined in Figure 7.20.

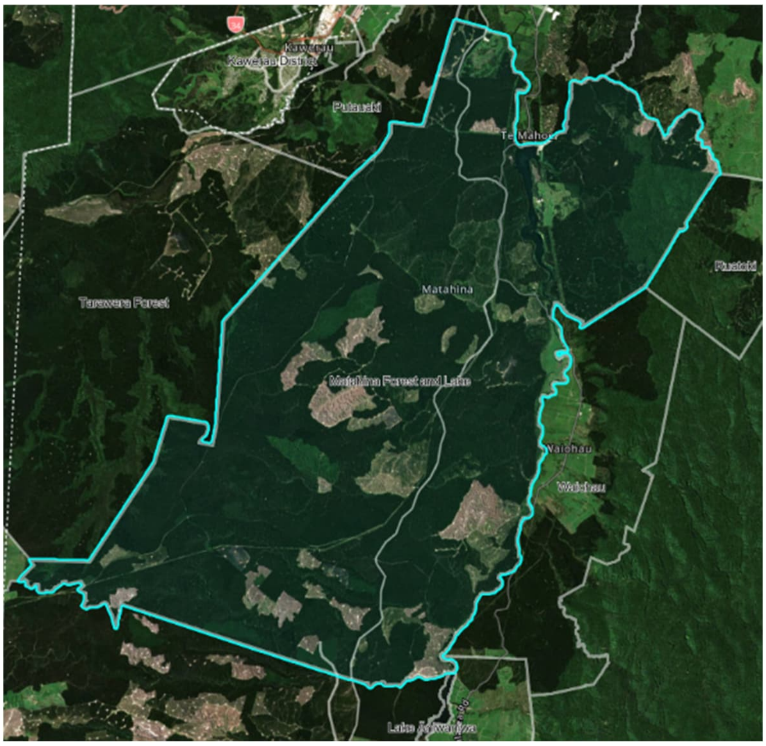

Figure 7.20: Lake Matahina community

In addition to the climate risks discussed in the sector analyses, 10 Lake Matahina -specific climate risks were identified through a combination of workshops and community meetings. Details on the nature and location of these risks are detailed in Figure B19 of Appendix B.

Climate hazards identified by the community for Lake Matahina include flooding, landslides, increased temperature, and fire.

The climate risks identified were:

- Fluvial flooding of primary production land.
- Increased fluvial flood flows due to more intense rainfall events.
- Increased debris loading on the Lake Matahina Dam debris screens from fluvial floods.
- Sedimentation of the Lake from more frequent fluvial flood events.
- Degradation of water quality, ecology, and Mauri of the Lake from fluvial flood events.
- Landslide risk from more frequent high intensity rainfall events.
- Inland tsunami risk from landslides.
- Degradation of water quality, ecology, and Mauri of the Lake from increased temperature, dryness and drought.
- Fire risk to plantation forestry due to increased temperature, dryness and drought.
- Fire risk to plantation forestry from electricity lines due to increased temperature, dryness and drought.

7.4.2 Waiohau community

For the purposes of this climate change risk assessment, the geographical extent of the Waiohau area is defined as outlined in Figure 7.21.

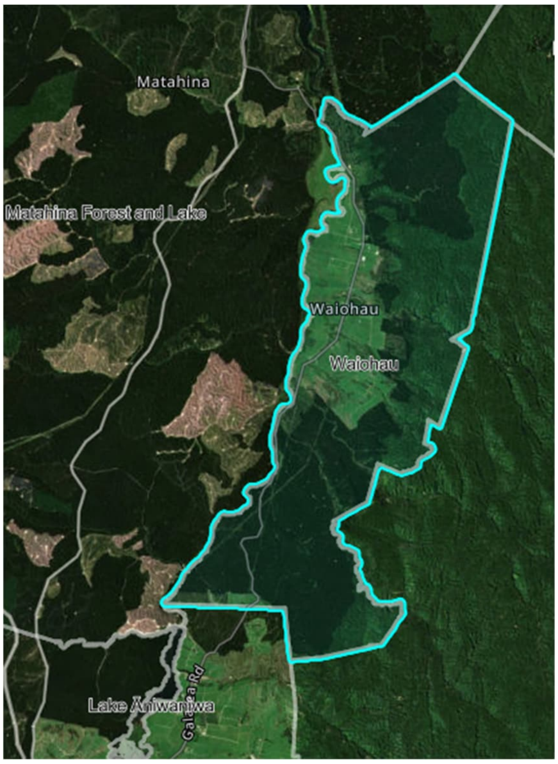

Figure 7.21: Waiohau community

In addition to the climate risks discussed in the sector analyses, 17 Waiohau-specific climate risks were identified through a combination of workshops and community meetings. Details on the nature and location of these risks are detailed in Figure B20 of Appendix B.

Climate hazards identified by the community for Waiohau include landslides, fluvial flooding, riverbank erosion, increased storm events, increasing temperature, dryness and drought, and fire.

The identified climate risks include:

- Community isolation due to landslides closing Galatea Road either side of the Waiōhau township.
- Fluvial flooding of Urupā and marae, residential buildings, Te Kura Māori ā Rohe o Waiōhau (including the onsite effluent treatment system), primary production land and the roading network including bridges.
- Streambank erosion extending to the Urupā.
- Pluvial flooding of primary production land.
- Public health risk from dust from unsealed access road to the Marae and Urupā, and from wildfire.
- Public health risk from bacterial and pathogen contamination of untreated water supplies due to increasing temperatures.
- Wildfire risk to plantation forestry from powerlines due to increased temperature, dryness and drought.

7.4.3 Lake Āniwaniwa community

For the purposes of this climate change risk assessment, the geographical extent of the Lake Āniwaniwa area is defined as outlined in Figure 7.22.

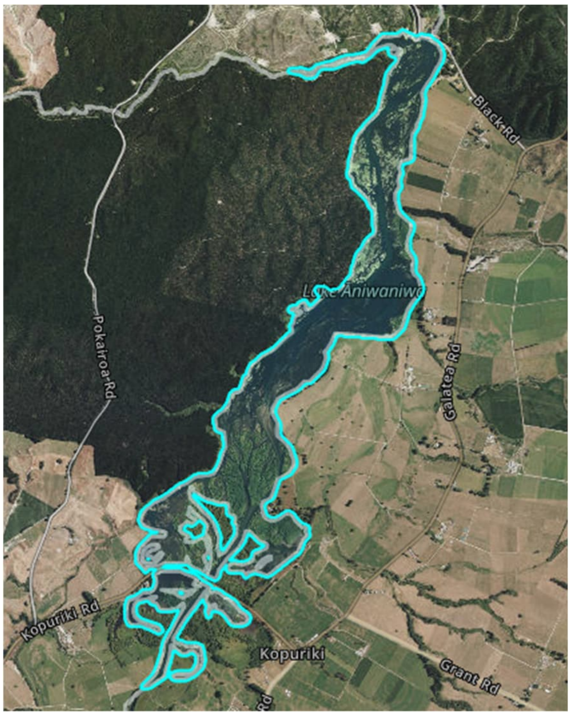

Figure 7.22: Lake Āniwaniwa community

In addition to the climate risks discussed in the sector analyses, four Lake Āniwaniwa-specific climate risks were identified through a combination of workshops and community meetings. Details on the nature and location of these risks are detailed in Figure B21 of Appendix B.

Climate hazards identified by the community for Lake Āniwaniwa include flooding, increased temperature, and fire.

The identified climate risks include:

- Fluvial flooding of primary production land due to aggradation of the Rangitaiki River and the bed of the Lake.
- Debris loading on the Āniwaniwa Dam debris screens from fluvial floods.
- Sedimentation of the Lake from more frequent fluvial flood events.
- Degradation of water quality, ecology, and Mauri of the Lake from increased temperature, dryness and drought.

7.4.4 Galatea community

For the purposes of this climate change risk assessment, the geographical extent of the Galatea area is defined as outlined in Figure 7.23.

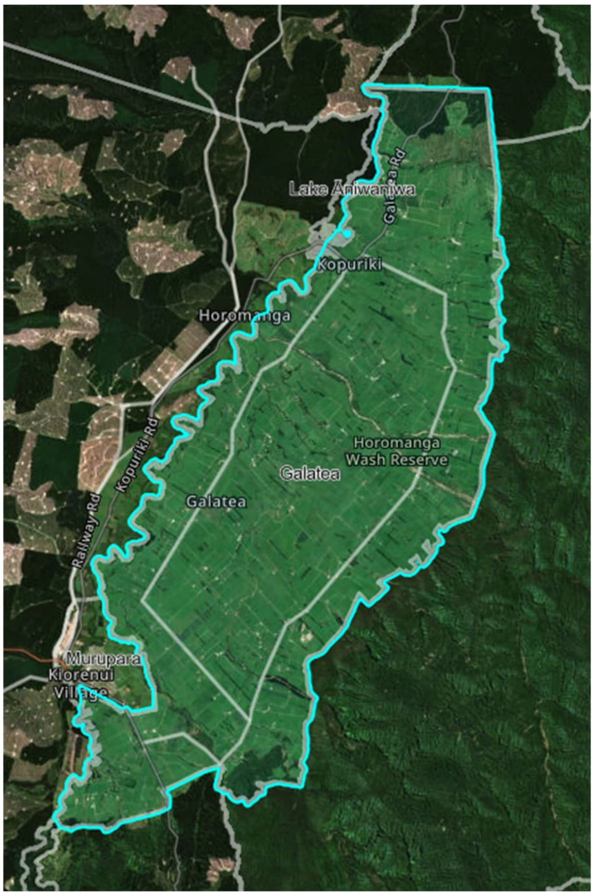

Figure 7.23: Galatea community

In addition to the climate risks discussed in the sector analyses, 16 Galatea -specific climate risks were identified through a combination of workshops and community meetings. Details on the nature and location of these risks are detailed in Figure B22 of Appendix B.

Climate hazards identified by the community for Galatea include fluvial flooding, debris flows, increasing temperature, dryness and drought, and fire.

The identified climate risks include:

- Fluvial flooding impacting primary production land, the roading network (including scouring of bridge foundations), water quality, and freshwater ecology.
- Debris flow risk to rural properties, including buildings, that are located along the foothills of Te Urewera where streams exit, and to Troutbeck Road including bridges.
- Increasing temperature risks include impact on water quality, freshwater ecosystems {including traditional food gathering locations for watercress), and the mauri of the streams
- Increasing temperature, fewer frost days, increases in dryness and drought, and changes in seasonality were identified as risks to the dominant rural landuse (dairy farming) due to adverse impacts on pasture growth. This will especially impact those farms that require irrigation should freshwater abstraction limits be constrained.
- Increased fire risk to the Galatea airport due to increasing temperature, dryness and drought was also identified as a climate risk that will increase in the future.

7.4.5 Kāingaroa Forest community

For the purposes of this climate change risk assessment, the geographical extent of the Kāingaroa Forest area is defined as outlined in Figure 7.24.

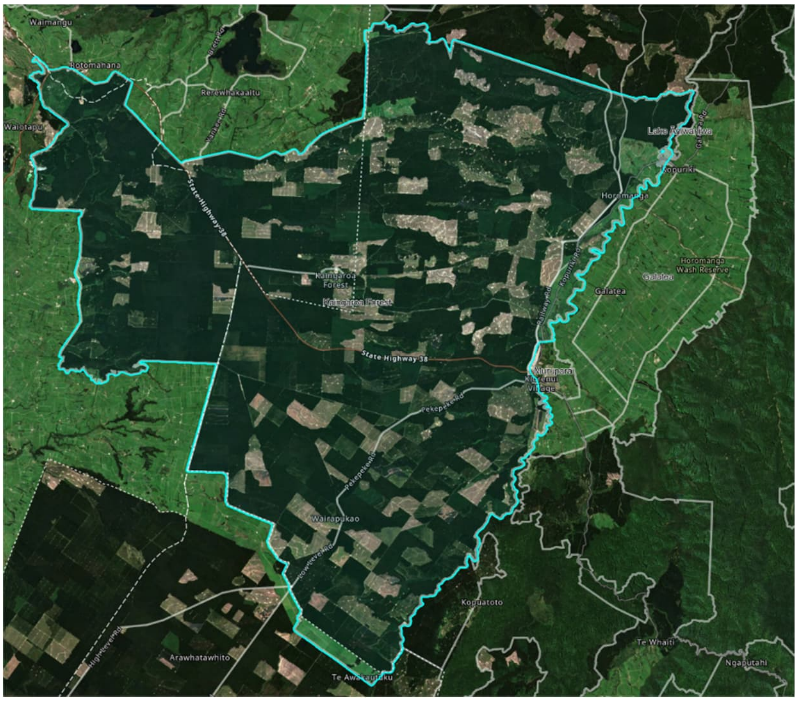

Figure 7.24: Kāingaroa Forest community

In addition to the climate risks discussed in the sector analyses, 15 Kāingaroa Forest-specific climate risks were identified through a combination of workshops and community meetings. Details on the nature and location of these risks are detailed in Figure B23 of Appendix B.

Climate hazards identified by the community for Kāingaroa Forest include flooding, landslides, storminess, increasing temperature, and fire.

The identified climate risks include:

- Fluvial flooding of rural properties, Moewhare Marae, primary production land, and the roading network.
- Risk to the mauri of streams and rivers from forestry slash washed off the hills and into the freshwater systems during storm events featuring high intensity rainfall.
- Landslide risk to the road and rail networks during storm events.
- Tree fall risk to road and rail networks during storm events.
- Health and safety risk to forestry workers during storm events.
- Increasing temperature, in combination with changes in seasonality, will result in longer growing seasons enabling increased duration of allergenic pollen production with consequential impacts on allergy sufferers.
- Increasing temperature risk to wetland ecosystems including reduced resilience to pest flora and fauna.
- Fire risk to plantation forestry due to increased temperature, dryness and drought.

7.4.6 Murupara community

For the purposes of this climate change risk assessment, the geographical extent of the Murupara area is defined as outlined in Figure 7.25.

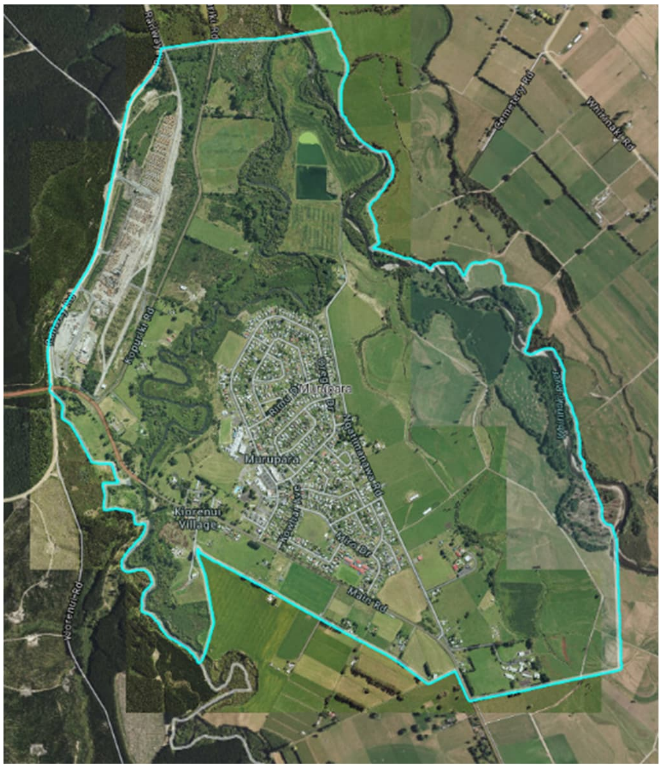

Figure 7.25: Murupara community

In addition to the climate risks discussed in the sector analyses, 11 Murupara-specific climate risks were identified through a combination of workshops and community meetings. Details on the nature and location of these risks are detailed in Figure B24 of Appendix B.

Climate hazards identified by the community for Murupara include fluvial and pluvial flooding, erosion, increasing temperature, and fire.

The identified climate risks include:

- Fluvial flooding impacting residential properties as well as primary production land, Kani Rangi Park, the Murupara oxidation ponds, the roading network (including scouring of bridge foundations), water quality, freshwater ecology, and the mauri of rivers and streams.
- Fluvial erosion of bridge supports and riverbanks (including the riverbank directly upstream of Tipapa Marae) and the closed Murupara landfill.
- Increasing temperature risks include impact on water quality, freshwater ecosystems (including traditional food gathering locations for watercress), and Mauri of the streams.
- Increasing temperature, fewer frost days, increases in dryness and drought, and changes in seasonality were identified as risks to the dominant rural landuse (dairy farming) due to adverse impacts on pasture growth. This will especially impact those farms that require irrigation should freshwater abstraction limits be constrained.
- Increased risk to the mauri of the Rangitāiki River from forestry slash being mobilised during high intensity rainfall events.

7.4.7 Te Urewera community

For the purposes of this climate change risk assessment, the geographical extent of the Te Urewera area is defined as outlined in Figure 7.26.

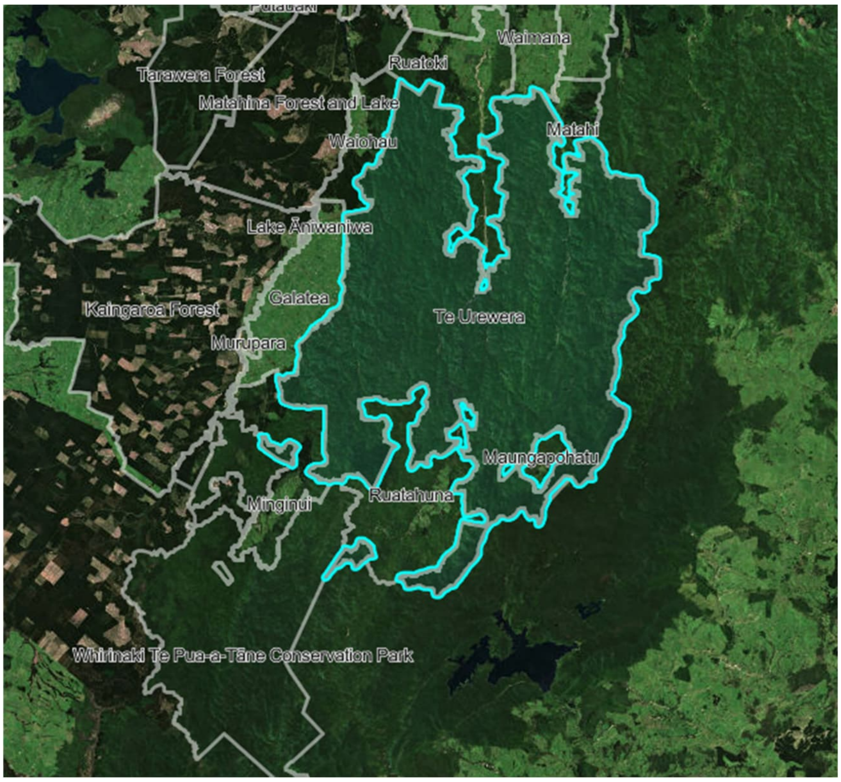

Figure 7.26: Te Urewera Community

In addition to the climate risks discussed in the sector analyses, seven Te Urewera-specific climate risks were identified through a combination of workshops and community meetings. Details on the nature and location of these risks are detailed in Figure B25 of Appendix B.

Climate hazards identified by the community for Te Urewera include increased temperature, landslides and fire.

