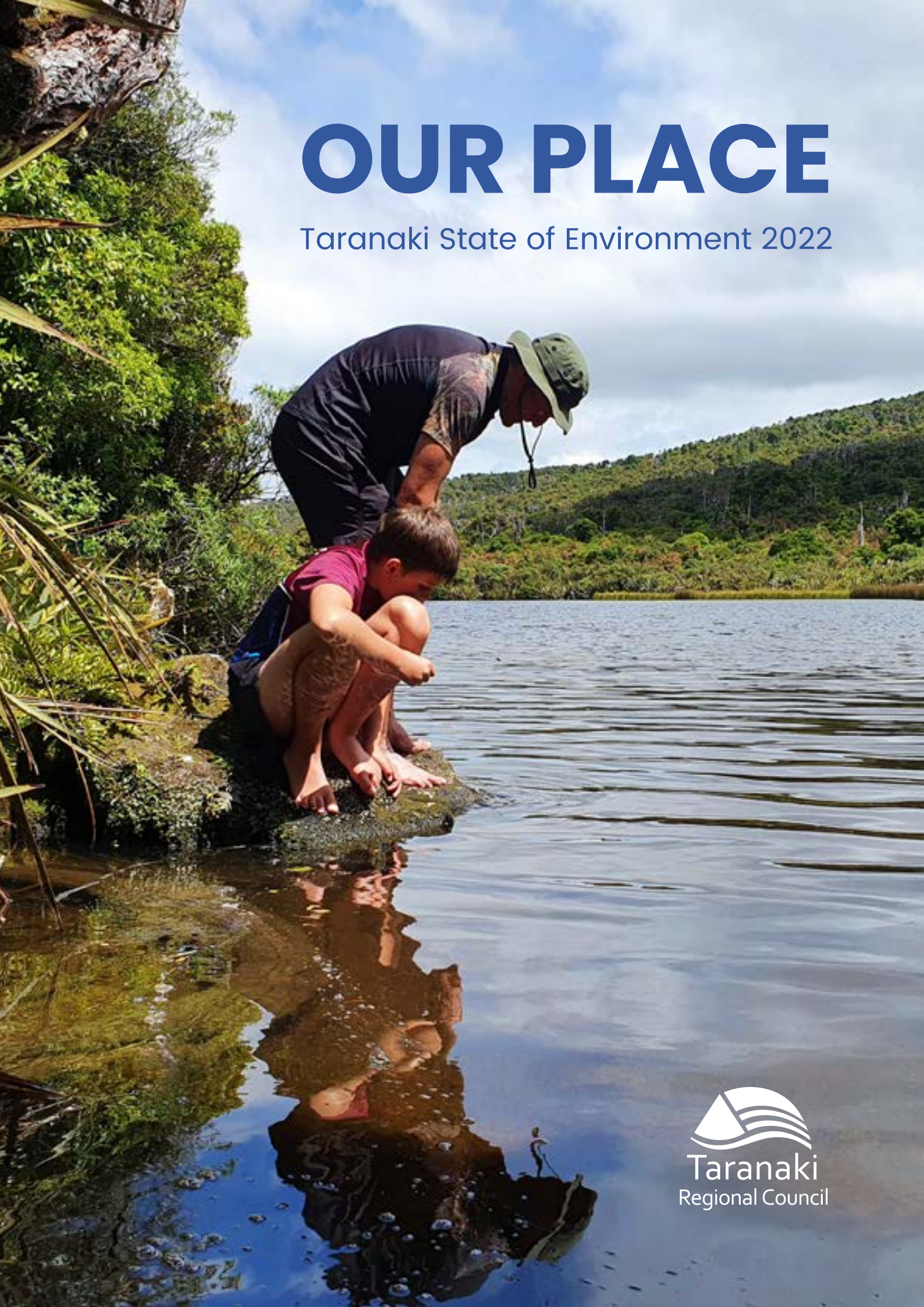

OUR PLACE

Taranaki State of Environment 2022

Taranaki
Regional Council

OUR PLACE

Taranaki State of Environment 2022

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Taranaki
Regional Council

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Introduction

Kia ora koutou and welcome to Our Place: **Taranaki State of Environment 2022**.

Taranaki is blessed with a beautiful, unique and diverse natural environment. It's why we live here and why we love it. It's why people visit. But that environment is not always perfect, which is why we must work hard to protect and restore it. We all want to leave Taranaki better off for future generations. To achieve this, Taranaki Regional Council is working hard to understand where we are at and what we need to do next.

The Resource Management Act 1991 requires regional councils to monitor the state of the environment. Reports like this can help us to answer important questions about the quality of our environment, the effectiveness of our programmes, and our future direction. This is our fifth State of Environment report since the first in 1996, and follows our last report in 2015.

Over the past few months, we have compiled and assessed a range of data and science collected by the Council and others. This State of Environment report covers different aspects of Taranaki climate and air, land and water. We assess the current state of our environment against a range of environmental health measures, as well as how things have changed over time.

This report covers three major environmental domains. In 'Climate and Air' we look at our climate and the impacts of climate change on Taranaki, and report on the region's air quality. The 'Land' chapter includes productive land and soils and explains how our efforts to reduce hill country erosion are reducing sedimentation in rivers and streams. We also report on contaminated land and solid waste management, and provide an update on efforts to protect and enhance our region's ecosystems. We address the pressures of pest animals and plants in the biodiversity and biosecurity section and recognise the work being done to protect and restore native habitats. 'Water' covers a range of topics including Māori freshwater values, water quality, water availability and its use. In addition to covering groundwater, rivers, aquatic ecosystems, lakes and wetlands, estuaries and the coast, we also provide an overview of recreational use of water.

In each chapter we take stock of 'What we know', looking at the current state of the environment and drawing on the data and information we hold. In 'What we're doing' we reflect on work undertaken and the impact of our efforts. 'Where we're heading' takes a look at the world around us, the changing expectations and requirements of councils and communities, and the important role that iwi and hapū have in ensuring we are caring for te taiao (the environment).

Aspects of our environment are in good condition and there has been good progress in some areas. For example, reduced soil loss through erosion and improved habitat for native species is evident in the monitoring we have undertaken. However, areas such as soil health and possum control require further attention. As outlined in the report, climate change is already affecting the region in a range of ways – and further changes are expected.

Freshwater improvement remains a significant focus for Taranaki, particularly in regard to sediment and bacteria levels in freshwater and coastal environments. We are experiencing a significant step-change in environmental policy and legislation, with new requirements and expectations of councils and communities. The role of iwi and hapū in decision-making is also changing. The Council is committed to responding to these changes and adapting our approach to accommodate new ways of working.

Throughout the report, we take the opportunity to celebrate just some of the many contributions made by our community, schools, businesses, landowners and iwi and hapū. Much of this work to protect and improve our environment is voluntary, often supported by the Council through funding and in-kind support.

We trust you will find this report informative and that the findings will prompt constructive discussion. Certainly, the challenges before us are complex, but they are not insurmountable. By drawing on our knowledge and experience, and ensuring decisions are informed by science and mātauranga Māori, we will be well placed to guide decision-making and ensure Taranaki remains one of the best regions to live, work and play.

Taranaki at a glance

Average annual sunshine hours

2,250 1972

2,300 2016

Population as at **2018**

117,561

↑**10.3%** increase between **1999** and **2018**

5,947mm

Mean annual rainfall on Taranaki Maunga

1933–2021

5,457km²

Marine area

extending 12 nautical miles into the territorial sea

295km

Coastline

Land area

93% Rural

7% Urban

723,610ha

Total land area of Taranaki

2 Marine reserves

530 Named rivers and streams

Over **5,000**

identified and mapped wetlands

28.6%

Land used for dairy production

1,889

Archaeological sites of significance

19 Large lakes

Top three industries by GDP ($m)

$1,750

Forestry, fishing and mining

$980

Primary manufacturing

$817

Agriculture

Gross Domestic Product per capita as at **2020**

$75,874

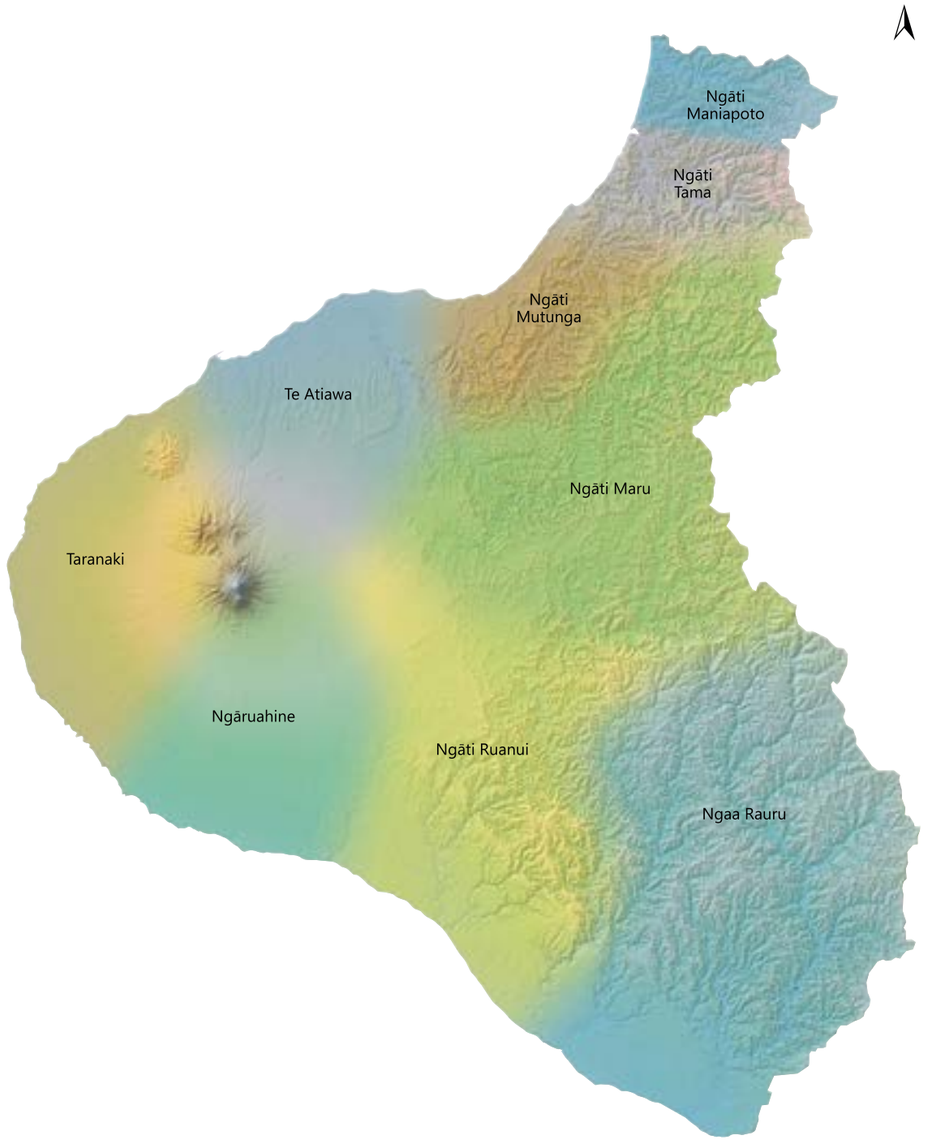
Taranaki

$64,626

New Zealand

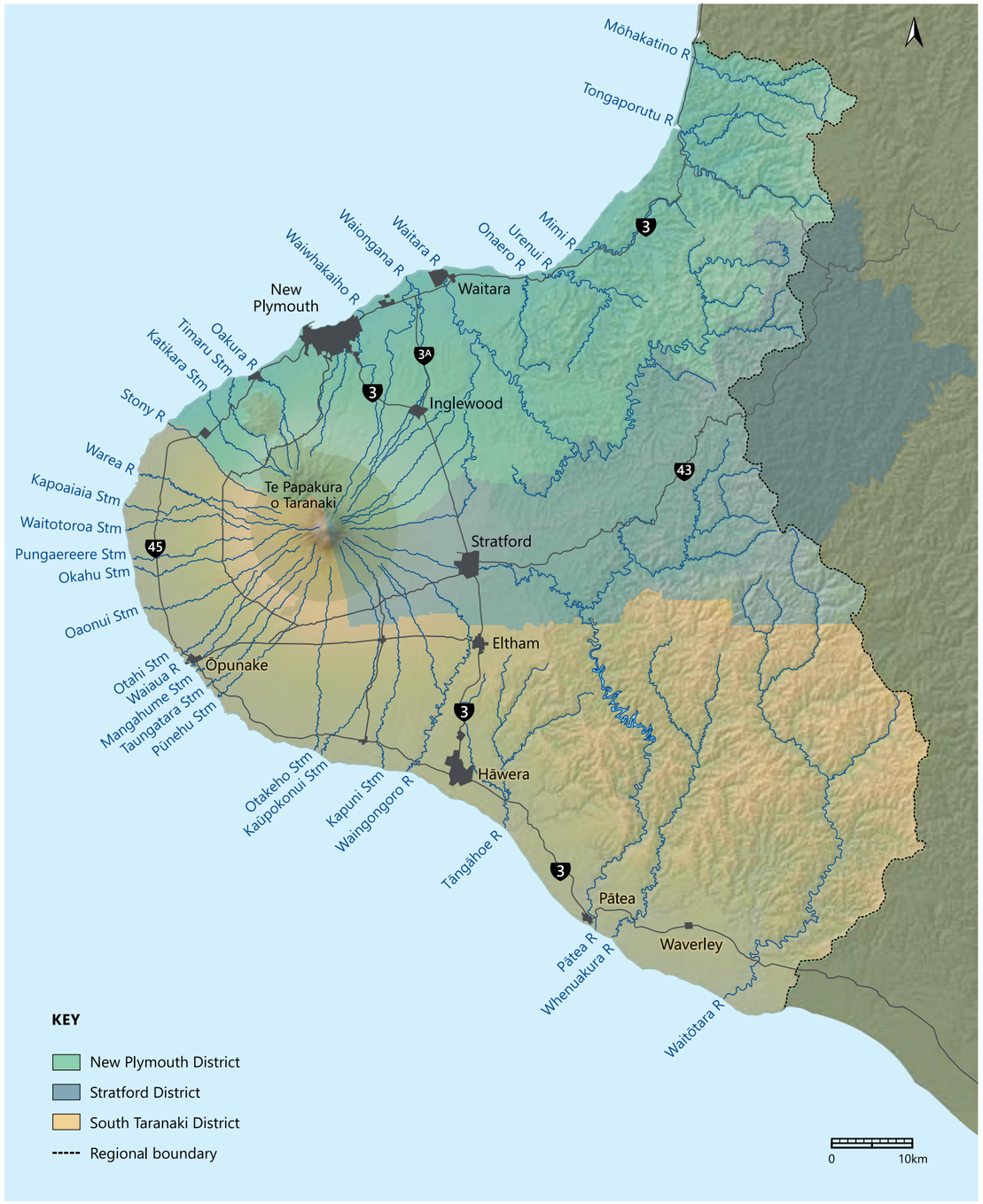
9 Iwi in Taranaki

Iwi boundaries



The iwi boundaries shown in this map are provided as an approximate guide only.

Taranaki region



Climate and Air

The people of Taranaki rightly expect nothing less than clean, unpolluted air. It is vital to the wellbeing of people and the health of the environment. This chapter details the air quality monitoring carried out across the region and the compliance programmes in place to maintain and improve our current levels of air quality.

Through extensive climate monitoring at sites across the region, the Council has collected data on sunshine, rain, wind and temperature, all of which helps guide decision-making by the Council and many other individuals and agencies.

We know the climate is changing at a rapid pace. Taranaki is already feeling the effects of climate change, with the potential for significant impacts in the future. Changes to air quality standards are also expected. This chapter outlines what we are doing to help Taranaki withstand the challenges that lie ahead.

Climate

Taranaki is one of the sunniest and windiest regions in Aotearoa. Crowned the sunshine capital of New Zealand in 2021, New Plymouth often enjoys more than 2,500 sunshine hours a year.

Taranaki climate is largely influenced by its location and exposure to weather systems migrating across the Tasman Sea. Consistent rainfall, a moderate climate and fertile, free-draining soils mean the region is well-suited to productive land uses such as sheep, beef and dairy farming.

Science tells us the climate is changing at a rapid pace. The Intergovernmental Panel on Climate Change (IPCC) reports New Zealand warmed by around 1.1°C between 1910 and 2020, and annual temperature changes have exceeded natural variability across the country. The National Institute of Water and Atmospheric Research (NIWA) in the report *Climate change projections and impacts for Taranaki* (2022) predicts increases of 0.5 to 1.0°C by 2040 and 1.25-3.0°C by 2090.

Understanding climate change and its local effects requires good quality, long-term data and the latest science to support decision-making. In Taranaki, our network of observation stations collects climate data from across the region. This includes information on air temperature and wind, rainfall, soil temperature, soil moisture and river flows.

This section presents a summary of climate conditions based on climate data and other information we have collected, as well as climate projections for the coming decades based on up-to-date information from NIWA. The report indicates the conditions we could expect to see in Taranaki in the coming years and how these changes might affect the way we live, work and play. This will inform how we plan, prepare and adapt to a changing climate in Taranaki.

2,556 hrs
Average sunshine hours

1,620 mm
Average rainfall
non-mountain

14 °C
Average air temperature

126 km/hr
Strongest wind gust
Hāwera - 2018

What we know

In considering weather and climate we are mainly interested in sunshine, rain, wind and temperature data. This helps guide decision-making around growing seasons, flood management, fishing, swimming and surf conditions. River flows are influenced by rainfall and temperature and tell us how dry or wet a summer is. River flow measurements can help us ensure water use is managed in a way that protects freshwater ecosystem health. Find more information on river flows in the Water chapter.

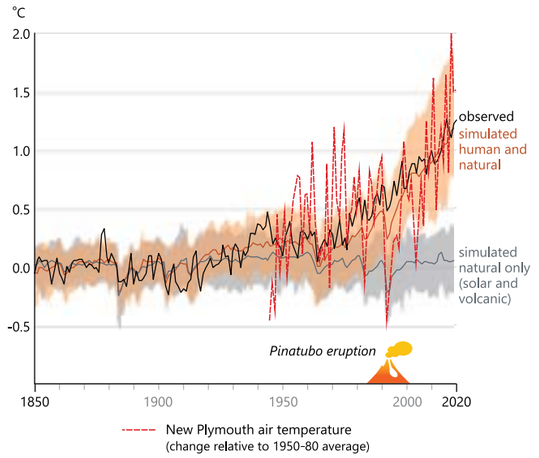
Air temperature

Annual mean air temperatures in the region's main urban areas are around 13-14°C, while temperatures at Taranaki Maunga Dawson Falls and North Egmont Visitor Centre average slightly over 9°C. Winter temperatures average between 7 and 8°C, with a fresher 3°C at our mountain sites. Summer daily averages are from 19 to 20°C, and 16°C on Taranaki Maunga. Although summer days can feel hot, the temperate climate, and our proximity to the ocean mean that, in summer, the mercury rarely climbs above 30°C.

Averages °C	New Plymouth	Hāwera and Stratford	North Egmont and Dawson Falls
Year	14	13	9
Winter	8	7	3
Summer	20	19	16

Annual mean air temperatures for Hāwera, Stratford, New Plymouth and mountain sites, with summer high (95th percentile of daily averages) and winter low (5th percentile of daily averages) for the period 2015 to 2020. These are not the hottest and coldest temperatures, but show the range of values that can normally be expected.

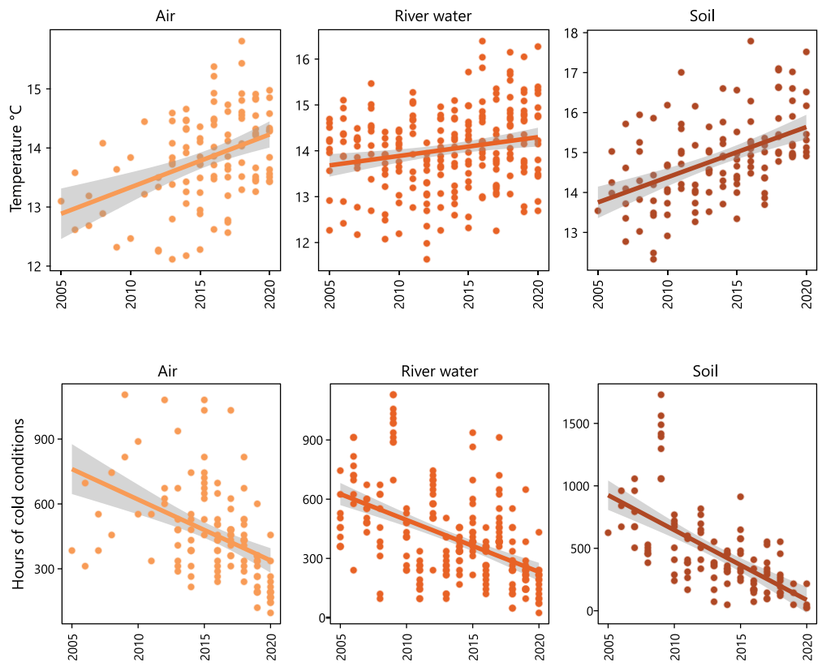
Air temperature observations have been taken at MetService's New Plymouth Airport climate station since 1944. The data is highly variable but shows patterns similar to the rising global trend of 0.1°C per decade for much of the last century. From the 1970s, this trend increased to around 0.18°C per decade. There was a large temperature drop in 1992 due to ash from the Mount Pinatubo eruption, however since that time the temperature has rebounded. In the last 20 years, we have experienced an unprecedented increase in temperature of 0.5°C per decade.



Air temperature data collected at the New Plymouth climate station since 1944 is shown by the red dotted line as a three-year running average. Base diagram source: IPCC.

Temperatures measured at climate stations across the region show marked increases in air, water and soil temperature, particularly over the past decade. Changes in river water temperature are more subtle, while air and soil temperatures have risen sharply, with soil temperature increasing at a rate of around 1.4°C per decade. Changes over 10 to 15 year periods are affected by long-term climate trends as well as changes due to shorter climatic cycles, such as the El Niño-Southern Oscillation. An assessment of cold temperature trends for air, soil and river water suggests that in coming years we can expect to see fewer cold hours and milder winters in the region.

Taranaki is one of the sunniest and windiest regions in New Zealand, due to its location and exposure to weather systems that migrate across the Tasman Sea.



Trends in air, river water and soil temperature (top) and trends in low temperature hours (bottom) for the period 2005 to 2020.

NIWA reports that by 2040 we can expect to see an increase in annual and seasonal mean temperatures of 0.5 to 1.0°C, and between 1.25 and 3°C by 2090 when compared to the period 1985 to 2022. We can also expect to see increases in maximum and minimum temperatures and an increasing fluctuation of temperatures (diurnal temperature range) across the day.

Frost days are projected to decrease by 2-10 days by 2040. By 2090, frost days could decrease by up to 23 days per year, with frosts becoming an uncommon occurrence across much of Taranaki. Growing degree days, with temperatures that support plant growth, are projected to increase by the year 2040 and more considerably by 2090 in particular coastal areas north of Taranaki Maunga. In the long term, this may influence the types of crops that can be grown and result in earlier harvesting times for current crops.

Wind

A measure of windiness is the average daily maximum wind gust in km/hr. The Ministry for the Environment (MfE) reported in *Our Atmosphere and Climate* 2020 that Wellington is New Zealand's 'windy city' with average daily maximum wind gusts of 65km/hr recorded from 2010–2019. Invercargill, at 47km/hr, came in second place, with New Plymouth following closely in third place with gusts up to 46.3km/hr.

Our coastal Taranaki climate stations measure some of the strongest winds with peak gusts of around 120km/hr. Hāwera and Cape Egmont are similarly windy to New Plymouth, with predominant southerly and westerly winds in New Plymouth and northerly and westerly winds in Hāwera. Southeasterlies, southwesterlies, and northeasterly winds are all prevalent at Cape Egmont.

Our data indicate a rising trend in wind gust speed, more time with gale-force gusts, and less time with calm conditions. NIWA climate projections for New Zealand suggest winds will strengthen as we progress through the 21st century. Projections for Taranaki suggest small changes in wind speed by 2040, with stronger patterns and seasonal changes evident by 2090.

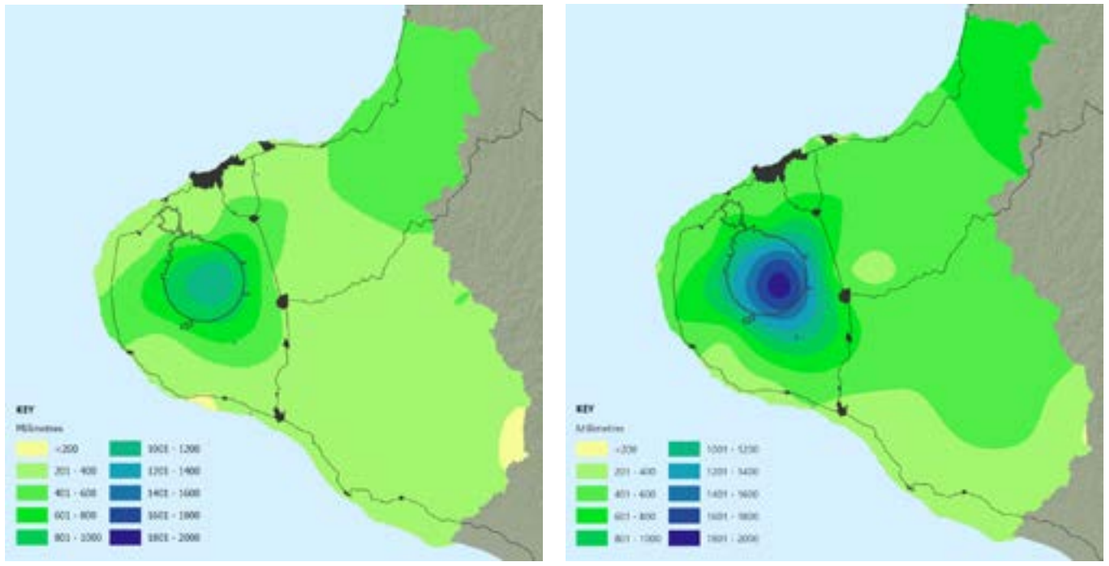
Rainfall

Taranaki enjoys regular rainfall throughout the year, with New Plymouth receiving 1,300 to 1,500mm of rainfall annually. Taranaki Maunga receives a deluge of 7,000mm of rainfall annually at the summit, intercepting cloud tracking in from the west, dropping sharply with distance from the peak to 3,000mm. When we report on rainfall, we're generally referring to precipitation, which includes snow, hail and sleet.

The rainfall total in summer (December–February) is typically 60-75% of that in winter (June–August), although long hot summer days accompanied by windy conditions result in rapid drying conditions compared to winter. The lower eastern hill country receives around 2,000mm of rain, while coastal areas around and south of Manaia are drier, receiving 1,000 to 1,300mm a year.

In 2020 MfE reported evidence of a decreasing trend in total rainfall in New Plymouth during the period 1960 to 2019.

Climate change projections for the wider region, however, suggest increasing precipitation and more extreme rainfall events in the coming decades, with longer and more frequent dry spells. NIWA reports Taranaki can expect a mixture of changes in rainfall, with an increase in rainfall of up to 8-12% in winter, with decreases in inland and northern areas in autumn and spring under different climate change scenarios. An increase in the number of dry days, particularly from spring through to autumn, can be expected with little change in winter projected by 2090. For all future climate scenarios, we anticipate seeing an increase in drought conditions, particularly by 2090.



Average total annual rainfall 2015–2020 for summer (left) and winter (right) based on measurements collected at rainfall stations across Taranaki.

River flows

River flows are a product of rainfall and temperature. Higher temperatures generally increase rates of drying due to evaporation and transpiration and, if there are longer rain-free spells, lower river flows will occur. An overall declining trend in flows is indicated with a general tendency for rivers to experience extended periods at low flow, when compared to 20 or 30 years ago. Measures of high storm flows indicate there will be more hours at high flows at some sites and fewer at others. Investigating rainfall and river flow patterns in detail is beyond the scope of this report, but we intend to explore and report on this soon.

In the future, we can expect to see similar overall river flows (in terms of annual discharge) but a decrease in annual low flows. NIWA recently assessed hydrological changes in the region's rivers between the baseline period (1986–2005) and two future periods: mid-century (2036–2056) and late-century (2086–2099). They report that average annual discharge remains stable or will increase slightly by mid-century across some coastal and northern parts of Taranaki. By late-century, mean annual discharge remains stable for much of the region, with increases in coastal parts of Taranaki. It is expected mean annual low flows will decrease across the region by mid-century. This pattern is similar by late-century, with decreases of up to 50% for most of the river systems in the region.

Sea level

NIWA also reports that rising sea levels in past decades have affected human activities and infrastructure in coastal areas of New Zealand, contributing to increased vulnerability to storms and tsunami. In the coming years, a further sea level rise will have increasing implications for development in coastal infrastructure such as transport networks (roads, ports and airports), wastewater treatment plants and potable water supplies, as well as creating capacity and performance issues with stormwater and overland drainage systems.

In 2017, MfE reported a doubling in the rate of sea level rise along the New Zealand coastline over the past five to six decades, from an average of about 1mm/year earlier last century to nearly 2mm/year from 1961 to 2015. There was a New Zealand-wide average relative sea level rise of nearly 1.81 (±0.05) mm/year up to 2015. Relative sea level rise along the Taranaki coast also incorporates a component of vertical land movement, reflecting the land movements that accompany our active tectonic environment. In New Plymouth, average relative sea level rise is 1.37 (±0.16) mm/year.

What we're doing

Climate affects rainfall, river flows and wind speed, so any changes to the climate will have environmental and social impacts. Changes in frequency and intensity of rainfall, river flows and wind events may lead to natural hazards such as floods or cause damage to buildings, crops and forests. Extended dry or still periods will impact on river flows and water temperature, creating stress on the life in the river, loss of grassland productivity and heat stress on livestock and crops.

We are working to better understand the range of impacts we can expect in coming years. The Council recently commissioned the NIWA report *Climate change projections and impacts for Taranaki* (2022), which outlines possible changes in climate and how these may affect us.

The Council's draft Climate Strategy will be further refined as we take stock of the recent NIWA findings. As a Council, we are investigating options to improve public transport and reduce carbon emissions from our public transport fleet and other road-based emissions. Our scientists and data analysts are studying climate issues in greater detail and our policymakers are considering the impacts of a future climate on the environment, including water availability and ecosystem health.

We are working in partnership with local district councils, building our collective understanding of climate change impacts, risks and opportunities. Along with local councils, iwi and hapū, and research partners such as Massey University and GNS Science we are looking at ways to support those in vulnerable areas of our region to adapt to climate changes and to advance our knowledge as to how we can best respond as a region.

Where we're heading

The IPCC's Sixth Assessment Report *Climate Change 2022: Impacts, Adaptation and Vulnerability* (2022), along with updated projections for a range of climate change measures, tells us New Zealand warmed by around 1.1°C between 1910 and 2020 and annual temperature changes have exceeded natural variability across the country. The report concludes human-induced climate change is affecting many weather and climate extremes across the globe, including in New Zealand. Evidence of observed changes in extreme weather events and their attribution to human influence has strengthened since the Fifth Assessment Report in 2014.

Locally, much of Taranaki will experience an increase in rainfall intensity, with an increasing risk of erosion and landslides (NIWA, 2020). We are also likely to experience more frequent and severe drought conditions, impacting the productivity of primary industries. Changes in rainfall can have positive and negative effects, with different plants and crops responding in different ways. Pest species may increase in number and in distribution, migrating to areas where conditions permit their spread. Reductions in cold conditions may enable people to diversify their crops, however warmer temperatures may also increase the risk of plant and animal pests and diseases.

Understanding climate change and its local effects requires good quality, long-term data, robust science and collective efforts to support good decision-making. This includes understanding natural climate variation, such as the effects of El Niño and La Niña, and the effects of human-induced climate change. Working in partnership with iwi, hapū, district councils, emergency management staff and experts from research institutes such as NIWA and Massey University ensures we provide the best information possible and co-ordinate our responses.

As we build our understanding of the drivers and impacts of climate change through our science and monitoring, we will investigate and report on a range of climate-related themes – from water availability and land management to flood management and biosecurity. We will look for ways to adapt to a rapidly changing climate – the opportunities as well as risks.

Potential impacts of climate change are likely to include reduced low flows in our region's rivers, increased risk of erosion and landslides.

Gap bridged with flood barrier

A multi-year upgrade of the Council's flood defences for Waitara township was completed in 2021 with the installation and testing of a temporary flood barrier for the Town Bridge.

The barrier is stored nearby in lightweight kitset form, ready to be quickly deployed if, and when, floodwaters threaten to overtop the bridge deck.

How can it keep so much water back when it looks almost low enough to step over?

Looks are deceiving. The barrier may not look high but it matches the height of the flood walls either side. As a result of the upgrade, those flood walls and stopbanks are significantly higher than when they were first built in the 1990s. Without the new barrier, the bridge would be a weak link in the boosted flood defences.

If floodwaters were ever high enough to flow over the bridge deck, the river would be flowing fast and wide. So, without the barrier, a considerable amount of water would quickly pour into the CBD.

Is there a barrier at both ends of the bridge?

A barrier is needed only on the town side of the bridge, as the eastern side is higher and floodwaters would not overtop at that end.

What other improvements have been made to the town's flood defences? How watertight is the town now?

Floodwalls and stopbanks were raised, rock linings and rock groynes were upgraded, and floodgates installed to prevent floodwater getting into stormwater pipes. Waitara now has protection from floodwaters up to 3,840 cumecs (cubic metres a second).

Why was an upgrade needed?

More hydrology data and more modelling capacity is available now than in the 1990s when the scheme was originally designed. And there is also more understanding of the potential effects of climate change.

So is the town protected from a 'one-in-100-year' flood? How come we hear about these so often these days?

That's an old definition, and it's misleading. Of course, nature doesn't take any notice of our calendars – she operates to her own timetable. It's more accurate to say there's a 1% chance of a flood that big in any given year, regardless of when the last big one was.

Waitara's 3,840 cumecs protection is more than enough to meet the 1% exceedance standard. In other words, there's less than1% chance that such a flood will occur in any given year.

What other flood protections schemes are there?

There's a Council scheme similar to Waitara's for the Lower Waiwhakaiho River on the northern edge of New Plymouth, and smaller-scale schemes at Ōkato, Ōpunake and Waitōtara.

Air

Clean, unpolluted air is essential to the wellbeing of our communities and the environment. Taranaki enjoys a relatively high standard of air quality. Presently, it is one of only two regions in New Zealand not considered at risk of exceeding current national air quality standards. This means Taranaki does not have a gazetted airshed and Ministry for the Environment (MfE) monitoring is not compulsory in Taranaki, as it is in other parts of New Zealand.

As a region with significant industry, it is important good air quality is maintained and protected. In New Zealand, the Resource Management (National Environmental Standards for Air Quality) Regulations (NES) set a level of protection for people from air pollutants, dioxins and other toxins in the air. The NES prescribe standards and controls for a range of contaminants and prohibit certain activities, such as the burning of tyres.

To ensure our communities have clean, unpolluted air, the Council monitors air quality at a range of locations throughout the region and works with communities to raise awareness around air quality issues. Air discharges from industry and agriculture are regulated and, with no widespread change in the nature of regional emissions, there are no significant pressures upon the quality of air in the region.

Air quality monitored at
30
sites
for **25 years**

319
discharge to air consents
in 2020

214
air quality incidents
involving mostly smoke, dust or odour in 2019/2020

97% of air consent holders achieve
HIGH or GOOD
performance grade

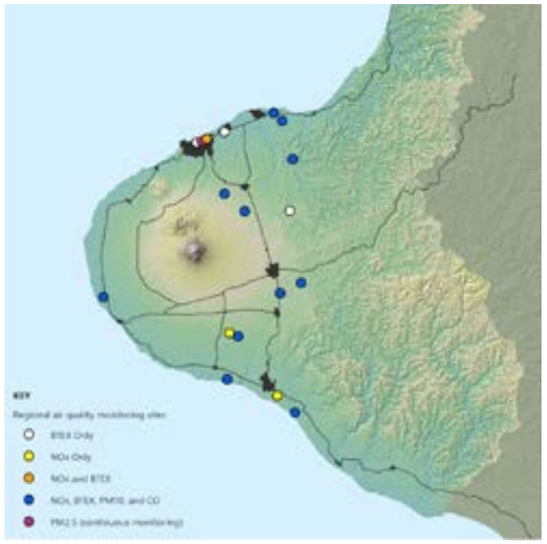
What we know

Air quality data has been gathered and maintained for more than 25 years at up to 30 representative sites, including urban, industrial, rural, coastal and pristine areas. This helps guide community decisions around which discharges need to be controlled or reduced through good practices and regulation.

The Council measures key indicators of ambient air quality, including inhalable particulates; chemicals such as nitrogen oxides, benzene, carbon monoxide, sulphur oxides and formaldehyde; and suspended particulates and deposition. Air quality is also monitored as part of resource consent compliance programmes to ensure resource consent conditions and regional air plan rules are met in industry and agriculture.

Results are compared with MfE national ambient air quality guidelines and NES as appropriate.

In general, we use screening methods to monitor air quality at locations that have the most potential for adverse impacts because of surrounding land use. This methodology is useful for giving an indication of the state of the region's air quality and for determining whether there is any justification for further investigation using much more expensive techniques, as stipulated in the NES. Consistently good results from our air quality monitoring programme confirm the screening approach is justified and cost-effective.



