OUR FRESHWATER

TŌ TĀTAU WAI MĀORI

Malcolm Rutherford

HIGHLIGHTS

Tairāwhiti has several large freshwater catchments, including the Waipaoa (2,165km^2), Waiapu (1,730km^2) and Motu (700km^2).

70% of our freshwater swimming spots are classified excellent in terms of bacteria levels. However, some spots such as at Rere Rockslide have regular exceedances. At Rere, Council is working with the community through the Wharekopae River water-quality project to improve water quality.

Wainui and Hamanatua Streams can have elevated levels of E.coli bacteria. Signs warn against swimming at these streams. There is an increased high risk to anyone, but particularly children, swimming in these streams. To improve the water quality of Wainui Stream, Council funded a wetland in Heath Johnston Park. Investigations into sources of contamination at Hamanatua Streams are planned.

Water quality in the Motu catchment is affected by increasing intensification of pastoral farming and cropping. This has seen the river deteriorate significantly in recent years with negative effects on native fish and trout. Council will begin working with the community to develop the Motu Catchment Plan in 2020.

High sediment loads are a key feature of the Gisborne region, owing mostly to our soft sediment geology. This can also lead to increased levels of phosphorus.

There is 37,6812,000m^3 of water allocated a year for irrigation. There has been a 51% increase in the area consented for irrigation since 2016, with 7,120ha now consented to be irrigated, predominantly on the Poverty Bay Flats.

The Managed Aquifer Recharge Trial is investigating whether it's possible to take water from the Waipaoa River in times of high flow to recharge the Makauri Aquifer.

Many shallow bores on the Poverty Bay Flats and at Wainui have recorded E.coli indicating that shallow groundwater should not be used for drinking water without adequate treatment. All Council water supplies from shallow groundwater are treated, which includes chlorination to make it safe to drink.

Urban streams around Gisborne are heavily impacted by the urban area. Key issues are high bacteria, nutrients and some heavy metals. Council's DrainWise project is helping fix stormwater and wastewater issues. The Waipaoa Catchment Plan includes projects to improve the water quality in the Taruheru and Waikanae catchments. Read about Enviroschools WaiRestoration at Waikanae Stream on **page 72**.

OUR FRESHWATER

The sustainable management of our freshwater is critical to our region. Our Freshwater Plan was notified in October 2015 and sets our region's freshwater management framework. Our rivers and streams are important places for recreation, the collection of kai, fishing, kayaking, exercise of cultural practices and enjoyment. Council monitors stream groundwater levels of our main aquifers, river flows, water quality and freshwater ecology at a range of sites across the Gisborne region.

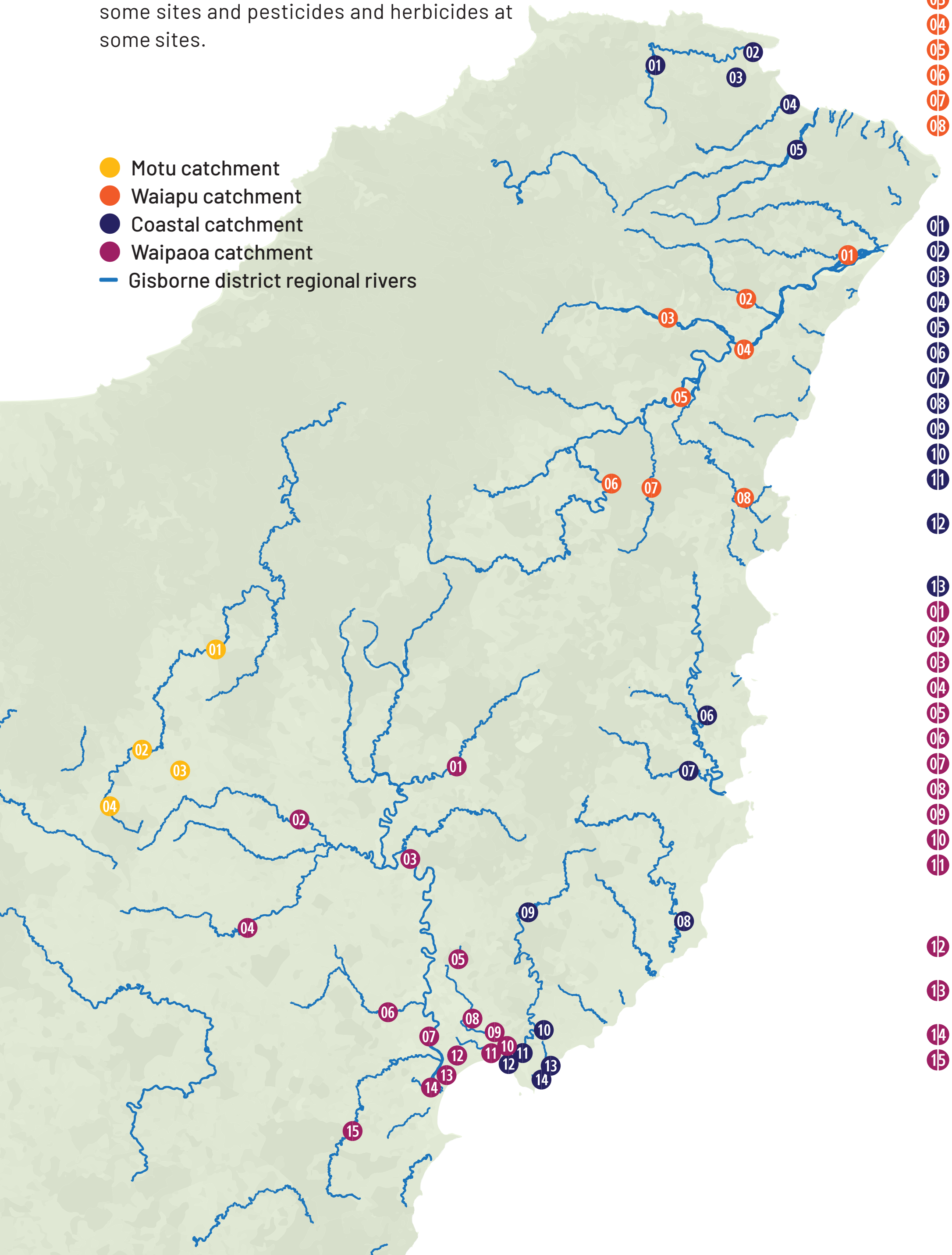
Data on Gisborne water quality can be viewed at **www.lawa.org.nz**.

Further in-depth water quality analysis can also be found in ***Our freshwater - technical report***.

SURFACE WATER QUALITY

Catchments

There are 45 freshwater quality monitoring sites across the Gisborne region that are sampled on a monthly basis for a range of chemical parameters. These are primarily freshwater, but include a number of estuarine sites that are influenced by the tide to varying degrees. Water quality sampling tests for a range of chemical parameters, including physical measurements such as water temperature and dissolved oxygen, nutrients such as nitrogen and phosphorus, bacteria such as E.coli, heavy metals at some sites and pesticides and herbicides at some sites.



01 Motu River above Falls
02 Motu River at Kotare Station Bridge
03 Matawai Stream at Tawai
04 Matawai Conservation Area
01 Poroporo River at Rangitukia Rd Bridge
02 Mangaoporo River at Tutumatai Bridge
03 Tapuaeroa River at Tapuaeroa Rd
04 Waiapu River at Rotokautuku Br (SH35)
05 Mata River at Aorangi (Makarika Rd)
06 Mata River at Pouturu Bridge
07 Ratahi Lagoon at Sh35 Culvert
08 Ihungia River at Ihungia Rd Bridge

01 Oweka River at SH35 Bridge
02 Wharekahika River U/S of Wharf Bridge
03 Mangatutu Str at Sh35-Waipahuru Bridge
04 Karakatuwhero River at SH35 Bridge
05 Awatere River at SH35 Bridge
06 Hikuwai River at Willowflat
07 Mangaheia River at Paroa Road Bridge
08 Pakarae River at Pakarae Station Bridge
09 Waimata River at Monowai Bridge
10 Waimata River at Goodwins Rd Bridge
11 Taruheru River at Peel St Bridge
Waimata River at Grant Rd
12 Turanganui River at Gladstone Rd Bridge
Kopuawhakapata Stream at Hirini St
Waikanae Creek at Grey St Bridge
13 Hamanatua Stream at Okitu Bridge
01 Waingaromia River at Terrace Station
02 Waikohu River at Mahaki Station
03 Waipaoa River at Kanakanaia
04 Wharekopae River at Rangimoe
05 Waihirere Str at Domain
06 Whakaahu Str at Brunton Rd
07 Waipaoa River at Matawhero Bridge
08 Taruheru River at Tuckers Rd Bridge
09 Taruheru River at Lytton Rd Bridge
10 Taruheru River at Wi Pere Pipe
11 Taruheru River at Peel St Bridge
Waikanae Creek at Grey St Bridge
Turanganui River at The Cut
Waikanae Creek at Stanley Rd Bridge
12 Sisterson's Drain Site 1at Wetland Inflow Point
13 Awapuni Drain Site 6 U/S Of Rayonier at Fenceline
14 Waipaoa River at Railway Bridge
15 Te Arai River at Pykes Weir

The Waipaoa catchment is the largest catchment in Tairāwhiti (2,165km2). It is subject to the Waipaoa Catchment Plan, which sets water-quality objectives and limits. The plan also includes the Taruheru and Waikanae catchments. The catchment is divided into four Freshwater Management Units (FMU: Hill Country, Te Arai, Poverty Bay Flats, Gisborne Urban) and the objectives and limits are different in each FMU. There are 17 monitoring sites in the catchment plan (including Taruheru, Waikanae and Te Arai catchments).

The Motu River covers a catchment area of 700km^2 in our region. It is Tairāwhiti's only truly upland river – rising in the Waioeka Range and flowing through Matawai to Motu and eventually draining into the Bay of Plenty region. It is often described as an 'upside-down' catchment with farmland in the headwaters and a lot of native forest surrounding the lower reaches that drain into the Bay of Plenty region. Council has four water-quality monitoring sites on the river – starting with a native bush catchment reference site at the top of the catchment and the lowest site being above the Motu Falls.

The Waiapu catchment is the second largest in our region, with a catchment area of 1,730km^2. There are seven water-quality monitoring sites within the catchment. The catchment is one of the most erosive in the district and consequently has typically high suspended sediment and turbidity levels, and low visual clarity.