The identified climate risks include:

- Increasing temperature resulting in increased risk to terrestrial and freshwater ecosystems from new exotic pest and weed species.
- Fire risk to native flora and fauna and recreational users due to increased temperature, dryness and drought.
- Impact on tourism from increased landslides due to more frequent high intensity rainfall events.

7.4.8 Minginui and Te Whāiti community

For the purposes of this climate change risk assessment, the geographical extent of the Minginui and Te Whāiti area is defined as outlined in Figure 7.27.

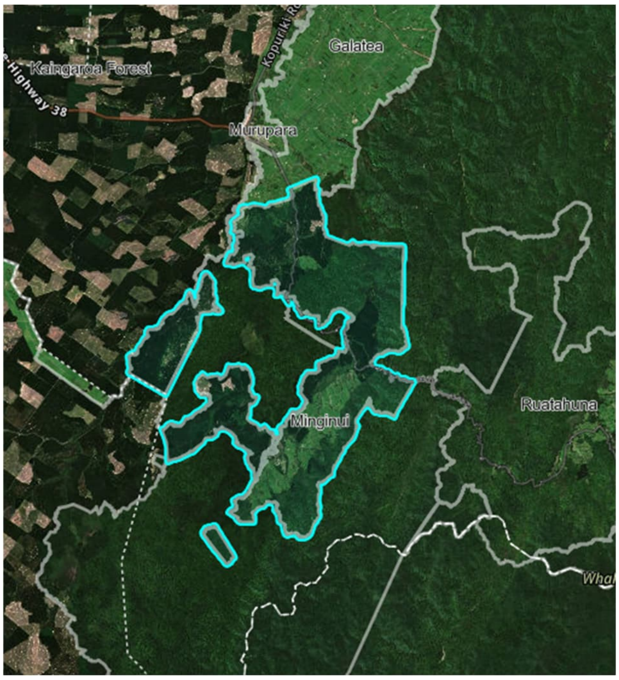

Figure 7.27: Minginui and Te Whāiti community

In addition to the climate risks discussed in the sector analyses seven Minginui and Te Whāiti-specific climate risks were identified through a combination of workshops and community meetings. Details on the nature and location of these risks are detailed in Figure B26 of Appendix B.

Climate hazards identified by the community for Minginui and Te Whāiti include increased storm events, landslides, fluvial flooding, increasing temperature, and fire.

The identified climate risks include:

- Community isolation due to landslides closing State Highway 38 between Murupara and Te Whāiti and between Te Whāiti and Wairoa.
- Fluvial flooding causing erosion to the Mangawiri Stream and scouring of bridge support structures.
- Public health risk from bacterial and pathogen contamination of untreated water supplies due to increasing temperatures.
- Increased fire risk to Minginui township, plantation forestry and Te Urewera due to rising temperatures and dryness and drought.
- Increasing temperatures and more frequent periods of continuous hot days will also result in increased public health risks from algal blooms and exotic pests such as mosquitoes. In combination with changes in seasonality, longer growing seasons will result in increased duration of allergenic pollen production (due to a longer growing season) with consequential impacts on allergy sufferers.

7.4.9 Ruatāhuna community

For the purposes of this climate change risk assessment, the geographical extent of the Ruatāhuna area is defined as outlined in Figure 7.28.

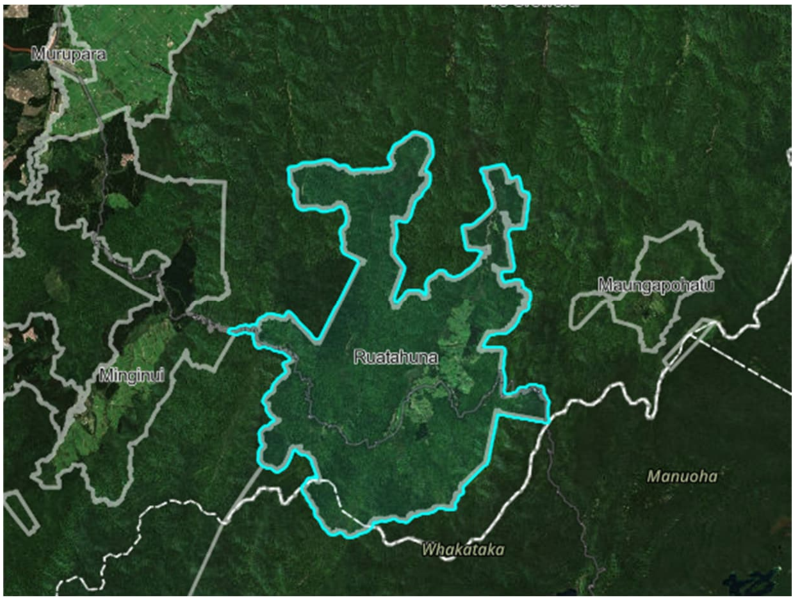

Figure 7.28: Ruatāhuna community

In addition to the climate risks discussed in the sector analyses, six Ruatāhuna-specific climate risks were identified through a combination of workshops and community meetings. Details on the nature and location of these risks are detailed in Figure B27 of Appendix B.

Climate hazards identified by the community for Ruatāhuna include increased storm events, landslides, and increasing temperature.

The associated climate risks include:

- Increased power outages due to tree fall and/or arcing power lines are likely due to more frequent storm events.
- Increased intensity and frequency of high intensity rainfall events will result in more frequent damaging landslides to natural ecosystems, buildings and infrastructure, and result in community isolation.
- Public health risk from bacterial and pathogen contamination of untreated water supplies due to increasing temperatures and/or more frequent storm events.
- Increasing temperatures and more frequent periods of continuous hot days will also result in increased public health risks from algal blooms and exotic pests such as mosquitoes. In combination with changes in seasonality, longer growing seasons will result in increased duration of allergenic pollen production (due to a longer growing season) with consequential impacts on allergy sufferers.
- Increased risk to the mauri of Te Urewera from introduced exotic pest species and drought due to increased temperatures, more frequent periods of continuous hot days, dryness and drought.

8.0 Next steps | E whai ake nei

This Climate Change Risk Assessment provides a district level overview of current and future climate risks in order to identify and highlight areas where a focused effort is needed to manage these risks. It builds from the 2023 Bay of Plenty Regional CCRA.

The project has generated a significant body of granular spatial and non-spatial information, providing a platform for adaptation planning and response at a range of scales (including community level). The outputs from this assessment will assist in establishing a common baseline of climate risk for the district and are available for all to use: businesses, primary producers, communities, iwi/Māori and others.

The risk assessment can be used to:

- Raise community awareness, to support understanding of the changing climate and enable communities to take action.
- Support risk awareness and adaptation planning within the private sector.
- Support the prioritisation of adaptation responses and investment by Council.

An additional benefit of the project has been the valuable connections established between and across sectors through the risk assessment workshops and community hui. These relationships will be important in taking this work forward, sharing expertise and knowledge and ensuring a coherent response to climate risks for the District.

Appendices

Appendix A. Risk assessment matrices | Kupu Āpiti B. Poukapa Aromatawai Tūraru

Table A1: Exposure rating criteria

Exposure Level	Qualitative definition (for an event impacting on a single element or general single group). Eg an economic sector within a District, or a large infrastructure location (eg treatment plant).	Quantitative definition for an event impacting on a wide number of elements (useful where geospatial data exists). Eg infrastructure networks.
Very High	Has happened several times in the past year and in each of the previous 5 years or Could occur several times per year in the future	Significant and widespread exposure of elements to the hazard. Option 1: >50% of sector or element is exposed to the hazard in a 1% event Option 2: >25% of the of sector or element is exposed to the hazard in a 1 in 10 year event Option 3: >10% of network is exposed annually
High	Has happened at least once in the past year and in each of the previous 5 years or May arise about once per year in the future	High exposure of elements to the hazard. Option 1: 25-50% of sector or element is exposed to the hazard in a 1% event Option 2: 5-25% of the of sector or element is exposed to the hazard in a 1 in 10 year event Option 3: 0-5% of network is exposed annually
Moderate	May have occurred once in the last 5 years or May arise once in 25 to 50 years in the future	Moderate exposure of elements to the hazard. Option 1: 5-25% of sector or element is exposed to the hazard in a 1% event Option 2: 0-5% of the of sector or element is exposed to the hazard in a 1 in 10 year event
Low	Has not occurred in the past 5 years or Unlikely during the next 50 years in the future	Isolated elements are exposed to the hazard. Option 1: 0-5% of sector or element is exposed to the hazard in a 1% event
Very Low	Has not occurred in the past 5 years or Unlikely during the next 50 years in the future	Isolated elements are exposed to the hazard. Option 1: 0-5% of sector or element is exposed to the hazard in a 1% event

Table A2: Sensitivity rating criteria

Sensitivity Level	Definition
Extreme	Extreme sensitivity to a given climate hazard
High	High sensitivity to a given climate hazard
Moderate	Moderate sensitivity to a given climate hazard
Low	Low sensitivity
Very Low	Little to no sensitivity

Table A3: Adaptative capacity rating criteria

Adaptive capacity	Definition
Very high	Very High capacity to adapt
High	High capacity to adapt
Medium	Medium capacity to adapt
Low	Low capacity to adapt
Very low	Very low capacity to adapt

Table A4: Vulnerability matrix

			Sensitivity				
Vulnerability			Very low	Low	Moderate	High	Extreme
			1	2	3	4	5
Adaptive capacity	Very low	VL	VL1	VL2	VL3	VL4	VL5
	Low	L	L1	L2	L3	L4	L5
	Medium	M	M1	M2	M3	M4	M5
	High	H	H1	H2	H3	H4	H5
	Very high	VH	VH1	VH2	VH3	VH4	VH5

Table A5: Risk matrix

			Exposure				
Risk			Very Low	Low	Moderate	High	Very High
			VL	L	M	H	VH
Vulnerability	Extreme	5	VL5	L5	M5	H5	VH5
	High	4	VL4	L4	M4	H4	VH4
	Moderate	3	VL3	L3	M3	H3	VH3
	Low	2	VL2	L2	M2	H2	VH2
	Very Low	1	VL1	L1	M1	H1	VH1

Appendix B. Community summaries | Kupu Āpiti C. Whakarāpopototanga Hapori

WHAKATĀNE COMMUNITY BOARD

SUMMARY OF CLIMATE RISKS IDENTIED FOR THE WHAKATĀNE COMMUNITY

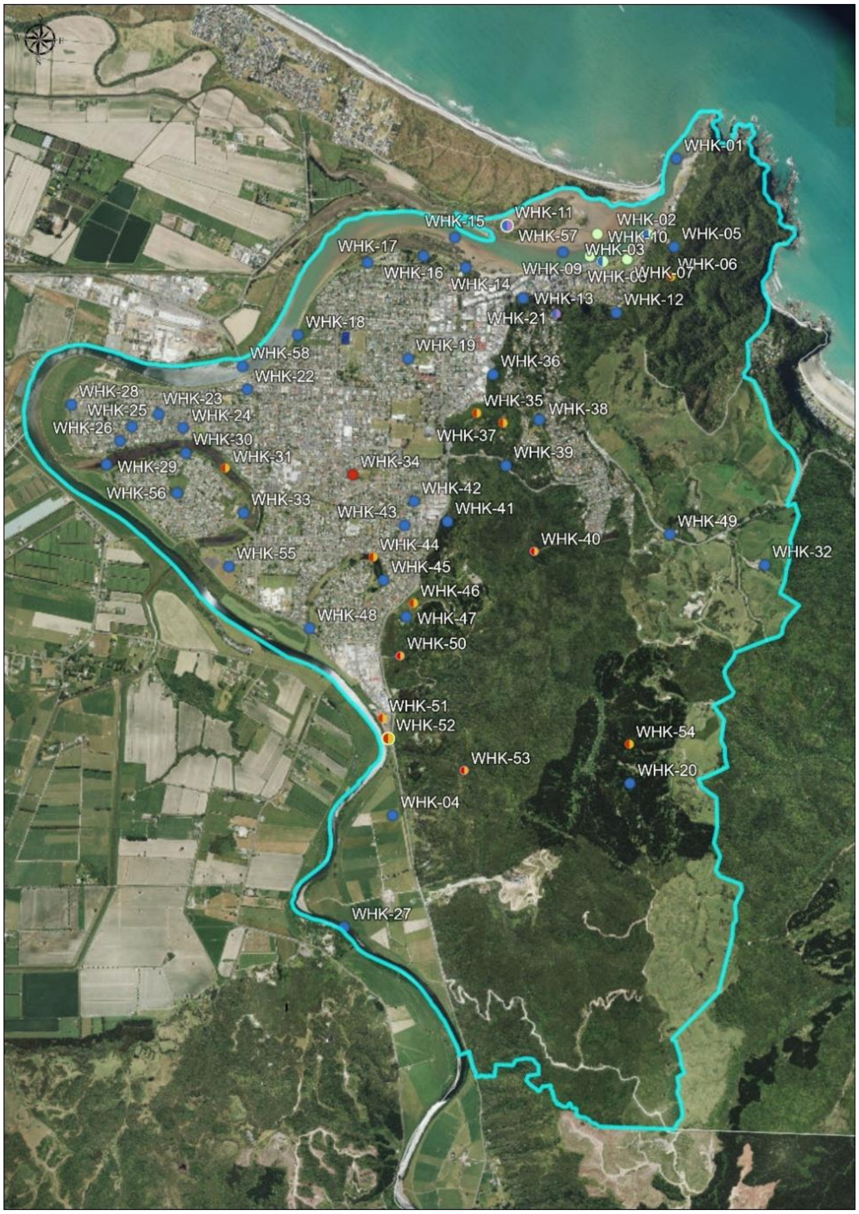

Figure B1 – Locations of climate risks identified by the community for the Whakatāne area

ID	Risk to	Climate Hazard
WHK-01	Navigability of the Whakatāne River entrance	Fluvial flooding due to more frequent high intensity rainfall events.
WHK-02	Reduced access through the Whakatāne River entrance	Coastal storm events.
WHK-03	Whakatāne boat ramp	Fluvial flooding due to more frequent high intensity rainfall events.
WHK-04	Primary production land	Fluvial flooding due to more frequent high intensity rainfall events especially when peak flood flows coincide with high tides.
WHK-05	Residential properties and roading network	Increased risk of landslides due to more frequent high intensity rainfall events.
WHK-06	Native forest	Increased fire risk due to rising temperatures and dryness and drought.
WHK-07	Public health	Sea level rise causes rising groundwater causing liquefaction which increases potential exposure of dioxin-contaminated wood waste.
WHK-08	Wharf structures	Fluvial flooding and sea level rise due to more frequent high intensity rainfall events, sea level rise and coastal flooding due to more frequent storm-tides and waves.
WHK-09	Usability of the Whakatāne harbour	Increasing sedimentation due to sea level rise.
WHK-10	Whakatāne township	Increased risk from tsunami due to sea level rise.
WHK-11	Islands and habitat within the Whakatāne Harbour	More frequent inundation due to fluvial flooding, sea level rise, and increasing salinisation of ground water.
WHK-12	Residential properties and roading network	Increased risk of landslides due to more frequent high intensity rainfall events.
WHK-13	Commercial properties and roading network	Increased risk of landslides due to more frequent high intensity rainfall events.
WHK-14	Stormwater pump stations functionality	Increased risk of being overwhelmed or power failure due to more frequent high intensity rainfall events.
WHK-15	Increased risk to Whakatāne sewer main underneath the Whakatāne River	Fluvial flooding and erosion due to more frequent high intensity rainfall events.
WHK-16	Stormwater pump stations functionality	Increased risk of being overwhelmed or power failure due to more frequent high intensity rainfall events.

WHK-17	Stormwater pump stations functionality	Increased risk of being overwhelmed or power failure due to more frequent high intensity rainfall events.
WHK-18	Stormwater pump stations functionality	Increased risk of being overwhelmed or power failure due to more frequent high intensity rainfall events.
WHK-19	Roading network and residential properties	Pluvial flooding due to more frequent high intensity rainfall events.
WHK-20	Wainui te whara catchment and residential areas of Whakatāne	Increased risk of debris flows and debris floods due to more frequent high intensity rainfall events.
WHK-21	Residential properties and roading network	Increased risk of landslides due to more frequent high intensity rainfall events.
WHK-22	Stormwater pump stations functionality	Increased risk of being overwhelmed or power failure due to more frequent high intensity rainfall events.
WHK-23	Roading network and residential properties	Pluvial flooding due to more frequent high intensity rainfall events.
WHK-24	Roading network and residential properties	Increased risk of surface flooding from overwhelmed stormwater infrastructure due to more frequent high intensity rainfall events.
WHK-25	Roading network and residential properties	Pluvial flooding due to more frequent high intensity rainfall events.
WHK-26	Roading network and residential properties	Pluvial flooding due to more frequent high intensity rainfall events.
WHK-27	Stopbank	Increased risk of overtopping or breach from fluvial flooding due to more frequent high intensity rainfall events.
WHK-28	Stormwater pump stations functionality	Increased risk of being overwhelmed or power failure due to more frequent high intensity rainfall events.
WHK-29	Stormwater pump stations functionality	Increased risk of being overwhelmed or power failure due to more frequent high intensity rainfall events.
WHK-30	Awatapu Area	Pluvial flooding from increased frequency of high intensity rainfall events combined with the reduced height of the stopbank at the walkway.
WHK-31	Public health	Increasing temperature of standing water bodies resulting in increased risk of mosquito-borne and other diseases as well as algal blooms due to higher mean temperatures and drought weather.
WHK-32	Groundwater and Wairere stream	More frequent leaching of contaminants from the closed partially lined landfill at Burma Road from pluvial flooding

		due to more frequent high intensity rainfall events.
WHK-33	Groundwater and Awatapu Lagoon	Increased pluvial flooding resulting in more frequent leaching of contaminants from the closed unlined landfill due to more frequent high intensity rainfall events.
WHK-34	Public health	Increasing temperatures and heatwaves in urban environments causing high temperatures on sealed surfaces and increasing need for air conditioning systems.
WHK-35	Public health	Longer growing seasons and increased pollen spread from exotic flora due to increasing temperatures and changes in seasonality.
WHK-36	Residential and commercial properties	Increased risk of landslides due to more frequent high intensity rainfall events.
WHK-37	Native forest	Increased risk of fire due to rising temperatures and dryness and drought.
WHK-38	Reserve/open space	Fluvial flooding due to more frequent high intensity rainfall events.
WHK-39	Roading network	Increased risk of landslides due to more frequent high intensity rainfall events.
WHK-40	Powerlines	More frequent extreme winds causing increased fire risk, and interruptions to power supply.
WHK-41	Roading network	Increased risk of landslides due to more frequent high intensity rainfall events.
WHK-42	Residential properties, commercial properties and the roading network	Fluvial flooding due to more frequent high intensity rainfall events.
WHK-43	Residential properties, 3Waters assets, and the roading network	Pluvial flooding and fluvial flooding from the Wainui te whara stream due to more frequent high intensity rainfall events.
WHK-44	Public health	Increasing temperature of standing water bodies resulting in increased risk of mosquito-borne and other diseases as well as algal blooms due to higher mean temperatures and drought weather.
WHK-45	Sullivans lake	Silt carried in stormwater network from increased risk of landslides on Valley road due to more frequent high intensity rainfall events. Siltation likely to increase as Sullivan lake is used as stormwater detention pond.
WHK-46	Trees and vegetation	Increased fire risk due to rising temperatures and dryness and drought.