Regional air quality monitoring site locations.

Particulate matter

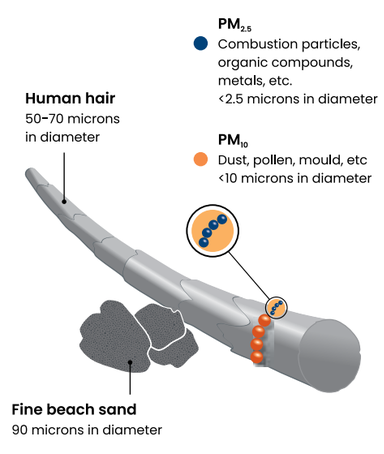
Air quality is influenced by particles in the air that are small enough to inhale. Health impacts include respiratory irritation, shortness of breath, or worsening conditions such as asthma and heart disease. These particles come from activities such as transportation (petrol and diesel fuels), industrial processes and burning coal or wood in domestic fires. They can also come from natural sources including sea salt, dust, pollens and volcanic activity.

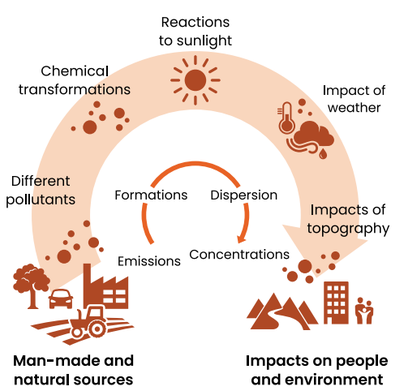
Particulate matter (PM) is measured in terms of size. PM_{10} refers to particles measuring 10 microns or less in diameter per cubic metre of air, which includes particles less than 2.5 microns ($PM_{2.5}$). In the past, PM_{10} has been the standard against which national air quality has been measured however many developed countries have moved to levels of greater protection of $PM_{2.5}$.

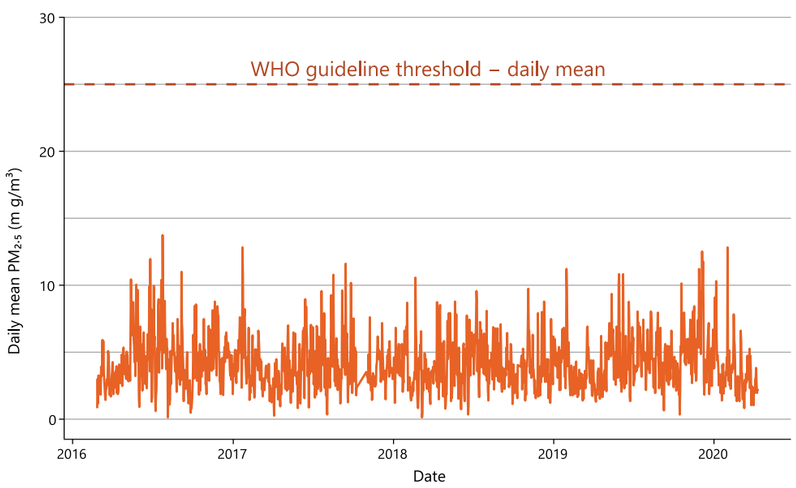
In Taranaki, airborne concentrations of $PM_{2.5}$ are monitored at one continual site and PM_{10} is monitored at 14 sites. Both are compared to national standards set by MfE, as well as international guidelines. Monitoring suggests air quality in Taranaki is generally good. For PM_{10} the majority of results lie in the MfE's grades of 'excellent' or 'good', and to date

have not triggered the 'action' category of air quality. Finer particles ($PM_{2.5}$) pose a greater public health risk than the larger particles in the PM_{10} range. While New Zealand has not yet formally set a standard $PM_{2.5}$, results are well within World Health Organization (WHO) guidelines.

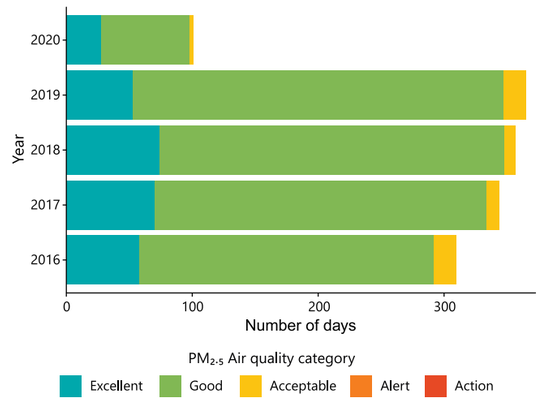
Survey results also suggest onshore winds have a major influence on air quality, with airborne salt causing PM concentrations to double. Lower air quality is often observed with westerly winds, due to the increase in salt particulates blown onshore. Traffic flows show no discernible effect even in urban areas, while on calm winter evenings the smoke from domestic fires increases particulate concentrations.







Daily mean $PM_{2.5}$ concentrations between March 2016 and April 2020, measured at Central School. All recorded $PM_{2.5}$ levels are well below the WHO guideline threshold of 25 µg/m3.



Daily air quality categories for $PM_{2.5}$, as measured at Central School. No daily means have ever exceeded the Acceptable band. Due to technical issues only 100 days were monitored in 2020.

Carbon monoxide, nitrogen oxides and volatile organic compounds

Carbon monoxide (CO) is the result of incomplete fossil fuel combustion and at high indoor concentrations can cause dizziness or aggravate heart conditions. In some cases, it can be fatal. It is emitted from motor vehicle emissions and from burning of fuels in confined spaces.

In New Zealand, the standard for CO is 10mg/m³ (calculated as an average exposure over eight hours of measurement). CO is monitored in Taranaki around significant potential sources, such as gas production stations, and this shows levels well below both the national guidelines and standards.

Nitrogen oxides (NOx) are a group of gases that can cause lung inflammation and increase a person's vulnerability to respiratory infections and asthma, while long-term exposure can lead to lung disease. They are produced through biological activity from natural sources such as soil and vegetation and also come from motor vehicles and industrial fuel combustion processes. Domestic appliances such as gas stoves or unflued gas heaters can be significant indoor sources of nitric oxide and nitrogen dioxide.

30 NOx monitoring sites at **14** locations around the region

0 exceedances in the last five years of the NOx-1hr NES of 200 µg/m³

54.6 Maximum measured regionally since 2016 estimated 1hr NOx concentration µg/m³

The Council has surveyed NOx at various sites (urban, industrial and rural) as part of State of the Environment monitoring since 1997. We use screening techniques, which are not directly comparable to national standards. However, results show air quality in each location will achieve the standards and do not suggest NOx concentrations in the region are increasing.

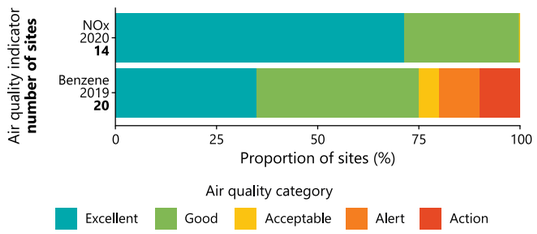
We also monitor volatile organic compounds (VOCs). The four most common VOCs are benzene, toluene, ethylbenzene and xylenes, often found together and referred to as BTEX. Short-term exposure to high levels of BTEX can irritate the eyes, nose and throat, can cause difficulty breathing and damage the central nervous system, as well as other organs. These volatile gases occur in solvents (including paints and glues) and petrol and diesel fuels. They are also produced during the combustion of organic matter such as petrol, diesel and some other hydrocarbons.

20 BTEX monitoring sites around the region

2 exceedances in 2019 survey of the Benzene-1hr National guideline of 22 µg/m³

633.4 Maximum measured in 2019 survey estimated 1hr Benzine concentration µg/m³ (measured at New Plymouth petrol station)

Presently, there is no national standard for BTEX compounds. The results of BTEX monitoring in Taranaki, using screening techniques, indicate levels of BTEX to be generally better than the current MfE guideline value. Levels of toluene and xylene are particularly low by comparison.



Number of NOx and BTEX monitoring sites falling into different air quality categories. The Action BTEX concentrations were recorded at a central New Plymouth petrol station.

What we're doing

Air quality in Taranaki

The Resource Management Act 1991 (RMA) requires councils to have regional plans to address regional resource management issues. The Regional Air Quality Plan for Taranaki (the Plan) became operative in July 2011. The objective of the Plan is to "maintain the existing high standard of ambient air quality in the Taranaki region and to improve air quality in those instances or areas where air quality is adversely affected, whilst allowing for communities to provide for their economic and social wellbeing". The Plan sets out which activities can occur without a consent, activities that are banned outright and activities that need a consent from the Council before they can occur.

Where activities require resource consent, they are monitored for compliance to ensure they do not have an adverse effect on people or the environment. We design a monitoring programme based on the range of air quality pollutants to be measured. Equipment ranges from simple but effective dust deposition gauges to more complex air quality analysing equipment.

In 2020, there were 319 consents allowing discharges to the air. The hydrocarbon extraction and processing industry held 188 (59%) and broiler (poultry) farms held 39 (12%) of these consents. The remaining 92 (29%) were associated with, but were not limited to, manufacturing and processing, waste management, crematoriums, piggeries and power generation. Compliance monitoring showed 97% of air permit holders routinely achieve a 'high' or 'good' level of environmental performance.

Breaches in resource consent conditions lead to further investigation and enforcement, if required. Consent holders may self-report an incident, they may be discovered by Council staff during inspections or members of the public may report them. The most common complaints about air quality from the public relate to dust, smoke or odour. In the 2019-2020 year, the Council recorded 214 incidents involving air quality. Air quality incidents made up 40% of all environmental incidents the Council dealt with. Upon investigation, 25% of all incidents involved unauthorised activities and discharges.

Since the Plan became operative, increased levels of poultry farming and hydrocarbon exploration and production have led to more resource consents for air discharges. However, because of effective regulation and monitoring, there have been negligible impacts on air quality in the region.

Where we're heading

To provide greater protection to the health of our communities, the Government is proposing new measures to improve air quality across New Zealand. Evidence suggests a strong link between $PM_{2.5}$ and adverse health effects. The new standard for particulate matter proposes to change the current standard to $PM_{2.5}$ (a subset of PM_{10} fine particulate) for any 24-hour period and as an annual average.

The Council supports the proposal and already conducts routine monitoring for $PM_{2.5}$. Results show the region's air quality is well within the WHO guideline of 25 µg/m³ (24-hour average) and annual guideline of 10µg/m³. Investigations have shown a major influence on $PM_{2.5}$ levels in Taranaki is sea spray, with a localised influence on calm winter evenings being smoke from domestic fires.

The Users' Guide to the revised NES for Air Quality provides a guide to the standards addressing dioxins and other toxics, ambient air quality, the wood burner design standard and the control of greenhouse gases at landfills.

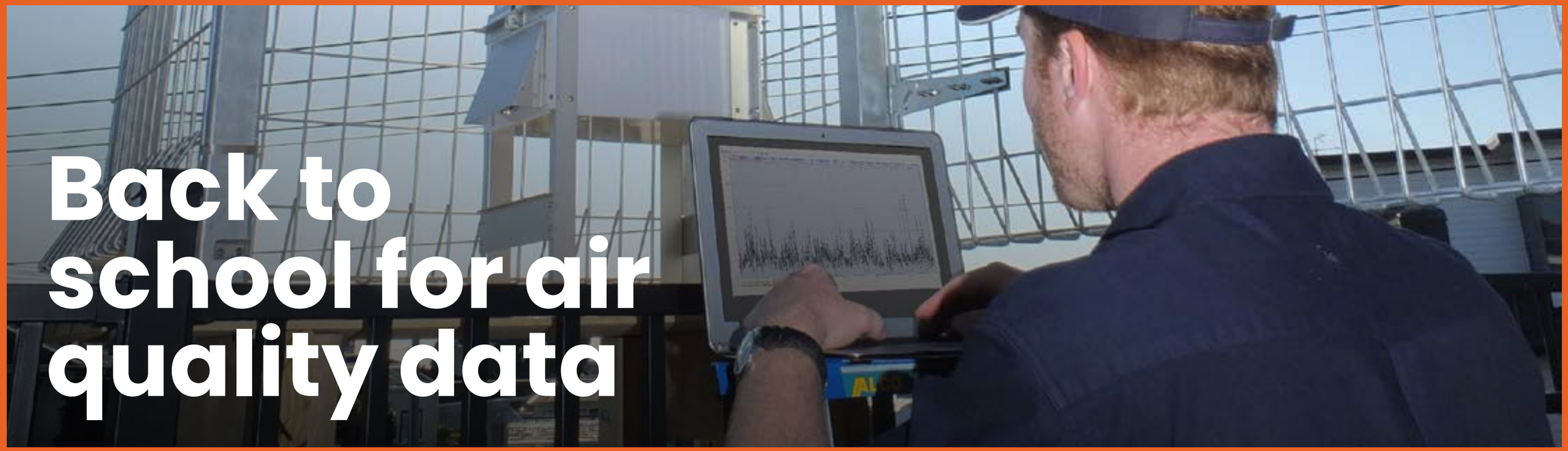
Locally, the Council is reviewing its Regional Air Quality Plan, as required by law. It will be combined with management of water and land resources into an integrated Natural Resources Plan for the region. The review process includes public consultation, to ensure the new Plan reflects community aspirations for air quality, and will reflect the changing industrial landscape, improved knowledge, and community expectations of our region.

Information, education and advice

While air quality is generally good, in winter, concentrations of fine particles have the potential to breach the NES. This is particularly the case in areas such as Stratford and Inglewood where a combination of factors such as altitude, topography and meteorology can trap fine particles on cold still nights.

There are many ways we can all improve air quality:

- Recycle rubbish, compost green waste or chip it and use for mulch – in many urban areas burning rubbish and green waste is banned. Take care to only burn approved materials – do not burn tyres or treated timber.
- When installing or upgrading your heating appliance – choose a low- to no-emissions option, such as an ultra-low emissions wood burner or heat pump.
- No one likes a smoky fire – if you do have a wood burner, use only dry-seasoned and non-treated wood. Get your fire going quickly, keep it burning hot, and don't damp your fire down overnight.
- Tune and service your vehicle regularly, and use sustainable transport options such as public transport, car-pooling, electric vehicles, cycling and walking. You'll save money too.



Back to school for air quality data

Air quality in New Plymouth is continuously monitored using equipment strategically sited at a primary school near the city's business district (CBD).

The arrangement between Central School Te Kura Waenga o Ngāmotu and Taranaki Regional Council dates back to 2015. It gives the school a passive but unique role in the important task of keeping tabs on what's happening to our environment.

Why Central School?

As the name implies, it's centrally located. Main traffic routes are within a couple of hundred metres to the north and the CBD lies just beyond them. To the south, west and east are residential areas.

Central School is at the 'crossroads' of prevailing winds from the west and southeast. It's in the path of air flows that have just passed, or are about to pass, over residential areas. So, it's a sensitive site, exposed to possible emissions from traffic, as well as commercial and residential areas.

New Plymouth has the most people, traffic and industry in Taranaki, so is the logical place for continuous air quality monitoring. The Council also carries out intermittent air quality monitoring elsewhere across the region, including monitoring to assess whether major consent holders are meeting their environmental obligations.

How do you monitor air quality, anyway? And what are you finding?

The equipment at Central School measures levels of tiny particles, known as 'particulate matter', which circulate in the air. It's calibrated for particles just 2.5 micrometres in diameter - that's 2.5 millionths of a metre. Being so tiny, they can easily enter our airways and lodge in respiratory or lung tissue, leading to serious issues - particularly for vulnerable groups such as the very young, the very old, and those with existing health issues.

The monitoring station at Central School plays an important role in the health of our region. In early 2022, the Council upgraded the station with the latest technology to ensure Taranaki continues to meet national monitoring standards.

$PM_{2.5}$ readings at Central School consistently fall well within international guidelines. Monitoring at other sites also takes in nitrous oxides, carbon monoxide and volatile organic compounds. Results of all the monitoring show that, in general terms, Taranaki has good quality air.

What happened during our first and longest COVID-19 lockdown in 2020? Did air quality improve?

Maybe, but the evidence is inconclusive. Because of an unfortunately timed equipment failure, we have data for only the first couple of weeks of the 2020 lockdown.

The date shows $PM_{2.5}$ levels dropped after the lockdown started on 26 March 2020. But this also coincided with the arrival of a new weather system that brought southeast winds. We often see low $PM_{2.5}$ levels during moderate-to-strong southeasterlies. There is another reason for caution in interpreting the data. When we compare our 2020 lockdown readings with those from the same time period in previous years, we see they're all within a similar range.

However, the pandemic period shows the importance of air quality monitoring. Research carried out early in the spread of COVID-19 indicated that even a small increase in long-term exposure to $PM_{2.5}$ was linked to a large increase in COVID-19 mortality rates. So it's more important than ever to keep tabs on $PM_{2.5}$.

Land

The health and wellbeing of our land or whenua lies at the core of everything the Council does. Working alongside industries, farmers, iwi and communities, our programmes are designed to not only care for our land today but to leave it in a better state for future generations.

The sustainable use, development and protection of our land is crucial to a strong regional economy, while a healthy environment is what makes Taranaki an enviable place to live, work and play. For Māori, earth mother Papatūānuku is the source and sustainer of the land and all its life, including humans. People of a place are related in personal terms to its mountains, land, and rivers, as well as the ecosystems and species present through whakapapa.

So just how healthy is our land and the taonga species that call it home?

Productive Land

Land is one of our most valuable assets, providing recreational opportunities and giving us a sense of place and connection to our local environment. Farming and forestry provide dairy, meat, wool and timber products that contribute significantly to the regional economy and support communities.

The natural variations of climate, topography and soil shape how land is used and managed across the region. Regular rainfall and deep, fertile and free-draining volcanic soils surrounding Taranaki Maunga sustain intensive agricultural activities. Dairy farming is the predominant land use on the ring plain. On the steeper sedimentary hill country in the east of the region, the shallower, more erodible soils support less intensive agricultural activities, such as sheep and beef farming, and plantation forestry.

Land use creates pressures on the environment that must be managed. In intensively farmed areas, run-off of nutrients and bacteria can affect the water quality in rivers, streams, lakes and estuaries. The erosion of streambanks and riverbanks can increase sediment concentrations, smothering aquatic life and degrading freshwater and marine ecosystems. If soils are not managed appropriately, soil health can deteriorate through changes to its chemical and physical structure and to its ecological microcommunities. In the hill country, avoiding erosion and the loss of soils to waterways is the most significant challenge and a key land management objective for the region.

The Council works with landowners to help them optimise the use of their productive land, while minimising the effects of their activities on the environment. We monitor impacts of land use on the environment and develop plans and strategies with the goal of achieving sustainable land use.

464 Sustainable land management plans cover

68% of private eastern hill country land

5,523ha erosion-prone land **retired** since 2009

51% of total land area is **used for agriculture**

7% is **urban**

What we know

Land use

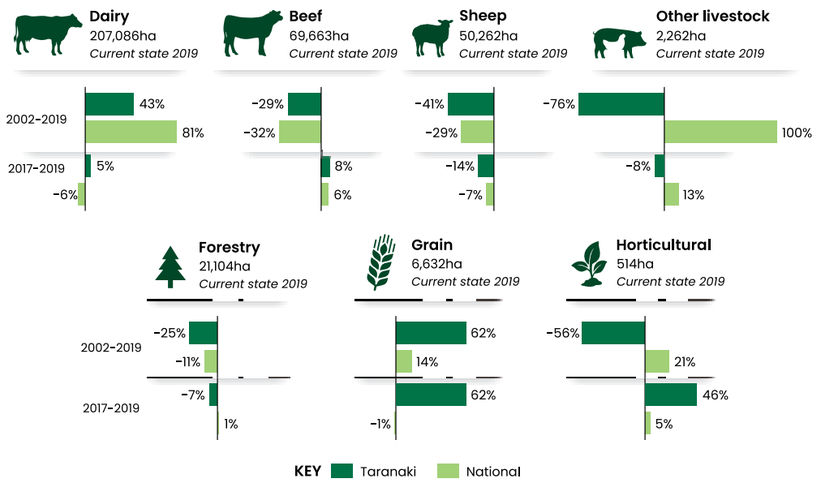
Around half of Taranaki land area is used for agriculture and horticulture. Dairy farming remains the predominant land use, accounting for 207,086ha, or 58% of land used for primary production in 2019. The area utilised for dairying across Taranaki has increased by 62,095ha (43%) since 2002, primarily through conversion from dairy support or sheep and beef farming. Much of this change occurred prior to 2012 and has slowed considerably in recent years. While there is some dairy farming in the lower hill country, most occurs on the ring plain of Taranaki Maunga and on the marine terraces in northern and southern coastal areas.

Sheep and beef farming occurs mainly on the steeper, less fertile slopes of Taranaki eastern hill country. Land used for sheep and beef farming in Taranaki has reduced by 35,389ha (-41%) and 28,901ha (-29%) respectively since 2002. The decline in the area used for sheep farming has continued in recent years, reducing by 8,128ha (-14%) since 2017, however the beef farming area has increased by 5,376ha (8%) over the same period. These trends generally follow those seen elsewhere in New Zealand.

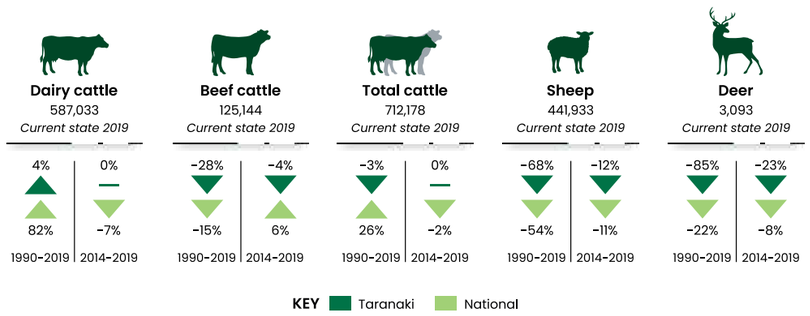
Horticulture and grain production accounts for just 7,146ha (2%) of the total area used for agricultural and horticultural production in Taranaki, with less than 1% in horticultural land use. However, this is increasing. Between 2017 and 2019 the area in grain production grew by 2,540ha (62%), and horticultural land use by 162ha (46%).

As of 2019, there were about 587,000 dairy cattle in Taranaki, up 4% (24,000 cows) from 1990. Nationally, the total dairy herd increased 82% over the same period. However, from 2014 to 2019, dairy cattle numbers remained steady in Taranaki, while nationally there was a 7% decline. The most notable change in livestock numbers in Taranaki has been the significant long-term reduction in beef cattle and sheep. As of 2019, there were 28% fewer cattle (-49,244) and 68% fewer sheep (-933,407) in Taranaki compared to 1990. Since 2014, these numbers have continued to decline, although at a reduced rate of -4% and -12%, respectively.

In Taranaki, 51% of total land area is used for agriculture and horticulture, 38% remains under indigenous forest cover, urban areas account for 7%, and production forestry 4%.



Change in land use area, 2002-2019.



Change in livestock numbers, 1990-2019.

Reducing erosion

Most of New Zealand's erosion-prone hill country is in the southeast and west of the North Island, with around 15% in Taranaki. Soft sediments, steep slopes and high rainfall, combined with the loss of the original vegetation cover, mean this land is susceptible to accelerated soil erosion. The loss of land's productive capacity for farming has a detrimental effect on in-stream water quality and aquatic ecosystems, causes downstream effects on property and infrastructure and can smother seabeds in the coastal marine area. It is estimated New Zealand loses 192 million tonnes of sediment per year due to erosion.

The Council has monitored sustainable land use in the eastern hill country since 1994. It is estimated 87% of eastern hill country land in private ownership is now managed sustainably. The Council assesses this by comparing current land use practices to those practices the land is able to sustain, using a nationally accepted classification system for land use capability.

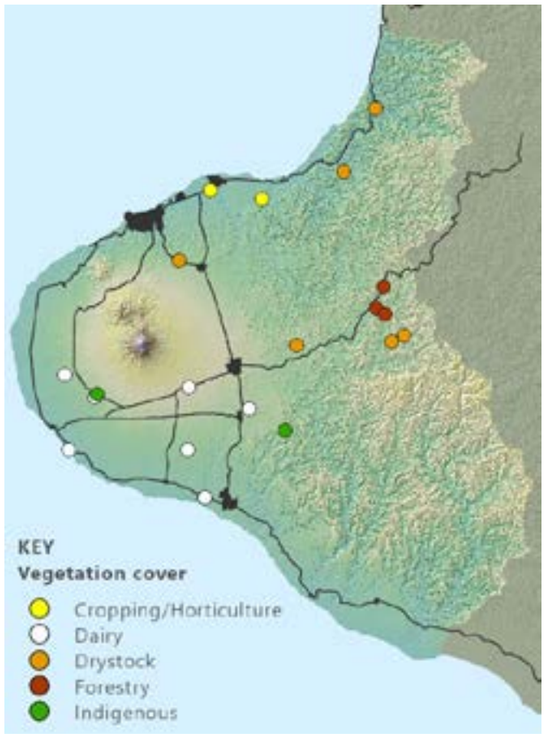
To assess the sustainability of land use practices, 25 representative sites in the eastern hill country are analysed every five years. Up until 2007, there was an overall increase in sustainability of around 3%. Between 2007 and 2017 there was little change, with sustainability gains on more marginal land from forestry and reversion to mānuka offset by the conversion of drystock land to more intensive land uses like dairy farming. In recent years, there has been growing interest in actively reverting (or planting) marginal pasture land to mānuka or planting mānuka forests, as mānuka honey and biopharmaceuticals gain in popularity.

Soil health

Soil health monitoring (undertaken every five years) shows most soil health indicators are in the target range. However, soil compaction and elevated nutrient levels from intensive grazing remain a challenge. The quality of soils has been monitored in Taranaki since 1995, with the most recent survey in 2017. When compared to 2012, the 2017 results showed a general decline in soil health at a number of monitored sites, mainly due to soil compaction.

Eighteen sites under active land use were sampled in 2017, including three plantation forests, seven dairy pastures, six drystock pastures and two cropping sites. Two indigenous forest cover sites were also sampled for comparison. Samples were assessed for physical condition, chemical fertility, trace elements, organic matter and microbial health indicators, which were compared against optimal ranges. For the 18 sites under active land use, the majority of soil heath indicators were in the target range. Where there were exceedances, these were typically for macroporosity. Macroporosity is a measure of the proportion of large pores (spaces between soil particles) found within the soil. Macropores provide air for plant roots and allow water to flow through the soil. The ideal range for macroporosity was exceeded at 11 of 18 sites surveyed (61%), all of which were under either dairy or drystock land use. The loss of soil macropores at these sites is due to soil compaction, which can be caused by heavy machinery like tractors, high animal stocking rates or stock damaging soil when it is wet. Soil compaction is a common issue across New Zealand, particularly in areas of intensive agricultural land use. Elevated Olsen phosphorus and/or nitrogen levels were also found at some dairy and flatland drystock sites.

Manaaki Whenua - Landcare Research also monitored four coastal sand country sites between 1994 and 2017, finding an overall decrease in the area of bare sand at three of the four sites. This can be attributed to stabilisation planting, forestry planting, better grazing management and the re-contouring or clay capping of dunes and the establishment of irrigation. Analysis of aerial photography by the Council shows a decrease in the area of bare sand by 72ha across the region from 2012 to 2017.



Soil health is assessed at sites across the region under different types of land use and vegetation cover.

What we're doing

Sustainable land management and hill-country erosion

The Council works closely with landowners to reduce accelerated erosion through its Sustainable Land Management Programme. Council officers prepare comprehensive farm plans using land use capability mapping to determine property-specific soil conservation solutions.

Over the last 25 to 30 years, we have prepared 464 comprehensive farm and agroforestry plans for around 210,294ha (69%) of the eastern hill country under private ownership, with 90% of farmers implementing these plans to some degree. Plans cover all aspects of a farming operation, specifically addressing management practices that protect soil and water, while maximising productivity. Through these farm plans, 15,697ha of forestry have been established and 63,730ha of marginal land have been retired.

Manaaki Whenua's SedNetNZ model estimates soil conservation works implemented over the past 25 years have resulted in a 29% net reduction in mean annual suspended sediment load across the region, with a further 15% reduction expected as existing soil conservation works mature. We expect further gains as the remaining 30% of landowners without farm plans join the Council's Sustainable Land Management Programme.

Critical to the success of this Programme is the provision of plants to support soil conservation and riparian management. The Council operates two plant provision schemes: one to support the planting of stream riparian margins, the other to stabilise erosion-prone land.

To date, the Council has provided more than seven million native plants to plan holders at cost to reduce streambank erosion. Additionally, around 75,000 poplar and willow poles have been provided to hill country planholders for open-spaced planting to reduce accelerated erosion. We expect demand for poles to increase because of soil conservation recommendations in compulsory freshwater farm plans.

South Taranaki Regional Erosion Support Scheme (STRESS)

In 2009, South Taranaki Regional Erosion Support Scheme (STRESS) grants became available which have helped fund the establishment of a further 46,000 poles. That year the Council secured $1.06 million in Government funding. The scheme's initial focus was the Waitōtara catchment, which suffered significant damage in a 2004 storm. It now delivers poplar and willow pole planting, retirement and reversion fencing for erodible land right across the region.

The scheme has been well-received by the public, with around 40% of farm planholders now participating in STRESS. The Council has successfully renewed its four-year contract three times. The most recent funding round saw the scheme receive $3.99 million in Government funding with prioritised works extended to the Pātea and Waitara catchments.

The Government's Afforestation Grant Scheme and One Billion Trees Programme (1BT) also assisted with afforestation and native reversion. Both schemes were delivered through the Council's Sustainable Land Management Programme, complementing STRESS. Council officers helped planholders access grants from 1BT, particularly for native reversion and forestry projects that sit outside STRESS criteria. Providing this service to planholders on behalf of the Government helps the Council achieve sustainable land use change, reduced sediment production and reduce sediment loss.

A council officer taking a soil sample.

237 km

of fencing erected to protect **894ha** of afforested areas and **5,523ha** of land retired through STRESS
Between 2009 and 2021

46,000

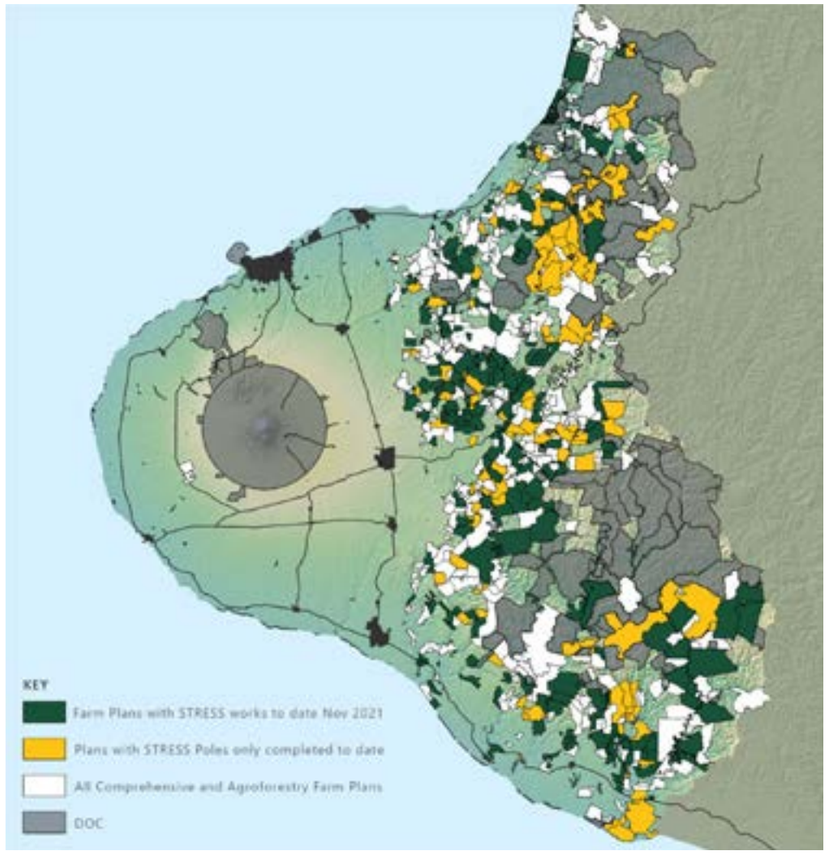
Poplar and willow poles planted to treat more than **1,600ha** of erosion prone land
Between 2009 and 2021

While the significant effort and investment in land stabilisation works in Taranaki has been successful in reducing sediment loads in erosion prone catchments, more work is required. Over the next three to five years, the Council will update soil conservation recommendations in its existing farm and agroforestry plans. We will also work to extend the Sustainable Land Management Programme to the 30% of the hill country in private ownership that don't yet have plans. Through appropriate regional rules, the Council's plans will direct the recommendations for soil conservation measures to reduce sediment production. Once these plans are in place for all farms, annual monitoring will track the implementation progress of recommendations, which can be used to report on sediment reduction targets.

Soil health

Poor soil quality can be reversed with appropriate land management practices. In response to new Government regulations, the Council will monitor the use of synthetic nitrogen fertilisers to ensure application rates remain within set limits. Our on-farm compliance inspections will also cover high-risk activities like intensive winter grazing, which have the potential to adversely impact on soil health.

A council officer helping to plant poplar poles.



Farm plan holders participating in STRESS, 2021.

Understanding and planning for the impacts of climate change

Climate change will influence the levels of intervention required to meet water quality targets into the future. More plentiful and intense rainfall can lead to accelerated erosion and increased run-off of contaminants from pasture and urban environments. How climate change will affect these processes is important when considering how effective our land management interventions are likely to be, and how they will help achieve water quality targets.

Modelling work in eastern areas of New Zealand has shown that in some catchments, sediment loss may exceed the reductions we can achieve through our current land management interventions. Ongoing action to reduce erosion and protect our valuable soils will be necessary to ensure we don't lose traction or see a reversal in the gains we have made. The Council has commissioned work to better understand the likely implications of climate change for Taranaki. Further work using the Manaaki Whenua SedNetNZ model will estimate the potential impacts on forecasted sediment loads. We will then be able to reassess the reductions in sediment loads needed to achieve freshwater improvement in coming years.

Soil mapping using S-map

Soil mapping gives farmers the information to make informed management decisions that optimise their agricultural practices. While we have some knowledge of our region's soils, there are large areas of Taranaki where soils are yet to be mapped.

Over the next four years (2022-2026) we will work to improve the quality and comprehensiveness of soil mapping across the region using 'S-map', New Zealand's national geospatial soil information system. Manaaki Whenua scientists will carry out soil mapping and analysis, with the support of farmers and Council staff. The Council will contribute funding and in-kind support, with significant additional funding provided by the Ministry for Primary Industries (MPI).

Soil mapping will focus on the Waingongoro and Waitara Rivers, and southwestern ring plain catchments. Once mapping is complete, soil information will be digitised and made available to the public via the S-map online portal.

Mapping our land surface

S-map is just one of many projects that will be able to make use of Taranaki new LiDAR (light detection and ranging) data. LiDAR surveys have been flown to gather land surface and elevation data. This is used to generate 3D maps and models that will have a wide range of potential uses in environmental management and planning, management of natural hazards, planning of facilities and infrastructure and tracking changes in the landscape over time.

Funding for the $750,000 project has come from the Provincial Growth Fund, via Land Information New Zealand – Toitū te Whenua (LINZ), with contributions from Taranaki four councils and the University of Auckland. Taranaki Regional Council is the lead agency regionally.

The LiDAR data will also help New Plymouth, Stratford and South Taranaki District Councils in their land use planning and the provision of services like pipelines and roads. Auckland University came on board because it saw great value in obtaining data on the volcanic cone of Taranaki Maunga. Other applications include:

- Assessing vegetation cover and habitat quality
- Getting a more accurate picture of erosion
- Allowing better modelling of the effects of floods and droughts
- Monitoring the changes in coastal dunes
- Providing a clearer picture of the steepness of hill country land
- Allowing sharper definition of sites of cultural significance

Regenerative agriculture

In recent years, regenerative agriculture has started to capture the interest of New Zealand's farming community. Regenerative practices seek to optimise farmer performance while supporting farmer wellbeing, maximising stock health and reducing the impact of farming practices on the environment. Interestingly, many farmers in the region are already employing what could be recognised as regenerative practices.

The benefits are not always easy to measure using conventional academic approaches and there is a need to better understand what regenerative agriculture means for New Zealand. Scientists are working to test the claimed benefits of regenerative agriculture and fill the evidence gaps specific to New Zealand. Much of this work is being delivered through the Our Land and Water National Science Challenge.

Putting cultural values on the map

Keith Holswich.

A Taranaki man believes so strongly that protection of sites significant to tangata whenua is an important national priority, that he's put countless voluntary hours into digitally mapping more than 100 sites special to his Ngāti Rāhiri hapū.

Keith Holswich is determined a hapū decision to share details of the sites will result in their protection, as envisaged at the time of the 'courageous' move to open up access to knowledge that had always been held closely.

Getting site details into a Geographic Information System (GIS) digital mapping format allows easy sharing with councils responsible for issuing consents, as well as with hapū members young and old, researchers and the public.

All the sites were accurately surveyed as a first step, and the GIS work started two years ago. The groundwork has been completed but maintenance and improvements will continue indefinitely.