Waiapu River at Rotokautuku

FRESHWATER QUALITY

Rivers

Nutrients

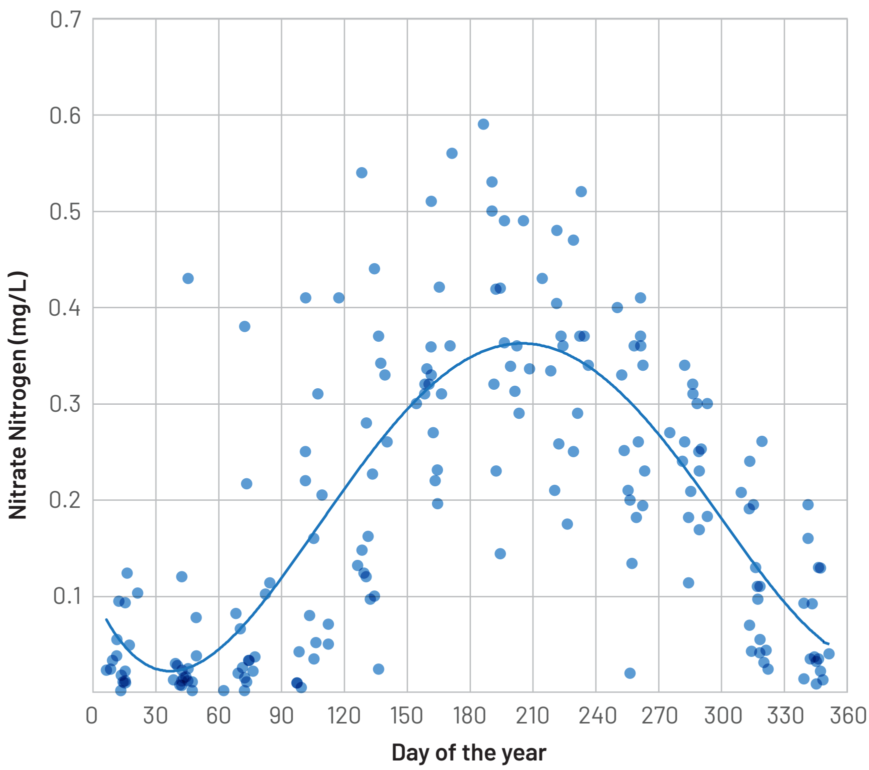
Nutrients are an important factor that controls primary production in a stream. This primary production you might know as periphyton and algae blooms, or as freshwater plants. Organisms that live in the stream are dependent on this growth to eat and live on. However, too much growth can cause detrimental effects in stream health such as unhealthy low dissolved oxygen levels causing fish to struggle to survive, nuisance algae blooms which can cause skin irritations or make dogs sick, a reduction in the clarity of the water which doesn't look very nice, or the choking of a stream with weed.

In general, nutrients in our region's rivers are typically low compared to other regions in New Zealand, but there are hotspots caused by human activities. These are primarily related to the Taruheru River that drains intensive horticultural lands; streams in the Awapuni Moana area subject to disrupted hydrology and commercial practices, other streams around the urban Gisborne city area that are impacted by urban stormwater runoff as well as acute and chronic wastewater leakage. The main sources of nutrients are suspected to be accumulated effects from fertiliser use and rotting organic matter, and urban related wastewater issues. The latter includes septic disposal systems, illegal wastewater connections into wastewater drainage networks, and damaged wastewater piping.

Seasonality is often observed in nutrient concentrations at a lot of sites. The graph is an example of this seasonality, clearly showing this pattern from monthly water samples collected at Motu River at the Kotare monitoring site. There are higher concentrations of nutrients in winter than summer. Sites that show generally high nutrients in particular (such as those in the graph below) often show this seasonal nutrient signal. It may be that fertilisers, rotting organic matter, deeper groundwater and stormwater runoff build up during summer and are then mobilised by higher quantities of rainfall that occur during winter and when shallow groundwater tables come up as soils become saturated. Total fluxes of contaminants (for example tonnes of nitrogen per month) leached from these catchments will be higher during winter as not only are some contaminants more concentrated, but there is more water moving through these rivers as river flows are typically elevated.

There are two key nutrient components that greatly affect stream health, phosphorus and nitrogen. Each parameter has a number of different chemical forms in which it can be present in the environment. The chart on **page 56** shows ammonia nitrogen and dissolved reactive phosphorus as indicators for nutrients across water-quality sites.

Motu at Kotare Nitrate-N (monthly water sampling 2004-20)



Ammonia nitrogen

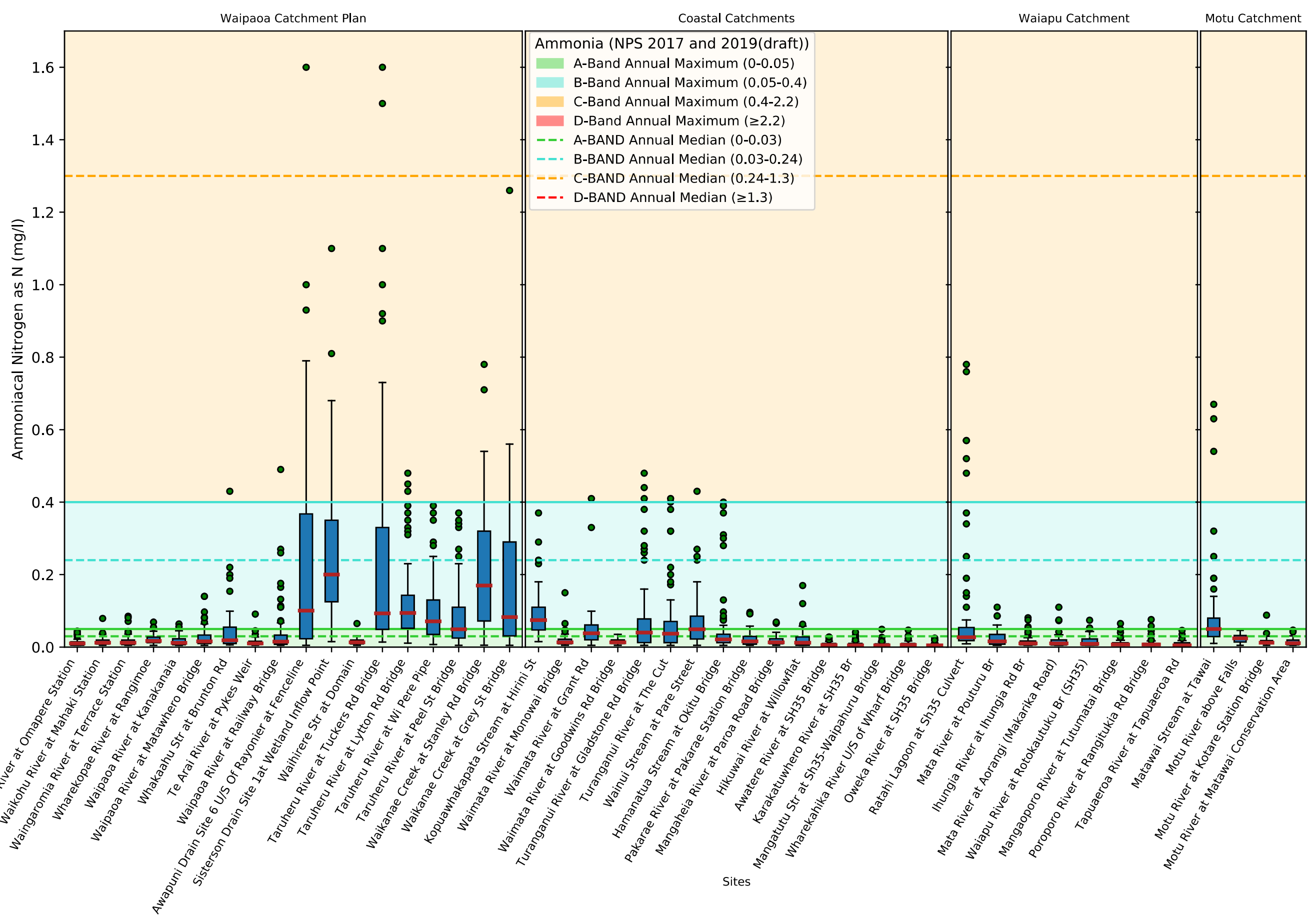
Ammonia nitrogen can be toxic to aquatic life and increasing levels can affect the ability for sensitive in-stream fauna to survive.

Sites with the highest ammonia nitrogen are those in the Gisborne city urban area (Taruheru, Waimata, Waikanae, Turanganui, Kopuawhakapata and Wainui Streams). Typical urban sources of ammonia nitrogen include raw wastewater and industrial process discharges. Other sites with high ammonia include streams of the Awapuni Moana area, as well as the Matawai Stream at the Tawai monitoring site. Awapuni Moana streams are likely influenced by disrupted hydrology of the catchment caused by its drainage scheme and its closeness to sea level, and the commercial activity discharges close to the water-quality monitoring sites. Matawai Stream at the Tawai site is below a dairy farm and is showing significant increasing phosphorus levels and turbidity, but a reduction in nitrate nitrogen over time.

Most sites in the region fall into the A band for median ammonia, with the exception of Awapuni, Sisterson's, all Taruheru and Waikanae Stream sites which have a median result that fall into the B band. No sites exhibited median results below the national bottom line (D band).

Annual maximum ammonia results are a lot more variable, with ten sites in the A band, 20 sites in the B band, and 15 sites in the C band. No sites showed ammonia results in the D band for annual maxima ammonia.

Ammoniacal nitrogen as N (2015-20)



Dissolved reactive phosphorus

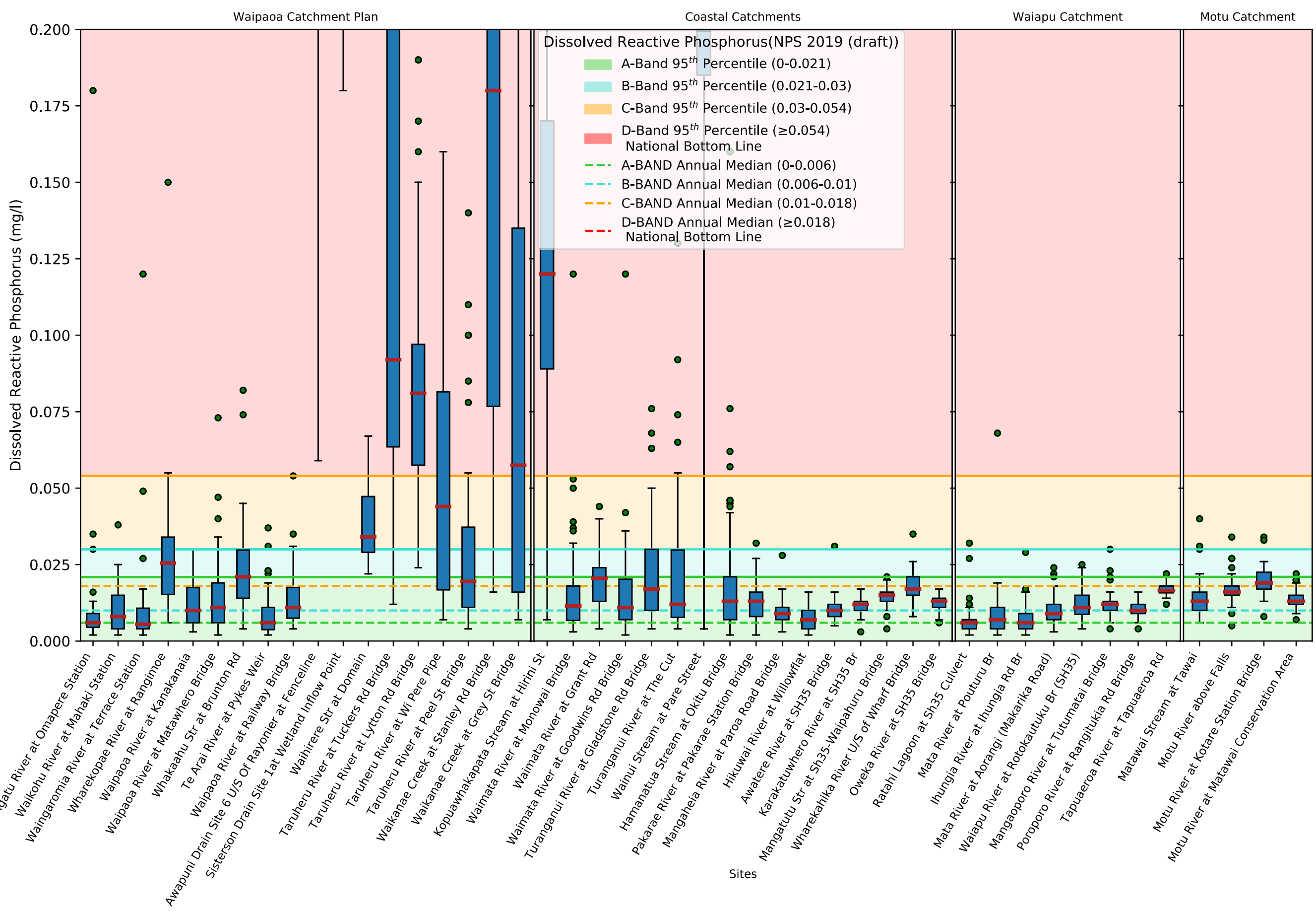
Dissolved reactive phosphorus (DRP) is a sub-component of total phosphorus in the form readily available to be used by algae and other forms of growth, otherwise termed 'bio-available' phosphorus. It readily binds to sediments and is quickly utilised in the environment.

