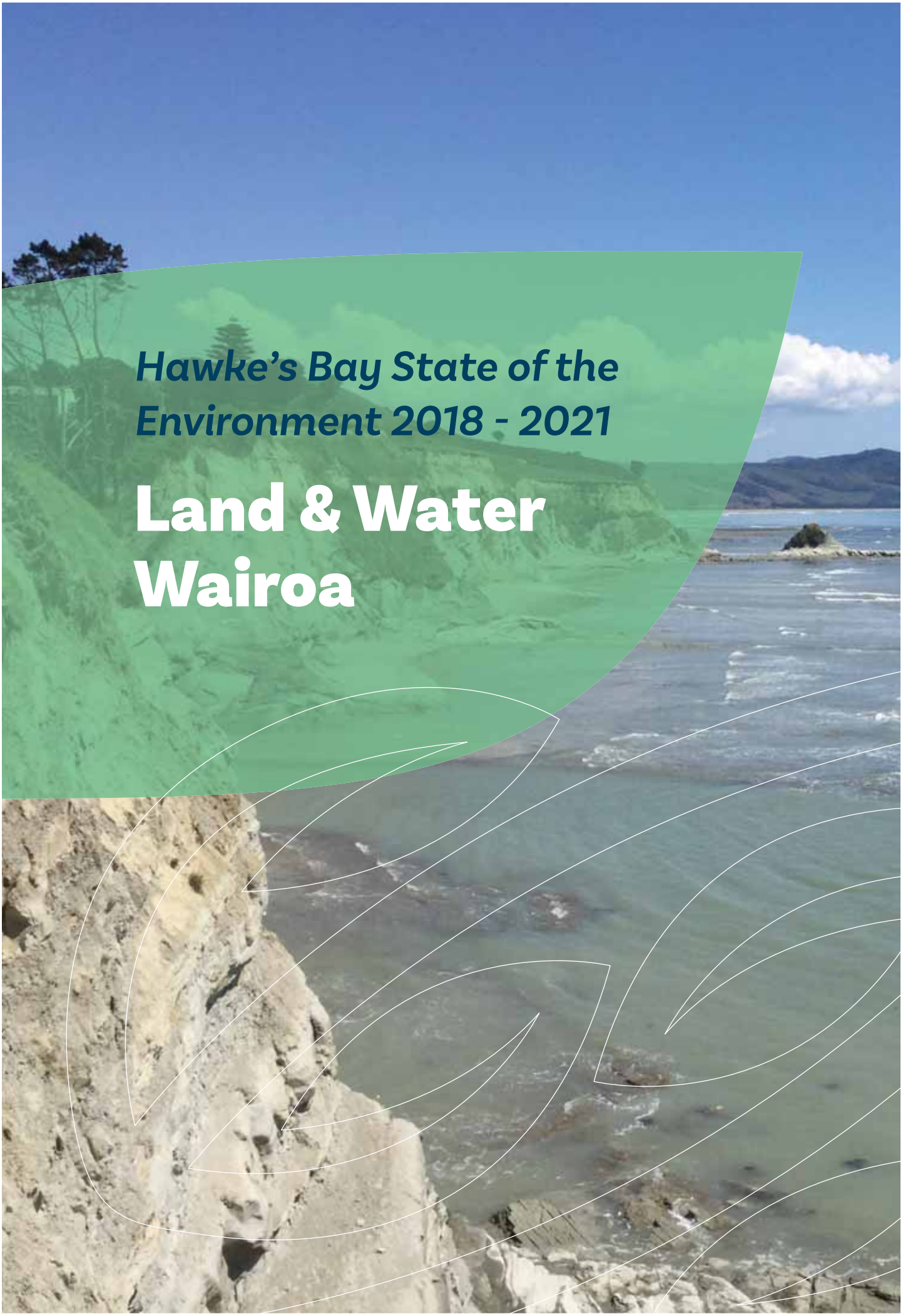
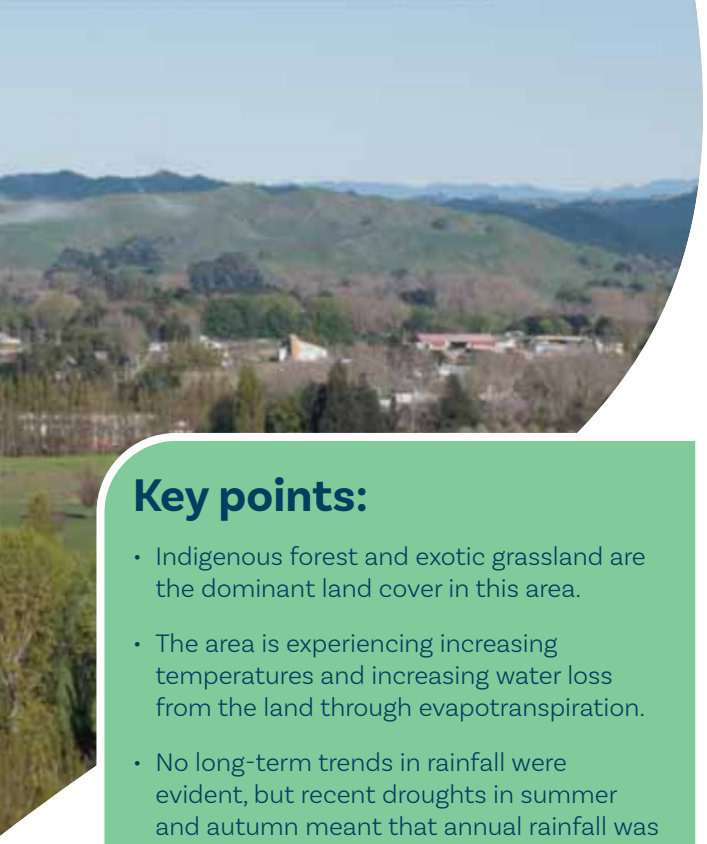


*Hawke's Bay State of the Environment 2018 - 2021*

# Land & Water Wairoa



# 15. Wairoa/Northern Hawke's Bay catchments

## Key points:

- Indigenous forest and exotic grassland are the dominant land cover in this area.
- The area is experiencing increasing temperatures and increasing water loss from the land through evapotranspiration.
- No long-term trends in rainfall were evident, but recent droughts in summer and autumn meant that annual rainfall was lower than the long-term average.
- Annual mean flow in the main rivers in this catchment has decreased (less water on average).
- Sediment and *Escherichia coli* are the main stressors for the river and estuarine systems, impacting recreational values and macroinvertebrate health.
- Northern rivers have poorer recreational water quality than similar systems elsewhere in the region.

***For the roughly 6000 people who call the northern Hawke's Bay home, the natural resources – sandy beaches, winding rivers, and productive soils – create a daily connection with their natural environment. The health of these systems, and the values that they provide to people, are an essential part of how we live.***

***To ensure that these resources stay healthy for years to come, we need to understand the current health of our land, rivers, lakes, and beaches – and how climate change and human use will affect them in the future.***

## Land Cover

The Wairoa/Northern Hawke's Bay catchments includes indigenous forest in the southern Huiarau Ranges, lower hill country, Wairoa township, and numerous coastal towns and settlements. The dominant land cover in the area is exotic grassland associated with sheep/beef farming (33%) and indigenous forest (35%; Figure 15-1). This has not changed significantly over the last two decades (Figure 15-2).