Keith is heartened by the support he won by approaching corporate sponsors regionally, nationally and even internationally, with a specialist Australian GIS company providing valuable in-kind resources at no cost.
"It demonstrates the willingness of good corporate citizens to become involved in the preservation of historical sites in Taranaki, not just for the benefit of the hapū, but for New Zealanders as a whole. This is about the living history of the land we live in, the land that sustains us."

He's also grateful for the support and encouragement of Council officers working on a region-wide list of significant sites, for use in resource management.

Since 2019, Council staff have been researching publicly available information including press articles, old maps, video clips, treaty settlements, photographs and archival records. Details of about 800 sites have been compiled and officers are now working with individual iwi and hapū on changes and modifications. They're also working with the region's three district councils.

Keith firmly believes work of this nature is nationally important and should be resourced accordingly. But as a retired surveyor, he was happy to be able to utilise his skills on behalf of his hapū. "When you see that something needs doing but it's not being done, you jump in," he says.

Keith's effort was recognised with a Taranaki Regional Council Environmental Award in 2021.

Contaminated land

Under the Resource Management Act 1991 (RMA), regional councils have a responsibility to investigate and monitor potentially contaminated land. Information collected is held in a database maintained by regional councils that is available to communities, regulators and environmental consultants.

A variety of industrial, commercial and farming activities can result in chemical contamination of soil, air and water. A site is considered to be contaminated when hazardous substances are at significantly higher concentrations than their normal levels, and there is likely to be a risk to human health or the environment. Potentially contaminated land is land that has been used for an activity that is more likely than other activities to cause contamination.

Many hazardous substances occur naturally in soil, air and water. For example, lead and mercury occur because of weathering of rocks or from geothermal activity. Many chemicals, particularly trace elements, are needed by living organisms in order to live and grow. However, above a certain level even these chemicals can become toxic, interfering with the complex biochemical reactions of plants and animals.

Other hazardous substances do not occur naturally. Over time, some of these have become widespread in our environment. One example is the organochlorine DDT, formerly used as a pesticide. Other contamination may occur unintentionally, for example spills or leaks from storage tanks.

The Ministry for the Environment (MfE) has compiled a Hazardous Activities and Industries List (HAIL) of 52 specific land uses that can potentially cause contamination. Sites that may be contaminated include landfills, timber treatment sites, scrap yards, service stations and motor vehicle workshops, bulk chemical storage areas and metal foundries.

1,336
sites
in the **Register of Selected Land Use**

56%
no contamination

40%
low-level contamination

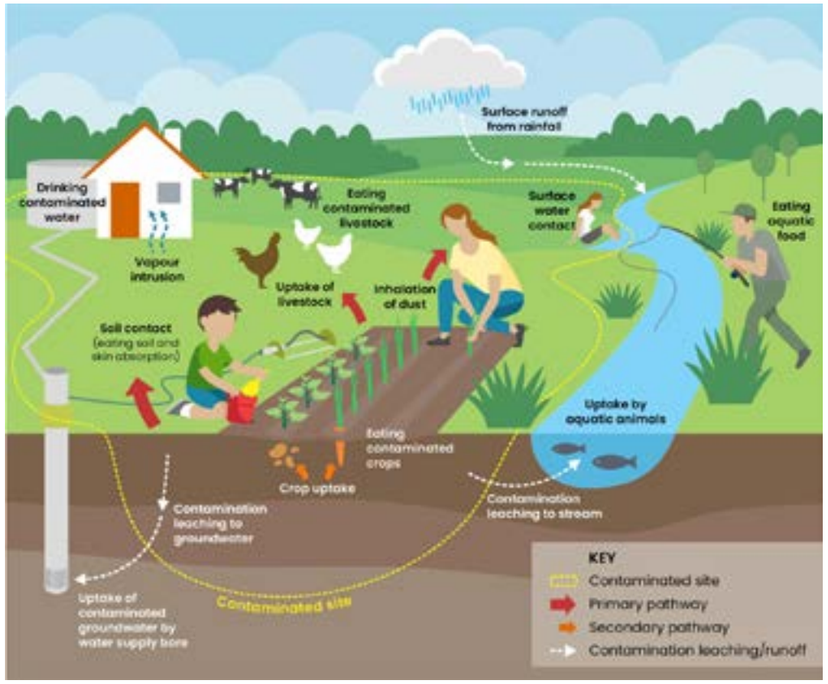
18
contaminated sites have been **remediated**

0
sites
present an unacceptable risk to the community

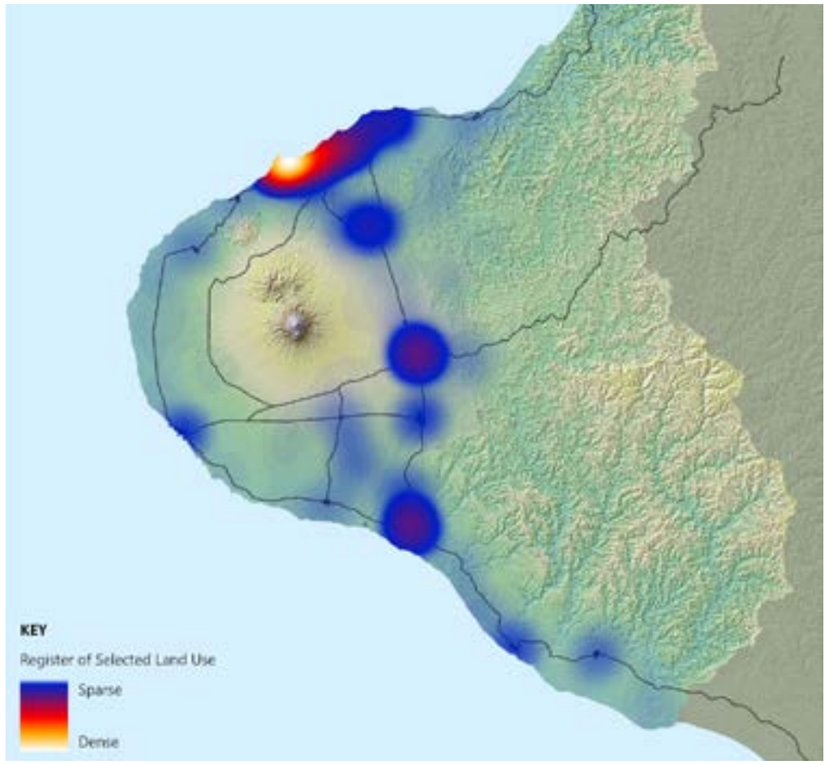
What we know

Since 1992, the Council has identified and investigated sites in the region that have the potential to be contaminated. This has included a number of investigations into sites that present a higher risk such as timber treatment plants, landfills, historic petroleum wells and pesticide storage sites.

There are 1,336 sites included in the existing database, known as the Register of Selected Land Use (RSLU). The majority of these sites are in urban areas where commercial and industrial activities tend to be located, with the highest concentration in the Port Taranaki commercial area. The database contains sites where there have been investigations into soil contamination as well as sites where activities on the HAIL are known to have occurred.



Pathways by which contaminants can affect human health (MfE, 2012).



Distribution of sites in the Register of Selected Land Use database.

None of the sites in the RSLU database are considered to present an unacceptable risk to the environment. The majority had no contamination, or had some contaminants present but satisfied relevant guidelines for the type of land use.

Category of sites in the RLSU database	Number of sites
No contamination found	754
Contaminant/s present but site meets guideline values – no unacceptable risk	529
Remediated	18
Verified HAIL – risk not assessed	35
Contaminated – risk unacceptable	0

Remediation of a number of sites was partially or wholly funded by the Council where significant risk to the environment existed. This included the former Pātea Freezing Works, in conjunction with South Taranaki District Council (STDC) and the Government, after a 2008 fire at the derelict site exposed asbestos and other hazards. The Council carried out air and ecological monitoring throughout the remediation process.

Present day activities are much less likely to result in contamination of land because of greatly improved regulation of hazardous substances and processes. If a significant issue were to arise, primary responsibility rests with the site owner. Regional councils in some circumstances may apply for grants from MfE's Contaminated Site Remediation Fund, either to assist council initiatives or on behalf of landowners.

What we're doing

The Council is part of a national regulatory group that works closely with MfE to refine the contaminated land management framework. One of the long-term projects of this group is to improve the consistency of data held and reported by regional councils. This will create a clearer nationwide picture and more uniform processes across regions, but requires a significant amount of work to implement.

Along with changes in information technology, the national data consistency project has required the creation of a new contaminated land database for Taranaki. The existing sites have been transferred to this database and are being reassessed under the updated classification schemes. Work is also under way to digitise all physical records and verify existing information.

In 2012, the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health 2011 (the NES-CS) came into effect. This requires district councils to use their consenting processes to ensure potentially contaminated sites undergoing development are identified, investigated and, if necessary, remediated or otherwise managed to protect human health. The regional council database supports this function.

With the introduction of the NES-CS, the majority of new contaminated land information now comes from investigations undertaken when land is subject to subdivision, a change of land use, or development that involves significant soil movement. Owners or developers must engage suitably qualified environmental professionals to assess the site and, if necessary, create plans for remediation or management of soil contaminants. These reports are recorded in the Council's database for future reference.

The Council continues to work with other regulators and the professional sector to ensure all information relating to soil contamination is collated in a central database and made available to interested parties.

Where we're heading

Once all entries in the new database have been reclassified and validated, the existing public website portal will be upgraded to include significantly more information. Additional functionality may be added to automate distribution and collection of data. This will greatly improve public access to the database and reduce the reliance on manual information requests.

As well as an update to the range of activities in the HAIL since the RSLU database was created, there have been significant changes in industry within Taranaki over the years. Therefore, identification of additional HAIL sites, both old and new, is an ongoing component of contaminated land management. Aerial photography is one resource commonly used for site identification and recent nationwide projects have expanded the online availability of aerial imagery. Though this process is currently manual, a 2021 Government technology initiative has trialled the use of computer-based neural networks to automatically locate certain HAIL sites after being trained on existing datasets. Such tools will play an increasing part in the sector in coming years.

Solid waste

The three district councils in Taranaki provide the majority of the region's waste services and infrastructure including kerbside recycling and rubbish collection, transfer stations and resource recovery facilities and disposal of landfill waste to Bonny Glen Landfill in Marton.

The Taranaki Solid Waste Management Committee is a collaboration between the Council and the district councils, who work together to identify opportunities to reduce and manage waste. In 2011, the Committee adopted the Waste Management and Minimisation Strategy for Taranaki, which seeks to reduce the harmful effects of waste and improve the efficiency of resource use. This strategy guides the development and implementation of regional waste minimisation and management plans.

An important focus of this strategy is ensuring our communities understand how and why we need to minimise the production of waste. Facilitating and measuring the outcomes from behaviour change around waste minimisation is an integral part of achieving the targets from each council's waste management and minimisation plan.

43% of kerbside refuse is **food waste**

Commercial refuse is **60%** of **landfill waste**

13 **transfer stations**

The Junction has **diverted** **38.8+ tonnes** of waste from **landfill**

What we know

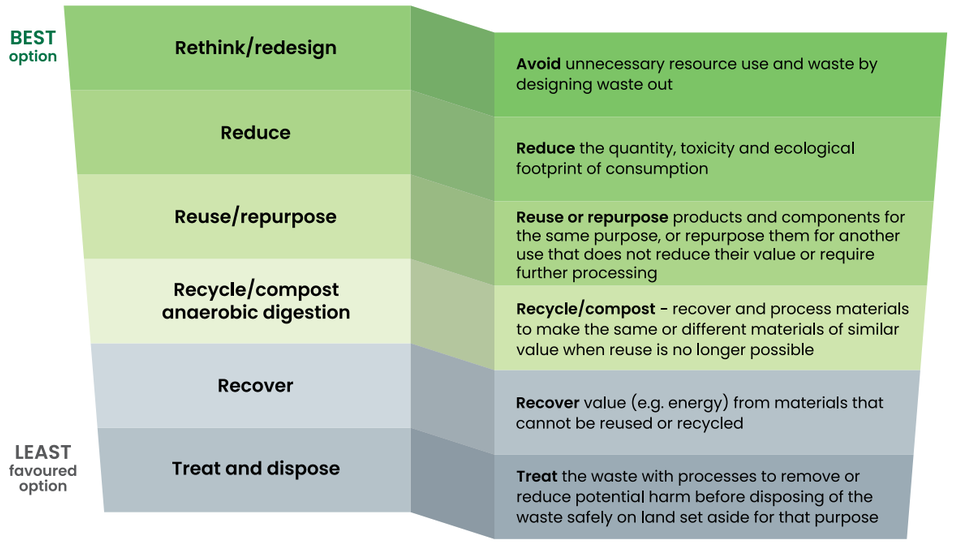
Landfill waste

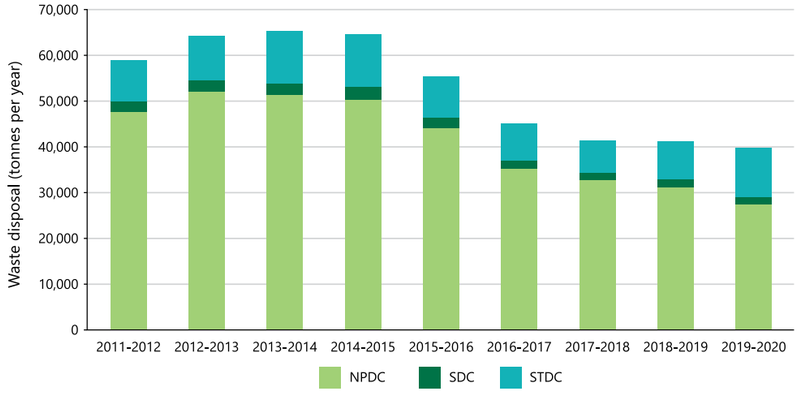
Historically there were numerous municipal landfills across the region, with most towns having at least one active disposal site and, in some cases, many sites. Most sites were poorly controlled and presented risks to the surrounding environment. As standards improved, it became more economical to maintain fewer, better-engineered landfills.

From 2004, all waste collected in Taranaki was disposed of at the Colson Road Landfill in New Plymouth, until its closure in 2019. It has since been disposed of at the Bonny Glen Landfill in Marton in Manawatū-Whanganui, with 13 transfer stations in Taranaki servicing both urban and rural communities.

Total waste to landfill continues to reduce over time, presently decreasing at about 3% per year. The volume of waste to landfill peaked at 65,257 tonnes in 2013-2014 and reduced significantly from 2015 when all three district councils aligned their recycling collection services and created a regional materials recovery facility in New Plymouth to process recyclables. In 2014, the waste to landfill in the region per person was 595kg falling to 311kg per person in 2020-2021.

In Stratford and South Taranaki, there has been additional commercial and green waste introduced via the Hāwera and Stratford transfer stations since Colson Road Landfill closed. Reducing commercial and organic waste is a focus for the region's councils.



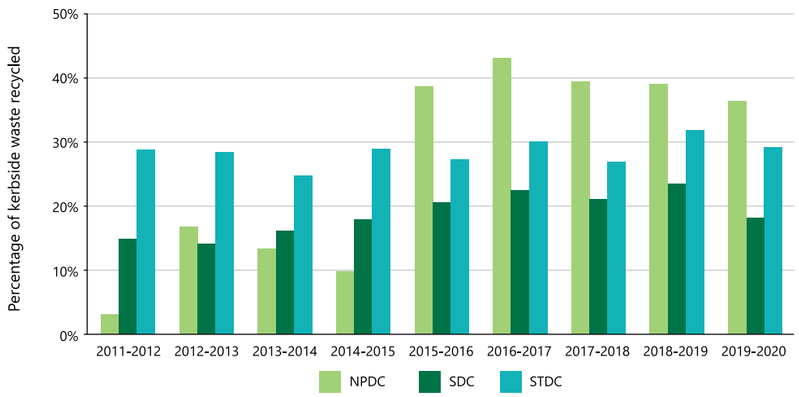


Total waste to landfill, 2011-2020.

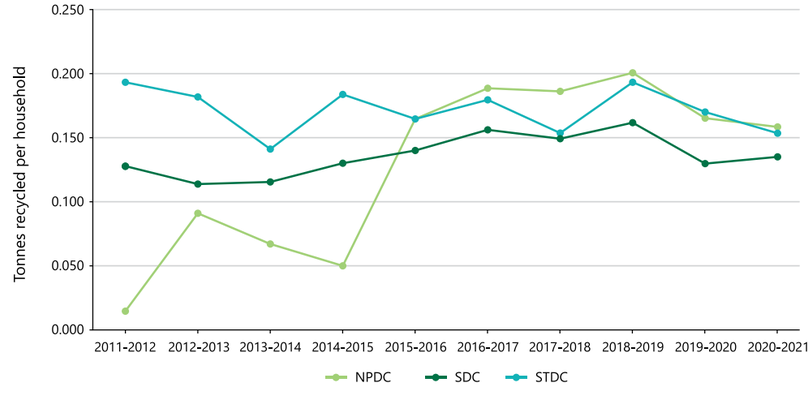
Kerbside collection

All district councils provide kerbside landfill, glass and mixed recycling services and separate glass collection. Over the past five years, Stratford and South Taranaki household waste disposal has remained static. Stratford has the highest disposal rates per household for landfill waste collected at kerbside, and will need to increase its recycling rate of 20% to meet its 2023 target of 29%.

On a per household basis, the three councils have similar rates of recycling at kerbside with a slight decreasing trend in the last two years.



Proportion of kerbside waste recycled annually, 2011-2020.



Kerbside recycling per household, 2011-2021.

Contamination of kerbside recycling bins is an ongoing issue and occurs when people place non-recyclable items in recycling bins. Contamination in Taranaki has increased steadily over time, particularly since 2018. In the 2020 kerbside recycling audit, the most prominent contaminants were mixed materials, lids on bottles and dirty recycling.

In the past five years, the recycling market has seen significant changes. In early 2018, China introduced tighter restrictions on acceptable products, to improve its own recycling and environmental outcomes. This prompted the waste industry in New Zealand to look at local processing options for recycling in an attempt to reduce the reliance on the more volatile international markets.

In Taranaki this prompted a number of initiatives including the sourcing of local markets for paper, cardboard and plastics, improving the quality of sorted recycling, accepting only plastics 1, 2 and 5 and aligning operations with recommended national standards for what is acceptable at the kerbside.

Composting and organic waste

After identifying that 43% of kerbside landfill was food waste, New Plymouth District Council (NPDC) introduced a weekly food scraps collection in 2019 as part of its kerbside service. Data from 2019 to 2021 shows 2,828 tonnes was diverted from landfill to a commercial composting facility.

This service also provided an opportunity to introduce a fleet of electric collection vehicles, which has reduced carbon emissions by 69,103kg CO_2 eq., equivalent to removing about 15 cars from the road annually.

Options for processing organic waste in an environmentally sustainable manner are somewhat limited. Proposed national emission reduction targets that focus on reducing emissions from organic waste mean we need to look at alternative solutions to address the high proportion of organic waste going to landfill in Taranaki.

Taranaki district councils are co-funding a feasibility study, investigating how they might collectively build and operate an organic waste processing facility. If this proves feasible, such a facility could potentially process domestic, commercial and industrial organic waste streams from around the region.

What we're doing

The Junction

There are 13 transfer stations in Taranaki servicing both urban and rural communities. As part of the upgrade to the Resource Recovery Facility in New Plymouth, NPDC established The Junction Zero Waste Hub on Colson Road.

The Junction is operated by Waitara Initiatives Supporting Employment and Sustainable Taranaki, both charitable trusts that run daily services and education initiatives focused on reuse and recycling. It is a shop and drop zone that resells items from tools and household items to building materials. It also manages e-waste services. Items diverted from landfill are sorted, checked and resold. Excess glass and recycling can be dropped off in a drive-through style depot, as can building materials such as windows, timber framing and other reusable items.

Working with businesses

In 2019, NPDC employed a commercial waste minimisation officer who has since supported more than 60 businesses with waste reduction programmes and general guidance. Surveys in 2019 and 2020 also helped understand the needs and barriers faced by the business sector in reducing waste.

The Resource Wise Business Programme helps businesses reduce waste to landfill in the commercial and industrial sector. Businesses attend introductory workshops, nominate two or more waste champions and commit to the four-year programme. A waste minimisation officer conducts yearly audits with the waste champions. The information collected helps assess current and potential diversion rates and in the design of an action plan to reduce waste to landfill.

A survey of businesses involved in the programme showed 86% are now diverting food waste and paper towels from landfill and 100% of businesses improved their waste sorting stations. A third intake of businesses will join the programme in June 2022.

Raising awareness

Regular community workshops help the community improve waste habits and reduce food waste. In the past year, this has expanded into awareness of sanitary waste and flushable single use contaminants such as tampons, pads and wipes. All district councils run menstrual cup workshops for schools and community groups to promote reusable cups and pads.

This is an important campaign advocating for positive change in perceptions and reducing negative behaviours around menstrual education. It aligns with the national period poverty initiative created by the Government.

Where we're heading

National changes

In the past five years, there has been significant growth in the community's awareness of waste issues, alongside changes in recycling markets nationally and internationally. The increasing profile of waste and climate change in New Zealand has seen Government initiatives including a ban on single use plastic bags in 2019, introduction of six mandated priority products that will place lifecycle responsibilities on producers in 2020 and increasing the waste levy imposed on every tonne of landfill waste to $60 by 2026.

The Government is currently considering proposals for a new national waste strategy and more comprehensive waste legislation. In addition, an emissions reduction plan with specific references to waste and a circular economy is under development. This will likely create significant change in the waste management sector in the near future.

Waste minimisation

The region's focus is on working towards Zero Waste and developing a circular economy that addresses waste at the product's source and the end of its lifecycle. This is in line with the national approach directed and supported by MfE.

The concept at the heart of a circular economy is ensuring we can unmake everything we make. It is essential to keep resources in use for as long as possible to extract the maximum value from them, then recover and regenerate products and materials once they are no longer in use.

Reaching Zero Waste would mean no rubbish is disposed to landfill, due to extremely high levels of resource efficiency, re-use, recycling and re-purposing. The Zero Waste concept is being rolled out around the world including many parts of New Zealand.

Commercial waste

Commercial waste makes up 60% of waste to landfill and therefore its reduction is key to achieving the goal of Zero Waste. In 2019 a feasibility study into options for reducing and diverting more commercial and industrial waste from landfill concluded the following would have the most impact:

- promoting existing recovery services in the region;
- extending the current domestic kerbside collection to appropriate small businesses;
- constructing a commercial and industrial recovery facility; and
- investigating a commercial food waste collection targeting medium-sized businesses.

These actions will be implemented over the coming years. A commercial waste sorting facility is due to open in 2022 and an extension of the kerbside residential collection service to small businesses, organisations and marae is set for 2024.

Working together to reduce waste

In 2020, Enviroschools Taranaki collaborated with South Taranaki District Council (STDC) to deliver a range of workshops to local communities. The Enviroschools programme has waste as one of its key theme areas and 100% of its schools and kindergartens are working on waste issues.

These workshops drew on concepts from the Future Living Skills Programme. While the focus was on general sustainable living skills, many of the workshops included waste avoidance, waste alternatives, waste minimisation, resource recovery and/or and re-use components.

Workshops included:
- No dig lasagne garden composting in Ōpunake
- Make your own bathroom, kitchen & laundry products in Hāwera
- Waikawa (large basket) weaving in Eltham
- Low waste, low cost seasonal cooking in Waverley
- Plastic Free July in Hāwera

At many of the workshops, attendees were given resources such as recipe books or low-waste living products.

Enviroschools also hosted a well-received Plastic Free July lunchtime drop-in session for STDC staff featuring bees wax wrap making, homemade household cleaners and raranga (weaving).

STDC Environment and Sustainability Officer Brittany Rymer said it was great to partner with Enviroschools to take sustainable lifestyle education opportunities to the community.

"Their workshops help give residents the knowledge, tools and confidence needed to reduce their waste and live more sustainably."

The community education partnership was expanded for the 2021-2022 financial year, with 12 workshops planned across the South Taranaki district including Pātea, Waverley and Kaponga. These will cover waste avoidance and minimisation topics including grow your own groceries, green gifting, preserve your harvest and composting/green waste.

Taranaki Regional Council co-ordinates the Enviroschools programme in Taranaki, with support from Toimata Foundation, the three district councils, Toi Foundation and Kindergarten Taranaki.

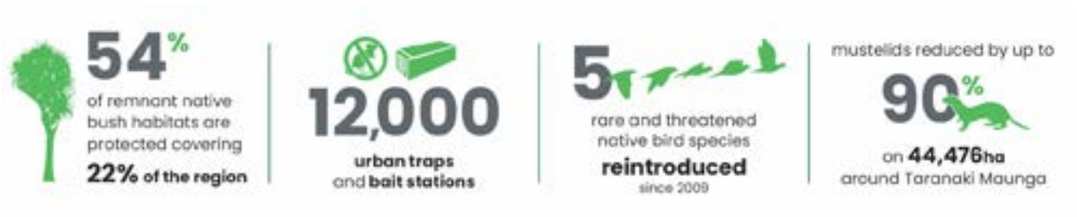
Biodiversity & Biosecurity

Taranaki is home to forests, wetlands and lakes, along with hundreds of streams and rivers winding their way from the mountain to the sea. Standing proud, Taranaki Maunga and Te Papakura o Taranaki are cloaked in native bush, home to birds, lizards and insects. To the north and east of the region, indigenous forest and wetlands can be found throughout the steep hills and valleys stretching inland to Whanganui and the King Country.

Prior to human settlement, much of the region would have been covered in native vegetation. Today, around 40% of Taranaki native forest and bush habitat remains. Taranaki Maunga and Te Papakura o Taranaki contain the region's only true alpine and subalpine habitats. Large tracts of forest can still be found in the hill country to the east, with smaller fragmented habitats scattered around the volcanic ring plain. The Sugar Loaf Islands and surrounding Marine Park provide habitat for nesting seabirds such as white-fronted tern, northern diving petrel and grey-faced petrel/oi, and a refuge for the largest New Zealand fur seal breeding colony/rookery on the west coast of the North Island.

Threats to native ecosystems and productive land include the destruction of habitat by invasive pest animals such as stoats, weasels and ferrets (collectively known as mustelids), possums and rats, along with the invasion of pest plants. These pests present challenges to the preservation and restoration of habitat on land and in lakes, streams and the coastal environment. To understand and respond to these challenges, the Council monitors various aspects of biodiversity and ecosystem health, such as the extent and condition of native habitat, presence of weeds and pest animals, abundance of native species and pressures from surrounding land use.

For the past 30 years, the Council has undertaken a range of work to tackle some of our biggest biodiversity and biosecurity challenges and has a range of strategies, plans and processes in place to address current and future issues.



What we know

Extent of indigenous habitats

Before human settlement much of Taranaki was covered in dense forests and wetlands, fringed with coastal dune and cliff habitats, supporting a unique assemblage of life. Since that time forest clearance, wetland drainage and realignment of streams, coupled with the introduction of predators, browsers and a variety of weed species have continued to affect its indigenous biodiversity.

Today, native forest and bush habitats make up around 40% of the region's land area, although many are isolated and modified to some degree. Around 55% of the steeper hill country to the north and east still has some native vegetation cover. By contrast, the flatter, more fertile ring plain has retained less than 5% of its native vegetation (outside of Te Papakura o Taranaki). The remaining habitat includes 36 types of native forest and shrubland ecosystems, and at least 12 threatened or naturally uncommon coastal and wetland ecosystems.

At least seven forest types now cover less than 5% of their former extent and a further five, less than 30%. From 2001 to 2018, the overall extent of the region's indigenous vegetation cover further declined by around 5,120ha. Around 3,765ha of this was lost from habitats already greatly reduced. The majority of the loss happened between 2001 and 2012. Between 2012 and 2018, this trend reversed with a 650ha gain in indigenous cover, compared to the previous five years. In part, this turnaround has been the result of extensive revegetation of riparian areas on the ring plain and regeneration of previously farmed and forested steep hill country. The success of the Council's wetland and riparian programmes has seen more than 7.2 million native plants distributed, and thousands of kilometres of streambanks replanted.

	Indigenous vegetation (ha)	Exotic vegetation, transport routes and urban areas
2001	294,003	425,329
2008	291,746	427,579
2012	288,228	431,100
2018	288,881	430,448
2001-2018	-5,122 (loss)	+5,119 (gain)

Change in indigenous vegetation compared to exotic vegetation in Taranaki, 2001 to 2018.

Native habitats in urban areas are also important for biodiversity. New Plymouth city is top of the table in New Zealand when it comes to native vegetation cover, with around 8% remaining. NPDC plans to increase this to 10% by 2030 through local revegetation programmes.

Protection of native habitats is increasing. More than 54% of our remnant native habitats, covering about 22% of the total land area of the region, are now formally protected (up from 51% in 2014). Public land is protected as reserves and parks by the Department of Conservation (DOC) and

district councils and private land is covered by conservation covenants or QEII open space covenants. Further protection is in place for designated Significant Natural Areas (SNA) and other forest, wetland and coastal areas through national policy and regional and district plans.

Condition of indigenous habitats

Between 2015 and 2020, the Council assessed the general health or condition of 223 patches of native bush. Results show forest remnants in Taranaki are generally in 'Good' or 'Very good' condition and continue to improve under management.

Forest condition assessment, 2015-2020.

The ring plain is scattered with numerous small (<50ha) remnant areas of native habitat. These are increasingly connected by riparian planting and are likely to be benefiting from the improving condition of Te Papakura o Taranaki. Most remnants are fenced and stock-proof and all come under the long running Self-Help Possum Control Programme, meaning there is limited pressure from pest species. These areas show increased abundance of palatable plant species, such as king fern, kanono and kohurangi.

Remnants in the hill country score slightly lower, with high numbers of possums and goats having a significant impact on regeneration of understorey and canopy species. Although degraded, larger remnant tracts of forest provide habitat for iconic threatened species such as western North Island brown kiwi and native bats. North Island kākā and a very small population of yellow crowned kākāriki still live in remote areas, although their future is uncertain.

Weeds are a constant threat and have the biggest impact on coastal areas, wetlands and regenerating bush margins. Fast growing, climbing and sprawling species such as blackberry, tradescantia, climbing asparagus and old man's beard are particularly bad for regenerating bush areas in the region. Since 2018, Council Environment Officers have identified more than 160 exotic plant species naturalising or beginning to spread into local native ecosystems.

Each spring, the Council uses standard counts to monitor forest birds in urban reserves and rural bush areas around the ring plain. These counts have shown increases in both abundance and variety of species over the last five to 10 years. Although there are more native than exotic bird species found in areas dominated by native vegetation, introduced species such as rosellas, blackbirds and chaffinches are commonly found throughout all bush areas.

Annual garden bird surveys have also shown increases in the number of tūī, kererū and tauhou/silvereyes in urban areas.

	Native bird species	Exotic bird species
Urban reserves and parks	19	18
Small rural bush remnants <50ha	20	16
Large bush areas >300ha	17	10

Number of native and exotic bird species recorded in urban reserve and parks, small and large bush areas, 2015-2020.

Coastal habitat

Small coastal turfs and herbfields are scattered along the coast in areas where the beach meets the land, with coastal sand dunes and beaches covering 15,700ha of the region. Some of the region's best remnant habitats can be found along the coastal cliffs of South Taranaki. Tiny endemic herbs are found in these areas, including *Crassula manaia*, which is found nowhere else in the world. These areas are under constant threat from coastal erosion and pressure from competition with exotic pasture grasses.

Most coastal turf communities and herbfields can be found along a 120km strip of South Taranaki coastline. Often sandwiched between eroding coastal cliff edges and intensively farmed land, these fragile habitats are considered nationally threatened. Sand blowouts and erosion, along with the impacts of weeds and pest animals, continue to reduce these threatened habitats. Less than 2,000ha (12%) is considered indigenous or partially modified.

Threatened shorebirds, such as the New Zealand dotterel and the variable oystercatcher, nest along the coast. Good numbers of the world's smallest penguin, the native kororā/little blue penguin, roost and nest along most of the shoreline, even in coastal areas of urban New Plymouth. Dogs and habitat disturbance remain a constant threat for all of these species.

Weedy exotic plants often overrun coastal dune systems, which are heavily impacted by vehicles and foot traffic. Surrounding land use pressures are also affecting these areas and sand blowouts and erosion are common. Coastal dune systems in the region are highly degraded with 66% of those monitored between 2016 and 2020 in either 'Fair' or 'Poor' condition, 33% in 'Good' condition and 0% in 'Very Good' or 'Excellent Condition'.

Coastal dune condition assessments, 2016-2020.

Biodiversity and beef? No tension, say farming couple

Mat and Vanessa Vujcich.

Vanessa and Mat Vujcich have given over a good third of their 100ha beef unit to biodiversity – and they say there doesn't have to be tension between environmental priorities and business imperatives. If anything, it's proved quite the opposite.

"Our animal performance has been improving because we focus on looking after the land holistically," says Mat. "It's all one package really – looking after the bush, restoring wetlands, controlling pests, and keeping pasture soils and waterways healthy as well."

They've got QEII covenants on 28ha of bushland on their farm near Inglewood. The protected bush is also part of the Council's Key Native Ecosystem programme. This opens opportunities for assistance with fencing and pest control, which they have gladly taken up.

There is also extensive wetland and riparian fencing and planting along waterways outside the protected areas. The farm borders Te Papakura o Taranaki and Mat and Vanessa recognise the importance of their planted riparian strips as corridors for native species. They also control pests so native species can thrive.

They enjoy seeing the property's growing abundance of native birds and native plant species as they work day-to-day on the farm. For Vanessa, it's the birds that are special, particularly those classified as threatened or at risk. She's delighted every time she sees kārearea, or New Zealand native falcon, wheeling above her, and proud that whio/blue duck, are taking advantage of the corridors to expand their range from the national park.

Another notable feature of the property is the number of miromiro, or tomtits – they've even been seen cavorting around the homestead. While not classified as threatened, they're not usually encountered up close in a working farm environment. Kererū, tūī, korimako/bellbirds, pihoihoi/pipits and riroriro/grey warblers are among the other native bird species on the property.

Mat has a keen eye for the native bush on the property, and the changing display as different species come into flower at different times. Kamahi is abundant and their bush is also home to threatened swamp maire, as well as rimu, miro, tawa, rewarewa and kahikatea.

The covenanted Piakau Stream and other waterways on the property also provide good habitat for native fish species, with shortjaw kōkopu, kōaro and tuna, or longfin eel, recorded there.

Mat and Vanessa see the native biodiversity as something to be treasured. It's also spurred their interest and adoption of regenerative farming practices. They view biodiversity in the soils and pasture every bit as important as biodiversity of bush, wetlands and riparian habitats. Their involvement in a local network of like-minded people has led to visits from Inglewood High School students and teachers to study the stream life and even help to plant a riparian corridor on the property.

Vanessa and Mat say land ownership is not just about the money that can be made from it. It's about the future.

Kererū.

Threatened species

According to the latest national threat classifications, at least 40 of Taranaki land and shorebird species are now considered threatened or at risk, along with two species of native bat, 10 reptiles and around 90 native plants.

Since 2015, the number of species considered to be in trouble has increased in Taranaki. This is due in part to the reintroduction of three rare bird species previously lost to the region. Joint projects between community groups, iwi, DOC and the Council have seen five rare and threatened native bird species (whio/blue duck, stichbird/hihi, saddleback/tīeke, brown teal/pāteke and kōkako) reintroduced to the region since 2000. Several others, such as North Island brown kiwi, whitehead/pōpokotea, tītipounamu/rifleman and North Island robin/toutouwai, have been relocated to restore local populations following intensive predator control efforts by communities and local agencies.

Other additions to the threatened list are for more sombre reasons. In the last five years, three of the region's 11 native lizard species have become more threatened. This includes the copper skink, which has gone from 'Not Threatened' to 'At Risk', and the Kupe skink, which has become so rare it is listed as 'Nationally Critical'; one step from 'Extinct'.

The number of native plants on the list has also increased. Several plants and trees were added to the national lists in 2018 after the discovery of myrtle rust, due to the increased risk this fungus has on their survival and reproduction. Certain natives, such as swamp maire/waiwaka and ramarama, are particularly susceptible.

At least three plant species are likely to have become regionally extinct in the past 30 years, and some are just hanging on. The nationally threatened dactylanthus/pua o te reinga is still present in Taranaki, although greatly reduced in abundance. Historically, large scale clearing of indigenous vegetation has meant loss of habitat for this parasitic plant, while possums directly damage the plants when they flower. Regular possum control in key areas is helping to maintain the species in the region.

Taranaki also has at least seven species of threatened or at-risk terrestrial invertebrates, including the nationally threatened Notoreas moth (*Notoreas perornata*). This moth is only known to be found in a handful of small coastal herbfield sites, including in South Taranaki. Recently, the newly described Jacinda wētā was discovered in the bush at Pukeiti and on Taranaki Maunga. Increased predator control may be making these species more detectable and show that there is still lots more to discover, as the condition of our ecosystems improve under management.

	Threatened	At risk
Birds	11	29
Bats	1	1
Lizards	1	9
Invertebrates	1	6
Plants	41	49
Total	55	94

Number of threatened or at risk native species that use terrestrial habitats in Taranaki as at 2020.

Pest animals

A key focus for pest control in the region is Taranaki Maunga and Te Papakura o Taranaki, covering approximately 34,170ha. The Department of Conservation, with support from the Taranaki Mounga Project, oversees day-to-day management of Te Papakura o Taranaki. Pest control operations primarily control possums, mustelids and to some extent rats. The national park is very nearly free of feral goats, and has no feral deer or pigs.