High measurements are not visible off the top of the graph to help visualise most site data. This plot shows the extent to which the two Awapuni and Sisterson's Drain sites stand out from others in the network, which are significantly higher than any other monitoring site in the region. Land uses above the Sisterson's drain site includes a fertiliser including a fertiliser storage and distribution site, wood processing plant and horticultural landuses. Other sites that have high DRP include Taruheru at Tuckers Road, two Waikanae Creek sites, Kopuawhakapata Stream and the Wainui Stream at Parae Road. There are generally high DRP results at the Waihirere Domain site which is interesting, but this is explained when looking at the low total phosphorus results for this site suggesting that DRP is not being absorbed by green growth due to the high degree of forest shading in this stream not providing enough light for things to grow.

Twenty-nine per cent of sites (13 out of 45) exceed the national bottom line D band for the 95th percentile (incidents of high results), while one third of sites (15 out of 45) exceed the national bottom line D band for the annual median.

While absolute levels of nutrients are low compared to most other sites, there have been significant increasing trends of most nutrients observed at the Ihungia River at Ihungia Road Bridge, in particular the nitrogen species. Again, absolute levels of ammonia nitrogen are low in the the Mata River, but also has an observed trend of increasing levels.

Dissolved reactive phosphorus (2015-20)



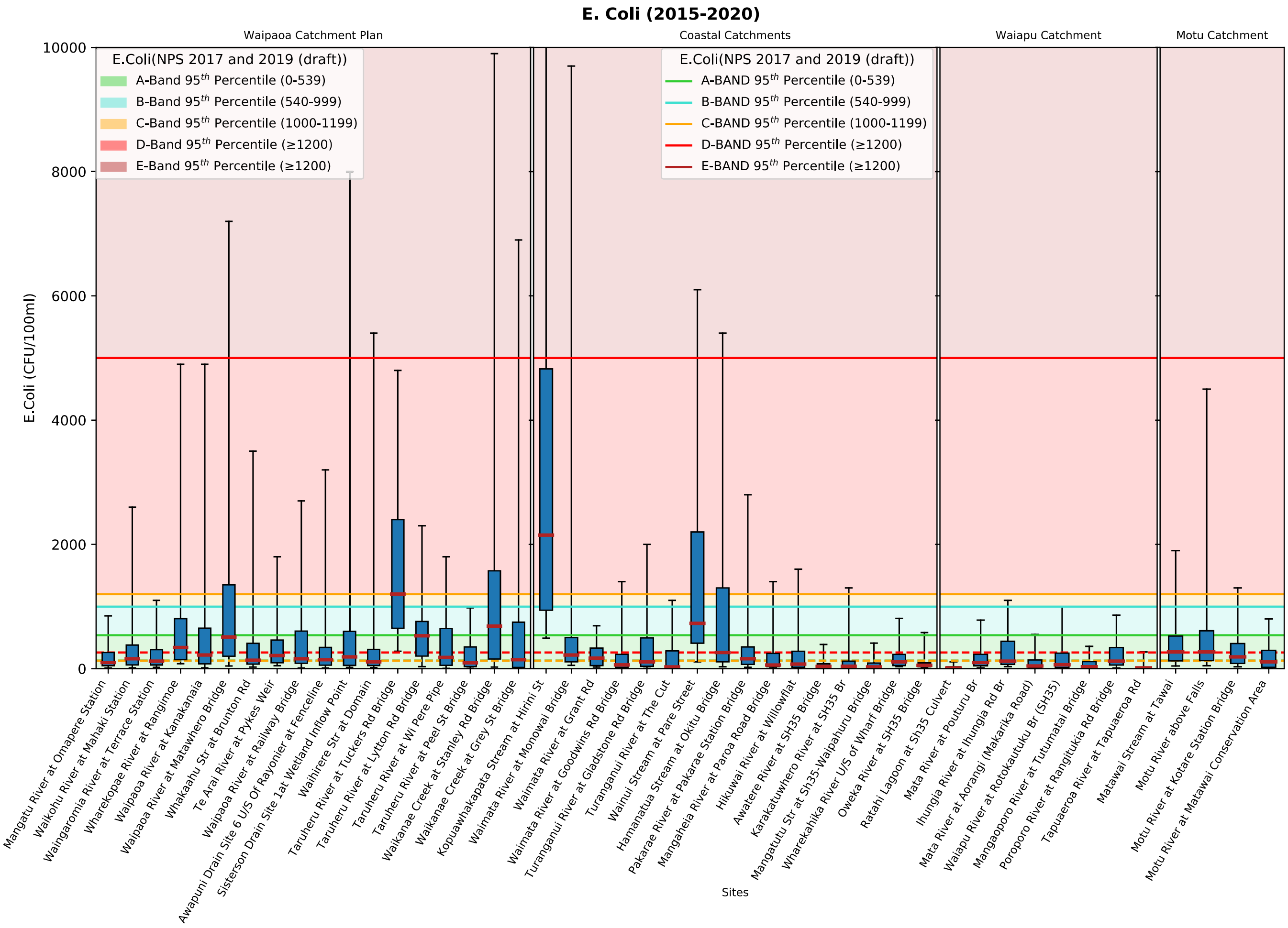
E.coli bacteria – monthly sampling

The highest E.coli results from all streams monitored were from Kopuawhakapata Stream at Hirini Street, which is off the top of the chart at 19,700 CFU/100ml. The generally high E.coli results from this stream are thought to be due to various forms of wastewater access into the stream, such as illegal connections to the stormwater network and old wastewater pipe infrastructure in that part of Gisborne. Other sites that also had very high E.coli results were Wainui Stream at Parae Street and Hamanatua Stream at Okitu Road Bridge. These catchments are surrounded by a high density of septic wastewater treatment systems, birds are observed in the stream and particularly above the Hamanatua Stream, animals such as horses are commonly observed in the waterway.

The Cut mostly has low E.coli results likely due to the influence salt water has on de-activating E.coli bacteria. See ***Our coast and estuaries*** for recreational waters assessment of some of the estuarine sites that are also sampled using the enterococci bacterial parameter which is a better indicator in highly saline environments.

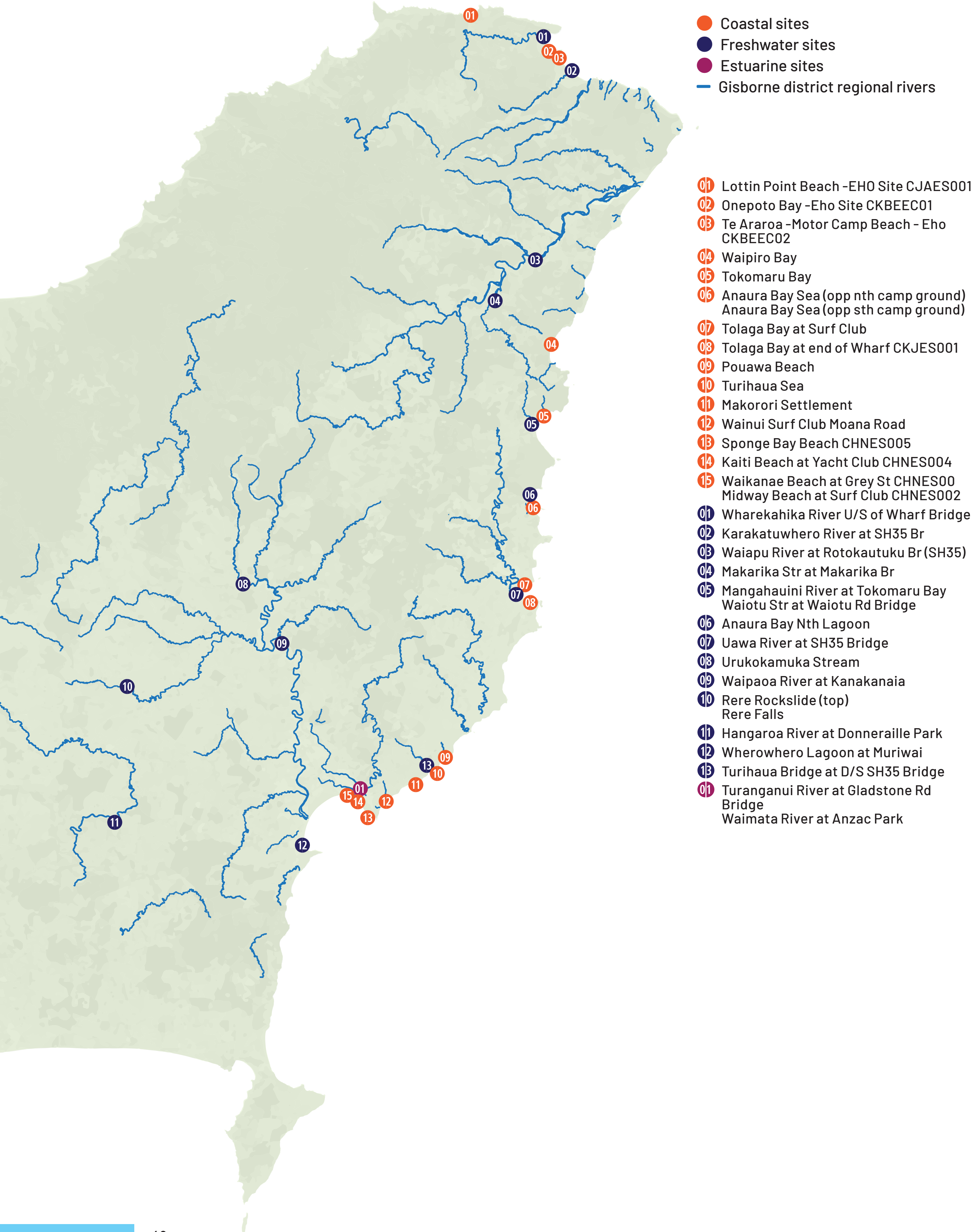
Ratahi Lagoon has the lowest E.coli result of all locations, likely due to complex environmental interactions occurring in the lake.