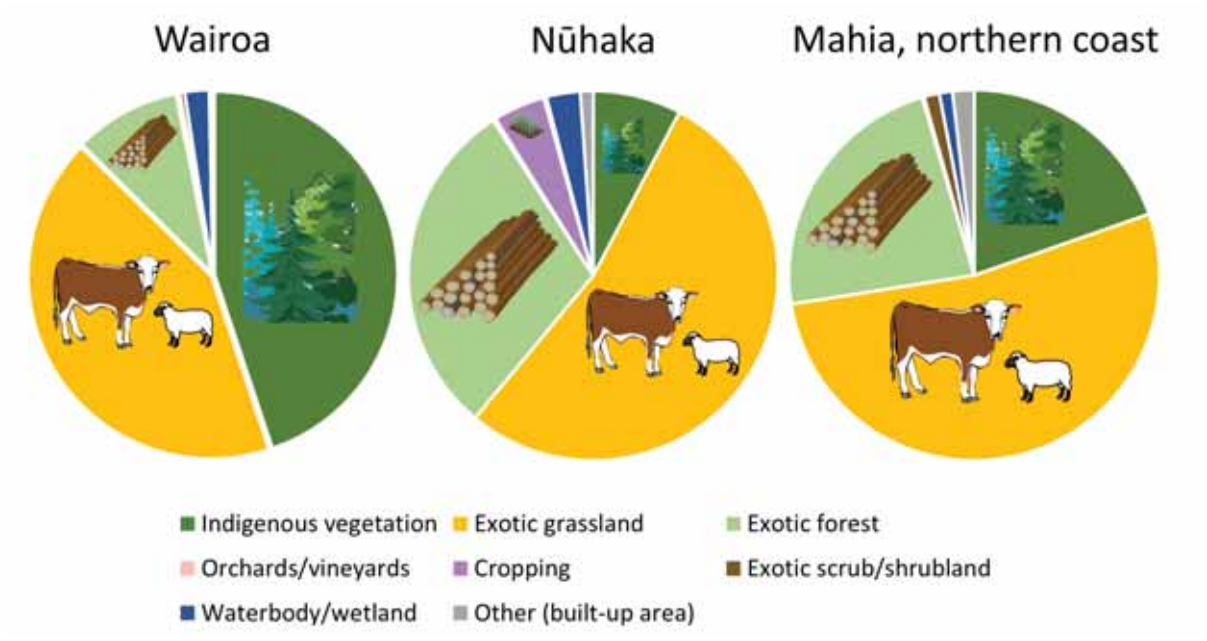



*Figure 15-1. Land cover in the Wairoa/Northern catchment. The 'other' category includes built-up areas (settlements, urban parkland, and transport infrastructure) and bare surfaces such as bare soil, gravel, and rock.*

**Both land use type and soil type determine how sediment moves off the land, into waterways, and out to the coast.**

The soils underneath productive land tend to be brown soils, podzol soils in the north-eastern Huiarau ranges and lower hill country east of Wairoa River, and pumice soils in the northern and southwestern area of Wairoa, Nūhaka, and Mahia. Each of these soil types has different properties, which means sediments and nutrients behave differently when applied to these soils. Brown soils tend to have low to medium fertility levels and relatively stable topsoil. Podzol soils can be strongly acidic, while pumice soils tend to have low natural nutrient levels and high drainage capacity.

Both land use type and soil type determine how sediment moves off the land, into waterways, and out to the coast. Both pumice soils and podzol soils are highly erodible due to low soil stability and limited rooting depths respectively. Coupled with steep terrain, this means that the area is prone to erosion.

While sediment loss and erosion are a natural feature of the landscape, the rate of sediment loss has increased because of changes in land use (see Soil and sediment chapter). Sediment load lost from these catchments averages just over 3 million tonnes per year, estimated to be approximately 240% more than before human arrival.

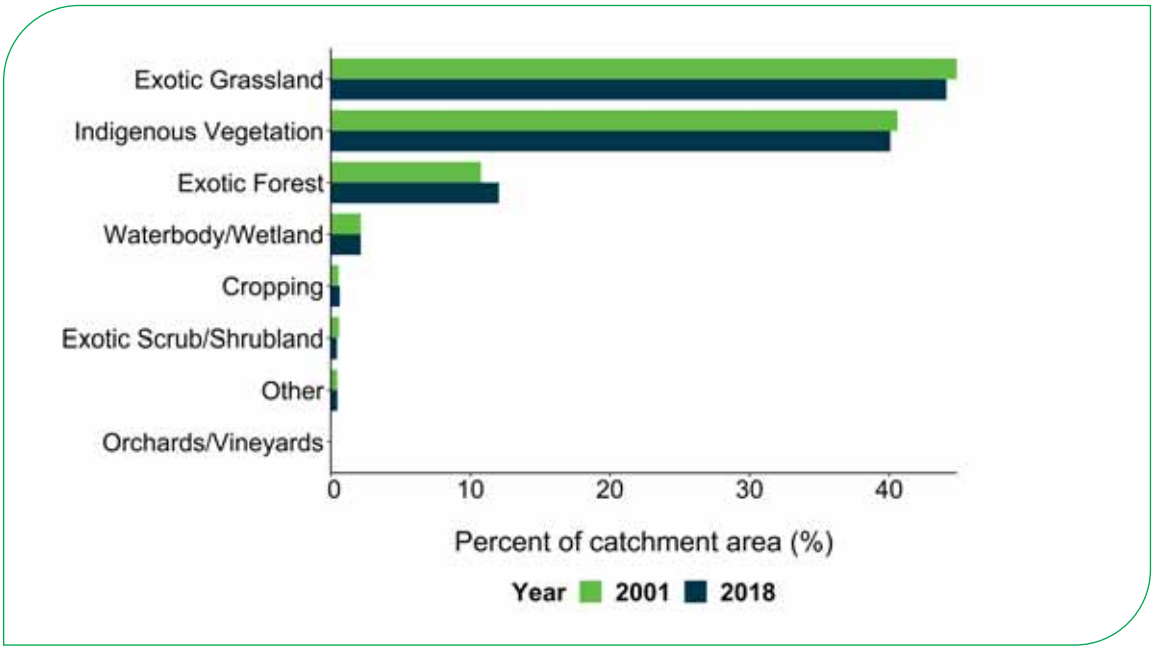
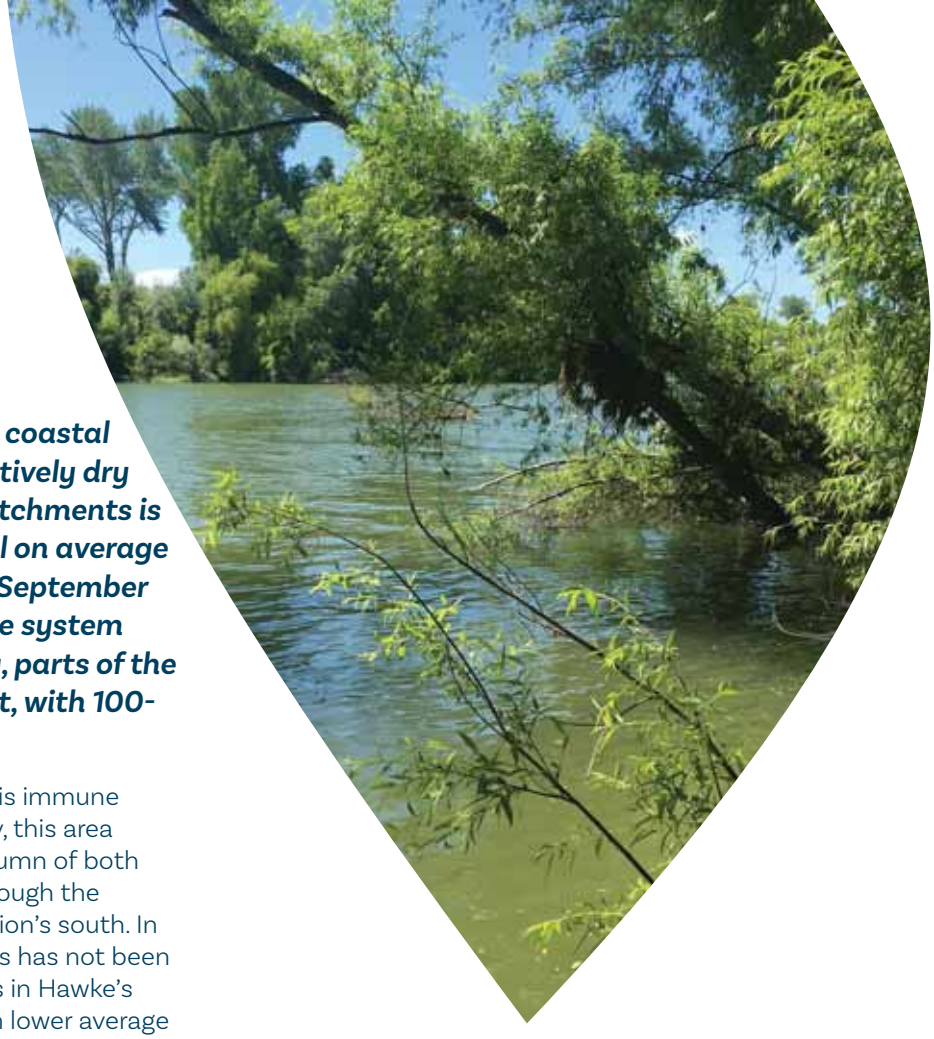