The Taranaki ring plain surrounds Te Papakura o Taranaki and is generally characterised by modest sized and highly developed dairy farms in private ownership. Possum control is a key focus however, mustelids, feral cats and rats are increasingly subject to co-ordinated management by landowners through Council programmes and by other agencies and organisations. Rabbits, hares and hedgehogs are also common in the agricultural landscape and while they can thrive in drier conditions, such as well-drained sandy soils on the coast, their populations are variable across the years owing to the region's relatively high rainfall climate.

The Self-help Possum Control Programme has been running since 1992, keeping possum numbers low on the ring plain. Possum numbers are measured using the residual trap-catch (RTC) index, a simple method of determining relative possum abundance. The aim of the programme is for landowners to keep possum numbers below 10% RTC, or fewer than 10 possums caught for every 100 trap nights.

The number of landowners involved has increased over the past decade, from 3,753 properties covering 227,000ha in 2008 to 4,211 covering 240,000ha in 2020. The RTC has increased in recent years, from 6% in 2015/2016 to 6.8% in 2019/2020. It is of increasing concern that control by landowners is losing ground, with increasing impacts on indigenous flora and fauna in 24,016ha of riparian margins and threatened ecosystem areas on the ring plain.

Possum.

Stoat.

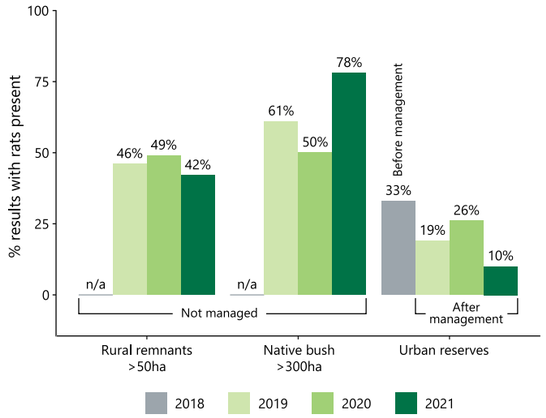
To the north and east of the region there are large areas of indigenous forest and wetlands among the steep hills and valleys. Less investment in biosecurity initiatives in the eastern hill country means that in large areas of forest species are in decline, reduced or displaced by browsing pests. Indigenous fauna is predated on leading to risk of population fragmentation and/or localised extinction.

On private land in the eastern hill country, possum numbers are generally very high, due to the challenging geography and prioritisation of labour towards agricultural production. Monitoring results show an average RTC of 49.8%. Control is generally only done by fur trappers, to protect new forestry and for a small number of conservation projects.

The control of feral goats, fallow and red deer and pigs on private land is sporadic, by recreational hunters or undertaken periodically during exotic and mānuka forest establishment. Mustelids, feral cats and rodents are also present in relatively high numbers. While these species are not usually controlled on private land, there are a large number of well-co-ordinated community restoration projects, many protecting the western North Island brown kiwi.

The urban predator control programme focuses on co-ordinated rat, mustelid and possum control in parks and in backyards. By June 2020, 12,000 traps and bait stations had been deployed across the New Plymouth, Waitara, Oākura, Ōkato and Ōpunake urban areas. The early concept was to appeal to 'hearts and minds' of the most densely populated part of the region, but very quickly calls came from other rural and urban communities to bring these programmes to their local districts and towns.

Monitoring of catch count data indicates significant decline of rodents and possums in urban areas where there is co-ordinated pest control. Monitored bush reserves in New Plymouth with regular rodent control recently achieved a monitoring rate of less than 10% (rodent tracking rate). Although there is still work to do, this is considerably lower than the 40-50% regularly recorded in small rural bush remnants (<50ha), or the over 75% recorded in large areas of contiguous bush (>300ha) without effective rat control.



Rat abundance in urban reserves, small rural bush remnants and large areas of native forest in Taranaki, 2018-2021.

Pest plants

Pest plants such as old man's beard, giant gunnera and wild ginger also manifest in natural areas, such as the coast, riversides, the margins of forest fragments and wetlands and in unmaintained parts of the urban environment. On lowland farms, if left unmanaged, some pest plant species can affect production, such as giant buttercup and ragwort.

Old man's beard is considered the most damaging of invasive climbing weeds in New Zealand. In Taranaki, landowners are required to control it on their property. There are exceptions, including three key areas with dense plant populations - Kaūpokonui Stream, Pātea River and Waingongoro River - where the Council has begun control operations. Once control has been completed landowners must maintain the gains made, the same as other landowners in the region.

The Council supports landowner control of the aggressive environmental weed species giant gunnera, kahili, wild ginger and giant reed. Giant buttercup, gorse, wild broom, yellow ragwort and the three key thistle species are primarily agricultural pests. Landowners must control these species and are motivated to do so largely in order to maintain land productivity. The Council will issue Notices of Direction to landowners when necessary, especially where a neighbour is working hard to control the pest species.

Pest plant issues tend to be localised in the hill country, with species such as yellow bristle grass, tutsan, Japanese honeysuckle, Himalayan strawberry, Darwin's barberry and Chinese privet found along waterways, transport corridors and areas of disturbed land such as deforested and highly erodible land.

Eradication programmes are in place to rid the region of five highly damaging pest plants: climbing spindle berry, giant reed, madeira vine, moth plant and Senegal tea.

In 2019-2020 the Council actively monitored 189 sites with current or recent presence of eradication species, and undertook direct control at 106 of those sites.

Climbing spindle berry.

Giant reed.

Madeira vine.

Moth plant.

Senegal tea.

What we're doing

Regional Biodiversity Strategy

First adopted in 2008 and updated after a review in 2017, the Council's Regional Biodiversity Strategy outlines 180 actions to help maintain and improve biodiversity in the region. These actions contribute toward four key priorities: working with landowners through our Key Native Ecosystems (KNE) programme; enhancing biodiversity components of existing Council programmes; working with others to promote integrated management of indigenous biodiversity, and monitoring the extent and state of biodiversity on private land to enable sound management decisions and prioritisation.

One aim of the strategy is for more than 25,000ha of Taranaki remnant native ecosystems on private land to be under active management. The KNE programme presently covers almost 18,000ha and this figure continues to grow each year. Many of the Council's other programmes and initiatives also contribute toward this target.

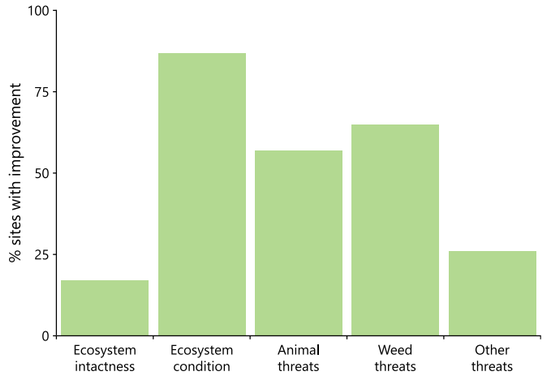
Another requires that 60% (170,000ha) of Taranaki remnant native ecosystems, including the public conservation estate, be formally protected. Presently, 54% (157,623ha) of the region's remnant native ecosystems are protected under DOC, QE II National Trust, or Conservation Covenant.

Others objectives include creating wildlife corridors from the maunga to the sea through retirement and vegetation of intensively farmed catchments, maintaining low levels of possums and predators to protect remnant ecosystems and indigenous wildlife and supporting and resourcing Wild for Taranaki and community groups to deliver biodiversity initiatives and outcomes.

Key Native Ecosystems (KNEs)

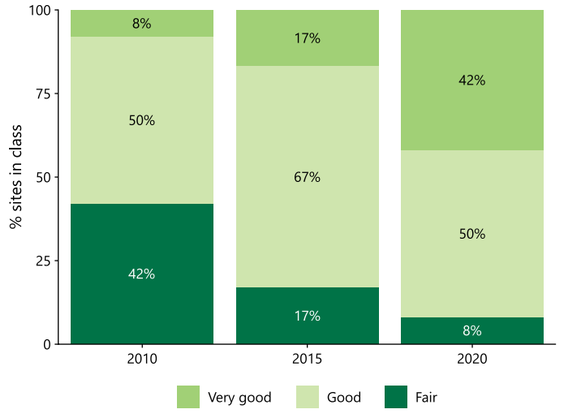
Since 2006, the Council has been identifying and surveying areas of important biodiversity value. As of 30 June 2021, it had identified more than 330 KNEs, covering a variety of habitats. For sites of high biodiversity value on private land, the Council provides free advice to landowners to help restore and protect those values. In some cases, sites may qualify for a Council-developed Biodiversity Plan.

Monitoring data from 46 forest remnant sites with a Biodiversity Plan shows strong gains from this programme. After five years of management, 26 sites (56%) showed reduced threats from animal pests, 34 sites (65%) showed reduced threats from weed pests, with 12 (26%) showing a reduction in other threats such as habitat loss or modification. Ecosystem intactness improved at 8 (17%) of sites and a total of 40 sites (86%) showed an improvement in ecosystem condition.



Ecosystem improvements at sites re-measured between 2015 and 2020, after five years with a Biodiversity Plan.

Ten-year repeat forest assessments have just got underway. Initial results from 12 sites show continued improvement. In 2010, initial surveys showed only one site (8%) was in 'Very Good' condition. After five years with a Biodiversity Plan, this climbed to two (17%) and after 10 years, five sites (42%) were in 'Very Good' condition. Eleven out of the 12 sites (92%) were in 'Good' or 'Very Good' condition.



Changes in overall ecological condition of forest remnants after 10 years with a Biodiversity Plan.

Pest management: a strategic approach

In 2018, the Council adopted a revised Regional Biosecurity Strategy (Strategy) and Regional Pest Management Plan (RPMP) to help address key biosecurity challenges for the region over the following 10 to 20 years. The RPMP is the Council's 'rule book', targeting specific pests for eradication or sustained control in the region. The Strategy outlines broader biosecurity goals and actions, covering all pests and harmful organisms, not just those in the RPMP.

The Strategy sets out five priorities that govern the activity of Council programmes and work. These broadly include excluding new pests, eradication of serious pests with limited distribution, sustained control of pervasive and widespread priority pest species, collaborating with others to achieve identified outcomes and regional leadership through strategy, planning and contributing to collaborative initiatives. The Strategy identifies 76 harmful organisms, including 35 pest animals and 41 pest plants. Twenty-one of the pest species targeted for eradication and sustained control are present in the region. Council responses to these priority species includes a combination of planning tools – such as advice, rules and monitoring aimed at co-ordinating on-going 'self-help' control by the community and Council-funded eradication programmes.

Sustained control of the 16 pervasive pest species is carried out either over the entire region, or in the case of the brushtail possum and mustelids, on about 240,000ha of private land surrounding Te Papakura o Taranaki. These species include:

- Pest animals - Brushtail possums, mustelids
- Pest plants – old man's beard, giant gunnera, kahili and wild ginger, giant buttercup, gorse, nodding, plumeless and variegated thistle, wild broom and yellow ragwort

The Council fields many inquiries regarding pest species and provides advice and information to the community on a daily basis. Species particularly harmful to the environment are further identified in the RPMP for advice, action and regulation. Some are not currently within the region but pose risk of entry, or are within the region but are very widespread. These species are therefore subject to monitoring, advice, information, and action where appropriate.

Our rangatahi making a difference

Environmental Educator Ash Muralidhar (left) and Rotokare Youth Ambassadors.

Rotokare Scenic Reserve Trust has impressive biodiversity successes to its credit – most recently the release of Rotokare-bred kiwi into the Kaitake Range under its flourishing 'Taranaki Kōhanga Kiwi at Rotokare' partnership with Taranaki Kiwi Trust.

The accessible wildlife sanctuary with strong community roots can also be thanked for the return of tīeke (saddleback) to Taranaki after 150 years, and for successfully breeding hihi (stitchbird), one of New Zealand's rarest species. And the list goes on.

And the accomplishments don't stop there. The Rotokare Scenic Reserve Trust is nurturing and equipping young environmental and conservation champions, who are already putting their enthusiasm and skills to work not just at Rotokare, but right across the region.

"It's exciting to see our rangatahi spreading their wings with confidence and setting out to make a real difference across the region," says Rotokare's Environmental Educator, Ash Muralidhar, who runs the Youth Ambassador Programme. "This is why the programme is such an important extension to the work we do with native species and landscapes."

Almost 50 young people have been through the programme in its first five years, taking a hands-on approach as they learn about predator control, monitoring native birdlife, creating habitats for invertebrates and monitoring and improving the health of wetlands.

The Trust takes a 'toolbox' approach to its education and training, calling in its own experts and others from around the region and the country to contribute to the skills and knowledge of the Ambassadors.

The Youth Ambassador Programme was initially set up for senior primary school students but graduates refused to leave at the end, so it has been extended to encompass junior and senior programmes.

While the graduates remain firmly connected to the sanctuary, they have also gone on to a variety of projects – in some cases starting their own. These include predator-trapping programmes, fundraising and educational work with schools and at workshops they've organised themselves. They've volunteered with conservation programmes across Taranaki and as far afield as South Africa, won conservation awards and taken part in high-level environmental forums.

"It's so great to see our Ambassadors realising that they can make a difference, and seizing opportunities and creating their own opportunities to do so," says Ash. "We also see their enthusiasm taking root in their own homes, with their own whānau inspired to become involved in conservation efforts."

Tieke (saddleback).

Taranaki Taku Tūranga - Towards Predator-Free Taranaki

The Council-led Towards Predator-Free Taranaki is a large-scale project aimed at restoring the region's unique wildlife and plants and protecting lifestyles and livelihoods by removing introduced predators. Launched in 2018, the project uses the latest trapping techniques, innovation and technology to help move New Zealand towards its Predator Free 2050 target.

Taranaki has unique advantages because of its relatively compact geography, its regional and national expertise in biodiversity and predator control, and strong community collaboration and enthusiasm at all levels. The region-wide programme builds on the community's successful biodiversity work, including the Self-help Possum Control Programme, Riparian Management Programme and protection of KNEs. Residents, businesses, schools, iwi, environmental and community groups are working alongside Council staff to remove possums, rats and mustelids from urban, rural and public land across the region.

By June 2020, the project's rural programme had deployed 4,091 mustelid traps across 44,473ha of the ring plain, centred around the rural Waiwhakaiho and Te Henui catchments, and within a buffer surrounding the whole of Te Papakura o Taranaki. Monitoring showed up to a 90% reduction in mustelid populations in areas under trapping control. The plan is to roll predator control out across 231,344ha of the ring plain over a 10-year period, expanding the scope of the Self-help Possum Control Programme.

A further initiative has been a partnership between Taranaki Mounga Project, the Council and the Kaitake community, attempting to eradicate possums from the Kaitake Range. This includes pest control within Te Papakura o Taranaki along with around 2,000ha of surrounding private rural land. This work is ongoing, using a variety of methods, with preliminary results indicating eradication is possible and imminent, though further investment will be required.

Aquatic pests

Aquatic pest organisms, such as pest fish, macrophyte weeds, snails and algae, pose a significant and often irreversible threat to freshwater and marine ecosystems. There are small, localised populations of gambuisa in New Plymouth and Waitara urban areas. Rudd and the sports fish perch, a voracious predator of native species, are present in our largest lake, Lake Rotorangi, and a number of other locations. The notable freshwater macrophyte weed hornwort is present at limited sites and is spreading to a small number of new locations, most likely via boats, boat trailers, eel fishing and/or duck shooting decoys and equipment. The coastal pest plant sea spurge was recently found in dunes near Oākura. At Port Taranaki the exotic seaweed undaria has been present for more than 10 years, despite control measures.

Check Clean Dry is a freshwater pest advocacy programme co-funded by MPI and delivered locally by the Council. The programme aims to educate boaties, anglers, paddlers, trampers and other freshwater users to follow the Check, Clean, Dry procedure when moving between waterways. This helps minimise the risk of transfer of exotic freshwater organisms, such as the algae didymo, macrophyte pest plants, pest fish and invertebrate pests such as snails and exotic leeches.

Where we're heading

National direction and policy changes

The Government has indicated changes to national policy and legislation are in progress, with a new National Policy Statement for Indigenous Biodiversity (NPS-IB) in development.

The aim of the proposed NPS-IB is to promote the maintenance and protection of indigenous biodiversity while providing for the social, cultural and economic wellbeing of communities. Councils will need to identify and map areas where there is significant vegetation and habitats of indigenous fauna, and manage the protection of these Significant Natural Areas (SNAs) through plans and consent processes under the RMA.

The proposed NPS-IB places importance on people and partnerships, and on the protection, restoration and enhancement of indigenous biodiversity. It recognises the need to incorporate mātauranga Māori and tikanga Māori, and the importance of recognising and protecting taonga species and ecosystems.

Public consultation on the proposed policy statement took place between November 2019 and January 2020. Following consideration of submissions, the Government is expected to release an exposure draft of the NPS-IB in 2022. It is likely to be accompanied by support measures to ensure iwi/Māori, landowners, councils and other stakeholders are assisted to protect our indigenous biodiversity.

Preparing for new pest incursions

New incursions of pest organisms and expansion of small populations within the region present an ongoing challenge. Pathways analysis, planning, monitoring and management are essential at national, regional and even sub-regional scales going forward, if we are to hold the tide of pest species back.

In May 2017, myrtle rust was detected on mainland New Zealand for the first time and is now widespread across much of the country, including Taranaki. This fungal disease affects myrtle plants including natives such as pōhutukawa, mānuka, and kānuka, and productive species such as feijoa. Shortly after the discovery of myrtle rust *Mycoplasma bovis*, a bacterium that causes health issues in cattle, was detected in New Zealand. MPI's rapid and stringent response confirmed and cleared 270 properties nationally, including one in Taranaki. In April 2022, two properties in Canterbury remained under quarantine control.

There are a few other organisms occasionally observed in the region, such as Argentine ants, rooks and rainbow lorikeets and a few reptile species – plague skinks, eastern water dragons and red-eared slider turtles. No wallabies have yet been identified in Taranaki, nor certain species of feral deer including wapiti, sambar, rusa and white-tail. The illegal release of deer happens on occasion, and DOC has swiftly addressed isolated instances of sika deer release. The community must remain vigilant to minimise the potential for new pest incursions into the region. The Council will continue to monitor and respond accordingly.

Weed Wizard works magic

The Weed Wizard does his best David Bellamy impression among old man's beard.

Our region's very own Weed Wizard has been on a mission to help rid the region of pest plants, using a light-hearted approach to tackle a serious problem.

It all started on a noisy roadside outside Stratford, where Council Environment Officer Mike Beech recorded a spontaneous video about pampas. From there, it evolved into a Weed of the Week and the Weed Wizard – as he was quickly dubbed by his colleagues - was born.

The short videos are shared on the Council's social media platforms and have been viewed and shared by thousands of people. Behind the tongue-in-cheek style is a serious goal - to raise awareness of what different pest plants look like, why it's important to control them and how to remove and dispose of them.

The unscripted videos have seen the Weed Wizard waltzing with woolly nightshade, napping in tradescantia and hunting for pandas among bamboo. The Weed Wizard has also appeared at local markets and was even interviewed on breakfast radio!

The videos have featured plants listed in the Regional Pest Management Plan, such as ragwort, ginger and gunnera. But the Weed Wizard didn't stop at that. There are hundreds of invasive weeds in the National Pest Plant Accord that landowners have no obligation to control, but are nonetheless damaging native ecosystems.

The Council works closely with Weedbusters to educate, raise awareness and inspire people to take responsibility for weeds on their own land. The Weed Wizard has helped with that mission, engaging an audience who may otherwise have been tricky to reach.

Ridding Taranaki of pest plants will be an uphill battle, but every little bit will make a difference for our native biodiversity.

You can view the Weed Wizard videos on the Council's YouTube channel.

Water

Ki uta ki tai. From the mountains to the sea.

The journey of water across land. Winding along rivers and streams, connecting with wetlands, estuaries and groundwater aquifers, eventually meeting the ocean.

In Taranaki, water sustains us in many ways – be it culturally, spiritually, physically or economically. We need it to drink, to grow crops and pasture, to generate power, to do business. We play in it, collect kai from it, honour it. Clean, healthy water supports our ecosystems and is fundamental to the future of our environment.

It’s an exciting time for freshwater management, as national requirements usher in a new way of working alongside iwi and hapū and improved engagement with the wider community.

As we look to the future, we must understand where we are now. This chapter covers the current state of our surface and groundwater, rivers and streams, lakes and wetlands, estuaries, aquatic ecosystems and our coastal environment and looks ahead to what comes next.

Māori freshwater values

Tangata whenua (people of the land) hold an inherited responsibility through whakapapa (genealogical relationships) to ensure the health and wellbeing of their ancestral awa (rivers and streams) and other interconnected aspects of te taiao (the natural environment).

Over centuries of occupation, local iwi and hapū relied on te taiao to provide physical and spiritual sustenance. The awa, ngutuawa (estuaries) and repo (wetlands) provided important areas for mahinga kai (resource gathering practices) and other tikanga (cultural and spiritual practices). Awa, particularly, are a very important source of identity for tangata whenua who maintain an intimate relationship with their ancestral wai (water).

Māori freshwater values and mātauranga Māori (traditional Māori knowledge systems) recognise the interconnectedness and interrelationships of all living and non-living things and have guided the sustainable use of the many resources that the awa of the region have provided to tangata (people) for centuries. This relationship will help to ensure that the health and wellbeing of present and future generations can be sustained in a way that balances the needs of te tangata and te taiao.

A key part of the National Policy Statement for Freshwater Management 2020 (NPS-FM) is to incorporate cultural understandings and mātauranga Māori by empowering tangata whenua to be involved in the management and monitoring of wai māori (freshwater).

Council and **8 iwi authorities** have an agreement to work in **partnership** to support freshwater policy development

Kaupapa Māori approaches for environmental monitoring will **complement** **scientific monitoring techniques**

Empowering **tangata whenua involvement** in monitoring and management of wai māori is a key part of the National Policy Statement for Freshwater

What we know

A range of kaupapa Māori approaches for monitoring and reporting on the health and wellbeing of wai have been developed in Aotearoa, many of which are complementary to scientific monitoring techniques. The tools can be used to account for the state of the environment through a te ao Māori lens and provide knowledge and wisdom for all New Zealanders to improve our understanding of New Zealand's unique freshwater environments.

In the coming months, the Council will work collaboratively with tangata whenua to identify Māori freshwater values and enable the development of monitoring tools that will provide meaningful insight into the health and wellbeing of freshwater.

Mahinga kai

Mahinga kai was elevated to a compulsory value under the NPS-FM. This gives greater recognition to values that Māori hold for freshwater and provides an opportunity for tangata whenua to meaningfully exercise their freshwater interests and obligations.

Mahinga kai is about people, their connections to places including the places where natural resources are obtained, the resources themselves and the principles and values that inform how these resources are harvested and managed. A literal definition of mahinga kai is 'food-gathering place' and includes the cultural practices associated within this context. However, the concept within te ao Māori is much deeper and broader and is more than just fishing or collecting kai. Mahinga kai is inclusive of other natural resources including stones, wood, tools, clay used for dyes, rongoā (medicinal plants), flaxes for weaving, birds and fish that were utilised for a variety of purposes. Mahinga kai is also concerned with sustainability, subsistence, prosperity, upholding the tikanga of past generations and ensuring current and future generations will be physically and spiritually sustained by te taiao.

Other Māori freshwater values

Wai tapu is also identified in the NPS-FM. While this value is not compulsory for inclusion, it must be considered. Wai tapu represent the places where rituals and ceremonies are performed, or where there is special significance to tangata whenua. Rituals and ceremonies include, but are not limited to, tohi (baptism), karakia (prayer), waerea (protective incantation), whakatapu (placing of rāhui), whakanoa (removal of rāhui), and tuku iho (gifting of knowledge and resources to future generations). In providing for this value, the wai tapu are free from human and animal waste, contaminants and excess sediment, with valued features and unique properties of the wai protected. It may also be important there is no artificial mixing of the wai tapu and that identified taonga in the wai are protected.

Tangata whenua may identify other Māori freshwater values and collaborative work will establish how these values can be monitored to enhance our community's understanding of the state of our freshwater ecosystem. This may include wai tapu, tauranga waka (canoe landing places) and other values of importance to tangata whenua.

The Council will work collaboratively with, and enable, tangata whenua to identify any Māori freshwater values and to be actively involved in decision-making processes relating to these values. Tangata whenua will also be actively involved to the extent they wish to be in developing and implementing mātauranga Māori monitoring approaches relating to the identified Māori freshwater values.

What we're doing

The Council is working toward enabling the application of diverse systems of values and knowledge. It recognises that mātauranga Māori has a rightful place alongside scientific methods when it comes to informing our communities about the health and wellbeing of our freshwater ecosystems. Councils are required to work in partnership with tangata whenua to develop monitoring approaches that include measures of mātauranga Māori. This will be particularly important in areas where there are freshwater values that have been identified by tangata whenua, including mahinga kai.

Iwi management plans

An iwi management plan is a document that is developed and approved by hapū and/or iwi. These plans are generally prepared as an expression of rangatiratanga (self-determination) and are written statements by hapū/iwi identifying important issues regarding the use of natural and physical resources in their rohe (tribal area). Iwi management plans provide the opportunity for the Council and the greater community to gain insight into the perspectives of ngā iwi o Taranaki.

The plans provide knowledge and understanding about what is important to iwi and hapū, what 'sustainable management' means from a tangata whenua perspective and how the environment could be managed and respected in a way that is consistent with their tikanga and mātauranga. Among other useful and insightful information, the plans can assist in developing a preliminary understanding of Māori freshwater values and Te Mana o te Wai, which is a central component of the NPS-FM.

The Council is working to build a better understanding of iwi management plans to assist freshwater policy development and to inform consenting processes. This will ensure meaningful consideration is given to tangata whenua objectives, goals and/or aspirations. Improving our understanding of iwi management plans is supplementary to meeting kanohi te kanohi (face to face) as we work to understand issues and aspirations iwi have and how we can work together on behalf of our communities.

A partnership approach

In 2022 the Council and eight iwi authorities put in place a three-year agreement to support freshwater policy development for the region. This agreement ensures the Council and tangata whenua can work in partnership by giving effect to the principles of Te Tiriti o Waitangi (Treaty of Waitangi) to inform an understanding of Te Mana o te Wai, the incorporation and recognition of mātauranga Māori, the identification of Māori freshwater values and to enable tangata whenua to be involved in decision-making processes.

Where we're heading

The Council is developing a new Regional Policy Statement (RPS) and Natural Resources Plan (NRP) for Taranaki that will give effect to the NPS-FM. Te Mana o te Wai is a fundamental concept within the NPS-FM. The Council is working with iwi to understand the meaning and application of this concept from a local perspective.

The NPS-FM outlines a hierarchy of obligations (right) under Te Mana o te Wai that the Council must follow when developing policy. When managing freshwater, the hierarchy prioritises the health and wellbeing of the water to be protected, followed by human health needs. It then accounts for all other uses of the water, which encompasses cultural, social and economic wellbeing. By protecting the health and wellbeing of freshwater, we also protect the health and wellbeing of the people and environment.

The NPS-FM represents a step-change in freshwater management for New Zealand. In addition to reviewing our approach to managing the use of freshwater, we will also work alongside tangata whenua and our community to establish limits on resource use to ensure that water quality is maintained, or enhanced where it is degraded.

Ngāti Mutunga and the Mauri Compass

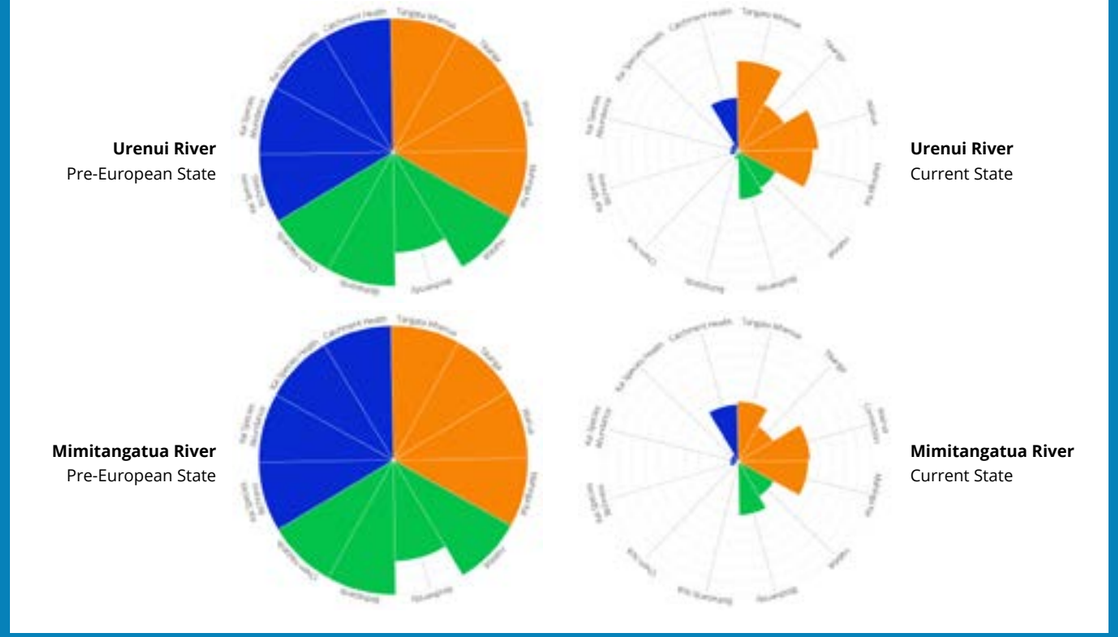
Ngāti Mutunga had been looking for a monitoring tool to assist them in fulfilling their kaitiaki responsibilities and enable them to play a proactive role in environmental management. This was particularly around the priority area of freshwater governance.

Ngāti Mutunga Environmental Officer Marlene Benson says that at times the iwi had been unable to participate effectively in the Resource Management Act process because of a lack of useful data about taonga species. There was also no recognised tool to monitor the effect of consented activities on the mauri (life force) of its awa. They chose the Mauri Compass, developed by Ian Ruru of Te Rūnanga o Turanganui a Kiwa and the Gisborne District Council, because they felt it had a good balance of mātauranga Māori and science data collection.

They like that it:

- Is by Māori for Māori
- Is holistic and inclusive -acknowledges te ira tangata (the human element) as part of our ecosystem
- Includes and prioritises Māori values and tikanga
- Provides an avenue for whanau/iwi to connect with ancestral lands through participation
- Provides measurable and comparable outcomes for use in a colonial system
- Has been implemented and influential within other iwi/ council bodies

With the support of Te Ohu Kaimoana and Te Wai Māori Trust, Ngāti Mutunga engaged the services of Ian Ruru and his sons Manawa and Riaki to apply the Mauri Compass tool to assess the historical and current state of mauri on two of the Ngāti Mutunga tupuna awa - Urenui and Mimitangiatua.



The Compass uses 12 indicators of a waterbody across three key areas: Te Ao Maori, Nga Tini a Tangaroa and Te Ao Taiao and involves both wānanga (space of learning) and fieldwork.

During the wānanga sessions topics discussed by tangata whenua included historic practices and kōrero tuku iho (information passed down) including mahinga kai, ceremonies, wāhi kainga (place of dwelling), and wāhi tapu (sacred place) sites, taniwha (supernatural guardian) and tauranga waka (canoe landing place, safe anchorage).

Ngāti Mutunga carried out the original taonga species survey in 2020 on four sites on each awa with the focus on tuna. As predicted, they found the mauri of both awa had declined since European settlement.

“Three of the 12 Mauri Compass indicators focus on the health and wellbeing of our freshwater sentinel taonga, the tuna. Species richness, tuna abundance and tuna health had each fallen 80%, which is a talisman for the decline in Ngāti Mutunga connection, tikanga, mahinga kai practices, and overall wairua of our tupuna awa,” Mrs Benson says.

“While a bit depressing, the assessment provided a tangible and visual reminder of the work that we have to do immediately, before it’s too late.”

She says Ngāti Mutunga whānau aged from 2 to 70-plus had been involved with the process.

“It will be easy to engage the wider Ngāti Mutunga whānau during any future mahi we do. This will increase everyone’s skills in the collection of scientific data while recognising and affirming the cultural knowledge, expertise, and experience of Ngāti Mutunga whānau participating in this work.
“It also helps to reconnect us and strengthen our relationships as tangata whenua to our whenua, our awa and ngā mātua tupuna (ancestors before us). We believe this to be important in enhancing and maintaining the mauri of the environment and the health and wellbeing of our people.”

Since the original survey Ngāti Mutunga has used the Mauri Compass to monitor resource consents at the Urenui and Onaero Campgrounds and to inform Cultural Impact Statements provided to the New Plymouth District Council.

Surface water quantity

In Taranaki water is taken from our rivers for a range of purposes, including public supply, hydroelectric power generation and industrial manufacturing and processing. The Council's role is to ensure the water we use provides for the needs of both freshwater ecosystems and people.

Data from our river flow monitoring network helps us understand how river flows change in response to natural stream processes, changes in climate and water use. This enables us to assess the likely impacts of current and future water takes on our waterways and the environmental, social and cultural values they support. To protect these values, we set limits on how much water can be taken from rivers, streams and lakes, and the rate at which it can be abstracted. We manage the use of water through policies, regional rules and resource consents issued to water users.

The Council monitors river flows and levels at 41 locations across the region, with an additional three sites monitored and maintained by NIWA. We also monitor water usage to ensure water use is managed in line with the requirements of each resource consent.

This section provides an overview of the current state of surface water and the changes in the amount of water allocated for use in the region.

River flow and levels **monitored at**

44 locations

116 surface water take consents

as at 1 July 2020

96% of consented surface water is used for **hydro-electric generation**

Water demand has increased **3%** since 2013

What we know

River flows

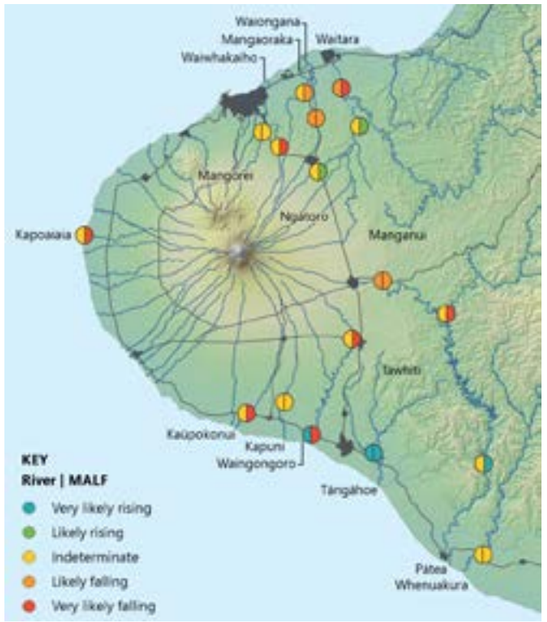
For water management purposes we describe river flows using statistics known as the mean flow and the mean annual low flow (MALF). Mean annual low flow is the minimum flow recorded each year, averaged across the entire data record for a site, and generally the minimum flow needed to maintain a catchment's natural character and ecosystem health. It helps us set minimum flow thresholds for rivers and streams, the point at which consent holders need to reduce or cease taking water to protect the health of the waterway.

Low river flow conditions often occur in summer during prolonged periods of dry weather or drought. The annual mean flow of monitored rivers indicates how their flow might be changing over time. Being an annual average, the mean flow statistic incorporates the full range of flows experienced at a site over the course of a year. This accounts for flow variability across seasons, including low flows and floods.

Of the 41 sites where we monitor river flows, 17 have been monitored for at least 20 years. Data from these sites have been used to identify any trends in river flow and MALF over time. There was no clear evidence of a trend in mean river flow at 12 of the 17 monitored sites (71%). Two sites showed an increase in flow over time (12%), while flows were reducing at a further three sites (18%). Ten sites (59%) have seen reductions in their MALF over time (i.e. lower low flows), while four sites (24%) show an increase (i.e. higher low flows). While the drivers of these changes are uncertain, a mixture of land and stream modification, water use and a changing climate are all potential factors.

Water use

In Taranaki, the use of small amounts of freshwater for domestic purposes or stock or dairy farm use is generally permitted under the Regional Freshwater Plan (RFP). In most catchments, a resource consent is not required if water take is taken at a rate of less than 1.5L/s, is less than 25% of the total stream flow and the volume does not exceed 50 cubic metres a day. There are however, exceptions in particular catchments, so it pays to check with the Council in advance if unsure of the rules.



Trends in river flow and mean annual low flow (MALF) at sites with 20 years or more of flow data available.

To take water for any other purpose and/or at greater volumes, a resource consent is required. In most cases these consents will have a set minimum flow limit, at which point the take must reduce or cease to ensure that ecosystem health is protected. There are some exceptions to this for specific activities, like providing water for stock drinking purposes or for firefighting.

As of 1 July 2020, there were 116 resource consents issued for water takes, allowing up to 502,478m³ of water to be taken per day. Demand for water has not changed significantly in the past decade, increasing just 3% from 2013 when the total allocated volume was 489,104 m³ per day. This increasing demand has mainly been for water from smaller catchments and predominantly for pasture irrigation.

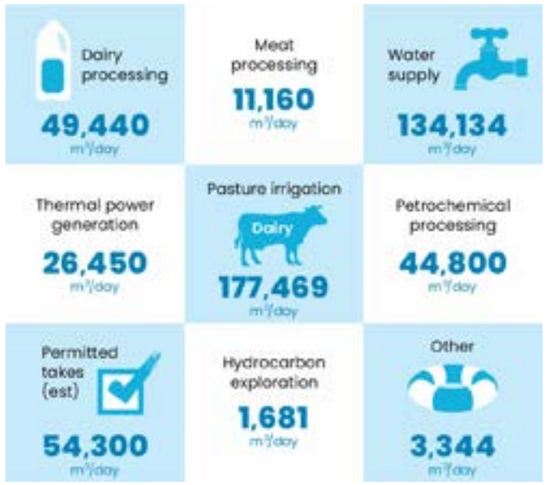
YEAR	1999	2003	2008	2013	2020
VOLUME (1000)	321	442	474	489	502

The amount of water allocated for consumptive uses in Taranaki.