E.coli bacteria (monthly sampling)

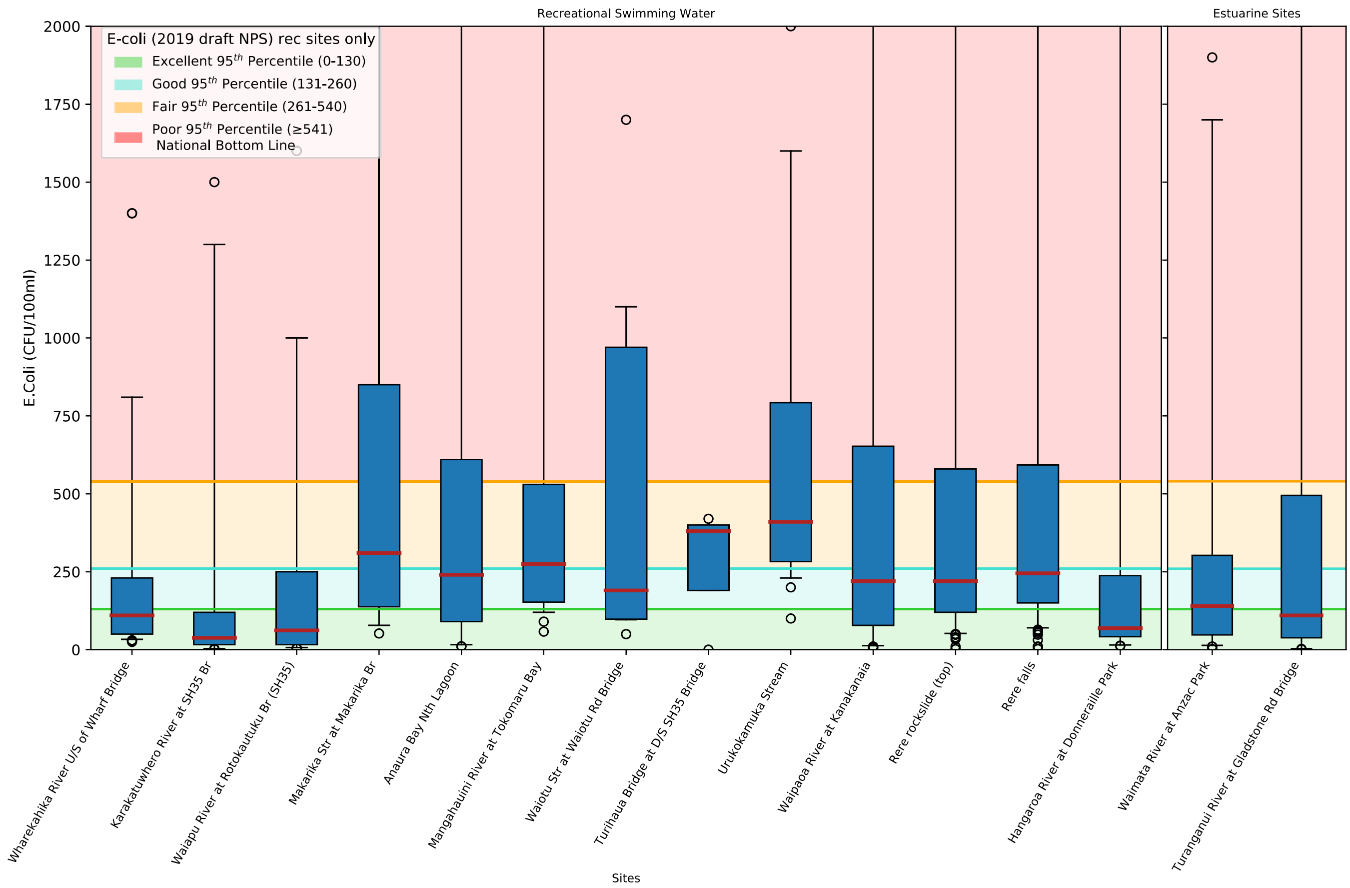


Kerry Fox

Recreational water monitoring sites



E.Coli recreational water sites (2015-20)



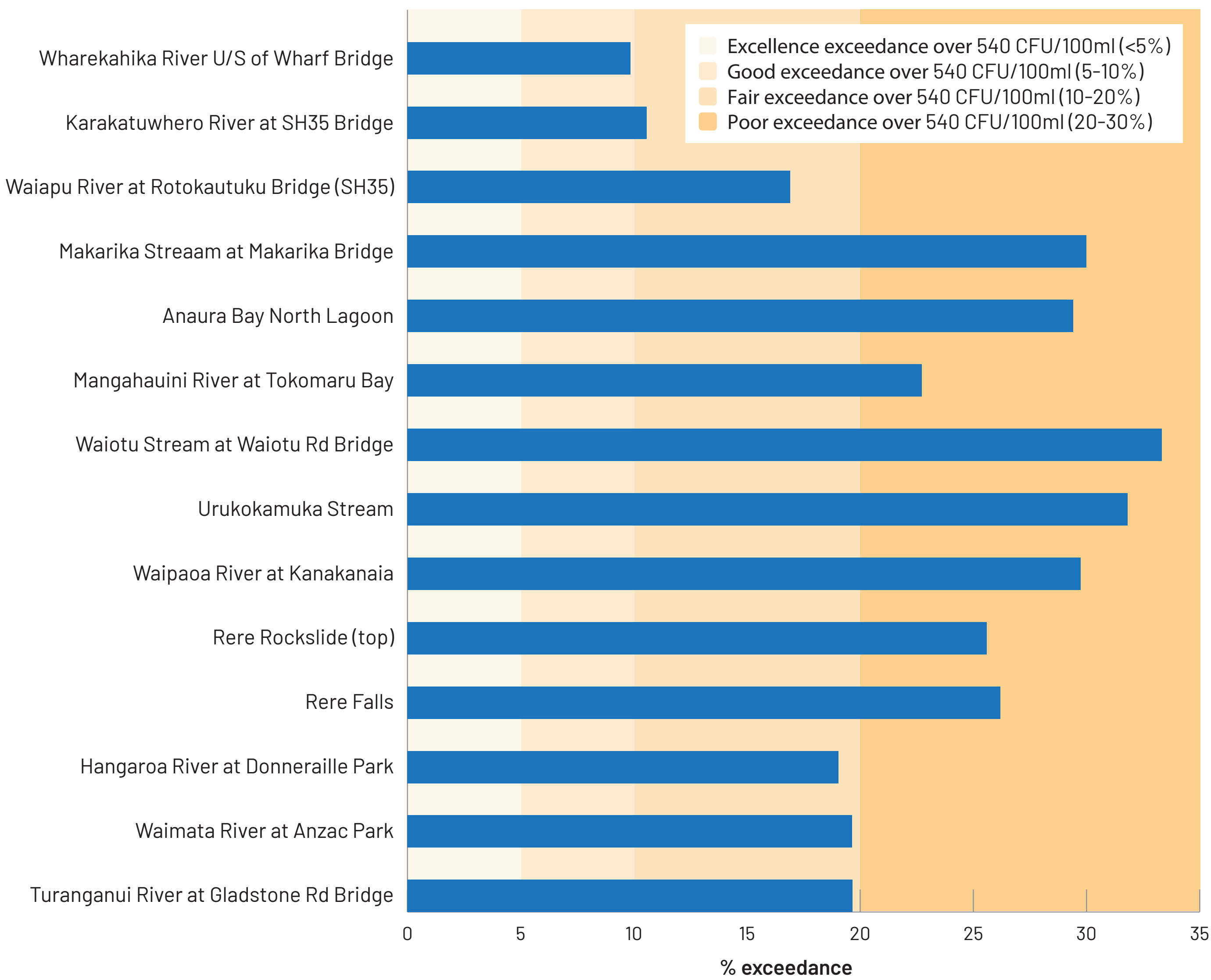
A number of high results over 2,000 CFU/100mL have not been shown on the graph below. These include one each from the Waiapu and Turanganui Rivers, two results each from Waipaoa River at Kanakanaia and Rere Rockslide (top), and three results from Rere Falls. One of these three Rere Falls high results included the highest result observed of 98,000 CFU/100mL.

An important metric to look at for bacteria is the 95th percentile which helps describe the frequency at which high results are observed. Using the NPS grading which compares the 95th percentile (top whisker) against bands, 93% of freshwater sites monitored for summer recreational waters (14 of the 15 sites) monitored fall below the national bottom line for human recreation contact during the summer bathing season in the category described as "poor". The NPS describes the "poor" category as "estimated risk of campylobacter infection as a >5% occurrence, at least 5% of the time". This means these sites represent a high risk for bacterial infection.

Another way to look at E.coli results is the percentage of the time each site exceeds 540 CFU/100mL. The categories described above represent NPS attribute bands (ie, "poor" = D band, "fair" = C band, "good" = B band and "excellent" = A band. This shows that there are a number of rivers that are used for freshwater swimming in the region which frequently exceed NPS attribute bands. Eight sites fall in the poor category with the highest being Urukokomuka, Waiotu Stream and Makarika Stream. A further five sites fall in the fair category. The safest freshwater swimming sites monitored were the Karakatuwhero River at Te Araroa, and the Wharekahika River at Hicks Bay.

Of the sites monitored, coastal swimming sites are a lot safer to swim at than freshwater swimming sites (see ***Our coast and estuaries***). Ninety per cent of E.coli samples from our region's beaches had "excellent" results, compared to only 70% "excellent" results from freshwater swimming sites.

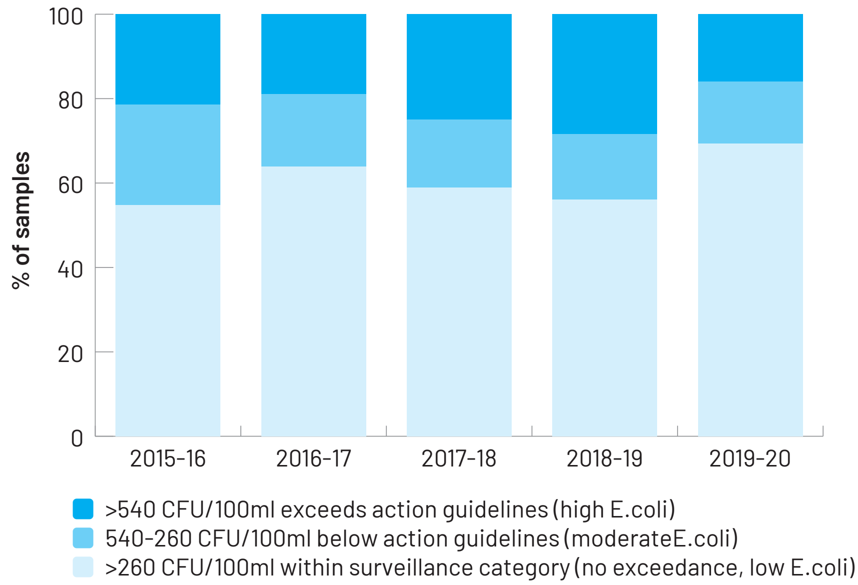
E.coli % exceedances over 540 CFU/100mL (2015-20)



This graph shows the percentage of samples (the percentage of time) that samples are above the action limit of 540 CFU/100mL, between the action limit and above the surveillance category (orange), or within the surveillance category 260 CFU/100mL (green), and the percentage of time that samples are below the action limit of 540 CFU/100mL. The total count of sites and samples has been variable throughout the years, with 12 new freshwater swimming sites added in 2018 that are sampled weekly during summer added in 2018. Before this, only three sites were sampled weekly during summer (Rere Rockslide, Rere Falls and Donneraille Park). The graph also includes SOE monthly E.coli results where weekly summer sampling occurs at the same location (for example Waipaoa at Kanakanaia is sampled monthly year-round, but also weekly during summer for E.coli).