WHK-47	Residential buildings, electricity infrastructure, and roading network	Increased risk of landslides due to more frequent high intensity rainfall events.
WHK-48	Stormwater pump stations functionality	Increased risk of being overwhelmed or power failure due to more frequent high intensity rainfall events.
WHK-49	Roading network	Increased risk of landslides due to more frequent high intensity rainfall events.
WHK-50	Powerlines	More frequent extreme winds causing increased fire risk to native forests and rural lifestyle blocks, and interruptions to power supply.
WHK-51	Public health, residents and workers	Increased odour in the vicinity of the Whakatane Resource Recovery Centre caused by increased temperatures.
WHK-52	Treatment processes at the Whakatāne Water Treatment Plant	Sea level rise, salinity and increasing algal blooms compromising the intake at the Whakatane River.
WHK-53	Powerlines	More frequent extreme winds causing increased fire risk, and interruptions to power supply.
WHK-54	Plantation forestry	Increased fire risk due to rising temperatures and dryness and drought.
WHK-55	Roading network	Fluvial flooding due to more frequent high intensity rainfall events.
WHK-56	Low lying urban area	Pluvial flooding due to more frequent high intensity rainfall events.
WHK-57	Moored boats	Debris associated with fluvial flooding due to more frequent high intensity rainfall events.

SUMMARY OF CLIMATE RISKS IDENTIED FOR THE ŌHOPE COMMUNITY

Figure B2 – Locations of climate risks identified by the community for the Ōhope area

ID	Risk to	Climate Hazard
OHP-01	Residential properties	Increased risk of landslides due to more frequent high intensity rainfall events.
OHP-02	Residential properties	Increased risk of landslides due to more frequent high intensity rainfall events.
OHP-03	Residential properties	Coastal erosion and coastal inundation due to relative sea level rise and more frequent coastal flooding events.
OHP-O4	3Waters and roading network, electrical infrastructure and residential properties	Coastal erosion due to relative sea level rise and more frequent coastal flooding.
OHP-05	Residential properties	Coastal erosion and coastal inundation due to relative sea level rise and more frequent coastal flooding events.

OHP-06	Roading network	Increased risk of landslides due to more frequent high intensity rainfall events.
OHP-07	Roading network	Estuarine inundation and erosion due to relative sea level rise.
OHP-08	Residential properties and reserve	Coastal erosion and coastal inundation due to relative sea level rise and more frequent coastal flooding events.
OHP-09	Reserve	Coastal inundation, coastal erosion and fluvial flooding due to increased storminess, sea level rise and more frequent high intensity rainfall events.
OHP-10	Residential properties	Coastal erosion and coastal inundation due to relative sea level rise and more frequent coastal flooding events.
OHP-11	Residential properties	Coastal inundation and fluvial flooding due to increased storminess and more frequent high intensity rainfall events.
OHP-12	Residential properties and primary production land	Fluvial flooding due to more frequent high intensity rainfall events.
OHP-13	Primary production land	Coastal inundation and fluvial flooding due to increased storminess and more frequent high intensity rainfall events.
OHP-14	Primary production land	Estuarine inundation due to change in tidal range or increased water depth and relative sea level rise.
OHP-15	Ōhope Waste Water Treatment Plant	Estuarine inundation and erosion due to change in tidal range or increased water depth and relative sea level rise.
OHP-16	Waste water network	Coastal erosion due to relative sea level rise and more frequent coastal flooding.
OHP-17	Beach and dunes	Coastal erosion and inundation due to relative sea level rise and more frequent coastal flooding.
OHP-18	Boat ramp and carpark	Estuarine inundation and erosion due to relative sea level rise and change in tidal range or increased water depth.
OHP-19	Residential properties and reserve	Estuarine inundation and erosion due to relative sea level rise.
OHP-20	Commercial activities	Increased frequency of storms and tropical cyclones.
OHP-21	Ōhope Holiday Park	Increase risk of tornadoes due to increased wind speed and tornados.
OHP-22	Port Ōhope Wharf	Estuarine inundation and erosion due to change in tidal range or increased water depth and relative sea level rise.
OHP-23	Recreational activities	Changes to estuarine biodiversity due to temperature increase of estuarine waters.

OHP-24	Ōhiwa Harbour	Sedimentation affecting kaimoana impacting on aquaculture activities due to more frequent high intensity rainfall events.
OHP-25	Ōhope Spit Wildlife Refuge Reserve	Coastal inundation and erosion impacting nesting birds habitat due to relative sea level rise and more frequent coastal flooding.
OHP-26	Navigability of Ōhiwa Harbour entrance	Storm events and tidal currents due to interannual variability and increase in storminess.

SUMMARY OF CLIMATE RISKS IDENTIED FOR THE COASTLANDS COMMUNITY

Figure B3 – Locations of climate risks identified by the community for the Coastlands area

ID	Risk to	Climate Hazard
CLD-01	River and wetland ecosystem	Frequent leaching of contaminants from contaminated woodwaste site due to sea level rise, coastal inundation and more frequent high intensity rainfall events.
CLD-02	Wahi Tapu site, Urupā and accessibility	Coastal erosion and inundation due to more frequent high intensity rainfall events and sea level rise, changes tidal range or increased water depth.
CLD-03	Scrubland adjacent to residential area	Increased fire risk due to rising temperatures and dryness and drought.
CLD-04	Urupā	Fluvial flooding and coastal erosion and inundation due to more frequent high intensity rainfall events and sea level rise, changes tidal range or increased water depth.

CLD-05	Stormwater network	Increased risk of being overwhelmed by heavy rain causing surface flooding on the road due to more frequent high intensity rainfall events.
CLD-06	Primary production land	Fluvial flooding due to more frequent high intensity rainfall events.
CLD-07	Ground soakage zone	Pluvial flooding due to more frequent high intensity rainfall events.
CLD-08	Ground soakage zone	Pluvial flooding due to more frequent high intensity rainfall events.
CLD-09	Scrubland adjacent to residential area	Increased fire risk due to rising temperatures and dryness and drought.
CLD-10	Cropping land near residential area	Increased fire risk due to rising temperatures and dryness and drought.
CLD-11	Wetland ecosystem and salt marsh	Increased risk of degradation from sea level rise, increased salinity and higher water temperatures.
CLD-12	Contaminated wood waste site	Fluvial flooding due to more frequent high intensity rainfall events.
CLD-13	Canal and stormwater network	Erosion exposing stormwater pipe due to more frequent high intensity rainfall events.
CLD-14	Public health and environmental contamination	Increased risk of overflows of the Whakatane waste water treatment ponds from fluvial and pluvial flooding due to more frequent high intensity rainfall events.
CLD-15	Damage to cars	Deteriorating road surface due to increased overall persistent rainfall during autumn and winter seasons.
CLD-16	Primary production land and roading network	Fluvial flooding due to more frequent high intensity rainfall events especially when peak flood flows coincide with high tides.
CLD-17	Roading network	Surface flooding due to more frequent high intensity rainfall events.
CLD-18	Urupā and accessibility	Coastal erosion and inundation due to sea level rise, changes tidal range or increased water depth.
CLD-19	Scrubland adjacent to residential area	Increased fire risk due to rising temperatures and dryness and drought.

CLD-20	Primary production land and roading network	Fluvial flooding due to more frequent high intensity rainfall events especially when peak flood flows coincide with high tides.
CLD-21	Whakatāne bridge and associated 3Waters infrastructure attached to the bridge	Increased risk of failure due to scour of support structures caused by increased fluvial flooding due to more frequent high intensity rainfall events.
CLD-22	Bridge and adjacent canal bank	Fluvial flooding due to more frequent high intensity rainfall events.
CLD-23	Primary production land and roading network	Fluvial flooding due to more frequent high intensity rainfall events especially when peak flood flows coincide with high tides.
CLD-24	Whakatāne green waste facility	Increased risk of overflows from the Whakatane waste water treatment ponds from fluvial and pluvial flooding due to more frequent high intensity rainfall events.
CLD-25	Urupā	Increased fire risk due to rising temperatures and dryness and drought.
CLD-26	Urupā	Increased fire risk due to rising temperatures and dryness and drought.
CLD-27	Public health and residents in the vicinity of the Whakatāne waste water treatment ponds	Increased odour caused by increased temperatures.
CLD-28	Public health	Pollen spread from pine plantation due to longer growing seasons.
CLD-29	Public health	Sand absorbing extreme heat from the sun along the beach from Thornton to the Whakatane river mouth due to rising temperatures.
CLD-30	Dunes	Coastal erosion along the coast between Thornton and Whakatane due to increased storminess and sea level rise. In rough seas or during a strong swell, storms carve away sand dunes reshaping, the coastline.
CLD-31	Cropping land near residential area	Increased fire risk due to rising temperatures and dryness and drought.
CLD-32	Cropping land near residential area	Increased fire risk due to rising temperatures and dryness and drought.

CLD-33	Cropping land near residential area	Increased fire risk due to rising temperatures and dryness and drought.
CLD-34	Public health	Increased risk of fire causing fine particulate matter in the air due to rising temperatures and dryness and drought.
CLD-35	Primary production land and roading network	Pluvial flooding due to more frequent high intensity rainfall events.
CLD-36	Stopbank and community west of Whakatāne	Increased risk of overtopping or breach from fluvial flooding due to more frequent high intensity rainfall events.
CLD-37	Primary production land	Pluvial flooding either side of Furguson Road due to more frequent high intensity rainfall events. Furguson Road is higher than the land.
CLD-38	Whenua Māori land	Increased fire risk due to rising temperatures and dryness and drought.
CLD-39	Cropping land near residential and industrial properties	Increased fire risk due to rising temperatures and dryness and drought.
CLD-40	Primary production land and residential properties	Pluvial flooding due to more frequent high intensity rainfall events.
CLD-41	Roading network	Fluvial flooding causing erosion to canal bank undercutting road due to more frequent high intensity rainfall events.
CLD-42	Cropping land near residential and industrial properties	Increased fire risk due to rising temperatures and dryness and drought.
CLD-43	Primary production land	Pluvial and fluvial flooding due to more frequent high intensity rainfall events.
CLD-44	Urupā	Pluvial flooding due to more frequent high intensity rainfall events.
CLD-45	Urupā	Pluvial flooding due to more frequent high intensity rainfall events.
CLD-46	Marae	Pluvial flooding due to more frequent high intensity rainfall events.
CLD-47	Cropping land near residential properties	Increased fire risk due to rising temperatures and dryness and drought.

CLD-48	Cropping land near residential properties	Increased fire risk due to rising temperatures and dryness and drought.
CLD-49	Rural properties	Pluvial flooding due to more frequent high intensity rainfall events.
CLD-50	Rural properties and roading network	Pluvial flooding due to more frequent high intensity rainfall events.
CLD-51	Primary production land	Pluvial flooding due to more frequent high intensity rainfall events.
CLD-52	Primary production land	Increased fire risk due to rising temperatures and dryness and drought. There was a hay fire 5 years ago.
CLD-53	Primary production land	Fluvial and pluvial flooding due to more frequent high intensity rainfall events.
CLD-54	Primary production land	Pluvial flooding due to more frequent high intensity rainfall events.
CLD-55	Roading network	Pluvial flooding due to more frequent high intensity rainfall events.
CLD-56	Rural and residential properties	Pluvial flooding due to more frequent high intensity rainfall events.
CLD-57	Primary production land, residential properties and roading network	Rising groundwater increasing liquefaction risk due to sea level rise.

RANGITĀIKI COMMUNITY BOARD

SUMMARY OF CLIMATE RISKS IDENTIED FOR THE PIKOWAI COMMUNITY

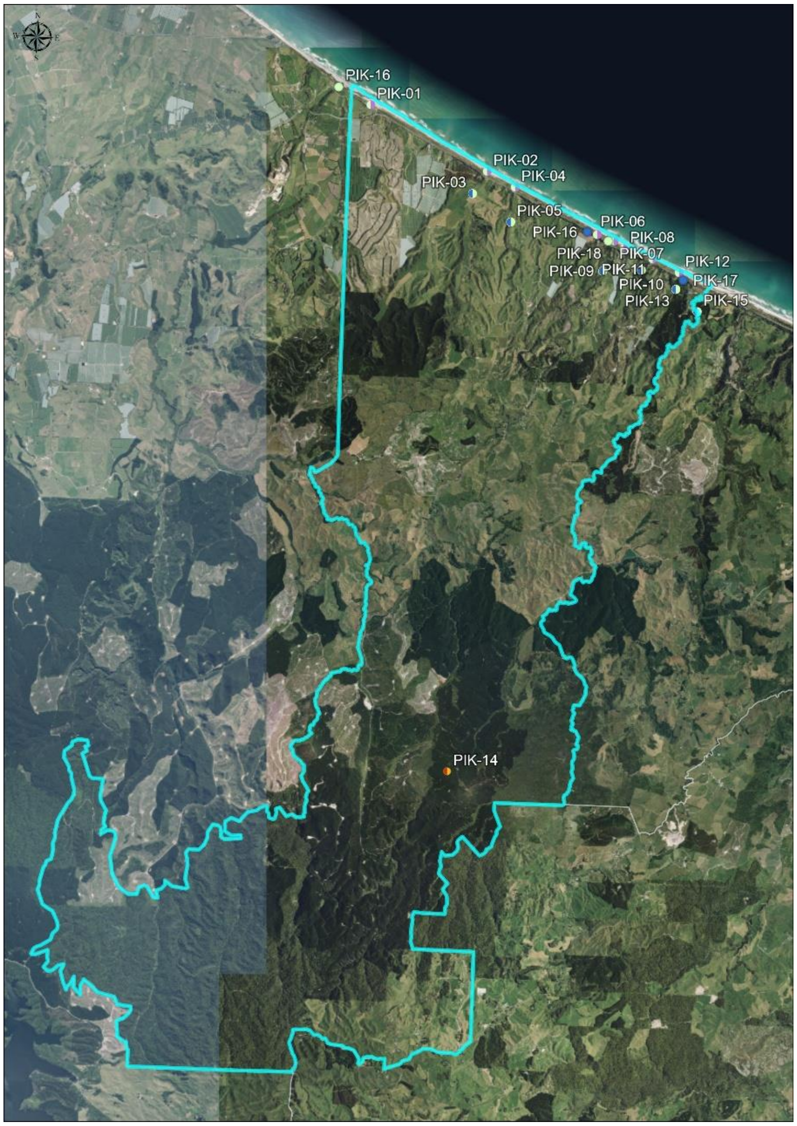

Figure B4 – Locations of climate risks identified by the community for the Pikowai area

ID	Risk to	Climate Hazard
PIK-01	Camp ground	Coastal erosion and inundation due to increased storminess and sea level rise.

PIK-02	Coastal dunes, Rail and State Highway networks	Coastal erosion and inundation due to increased storminess and sea level rise.
PIK-03	Primary production land	Coastal inundation and fluvial flooding due to increased storminess and more frequent high intensity rainfall events.
PIK-04	Coastal dunes, Rail and State Highway networks	Coastal erosion and inundation due to increased storminess and sea level rise.
PIK-05	Primary production land	Coastal inundation and fluvial flooding due to increased storminess and more frequent high intensity rainfall events.
PIK-06	Coastal dunes, Rail and State Highway networks	Coastal erosion and inundation due to increased storminess and sea level rise.
PIK-07	Coastal dunes, Rail and State Highway networks	Coastal erosion and inundation due to increased storminess and sea level rise.
PIK-08	Campground	Coastal erosion and inundation due to increased storminess and sea level rise.
PIK-09	Primary production land	Coastal inundation and fluvial flooding due to increased storminess and more frequent high intensity rainfall events.
PIK-10	Primary production land	Coastal inundation and fluvial flooding due to increased storminess and more frequent high intensity rainfall events.
PIK-11	Coastal dunes, Rail and State Highway networks	Coastal erosion and inundation due to increased storminess and sea level rise.
PIK-12	Coastal dunes, Rail and State Highway networks	Coastal erosion and inundation due to increased storminess and sea level rise.
PIK-13	Primary production land	Coastal inundation and fluvial flooding due to increased storminess and more frequent high intensity rainfall events.
PIK-14	Plantation forestry	Increased fire risk due to rising temperatures and dryness and drought.
PIK-15	Primary production land	Coastal inundation and fluvial flooding due to increased storminess and more frequent high intensity rainfall events.
PIK-16	Rail and State Highway networks	Increased risk of landslides due to more frequent high intensity rainfall events.
PIK-17	Rail and State Highway networks	Increased risk of landslides due to more frequent high intensity rainfall events.
PIK-18	Koiwi (skeletal remains)	Increased risk of koiwi (skeletal remains) being exposed from coastal erosion due to increased storminess and sea level rise. This risk applies to the entire length of the coastal dunes between Ōtamarākau and Matatā.

SUMMARY OF CLIMATE RISKS IDENTIED FOR MATATĀ COMMUNITY

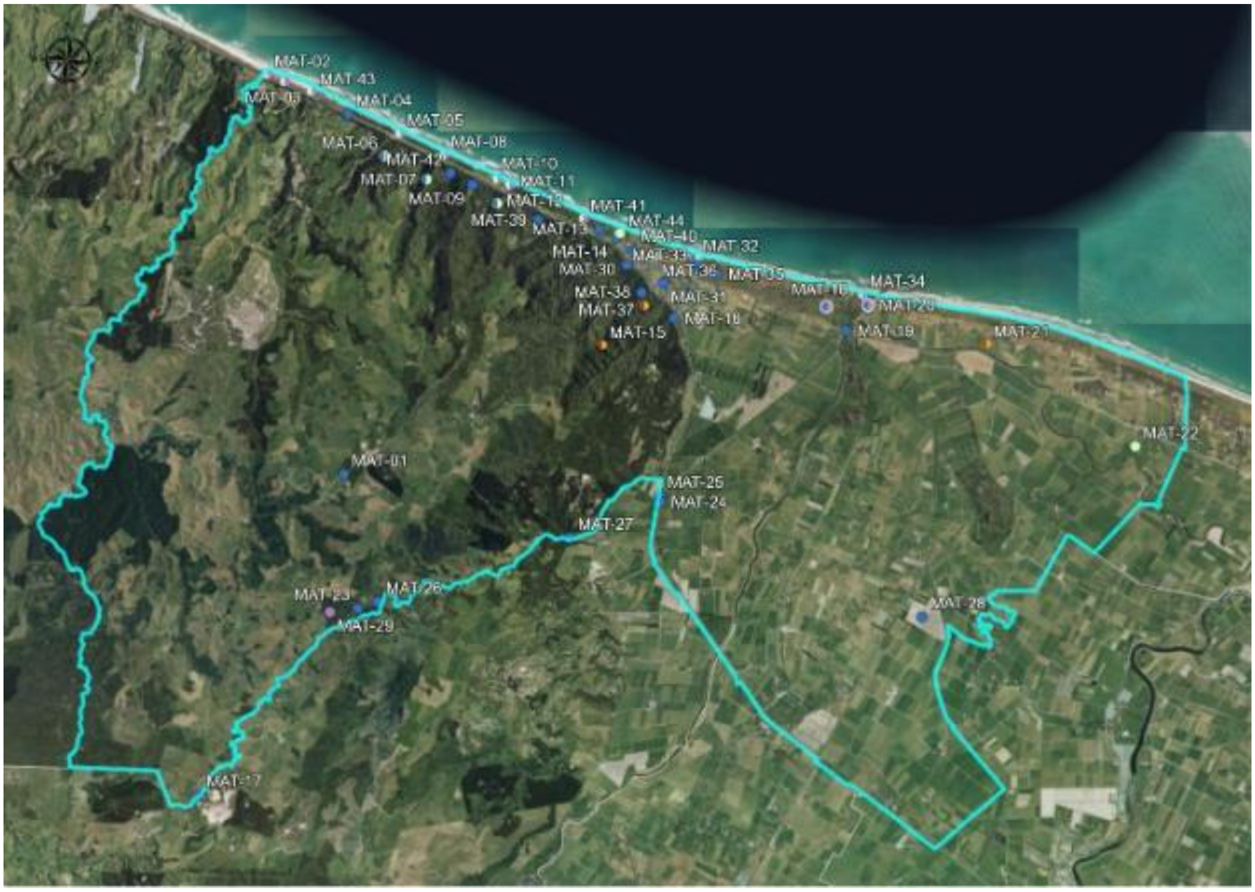

Figure B5 – Locations of climate risks identified by the community for the Matatā area

ID	Risk to	Climate Hazard
MAT-01	Roading network	Landslides and undercutting erosion due to more frequent high intensity rainfall events.
MAT-02	Coastal dunes, road and rail networks	Coastal erosion and inundation due to increased storminess and sea level rise.
MAT-03	Rail and State Highway networks	Landslides due to more frequent high intensity rainfall events.
MAT-04	Rail and State Highway networks	Landslides due to more frequent high intensity rainfall events.
MAT-05	Coastal dunes, road and rail networks	Coastal erosion and inundation due to increased storminess and sea level rise.
MAT-06	Primary production land	Coastal inundation and fluvial flooding due to increased storminess and more frequent high intensity rainfall events.