*Figure 15-2. Land cover change for Wairoa/Northern catchments (431,732ha) between 2001 and 2018. The 'other' category includes built-up areas (settlements, urban parkland, and transport infrastructure) and bare surfaces such as bare soil, gravel, and rock.*

# Climate



***Climate affects how the land can be used, as well as how land use contributes to the quality of groundwater, surface water, and coastal waters. Given Hawke's Bay's relatively dry climate, the Wairoa/Northern catchments is fortunate to receive more rainfall on average than most of the region. In early September 2018, when a stalled low-pressure system brought flooding to Hawke's Bay, parts of the Wairoa catchment were worst hit, with 100-year floods.***

However, that does not mean the area is immune to drought. Like the rest of Hawke's Bay, this area had low rainfall in the summer and autumn of both 2019-20 and 2020-21 (Figure 15-3), although the drought was not as severe as in the region's south. In addition, spring over the last three years has not been as consistently and impressively wet as in Hawke's Bay's southern catchments, resulting in lower average annual rainfall than in areas further south.

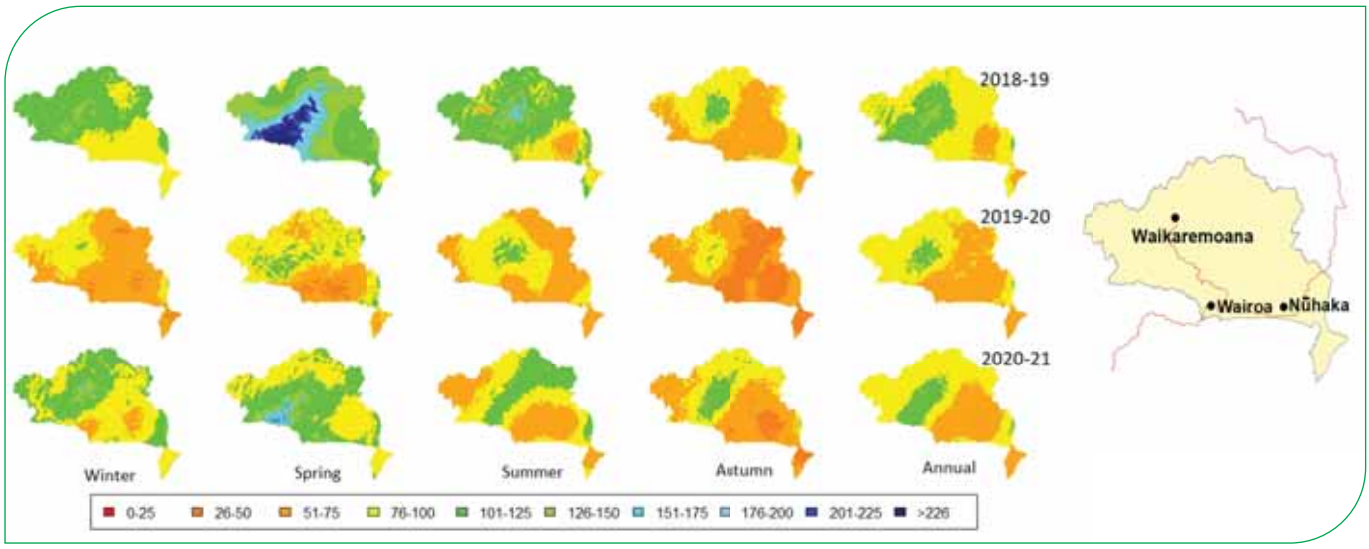



*Figure 15-3. Seasonal and annual rainfall for 2018-2021, shown as a percentage of the long-term average.*

Temperature and evapotranspiration both appear to have increased over the last 20 years in this part of the region, but no trend in rainfall was detected over this time. The number of days with a minimum temperature below the 10th percentile have decreased, but so too have the number of days with a maximum temperature greater than the 90th percentile. In other words, the range of daily temperatures has narrowed.

Climate change projections for the catchments include warming temperatures, fewer frosts, and lower annual rainfall. Projections show rainfall may decline 4% by the end of the century, with the largest decline during spring.

## Surface water flows

***While there are no trends in the long-term rainfall record, the lower-than-average rainfall from 2018-2021 contributed to lower flows in many of the Wairoa/Northern Hawke's Bay river systems. Compared with the long-term average, both the Waiau and Wairoa Rivers had significantly lower mean annual flows during this period. This indicates a lower number of large flows and floods, especially in 2019/20 and 2020/21, when annual mean flows were below their normal range (Figure 15-4).***

River flows vary widely by month. High flows quickly recede as the water is rapidly moved through the system and out to sea. Annual 7-day low flows were also lower than normal in 2019/20 and 2020/21. When river levels are at their lowest, fish communities and other species may not have enough space and flow for their needs, and less water is available for human uses.