The graph shows that on average, monitored freshwater swimming sites have bacteria levels considered safe to swim on average 62% of the time, and unsafe to swim 20% of the time. In 2019-20, these sites were safe to swim at 70% of the time and unsafe 16% of the time. High bacteria levels are often related to periods after rain when contaminants wash off the land and into waterways.

Annual % of E.coli samples within surveillance/action guideline categories



Water-quality monitoring in the Awapuni Moana catchment

#01 CASE STUDY | HE TAUIRA

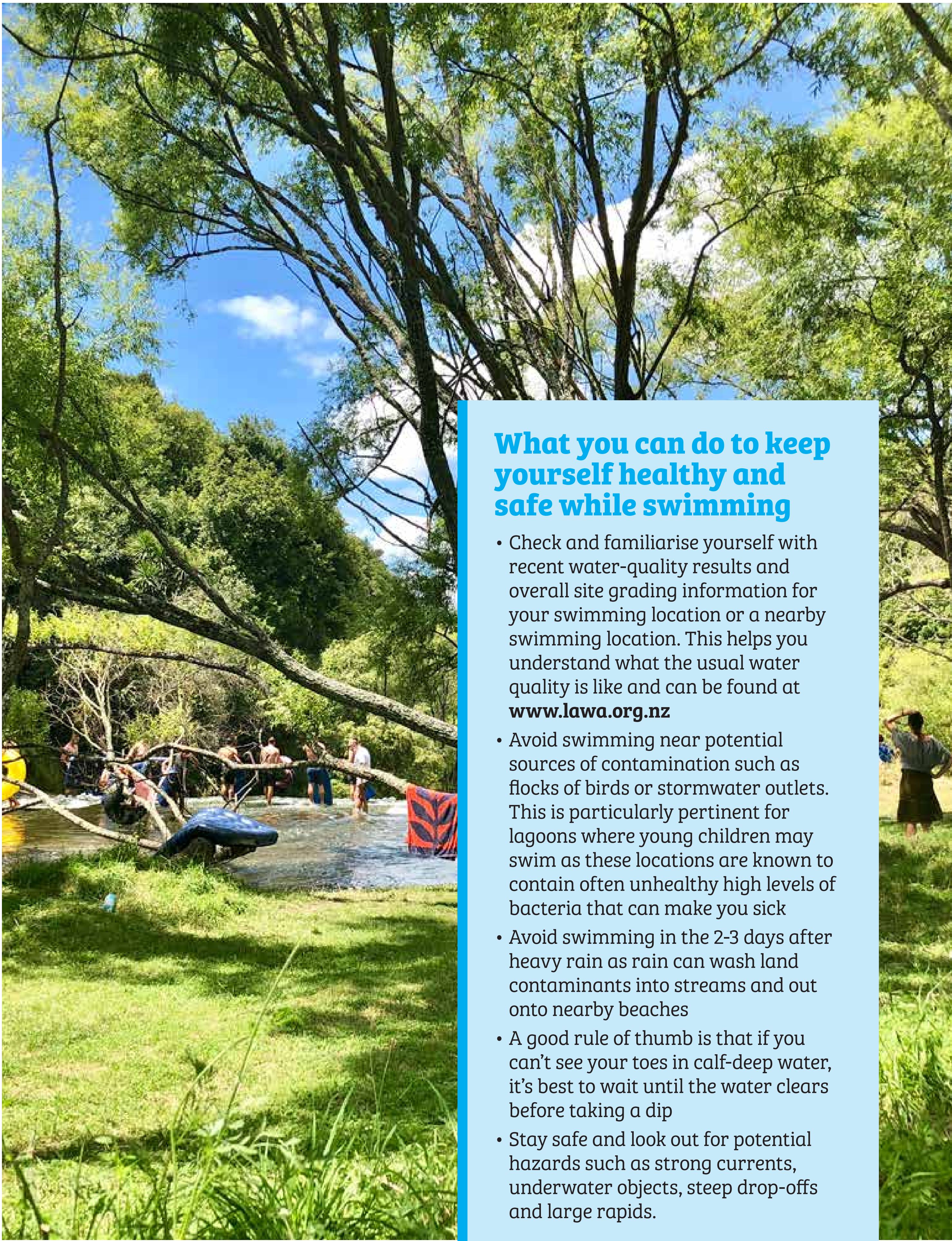
Improving water quality at Wharekopae

Liam Clayton, The Gisborne Herald

The Wharekopae River has long been identified as a hotspot for E.coli levels, and this is a particular concern as both the Rere Falls and Rere Rockslide are found on the river. Intensive water-quality monitoring shows that the levels of E.coli in the river exceed the action limit (unsafe for swimming) nearly half the time at both the Rere Falls and Rockslide. However, analysis of water quality data against rainfall shows that there is a very strong correlation with rain – with water quality generally worse after rain. This was particularly evident in the wet summer of 2018-19, where rainfall was frequent and water quality in the Wharekopae River worse than the previous summer.

The Wharekopae River water-quality project was established to help improve water quality in the river. Farmers in the catchment are developing farm environment plans and undertaking actions such as fencing for stock exclusion and bridging stock crossing locations. It's expected that these actions will start to lead to water-quality improvements.

Rere Falls (Wharekopae River); Kākahi (freshwater mussels – Echyridella menziesii) survey as part of the Wharekopae River water-quality project



What you can do to keep yourself healthy and safe while swimming

- Check and familiarise yourself with recent water-quality results and overall site grading information for your swimming location or a nearby swimming location. This helps you understand what the usual water quality is like and can be found at **www.lawa.org.nz**
- Avoid swimming near potential sources of contamination such as flocks of birds or stormwater outlets. This is particularly pertinent for lagoons where young children may swim as these locations are known to contain often unhealthy high levels of bacteria that can make you sick
- Avoid swimming in the 2-3 days after heavy rain as rain can wash land contaminants into streams and out onto nearby beaches
- A good rule of thumb is that if you can't see your toes in calf-deep water, it's best to wait until the water clears before taking a dip
- Stay safe and look out for potential hazards such as strong currents, underwater objects, steep drop-offs and large rapids.

#02 CASE STUDY | HE TAUIRA

DRAINWISE

Reducing our wastewater discharge

Our city's river water quality is significantly impacted by wastewater discharged into our rivers, particularly during wastewater overflow events. This results in health risks for our residents that use our rivers, beaches, and the sea. If we have wastewater overflows on private property, this then affects the health of that home.

Council's DrainWise project has been set up to reduce these health concerns, working together with property owners and the community to help fix the wastewater and stormwater problems that cause the overflows.

What causes emergency discharges in heavy rain?

During intense or heavy rainfall, some parts of Gisborne's wastewater network are inundated with rainwater (stormwater) and the network can't cope with the volume of water. To prevent wastewater from overflowing onto private properties and out of manholes onto roads – which can cause significant health risks – Council must release the excess water. The only way to do this is to open valves and discharge the wastewater and stormwater into the river. The discharge is highly diluted with rainwater, but there's still a risk to health.

Council only opens the valves when it's absolutely necessary and only in the areas with issues.

We need to work together

Council owns and manages 50% of the wastewater network. The remaining 50% is owned and managed by individual property owners.

Council is legally responsible for the wastewater network (for example, pipes and manholes) outside the property boundary, and homeowners are responsible for everything inside their property boundaries (such as pipes and gully traps).

The Council-managed wastewater network is designed to accepted New Zealand standards, and under normal conditions would be able to cope with higher wastewater volumes in heavy rainfall events.

The problem in Gisborne is that the amount of rainwater getting into the wastewater network, mostly from private properties, is extraordinarily high.

What Council's doing about it

- Wastewater network upgrades and renewals – $17.2m over 10 years
- Stormwater public network extensions – improving public drains on private land - $6m over 10 years
- Property inspections and investigations– checking and making minor repairs, giving advice, collecting data - $4m over 10 years
- Compliance and enforcement – making it easy and affordable to fix the issues
- Education and awareness – promoting good practices, campaigns like "Only Flush the Three Ps"
- Free minor gully trap repairs.

For further information, please visit **www.gdc.govt.nz/drainwise**

AQUATIC ECOSYSTEM HEALTH

Council monitors 81 sites across our region for aquatic ecosystem health.

- 10 sites have excellent aquatic ecosystem health – these sites are in forests high in the headwaters
- 14 sites have poor aquatic ecosystem health – these sites are in areas with cropping, urban or intensively managed pastoral land.

A full report on our region's aquatic ecosystem health is available on Council's website (**www.gdc.govt.nz**) entitled *"SOE Report 2015-2018 Aquatic Ecosystems in Gisborne Macroinvertebrate Communities. August 2018"*.

The Macroinvertebrate Community Index (MCI) is used to measure aquatic ecosystem health by measuring the bugs and critters that live in a stream. It is a wholesome measure of stream health and all the elements of stream health that combine to affect what lives in it.