MAT-07	Primary production land	Coastal inundation and fluvial flooding due to increased storminess and more frequent high intensity rainfall events.
MAT-08	Coastal dunes, road and rail networks	Coastal erosion and inundation due to increased storminess and sea level rise.
MAT-09	Roading network	Landslides due to more frequent high intensity rainfall events.
MAT-10	Campground	Coastal erosion and inundation due to increased storminess and sea level rise.
MAT-11	Coastal dunes, road and rail networks	Coastal erosion and inundation due to increased storminess and sea level rise.
MAT-12	Coastal dunes, road and rail networks	Coastal erosion and inundation due to increased storminess and sea level rise. Note, BOPRC reopen stream entrance out to sea as required.
MAT-13	Closed landfill	Damage to landfill cap from debris flows due to more frequent high intensity rainfall events.
MAT-14	Te Kaokaoroa Reserve, rail and State Highway networks	Debris flow and fluvial flooding due to more frequent high intensity rainfall events.
MAT-15	Native forest	Reduced resilience of native forest flora and fauna from increase in pest and weed species due to rising temperatures, increased dryness and drought.
MAT-16	Rail, State Highway, local roading networks and residential area	Debris flow due to more frequent high intensity rainfall events.
MAT-17	Roading network	Increased fluvial flooding due to more high intensity rainfall events.
MAT-18	Te Awa a Atua Nohoanga site	Fluvial flooding from more frequent high intensity rainfall events, and coastal erosion and inundation due to sea level rise, changes in tidal range or increased water depth.
MAT-19	Roading network	Increased fluvial flooding due to more frequent high intensity rainfall events.
MAT-20	Urupā	Fluvial flooding from more frequent high intensity rainfall events, and coastal erosion and inundation due to sea level rise, changes in tidal range or increased water depth.
MAT-21	Public health	Increasing temperature of standing water bodies resulting in increased risk of mosquito-borne and other diseases as well as increase in algal blooms due to higher mean temperatures and drought weather.
MAT-22	Primary production land use activities	Saline intrusion of groundwater from rising groundwater levels due to sea level rise.

MAT-23	Local roading network	Landslides due to more frequent high intensity rainfall events.
MAT-24	State Highway network	Pluvial flooding due to more frequent high intensity rainfall events.
MAT-25	Rail network	Fluvial flooding due to more frequent high intensity rainfall events.
MAT-26	Local roading network	Landslides due to more frequent high intensity rainfall events.
MAT-27	Rural residential properties, Manawahe Sun Club, roading network and primary production land	Debris flows due to more frequent high intensity rainfall events.
MAT-28	Primary production land	Fluvial and pluvial flooding due to more frequent high intensity rainfall events.
MAT-29	Electricity network	Electricity outages from lines arcing as a consequence of tree fall or strong winds due to increased storminess.
MAT-30	Residential properties and rail network	Landslides due to more frequent high intensity rainfall events.
MAT-31	Public health	Onsite effluent treatment systems overflowing caused by high groundwater levels due to more frequent high intensity rainfall events.
MAT-32	Public health	Onsite effluent treatment systems overflowing caused by high groundwater levels due to more frequent high intensity rainfall events.
MAT-33	Access to DOC camping ground	Fluvial flooding due to more frequent high intensity rainfall events.
MAT-34	Tarawera River mouth	Storm events and tidal currents causing erosion to dunes and fluvial flooding to primary production land due to increase in storminess and sea level rise. Note: BOPRC reopens river mouth as required.
MAT-35	Matatā Lagoon	Increased Raupō vegetation reducing lagoon capacity resulting in increased flooding due to more frequent high intensity rainfall events.
MAT-36	Te Awa a te atua	Groundwater rise and fluvial flooding due to sea level rise and more frequent high intensity rainfall events.
MAT-37	Native forest	Rising temperatures, dryness and drought increase fire risk.
MAT-38	Residential properties and rail network	Landslides due to more frequent high intensity rainfall events. Note: location of pumice and greywacke landslide, Pākehā Street 1936
MAT-39	Rail and State Highway networks	Landslides due to more frequent high intensity rainfall events.
MAT-40	Roading network in low lying area	Pluvial flooding due to more frequent high intensity rainfall events.

MAT-41	Coastal dunes, State Highway and Rail network	Coastal erosion and inundation due to increased storminess and sea level rise.
MAT-42	Rail network and State Highway network	Increased risk of landslides due to more frequent high intensity rainfall events.
MAT-43	Koiwi (skeletal remains)	Increased risk of koiwi (skeletal remains) being exposed by coastal erosion.

SUMMARY OF CLIMATE RISKS IDENTIED FOR THORNTON COMMUNITY

Figure B6 – Locations of climate risks identified by the community for the Thornton area

ID	Risk to	Climate Hazard
THN-01	Whakatāne Airport level of service	Increased wind and storminess
THN-02	Roading network and access to private properties	Pluvial flooding from more frequent high intensity rainfall events.
THN-03	Primary production land	Fluvial flooding from more frequent high intensity rainfall events.
THN-04	Primary production land	Pluvial and fluvial flooding from more frequent high intensity rainfall events combined with high ground water levels due to sea level rise
THN-05	Primary production land	Pluvial and fluvial flooding from more frequent high intensity rainfall events combined with high ground water levels due to sea level rise
THN-06	Roading network	High ground water levels due to sea level rise

THN-07	Rural lifestyle properties, primary production land and roading network	Pluvial flooding from more frequent high intensity rainfall events.
THN-08	Rural homes and associated buildings	Fire due to rising temperatures, dryness and more frequent drought conditions
THN-09	Thornton Beach Holiday Park	Increased coastal erosion and coastal inundation due to a combination of increased storminess and sea level rise
THN-10	Rural homes and associated buildings	Fire risk from Thornton Kanuka due to rising temperatures, dryness and more frequent drought conditions
THN-11	Whakatāne Golf Club and Whakatāne Airport	Fire due to rising temperatures, dryness and more frequent drought conditions
THN-12	Thornton Harbour and River entrance	Increasing sedimentation due to sea level rise
THN-13	Primary production land	Pluvial flooding from more frequent high intensity rainfall events.

SUMMARY OF CLIMATE RISKS IDENTIED FOR THE MANAWAHE COMMUNITY

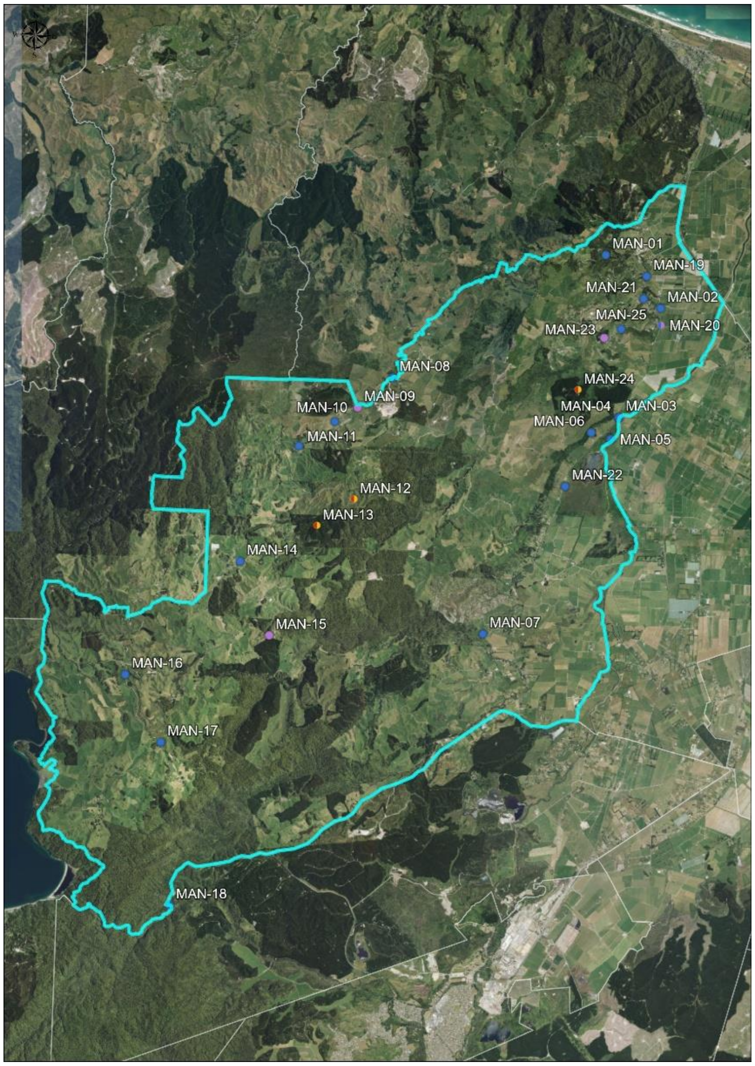

Figure B7 – Locations of climate risks identified by the community for the Manawahe area

ID	Risk to	Climate Hazard
MAN-01	Source of Matata water supply	Increased risk of landslides due to more frequent high intensity rainfall events. In dry summer months Matatā township has water restrictions.
MAN-02	Roading network	Pluvial flooding due to more frequent high intensity rainfall events. Culvert blockages causing scour and road outages.
MAN-03	Roading network	Riverbank erosion from fluvial flooding due to more frequent high intensity rainfall events.

MAN-04	Roading network	Increased risk of landslides due to more frequent high intensity rainfall events.
MAN-05	Braemar water supply	Fluvial flooding and river bank erosion due to more frequent high intensity rainfall events.
MAN-06	Braemar reservoir	Increased risk of landslides due to more frequent high intensity rainfall events.
MAN-07	Karaponga Dam's generating capability	Increased sedimentation and landslides due to more frequent high intensity rainfall events.
MAN-08	Roading network	Surface flooding overwhelming roadside drainage due to more frequent high intensity rainfall events.
MAN-09	Electricity network	Increased risk of arcing power lines during storm events due to increased wind and storminess resulting in electricity outages for part of the Manawahe community.
MAN-10	Roading network	Pluvial flooding due to more frequent high intensity rainfall events.
MAN-11	Roading network	Surface flooding overwhelming roadside drainage due to more frequent high intensity rainfall events.
MAN-12	Current primary production land use activities	Increased risk to land use activities due to increasing temperature, more heatwaves and drought.
MAN-13	Land use change from agriculture to plantation forestry	Land use change increasing fire risk to existing rural properties from fire due to rising temperatures and dryness and drought.
MAN-14	Roading network	Pluvial flooding due to protracted rainfall over long periods of time.
MAN-15	Electricity network	Increased risk of arcing power lines during storm events due to increased wind and storminess resulting in electricity outages for part of the Manawahe community.
MAN-16	Roading network	Pluvial flooding due to more frequent high intensity rainfall events.
MAN-17	Roading network	Pluvial flooding due to more frequent high intensity rainfall events.
MAN-18	State highway network	Increased risk of landslides due to more frequent high intensity rainfall events.
MAN-19	Roading network	Pluvial flooding due to more frequent high intensity rainfall events.

MAN-20	Roading network	Increased risk of landslides due to more frequent high intensity rainfall events.
MAN-21	Roading network	Increased risk of pluvial flooding overwhelming culvert due to more frequent high intensity rainfall events.
MAN-22	Roading network	Increased risk of landslides due to more frequent high intensity rainfall events.
MAN-23	Roading network	Increased risk of tree falls due to increased wind and storminess.
MAN-24	Plantation forestry	Increased fire risk due to rising temperatures and dryness and drought.
MAN-25	Roading network	Increased risk of landslides due to more frequent high intensity rainfall events.

SUMMARY OF CLIMATE RISKS IDENTIED FOR THE OTAKIRI COMMUNITY

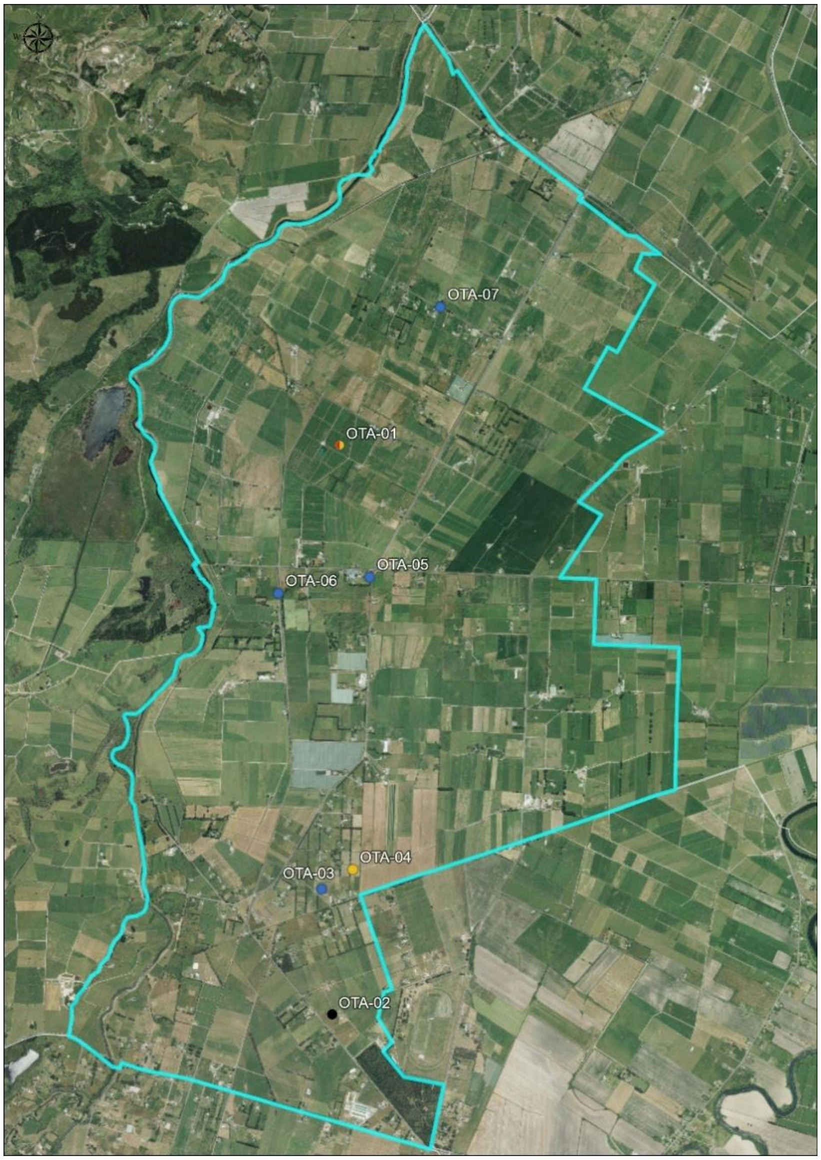

Figure B8 – Locations of climate risks identified by the community for the Otakiri area

ID	Risk to	Climate Hazard
OTA-01	Kiwifruit production	Fewer frosts and cold days due to rising temperatures.
OTA-02	Primary production land	Extreme seasonal groundwater fluctuations due to more frequent high intensity rainfall events combined with increased temperatures, heatwaves and drought conditions.

OTA-03	Primary production land, underground on site effluent systems and shallow bores	Pluvial flooding due to more frequent high intensity high rainfall events.
OTA-04	People, primary production land and associated buildings and infrastructure	Increased fire risk due to increasing temperature and persistent dry spells.
OTA-05	School	Increased risk of pluvial flooding due to more frequent high intensity rainfall events.
OTA-06	Roading network, primary production land and residential buildings	Pluvial flooding due to more frequent high intensity rainfall events. Note -1987 Edgecumbe earthquake lowered land up to 2.0 - 2.5metres.
OTA-07	Roading network and rural properties	Pluvial flooding due to more frequent high intensity rainfall events.

SUMMARY OF CLIMATE RISKS IDENTIED FOR EDGECUMBE COMMUNITY

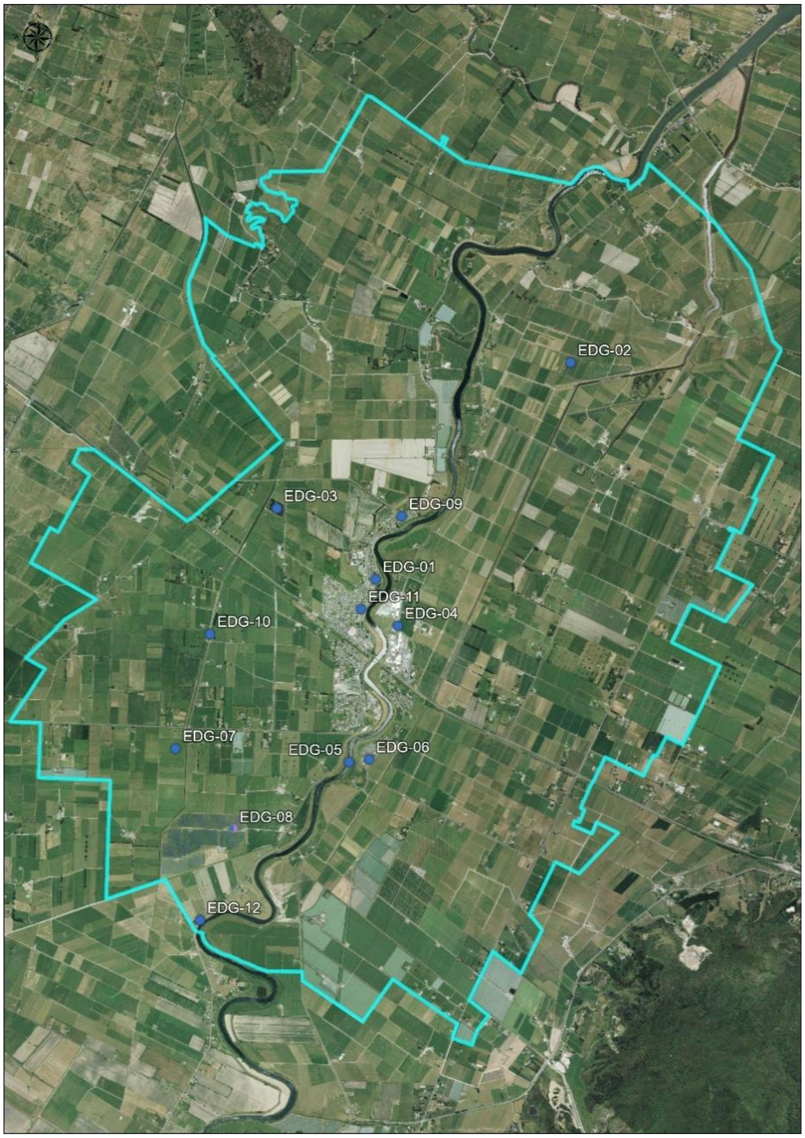

Figure B9 – Locations of climate risks identified by the Edgecumbe community

ID	Risk to	Climate Hazard
EDG-01	Edgecumbe Retirement Village	Fluvial flooding from more frequent high intensity rainfall events.
EDG-02	Primary production land and residential properties	Fluvial flooding from more frequent high intensity rainfall events.
EDG-03	Public health and environment	Overtopping of Edgecumbe Oxidation Ponds due to fluvial and pluvial flooding from more frequent high intensity rainfall events.