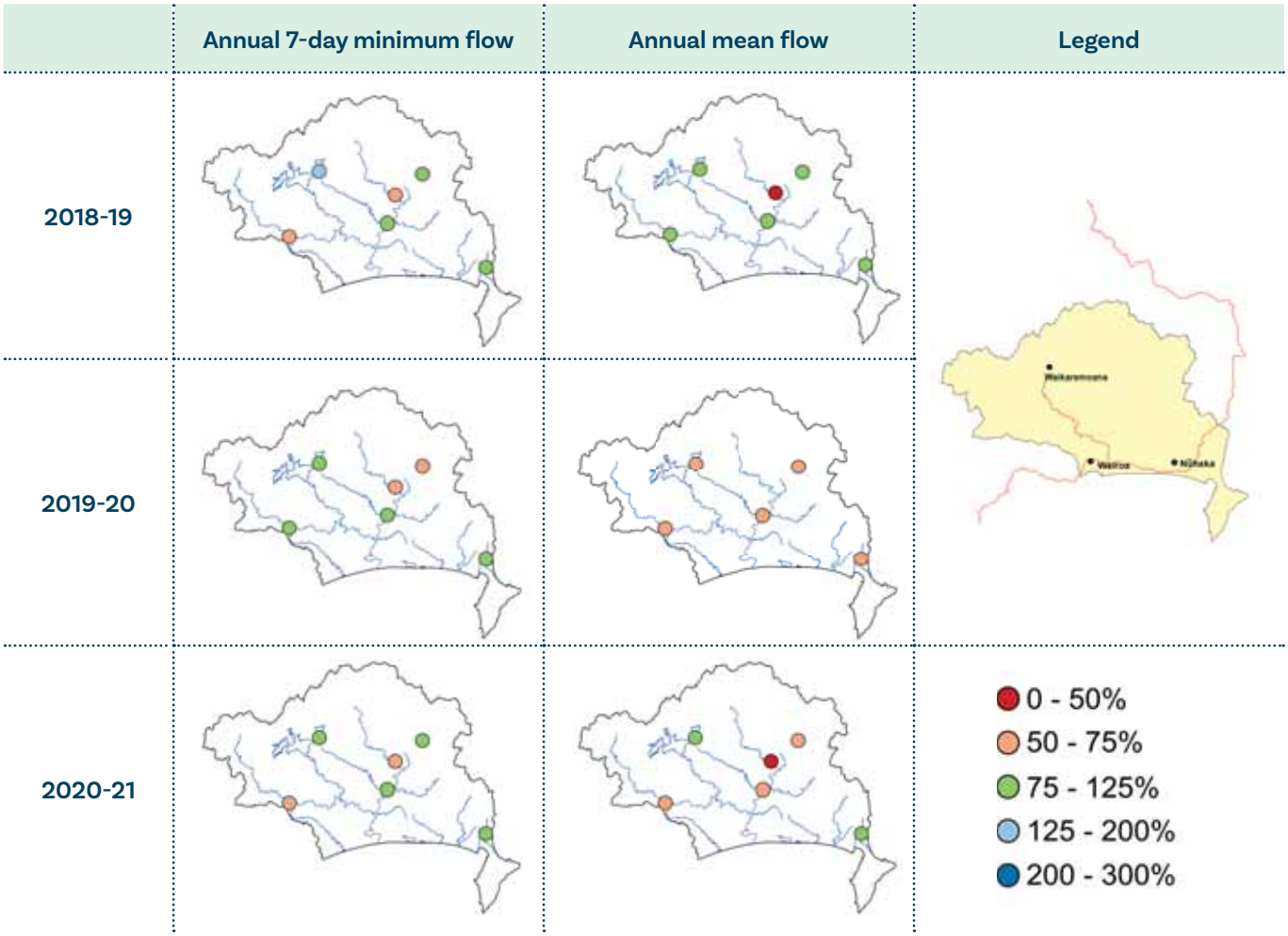



*Figure 15-4. River flows shown as the percentage of the long-term average.*

## Groundwater quality

***Mahia groundwater is an unconfined freshwater layer (or water table) that sits above a saline water body (Figure 15-5). This system has formed because of the area's proximity to the coast, and the coastal sand material surrounding the groundwater. The freshwater layer becomes depleted during summer, and it risks becoming so depleted that saline water is pulled into the water table, causing well water to become saltier. If significant rainfall occurs over winter, this can be reversed, as the rainwater percolates directly into the water table and replenishes the groundwater layer.***

HBRC monitoring between 2018 and 2021 found that groundwater in Mahia was compliant with health and irrigation guidelines, but shallow groundwater is vulnerable to contamination from land-use activities.

Any groundwater intended for human consumption should be regularly tested to ensure the quality meets the health standards for drinking water. Well security and the proximity of the well to septic tanks or stock are also key factors in protecting potable water supply.

Wairoa groundwater occurs deep in the ground, in two gravel layers that are confined by silt and clay (Figure 15-5). The quality of this groundwater is typically reduced, which means that the oxygen in the water has become depleted. A reduced environment means minerals can be leached, or dissolved, from the sediment, which in turn may increase iron and manganese in the groundwater. This is a natural process, and it is unlikely that land-use activities would impact the groundwater at Wairoa, because it is a confined aquifer.

Nonetheless, iron and manganese can affect the taste of the water and can clog irrigation and piping systems. HBRC monitoring has found that the groundwater quality in Wairoa exceeds the human health limits for manganese and the irrigation guidelines for both iron and manganese. Filtration or another treatment method may even be required to use this groundwater in irrigation systems.

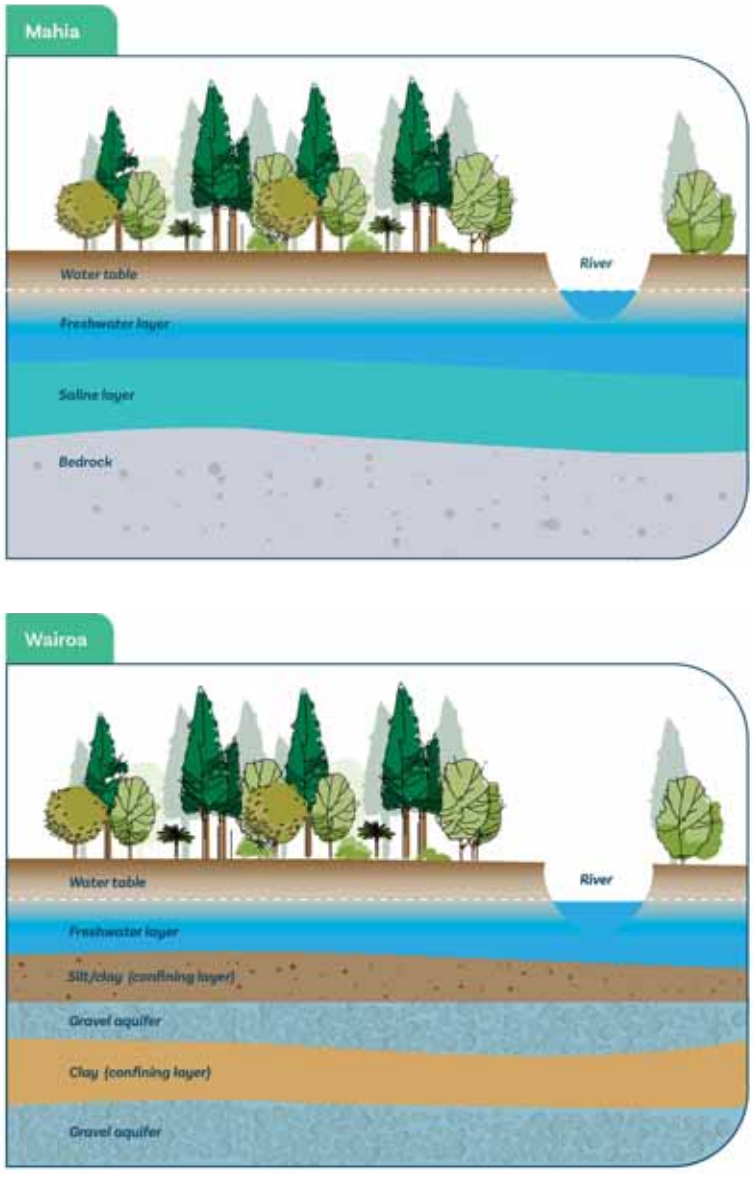



*Figure 15-5. Schematic of the Mahia and Wairoa groundwater systems.*

## River water quality

***While some of the water in the Wairoa/Northern Hawke's Bay river system finds its way into the groundwater, much of the river flow discharges into lakes or into coastal waters. This water, carried in rivers and streams over the land, collects sediment, nutrients, and other contaminants that can affect the health of our rivers, streams, estuaries, and coast.***

Figure 15-6 shows aspects of water quality that can help us determine the health of our rivers and streams. Excess nutrients can cause algal growth and deplete oxygen levels, whereas sediments can reduce light and habitat. Bacteria such as E. coli can make water unsuitable for swimming and contaminate shellfish.