Total surface water allocation, including hydroelectric schemes, is 11,694,698m³ per day. Approximately 96% of this is used for hydroelectric power generation and is considered non-consumptive, as the water is returned at or near the point of abstraction. The remaining 4% of allocated surface water is used for consumptive purposes.

When water taken for hydroelectric generation purposes is excluded, pasture irrigation accounts for 35% of all consented surface water use, while public water supply accounts for 27%. Dairy and meat processing combined account for 12%, while hydrocarbon exploration and petrochemical processing account for 9%. Other uses such as horticulture, swimming pools and quarries make up the remaining 6%.

It is estimated that 54,300m³ (11%) of water is taken per day for permitted activities, which do not require a resource consent under the RFP. This is primarily used for domestic and farm water supply.



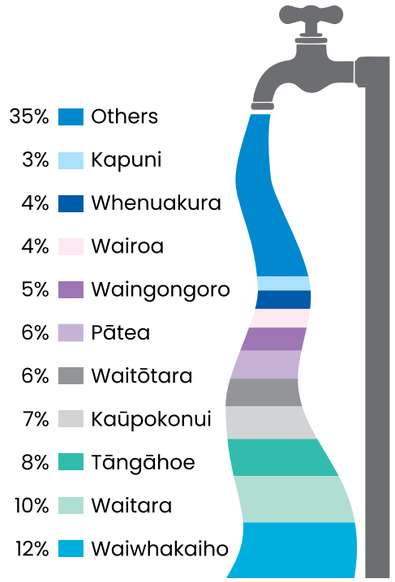
The amount of water allocated by various activity types in Taranaki, as at 2020.

Allocation by catchment

There are 217 river catchments in Taranaki, including 31 originating within Te Papakura o Taranaki. As of June 2020, consents to take water were issued in 46 catchments across Taranaki, with the largest volumes in the Waiwhakaiho, Waitara, Tāngāhoe, Kaūpokonui, Waitōtara and Pātea Rivers. These six catchments provide 49% of all the surface water consented for consumptive use.

Since 2008, the number of catchments where more than 20% of MALF has been allocated for use has dropped from 31 to 20, and the number where more than 30% of MALF has been allocated has dropped from 19 to 13.

To assess the pressure on rivers and streams as the result of water use, the amount of water allocated for use is compared with the median and the MALF. Overall, only 5% of total median flow has been allocated for use in Taranaki, up slightly from 4.8% in 2015. The proportion of water allocated is higher when compared to MALF, but even then, allocation is still low at only 15%.



The amount of water allocated by river catchment as a proportion of the total amount allocated across the region, as of 2020.

What we're doing

The Council has developed compliance programmes for all water take consents. These generally include regular inspections along with the collection of data to ensure compliance with consent conditions. Additional flow monitoring sites are installed, when required, to assess low flow consent conditions; such as those requiring consent holders to reduce or cease taking water. If a consent holder is found to be in breach of their consent conditions, enforcement action will likely occur and may even require the consent holder to cease their activities until they can comply completely with all consent conditions. If they fail to do so, further enforcement action would follow. Fortunately, the need to pursue enforcement actions relating to breaches of water take consents is rare. Over the 2020-2021 year, 97% of water users achieved either a 'high' or 'good' rating for consent compliance and environmental performance through their compliance monitoring programmes.

Where we're heading

Developing limits

To give effect to new requirements under the National Policy Statement for Freshwater Management 2020 (NPS-FM), the Council must develop environmental flow limits in consultation with our community. These include limits placed on how much water can be taken from rivers, streams and lakes, and the flow at which these takes must cease (the minimum flow). These limits will need to provide for the freshwater values identified by the community and place the health and wellbeing of freshwater first – before meeting the needs of people.

We'll also consider how we manage catchments where the amount of water currently allocated for use exceeds these revised limits and how we make sure water is being used in the most efficient manner possible. Any new water take consents issued by the Council are now also required to include environmental flow limits, regardless of the activity. The Council will be in discussion with water users, stakeholders, iwi/hapū and the wider community as we work together to design this new management approach.

Understanding the future impacts of climate change

Under the NPS-FM, the Council must also consider the effects of climate change on freshwater, and ensure this is factored into our new policy and planning framework, including limit setting.

The Council recently commissioned a report by NIWA to assess climate change projections for Taranaki to the end of this century. Findings suggest that mean annual river flows will remain largely unchanged to mid-century (2036-2056), and with a slight increase for some coastal areas, particularly in the north and west by late century (2086-2099). The remainder of the region is expected to remain the same.

The report suggests that by mid and late-century we may experience decreases in MALF by up to 50% throughout much of the region. The exception is southern parts of South Taranaki, where a smaller increase of 5-10% is projected. This would mean that, particularly during summer, water users are likely to experience more frequent and extended periods where water takes need to be reduced or ceased.

Measuring environmental flows

Regulations for the Measurement and Reporting of Water Takes (amended 2020) require that all water takes greater than five litres per second record measurements of the amount of water taken at 15 minute intervals and provide that data electronically to the Council by the end of the next day. These requirements will be phased in incrementally through to 3 September 2026. For takes over 20 litres, these requirements must be met by 3 September 2022.

The Council has contacted all water take consent holders to advise them of these requirements and where they can access support to ensure they comply. Council officers are also available to answer questions and provide advice as required.

Groundwater quantity

Rainfall or river water that seeps from soils into the pore spaces between fractures of solid rock or sediments, like sand or gravel, is known as groundwater. Groundwater is the largest source of accessible freshwater in the world, accounting for around 98% of freshwater available for use on Earth. While groundwater is generally hidden beneath the land surface, many of the region's springs, rivers and lakes are sustained by groundwater flow, particularly during summer when there is little rainfall.

Because of our climate and geology, huge volumes of water are hidden below the ground in Aotearoa. Geological formations that hold or allow the flow of groundwater are called aquifers. The amount of water within each aquifer depends not only on how large the geological formation is, but also how much space is available between individual grains within that formation. Generally, sands and gravels are more permeable and allow water to flow more freely, whereas silt and clay layers inhibit groundwater flow.

In Taranaki, there are 12 main underground groundwater systems, or aquifers; each one named for the geological formation it is contained within. The region's largest groundwater aquifer, found within the Taranaki Volcanic formation, covers a large part of the region. The volume of water available for use each year within this aquifer alone is equivalent to almost nine times the amount of water in Lake Taupō.

To protect these valuable resources the Council undertakes a groundwater quantity monitoring programme. This monitors the amount of groundwater people are presently allowed to take (the allocation) to ensure it does not exceed what the aquifers can sustainably maintain. We also monitor groundwater levels at a number of sites to assess the status of the resource and track any changes in groundwater levels over time.

73 ✓
Groundwater consents
which account for **2%** of available groundwater

12 **groundwater aquifers**
the largest having almost **9 times** the volume of water in **Lake Taupo**

Demand for groundwater
has not changed significantly since **2015**

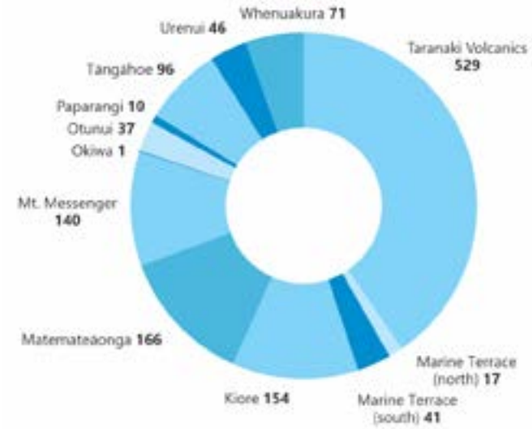
Groundwater levels
in monitored bores have not changed significantly since monitoring began

What we know

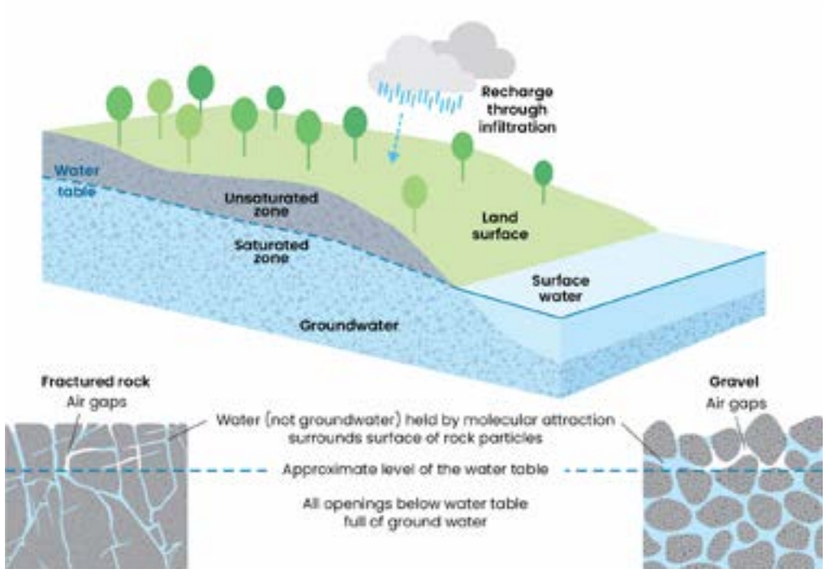
Groundwater allocation

The amount of groundwater allocated across the region is very low, with only small increases in demand over the last 10 years. As of 30 June 2020, there were 73 consents authorising groundwater use, up from 51 in 2013 (+43%). The total volume of groundwater allocated by these consents is equivalent to just over 2% of the region's total estimated sustainable yield.

Groundwater is generally used in rural areas where other water sources are not easily accessed. These are often properties that require more water than can be collected using a rainfall roof supply, or do not have access to a municipal supply scheme, stream or river. The volume required by each consent holder generally depends on its intended use. Uses include private households and farms, industrial facilities and town supplies. While there is plentiful groundwater in Taranaki, our aquifers generally do not release water easily, making it challenging to source groundwater, particularly for high demand uses such as irrigation or public supply. Groundwater quality can also limit its usability in some instances.

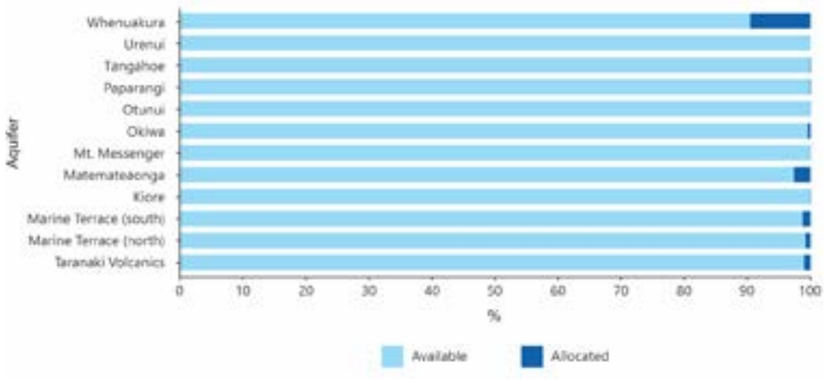


Estimated sustainable yields (1,000 GL/yr) for each of the region's groundwater aquifers.

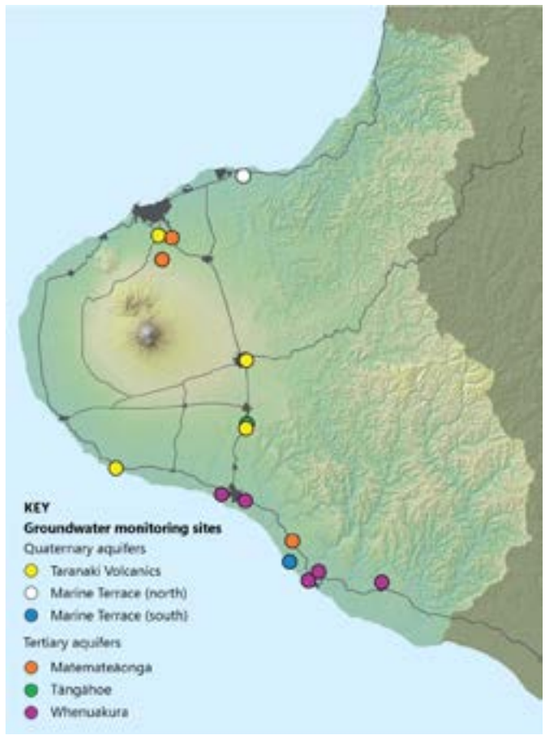


A simplified representation of a groundwater system. A proportion of rainfall infiltrates the land surface and 'recharges' groundwater aquifers. Water then moves downward to a depth where all spaces between individual grains are filled with water, a level otherwise referred to as the 'water table'. Groundwater then moves by gravity toward a discharge point, which could be a spring, a river, lake or the coast.

The highest level of allocation is in the Whenuakura aquifer, which has around 11% of its sustainable yield allocated, followed by the Matemateaonga aquifer at 3%. All other aquifer allocations combined make up less than 1% of the region's available groundwater.



Proportion of available groundwater currently allocated for use in each of the region's groundwater aquifers.



Groundwater level monitoring and the aquifers monitored at each location.

Groundwater levels

The Council monitors groundwater levels at 15 sites across the region. These measurements are collected continuously to protect aquifers from over-use. The majority of sites have data records spanning 10 to 37 years.

The information is analysed to assess whether there have been any effects on the aquifer from groundwater use. For example, if the water level in an aquifer has fallen over a sustained period of several years this may show that the current groundwater use is no longer sustainable.

From 2015 to 2020, water levels rose and fell in response to local rainfall patterns. The range of change in water levels varied considerably by site, from a few millimetres up to several metres. Over the longer term, some sites also showed a small continuous fall or rise in groundwater level. None of these changes was considered significant enough to affect the sustainability of the aquifer and could be linked to either localised groundwater use or longer-term rainfall patterns.

What we're doing

Working as one

Regional councils are increasingly working together to both guide and respond to national direction. We work through our network of special interest groups to develop strategy, guide scientific research and data initiatives. The regional sector's Groundwater Forum recently developed a research strategy to help guide future groundwater research. During the last few years, we have also been working towards the development of a national wells database. The aim is that the database will eventually contain information about all known groundwater wells across the motu, and that this information will be publicly available.

We are also working together to find effective ways to meet new national regulations around groundwater allocation, and regularly contribute information to the website LAWA (Land, Air, Water Aotearoa), designed to help connect the public to New Zealand's environment by sharing scientific data.

Where we're heading

Future proofing groundwater allocation

With low demand for groundwater in Taranaki, none of the region's aquifers is presently under significant pressure. While there may be an increase in demand as people look to move away from less secure surface water sources, it is not expected to place groundwater under significant pressure in the short to medium term.

That said, there remains potential for localised pressures to arise where there are multiple groundwater users in a specific area. These demand pressures are a primary consideration when assessing any resource consent applications for a groundwater take. Likewise, the conditions for a groundwater take to be considered a permitted activity under our regional rules are intended to minimise the potential for these effects to arise.

Planning ahead ensures that we are prepared for any change in water use demand should it occur. Work is under way to refine the estimates of the amount of groundwater available both at a regional and national level and what impacts, if any, are likely to be seen in the future due to climate change. The development of a new Regional Policy Statement and Natural Resources Plan for Taranaki is under way. With significant changes in requirements for freshwater management, there will be amendments to policies, rules and limits relating to water allocation, including groundwater.

Groundwater quality

Minerals, salts and contaminants can easily be dissolved into, and transported by, water. Aquifers close to the earth's surface are more at risk of contamination from land use activities given the shorter, or more direct pathways to them. Deeper aquifers, or those separated from the earth's surface by geological material that restrict the flow of water (an aquitard), are at less risk from surface contamination. The quality of groundwater can also be adversely impacted by rocks and sediments in the aquifer through which it flows.

The Council has routinely monitored groundwater quality since 1994. We do this to gain a better understanding of how groundwater quality varies across the region and to assess how its quality is changing over time. We examine how our groundwater resources are affected by land use activities and how suitable groundwater is for various uses (such as drinking water). Because groundwater provides a pathway from land to surface water, we also assess the risk groundwater may pose to the health of sensitive environments such as streams, lakes and estuaries.

Our current monitoring network includes 32 wells and bores. They are sampled every three months and analysed for a number of physical and chemical indicators of water quality. We compare the results against accepted levels for environmental or human health, including attribute limits set out in the National Policy Statement for Freshwater Management 2020 (NPS-FM) and the Drinking-water Standards for New Zealand 2018 (DWSNZ).

Water chemistry tested quarterly at

32

bores and wells

Elevated levels

of ammoniacal nitrogen, iron and manganese **occur naturally** in regional aquifers

Tests results show that **pesticides** and **heavy metals** are generally not an issue in our groundwater

Median **nitrate nitrogen concentrations** in

97%

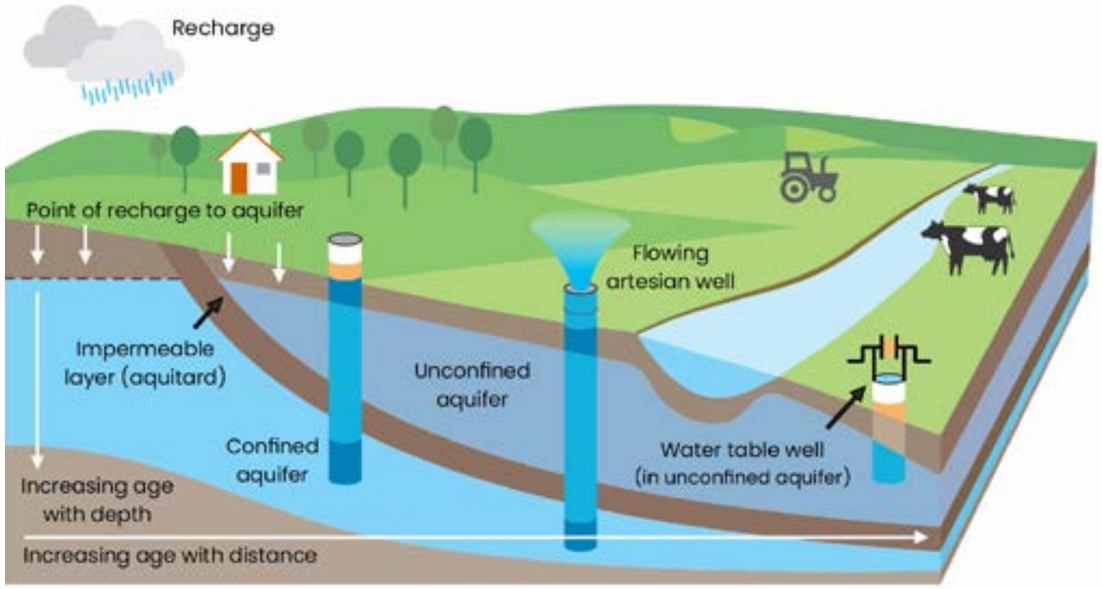
of groundwater bores were within accepted standards for drinking water in NZ

What we know

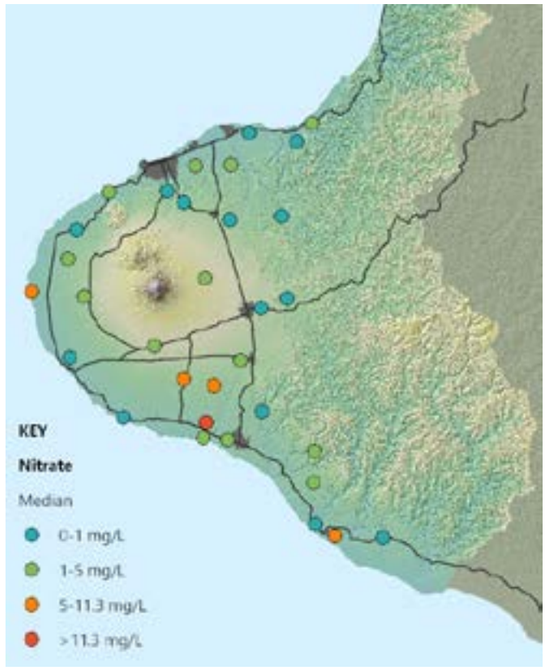
Council monitoring over the last five years shows indicators like *Escherichia coli* bacteria (*E. coli*), nitrate nitrogen (nitrate), ammoniacal nitrogen (ammonia), iron and manganese are occasionally found at levels considered unsafe for humans or stock to drink, or at levels that can make the water look or taste unpleasant. Acceptable levels are set out in the DWSNZ for a range of human health indicators.

People using private groundwater supplies are most at risk of drinking groundwater with *E. coli* bacteria and elevated levels of nitrate. Overall, median nitrate and *E. coli* bacteria levels in Taranaki groundwater are comparable to other regions where intensive agriculture is the predominant land use. Human activities and animal and industry wastewater discharged to land locally are both common sources of bacteria and nitrate. Poorly constructed wells and bores, or those that are not adequately isolated from direct sources of contamination, or surface run-off, are more likely to display elevated levels of *E.coli*.

At certain concentrations, nitrate can pose a health risk to babies and breastfeeding people. There is some discussion in the science community around whether a more stringent maximum acceptable value (MAV) should be set to protect our health, although there is not yet a strong consensus in New Zealand as to whether the science supports more stringent limits on nitrate levels in groundwater. In Taranaki, there was only one site where levels of nitrate exceeded the MAV for drinking water (11.3mg/L). At 27 of 32 sites (84%) the median nitrate concentrations were less than half of this limit.



An overview of aquifer types, recharge mechanisms, groundwater flow paths and residence times. In the unconfined aquifer, groundwater is pumped to the earth's surface. However, pressure in the confined aquifer can cause groundwater to flow to the surface without the use of a pump (flowing artesian well). Shallow, unconfined aquifers are more at risk from landuse impacts than deper, confined aquifers. (Source: modified from Environment Canada).



Median nitrate concentrations (as NO_3-N) at monitored groundwater sites in Taranaki (2015-2020). The safe drinking water limit for nitrate in New Zealand is 11.3mg/L.

The presence of *E. coli* is used as an indicator of the potential presence of pathogens that can make us sick. Monitoring during 2015 to 2020 showed that *E. coli* were detected on at least one occasion at 21 of the 25 (84%) sites located in aquifers most at risk from *E. coli* contamination. This highlights the importance of the proper construction of bores and treating groundwater prior to using it for household drinking water.

The presence of iron, manganese and ammonia in groundwater is mostly due to the local geology and natural processes that occur in aquifers with low levels of oxygen. The concentration of these contaminants in water at some locations can cause the staining of plumbing fixtures, clogging of pipes or result in the taste or look of groundwater being unpleasant, making it unsuitable for certain uses. Iron concentrations are a particularly common challenge for those utilising groundwater supplies in Taranaki.

Between 2015 and 2020, 12 of 32 monitored sites (38%) had concentrations of iron and/or manganese exceeding an aesthetic or heath-related standard set out in the DWSNZ. A further three sites (9%) had exceedances of the aesthetic standard for ammonia.

Test results show that pesticides and heavy metals are generally not an issue in our groundwater, although there have been isolated instances where contamination by chemical substances and herbicides/fungicides has been detected.

There was sufficient data available to assess trends in groundwater quality at 10 of the 32 sites monitored. In most cases, individual water quality indicators have shown little change over the last 10 years, or are changing at an insignificant rate. Meaningful changes were detected in only three bores, with levels of nitrate considerably improving in one bore and deteriorating in two others.

What we're doing

Protect yourself and your whanau

Where Council monitoring identifies a groundwater quality issue, the owner of that particular site is advised and directed to further information and/or support. Where the issue is significant, further investigations are carried out to establish potential sources of contamination and the appropriate remedial actions.

It is important to test a bore or well to ensure it is suitable for its intended use, particularly for drinking water supplies. There are also practical ways to reduce the risk of contamination of water supply, such as ensuring a well is covered and sealed from the ground surface, and keeping it securely fenced from stock. New bores should be installed to best practice construction standards, and older infrastructure maintained to address deterioration over time. Other measures include:

- Fixing leaking taps or pipes
- Keeping septic tanks and offal holes above the water table and well away from water abstraction points and streams
- Storing hazardous substances under cover, and on a sealed pad above ground
- Correctly using pesticides and fertiliser to prevent leaching
- Disposing of waste to appropriate recycling or landfill facilities
- Spreading effluent onto land at a rate soil and plants can absorb
- Not taking more water than is needed
- Telling the Council about bore locations

Where we're heading

The Council is reviewing its regional policy and plans to incorporate new guidance and thresholds for freshwater quality and health. Monitoring of groundwater quality in Taranaki may also need to change to help the Council meet rules in the new policy and plans, especially where relationships between groundwater and surface water may exist.

Monitoring shows that nitrate and ammonia are sometimes present at levels that could adversely affect receiving environments such as groundwater-fed lakes and streams. Groundwater rich in nitrate or ammonia can potentially affect the health of fish and insects in waterways connected to groundwater. More research is needed to find out where these connections may exist in Taranaki and the significance of any impacts from groundwater nutrient contributions in surface water systems.

Drinking water source protection

The security of New Zealand's drinking water has been a significant focus for resource managers since the outbreak of campylobacter in the Havelock North drinking water supply in 2016. The subsequent inquiry highlighted a number of areas for improvement in the management of public water supplies throughout New Zealand.

The Government recently consulted on a suite of proposed changes to the National Environmental Standards for Sources of Human Drinking Water (NES-DW) with a view to making drinking water safer. Proposed changes include:

- Standardising the way we define source water areas;
- Strengthening regulation of activities around water sources; and
- Including more water suppliers under the NES-DW.

The Council works in partnership with our region's district councils and Taranaki District Health Board to ensure our communities have safe and secure drinking water. In the coming months we will be working collectively to respond to any changes and new regulation, and provide advice and guidance to water suppliers on what these changes mean for us. This is likely to include reassessing source protection areas for drinking water supplies, and identifying activities within those areas that may pose a risk to each supply.

River water quality

Our rivers are a jewel in our natural environment. To Māori, they are a taonga. The water they carry is essential for the plants, insects and fish who call them home, and they are an important resource for the people of our region. Rivers are also highly valued for recreational uses, such as swimming, fishing and other water sports.

How well our rivers provide for the wide range of values they support is dictated by the quality of water within them, and the health of their ecosystems. A variety of natural and human factors can affect freshwater systems. Our use of land, stormwater run-off, industrial and wastewater discharges can contribute contaminants to our waterways, including excess nutrients, sediment and bacteria. The activities within a catchment can interact and have compounding or cumulative effects on downstream receiving environments such as lakes and estuaries. Understanding the significance of each contributing factor and how they interact is complicated, especially in a dynamic and uncertain environment impacted by factors such as climate change.

The Council measures water quality in the region's rivers and streams to assess whether water is suitable for use for various purposes, and to better understand the effects of different pressures, such as climate, land use, industrial activities and urban and rural wastewater discharges. This section provides an overview of the current state of key indicators of river water quality: nutrients, sediment and bacteria.

80%
of monitored sites in
'A Band'
for nitrate and ammonia toxicity

15
water quality
monitoring locations

E. coli concentrations have
increased at
70%
of monitored sites
over the last 10 years

½
of all monitored sites were in
'A Band'
for visual clarity

What we know

The water quality of Taranaki rivers has been monitored since 1995. Two additional sites were added in 2015 to better represent the eastern hill country which, together with two national sites run by NIWA since 1989, brought the total number of sites monitored in the region to 15. At these sites, up to 22 physical, chemical and bacteriological indicators are sampled every month.

Results are compared against attribute criteria set out in the National Objectives Framework (NOF) of the National Policy Statement for Freshwater Management 2020 (NPS-FM). In this section we report on some of the main indicators of freshwater quality: nutrients and sediment, both key drivers of ecosystem health; and bacteria (*E. coli*), a measure of the suitability of rivers for human contact. For most attributes, the NOF sets 'national bottom lines' which represent the minimum requirement for water quality state that must be achieved.

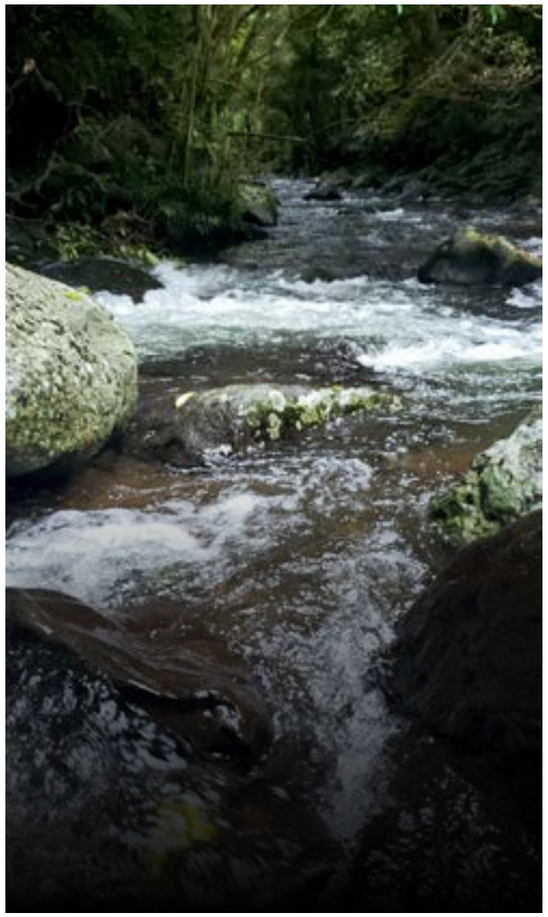
Changes in these attributes (trends) are determined over the long term (25 years) and short term (10 years), with trends adjusted for river flow.

Nitrogen (nitrate and ammonia)

Nutrients are essential for the growth of aquatic plants, which are an important food source for many small invertebrates and fish. The main nutrients in waterways are inorganic forms of nitrogen and phosphorus. Only small amounts of each are required in a natural ecosystem; too much can cause excessive algae and plant growth. This may lead to adverse effects on oxygen and pH levels, water clarity and biodiversity. Nitrogen can be present in water in a number of forms (nitrate, nitrite, ammonia and organic nitrogen). In rivers and lakes, too much nitrogen can lead to excessive growth of aquatic plants or algae. At high concentrations, nitrate and ammonia can be toxic for fish.

The NOF attributes for nitrate and ammonia nitrogen national bottom lines are intended to protect against toxic impacts on sensitive instream species. In addition, the NOF requires councils to set limits on nutrient concentrations in water to protect ecosystem health, and to meet limits for other attributes that may by impacted by nutrients, such as the growth of algae (periphyton). These limits are likely to be much lower than those required to avoid toxicity effects.

For ammonia (toxicity), the NOF defines band A (no or little observed effect on any species) through D (approaching acute impact on sensitive species) for two measures: an annual median and annual maximum. The minimum standard, or national bottom line, is set between bands B and C and represents the difference between an occasional impact on 5% of species (band B) and a regular impact on 20% of the most sensitive species.

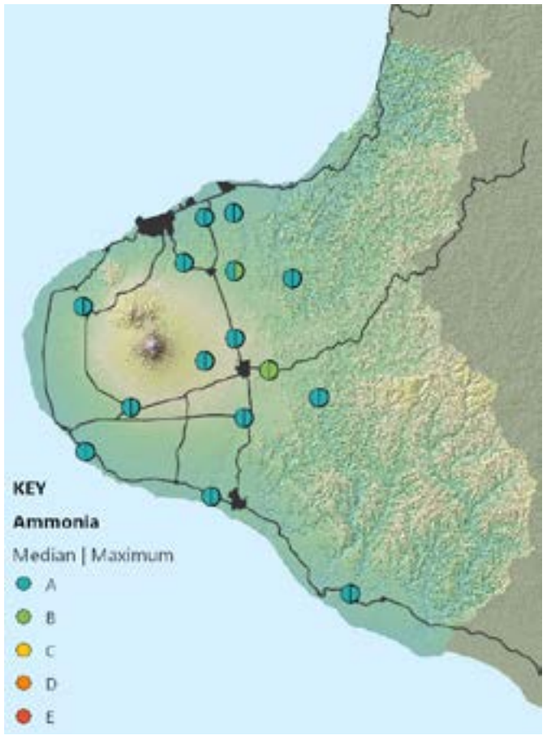


Attribute band and description	Numeric attribute state (as milligrams of ammoniacal-nitrogen per litre)	
	Annual median	**Annual maximum**
A - 99% species protection level: No observed effect on any species tested	≤0.03	≤0.05
B - 95% species protection level: Starts impacting occasionally on the 5% most sensitive species	>0.03 and ≤0.24	>0.05 and ≤0.40
National bottom line	0.24	0.40
C - 80% species protection level: Starts impacting regularly on the 20% most sensitive species (reduced survival of most sensitive species)	>0.24 and ≤1.30	>0.40 and ≤2.20
D - Starts approaching acute impact level (that is, risk of death) for sensitive species	>1.30	>2.20

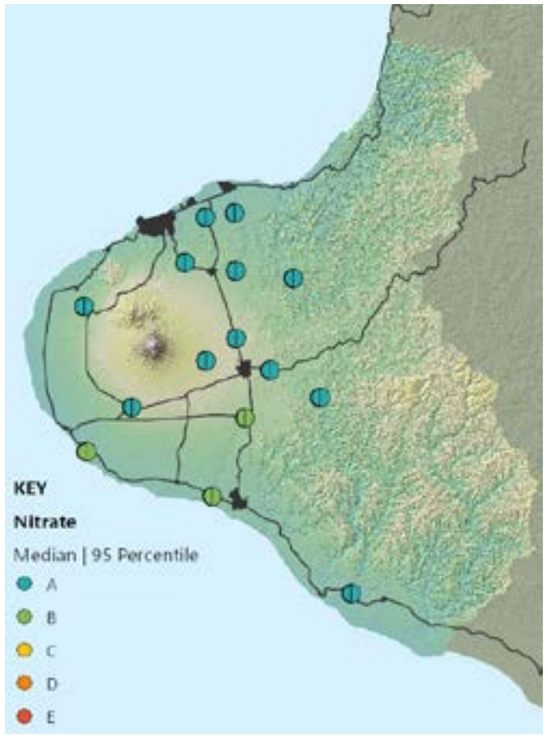
The NOF attribute table for ammonia (as NH_4-N) sets out the criteria for bands A through D for ammonia concentrations as a measure of toxicity in rivers and streams. The national bottom line is set below band B.

For ammonia, all Taranaki sites achieved the national bottom lines, with 14 of 15 sites achieving band A for annual median and 12 sites achieving band A for annual 95th percentile measures. The site in band B for both measures is impacted by discharges from the Stratford oxidation ponds.

Nitrate (toxicity) attribute bands range from band A (no or little effect on sensitive species) through to band D (impacts on growth of multiple species and approaching acute impact level for sensitive species at higher concentrations). The national bottom line sits between bands B and C. For nitrate, all 15 sites monitored in Taranaki achieved national bottom lines, with all but three falling in band A for both the annual median and 95th percentile measures. The sites in band B were in mid and lower parts of southern ring plain catchments, which are areas of more intensive pastoral agriculture.



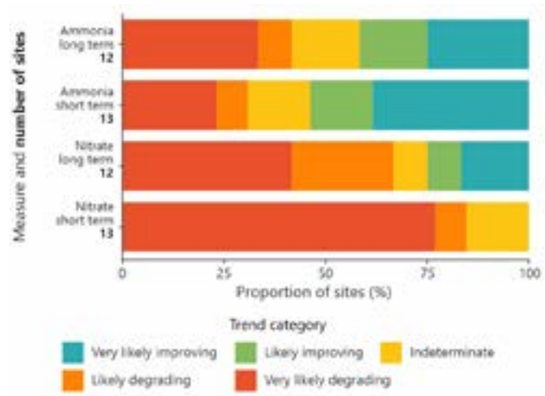
The current state of ammonia (toxicity) at monitored sites, as assessed against the NOF for both median and maximum measures.



The current state of nitrate (toxicity) at monitored sites, as assessed against the NOF for both median and 95th percentile measures.

The long-term trend for nitrate (toxicity) shows three of 12 sites improving (25%) and eight sites degrading (67%). The short-term trend shows no sites improving and 11 sites degrading (85%).

The long-term trend for ammonia (toxicity) shows five of 12 sites improving (42%) and the same number degrading. The short-term trend shows seven of 13 sites improving (54%) and four sites degrading (31%). The improvements occurred in mid and lower catchment sites, mainly on the ring plain. Deterioration occurred mainly in upper catchment sites, albeit at relatively low concentrations.



Summary of trends in nitrate and ammonia concentrations across monitored sites, over both short-term (10 year) and long-term (25 year) periods.