EDG-04	Edgecumbe industrial area	Fluvial flooding from more frequent high intensity rainfall events.
EDG-05	Edgecumbe township stopbanks	Fluvial flooding from more frequent high intensity rainfall events.
EDG-06	Electricity infrastructure	Fluvial flooding from more frequent high intensity rainfall events.
EDG-07	Primary production land	Silt deposition on pastoral land and orchards from increased frequency of fluvial flooding due to more frequent high intensity rainfall events.
EDG-08	Solar farm infrastructure	Wind and hail damage from more frequent extreme weather events.
EDG-09	Residential properties	Fluvial flooding from more frequent high intensity rainfall events.
EDG-10	Rural lifestyle blocks in low-lying areas	Fluvial and pluvial flooding from more frequent high intensity rainfall events.
EDG-11	Papa Taonga Reserve and adjacent footpath	Pluvial flooding from more frequent high intensity rainfall events.
EDG-12	Primary production land	Fluvial flooding from more frequent high intensity rainfall events.

SUMMARY OF CLIMATE RISKS IDENTIED FOR THE ONEPU COMMUNITY

Figure B10 – Locations of climate risks identified by the community for the Onepu area

ID	Risk to	Climate Hazard
ONP-01	Rural properties, roading network and primary production land	Pluvial flooding due to more frequent high intensity rainfall events.
ONP-02	Plantation forestry	Increased fire risk due to rising temperatures and dryness and drought.
ONP-03	Plantation forestry	Increased fire risk due to rising temperatures and dryness and drought.
ONP-04	Plantation forestry	Increased fire risk due to rising temperatures and dryness and drought.

SUMMARY OF CLIMATE RISKS IDENTIED FOR THE TE TEKO & TE MAHOE COMMUNITY

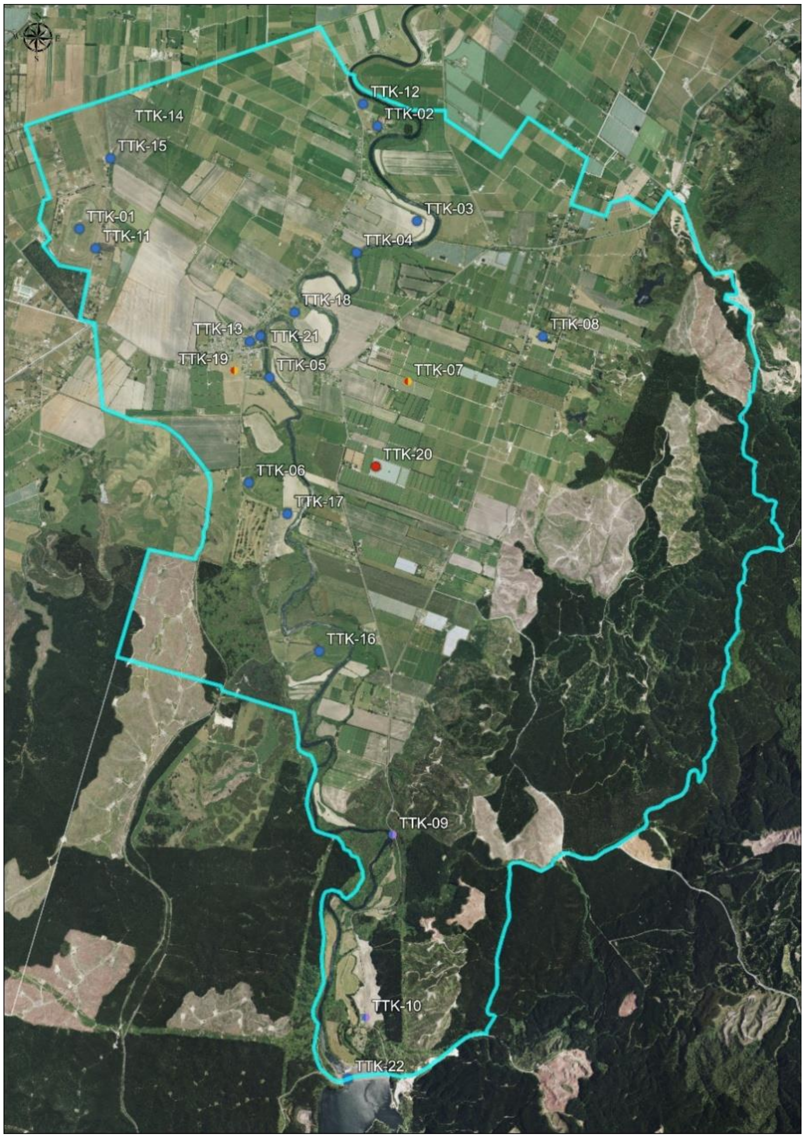

Figure B11 – Locations of climate risks identified by the community for the Te Teko and Te Mahoe area

ID	Risk to	Climate Hazard
TTK-01	Racecourse Park	Pluvial flooding due to more frequent high intensity rainfall events.
TTK-02	Kokohinau Marae	Fluvial flooding and high river flows causing erosion of the river bank due to more frequent high intensity rainfall events.
TTK-03	Primary production land	Increased risk of overtopping or breach of stop bank from fluvial flooding due to more frequent high intensity rainfall events.

TTK-04	Riverbank	Erosion due to more frequent high intensity rainfall events.
TTK-05	Stopbank and Te Teko community	Increased risk of overtopping or breach from fluvial flooding due to more frequent high intensity rainfall events.
TTK-06	Groundwater	Leaching of contaminants from the closed landfill at Tahuna Road from pluvial flooding due to more frequent high intensity rainfall events.
TTK-07	Kiwifruit production	Fewer frosts and cold days due to rising temperatures.
TTK-08	Paul Road water supply	Pluvial flooding due to more frequent high intensity rainfall events.
TTK-09	Roading network	Erosion at the river bend from fluvial flooding caused by more frequent high intensity rainfall events.
TTK-10	Community isolation	Increased risk of roading network being closed from fluvial flooding and landslides due to more frequent storm events.
TTK-11	Roading network	Increased risk of surface flooding due to more frequent high intensity rain fall events.
TTK-12	Urupa	Fluvial flooding and high river flows causing erosion of the river bank due to more frequent high intensity rainfall events.
TTK-13	Roading network, residential properties and school	Pluvial flooding due to more frequent high intensity rainfall events.
TTK-14	Primary production land	Extreme seasonal groundwater fluctuations due to more frequent high intensity rainfall events combined with increased temperatures, heatwaves and drought conditions.
TTK-15	Roading network and primary production land	Pluvial flooding due to more frequent high intensity rainfall.
TTK-16	Primary production land	Fluvial flooding due to more frequent high intensity rainfall events.
TTK-17	Primary production land	Fluvial flooding due to more frequent high intensity rainfall events.
TTK-18	Urupa and Marae	Fluvial flooding and high river flows causing erosion of the river bank due to more frequent high intensity rainfall events.
TTK-19	Primary production land and adjacent residential area	Increased fire risk due to rising temperatures and dryness and drought.
TTK-20	Kiwifruit production	Fewer frosts and cold days due to rising temperatures.
TTK-21	Stopbank, Te Teko community and Te Kura o Te Teko	Increased risk of overtopping or breach from fluvial flooding due to more frequent high intensity rainfall events.
TTK-22	Primary production land	Increased risk from more frequent high discharge flows due to increased frequency of storm events with high rainfall.

SUMMARY OF CLIMATE RISKS IDENTIED FOR THE AWAKERI COMMUNITY

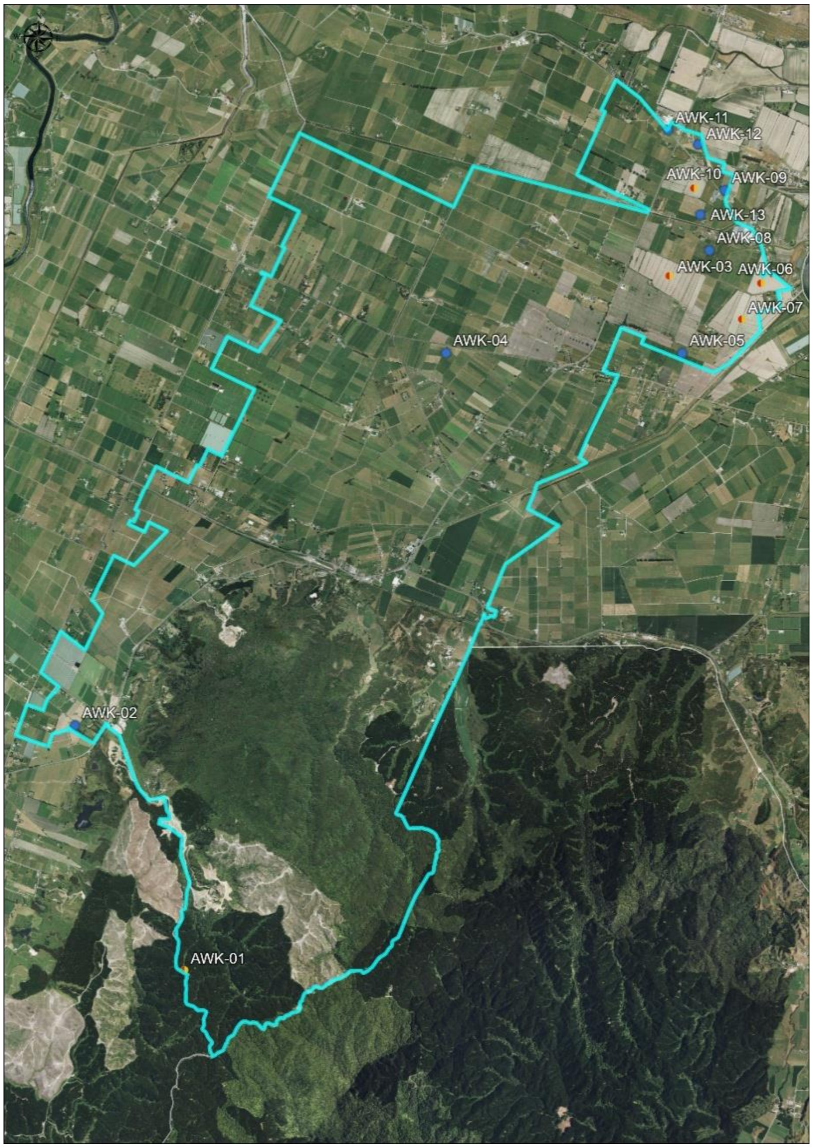

Figure B12 – Locations of climate risks identified by the community for the Awakeri area

ID	Risk to	Climate Hazard
AWK-01	Kiwi population in plantation forestry	Increased fire risk due to rising temperatures and dryness and drought.
AWK-02	Primary production land	Pluvial flooding due to more frequent high intensity rainfall events.

AWK-03	Cropping land near residential properties	Increased fire risk due to rising temperatures and dryness and drought.
AWK-04	Primary production land	Pluvial flooding due to more frequent high intensity rainfall events.
AWK-05	Primary production land	Pluvial flooding due to more frequent high intensity rainfall events.
AWK-06	Cropping land near residential properties	Increased fire risk due to rising temperatures and dryness and drought.
AWK-07	Cropping land near residential properties	Increased fire risk due to rising temperatures and dryness and drought.
AWK-08	Primary production land	Pluvial flooding due to more frequent high intensity rainfall events.
AWK-09	Primary production land	Pluvial flooding due to more frequent high intensity rainfall events.
AWK-10	Cropping land near Te Kura o Te Paroa and residential properties	Increased fire risk due to rising temperatures and dryness and drought.
AWK-11	Land either side of Thornton Road	Pluvial flooding due to more frequent high intensity rainfall events.
AWK-12	Stream	Increased risk of frequent leaching of contaminants from contaminated woodwaste site due more frequent high intensity rainfall events.
AWK-13	Primary production land	Pluvial flooding due to more frequent high intensity rainfall events.
AWK-14	Residential buildings (flood-impacted buildings, on-site effluent treatment systems, health and wellbeing of people)	Pluvial flooding due to more frequent high intensity rainfall events.
AWK-15	Te Kura o Te Paroa	Pluvial flooding due to more frequent high intensity rainfall events.

SUMMARY OF CLIMATE RISKS IDENTIED FOR THE POROPORO COMMUNITY

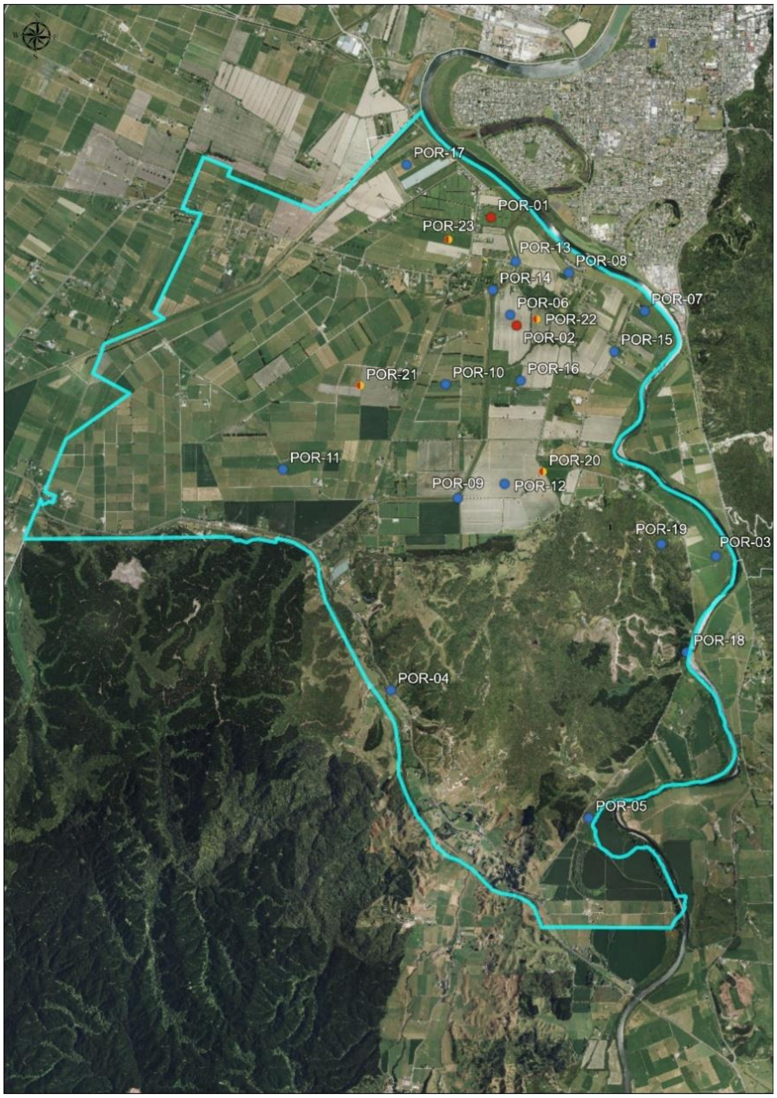

Figure B13 – Locations of climate risks identified by the community for the Poroporo area

ID	Risk to	Climate Hazard
POR-01	Public health	Use of agricultural and horticultural sprays and pollen spread due to longer growing seasons.
POR-02	Primary production land	Increased risk from exotic pest species due to increasing temperatures and changes in seasonality.
POR-03	Primary production land	Fluvial flooding due to more frequent high intensity rainfall events.
POR-04	State highway network - White Pine Bush Road	Increased risk of landslides due to more frequent high intensity rainfall events.

POR-05	Primary production land	Fluvial flooding due to more frequent high intensity rainfall events.
POR-06	Primary production land	Low lying land at risk from rising groundwater and fluvial flooding due to more frequent high intensity rainfall events.
POR-07	Stop bank	Increased risk of overtopping or breach of stop bank from fluvial flooding due to more frequent high intensity rainfall events.
POR-08	Roading network	Pluvial flooding due to more frequent high intensity rainfall events. The Marea permits access when road is in flood.
POR-09	Stop bank	Increased risk of overtopping or breach of stop bank from fluvial flooding due to more frequent high intensity rainfall events.
POR-10	Primary production land	Low lying land at risk from rising groundwater and fluvial flooding due to more frequent high intensity rainfall events.
POR-11	Primary production land	Low lying land at risk from rising groundwater and fluvial flooding due to more frequent high intensity rainfall events.
POR-12	Primary production land	Increased risk of pluvial flooding due to more frequent high intensity rainfall events.
POR-13	Roading network	Fluvial flooding inundating bridge due to more frequent high intensity rainfall events.
POR-14	Waioho Stream	Fluvial flooding and erosion of the stream bed and stream bank due to more frequent high intensity rainfall events.
POR-15	Roading network	Fluvial flooding overtopping the stop bank due to more frequent high intensity rainfall events.
POR-16	Roading network and primary production land	Fluvial flooding due to more frequent high intensity rainfall events.
POR-17	Primary production land	Pluvial flooding due to more frequent high intensity rainfall events.
POR-18	Roading network	Increased risk from fluvial flooding causing erosion to the river bank and landslide risk to the road due to more frequent high intensity rainfall events.
POR-19	Public health	Wood waste site contaminating Whakatāne water supply due to more frequent high intensity rainfall events.
POR-20	Cropping land near rural properties	Increased fire risk due to rising temperatures and dryness and drought.

POR-21	Cropping land near rural properties	Increased fire risk due to rising temperatures and dryness and drought.
POR-22	Cropping land near rural properties	Increased fire risk due to rising temperatures and dryness and drought.
POR-23	Cropping land near rural properties	Increased fire risk due to rising temperatures and dryness and drought.