Nitrogen does not seem to be a major problem for rivers and streams in the Wairoa/Northern catchments, but excess sediment from the land may be decreasing water clarity and harming invertebrate communities. The soft sedimentary geology that dominates the area, coupled with high rainfall in the upper ranges and unstable topsoil, means the catchments are prone to high erosion.

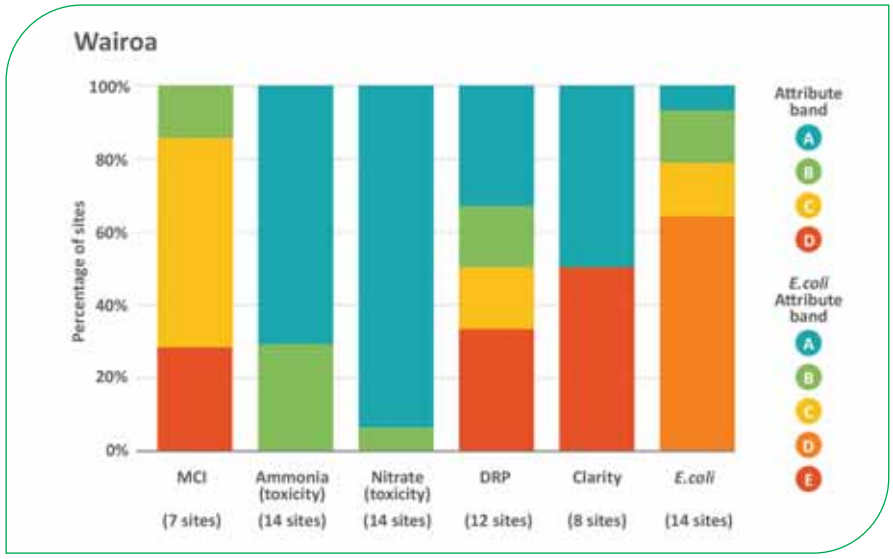



*Figure 15-6. Bands (A = Good, D/E = Poor) in the National Policy Statement for Freshwater Management (NPS-FM) for river attributes in the Wairoa/Northern Hawke's Bay catchments. DRP = dissolved reactive phosphorus. MCI = macroinvertebrate community index. Grading based on latest five years of available data.*

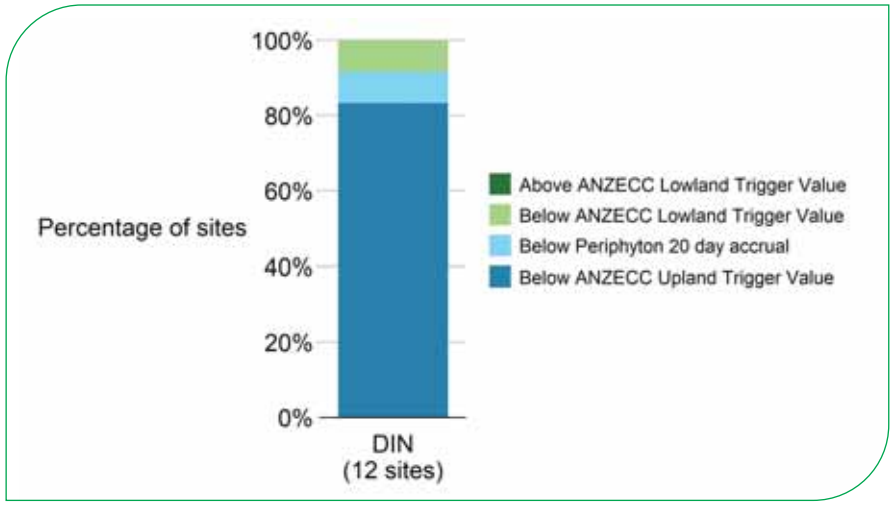



*Figure 15-7: Median dissolved inorganic nitrogen (DIN) concentrations for sites in the Wairoa/ Northern Hawke's Bay catchments, relative to ANZECC upland and lowland (2000) or Biggs (2000) periphyton trigger values.*

**The Wairoa/Northern catchments has some of the lowest recreational water quality in the region.**

The rivers in these catchments all fail the recreational clarity guideline of 1.6m, and the monitoring sites in the major sub-catchments of the Wairoa (Hangaroa, Ruakituri, Mangapoike, and Waiau Rivers) fail to meet the National Policy Statement for Freshwater Management (NPS-FM) bottom limit (band D) for suspended sediment. Sediment is likely to harm animal communities living on the bottom of the riverbed, which is indicated by the 'fair' and 'poor' ratings for macroinvertebrate communities in these rivers (Figure 15-7).