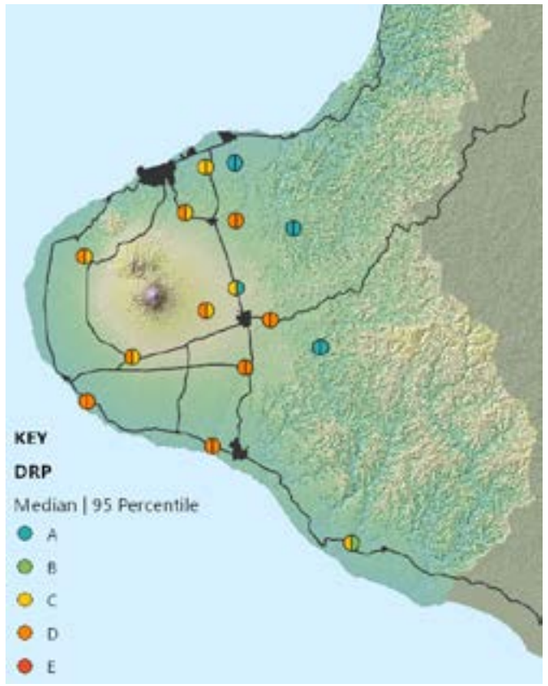
Phosphorus (dissolved reactive phosphorus)

Like nitrogen, phosphorus can be present in water in different forms, and is an essential nutrient for instream plant life. Most phosphorus enters rivers attached to sediment. In its dissolved form (dissolved reactive phosphorus) it is more readily available for plants and in certain conditions can lead to excessive growth of plants and algae. Phosphorus is naturally elevated in our region's soils due to the volcanic geology however fertiliser application along with the discharge of domestic and animal waste also contribute to elevated levels of phosphorus in Taranaki streams and rivers.

The NOF describes the state of dissolved reactive phosphorus (DRP), for both median and 95th percentile concentrations. There is no national bottom line for DRP, but limits must be set to achieve water quality objectives.

Monitoring results for the five years to 2020 show a strong spatial variation in the state of DRP regionally. This reflects the variation in geology between sites on the volcanic ring plain and those catchments sourced from the sedimentary hill country. All sites on the ring plain have median DRP concentrations within bands C or D, where ecological communities are expected to be impacted in streams where

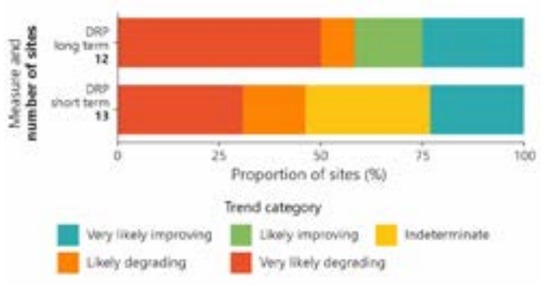
other conditions favour excessive algal growth and primary production. Most sites within hill country catchments fell within band A, where ecological communities are expected to be similar to natural reference conditions. One hill country site on the Whenuakura River however, was affected by a major erosion event in June 2015 and falls within band C.



The state of phosphorus at monitored sites, as assessed against the NOF dissolved reactive phosphorus (DRP) attribute.

Long-term trend analysis shows five of 12 sites improving (42%) and seven degrading (58%). While still uncertain, erosion control efforts in the hill country and removal or upgrading of major point source discharges on the ring plain (at Eltham and Stratford) may be contributing to reductions in DRP concentration over time.

Short-term trends show three of 13 sites (23%) improving and six degrading (46%). The degrading trends are largely found in upper and mid catchment locations on the northern (Mangaoraka and Waiwhakaiho) and eastern slopes of the ring plain (Maketawa and Pātea). Further investigation is required to determine the drivers of this degradation and the potential role of natural sources of phosphorus within the wider region.



Trends for DRP concentrations over both short (10 year) and long-term (25 year) time periods.

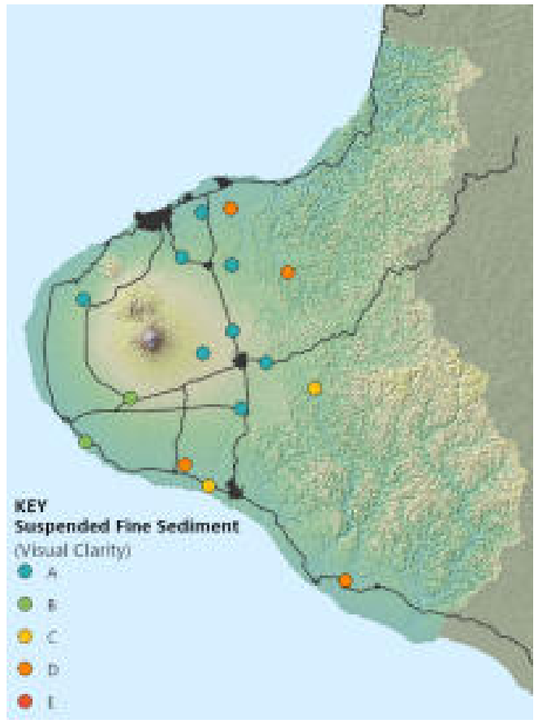
Sediment

Erosion-prone land is managed to protect and conserve soils and to reduce the loss of sediment to rivers, lakes and estuaries, which can adversely affect freshwater and coastal ecosystems. In rivers, excess sediment can smother streambeds, reducing the amount of habitat available to insects and fish. It can also make water unsuitable for swimming and recreation, and reduce flood-carrying capacity of rivers.

Like nitrogen and phosphorus, sediment is a natural component in our region's rivers and streams. Hills, mountains and riverbanks contribute gravel, soil, silt and mud to waterways though erosion and run-off. In Taranaki, land use practices in the eastern hill country has led to excessive loss of soil and accumulation of sediment in rivers such as the Pātea, Tāngāhoe and Waitōtara. Further contribution from human activities such as production forestry, earthworks, gravel extraction, agricultural run-off and urban stormwater can also lead to excess sediment in freshwater and coastal receiving environments.

The NOF sets limits for suspended fine sediment in water. This is assessed using visual clarity, a measure of how easy it is to see a black disk through the water. Visual clarity is reduced when water is discoloured, which is typically a result of high sediment concentrations. Visual clarity ranges from band A, where there is minimal impact on instream biota, through to band D, where ecological communities are significantly altered and sensitive species are at risk of being lost. The national bottom line is drawn between bands C and D.

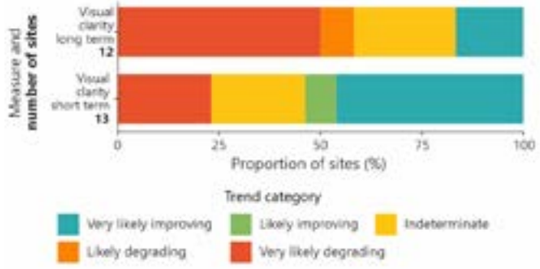
Visual clarity has been measured at 16 sites on streams around the region for between five and 25 years. Thirteen of the sites are on the ring plain, and three in the eastern hill country. The current state is assessed on median monthly values over the five years to June 2020. Eight sites (50%) achieved NOF band A for visual clarity, four (25%) fell within bands B or C, and four (25%) fell within band D. Of the four sites below the national bottom line, two are in the eastern hill country (Whenuakura and Waitara catchments) and two on the lower ring plain (Waiokura and Waitara).



The current state of suspended fine sediment (as visual clarity) monitored sites, as assessed against the respective NOF attribute bands.

Trends in visual clarity have been analysed over the long term (25 years) and short term (10 years) to 2020. Over the longer term, clarity degraded at seven of the 12 sites monitored (58%), and improved at two sites (17%) on the lower ring plain. The removal of point source discharges in both the Waingongoro and Pūnehu catchments may be contributing to this improvement.

Conversely, over the shorter term, visual clarity improved at seven of the 13 sites monitored (54%), with only three sites degrading (23%). Improvement occurred at all lower and most mid ring plain sites, and the Mangaehu hill country site. Degradation occurred in the Stony-Hangatāhua River (due to headwater erosion within Te Papakura o Taranaki), an upper ring plain site (Manganui) and a combined hill country and ring plain site (lower Waitara River). Further analysis is necessary to determine the drivers of these recent trends however fencing and planting of riparian margins on the ring plain, and erosion control measures taken in the eastern hill country, are expected to contribute to improvements over time.



Summary of trends for fine suspended sediment (as visual clarity) at these sites over both short (10 year) and long-term (25 year) time periods.

Significant amounts of erosion occur in the upper Stony-Hangatāhua River catchment where the river has carved a deep gorge within Te Papakura o Taranaki.

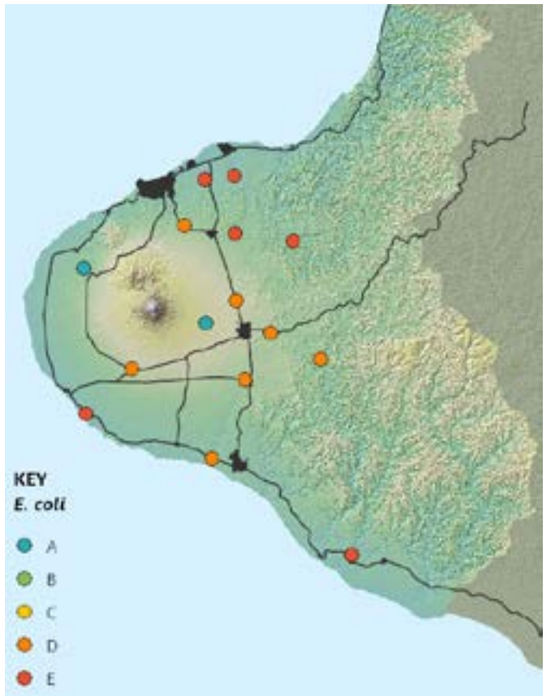
Bacteria (*E. coli*)

Water that is contaminated by human or animal faeces may contain a range of pathogenic (disease-causing) microorganisms which can pose a health hazard when the water is used for drinking or for recreational activities. Bacteria are present in the gut of people and animals and can enter rivers, lakes and coastal waters through animal and bird droppings, stormwater run-off, and effluent and wastewater discharges.

Faecal bacteria such as *E. coli* provide an indication that other pathogens harmful to humans may also be present. The NOF specifies an *E. coli* attribute for human health consisting of five categories or states (bands A to E) across four statistical criteria. The bands relate *E. coli* concentration to the risk of Campylobacter infection if water was swallowed during recreational activities. The four individual statistical measures are:

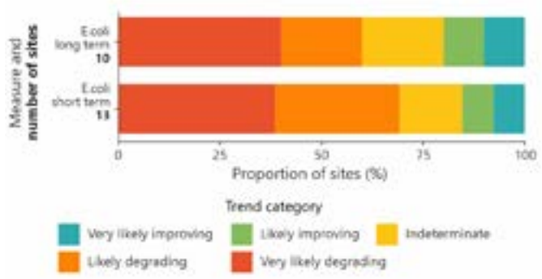
- Percentage of exceedances greater than 540cfu/100 mL (G540): This measure indicates how often the level of *E. coli* exceeds the acceptable threshold for swimming.
- Percentage of exceedances greater than 260cfu/100 mL (G260): This measure indicates how often the level of *E.coli* exceeds the point where additional monitoring is warranted.
- Median: The mid-point of measured *E. coli* concentrations.
- 95th percentile: an indication of the upper range of measured *E. coli* levels.

The overall standard for *E. coli* is assigned based on the worst grade across the four criteria. While there is no national bottom line, national 'swimmability' targets have been set using band C as the minimum requirement. Using these criteria, only two sites In Taranaki (13%) met the swimmability standard. The other 13 sites (87%) fell within band D for two or more criteria, typically failing to achieve the 95th percentile measure, and hence failed to meet swimmability standards. The median, G260 and G540 requirements were met by four (27%), four (27%) and six (40%) sites, respectively.



The current state of E. coli at monitored sites, as assessed against the respective NOF attribute bands.

Analysis of long-term trends in *E. coli* concentrations show two of 10 sites improving (20%) and six degrading (60%). Over the shorter 10-year period, two of 13 sites have shown improvement (15%) while nine have deteriorated (69%).



Summary of trends in E. coli concentrations at monitored sites over both short (10 year) and long-term (25 year) time periods.

Broadly speaking, sites in the upper river catchments showed better results compared to the sites in the middle and lower catchments. This is common in catchments throughout New Zealand, and generally reflects the increasing cumulative impacts of intensive agriculture, urban stormwater and wastewater discharges as water makes its way downstream through the catchment.

What we're doing

Improving monitoring technology

We are deploying new technology at monitoring sites in the Waingongoro and Mangaehu catchments to collect continuous measurements of water quality indicators including pH, conductivity, turbidity and temperature and nitrate. This equipment provides a much more comprehensive understanding of water quality without the need to physically collect water samples, which can be challenging during high river flows.

In time, we hope to increase the number of sites collecting continuous water quality measurements and improve our understanding of how rivers and streams respond to natural drivers such as a changing climate and human activities such as land use.

A Council officer checks a continuous water quality monitoring instrument in the Waingongoro River.

Catchment modelling

The Council recently commissioned the development of catchment water quality models to estimate the water quality state across all river and stream reaches in Taranaki. Despite some limitations and uncertainty, these models provide a more comprehensive picture of water quality across the region than can be provided by site-specific monitoring data alone. Through this modelling approach we're able to make predictions about the water quality at any given location based on a range of environmental characteristics that are common to those catchments where monitoring data is available. These characteristics include the geology, land cover, elevation, rainfall and the number of farmed animals.

To refine these models and improve our understanding of the actions we can take, we need to assess whether contaminants are the result of human activities or natural processes. The Council will undertake investigations to better understand the role of natural processes in contributing to both phosphorus concentrations in our ring plain rivers, and sediment loads in the eastern hill country. We're also looking into how climate change will affect Taranaki into the future, how this may impact on our freshwater quality and our ability to meet water quality targets, particularly in relation to sediment loads.

Drawing on this information, these models will help us estimate the likely impact that any future changes we make will have on freshwater. This will help inform conversations as a community around changes we need to make, and which tools in our toolbox we can employ to achieve our collective vision for freshwater in Taranaki.

Where we're heading

Since our last State of Environment report in 2015, a number of key programmes and interventions designed to reduce inputs of nutrients to our waterways have continued. These have included the roll out of the regional riparian management programme, the diversion of dairy shed effluent discharges from water to land-based irrigation and hill country farm plan development and implementation.

The diversion of remaining dairy shed effluent discharges from water will continue as consents come up for renewal, further reducing direct discharge nutrients, sediment and bacteria to waterways. It is expected that discharges to land will make up a minimum of 85% of all dairy effluent discharge consents by 2025, up from approximately 60% in 2021.

In the hill country, there will be a continued focus on extending the coverage of properties with comprehensive farm and agroforestry plans, and most importantly supporting the implementation of those plans on the ground. We anticipate these interventions will result in improvements in regional water quality, although it is clear that further work will be required in some areas to meet minimum water quality standards and/or achieve water quality targets.

The Council is required to establish action plans to improve freshwater quality above minimum standards, to achieve target states, or where monitoring indicates any deterioration in water quality. These requirements apply to all compulsory attributes set out in the NOF, which include nutrients, suspended and deposited sediment, and *E. coli*. Work is under way to understand the current loads of these various attributes, and the reduction in load that will be required to meet potential targets.

Aquatic ecosystems

With around 20,000km of rivers and streams along with numerous lakes and wetlands, our region's waterbodies provide important habitat for a range of insects, fish, birds and plants.

Over the years, land use and industrial and urban activities have resulted in significant loss of freshwater habitat. Stream and wetland reclamation, excess nutrient and sediment inputs from agricultural land use, deforestation and urbanisation have all contributed to loss and degradation of aquatic ecosystems. Improving habitat has and continues to be a strong focus for the Council. While we are making good progress in improving habitat through our riparian, land management and biodiversity initiatives, significant work is required to address the legacy of poorly designed and installed structures in the region.

Many native and non-native fish are migratory, moving between marine and freshwater environments over their life cycle. As hydroelectric schemes were introduced, and roads and farm tracks crossed streams to open up access to land for development, barriers to fish passage grew. We know that the total number of instream structures in the region is likely to be in the tens of thousands however, we don't yet know how many of these structures present a barrier to fish passage.

The Council is taking steps towards improving ecosystem health, and identifying structures for removal and remediation. This section discusses three key aspects of our region's aquatic ecosystems: macroinvertebrates, periphyton (algae) and fish.

45%
Taranaki's native freshwater fish are **at risk of decline**
including inanga and torrentfish

Over the last 10 years
macroinvertebrate community index data shows
38%
of monitored sites are **very likely degrading**

13
periphyton sites
monitored monthly
since July 2017

Culverts & weirs
can prevent fish from accessing important habitat

What we know

Macroinvertebrates

Freshwater macroinvertebrates are small animals without backbones including insects, shrimps, snails and worms that live in streams and rivers. They play an important role in streams as they feed on aquatic plants, algae and dead leaves, and are an important food source for fish. Some macroinvertebrates prefer clean streams, while others are more pollution-tolerant. Because they tend to stay in one place, macroinvertebrates are good indicators of the health of the stream at a particular location.

Macroinvertebrate data has been collected every year since 1995. Data from 2015 to 2020 were assessed to determine the current state at 58 sites where data records were five years or longer. Macroinvertebrate health was assessed against criteria set out in the National Objectives Framework (NOF) of the National Policy Statement for Freshwater Management 2020 (NPS-FM) for three measures: the macroinvertebrate community index (MCI), semi-quantitative MCI (SQMCI), and average score per metric (ASPM). Under the NOF, band A is indicative of pristine conditions, while bands B and C are indicative of mild and moderate organic pollution or nutrient enrichment, respectively. Band D is below the national bottom line and is indicative of severe pollution or enrichment.

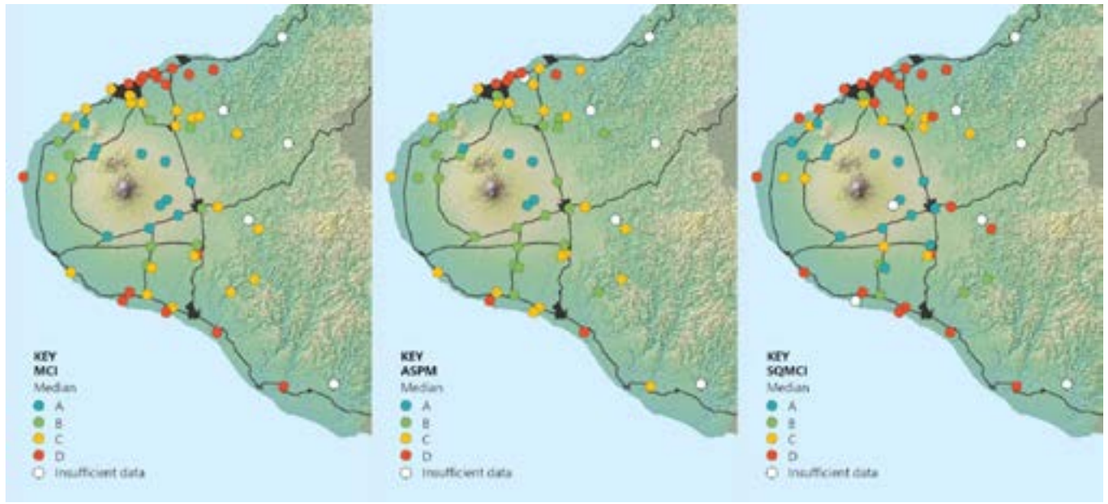
During the past five years 35 (60%) monitored sites fell within either the NOF band A, B or C for all of the three measures, while 23 sites (40%) failed to achieve the national bottom line for one or more measures. Six sites (10%) fell within band A for all three measures.

In general, sites in the upper catchment were in better ecological health than sites further down the catchment towards the coast. This pattern is commonly seen across New Zealand, with the impacts of land use and discharges often increasing as rivers and streams make their way through the landscape and down the catchment. We know that higher concentrations of nutrients and sediment contribute to the excess growth of algae and fine sediment deposition, and that these in turn affect freshwater ecosystems.

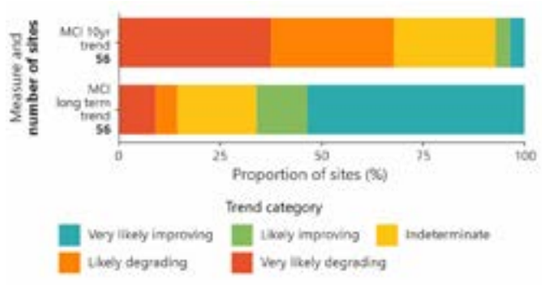
Lowland streams are less able to deal with pollution, as they tend to be warmer and naturally muddier, with lower dissolved oxygen levels. Larger, wider rivers also occur lower down the catchment and these rivers generally have less shading that also helps promote algae and aquatic plant growth. Pollution-tolerant macroinvertebrates favour rivers with excessive algae and aquatic plant growth. When present in high numbers, they provide an indication of the level of pollution a stream or river is likely experiencing. We assessed changes in macroinvertebrate communities over two time periods: short-term trends were assessed for the 10-year period from 2011 to 2020. Long-term trends were assessed for those sites with more than 10 years of data.

For sites with long-term records, macroinvertebrate health was very likely improving at the majority of sites (30 sites, 54%). Only a small percentage of sites were found to be very likely degrading (five sites, 9%). For at least one site, this was likely due to natural erosion events within Te Papakura o Taranaki.

Over the 10-year period from 2011 to 2020, the minority of sites were very likely improving (two sites, 4%), while over a third of sites (21 sites, 38%) were very likely degrading and 17 sites (30%) were likely degrading.



MCI (left), SQMCI (right) and ASPM (middle) five-year medians displaying colour-coded bands.

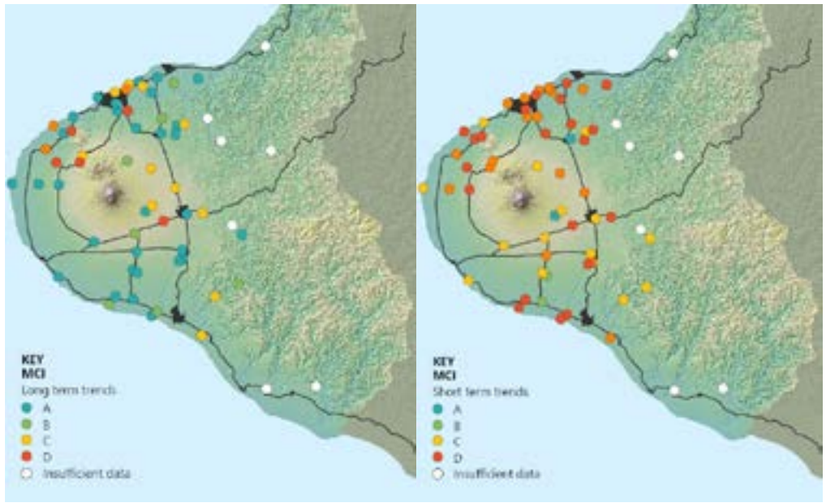


Proportion of improving, indeterminate and degrading 10-year (top) and long-term (bottom) trends for macroinvertebrate sampling sites.

Various initiatives to improve stream health in Taranaki continued since our last report in 2015. These included addressing hill country erosion, fencing and planting of waterways, and removal of dairy pond discharges to water. Identifying further actions that we can take to maintain and improve freshwater ecosystems will be required as we develop catchment action plans – a requirement of the NPS-FM.

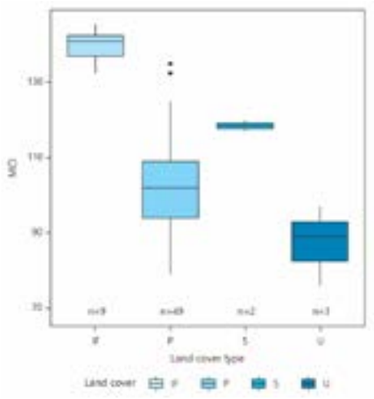
A number of factors help explain the variability in macroinvertebrate health across the region. Of these, land cover type had the greatest influence on the MCI score. In New Zealand, sites in the indigenous forest land cover class can generally be considered pristine therefore the streams that flow through them are very healthy. This is also the case in Taranaki, where sites with predominately indigenous forest upstream had MCI scores significantly higher than sites in scrub, pasture and urban environments. Sites with urban land cover had the lowest MCI scores, reflecting the various water quality, habitat and hydrological impacts such as contaminated stormwater discharges, occasional sewage overflows and culverts. Sites in pasture land cover had the second lowest MCI scores, with nutrient enrichment and sediment inputs more likely causes of decreased macroinvertebrate health at these locations.

Another linked group of factors correlated with macroinvertebrate health is network and catchment position, altitude and distance from the national park. Sites located in smaller streams (lower order) or in the upper (higher altitude) portion of the catchment were in significantly better health than lowland or large streams. This also applied to ring plain streams close to, or within, Te Papakura o Taranaki. Typically, streams grow in size and have higher numbers of smaller streams flowing into them as they progress down the catchment, so all four of these factors can be related to one another.



Long term (left) and 10-year (right) trends for macroinvertebrate sampling sites across the region.

There are likely to be a number of different reasons for the poor short-term trend results and the reasons for the decline are typically site-specific. At least one site appears to be affected by natural erosion events. Other sites may have been affected by activities such as poor waste management from businesses/industry located upstream, as has been occasionally identified through consent compliance monitoring. Other factors that may be affecting short-term trends include climatic variation, in particular having hotter, drier summers and, in some areas of the region, more intensive agricultural production.



Boxplots of MCI scores for four land cover types (IF = indigenous forest, P = pasture, S = scrub and U = urban) sampled in the Taranaki region.

Periphyton (algae)

Periphyton is the 'slime' on riverbeds. It is mostly algae, but also fungi and bacteria that grow on the beds of our rivers, lakes and streams. Periphyton forms the base of the food web in rivers, turning dissolved nutrients into nutritious food for invertebrates, so some periphyton is needed to support a healthy ecosystem. Too much periphyton however, can decrease the habitat available to freshwater macroinvertebrates and make rivers and streams unsightly and less desirable for people to swim in. Excessive periphyton can also cause fluctuations in water quality, which in extreme cases may impact on other freshwater life.

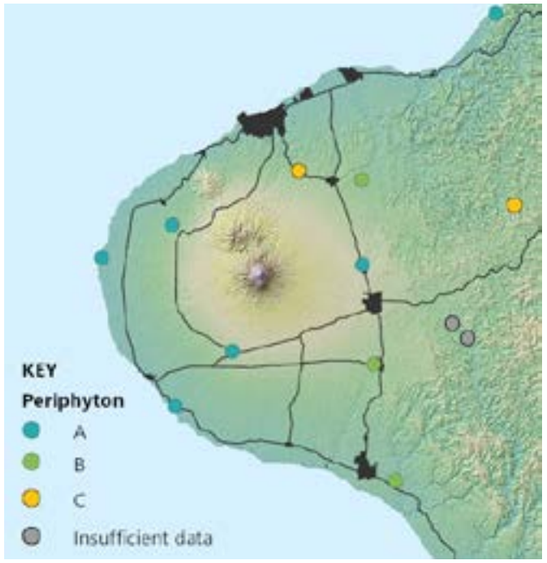
Periphyton appears as slimy mats or as strands (known as filaments). The amount in rivers and streams depends on a range of factors, which vary seasonally and tend to peak in summer or autumn. The most important factors are nutrients, stream flow and light.

Periphyton is measured by the concentration of chlorophyll-*a* per square metre (a pigment that plants use for photosynthesis). Monitoring is carried out where periphyton is likely to grow. This includes sites with rocky or sandy streambeds where periphyton can attach, and where the water is shallow enough for light to penetrate. This means monitoring tends to focus on the ring plain around Taranaki Maunga where most rivers have rocky streambeds.

Periphyton at 13 monitored sites were compared to the NOF attribute criteria. No sites fail to achieve the national bottom line (band D). Two sites (15%) fell within band C, two sites (15%) within band B, six sites (45%) within band A, while a further two sites (15%) had insufficient data to determine current state.

Periphyton is also measured visually at the same 13 sites so that it can be compared to guidelines for ecological health or aesthetic values. Weighted composite cover measures the combined cover of some of the less desirable forms of periphyton, such as long filaments and thick mats. The aesthetic guideline for weighted composite cover is 30% or less. Six of 13 sites have never exceeded this value, while five sites exceeded the guideline between 4% and 15% of the time. The remaining two sites exceeded this value more than 25% of the time.

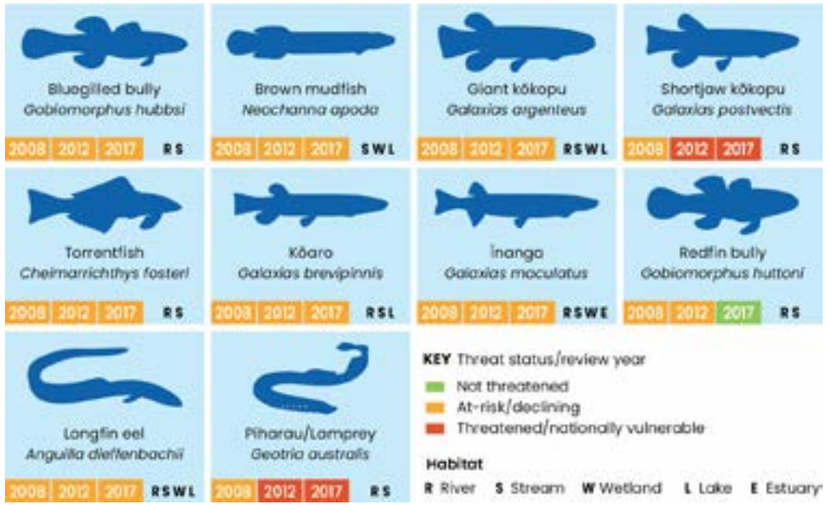
Monthly periphyton monitoring has been running for almost five years. While we are able to assess the current state of periphyton at our monitoring sites, we don't yet have enough data to establish any trends. However, as we collect more data we will be able to assess how periphyton is changing over time.



Periphyton monitoring sites as measured against the National Objectives Framework periphyton attribute criteria.

Fish passage

Twenty native fish species inhabit freshwater ecosystems in Taranaki for all or part of their life cycle, with many migrating between the freshwater and marine environment. These fish include piharau (lamprey), tuna (eels), banded kōkopu, giant kōkopu, kōaro, īnanga and shortjaw kōkopu (migratory galaxids more commonly known as whitebait), the elusive brown mudfish, and a number of other species. Many of these fish are threatened with extinction or population decline because of human pressures. Non-native fish in the region include the sport fish trout and perch and a few pest species, including gambusia and rudd.



Native freshwater fish species in Taranaki that have been classified as 'At Risk' or 'Threatened' since 2008. Note: The Threat Status of the Redfin bully (Gobiomorphus huttoni) has improved in the most recent assessment, after scientists learnt more about the population.

Poorly designed or maintained culverts, weirs and other instream structures can reduce the connectivity between these environments. Where these artificial barriers restrict the upstream passage of fish, it reduces the amount of habitat they can access. Given the sheer number of rivers and streams in Taranaki, there are likely tens of thousands of structures throughout the region. Over the life of the structure, some of these could act as a full, partial, or temporary barrier to fish passage, undermining the hard work of landowners and communities to enhance fish habitat, such as riparian restoration.

Piharau/lamprey (Geotria australis) is one of two native freshwater fish in Taranaki classified as 'Threatened - Nationally Vulnerable'. Evolutionarily, piharau are among the last extant (still living) members of the most primitive group of vertebrates; Agnatha (jawless fish).

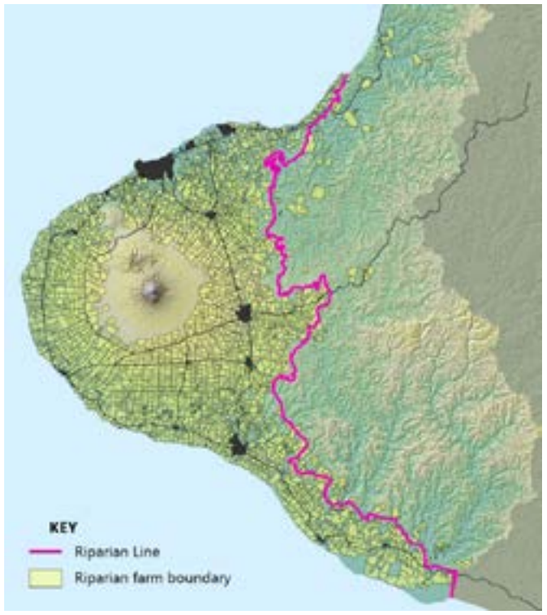
What we're doing

Riparian Management Programme

For more than 25 years, the Council has worked with Taranaki landowners to fence and plant thousands of kilometres of waterways. The Council adopted its riparian management strategy in 1993 to address the adverse effects to waterways of contaminants from overland run-off. Under the resulting voluntary Riparian Management Programme, landowners received customised plans, advice and information. Landowners pay for fencing, plants and planting, while the Council supplies native plants at wholesale rates. The programme covers all areas of intensively farmed land in Taranaki.

Riparian margins are 89.5% fenced and 80.9% planted (or vegetated) as a result of 6,003km of new fencing and 4,575km of planting. More than 7.2 million native plants have been supplied to landowners at cost. This is significant under a voluntary approach and puts Taranaki ahead of the rest of the country with plan preparation and implementation.

Landowners have paid the majority of implementation costs however, for the last three years the Council has participated in two Government grant schemes MfE's Freshwater Improvement Fund (two years), and the Jobs for Nature Fund in 2021. Grants totalling $7 million resulted in 1.07 million native plants being planted to accelerate implementation. Contractors planted most of these as part of the Government's Covid-19 recovery initiative.



Area covered by the Council's riparian management programme.

The Council has encouraged planholders to implement their riparian plans through annual fencing and planting. There is 1,742km of fencing and 2,466km of planting left to do, as the programme addresses all waterways (including drains) of any size. When existing plantings mature to provide bank stability and shading and additional filter strips are created/planted, further improvement in water quality is expected. Native planting will complement improved water quality with enhanced biodiversity as hundreds of hectares of new habitat are created, generating wildlife corridors from Te Papakura o Taranaki to the sea. An independent NIWA study in 2018 found riparian restoration in Taranaki as part of the Riparian Management Programme has had a beneficial effect on water quality (based on *E.coli* concentrations) and the health of aquatic invertebrate communities.

Since 2011, the Council has signalled its intention that regulation will be introduced to complete the riparian programme by 2020 or near thereafter. The NPS-FM requires regional councils to develop regional plans and rules to address water quality issues by the end of 2024.

It is intended that farmers on the intensively farmed ring plain and coastal terraces, who have not made significant progress implementing their riparian plans, will require a resource consent. Additionally, new stock exclusion regulations under the RMA take effect in 2023 but will only apply to 1m wide streams.

The Government intends to introduce compulsory Freshwater Farm Plans towards the end of 2022. These may give effect to recommendations in the Council's riparian management plans, which will help complete the job. To ensure our riparian management plans cover all waterways and wetlands, we will carry out audits over the next few years. These will also collect information required under the NPS-FM.

The Riparian Management Programme shows what can be achieved when there is collective goodwill and collaboration. Landowners can be proud of the work they have done and the difference it has made. This Taranaki spirit will be required as we tackle water quality challenges into the future.

Fencing and planting along riparian margins helps to improve the health of freshwater ecosystems.

Freshwater fish habitat loss and degradation

The way land is used can impact the habitats of our freshwater fish in a variety of ways. Intensive agricultural and industrial land use can lead to nutrient enrichment and the proliferation of algae in waterways, reducing oxygen levels and affecting fish habitat availability and food sources. Urban development and infrastructure, roading and forestry can introduce sediment and other contaminants into waterways through stormwater run-off, earthworks or erosion. Hydroelectric power generation alters the physical nature (flow and temperature) of waterways and can present a significant barrier to fish passage.

Stream and wetland modification continues in the region, both authorised and unauthorised, as people look to develop land. The modification of waterways and removal of instream debris, substrates and vegetation can degrade or remove fish habitat.

Non-compliant stream culverts can prevent the upstream migration of fish due to the swift flows, shallow flows, steep approaches (waterfalls), overhangs (or perches) and by not providing rest areas.

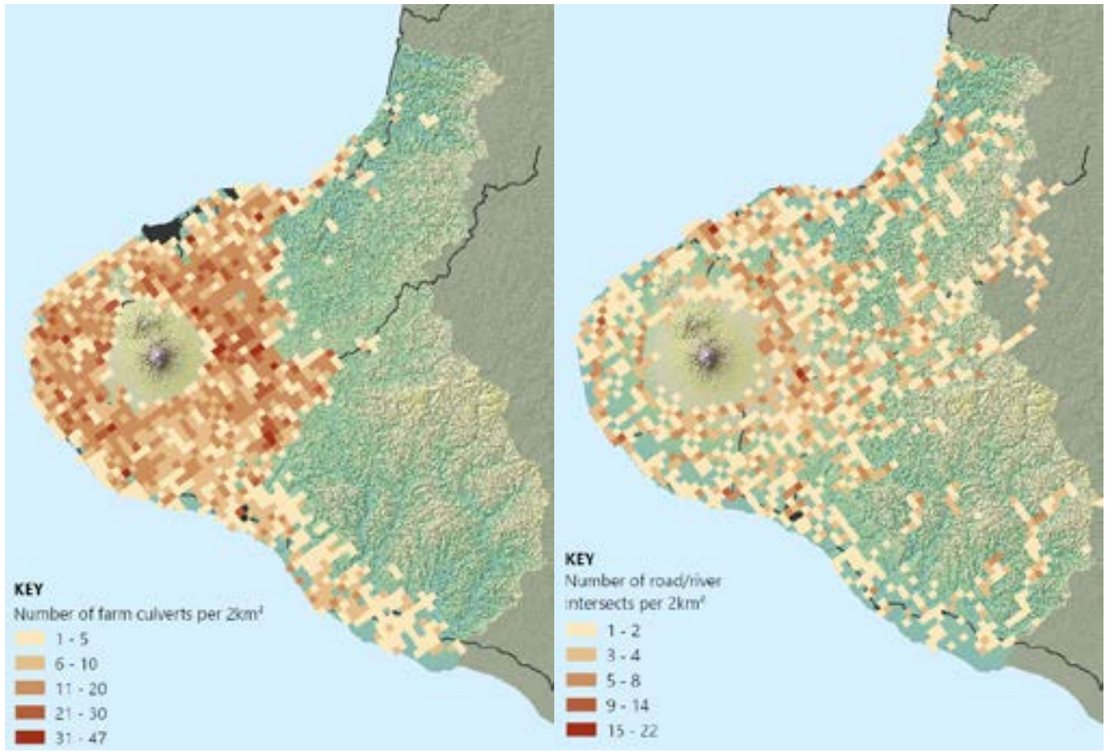
The Council supports and promotes initiatives to remediate some of the damage done by historical activities through our Key Native Ecosystem (KNE) programme and Riparian Management Programmes, which aim to restore degraded habitats. We also monitor a range of consented activities, like those that require discharges of contaminants to land and water, and monitor structures such as culverts to ensure fish passage is maintained. When necessary, the Council will take enforcement action against those responsible for unauthorised activities, for example discharging toxicants to waterways or filling in wetlands and streams, which kill fish and degrade habitat. Occasionally, Council enforcement has resulted in prosecution.