TĀNEATUA COMMUNITY BOARD

SUMMARY OF CLIMATE RISKS IDENTIED FOR THE TĀNEATUA COMMUNITY

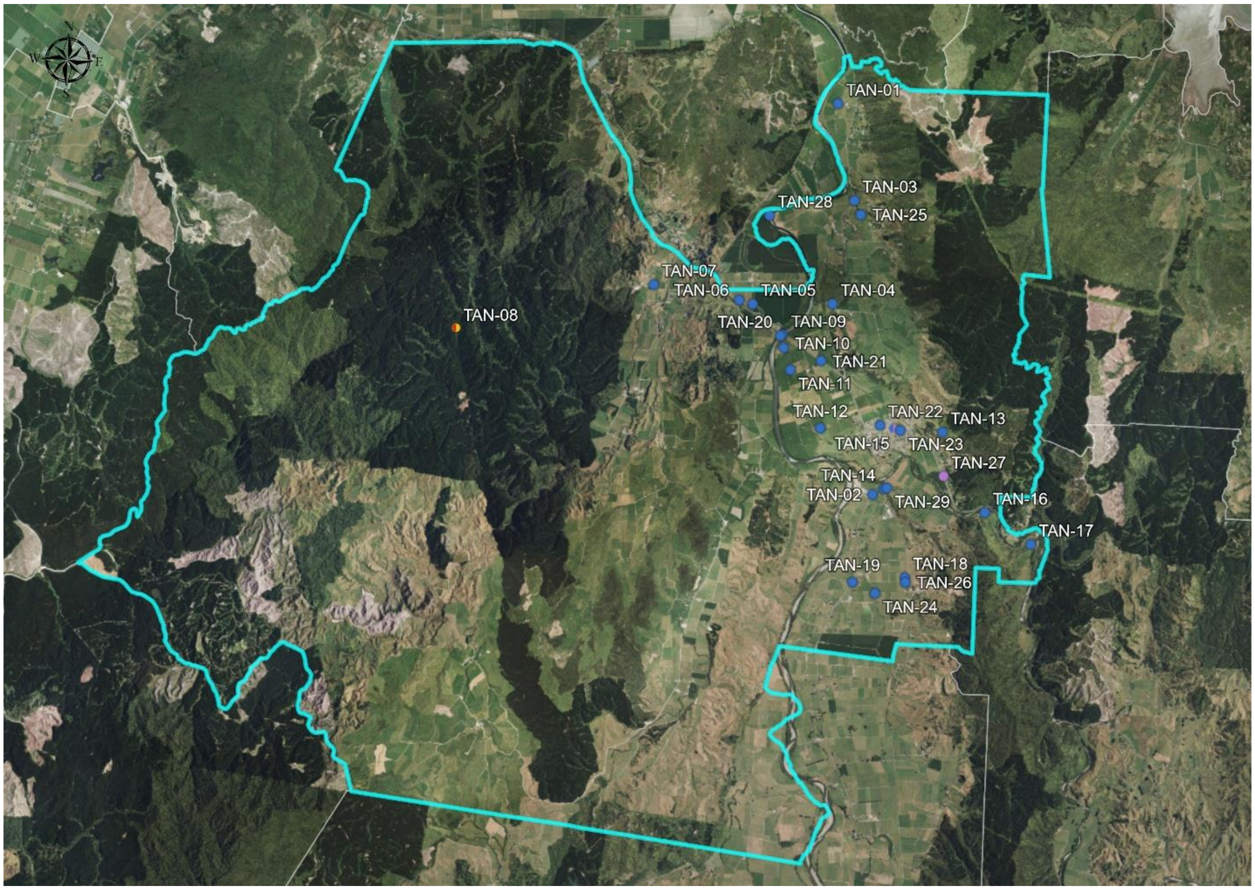

Figure B14 – Locations of climate risks identified by the community for the Tāneatua area

ID	Risk to	Climate Hazard
TAN-01	Primary production	Fluvial flooding due to more frequent high intensity rainfall events.
TAN-02	Roading network and primary production land	Fluvial flooding due to more frequent high intensity rainfall events. Flooding occurs here due to an undersized culvert.
TAN-03	Roading network	Fluvial flooding due to more frequent high intensity rainfall events.

TAN-04	Primary production land and residential building	Fluvial flooding due to more frequent high intensity rainfall events.
TAN-05	Residential properties	Fluvial flooding due to more frequent high intensity rainfall events.
TAN-06	Roading network	Fluvial flooding due to more frequent high intensity rainfall events.
TAN-07	Primary production land	Fluvial flooding due to more frequent high intensity rainfall events.
TAN-08	Plantation forestry	Increased fire risk due to rising temperatures and dryness and drought.
TAN-09	State highway network	Increased risk of failure of the Pekatahi bridge from scouring of support structures and wood debris build up on piles caused by increased fluvial flooding due to more frequent high intensity rainfall events.
TAN-10	Closed Landfill	Increased risk of erosion caused from fluvial flooding due to more frequent high intensity rainfall events.
TAN-11	Primary production land	Fluvial flooding due to more frequent high intensity rainfall events.
TAN-12	Waste water oxidation ponds	Increased risk of overtopping from fluvial flooding due to more frequent high intensity rainfall events.
TAN-13	Residential property	Increased risk of landslides due to more frequent high intensity rainfall events. Past event - landslide destroyed residential property here.
TAN-14	Primary production land	Fluvial flooding due to more frequent high intensity rainfall events.
TAN-15	Community isolation	Increased risk of roading network being closed from fluvial flooding and landslides due to more frequent high intensity rainfall events.
TAN-16	Water supply	Increased risk to water pump station from fluvial flooding due to more frequent high intensity rainfall events.
TAN-17	Primary production land	Fluvial flooding due to more frequent high intensity rainfall events.
TAN-18	Roading network and primary production land	Pluvial flooding due to more frequent high intensity rainfall events.
TAN-19	Roading network	Pluvial flooding due to more frequent high intensity rainfall events.

TAN-20	Primary production land and roading network	Increasing aggradation of the riverbed in fluvial floods due to more frequent high intensity rainfall events.
TAN-21	Roading network, primary production land and Tāneatua township	Fluvial flooding due to more frequent high intensity rainfall events. The Pekatahi bridge gets blocked by debris and the railway embankment acts as dam.
TAN-22	Residential properties and roading network	Pluvial flooding due to more frequent high intensity rainfall events.
TAN-23	Roading network	Pluvial flooding due to more frequent high intensity rainfall events.
TAN-24	Primary production and rural properties	Fluvial flooding due to more frequent high intensity rainfall events. Silt aggradation of Waiwherowhero stream bed reduces flow capacity and impacts the ability for watercress to grow particularly in the northern end of stream.
TAN-25	Primary production land and rural properties	Pluvial flooding due to more frequent high intensity rainfall events. The affected land here is situated behind a stopbank with floodgates that allow flood water to flow from the hill side area of the stopbank back to the Whakatāne river. The size of the floodgates is the issue as it is undersized which causes ponding of water as it restricts how fast water can drain from the land area on the hill side of the stopbank.
TAN-26	Primary production land	Pluvial flooding due to more frequent high intensity rainfall events. Debris from quarry blocking undersized culverts.
TAN-27	Roading network and electrical infrastructure	Increased risk of tree falls due to increased wind and storminess.
TAN-28	Whakatāne River	Fluvial flooding causing riverbank erosion and stop bank erosion due to more frequent high intensity rainfall events.
TAN-29	Roading network	Fluvial flooding due to more frequent high intensity rainfall events.

SUMMARY OF CLIMATE RISKS IDENTIED FOR THE RŪĀTOKI COMMUNITY

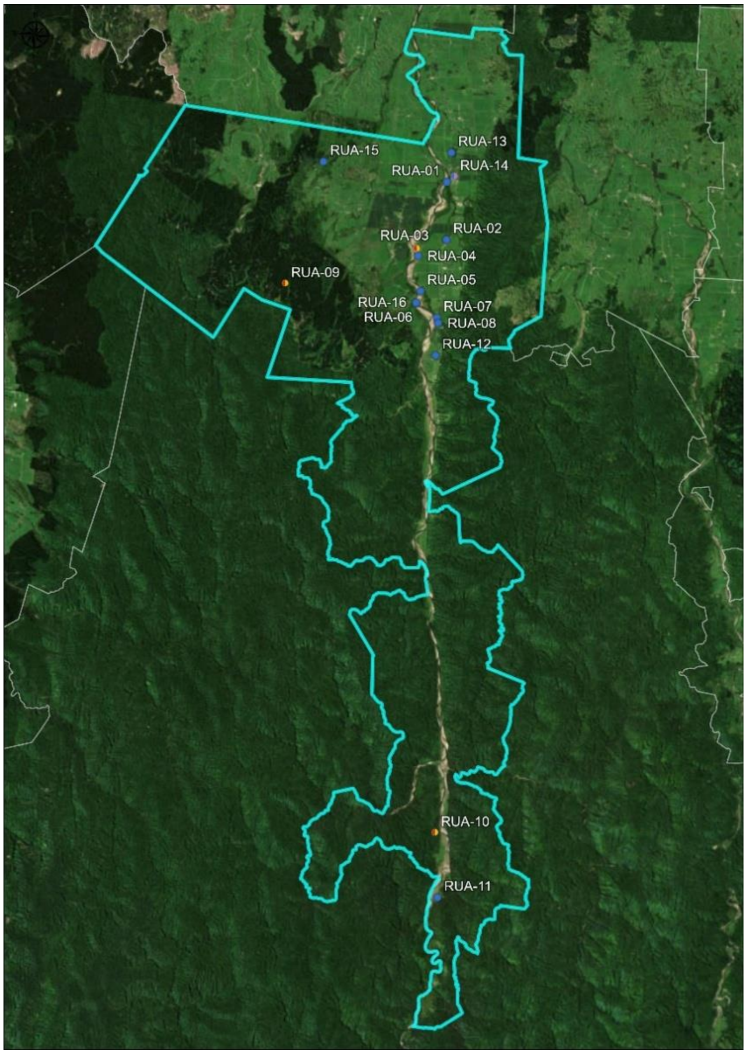

Figure B15 – Locations of climate risks identified by the community for the Rūātoki area

ID	Risk to	Climate Hazard
RUA-01	Roading network	Increased risk of failure of the Ohotu Road bridge from the scouring of support structures and wood debris build up on piles caused by increased fluvial flooding due to more frequent high intensity rainfall events.
RUA-02	Marae and Urupā	Fluvial flooding due to more frequent high intensity rainfall events.
RUA-03	Te Urewera	Increased risk of introduced exotic pest species and drought due to increased temperatures, higher drought frequency and persistence.

RUA-04	Primary production land	Riverbank erosion due to more frequent high intensity rainfall events.
RUA-05	Primary production land, roading network and rural houses	Aggradation of the riverbed from fluvial flooding due to more frequent high intensity rainfall events.
RUA-06	Water supply	Fluvial flooding and erosion due to more frequent high intensity rainfall events.
RUA-07	Marae and Urupa	Fluvial flooding due to more frequent high intensity rainfall events.
RUA-08	Roading network and primary production land	Fluvial flooding and erosion due to more frequent high intensity rainfall events.
RUA-09	Plantation forestry	Increased fire risk due to rising temperatures and dryness and drought.
RUA-10	Native forest	Increased fire risk due to rising temperatures and dryness and drought.
RUA-11	Marae	Increased risk of fluvial flooding due to more frequent high intensity rainfall events.
RUA-12	Roading network and primary production land	Fluvial flooding due to more frequent high intensity rainfall events.
RUA-13	Roading network	Pluvial flooding due to more frequent high intensity rainfall events.
RUA-14	Community isolation	Increased risk of roading network being closed from fluvial and pluvial flooding and landslides due to more frequent high intensity rainfall events.
RUA-15	Roading network	Fluvial flooding due to more frequent high intensity rainfall events.
RUA-16	Public health	Increased risk of contamination of water supply from fluvial flooding due to more frequent high intensity rainfall events. Ruatoki water is supplied from a shallow bore at this location. When the river is in flood turbidity impacts the UV treatment process.

SUMMARY OF CLIMATE RISKS IDENTIED FOR THE WAIMANA – NUKUHOU NORTH COMMUNITY

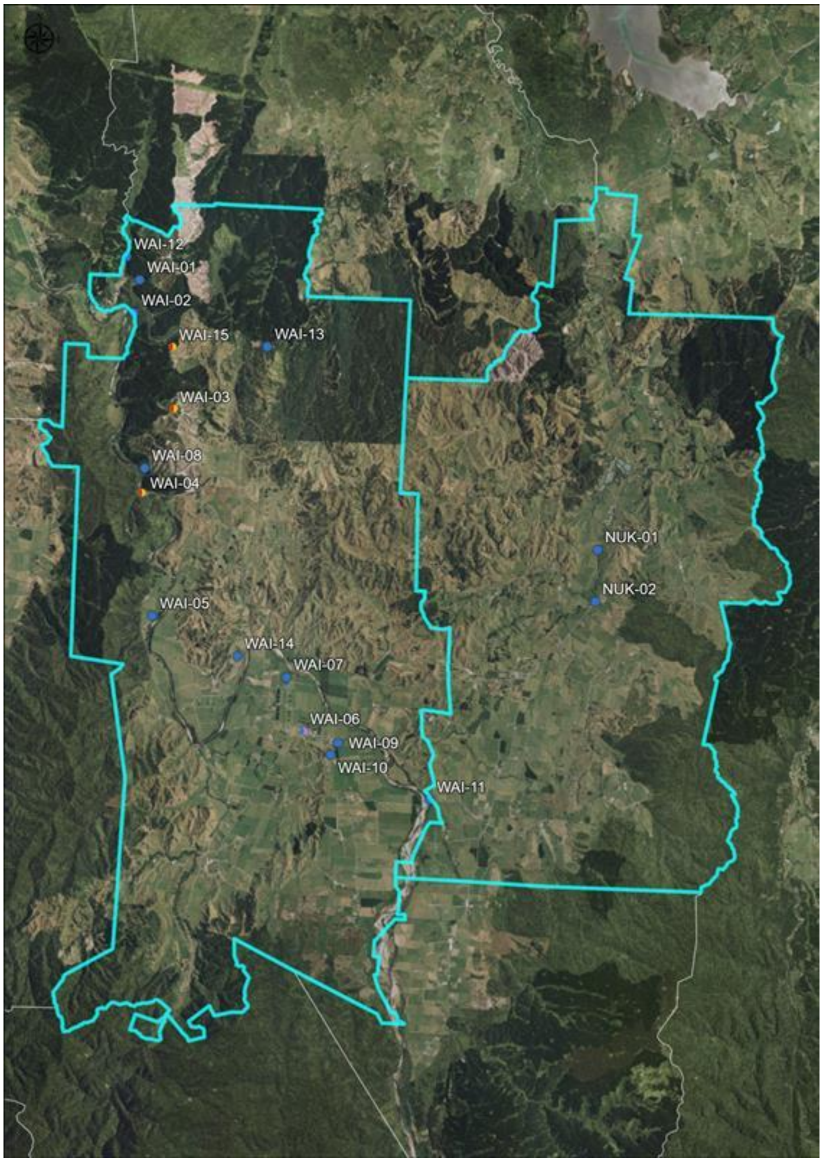

Figure B16 – Locations of climate risks identified by the community for the Waimana – Nukuhou North area

ID	Risk to	Climate Hazard
WAI-01	Roading network	Increased risk of landslides due to more frequent high intensity rainfall events.
WAI-02	State highway network	Increased risk of landslides due to more frequent high intensity rainfall events.

WAI-03	Plantation forestry	Increased fire risk due to rising temperatures and dryness and drought.
WAI-04	Public health	Increasing temperature of freshwater bodies resulting in increased pathogens and other diseases as well as algal blooms due to higher mean temperatures and drought weather.
WAI-05	Electricity infrastructure and natural gas line	Fluvial flooding due to more frequent high intensity rainfall events.
WAI-06	Community isolation	Increased risk of roading network being closed from fluvial flooding and landslides due to more frequent storm events.
WAI- 07	Primary production land	Fluvial flooding due to more frequent high intensity rainfall events.
WAI-08	State highway network	Fluvial flooding due to more frequent high intensity rainfall events.
WAI-09	Electricity infrastructure	Fluvial flooding due to more frequent high intensity rainfall events.
WAI-10	Water supply	Increased risk to Waimana water supply and pump station from fluvial and pluvial flooding due to more frequent high intensity rainfall events.
WAI-11	Roading network	Riverbank erosion due to more frequent high intensity rainfall events.
WAI-12	Roading network	Fluvial flooding and forestry slash due to more frequent high intensity rainfall events.
WAI-13	Roading network	Increased risk of landslides due to more frequent high intensity rainfall events.
WAI-14	Roading network	Increased risk of landslides due to more frequent high intensity rainfall events.
WAI-15	Rural houses	Increased fire risk due to rising temperatures and dryness and drought.
NUK-01	Streambank erosion	Fluvial flooding due to more frequent high intensity rainfall events.
NUK-02	State highway network	Fluvial flooding due to more frequent high intensity rainfall events.

SUMMARY OF CLIMATE RISKS IDENTIED FOR THE MATAHI COMMUNITY

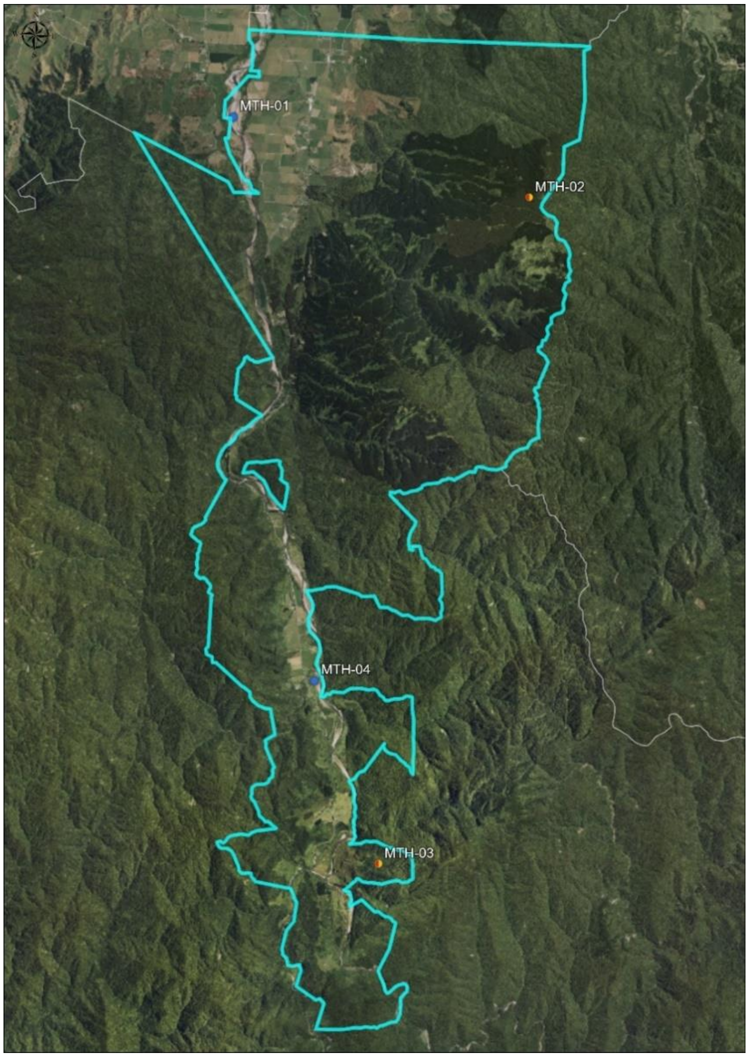

Figure B17 – Locations of climate risks identified by the community for the Matahi area

ID	Risk to	Climate Hazard
MTH-01	Primary production land	Fluvial flooding from aggradation of the river bed due to more frequent high intensity rainfall events.
MTH-02	Plantation forestry	Increased fire risk due to rising temperatures and dryness and drought.
MTH-03	Native forest	Increased fire risk due to rising temperatures and dryness and drought.
MTH-04	Riverbank	Fluvial flooding and high river flows causing erosion of the river bank due to more frequent high intensity rainfall events.