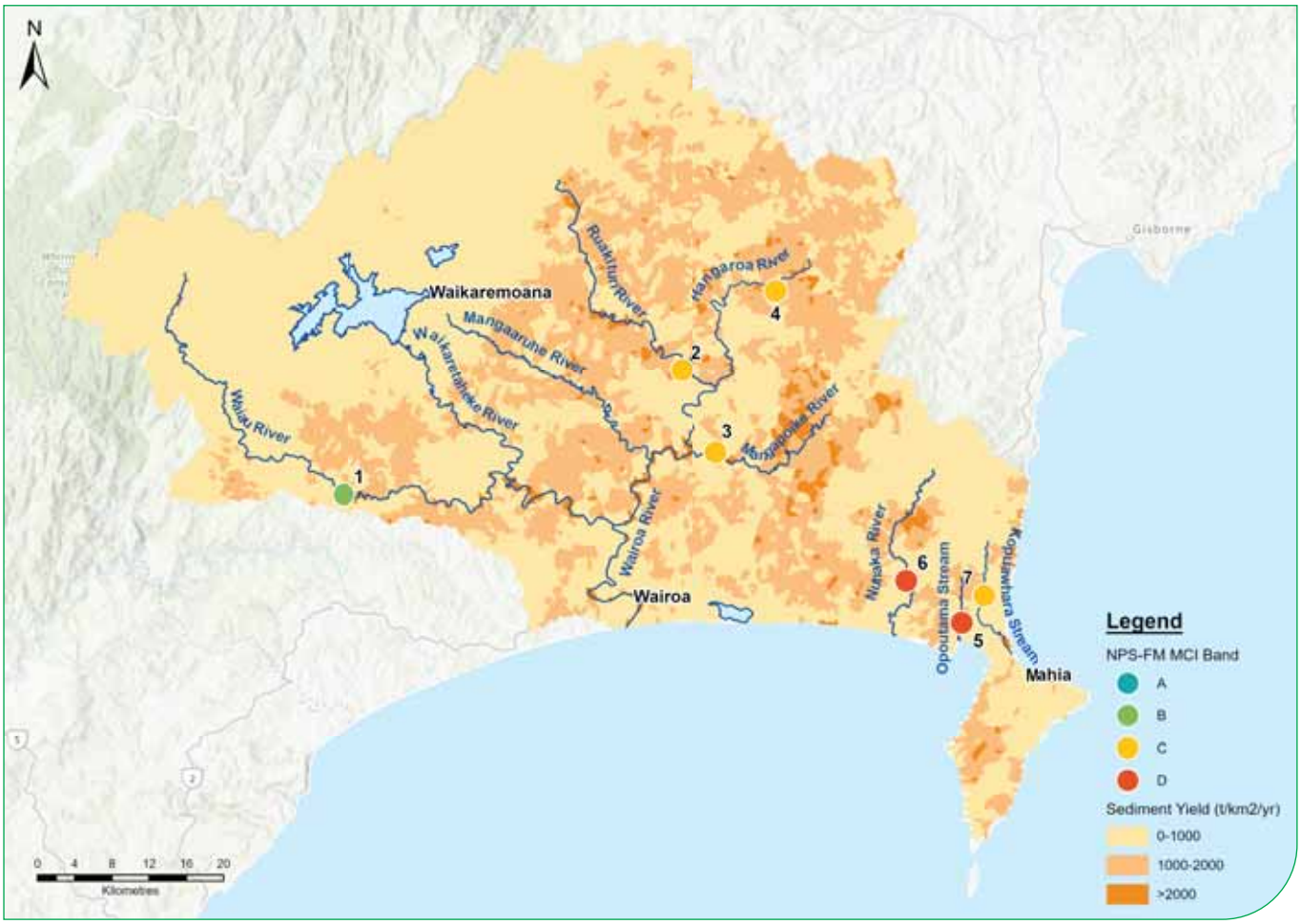



*Figure 15-7. Macroinvertebrate community index (MCI) scores and sediment yields in the Wairoa/Northern Hawke's Bay catchments. 1: Waiau River at Otoi, 2: Waikatuku Stream off Harrison Road, 3: Ruakituri River at Sports Ground, 4: Mangapoike River at Suspension Bridge, 5: Hangaroa River at Doneraille Park, 6: Opoutama Stream at Smiths Woolshed, 7: Nūhaka River at Nūhaka Valley Road, 8: Kopuawhara Stream at Railway Bridge.*

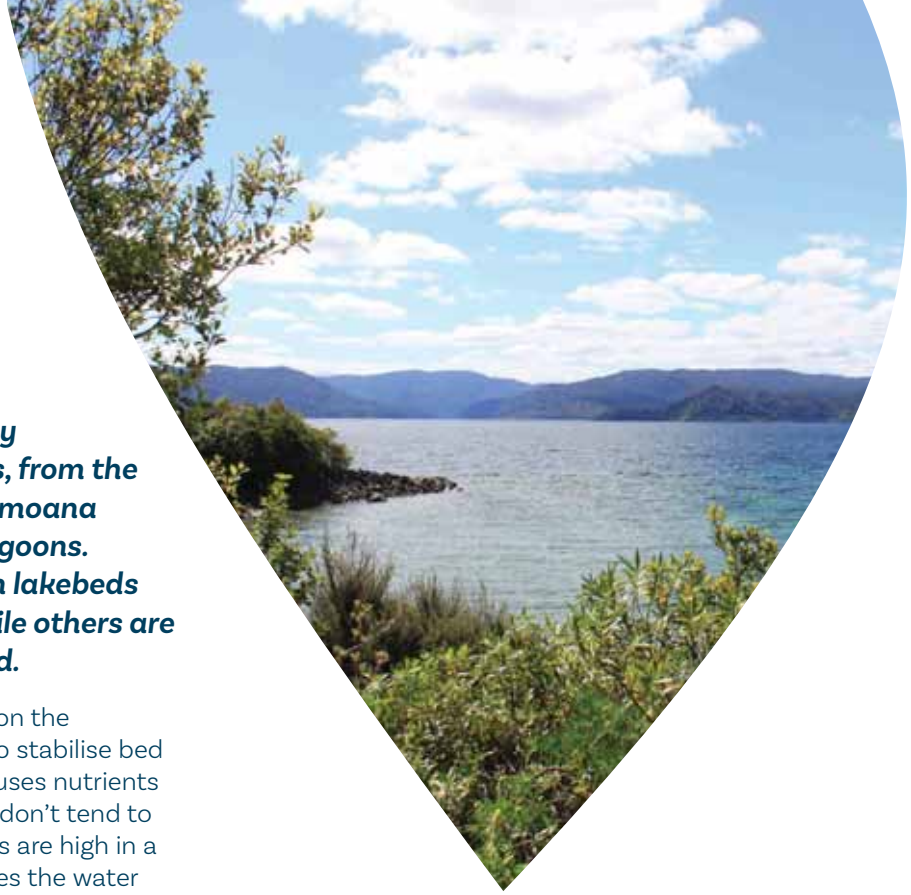
Faecal contamination is also a significant issue in these catchments. Nine of the 14 monitoring sites fall into the D band (poor) for *E. coli* under the NPS-FM. Recreational activities and food gathering may not typically occur at some sites where *E. coli* levels are high, but the elevated bacteria levels can affect downstream sites where people do swim and collect shellfish. The Wairoa/Northern catchments have some of the lowest recreational water quality in the region, with the Wairoa and Nūhaka Rivers exceeding water quality guidelines for swimming 20% of the time (see Marine and coastal environments chapter). Faecal source tracking in these rivers show that ruminant animals (cows, pigs, sheep, and deer) are the major source of bacteria.

Riparian management is usually the most effective way to stabilise stream banks, reduce *E. coli*, and improve ecosystem health. Riparian planting provides shade, lowers river temperatures, limits periphyton and macrophyte growth, regulates dissolved oxygen, filters sediment run-off, and provides adult insect habitat. Targeted erosion control and excluding stock from riverbanks also reduces bank erosion and prevents sediment from entering waterways, as well as reducing direct faecal contamination.

The Resource Management (Stock Exclusion) Regulations [2] 2020 require farmers to keep cattle, deer, and pigs out of waterways in low-slope areas by July 2025. The proportion of stream length covered by these rules will vary among catchments depending on their topographies.

**The Resource Management (Stock Exclusion) Regulations [2] 2020 require farmers to keep cattle, deer, and pigs out of waterways in low-slope areas by July 2025.**

[2] https://www.legislation.govt.nz/regulation/public/2020/0175/latest/LMS379869.html



## Lake water quality

***The Wairoa/Northern Hawke's Bay catchments have a range of lakes, from the extensive and deep Lake Waikaremoana to numerous shallow lakes and lagoons. Some of these lakes are clear with lakebeds dominated by aquatic plants, while others are turbid and algal bloom dominated.***

When nutrients are low in a lake, plants on the lakebed dominate and their roots help to stabilise bed sediments (Figure 15-9). The vegetation uses nutrients from the water to grow, so algal blooms don't tend to occur. On the other hand, when nutrients are high in a lake, algal blooms dominate, which makes the water cloudy and stops light from reaching the lakebed. As a result, plants struggle to grow on the lakebed, which keeps the lake murky.