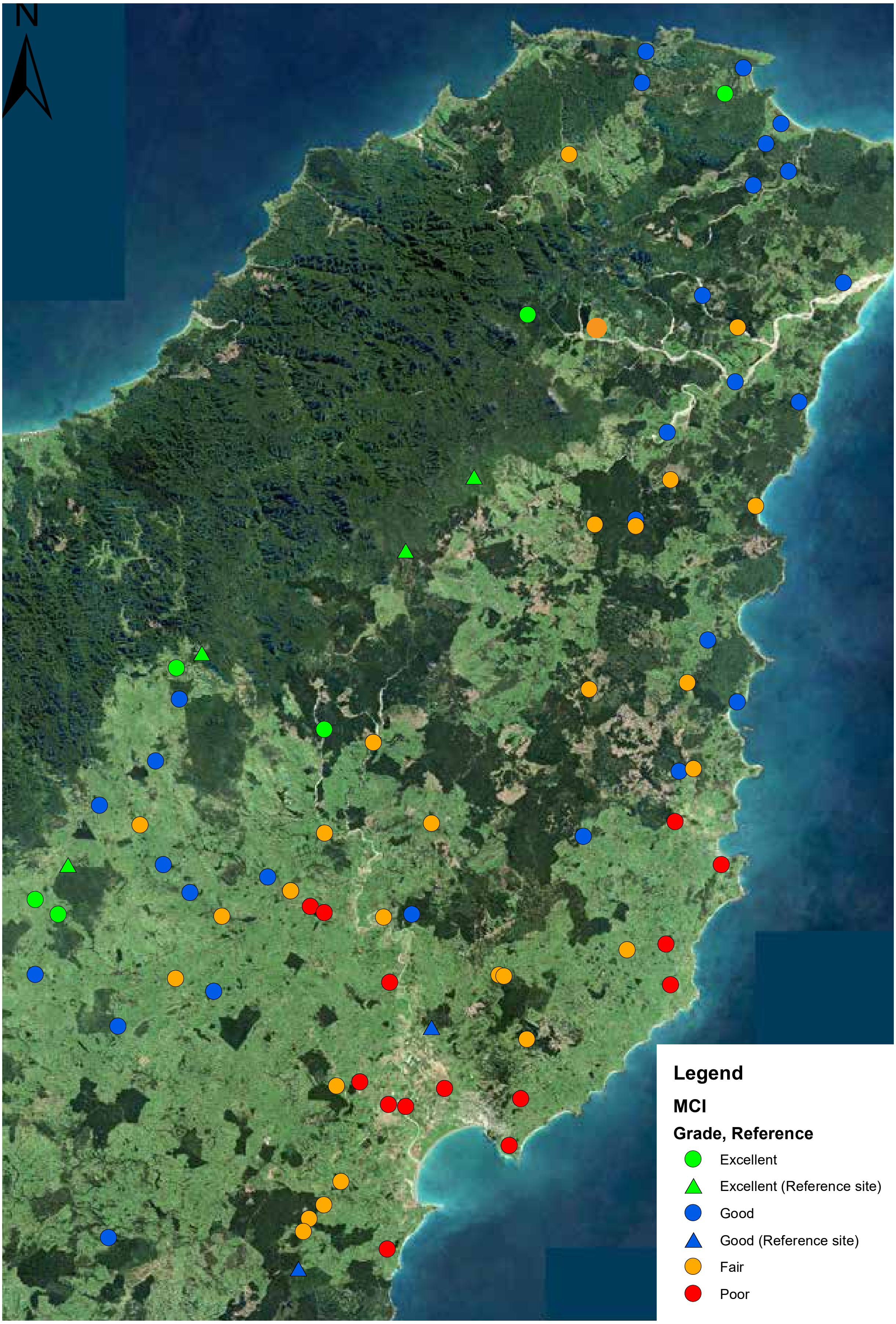
Stonefly larvae that lives in the stream is considered a sensitive species and finding these in your stream is usually a good sign your stream is healthy.

Deposited sediment measurement using the bathyscope at Waimata River at Monowai Bridge. Deposited sediment can smother organisms that live on the stream bed and reduce the amount of available in-stream habitat for them to live in, on and under

Stonefly larvae (left), and its adult version (right)

Leaf veined slug freshwater macroinvertebrate

Freshwater biomonitoring sites across the Gisborne region showing average MCI score grades 2015-2018. Reference sites denote catchments containing more than 95% native vegetation.

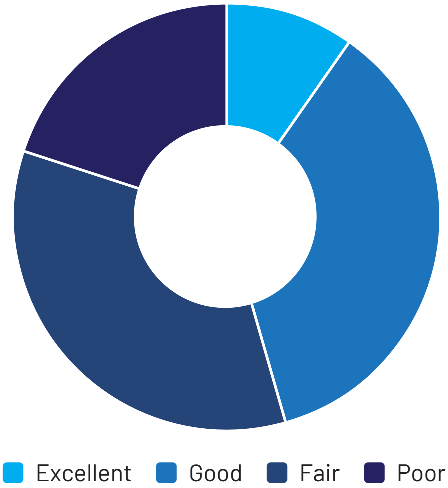


Eighty-one sites have been sampled across a range of land uses, geologies, stream and river sizes, as well as lowland and upland streams. The highest scores tended to be from sites that had little human impact and as such were surrounded by native bush, such as those in the headwaters of the Mata, or at the Matawai at the Conservation Reserve site.

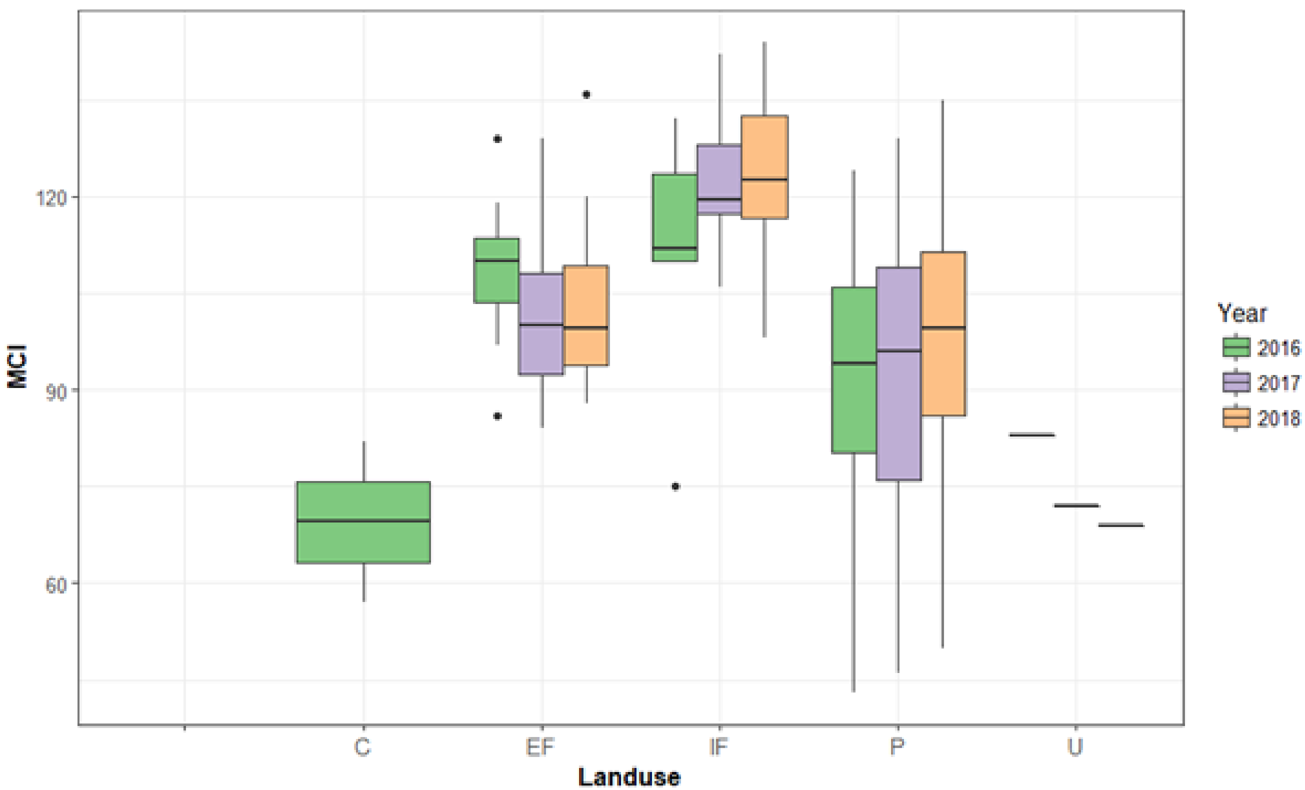
Site scores ranged from Taruheru at Tuckers Road with a "poor" MCI score of 48, up to an "excellent" MCI score of 141 from Mata Upper in the headwaters of the Mata River.

The sites that were in the "excellent" A band category above 120 are typically located in either indigenous forest or mature exotic forestry with one site being in pasture. These sites usually have good habitat such as good stream shading, don't have ready stock access to the stream and they usually have good water quality. The sites in the D band, "poor" category, were located in a mixture of pasture, urban and cropping land and had a mixture of hard and soft bottom classification. These sites usually had a lot of sediment due to erosive catchments or stock damage, get hot during summer because of a lack of stream shading, and lacked habitat for macroinvertebrates to live in and on, such as woody debris or undercut stream banks.

MCI scores across 81 biomonitoring sites in the Gisborne region (average of 2016-19 data over 81 sites)



Boxplot of MCI by land use (2016-18)



Plot of MCI values from 81 sites in Gisborne 2015-18 and land use. Cropland (C), Exotic Forest (EF), Indigenous Forest (IF), Pastoral (P), and Urban (U)

#03 CASE STUDY | HE TAUIRA

Wainui Stream water quality and Tamarau Wetland

Wainui Stream has had longstanding problems with water quality due to both urban and rural influences. Wainui Lagoon has been identified as unsafe for swimming for a long time and odour problems are common during summer. Over six months (spring to autumn) an intensive weekly water-quality monitoring programme across six sites in the catchment was undertaken and records of environmental conditions also kept. This identified that:

- 74% of the time the Wainui Stream is unsafe for swimming – with the worst water quality found at Heath Johnston Park and at Murdoch Road
- dissolved oxygen levels are so low that fish species would be very stressed 95% of the time
- sulphur is present at visible quantities at the Murphy Road site, where sediment bubbling and a strong sulphur smell was regularly observed
- faecal source tracking studies identified human sources of E.coli at both Heath Johnston Park and Murphy Road – indicating both a potential sewer cross connection and influence from septic tanks
- flow levels during summer were very low
- habitat assessments showed the habitat is very poor.

As a result of the water-quality study, Council funded the development of a wetland at Heath Johnston Park to enhance its freshwater ecological habitat, improve water quality and provide amenity value of the park. This wetland was designed to both clean the stormwater from the upper catchment, and to improve the habitat for native fish. The planting of the wetland and surrounding area has been undertaken by community volunteers, with trees supplied by the Women's Native Tree Project Trust and Rongowhakaata Iwi Trust.

The wetland and surrounding area was planted by community volunteers, with trees supplied by the Women's Native Tree Project Trust and Rongowhakaata Iwi Trust

#04 CASE STUDY | HE TAUIRA

Collaborating to restore our waterways and biodiversity

Enviroschools WaiRestoration is an innovative approach to restoring waterway health and biodiversity that brings together the energy of young people, educators, farmers, kaumatua, scientists, Council and many others.

Tairāwhiti's Enviroschools team attended the 2018 WaiRestoration Hui in Northland and returned buzzing with ideas of how the project could be adapted locally. The holistic approach of Enviroschools WaiRestoration delivers a range of positive outcomes - young people gain new skills, knowledge and employment pathways, communities come together to connect with special local places and restore waterways, Māori perspectives are celebrated and nature has the opportunity to thrive.

The first WaiRestoration waterway was Waikanae Stream, named after the kanae (mullet) that were once plentiful. Students from Gisborne Girls High School (GGHS), Gisborne Boys High School (GBHS), Campion College and Te Karaka Area School participated.

With support from Ngā Mahi Te Taiao, the students did water-quality testing which included looking at water clarity, invertebrate and fish life, as well as vegetation along the stream's edges. The study identified a need to fence off the paddocks running down to the stream from Gisborne Airport.

With tutoring from tertiary provider Turanga Ararau and funding from Gisborne Airport, students gained the skills (and NZQA credits) and resources (8-wire fencing materials) they needed to fence off approximately 500m of the upper Waikanae Stream.

The next step was a huge planting project that involved students, community and staff from Gisborne Airport, Eastland Port and Eastland Group. The Women's Native Tree Project and Gisborne Airport supplied the trees. After 1,300 trees were planted, the Department of Conservation helped lay rat and stoat traps to catch predators. There have been reported sightings of the matuku (bittern) in this area so ongoing predator control is key.