SUMMARY OF CLIMATE RISKS IDENTIED FOR THE WAINUI COMMUNITY

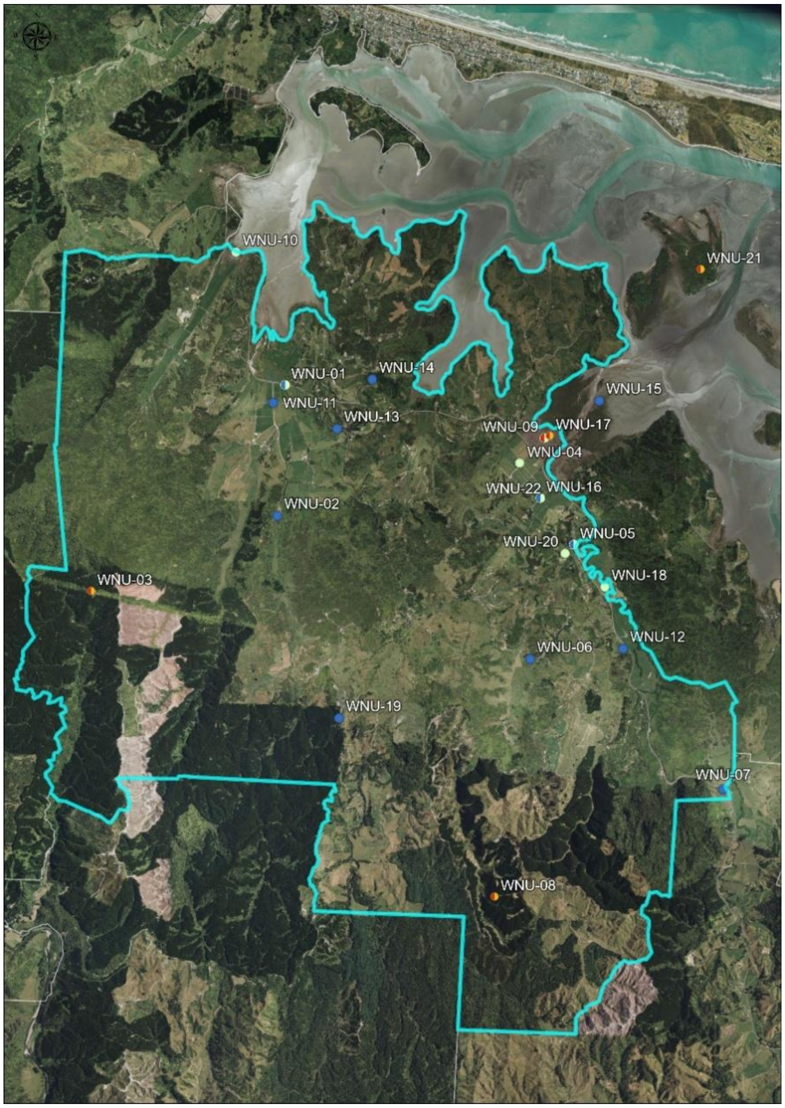

Figure B18 – Locations of climate risks identified by the community for the Wainui area

ID	Risk to	Climate Hazard
WNU-01	Roading network	Fluvial flooding due to more frequent high intensity rainfall events especially when peak flood flows coincide with high tides.
WNU-02	Marae	Fluvial flooding due to more frequent high intensity rainfall events.
WNU-03	Plantation forestry	Arcing between electricity lines increasing fire risk due to rising temperatures, dryness and drought.

WNU-04	Primary production	Land requiring land use change from agriculture due to rising groundwater from sea level rise.
WNU-05	Roading network	Fluvial flooding due to more frequent high intensity rainfall events, especially when peak rainfall coincides with high tides and coastal storms.
WNU-06	Roading network	Increased risk of landslides due to more frequent high intensity rainfall events.
WNU-07	Roading network	Fluvial flooding due to more frequent high intensity rainfall events.
WNU-08	Plantation forestry	Increased fire risk due to rising temperatures and dryness and drought.
WNU-09	Wetland ecosystem, salt marsh and native flora and fauna	Ecological degradation due to sea level rise, increased salinity and higher water temperatures.
WNU-10	Roading network	Estuarine inundation and erosion due to relative sea level rise.
WNU-11	Roading network and primary production land	Pluvial flooding due to more frequent high intensity rainfall events, especially when peak rainfall coincides with high tides.
WNU-12	Roading network	Increased risk of landslides due to more frequent high intensity rainfall events.
WNU-13	Roading network	Increased risk of landslides due to more frequent high intensity rainfall events.
WNU-14	Roading network	Increases risk of landslides due to more frequent high intensity rainfall events.
WNU-15	Estuarine ecosystems and kaimoana in Ōhiwa Harbour	Ecological degradation due to sedimentation due to more frequent high intensity rainfall events.
WNU-16	Roading network and primary production land	Pluvial flooding due to more frequent high intensity rainfall events, especially when peak rainfall coincides with high tides and coastal storms.
WNU-17	Saltmarsh	Increased fire risk due to increasing temperature and persistent dry spells.
WNU-18	Primary Production	Land requiring land use change from agriculture due to rising groundwater from sea level rise.
WNU-19	Roading network	Increased risk of landslides due to more frequent high intensity rainfall events.
WNU-20	Primary production land	Land requiring land use change from agriculture due to rising groundwater from sea level rise.

WNU-21	Saltmarsh	Increased fire risk due to increasing temperature and persistant dry spells. NB: Opotiki district
WNU-22	Roading network and primary production	Coastal flooding due to increased storminess and tropical cyclones.

MURUPARA COMMUNITY BOARD

SUMMARY OF CLIMATE RISKS IDENTIED FOR THE LAKE MATAHINA COMMUNITY

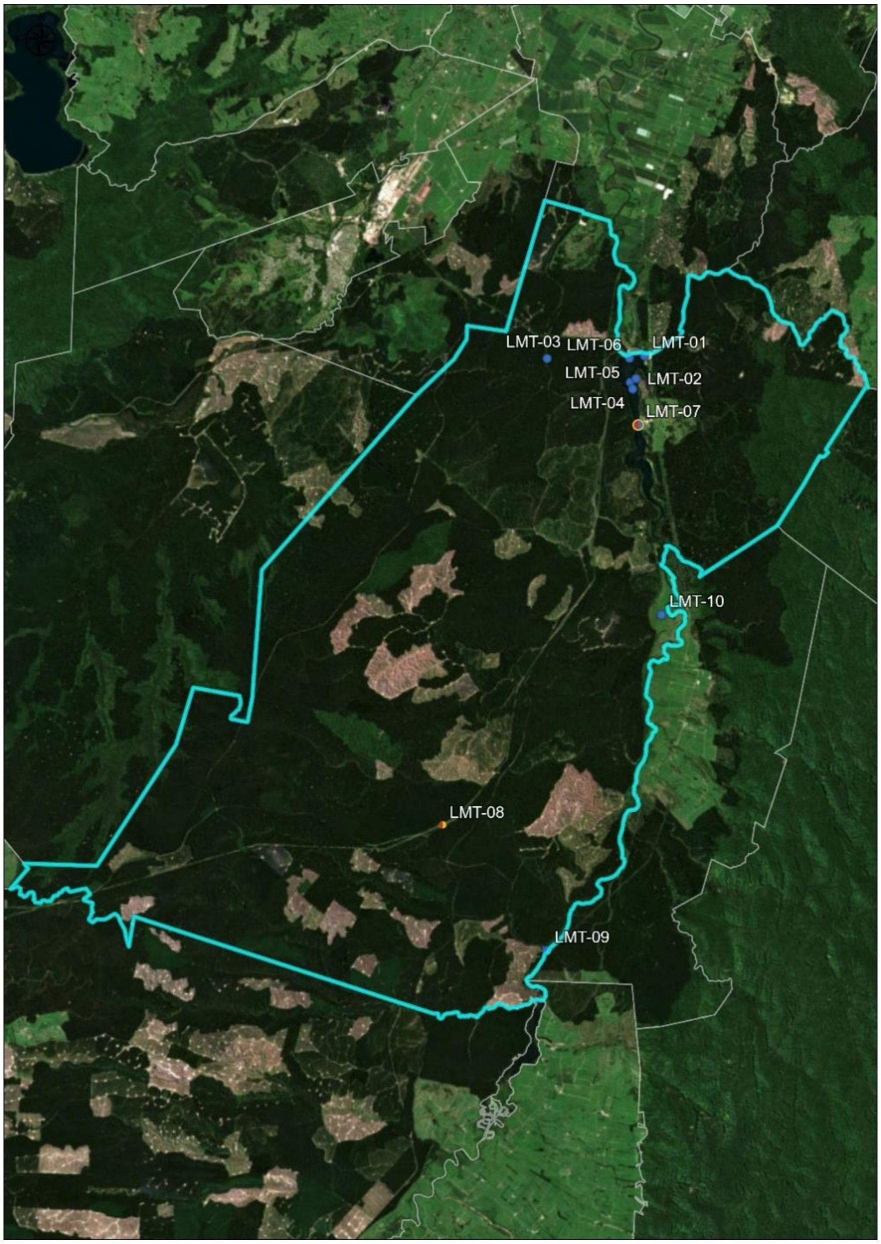

Figure B19 – Locations of climate risks identified by the community for the Lake Matahina area

ID	Risk to	Climate Hazard
LMT-01	Roading network	Increased risk of landslides due to more frequent high intensity rainfall events.
LMT-02	Roading network	Increased risk of landslides including undercutting of the road due to more frequent high intensity rainfall events.
LMT-03	Rail and road networks	Increased risk of landslides due to more frequent high intensity rainfall events.
LMT-04	Matahina Dam	Increased risk of landslide-induced tsunami due to more frequent high intensity rainfall events.
LMT-05	Lake Matahina	Increased risk to lake capacity from sedimentation caused by fluvial flooding due to more frequent high intensity rainfall events.
LMT-06	Matahina Dam	Increased debris loading on the gate to the penstock requiring more frequent clearing of debris caused by increased frequency of fluvial flooding due to more frequent high intensity rainfall events.
LMT-07	Freshwater Water quality, ecology, and Mauri of the Lake	Increased risk to water quality, ecology, and Mauri of the stream due to increased temperatures and fluvial flooding due to more frequent high intensity rainfall events.
LMT-08	Electricity infrastructure	Increased fire risk to powerlines due to rising temperatures and dryness and drought.
LMT-09	Rangitaiki River	Increased flows when the Aniwaniwa Dam releases water to control lake levels due to more frequent high intensity rainfall events.
LMT-10	Primary production land	Fluvial flooding due to more frequent high intensity rainfall events.

SUMMARY OF CLIMATE RISKS IDENTIED FOR THE WAIOHAU COMMUNITY

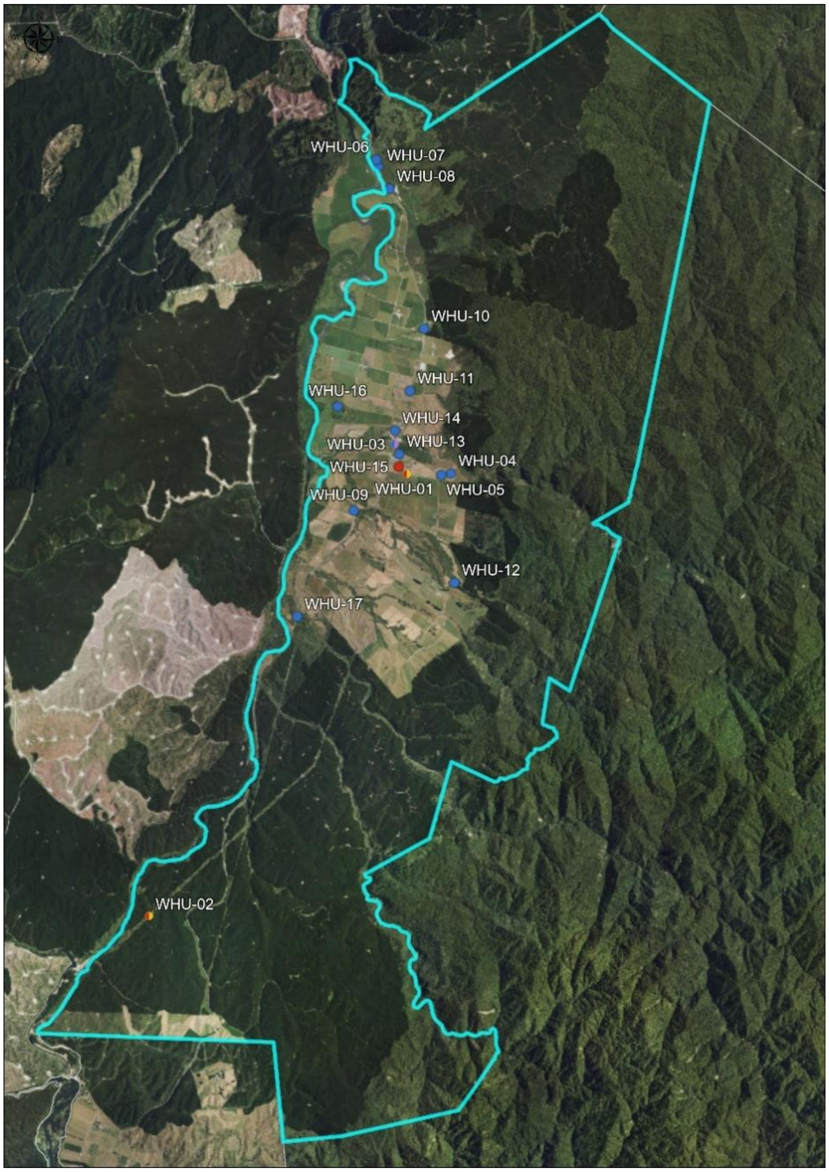

Figure B20 – Locations of climate risks identified by the community for the Waiohau area

ID	Risk to	Climate Hazard
WHU-01	Public health	Dust from unsealed access road due to dryness and drought.
WHU-02	Electricity network	Increased risk to powerlines from fire due to rising temperatures and dryness and drought.
WHU-03	Community isolation	Increased risk of roading network being closed from fluvial flooding and landslides due to more frequent storm events.

WHU-04	Urupa, marae, residential properties and primary production land	Increased risk of fluvial flooding due to more frequent high intensity rainfall events.
WHU-05	Urupa	Streambank erosion due to more frequent high intensity rainfall events.
WHU-06	Roading network	Fluvial flooding due to more frequent high intensity rainfall events.
WHU-07	Roading network	Increased risk of landslides due to more frequent high intensity rainfall events.
WHU-08	Roading network	Fluvial flooding due to more frequent high intensity rainfall events.
WHU-09	Primary production land	Fluvial flooding due to more frequent high intensity rainfall events.
WHU-10	Roading network	Fluvial flooding due to more frequent high intensity rainfall events.
WHU-11	Roading network	Fluvial flooding due to more frequent high intensity rainfall events.
WHU-12	Roading network	Fluvial flooding due to more frequent high intensity rainfall events.
WHU-13	School	Fluvial flooding due to more frequent high intensity rainfall events. Flooding comes close to school Wisconsin mound (waste water).
WHU-14	Primary production land	Fluvial flooding due to more frequent high intensity rainfall events.
WHU-15	Public health	Increased risk of bacterial and pathogen contamination of untreated water supplies due to increasing temperatures.
WHU-16	Primary production land	Fluvial flooding due to more frequent high intensity rainfall events.
WHU-17	Roading network	Fluvial flooding due to more frequent high intensity rainfall events.

SUMMARY OF CLIMATE RISKS IDENTIED FOR THE LAKE ĀNIWANIWA COMMUNITY

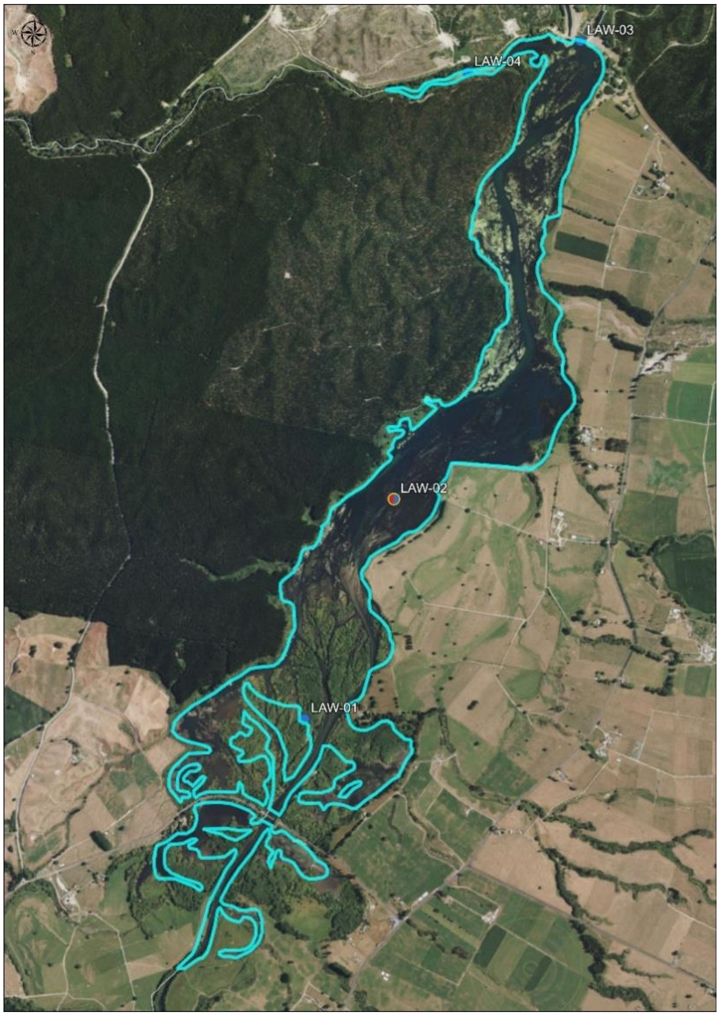

Figure B21– Locations of climate risks identified by the community for the Lake Āniwaniwa area

ID	Risk to	Climate Hazard
LAW-01	Primary production land	Fluvial flooding from aggradation of the river bed due to more frequent high intensity rainfall events.
LAW-02	Water supply, water quality, ecology, and Mauri of the lake	Increased risk to water quality, ecology, and Mauri of the stream from increased temperatures and fluvial flooding due to more frequent high intensity rainfall events and higher mean temperatures and drought weather.
LAW-03	Āniwaniwa Dam	Increased debris loading on the gate to the penstock and increased siltation requiring more frequent clearing of debris caused by fluvial flooding due to more frequent high intensity rainfall events.

LAW-04	Lake Āniwaniwa	Increased risk from harvested plantation forestry slope erosion and lake sedimentation due to more frequent high intensity rainfall events.