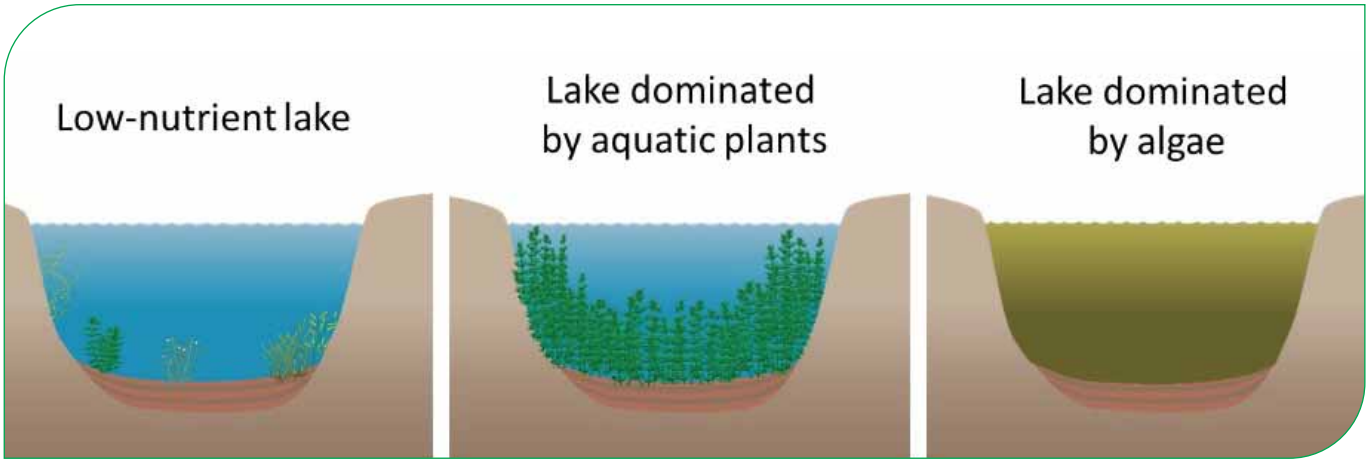



*Figure 15-9. Different lake states depending on aquatic plants and algae. Symbols courtesy of the Integration and Application Network (ian.umces.edu/symbols/).*

Rotonuiaha, Rotoroa, and Rotongaio – collectively known as the Putere Lakes – are located in a hill country farming and forestry landscape in the Waiau Catchment. The lakes have a rich human history, and local iwi have strong spiritual connections to the area.

The three lakes are close together, and all are enriched with nutrients, so it might be expected that they have similar water quality. However, Rotonuiaha and Rotoroa have periods of clearer water, while Rotongaio has more persistent algal blooms.

In 2020, Ngāti Pahauwera coordinated a water sampling programme of these three lakes to help inform management options. NIWA surveys in 2016 had showed the invasive aquatic plant hornwort dominated Rotoroa and Rotonuiaha, but the kaitiaki water sampling showed water clarity in these two lakes is high and algal blooms are rare. In contrast, Rotongaio, which had no hornwort, has the worst water quality and frequent algal blooms. Even though the lakes appear quite different, water quality in all three lakes is rated "very poor" according to the trophic lake index (Figure 15-10).

Hornwort can smother native aquatic plants and it is a nuisance to swimmers, so there is some interest in removing the weed. However, these results show that removing hornwort from the Putere Lakes needs to be considered cautiously, as hornwort may be stabilising sediments and removing nutrients from the water. Removing the weed may cause the lakes to become turbid and algal dominated, making it difficult for native aquatic plants to regrow.

Whakakī is the largest intermittently open and closed freshwater lagoon on the east coast of the North Island. A narrow strip of beach dune separates the lake from the ocean and creates a complex of lagoons. The complex has extremely high ecological and cultural values.

When the lake level increases, Whakakī can flood surrounding farmland and settlements, so the lake mouth is sometimes mechanically opened to allow it to drain to the sea. However, if the lake is opened in late spring, there is a risk that not enough rain will fall during the drier months to fill up the lake with freshwater. Low lake levels during the warmer months can mean the lake becomes too warm for the fish and invertebrates living there.

NIWA has monitored the vegetation in Whakakī since the early 1990s. The lake's aquatic plant community was healthy in 1991/92, but the plants had drastically reduced by 2009 and largely disappeared by 2016. Black swan numbers also decreased over this time (Figure 15-11). Swans eat aquatic plants, so it is likely that worsening water quality over time reduced food and led to the swan decline here.

HBRC has monitored water quality in Whakakī Lake for four years. These results indicate that the lake's water quality is "very poor" according to the Trophic Lake Index (Figure 15-9). The lake is now dominated by algae, with persistent blooms of toxic cyanobacteria. Multiple lines of evidence suggest that the lake has 'flipped' to this algal-dominated state during the last 20 years.

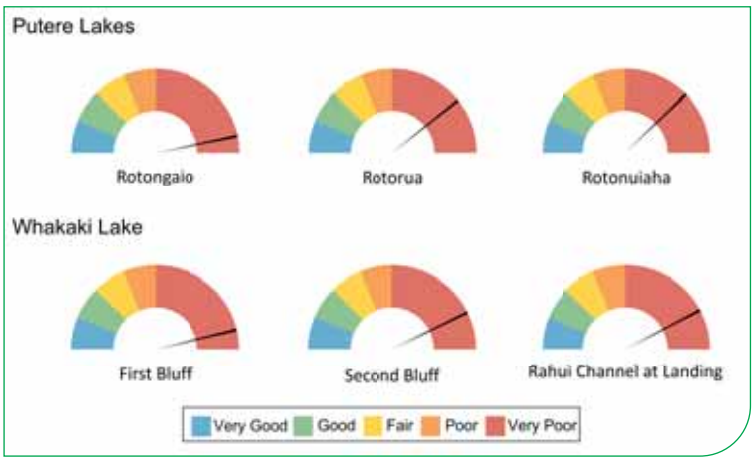



*Figure 15-10. Trophic Lake Index (TLI) for Putere and Whakakī Lakes. The TLI score for a lake is calculated using four separate water quality measurements: total nitrogen, total phosphorus, water clarity, and chlorophyll-a.*

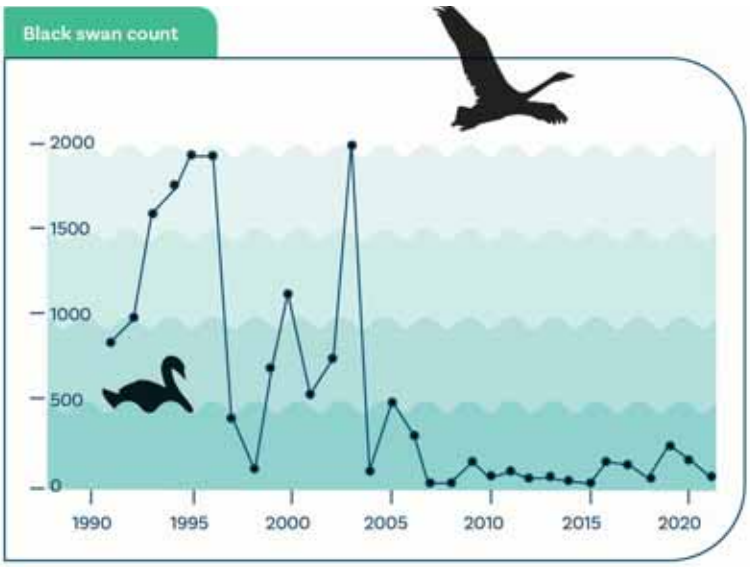



*Figure 15-11. Black swan numbers at Whakakī Lake since 1991.*

*Figure 15-11. Wairoa Estuary.*

## Estuary and coastal water quality

***The Wairoa Estuary (Figure 15-11) and Maungawhio Lagoon lie at the end of the Wairoa and Kopuawhara Rivers. They are the two main estuarine systems in the Wairoa/ Northern Hawke's Bay catchments. Like other estuaries, these sites provide feeding, nesting, and roosting areas for birds, as well as feeding and nursery habitats for coastal fish species. People often collect pipi and cockles/tuangi in the intertidal and shallow subtidal areas, and the estuaries support healthy flounder populations.***