Improving fish passage

The Council has compliance programmes and other initiatives in place to identify potential barriers to fish passage throughout the region. The land management team identifies structures through the riparian programme, with 11,804 structures identified to date. Desktop geospatial analysis has identified where local roads and state highways cross rivers and streams, and where a bridge or a culvert is expected be present. So far, 3,225 crossings have been identified.

Once a structure is identified, it needs to be inspected in order to assess compliance with fish passage requirements. This is a significant undertaking that the Council is beginning to work through. The compliance team is working with a number of landowners to reinstate or improve fish passage where barriers have been identified.

The Council is also exploring opportunities to increase its capabilities with the funding and/or support of fish passage remediation projects. We are working towards the removal of a number of significant barriers, following the successful removal of the Kaūpokonui Weir, a project championed by local iwi and hapū.



Left: Location and density of farm culverts identified on farms in the Riparian Management Programme. Right: Location and density of points where local roads or state highways intersect with rivers, indicative of the presence of bridges or culverts.

Award-winning project a win for region's fish

The removal of the weir was a huge milestone.

Fish can now move freely up and down Kaūpokonui Stream for the first time in 120 years.

Thanks to a project led by Te Korowai o Ngāruahine Trust, with support from Fonterra Kāpuni, Taranaki Fish and Game, South Taranaki District Council and Taranaki Regional Council, a 3m high disused weir in South Taranaki has been removed.

Up to 15 native fish species will no longer have to jump or climb the weir to navigate their way upstream, says Paddy Deegan, the Council's Freshwater Environmental Scientist.

"The weir was preventing access to a significant amount of habitat for many of these species, some of which are threatened or at risk of population decline," Mr Deegan says.

"Many fish aren't great climbers or jumpers, so with the weir removed fish can once again move freely up and downstream.

"Even one of our most athletic fish, the lamprey (piharau), struggled to navigate the weir. We expect that the number of species present in the stream and its tributaries above the old weir will increase, and fish numbers will grow overall."

Investigation into removal of the weir began in 2001, so the March 2021 removal (following a site blessing the previous month) was a huge milestone celebrated by all involved.

Monitoring since the weir's removal indicate the intervention has had an immediate positive impact. Sampling in the Kaūpokonui has detected piharau, smelt, īnanga, torrentfish, kōaro, and tuna (both longfin and shortfin eel) above the old weir.

Council staff consider this to be a good sign, and hope to see a big migration upstream in 2022 and successful spawning throughout the upper catchment in the years to come.

Council-Director Operations, Dan Harrison, says the weir demolition was probably the biggest single intervention to improve outcomes for the catchment's native fish.

"We were happy to work alongside iwi and hapū to support removal of this weir. It will have a massive positive impact on the number and types of fish seen in this and surrounding streams in years to come."

Te Korowai o Ngāruahine Trust representative, Kawarau Ngaia, acknowledged the efforts of the Trust's Environmental Policy Advisor Bart Jansma, saying his contribution to the success of the project was significant.

The project saw the Trust win a Taranaki Regional Council Environmental Award in 2021. It was also recognised on a national level, earning second place in the Cawthron New Zealand River Awards 'River Story' category.

The Te Korowai o Ngāruahine Trust team celebrating the weir removal.

Where we're heading

Responding to changes in national monitoring requirements

New national and regional directives, which have resulted in changes to regional policies and rules, increase the focus on protecting fish and their habitat. The NPS-FM, the National Environmental Standards for Freshwater (NES-F) and the National Environmental Standard for Plantation Forestry (NES-PF), all set out requirements for councils and communities to provide for better outcomes for fish.

The monitoring of fish and fish passage will grow significantly in the coming years to align with national objectives and to meet reporting requirements on NPS attributes. This will include assessing fish populations using the Fish Index of Biotic Integrity (Fish IBI), a measure of the condition of fish communities.

Environmental DNA (eDNA) is increasingly being used to identify fish populations throughout waterways in New Zealand. eDNA is a relatively new tool that allows us to identify nearly all of the different living organisms that exist within, or have come in contact with, a waterbody. By collecting a sample of water, genetic material can be extracted and cross-referenced against a library of genetic markers that are unique to different organisms. While we are not yet able to estimate the population size of specific species, eDNA can provide an idea of relative abundance. Although it may currently have some shortcomings, eDNA is nevertheless an exciting new technique to include in our monitoring toolbox. Councils are increasingly using eDNA to complement traditional survey techniques such as electric fishing, trapping and spotlighting.

Another change introduced by the NPS-FM requires that macroinvertebrates are monitored annually between December and March (inclusive), using particular methods. Traditionally, we have undertaken two surveys for macroinvertebrates: one in spring and one in summer.

In the future, our monitoring programme will align with these requirements and ensure we have good coverage of a variety of stream and river types. We will also look at different ways to analyse data to better determine what factors are the most important for creating healthy stream communities.

Work is underway to review the Council's periphyton monitoring programme, with plans to establish additional sites in areas of the region where conditions might support excessive periphyton growth. We will conduct a desktop analysis of environmental factors, followed by a survey of areas likely to support conspicuous periphyton growth. Work is underway to align our periphyton monitoring methodology with new National Environmental Monitoring Standards (NEMS). This will ensure we can compare results with other regions, as we do for a range of other water quality indicators.

Once enough data is collected, we can look at relationships between periphyton and the factors that impact periphyton growth, such as nutrients, light and stream flow. This will help us better target actions to improve water quality throughout the region. This will include setting nutrient limits as required by the NPS-FM.

NEMS are a series of documents providing guidance on sampling procedures for various types of environmental monitoring. A regional council initiative, NEMS assist in ensuring consistency in the application of work practices specific to environmental monitoring and data acquisition throughout New Zealand.

Monitoring of fish and fish passage will grow significantly in coming years to align with national objectives.

Lakes and wetlands

Lakes and wetlands support a diverse array of plants and animals, some of them rare and threatened. In Taranaki, lakes such as Rotokare, Rotomanu and Mangamahoe are popular spots for picnicking, fishing, swimming and boating. Highly valued by Māori, lakes and wetlands also provide traditional food sources – known as mahinga kai.

Lakes can be classified by how they are formed (geomorphic lake types) and by the mixing pattern of the water and how they are connected to the sea. Of the 37 named lakes and lagoons in Taranaki, eight are artificial, being the product of either quarrying or damming. The remainder have formed through natural processes and include a number of coastal dune lakes, along with volcanic, riverine and landslide lakes. The majority of these natural lakes are in South Taranaki.

Lake Rotorangi is the largest lake in the region, and at 46km is New Zealand's longest man-made lake. Formed in 1984 through the damming of the Pātea River for hydroelectricity generation, the lake is popular for boating, swimming and waterskiing, particularly in the summer. The lake has been monitored since 1984, more recently for state of the environment and recreational water quality purposes, but primarily to ensure Trustpower meets the requirements of its resource consents associated with the Pātea Hydroelectric Power Scheme.

Wetlands, including swamps, marshes, and bogs, are the meeting place of land and freshwater. As well as being important for biodiversity, wetlands benefit land management by acting as the 'kidneys' of the land, filtering water that flows into them and trapping sediment. They store water during rainfall, helping to reduce flood levels. In dry periods, they release water to help maintain flows.

Approximately **5,000** wetlands have been identified and mapped

87% of monitored wetlands are in **good or better condition**

100 wetlands have been **restored or protected** during the last five years

Only **8.4%** of Taranaki's **wetland habitat remains**

What we know

Lakes

Lake health can be measured in a range of ways however a common way is the trophic lake index (TLI). Trophic state is calculated from a range of key water quality indicators such as nutrients, water clarity and algae, and provides an overall picture of lake health. Generally, the lower the levels of nutrients and the clearer the water, the better the health of the lake.

Microtrophic and oligotrophic lakes are typically low in nutrients and algae, mesotrophic lakes have moderate levels of nutrients and algae, while eutrophic and supertrophic lakes exhibit excessive nutrient levels and high amounts of algae, and are often associated with poor water clarity. Because of this, eutrophic or supertrophic lakes are generally unsuitable for swimming and contact recreation.

TLI Score	Description	Classification
0 - 2	Microtrophic: The lake is very clean with very low levels of nutrients and algae. The lake can have snow or glacial sources.	Very good
>2 - 3	Oligotrophic: The lake is clear and blue, with low levels of nutrients and algae	Good
>3 - 4	Mesotrophic: The lake has moderate levels of nutrients and algae.	Fair
>4 - 5	Eutrophic: The lake is murky, with high amounts of nutrients and algae.	Poor
>5	Supertrophic: The lake has very high amounts of phosphorus and nitrogen, and can be overly fertile and often associated with poor water clarity. Excessive algae growth can occur. Suitability for recreational purposes is often poor.	Very Poor

Lake trophic index (TLI) scores range from very good (microtrophic) through to very poor (supertrophic).

Nutrients such as nitrogen and phosphorus readily accumulate in lakes, and increased concentrations tend to result in excess plant growth. Lake Rotorangi, the only regularly monitored lake in Taranaki, is classed as eutrophic. This status is influenced mainly by nutrients and water clarity however, the lake has less algae than is typical of eutrophic lakes. This is due to inflows from the Pātea River, which provides a continuous source of freshwater. Being a very long lake, conditions closer to the head of the lake can be quite different to those at the lower end.

When compared to criteria set out in the National Objectives Framework (NOF), Lake Rotorangi falls within band B for measures of total phosphorus, ammonia and chlorophyll-a. Total nitrogen concentrations fall within band C, while dissolved oxygen concentrations place the lake in band D and below national minimum standards overall. There is not yet enough data to assess the state of the lake against NOF measures for native and invasive submerged plants (measures of ecosystem health) or *E. coli* and cyanobacteria as measures of suitability for human contact. However, available data suggests that during summer the lake is usually suitable for recreational use.

Attribute	Unit	Attribute band	Description
Ecosystem health			
Phytoplankton (trophic state)	Annual median (mg chl-*a*/m2)	B	Lake ecological communities are slightly impacted by additional algal and/or plant growth arising from nutrient levels that are elevated above natural reference conditions
	Annual maximum (mg chl-*a*/m2)	B	
Submerged plants (natives	Lake submerged plant (Native Condition Index % of Maximum potential score)	NA	Insufficient data to assess this attribute
Submerged plants (invasive species)	Lake submerged plant (Invasive Impact Index % of maximum potential score)	NA	Insufficient data to assess this attribute however, available information suggests this may not achieve the national bottom line due to the presence of invasive species
Ecosystem health (water quality)			
Total nitrogen (trophic state)	Annual median (mg/m^3)	C	Lake ecological communities are moderately impacted by additional algal and plant growth arising from nutrient levels that are elevated well above natural reference conditions
Total phosphorus (trophic state)	Annual median (mg/m^3)	C	Lake ecological communities are moderately impacted by additional algal and plant growth arising from nutrient levels that are elevated well above natural reference conditions
Ammonia (toxicity)	Annual median (mg NH_4-N/L)	A	99% species protection level: No observed effects on any species tested
	Annual maximum (mg NH_4-N/L)	B	99% species protection level: Starts impacting occasionally on the 5% most sensitive species
Lake-bottom dissolved oxygen	Measured or estimated annual minimum (mm/L)	D	Likelihood from lake-bottom dissolved oxygen of biogeochemical conditions resulting in nutrient release from sediments
Mid-hypolimnetic dissolved oxygen	Measured or estimated annual minimum (mm/L)	D	Significant stress on a range of fish species seeking thermal refuge in the hypolimnion. Likelihood of local extinctions of fish species and loss of ecological integrity.

The current state of Lake Rotorangi as measured against National Objectives Framework attributes for water quality and ecosystem health.

From monitoring carried out over the past 25 years, we know conditions within Lake Rotorangi continue to change. Total nitrogen concentrations have improved over the past 25 years, while total phosphorus and algae (measured by chlorophyll-a concentrations) have degraded over the last 25 years, but have improved over the last 10 years.

Turbidity has also degraded over the longer term. The total phosphorus and turbidity changes are likely due to sediment entering the lake from erosion in the hill country upstream of the lake. Despite this change, dissolved phosphorus concentrations remain relatively low, limiting algae growth.

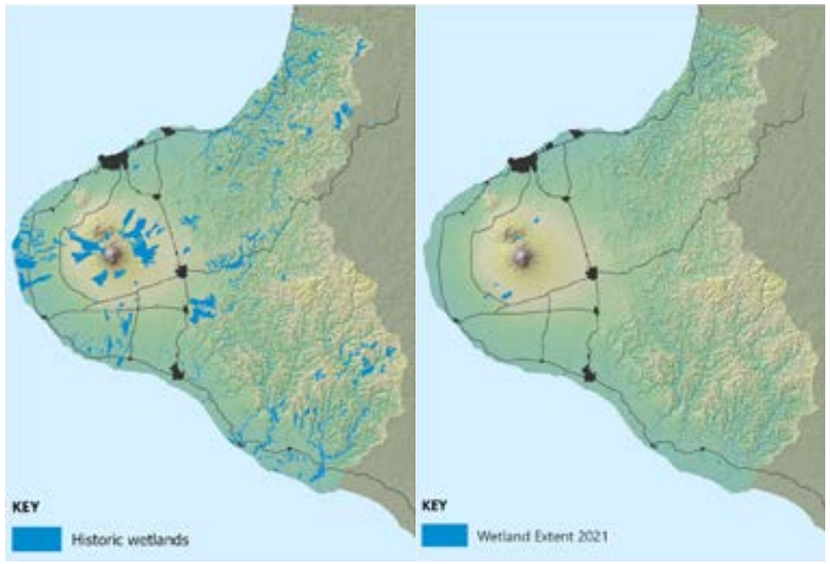
Wetland extent

All wetlands are dynamic, responding to changes in natural and human-induced factors. Changes in climate, land use, groundwater levels and sediment input can all affect wetland extent. In New Zealand, the vast majority of wetland habitat has disappeared; much of this loss has occurred through drainage for urban or rural development.

In Taranaki around 3,538ha (8%) of wetland habitat remains, compared to the North Island where just 5% of wetland habitat is left. Although small areas of wetland habitat are still being lost, the latest assessments show no major decrease in our region's wetland habitat.

Remaining wetland habitat.

On the ground, identification of swamp forest and urban wetland habitats, in addition to updated modelling of historical wetland extent, has helped improve our wetland extent estimations. During the past five years, 250ha of swamp forest and urban wetland habitat has been identified and added to our wetland extent map. Remote sensing data indicates there may be further areas of remnant swamp forest yet to be classified.

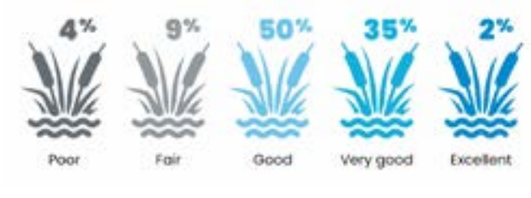


Estimated wetland extent prior to human settlement (left), compared to the current extent (right).

Wetland condition

The Council's biodiversity, predator and weed control, fencing, and enhancement planting programmes all contribute toward protecting and restoring Taranaki wetland ecosystems. To assess the basic ecological condition of wetlands, our scientists examine indigenous vegetation and fauna. We also assess pressures acting on wetlands, including stock access and presence of other animals, invasive plants, artificial drainage and catchment use.

Wetland condition assessments over the past five years show that 85% of wetlands monitored in Taranaki are in good or very good condition. Around 9% are in fair condition and 4% are in poor condition. Just 2% of wetlands are in excellent condition.



Condition of wetlands in Taranaki.

Since formal monitoring began in 2010, the Council has assessed 67 unique wetlands. Between 2015 and 2020, 21 were assessed for the first time, with a further 32 wetlands reassessed five years after their initial assessment. Based on five-year reassessment data, 74% of wetlands have shown improvement in their ecological condition, while 3% have unchanged ecological condition, and 23% have degraded in condition. Our repeat assessments show measures of indigenous vegetation, invasive species prevalence and stock exclusion have improved in the majority of wetlands over the five-year period.

Ten-year repeat wetland assessments are also underway. Preliminary results show that the majority (64%) of wetlands have improved in condition from their initial assessment in 2010. However, four wetlands have shown a decline in condition suggesting restoration works may need to be revisited.

The Council also monitors rare wetland bird species, such as the Australasian bittern (Botaurus poiciloptilus). Classified as 'Threatened-Nationally Critical' in New Zealand, bittern are a highly mobile, threatened, wetland specialist bird. We have records of bittern from 39 locations across the region, and are continuing to identify potential habitat and breeding locations.

What we're doing

A new regional lakes monitoring programme

Lake monitoring and reporting is a requirement of the National Policy Statement for Freshwater Management 2020 (NPS-FM). As a result, the Council is introducing a new regional monitoring programme to include a wider range of lakes throughout the region.

We have identified 17 natural lakes as potentially suitable for long-term monitoring. From 2023, we aim to include around a third of these in our regional lake water quality monitoring programme, while more will also be assessed for ecological health.

We recently undertook baseline water quality sampling of 15 of these proposed lakes. Preliminary results suggest they range in trophic condition from mesotrophic to supertrophic, meaning there will likely be significant requirements to address water quality issues under the NPS-FM, where these lakes are impacted by land use and other activities.

We also recently commissioned NIWA to carry out LakeSPI (Submerged Plant Indicator) surveys in Lakes Rotokare, Kaikura and Mangawhio. LakeSPI is a method of characterising the ecological health of lakes based on the proportion of native and invasive plants growing in them. The surveys found the lakes to be in moderate (Rotokare and Mangawhio) or high condition (Kaikura), with LakeSPI indices between 21% and 66%. The native condition scores of the lakes range from 28% to 52%, while the invasive impact scores ranged from 19% to 79%. For the LakeSPI index and the native condition score, higher scores represent better ecological health whilst for the invasive impact assessment the reverse is true. In time, further surveys will provide an overall picture of the ecological health of Taranaki lakes.

The 17 lakes, comprising four geomorphic types, that have been identified as possible candidates for inclusion in future long-term monitoring.

Preserving and restoring Taranaki wetlands

Although wetland loss has slowed in Taranaki, there is still a big job ahead to protect, restore, improve and maintain our region's wetlands. With the introduction of new national policy and regulations, wetlands have become a national focus for preservation and restoration.

Council officers are working on the ground identifying and mapping wetlands, confirming swamp forests, and encouraging and supporting landowners to fence, protect and restore wetland habitats.

Between 2015 and 2020, more than $525,000 has been spent through our land management and biodiversity programmes on restoring and protecting more than 100 wetlands. This funding has enabled stock exclusion fencing, enhancement planting, invasive weed and animal control, and track maintenance in and around wetlands. Because of this mahi, more than half of these wetlands (covering around 43ha) are now legally protected.

The Council actively works with landowners who want to protect and restore wetlands, and supports this via three wetland restoration funding pathways. The Environment Enhancement Grants Fund primarily supports the enhancement of wetlands of regional significance. The Wetland Contestable Fund is a Council initiative used to promote the restoration of wetlands regardless of size and condition. Finally, our Key Native Ecosystem (KNE) programme focuses on protecting the 'jewels in our biodiversity crown', those remnant wetlands that have significant indigenous biodiversity value. Read more about our KNE programme in the Biodiversity & Biosecurity section.

Constructed wetland vision comes to fruition

The constructed wetland at Awatuna with Taranaki Maunga in the background.

A constructed wetland is not only improving water quality on and around a South Taranaki dairy farm but is also helping educate others in the region.

Donna and Philip Cram began their environmental journey 15 years ago, when they stopped cows crossing through streams on their property. It's something all farmers must do now - but in those days it was common to graze cows to the water's edge.

The Crams now lead the way with a range of new sustainable farming practices to improve environmental and water quality, restoring their farm's biodiversity by keeping predators at bay. They are active in the farming community, including establishing a catchment group in the Oeo Catchment.

Working with the Council on a riparian protection scheme, they've fenced all 9.75km of the Oeo Stream tributary flowing through their property. They've built three culverts as "cow crossings" and planted 10,700 native plants over about 10 years on riverbanks and the farm – with help from their children and Opunake High School students.

But it's the wetland that's really catching attention. Years ago Philip identified an area receiving a large amount of water in a catchment area. With help from the Council and NIWA, a former streambed has been re-engineered into a wetland to reduce nutrients, bacteria and sediment leaching into the waterways.

It's now a three-cell 160m long constructed wetland covering 4500m^2 in a setting that reflects Taranaki Maunga. The Crams hope local schools will visit and learn about bird, plant and freshwater ecology and are working with Taranaki Enviroschools and other community groups to share the lessons they have learned.

While the wetland is "a really peaceful place to be with amazing views", Donna says it has a serious purpose. "We will have real data on reduction of nutrients in our run-off. That's very valuable to us and the farmers around us."

Regan Phipps, Council Manager of Science and Technology, says the Council, DairyNZ and NIWA are monitoring and sampling the wetland to assess how efficient it is in reducing nitrogen and phosphorous, *E. coli* and sediment in the catchment.

"Early indications are that the wetland is performing well, and significantly reducing the concentration of nitrate in the water flowing through it. Treatment performance is likely to improve further as the wetland matures."

He says the project is an example of what can be achieved with "a bit of vision, a willingness to work together and some hard graft".

"Not only is the wetland now helping to improve local water quality, it's helping to raise awareness of environmental issues, supporting education and providing a living demonstration of a functioning constructed wetland installation.

"The monitoring data will also provide evidence of constructed wetland performance in a local context, while contributing to the national understanding through our project partners. "

He says the Council has learnt valuable lessons that can be applied in future constructed wetland projects, saving effort, time and money.

"We hope this project will inspire others to consider what they could do to improve water quality in their local area."

The site of the wetland in May 2019, prior to construction.

Where we're heading

Preserving and restoring Taranaki lakes

Lake processes are complex and lake systems unique. In addition to aligning our lakes monitoring programme with the NPS-FM requirements, we need to assess the potential drivers of lake water quality. This will include how natural processes and the actions of people contribute to the health of the region's lakes.

Where waterbodies are not achieving national minimum standards, action must be taken. This may involve setting limits for certain activities or alternatively, lead to the development of an action plan. The Council's riparian and sustainable hill country programmes and the diversion of dairy effluent discharges away from waterways, are examples of elements of an action plan that the NPS-FM might require to reduce levels of inputs of nutrients and sediment to waterbodies. This would also address other pressures such as aquatic pest weed and fish species, bank erosion and stock access.

A significant challenge for Lake Rotorangi – and likely other recreational lakes in the region – is the invasive weed hornwort. First recorded in 2012, this aquatic pest has continued to spread and will eventually dominate the plant community in the lake.

Hornwort is transferred between lakes by contaminated boats and trailers, fishing equipment and eel nets. It can contribute to blockages of waterways and infrastructure and once established, is difficult and expensive to remove. People who see or suspect hornwort should report it to the Council or the Department of Conservation.

The invasive weed hornwort has established in Lake Rotorangi.

Innovative techniques for identifying and mapping wetlands

The introduction of the Resource Management (National Environment Standards for Freshwater) Regulations 2020 (NES-F) has set out clear consenting pathways for activities in and around natural wetlands, while the introduction of the NPS-FM aims to restore wetlands through long-term regional planning provisions.

The Council has responded to these new requirements by expanding our State of the Environment monitoring programme with respect to wetlands. In addition to our current rapid wetland condition assessments, the Council will also be intensively monitoring about 60 wetlands. Additional monitoring will include vegetation mapping and plots to determine indigenous vegetation dominance, and diversity. By expanding monitoring programmes, we will gain a more accurate understanding of wetland types, condition, size and the pressures on them.

With the introduction of the NPS-FM, there is a national push to identify new and more accurate wetland mapping techniques. Using tools such as LiDAR, we are working alongside other regional councils to develop methods that will enable us to meet the national 10 year goal of mapping all wetlands down to an area of 500m^2. Improved wetland mapping will enable us to more accurately determine the extent of our remaining wetlands, and to track changes in these wetlands over time. This in turn will help us develop a better understanding of pressures acting on the region's wetlands, guide policy development, and inform our biodiversity and land management programmes around wetland protection and restoration.

Estuaries

Estuaries are semi-enclosed coastal water bodies, which experience changes in salinity (saltiness) with the tides. In addition to providing important habitat to a range of fish, birds and other life, estuaries are sites of significant cultural importance for local iwi and hapū, as well as being valued for recreational activities such as swimming, kayaking and whitebaiting. Although there are a range of estuary types in New Zealand, there is only one type in Taranaki; the tidal river mouth.

The smallest tidal river estuaries in Taranaki experience limited intrusion of seawater, and support little estuarine habitat. In the larger estuaries, the tidal range can extend a considerable way upstream, submerging and exposing mudflats and saltmarsh vegetation over the tidal cycle.

Many of New Zealand's estuaries are under increasing pressure from the effects of land use, including sediment and nutrient run-off. Erosion of fine sediment from land into waterways can lead to excessively muddy estuaries and a loss of natural estuarine habitat. Sedimentation can also lead to changes in infaunal communities (burrowing animals) which can have knock-on effects higher up the food chain. Eutrophication refers to the negative effects of increased growth of phytoplankton and/or macroalgal species driven by increased nutrient availability. Eutrophic conditions interfere with natural ecological processes in estuaries by significantly affecting sediment and water quality. Eutrophication can also detract from the amenity of estuaries due to visual effects and odour issues.

The Council monitored estuaries for a number of years up until 2013, when we reviewed the programme in order to improve our ability to detect changes and identify the potential impacts of sediment and nutrients. As a result, we undertook a region-wide assessment to identify which, if any, estuaries are most under pressure, to prioritise monitoring and management efforts.

In 2019 an **Estuarine Vulnerability Assessment** was carried out at **20** sites

10 **of those** had a vulnerable rating of **moderate to high** or **high**

Taranaki only has **1** **type of estuary:** **tidal river mouth**

Sedimentation was identified as having a **very high** ecological impact in **7** **estuaries**

What we know

Estuary vulnerability assessment

In 2019, an Estuarine Vulnerability Assessment (EVA) was carried out by Robertson Environmental to guide the development of a new estuary monitoring programme. To provide a representative assessment, 20 sites were included. This included the region's larger estuaries north and south of the ring plain, as well as a number of smaller stream mouths where tidal intrusion was marginal but may occasionally occur. Three main outputs were provided for each estuary: a habitat map, a vulnerability rating and recommendations for future monitoring.

Overall vulnerability to the effects of sedimentation and eutrophication was determined to be 'high' in five estuaries, 'moderate to high' in another five, 'moderate' in nine and 'minimal' in one. Where the vulnerability of an estuary was 'high' or 'moderate to high', this was largely due to the effects of sedimentation rather than eutrophication. This was the case for seven of the 20 estuaries assessed, namely. Mōhakatino, Tongaporutu, Urenui, Mimitangiatua, Waitara, Pātea and Waitōtara.

Vulnerability to sedimentation was generally attributed to high sediment loads from the catchment, and the high proportion of soft mud cover in the estuary that was mapped during the condition assessment. Eutrophication was considered less of an issue in these estuaries due to them being well flushed, with no primary symptoms such as macroalgae and/or phytoplankton blooms identified during the condition assessments.

Vulnerability to eutrophication effects was 'moderate to high' for three estuaries, the Whenuakura, Oakura and Katikara. The latter two were the only estuaries where symptoms of eutrophication, in the form of phytoplankton blooms, were recorded. Other estuaries, such as the Whenuakura, were considered susceptible to eutrophication due to large areas of intertidal habitat which can support macroalgal blooms, high catchment nutrient loads, and where they were poorly flushed or restricted at the mouth.

Tunneling mud crabs (Austrohelice crassa) on an intertidal mudflat (top left); a royal spoonbill (Platalea regia).

Estuary	Coastal Stressor				Overall Vulnerability
	Sedimentation		Eutrophication		
	Susceptibility	Current Condition (2019)	Susceptibility	Current Condition (2019)	
Tapuae	Moderate	Moderate	Minimal	Minimal	Moderate
Timaru	Moderate	Moderate	Minimal	Minimal	Moderate
Te Hēnui	Moderate	Moderate	Minimal	Minimal	Moderate
Katikara	Moderate	Moderate	Moderate	High	Moderate-high
Waiongana	Moderate	Moderate	Minimal	Minimal	Moderate
Mimitangiatua	Moderate-high	Very high	Very high	Moderate	High
Manawapou	Moderate	Moderate	Minimal	Minimal	Moderate
Onaero	Moderate	Moderate	Minimal	Moderate	Moderate
Waingongoro	Moderate	Minimal	Minimal	Minimal	Minimal
Kaūpokonui	Moderate	Moderate	Minimal	Minimal	Moderate
Oakura	Moderate	Moderate	Moderate	High	Moderate-high
Tāngāhoe	Moderate	Moderate	Minimal	Minimal	Moderate
Urenui	Moderate-high	Very high	Very high	Moderate	High
Mōhakatino	Moderate-high	Very high	Moderate	Moderate	High
Waitōtara	Moderate-high	Very high	Minimal	Minimal	Moderate-high
Waitara	Moderate-high	Very high	Minimal	Moderate	Moderate-high
Pātea	Moderate-high	Very high	Very high	Moderate	High
Whenuakura	Moderate	Moderate	Very high	Minimal	Moderate-high
Tongaporutu	Moderate-high	Very high	High	Moderate	High
Waiwhakaiho	Moderate	Moderate	Minimal	Minimal	Moderate

Summary of Estuarine Vulnerability Assessment (EVA) ratings for 20 of the region's estuaries, from Robertson (2019).

What we're doing

Developing an estuary monitoring programme

By characterising the region's estuaries and understanding their vulnerability to different stresses, we are better able to tailor our monitoring approach to the needs of each estuary. Recommendations set out in the EVA have been used to guide the development of a new estuary monitoring programme for Taranaki.

Where an estuary's overall vulnerability was 'minimal' to 'moderate', it was recommended that synoptic (screening level) monitoring be completed every 10 years. This involves a high-level assessment of catchment variables and indicators of estuarine health to determine whether the vulnerability ratings have changed or remain the same.

For estuaries with overall 'moderate to high' or 'high' vulnerability, five yearly 'broad-scale' habitat mapping surveys were recommended to assess changes in dominant estuary features or habitats. Three years of annual 'fine-scale' surveying to assess the baseline condition of intertidal sediment through various physical, chemical and biological indicators was also recommended, except where the primary issue was eutrophication. In those estuaries, eutrophication targeted monitoring, mainly involving water sampling, was recommended over the summer months.

The Council is using these recommendations to guide its monitoring going forward. Fine-scale surveys are underway, beginning in the Tongaporutu and Mōhakatino estuaries. Robust monitoring data will enable the Council to better manage these estuaries, and the factors that may be affecting their health.

Where we're heading

The NPS-FM will require us to monitor relevant estuarine attributes in order to assess whether Council limits and policies are preventing adverse impacts in sensitive downstream receiving environments such as estuaries. Council officers are currently working with Ngāti Mutunga taiao staff to develop attributes that are relevant to the estuaries in North Taranaki, and potentially elsewhere in the region.

Fine-scale monitoring involves collecting sediment cores and washing them through filter mesh bags to find out what's living in the mud (in this case, estuarine worms!).

Te Āhua o Ngā Kūrei Estuary health monitoring

In 2019 Te Rūnanga o Ngāti Mutunga undertook a comprehensive study of the Urenui and Mimitangiatua estuaries, supported by the Taranaki Regional Council.

The project was funded by Curious Minds Taranaki, a Participatory Science Platform designed to bridge the gap between community groups, schools, iwi, businesses and science providers, and to encourage young people to become more involved with science.

Working with Urenui, Uruti, and Mimi Schools the project investigated shellfish abundance and diversity, sediment deposition across time, surface sediment chemistry, storm water testing and estuary water quality analysis, not to mention wider biodiversity surveying and pest species presence.

One of the key findings of the project was confirmation that human sewage was entering the estuary. Possible sewage run-off from Urenui Township had been a concern of the local community and Ngāti Mutunga for more than 50 years. These concerns increased when the population of Urenui and usage of the campground increased along with the aging of the septic tank systems in the township.

This contamination by human sewage has serious cultural, environmental and possible health implications for the awa, estuary and the local community. The testing undertaken during this project was carried out by Council staff (alongside Ngāti Mutunga whānau) and confirmed contamination was taking place.

The Council and New Plymouth District Council (NPDC) have worked together to identify and fix the sources of contamination. Community open days have been held and information packs sent out to residents to raise awareness around the importance of septic tank maintenance. This work is ongoing but is already making a positive impact, with monitoring showing a significant reduction in sewage contaminants entering the estuary.

In more good news, funding was included in the NPDC Long Term Plan in 2021 to design and construct a wastewater treatment facility for Urenui and Onaero. This would mean the septic tanks in these communities would be replaced by a community reticulated system, preventing any more sewage from entering the awa.

Urenui and Mimitangiatua estuaries are incredibly important to their associated communities for their cultural, historical, recreational, and environmental qualities. Te Āhua o Ngā Kūrei will continue to build on the results from the study and work to preserve and enhance the estuarine environments in the Ngāti Mutunga rohe.

Curious Minds Taranaki is a Participatory Science Platform delivered locally by Venture Taranaki in collaboration with Taranaki Regional Council and funded by the Ministry of Business, Innovation and Employment.

Coast

Intertidal rocky reefs are an iconic feature of the Taranaki coastline, providing habitat for a range of organisms that thrive in challenging coastal conditions. The seaweeds and animals that inhabit these reefs are an important part of the wider ecosystem, providing a food source for birds, fish and people. We monitor these habitats to improve our understanding of them, and identify changes over time.

Rocky reef systems are dynamic environments. Habitat complexity, wave exposure and sand inundation are three inter-related factors that have a major influence on the communities inhabiting rocky reefs. Reefs with high habitat complexity have a variety of substrates and spaces for a greater range of seaweeds and animals to occupy.

Manihi Reef, near Oaonui, has a range of boulders, rocks, cobbles and pools that provide a high level of habitat complexity. Wave exposure can shape rocky shore communities by limiting which seaweeds and animals are able to settle and become established, based on how much wave action they can tolerate. Waihi Reef, near Hāwera, is subjected to high wave exposure because of the short, steep profile of the reef, which gets battered by waves.

Sand inundation also has a pronounced and immediate impact, smothering and scouring rocky reef communities and reducing habitat complexity.

6
reef communities
surveyed twice per annum since 1994

½
monitored reefs are significantly affected by
sand inundation

83%
of reefs show a **declining long-term trend** in number of species

63%
of mussel samples collected from Waiwhakaiho Reef were **contaminated with norovirus**
Between 2015 and 2020

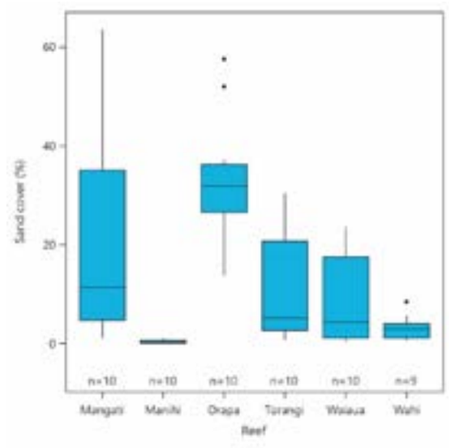
What we know

Since 1994, the Council has been surveying six reef communities in spring and summer each year: Tūrangi Reef at Motunui; Orapa Reef at Waitara; Mangati Reef near Bell Block; Waiaua Reef at Greenwood Road (west of Oākura); Manihi Reef near Oaonui; and Waihi Reef near Hāwera.