SUMMARY OF CLIMATE RISKS IDENTIED FOR THE GALATEA COMMUNITY

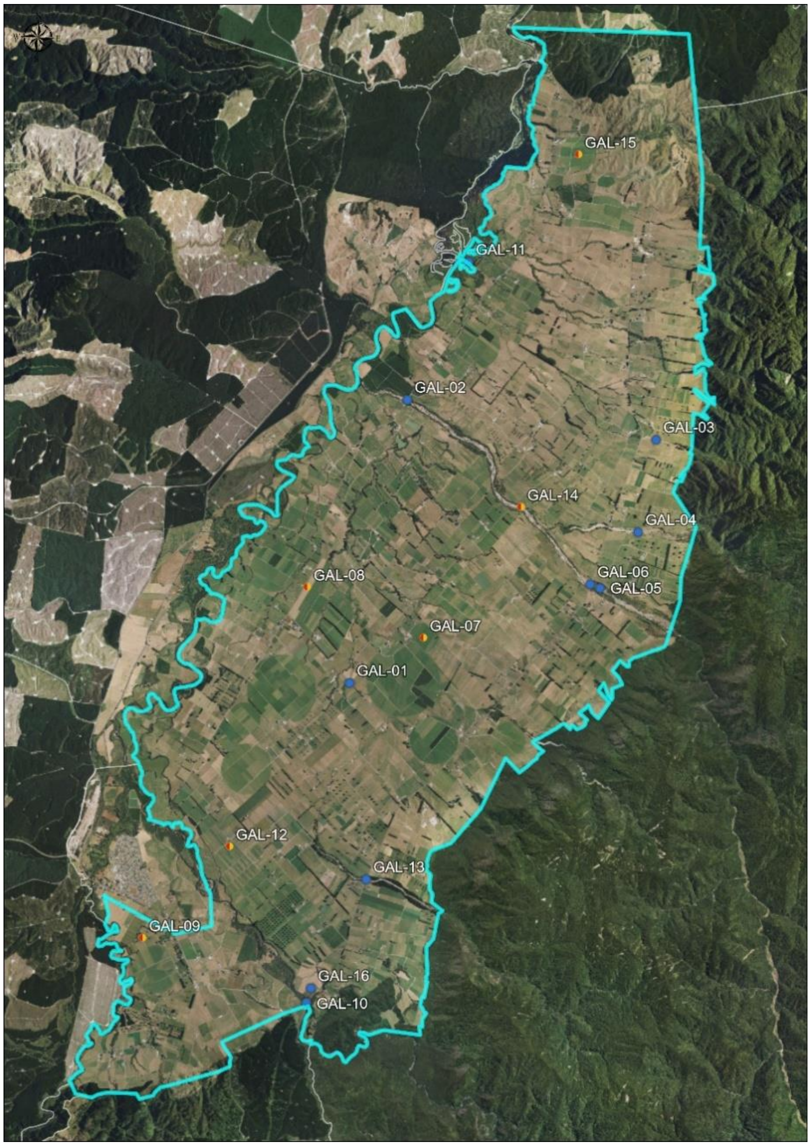

Figure B22 – Locations of climate risks identified by the community for the Galatea area

ID	Risk to	Climate Hazard
GAL-01	Roading network and primary production land	Fluvial flooding due to more frequent high intensity rainfall events.
GAL-02	Roading network	Fluvial flooding due to more frequent high intensity rainfall events.
GAL-03	Primary production land and roading network	Increased risk of debris flows due to more frequent high intensity rainfall events.

GAL-04	Primary production land and roading network	Increased risk of debris flows due to more frequent high intensity rainfall events.
GAL-05	Primary production land and roading network	Increased risk of debris flows due to more frequent high intensity rainfall events.
GAL-06	Roading network	Increased risk to bridge from fluvial flooding due to more frequent high intensity rainfall events.
GAL-07	Primary production land	Reduced pasture growth and potential constraints to access water for irrigation due to increasing temperature and persistent drought.
GAL-08	Operability of the Galatea Airstrip	Increased fire risk due to rising temperatures and dryness and drought.
GAL-09	Primary production land	Increased risk to land use activities due to increasing temperature, more heatwaves and drought.
GAL-10	Roading network	Increased risk to Whirinaki bridge from scouring of support structures due to more frequent high intensity rainfall events. Whirinaki Bridge foundations scoured out by flood event caused by Cyclone Cook in 2017.
GAL-11	Roading network	Fluvial flooding due to more frequent high intensity rainfall events. Flood events inundate the road which closes the Kopuriki Bridge.
GAL-12	Primary production land	Increased risk to land use activities due to rising temperatures and dryness and drought.
GAL-13	Roading Newtork	Increased risk to Mangamate bridge from scouring of support structures caused by fluvial flooding due to more frequent high intensity rainfall events.
GAL-14	Freshwater	Increased risk to water quality, ecology, and Mauri of the stream from increased temperatures and fluvial flooding due to more frequent high intensity rainfall events and higher mean temperatures and drought weather.
GAL-15	Primary production land	Increased risk to agricultural land use from changes in water allocation and summer irrigation restrictions due to rising temperatures and dryness and drought.
GAL-16	Roading network and rural properties	Fluvial flooding due to more frequent high intensity rainfall events.

SUMMARY OF CLIMATE RISKS IDENTIED FOR THE KĀINGAROA FOREST COMMUNITY

Figure B23 – Locations of climate risks identified by the community for the Kāingaroa Forest area

ID	Risk to	Climate Hazard
KRF-01	Rail network	Increased risk of landslides due to more frequent high intensity rainfall events.

KRF-02	Plantation forestry	Increased fire risk due to rising temperatures and dryness and drought.
KRF-03	Plantation forestry	Increased fire risk due to rising temperatures and dryness and drought.
KRF-04	Plantation forestry	Increased fire risk due to rising temperatures and dryness and drought.
KRF-05	Moewhare Marae	Fluvial flooding and rising groundwater due to more frequent high intensity rainfall events
KRF-06	Murupara township and infrastructure	Increased fire risk in plantation forestry due to rising temperatures and dryness and drought.
KRF-07	Murupara water supply reservoirs	Increased fire risk due to rising temperatures and dryness and drought.
KRF-08	Primary production land	Fluvial flooding due to more frequent high intensity rainfall events.
KRF-09	River ecosystem	Increased risk from floods containing slash left after clear felling of mature plantation forestry due to more frequent high intensity rainfall events.
KRF-10	Public Health	Strong winds causing a health and safety risk and track closure due to more frequent storm events.
KRF-11	Roading network and electrical infrastructure	Increased risk of tree falls due to more frequent storm events.
KRF-12	Public health	Increased risk of pine pollen spread due to longer growing seasons.
KRF-13	Roading network, primary production land and rural properties	Fluvial flooding due to more frequent high intensity rainfall events.
KRF-14	Wetland	Increasing temperatures reducing resilience to pest flora and fauna due to rising temperatures and dryness and drought.
KRF-15	Wetland	Increasing temperatures reducing resilience to pest flora and fauna due to rising temperatures and dryness and drought.

SUMMARY OF CLIMATE RISKS IDENTIED FOR THE MURUPARA COMMUNITY

Figure B24 – Locations of climate risks identified by the community for the Murupara area

ID	Risk to	Climate Hazard
MUR-01	Public health and environmental contamination	Increased risk of overflows from the Murupara wastewater treatment ponds from fluvial flooding due to more frequent high intensity rainfall events.
MUR-02	Murupara township	Increased fire risk due to rising temperatures and dryness and drought.
MUR-03	Closed Landfill	Increased risk of erosion due to increased river flows from more frequent fluvial flood events.

MUR-04	Freshwater	Increased risk to water quality from fluvial flooding and increased temperatures due to more frequent high intensity rainfall events and rising temperatures.
MUR-05	Roading network	Increased risk of surface flooding from overwhelmed stormwater network due to more frequent high intensity rainfall events.
MUR-06	Residential properties	Increased risk of erosion caused by fluvial flooding due to more frequent high intensity rainfall events.
MUR-07	Roading network	Increased risk of surface flooding from overwhelmed stormwater network due to more frequent high intensity rainfall events.
MUR-08	Freshwater	Increased risk to water quality, ecology, and Mauri of the stream from increased temperatures and fluvial flooding due to more frequent high intensity rainfall events and higher mean temperatures and drought weather.
MUR-09	Rangitāiki River bridge and residential properties	River aggradation from fluvial flooding due to more frequent high intensity rainfall events.
MUR-10	Tipapa Marae, rural and residential properties	Increased risk of erosion of the river bank from fluvial flooding and high river flows due to more frequent high intensity rainfall events.
MUR-11	Kani Rangi Park	Fluvial flooding and erosion due to more frequent high intensity rainfall events.
MUR-12	Rangitāiki River	Risk to the mauri of the Rangitāiki River, water quality, and ecology from lack of native riparian planting buffer along the banks of the river allowing forestry slash to be washed off the hills and into the river during storm events featuring high intensity rainfall.

SUMMARY OF CLIMATE RISKS IDENTIED FOR THE TE UREWERA COMMUNITY

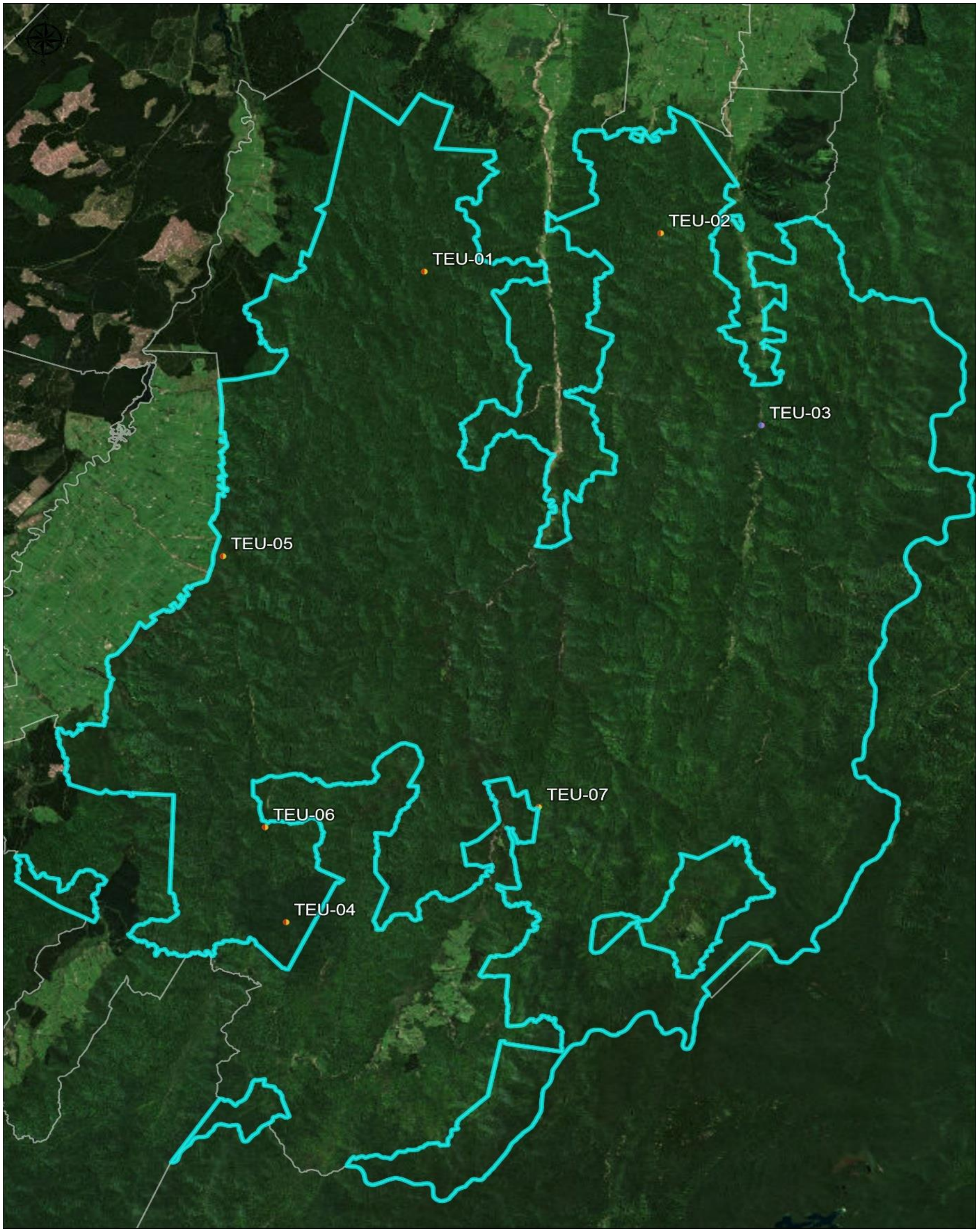

Figure B25 – Locations of climate risks identified by the community for the Te Urewera area

ID	Risk to	Climate Hazard
TEU-01	Te Urewera - forest ecosystem	Increased risk to forest from introduced exotic pest species due to increased temperatures, higher drought frequency and persistence.
TEU-02	Te Urewera - forest ecosystem	Increased risk from introduced exotic pest species due to increased temperatures, higher drought frequency and persistence.
TEU-03	Tourism activities	Increased risk of landslides due to more frequent high intensity rainfall events closing roading network.
TEU-04	Te Urewera	Increased fire risk due to rising temperatures and dryness and drought.
TEU-05	Galatea faces	Increased fire risk due to rising temperatures and dryness and drought.
TEU-06	Recreational access	Increased recreational access risk from fire risk due to rising temperatures and dryness and drought
TEU-07	Te Urewera - forest ecosystem	Increased risk to forest from introduced exotic pest species due to increased temperatures, higher drought frequency and persistence.

SUMMARY OF CLIMATE RISKS IDENTIED FOR THE MINGINUI AND TE WHĀITI COMMUNITY

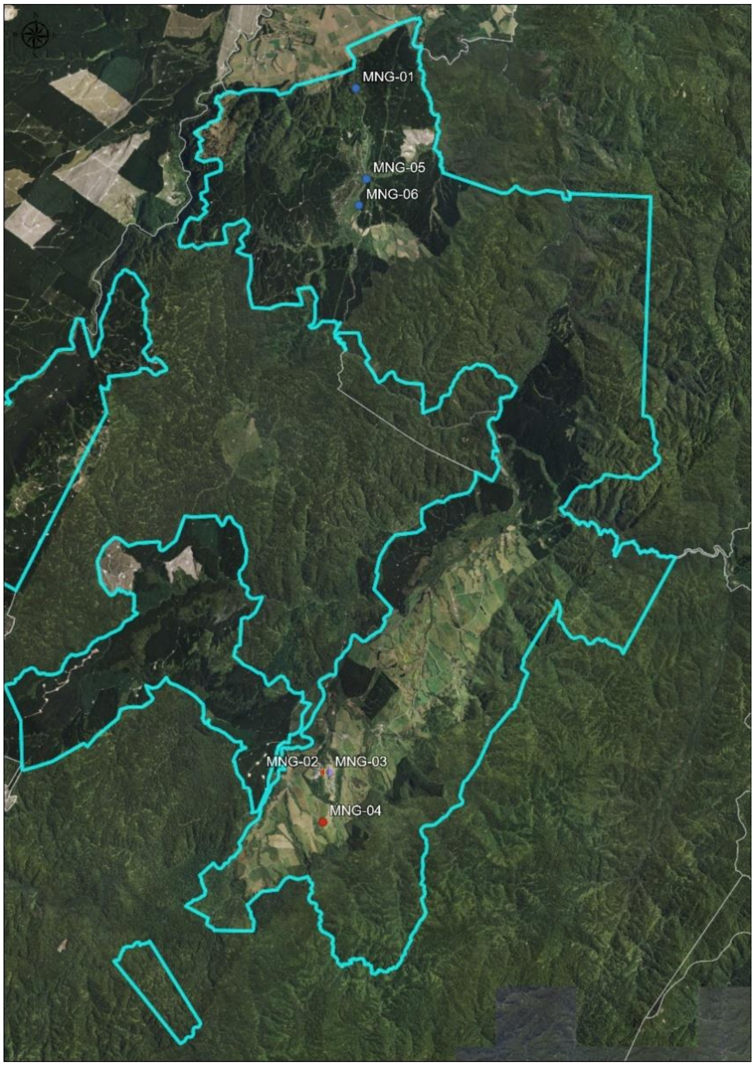

Figure B26 – Locations of climate risks identified by the community for the Minginui and Te Whāiti area

ID	Risk to	Climate Hazard
MNG-01	State highway network	Increased risk of landslides due to more frequent high intensity rainfall events.
MNG-02	Minginui township	Increased fire risk due to rising temperatures and dryness and drought.
MNG-03	Community isolation	Increased risk of roading network being closed from landslides due to more frequent severe weather events.
MNG-04	Public health	Increased risk of bacterial and pathogen contamination of untreated water supplies due to increasing temperatures.

MNG-05	Roading network	Fluvial flooding causing erosion to the Mangawiri Stream and scouring of bridge support structures due to more frequent high intensity rainfall events.
MNG-06	Highway network	Increased risk of landslides due to more frequent high intensity rainfall events.
MNG-07	Public health	Increasing temperatures and more frequent periods of continuous hot days will result in increased public health risks from algal blooms and exotic pests such as mosquitoes. In combination with changes in seasonality, longer growing seasons will result in increased duration of allergenic pollen production (due to a longer growing season) with consequential impacts on allergy sufferers.

SUMMARY OF CLIMATE RISKS IDENTIED FOR THE RUATĀHUNA COMMUNITY

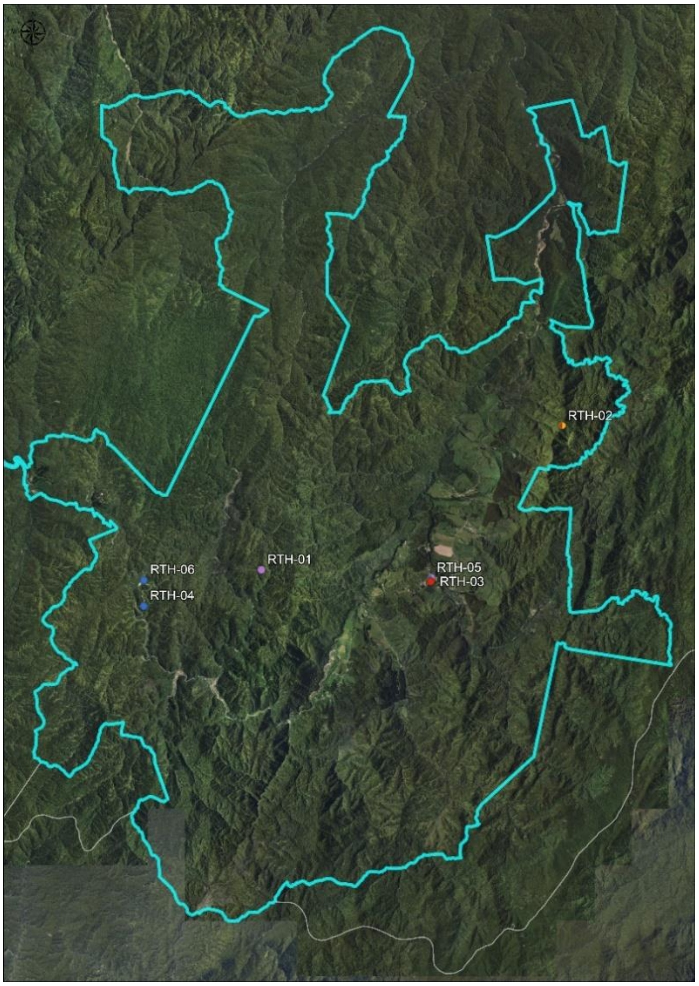

Figure B27 – Locations of climate risks identified by the community for the Ruatāhuna area

ID	Risk to	Climate Hazard
RTH-01	Electricity Network	Increased risk of treefall and arcing between powerlines during storm events due to increased wind and storminess resulting in electricity outages for part(s) of the Ruatāhuna community.
RTH-02	Te Urewera native forest ecosystem	Increased risk from introduced exotic pest species and drought due to increased temperatures, higher drought frequency and persistence.
RTH-03	Public health	Increased risk of bacterial and pathogen contamination of untreated water supplies due to increasing temperatures.

RTH-04	State highway network	Increased risk of landslides due to more frequent high intensity rainfall events.
RTH-05	Community isolation	Increased risk of roading network being closed from landslides due to more frequent high intensity rainfall events.
RTH-06	State highway network	Increased risk of landslides due to more frequent high intensity rainfall events.