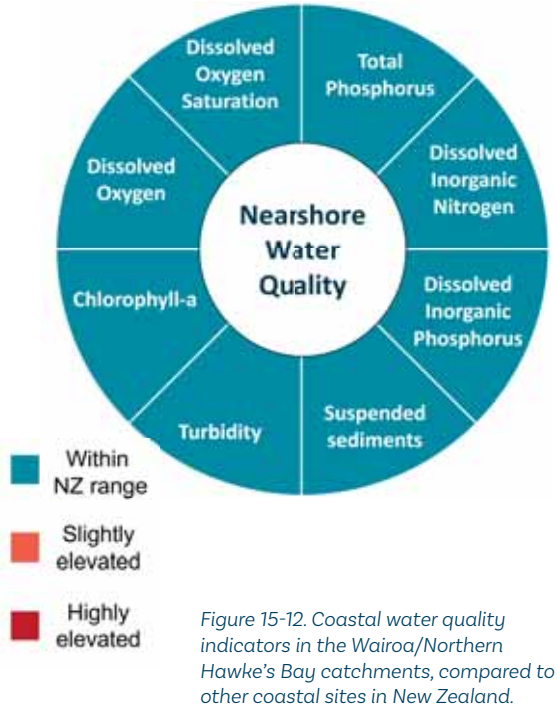



*Figure 15-12. Coastal water quality indicators in the Wairoa/Northern Hawke's Bay catchments, compared to other coastal sites in New Zealand.*

In the Wairoa Estuary and Maungawhio Lagoon, faecal contaminants such as E. coli and enterococci are present at levels that may restrict shellfish gathering (see Marine and coastal environments chapter). Similar to rivers in the area, the estuaries at times have high turbidity and suspended sediment levels, particularly when it rains heavily. Under typical conditions, the estuary is flushed out regularly with tidal waters, but during summer months the mouth can become restricted, which prevents tidal flushing.

The amount of fine sediments carried from rivers into both the Maungawhio and Wairoa systems may potentially compromise the animals and plants living there, decreasing the number of species that perform valuable functions to keep the estuary healthy.

Once released to the coast, the river and estuarine waters mix with open coastal waters, and any contaminants can affect the health of coastal waters. Fortunately, in this catchment, suspended sediment, turbidity, dissolved oxygen, chlorophyll-a levels, and phosphorus levels in coastal waters are within the ranges observed in other New Zealand open coast sites (Figure 15-12).

Compared to other sites in Hawke's Bay, dissolved nitrogen levels are elevated just offshore of the Wairoa River. While these levels are still within the national range, they indicate that the coast here is affected by discharge from the Wairoa River. The Wairoa River contributes on average 20% of the nitrogen in Opoutama Bay, although it can be as high as 40% at times.

These results indicate that contaminants in estuarine and coastal waters are being diluted by the large coastal water mass. However, increasing water temperatures and other oceanic changes associated with climate change may reduce the coast's ability to assimilate these contaminants.

Major peaks of sediment loss can occur during flood events, outside of typical sampling conditions. At these times fairly extensive plumes of sediment are visible, and the sediments may settle on the seafloor, smothering animals and plants.

## Recreational water quality

***The Wairoa/Northern Hawke's Bay catchments have many rivers and beaches that are popular swimming areas over the summer months. As is typical for the region, the northern coastal beaches tend to have excellent water quality and are almost always suitable for swimming (Figure 15-13). Mahia and Mahanga beaches were most suited for swimming, with only 2% and 3% of samples respectively indicating unsuitable swimming conditions.***

However, rivers in these catchments have some of the poorest recreational water quality compared to similar systems elsewhere in the region. Both the Wairoa and Nūhaka Rivers are mostly unsuitable for swimming due to the presence of bacterial contamination. Faecal source tracking in these catchments over the past five years shows the main source of this contamination is ruminant animals (cows, sheep, deer, and goats), with some bird faecal contamination.

Swimmability at the Wairoa and Nūhaka sites was less than 80%, which means these rivers were unsuitable for swimming more than 20% of the time. Both rivers were graded as 'poor' for primary contact recreation under the NPS-FM, and data from the Wairoa River over the last 21 years shows that water quality at this site is deteriorating over time.

Targeted erosion control and excluding stock from riverbanks also reduces bank erosion and prevents sediment from entering waterways, as well as reducing direct faecal contamination.

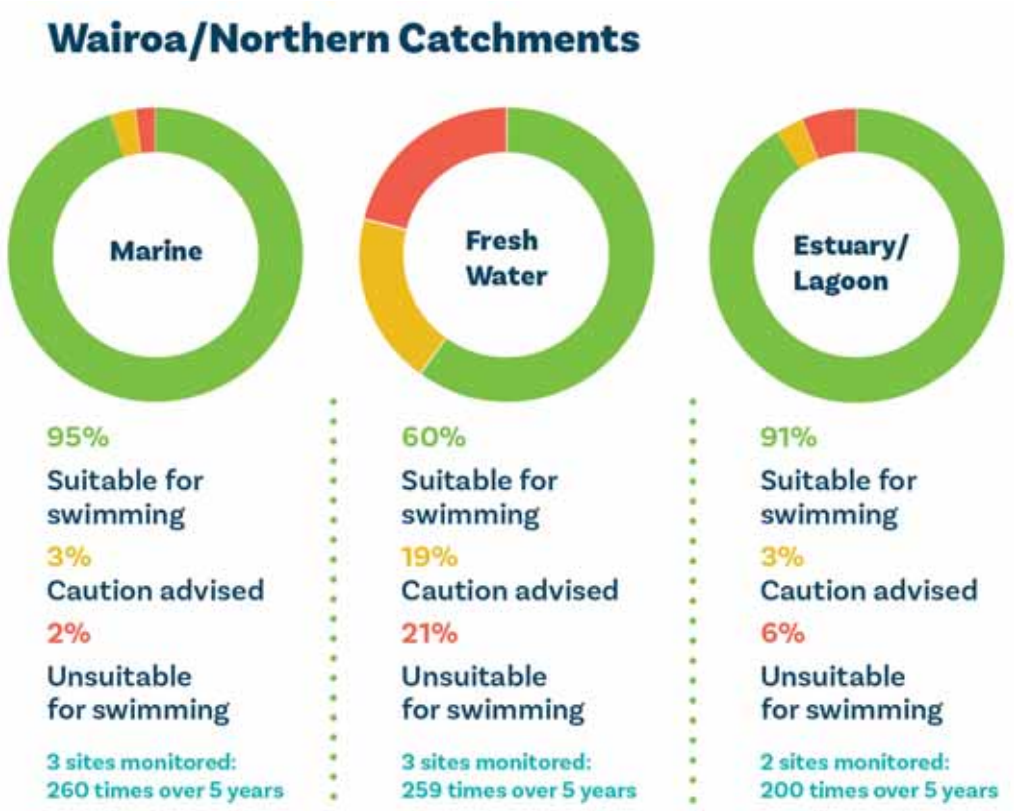



*Figure 15-13. Swimming suitability of marine, estuarine, and freshwater sites in the Wairoa/Northern Hawke's Bay catchments .*