In 2019, WaiRestoration fenced and planted Pakowhai Stream (near Muriwai). This is of particular importance because it is a spawning zone for inanga (native fish caught as whitebait). GBHS and GGHS students were again hands-on with fencing.

> "Enviroschools WaiRestoration is an awesome avenue of grassroots engagement" — Peter Hancock, Council

Matawai School, Waikirikiri School, and Wainui Beach School propagated and grew native trees in their school nurseries. GGHS, Gisborne Intermediate School, Lytton High School and Muriwai School were involved in the planting of the Pakowhai Stream site. In addition, Waikirikiri and Wainui Beach Schools have been preparing the trees they propagated for Sisterson's Wetland and Hamanatua Stream.

In 2020, students from Campion College, GBHS, GGHS and Te Karaka Area School began a three-term WaiRestoration programme with Turanga Ararau involving fencing, pest management and propagation of native plants.

Students gathered at Waipura Station, Makauri. Morehu Pewhairangi opened the day with karakia and shared the area's whakapapa.

Council's Peter Hancock explained the threatened status of the native fish habitat, the importance of healthy waterways, how to monitor the quality of the water and how to protect waterways.

Everyone present was enthralled to see banded kōkopu which were caught in fish traps set the previous night. This added to the enthusiasm from students to begin the fencing course and protect the stream.

To date, this initiative has had:

- Four secondary schools involved
- Approximately 35 students and their teachers engaged
- At least 12 stakeholders/partners including iwi and landowners
- 1.5km fencing built
- 1,500 natives planted.

The support of mana whenua and landowners gave students access to the land and fostered an understanding of its history and biodiversity potential.

Enviroschools Tairāwhiti is a collaboration between Council, the Williams Trusts, Eastland Group, and the Department of Conservation. If you're interested in Enviroschools, please contact Darnelle Timbs at **darnelle.timbs@gdc.govt.nz** or visit **www.enviroschools.org.nz**.

Enviroschools facilitator Kirsty Gaddum explains the life cycle of the tuna

Checking out the presence of life in the water

Students learn stream monitoring skills that provide information about the health of their waterways

Appropriate native species are used to help restore the waterways. Here students learn the names of the plants

Turanga Ararau tutor Pete Hema teaching fencing techniques to secondary students

Peter teaches students how to identify macro-invertebrates and use the information to assess stream health

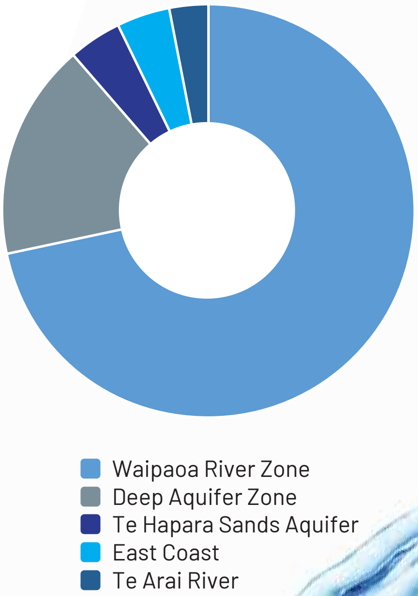
WATER QUANTITY

Water quantity refers to water volumes in rainfall, rivers and groundwater aquifers, and it typically becomes interesting if you end up with too much of it (floods) or not enough of it (droughts).

Use of water for irrigation

In 2016, there was 4,697ha consented to have irrigation water applied, this has increased to 7,120.9ha across the region – 96% of this is in the Poverty Bay Flats. This increase in irrigable area since 2016 is primarily the result of expansion and intensification of horticultural activities, particularly kiwifruit and apples, across the Poverty Bay Flats.

Source of irrigation water and area irrigated (ha)



Allocation vs actual use

The Waipaoa Catchment Plan was developed through the Freshwater Plan process in 2015 and incorporates 12 major sub-catchment areas with a combined land area of 2,205km^2. The area is largely defined by the water catchment boundary of the Waipaoa River but also includes the separate catchment areas of the Waikanae Stream and Taruheru River. These two areas do not drain directly into the Waipaoa River but are both important components of the Poverty Bay Flats and to the Poverty Bay/Tūranganui-a-Kiwa groundwater system and are included within this catchment plan.

Irrigation is essential to the Gisborne region due to the low rainfall and high summer temperatures. The Waipaoa Catchment Plan has set limits around the amount of water that can be allocated for each waterbody in the Poverty Bay Flats. In order to manage the amount of water being taken from our region's rivers and aquifers, consents are granted to people which allocate the amount of water that can be abstracted. Resource consent holders are required to measure and report on the amount of water they are using throughout the growing season. There is a total of 204 current water takes that Council currently manages across the region, with over 95% (197) of them located within the Waipaoa Catchment Plan.

The majority of water take consents are granted for a five-year period which allows Council to review each consent and consider reductions in allocation to align the renewed consent closer to the consent holder's past use and ongoing need. Many of our water sources are over or fully allocated in the Poverty Bay Flats. As a result, there are no new consents being issued for those waterbodies and there are waiting lists established for the water sources. As of May 2020, there are 63 waiting list applications for a consent to take water.

River hydrology and morphology

Water levels and river flows are monitored throughout the Gisborne district (see map on **page 76**). The red dots represent sites where both water level and flow are monitored (28 sites) and the yellow dots (seven sites) are water level sites only.

The sites have a range of catchment areas, ranging from around 10km^2 to more than 1,900km^2. The catchments include a variety of land uses, including urban, agricultural, forest and native forest.

Monitoring water levels and flows provides vital background information. This is essential when:

- setting and maintaining environmental flows to protect our waterways
- works are being carried out to existing roads, bridges and flood embankments
- new bridges are proposed, and
- interpreting water quality data.

Our river monitoring data assists when retrospectively analysing extreme events (floods and droughts) to assess event severity, and to inform stakeholders about risk. The data from monitoring also feeds into Council's flood forecasting model.

Monitoring focuses on individual sites, but also considers how different sub-catchments link and affect each other, such as how flood peaks travel downstream.

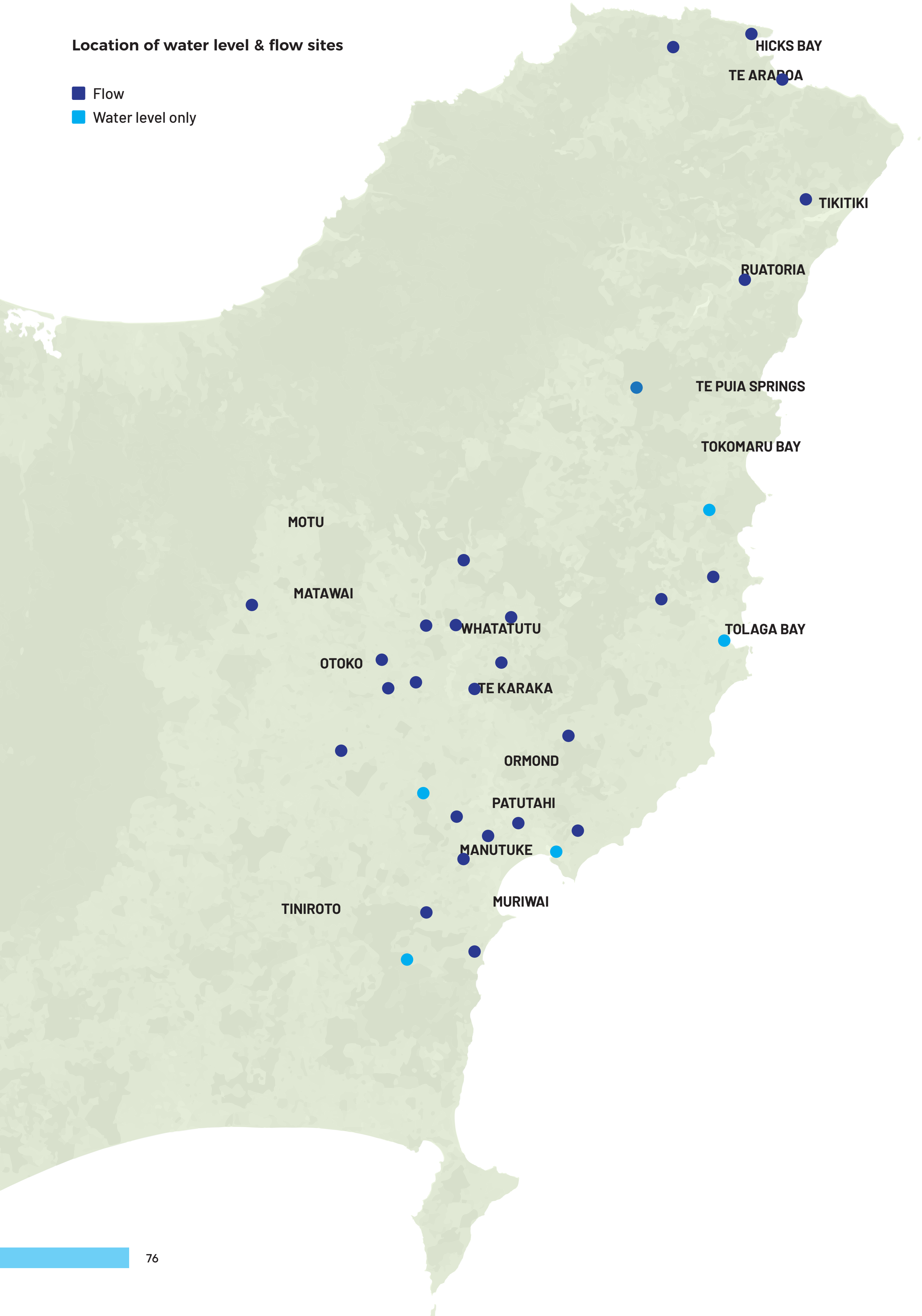
The two case studies (6 and 7) examine the Waipaoa River in more detail with respect to the June 2018 storm events and low flows (dry periods).

The table below summarises the maximum and median flows in selected catchments.

No	Site	Catchment area (km^2)	Data used in the analysis	Maximum flow (m^3/s)	Median flow (m^3/s)
1	Hikuwai River at Willowflat	307	July 1974 to May 2019	1,703	1.96
2	Mangaheia River at Willowbank	41	Aug 1988 to May 2019	207	0.25
3	Mangatu River at Omapere	182	July 1983 to May 2019	1,254	3.21
4	Te Arai River at Pykes Weir	84	July 1984 to May 2019	348	0.56
5	Waiapu River at Rotokautuku Br (SH35)	1,376	July 1989 to May 2019	4,629	35.97
6	Waimata River at Goodwins Rd Bridge	213	July 1987 to May 2019	1,098	1.24
7	Waipaoa River at Kanakanaia	1,580	July 1966 to May 2019	5,273	15.84
8	Wharekopae River at Rangimoe	175	July 1984 to May 2019	3,392	1.57

Taruheru at Tuckers Road during normal flow (left) and during the September 2015 flood (right)

Location of water level & flow sites



#05 CASE STUDY | HE TAUIRA

Controlling floods while preserving fish passage

Council is investigating a pilot project on the Whatatuna Stream, a known inanga (whitebait) spawning area, to improve fish passage. As part of the Waipaoa flood control scheme, large gates remain closed to prevent flooding. Council is looking at the feasibility of allowing these gates to remain open until flood conditions require them to be closed to avoid potential flooding upstream, which will minimise disruption to inanga movement along the stream.