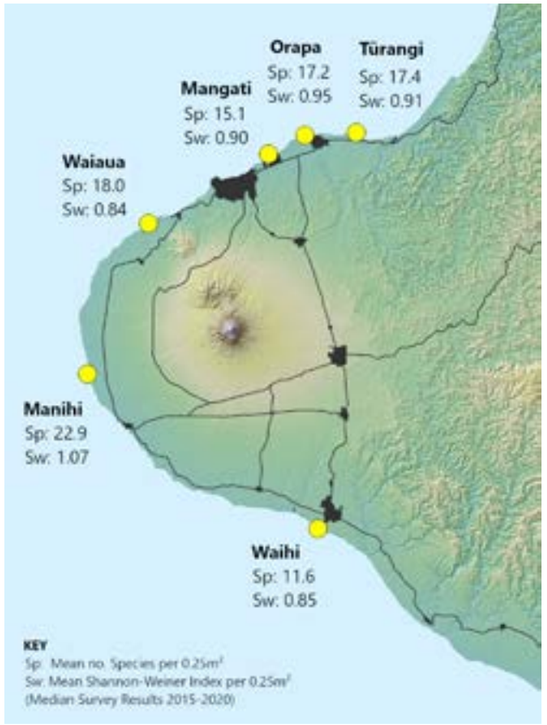
Biological diversity

Diverse biological communities are typically more resilient to stress, and are often indicative of environmental quality and ecosystem health. The Council uses two key metrics to assess the overall diversity of reef communities: the mean number of species, and mean Shannon-Wiener diversity index. The mean number of species refers to the average number of species found within 0.25m^2 of reef during a survey. The mean Shannon-Wiener diversity index considers how balanced the community is, by factoring in the number of species, as well as the relative abundance of each of those species.

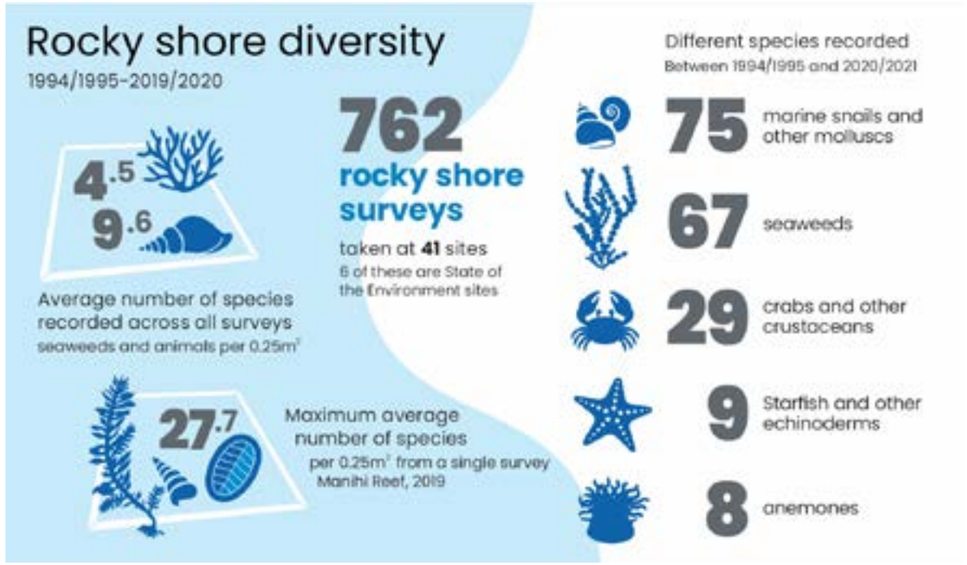
Results from 2015 to 2020 were consistent with those of previous surveys, and reflect key differences in intertidal rocky reef habitat and exposure around the Taranaki coastline. Manihi Reef had the greatest diversity of species and nearly double the number of species as Waihi Reef, which had the lowest number of species across all six sites. Waiaua Reef had the lowest Shannon-Wiener diversity index, despite having the second highest average number of species. At the three northernmost reefs, Tūrangi, Orapa and Mangati, diversity scores for both metrics were more comparable. Over the five-year period, sand cover was typically highest at Mangati and Orapa Reefs, but virtually absent at Manihi Reef.



Box and whisker plots showing the range in sand coverage at the different monitoring sites between 2015 and 2020.



Median survey results from the six State of the Environment monitoring sites between 2015 and 2020.

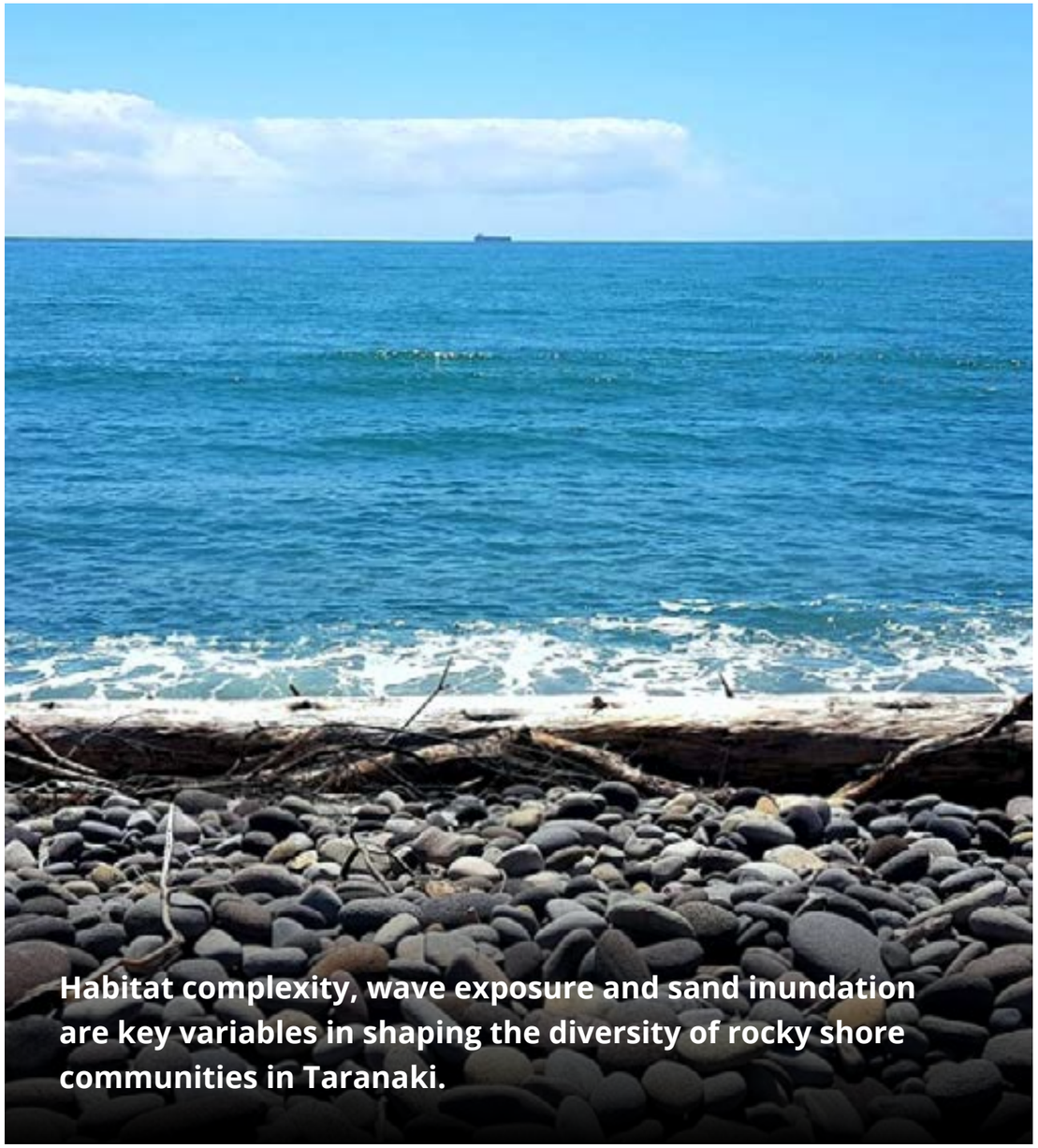


Long-term (1995-2020) trends were assessed with and without correction for sand cover, in order to determine whether any may be attributed to the impact of sand inundation. The results showed that sand cover negatively influenced trends in the average number of species found at three sites. At Mangati and Waiaua Reefs, trends were no longer decreasing when sand cover was taken into account, and at Orapa Reef, an indeterminate trend became an increasing trend. All three of these sites have been subjected to significant sand inundation events in the past. Waihi Reef, another site impacted by sand inundation, had a very likely decreasing trend that did not change following a correction for sand inundation, suggesting that this decline is being driven by other factors. A very likely increasing trend was found for the Manihi Reef site, and no trend was found for Tūrangi Reef. The trend with the greatest rate of change was the sand-adjusted trend at Orapa Reef, which was increasing by 1% per year. This rate of increase equates to the average number of species found at this site increasing by one every seven years.

Likely decreasing trends in Shannon-Wiener diversity index were found at two sites, and very likely decreasing trends were found at three sites. When sand correction was applied to the data, decreasing trends became increasing trends at Mangati and Orapa Reefs; reaffirming the influence of sand inundation events at these sites.

Short-term variability may be driven by sporadic events such as periodic sand inundation, or other cyclical patterns such as climatic cycles, or recruitment variability of different rocky shore species. Over the short term (2011-2020) period, very likely increasing trends in the mean number of species were identified at five out of six sites, and a likely increasing trend at just one site, Waihi Reef. The annual rates of change in these trends ranged from 2% at Waihi Reef to 8% at Waiaua Reef; much higher than those of the long-term trends. In some instances, adjusting for sand cover lessened the magnitude of the trends. Five out of the six short-term trends for Shannon-Wiener diversity index were very likely increasing, while there was no trend found at Waihi Reef.

Given the major role that habitat complexity, wave exposure and sand inundation play in shaping rocky shore communities on the Taranaki coast, it can be difficult to determine subtle changes that may be attributed to human activities. Although more noticeable impacts have been detected in the past, this monitoring programme has not linked any changes in rocky reef communities to human activities, such as wastewater discharges, in recent years. A separate Council monitoring programme however, has demonstrated the effects of wastewater contaminants in nearby shellfish on the rocky shore.



Habitat complexity, wave exposure and sand inundation are key variables in shaping the diversity of rocky shore communities in Taranaki.

Canny canine nose helps protect penguins

Penguin detector dog Rua with handler Jo Sim.

You may be unaware of the company you're keeping when you're on the New Plymouth Coastal Walkway or fishing from the breakwater at Port Taranaki.

Not only are there likely to be kororā, or little blue penguins, deep in crevices between the rocks all around and under you, but they are probably in numbers that would surprise you.

Rua the penguin detector dog knows. Handler Jo Sim has put him to work along the North Taranaki coastline, from the New Plymouth CBD out to Waitara, and at Port Taranaki.

"If people join me, they're always very surprised at how many we find," she says. "It surprised me, too, when I first started doing this work."

Kororā are particularly vulnerable to disturbance, so the information gathered by Jo and Rua is vital for their protection. For example, under the Council's new Coastal Plan, any work on maintaining and altering coastal structures in Taranaki should have 'no adverse effects on significant indigenous biodiversity' including kororā. First, find your kororā.

It is also valuable information at district level, where it can be fed into decisions on planning, recreation and even dog control bylaws.

Horowhenua-based Jo and Rua, with apprentice pup Miro, don't limit themselves to burrowing seabirds. They specialise in a wide range of native bird species, including kiwi. The human-canine team is in hot demand all over the motu and they've even worked in the Chatham Islands.

So how do you train a dog to find penguins? Or any species, for that matter? With a great deal of patience, says Jo. She trains her own animals, to the standard required to win accreditation by the Department of Conservation.

The first step is obedience training, then introducing the concept of indicating the presence of the target species. After that, the dog is introduced to the target's scent.

"With penguins, it's relatively easy because they have a strong and distinctive smell. I use penguin feathers, mainly."

Nine-year-old Rua has proved to be brilliant, Jo says – especially considering she was unsure about taking him in when he needed a new home. Miro has also shown good promise but at just a year old, "he still has some growing up to do".

But what's in it for the dogs? Surprisingly, it's generally reward enough to see the bird at the end of the trail. "They're so happy just to see it – their delight is obvious," says Jo. "Penguins are a bit of a challenge, though, because they're way down in their burrows and the dogs won't see them. So I've started using treats when we're looking for penguins."

Apart from the numbers found, there's one other aspect of their kororā quests that has surprised Jo: finding penguins and paradise ducks as nesting neighbours.

"It's more in embankments than in boulder banks – you peer down a burrow expecting to see another penguin, and a big white duck head stares back up at you."

Shellfish monitoring

Green-lipped mussels are filter-feeders, which means they filter seawater and consume the plankton and tiny particles of organic matter. During this filter-feeding process, mussels can end up ingesting and accumulating environmental contaminants that may also be in the water. Their ability to accumulate contaminants can lead to them becoming unsuitable for human consumption, but this also means they can be used as a bio-indicator for environmental monitoring purposes.

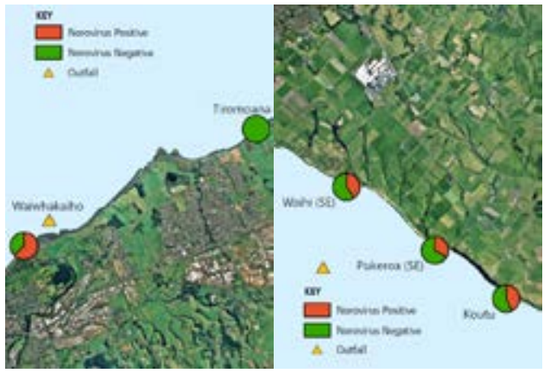
The Council monitors mussel reefs in the vicinity of the New Plymouth and Hāwera wastewater outfalls in order to assess potential impacts of the discharges over time. Norovirus and heavy metals have been the main contaminants of interest over the last five years.

Norovirus

Noroviruses are infectious to humans and can cause vomiting and diarrhoea when ingested. Municipal wastewater contains varying levels of norovirus, which can then pose an environmental health risk when the wastewater discharges into the sea. Norovirus infections can result from ingesting contaminated seawater; however, there is a higher risk of infection from consuming raw shellfish.

Between 2015 and 2020, five out of the eight mussel samples collected from Waiwhakaiho Reef were contaminated with norovirus, although mostly at low concentrations. Over the same period, all seven samples collected from Tiromoana Reef, just north of Bell Block, returned negative results. These differing results are likely related to the distance of the two sites from the outfall. Although there was no norovirus was detected at Tiromoana Reef during the monitoring period, it has been detected in the past.

Mussels were also collected from three reefs between Denby Road and the Tangāhoe River Mouth in relation to the Hāwera wastewater outfall. Based on the nine sampling occasions over the five years to 2020, at least one of the three sites was affected by low levels of norovirus 56% of the time, and two or more sites were affected 33% of the time.



Proportion of mussel samples collected near New Plymouth (left) and Hāwera (right) that tested positive for norovirus between 2015 and 2020.

Heavy metals

Heavy metals exist naturally in the environment at low levels, but can become toxic above certain concentrations and pose a health risk when they accumulate in kaimoana. Potential sources of heavy metals include human wastewater and waste products from industrial processes discharged into the environment.

In Taranaki, these discharges are monitored and regulated to prevent negative impacts at the coast. However, wastewater discharges are not the only source of elevated metals in the environment. When it rains, stormwater washes metal contaminants from land (particularly in urban environments) into rivers, streams, and eventually the coast via diffuse run-off pathways and piped stormwater discharges.

From 2015 to 2020, New Plymouth mussels were tested for metals at East End Beach, Waiwhakaiho Reef and Tiromoana Reef, and Hāwera mussels were tested at two sites at the southern ends of Waihi and Pukeroa Reefs. All mussels had concentrations of metals well within the applicable food safety guidelines.

What we're doing

Pātea Reef research

Research is underway to help improve our knowledge of subtidal reefs in the South Taranaki Bight (STB) through a combination of community and Council-led initiatives.

During 2020-2021, NIWA researchers visited South Taranaki waters to undertake mapping of the seafloor of targeted areas using acoustic multi-beam technology. Biological information was collected through videos and images of the different reefs using an underwater tow camera system. All up, roughly 76 hours of survey vessel time was spent in the STB, producing high-resolution bathymetry data for a number of previously uncharted reefs, and assessments of the biological communities for a subset of those.

The Council has supported this research by securing funding through the regional council Envirolink scheme for NIWA to collate, analyse and report on the survey data to ensure this valuable information is accessible for the Council and the community going forward.

In the past, subtidal reefs in Taranaki have received little scientific attention. The community-led citizen science initiative Project Reef has been working hard to bring these important habitats to the attention of the researchers and the wider public.

Where we're heading

Impacts of a changing climate

In order to understand the future of rocky reef communities in Taranaki, it is helpful to look back in time. We know that sand supply to the coast increased following a major erosion event on the mountain in 1998, which turned sections of rocky shoreline into sandy beaches. Erosion has been ongoing, with another significant event in 2008. Researchers have linked these erosion events to a possible increasing trend in storm intensity, based on increasing flood peaks observed in stream flow monitoring data.

A recent study by Rapizo and others (2020) also found evidence to suggest that the Taranaki wave climate has changed over the last 40 years, including an increasing trend in significant wave height during storm peaks. The influence of these factors is likely to continue changing over time, as will that of other factors such as sediment and nutrient run-off from land, invasive species, and global issues such as sea level rise, ocean warming and ocean acidification.

Ongoing monitoring and further investigation will be critical for understanding how local rocky reef communities respond, and how we best manage them going forward.

Recreational use of rivers, lakes and beaches

Every summer between November and March, Council staff work with the three district councils and the Taranaki District Health Board to ensure water quality in our rivers, lakes and beaches is suitable for swimming and recreation.

In Taranaki, the most popular freshwater and coastal bathing sites are suitable for swimming and recreation following two to three days of fine weather. However, during and after rainfall, faecal contamination can enter rivers, lakes and the coast through run-off or via stormwater.

Livestock, birds, dogs and even humans are among the many potential sources of faecal contaminants that can affect recreational water quality.

Our recreational bathing monitoring programme involves collecting weekly water samples to test for faecal indicator bacteria, and undertaking surveys for potentially toxic algae – also known as cyanobacteria. The latest results are published on the Land, Air, Water Aotearoa (LAWA) website via 'Can I Swim Here?' and on each of the councils' websites.

37
popular swimming spots
are monitored Nov-Mar each year

Water was suitable for swimming
90% of the time at **19 monitored beach sites** and **65%** of the time at **18 monitored freshwater sites**
2015-2020

Long-term trends show beach water quality **improving** at **33%** of sites and **deteriorating** at **20%** of sites

42
out of 175 lake surveys
showed **toxic algae** present at levels unsafe for swimming

What we know

The Council's recreational water quality monitoring programme has undergone considerable change recently. Prior to November 2021, we collected recreational water quality samples during fine weather. Sampling now occurs weekly regardless of weather conditions. This change brings the Council's monitoring programme into line with new national policy requirements and provides our community with greater awareness of suitability for swimming and recreating during a range of weather conditions.

To date, the dry weather monitoring approach has helped the Council to characterise recreational water quality around the region during fine conditions when many people are likely to swim. We know that many people across Taranaki are still getting in the water during wet weather (or soon after), so it is important to collect data during those conditions too.

Faecal indicator bacteria

In rivers and lakes, *Escherichia coli* (*E. coli*) is the preferred indicator organism; for beach sampling it is enterococci. By themselves, these organisms don't necessarily present a human health hazard. However, they are indicative of the presence of other harmful disease-causing bacteria, viruses and protozoa that cannot be detected so easily. When their numbers exceed guideline levels, faecal indictor bacteria signal an unacceptable level of risk to human health.
Both freshwater and marine guidelines have three levels: Surveillance (suitable for swimming), Alert (still suitable for swimming, but caution advised) and Action (unsuitable for swimming).

Recreational water	Faecal indicator bacteria	Guideline Mode		
		Surveillance	Alert	Action
Freshwater	*E. coli* (no per 100 ml)	No single sample >260	Single sample 261-550	Single sample >550
Marine	Enterococci (no per 100 ml)	No single sample >140	Single sample >140	Two consecutive samples > 280

Guideline values for swimming and recreation are set out in the Ministry for the Environment and Ministry of Health's 2003 Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas.

Between November 2015 and March 2020, we collected 1,232 samples from 18 freshwater river and lake sites across the region. As noted above, these samples were collected during fine weather conditions. Some sites were included in our annual monitoring programme while others were sampled on a rotational (three-yearly) basis.

Under the guidelines, 806 samples (65%) were at a surveillance level and suitable for swimming, while 208 samples (17%) were at alert level where caution was

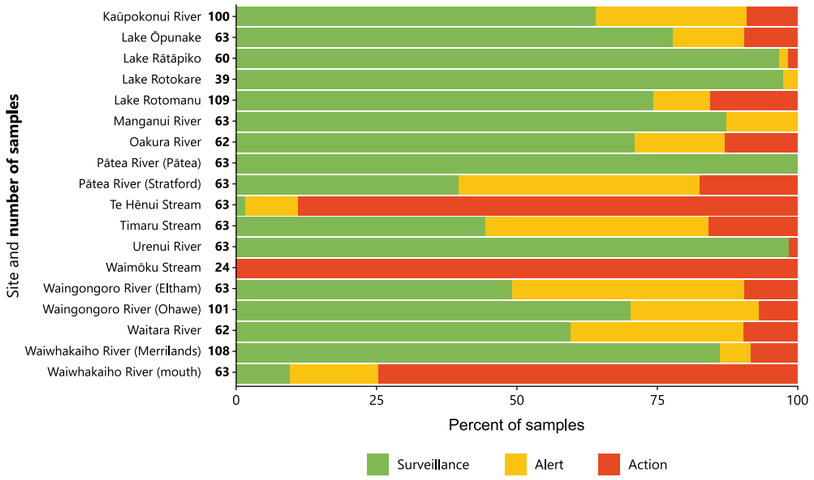
advised. A total of 218 samples (18%) were at action level, meaning these sites were unsuitable for swimming at this time.

More than half of those samples (127 of 218) came from just three urban sites in the lower reaches of Te Hēnui Stream, Waiwhakaiho River at New Plymouth and Waimoku Stream at Oākura. Permanent health risk warnings have been posted at each site. Bacteria levels at the remaining 15 sites were acceptable for swimming (below the action guideline) on 92% or more sampling occasions. Pātea and Urenui Rivers (under high tide conditions) and Lakes Rātāpiko and Rotokare were the sites suitable for swimming most often.

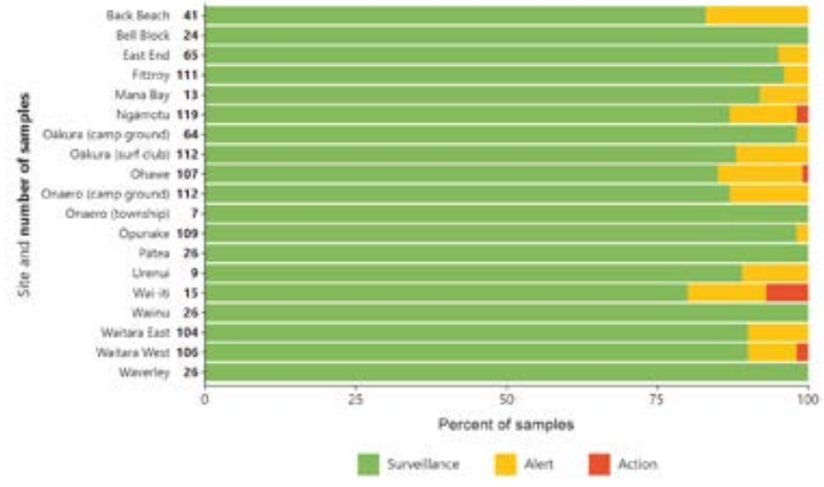
The proportion of guideline exceedances was far fewer in marine waters over the same five-year period, based on 1,196 water samples collected from 19 swimming beaches. Of those, 1,094 sample results (91.5%) were in surveillance mode, 96 samples (8%) were in alert mode and six (0.5%) were in action mode.

Of the 10 annually monitored beaches, four remained in surveillance mode on 95% or more of the sampling occasions (Ōpunake 98%, Oākura opposite the campground 98%, Fitzroy 96% and East End 95%). Another two beaches were in surveillance mode on 90% of the sampling occasions (Waitara East and Waitara West). The remaining four were in surveillance mode on 85 - 89% of occasions (Oākura opposite the surf club 88%, Ngāmotu 87%, Onaero at campground 87% and Ohawe beach 85%).

The proportion of sampling occasions where the rotationally monitored beaches were in surveillance mode ranged from 80 to 100%. There were six occasions where beaches were deemed unsuitable for swimming (action mode) between 2015 and 2020. This included Wai-iti and Ohawe on one occasion, and Waitara West and Ngāmotu Beach on two occasions.



Percentage of river and lake samples collected between 2015 and 2020 achieving surveillance, alert and action levels. The number of samples collected is shown next to each site name.



Percentage of beach samples collected between 2015 and 2020 achieving surveillance, alert and action levels. The number of samples collected is shown next to each site name. Sites with more than 50 samples were monitored annually; the others were monitored on a three-yearly rotational basis.

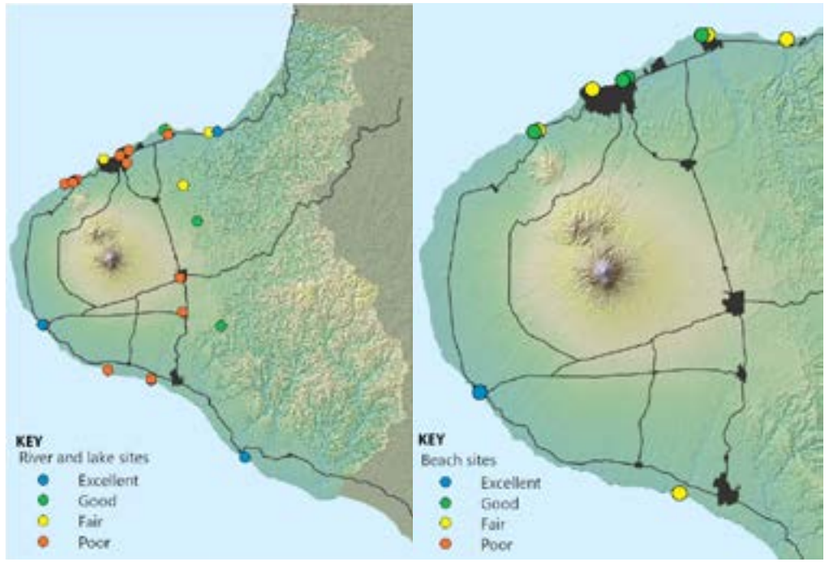
Long-term suitability for swimming

To assess overall suitability for swimming and recreation, long-term grades are calculated using five years' worth of data and applying the 95th percentile to *E. coli* results for freshwaters and enterococci for marine waters. These grades provide a general indicator of swimming water quality.

Out of 18 freshwater sites, the microbiological water quality for contact recreation was "excellent" at two sites, "good" at two sites, "fair" at one site, and "poor" at the other 13 sites. The highest quality was at two estuarine sites, Pātea and Urenui, followed by Lakes Rātāpiko and Rotokare. Further inland, Manganui River at Everett Park received a fair grade. The lowest graded sites were streams draining the ring plain, mainly near the coast, with two sites inland at Eltham and Stratford.

Of the 10 annually monitored swimming beaches, the long-term grade was 'excellent' at one (Ōpunake Beach), 'good' at four (Waitara West, Fitzroy, East End and Oākura Beach opposite the campground) and 'fair' at five (Onaero at the campground, Waitara East, Ngāmotu Beach, Oākura opposite the surf club and Ohawe Beach). None of the beaches had a 'poor' long-term grade.

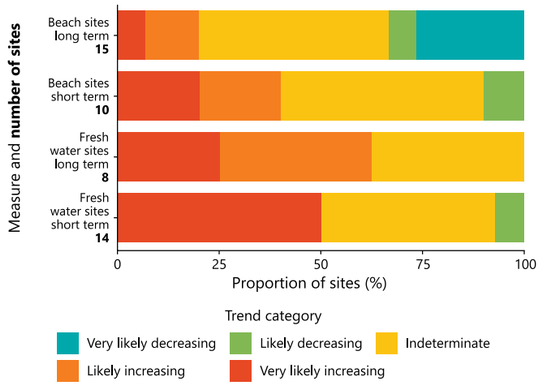
Long-term grades are generally higher (and the number of guideline exceedances lower) at beaches located further from potential sources of contamination such as river and stream mouths and stormwater outlets. The difference in water quality between Oākura opposite the campground and Oākura opposite the surf club is a good example of this. Although these sites are only 300m apart, the Waimoku Stream often meanders in front of the surf club; affecting coastal water quality where it enters the sea. As a result, microbiological water quality at the surf club site has received a 'fair' grade, while the campground site is graded 'good', with 10% fewer guideline exceedances.



Long-term (five-year) recreational water grades for annually monitored freshwater sites (left) and coastal beaches (right).

Eight river and lake monitoring sites had sufficient data to carry out long-term (20+ years) trend analysis. Five river sites (63%) showed deteriorating trends over the long term and no sites showed improvement. Trends for three sites (37%) were indeterminate. Short-term (10-year) trends could be calculated for 14 sites. Over the short term, one site (7%), Lake Rotomanu in New Plymouth, showed an improving trend. Seven sites (50%) showed a deteriorating trend: Kaūpokonui River at the beach domain, Oakura River at Corbett Park, Pātea River at Stratford, Timaru Stream at the coast, Waingongoro River at Eltham, Waingongoro River at Ohawe Beach, and Waitara River at the Waitara town wharf. Trends for six sites (43%) were indeterminate.

Fifteen beach monitoring sites had sufficient data to carry out long-term (20+ years) trend analyses. Short-term (10-year) trends could be calculated for 10 sites. Over the long-term periods, five sites (33%) showed improving trends, three (20%) degrading trends, while trends for the remaining seven sites (47%) were indeterminate. Over the 10-year period, one beach site (10%), Oākura opposite the surf club, showed improvement. Four beach sites (40%), Ngāmotu, Ohawe, Onaero at the campground, and Waitara East, showed deteriorating trends. Trends at the remaining five beach sites (50%) were indeterminate. When comparing the long-term results with the short-term results, there were only three beaches where trend direction did not change. Overall, compared to the long-term results, there were a higher proportion of deteriorating and indeterminate trends and a lower proportion of improving trends.



Summary of long-term and short-term trends of faecal indicator bacteria numbers for all monitored beaches and freshwater sites.

Potentially toxic algae (cyanobacteria)

In rivers, potentially toxic algae (or cyanobacteria) typically require a hard substrate such as cobbles and boulders to attach to. When conditions are suitable cyanobacteria can form in numbers that produce mats that cover stony riverbeds or in lakes form bright green or blue 'blooms' or scums at the lake edge. Both benthic (found in rivers) and planktonic (found in lakes) cyanobacteria increase in numbers during favourable conditions, which include warmer water temperatures and greater sunlight hours along with moderate nutrient levels.

Potentially toxic algae or cyanobacteria surveys consist of a visual assessment of benthic cyanobacteria on the riverbed, and microscopic analysis of water samples for planktonic cyanobacteria in lakes. When levels of cyanobacteria exceed the guidelines, there is an increased potential health risk. When 'action' mode is reached, sites are closed for recreational use. Since 2012, we have done monthly benthic cyanobacteria surveys from November through March at nine river monitoring sites in the region.

Mode	Benthic cyanobacteria – rivers		Planktonic cyanobacteria – lakes	
	Percentage cover of potentially toxigenic cyanobacteria attached to substrate	Presence of detaching and exposed mats	Cyanobacteria total cell count (cells/mL)	Bio-volume (mm3/L)
Surveillance (low risk)	Up to 20%	Nil	Less than 2,000	<0.5
Alert (medium risk)	20–50%	Minor	2,000 to 15,000	0.5-1.8
Action (high risk)	Greater than 50%	Significant	More than 15,000	>1.8

Benthic (rivers) and planktonic (lakes) cyanobacteria assessment guidelines (adapted from Ministry for the Environment and Ministry of Health, 2009).

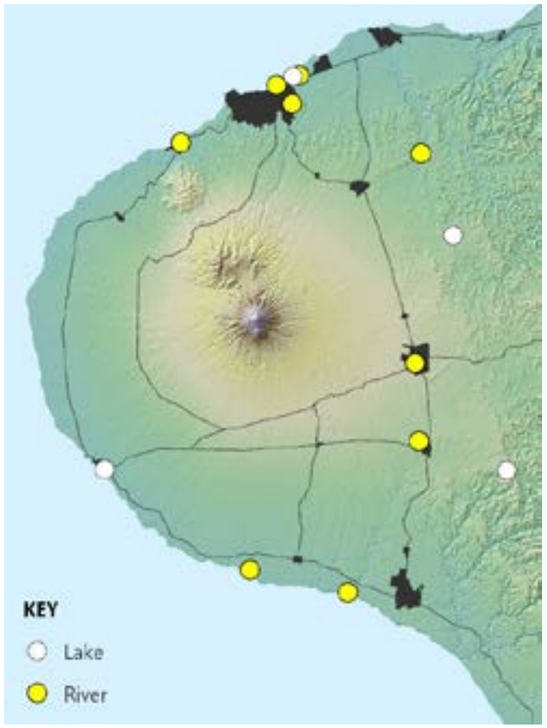
Cyanobacteria (Microcoleous sp.) mat found on the bed of a Taranaki river.

Period	Total surveys	Surveillance (up to 20% of substrate cover, and no detached or exposed mats)	Alert (20–50% of substrate cover, and/or minor presence of detached or exposed mats)	Action (greater than 50% of substrate cover, and/or signif-icant presence of detached or exposed mats)
2015-2016	121	105	15	1
2016-2017	107	104	3	0
2017-2018	96	92	4	0
2018-2019	114	106	8	0
2019-2020	98	88	9	1
Total	536	495	39	2

Benthic cyanobacteria results showing the number of Alert and Action mode events in monitored rivers, 2015-2020.

Since 2014, planktonic cyanobacteria has been monitored at four lakes during the recreational bathing season, with surveys carried out approximately every two weeks. During the past five years, there were 42 occasions (24%) when cyanobacteria levels reached action level. Each time the lake was closed to recreational users. During the majority of surveys, cyanobacteria levels were at alert (15%) or surveillance level (61%) where samples were below 0.5mm^3/L and no additional monitoring was required.

Roughly half of the action mode events for planktonic cyanobacteria during 2015-2020 occurred at Lake Rotokare, including the eight highest results.



Cyanobacteria monitoring sites in Taranaki lakes and rivers.

Monitoring period	Total surveys	Surveillance (<0.5mm3/L)	Alert (0.5 – 1.8mm3/L)	Action (>1.8mm3/L)
2015-2016	31	12	7	12
2016-2017	29	17	3	9
2017-2018	36	22	2	12
2018-2019	42	28	6	8
2019-2020	37	27	9	1
Total	175	106	27	42

Planktonic cyanobacteria results showing the number of surveillance, alert and action mode events in monitored lakes, 2015-2020.

What we're doing

New monitoring sites added

Keeping our community up to date with the latest water quality information is the focus of the recreational bathing monitoring programme.

A community survey of 524 people over summer 2019-2020 found that beach sites, particularly those central to New Plymouth, were the most frequented sites, with Fitzroy Beach and the Coastal Walkway top of the table in terms of popularity. Travel distance and proximity were important factors in determining where people choose to visit. For more than half of the respondents (56%), time constraints due to work and family commitments was the main reason people didn't visit rivers, lakes and beaches as much as they would like.

The survey also found that most people perceive access to recreational areas to be good, and identified that the majority of the most popular sites were already being monitored. In response to the survey findings, we added five new sites to the programme: Waiwhakaiho River at Meeting of the Waters, Lake Rotorangi, Tongaporutu Estuary, and Waiinu and Wai-iti Beaches. Monitoring of the new sites began in summer 2021-2022.

Faecal source tracking

When waterways become contaminated, identifying the source of the pollution is an important part of the contamination management strategy. During the past 12 years, the Council has carried out inspections and DNA analysis to identify sources of faecal contamination at popular swimming and recreation locations. Faecal source tracking methods have been employed at 20 locations around the region where water quality issues have warranted further investigation.

Faecal source tracking techniques can help identify sources of faecal contamination of water, for example whether they are from animals, humans or birds. If an initial test indicates high levels of *E. coli*, we can undertake further analysis from a 'toolbox' of methods. This could include extracting DNA from water samples to identify microorganisms present in faeces, which are specific to their animal hosts. When certain microorganisms are present, it indicates the source of the faecal contamination, which could be human, or from livestock, dogs or wildfowl. Livestock are often the main contributor of faecal bacteria in rural areas, whereas large flocks of birds (including gulls, ducks and pūkeko) have contributed to water quality issues in some urban areas near the coast. Occasionally, sources of human wastewater have

also been detected in urban waterways, often associated with aged or faulty infrastructure.

In 2019, faecal source tracking techniques were used to discover the presence of human sewage contaminants in the stormwater discharging from the Urenui township into the estuary. Other than this, no new sources of human faecal contamination in recreational waters have been found as a result of faecal source investigations in Taranaki over the last five years.

Where we're heading

One shortcoming of the current recreational water quality monitoring design is that there will always be a delay between sample collection, analysis, receiving results and delivering the public health advice. This is primarily because bacteria need time to grow in the lab as part of the analytical process. While we can try to minimise the time between sample collection and delivery of the information, there will always be a delay.

By collecting all-weather water quality data, it may be possible to develop a predictive rainfall risk model, which can forecast the contamination risk of bathing waters, based on preceding rainfall volumes and/or river flows. As the Council collects more data, we will be able to explore opportunities to develop a rainfall risk model to give real time predictions of water contamination risk.

In the meantime, the public is advised to check the latest testing results on the LAWA or Council websites, consider whether there's been heavy rain during the last three days, and avoid murky water where their toes aren't visible when knee deep. Check for submerged logs, swift water and other hazards such as cliffs or overhanging trees. Keep a close eye on your friends and whanau. And remember, if in doubt – stay out.

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