A key objective of our region's Freshwater Plan and in particular the Waipaoa Catchment Plan is to identify barriers to native fish – where stopbank improvement works are occurring on known fish barriers there is a requirement to improve fish passage.

The Waipaoa flood control scheme is a significant constructed earth stopbank designed to protect the highly productive Poverty Bay Flats and Gisborne city from floods. Resource consent was granted in late 2018 to widen and raise the height of the scheme to improve flood protection and resilience, including the requirement to identify and improve fish barriers at a number of tributaries entering the scheme.

Some tributaries are controlled by flood gates that prevent flood waters from moving up the tributaries. In tidal areas, the gates are regularly closed due to daily tidal movements. However, most of the time there is no need for the flood gates to remain closed – they could remain open and improve fish passage, only closing when required prior to flood conditions.

The Waipaoa River flood control scheme involves upgrading the existing Waipaoa stopbanks to cater for a 100-year rain event allowing for climate change effects to 2090. Stopbank construction improvement works will be occurring every summer (construction season) for the next ten years, with the upgraded scheme expected to be completed by 2031.

#06 CASE STUDY | HE TAUIRA

JUNE 2018
Waipaoa River Flood

Waipaoa River at Matawhero, looking downstream (12 June 2018)

Waipaoa River at Kaiteratahi, 11-12 June, showing ponding areas

Waipaoa at Matawhero in 2018 floods

A storm on 11-12 June 2018 produced heavy rainfall in the northern sub-catchments of the Waipaoa River, over the Whareratas and inland western areas. The soils were already saturated, so instead of soaking into the land and reaching rivers slowly, the run-off response was rapid. The storm generated the second highest water level at Waipaoa River at Matawhero since Cyclone Bola in March 1988.

The graph on **page 79** shows the peak flow at Kanakanaia and Matawhero. Kanakanaia, with a catchment area of 1,580km^2, is upstream of Matawhero, with a catchment area of 1,910km^2. The peak flow was approximately 4,700m^3/s at Kanakanaia and 3,400m^3/s at Matawhero.

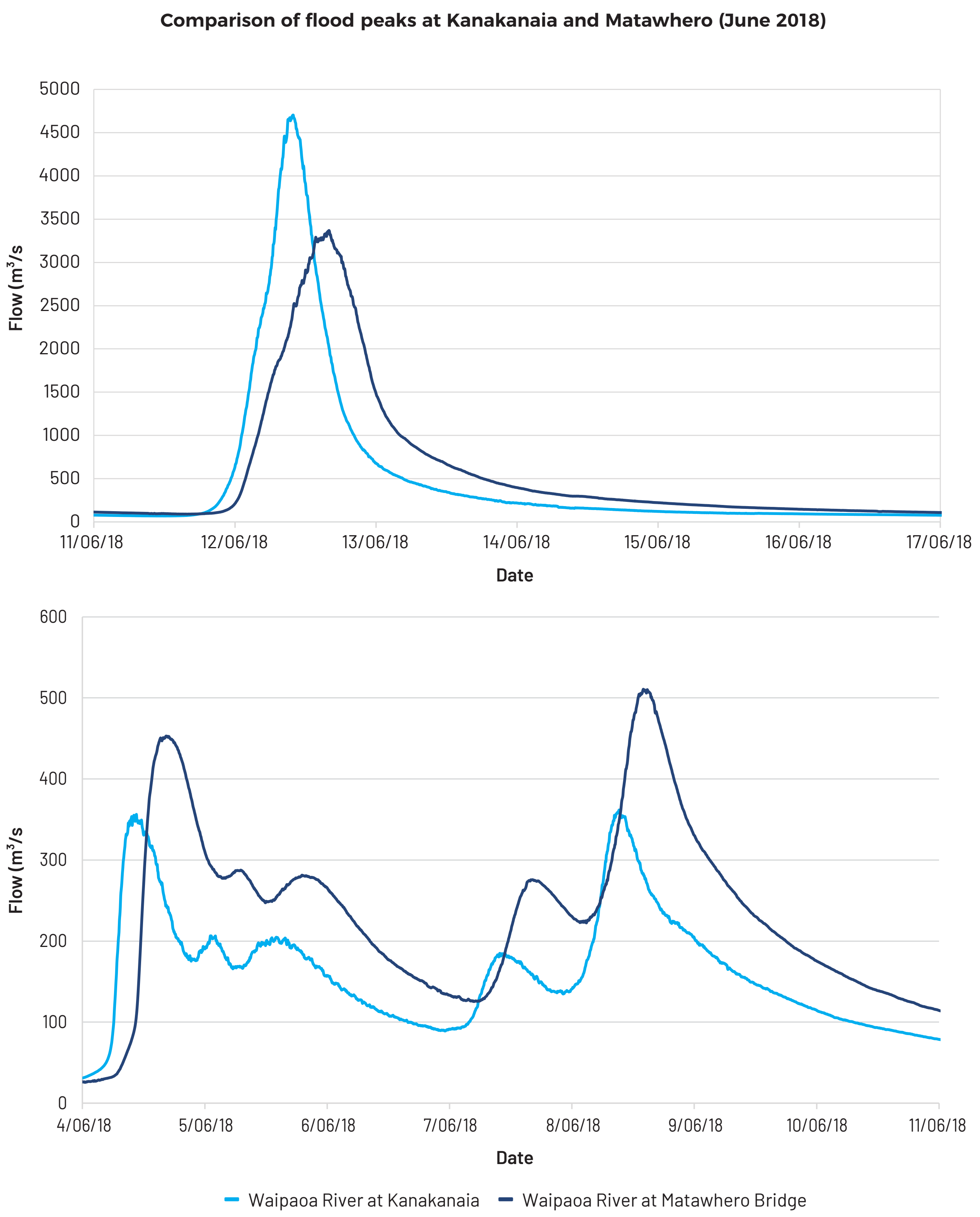
The centre left picture shows the impact of design storage in the Waipaoa River system between Kanakanaia and Matawhero.

When the flood gates in the stop banks close, this shuts out most of the recharge contribution from the sub-catchments downstream of Kanakanaia. The flood scheme is designed to have some ponding areas, where water flows in at upper levels, then flows back out when the river recedes. This return from storage is much slower than main river flow, so has the effect of "shaving off" the peak flow and prolonging the release at lesser flows. There is also the natural storage effect of the water "filling" the river channel itself, then releasing it; this can be significant. The net effect is to reduce the river peak downstream at Matawhero. Ponding areas (large floodplains) can occur naturally in a catchment; the flood scheme on the Waipaoa refines this natural process. This is a good example of the importance and success of the Council-managed flood control scheme.

In this case, the peak flows at Matawhero are significantly higher than at Kanakanaia. The sub-catchments downstream of Kanakanaia are still contributing flow; the flow is contained within the river channel and the ponding areas are empty. The delay in the timing of the peak reflects the amount of time it takes the flood peak to travel down the Waipaoa River from Kanakanaia to Matawhero (around six hours).

The graph on **page 79** shows how different the 11-12 June event was compared to Bola, in terms of the volume of water (and therefore rainfall) involved.

In the 11-12 June event, the flow peaked and receded relatively quickly. The flow measured 4,000m^3/s or more for four hours. In comparison, there was prolonged rainfall during Bola, and the flow measured 4,000m^3/s or more for 36 hours.


Comparison of flood peaks at Kanakanaia and Matawhero (June 2018)
Flow (m³/s)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
11/06/18
12/06/18
13/06/18
14/06/18
15/06/18
16/06/18
17/06/18
Date
Flow (m³/s)
600
500
400
300
200
100
0
4/06/18
5/06/18
6/06/18
7/06/18
8/06/18
9/06/18
10/06/18
11/06/18
Date
Waipaoa River at Kanakanaia
Waipaoa River at Matawhero Bridge

#07 CASE STUDY | HE TAUIRA

Low flows on the Waipaoa River

As the Poverty Bay Flats are used more intensively for agriculture, water availability becomes an important and often controversial issue. Planning for the future involves examining past flow records to assess water availability and also allows for risk assessment and contingency planning.

If the flow in the Waipaoa River at Kanakanaia falls below 4m^3/s, then A Block consent holders have to stop taking water from the river; if the flow falls below 1.3m^3/s, then B Block consent holders have to stop their water takes. This is to ensure that both flows and the ecological values are maintained.

The tables on **page 81** show the number of consecutive days where flow in the Waipaoa River at Kanakanaia (Te Karaka) fell below 4m^3/s and 1.3m^3/s between 2004 and March 2020. The "events" are grouped according to hydrological year that runs from July to June, so summer low flows are grouped together. The tables use the current best data available, but are subject to change.

The first table shows that the number of times the flow falls below 4m^3/s varying from one year to another, from years when this does not occur at all (2011-12) to years when this happens 141 times (2012-13). A further issue is that in years when the flows are at their lowest, the low flow "events" are not short, isolated periods, but can extend for up to 56 days. Depending on the time of year this can have significant implications for crops grown and water storage requirements, and can put significant pressure on crop owners who have investments in orchards that could die if they don't get water.

The second table shows that in most years the flow does not fall below 1.3m^3/s – and when it does (2012-13) it is for short periods (up to two consecutive days).

River flow measurement on the Waipaoa River using aerial drone imagery

Number of consecutive days flow falls below 4m³/s (grouped according to event & hydrological year)

Event	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	Average
1	1	1	6	2	14	5	3		10	1	2	5	43	4	6	6	
2	2		2	3	1	4	18		16	5	1	8	7	2	4	4	
3	17		1	9	6	29	1		4	10	6	5	14	1	6	2	
4	27		6	1	4	5			6	3	8	1			4	5	
5	1		11	6	16	2			20	19	1	3			3	29	
6	3		2	6	10	7			56	8	31					5	
7			4	18	23	2			13	3	44					3	
8			12	21	5	8			13	9	16					2	
9			20	3	6				1	2	7					3	
10			16	2	6				2							2	
11				2	1											1	
12					1											2	
13					7											6	
14					18												
15					1												
16					1												
Total no. of days	51	1	80	73	120	62	22	0	141	60	116	22	64	7	23	70	**57**
No. of events	6	1	10	11	16	8	3	0	10	9	9	5	3	3	5	13	**7**
Maximum duration (days)	27	1	20	21	23	29	18	0	56	19	44	8	43	4	6	29	**22**

Number of consecutive days flow falls below 1.3m³/s (grouped according to event & hydrological year)

Event	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	Average
1									2								
Total no. of days	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	**0.1**
No. of events	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**0.1**
Maximum duration (days)	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	**0.1**

GROUNDWATER

Groundwater quality

Groundwater is normally accessed from groundwater bores and mainly used in our region for irrigation and stock water, but in some areas water is used for domestic drinking water.

Council monitoring of groundwater quality focuses on water chemistry and the presence of pollutants such as E.coli and nitrates which can make water unsafe to drink.

Groundwater bore water level monitoring

TE HAPARA SANDS AND WAIPAOA GRAVELS

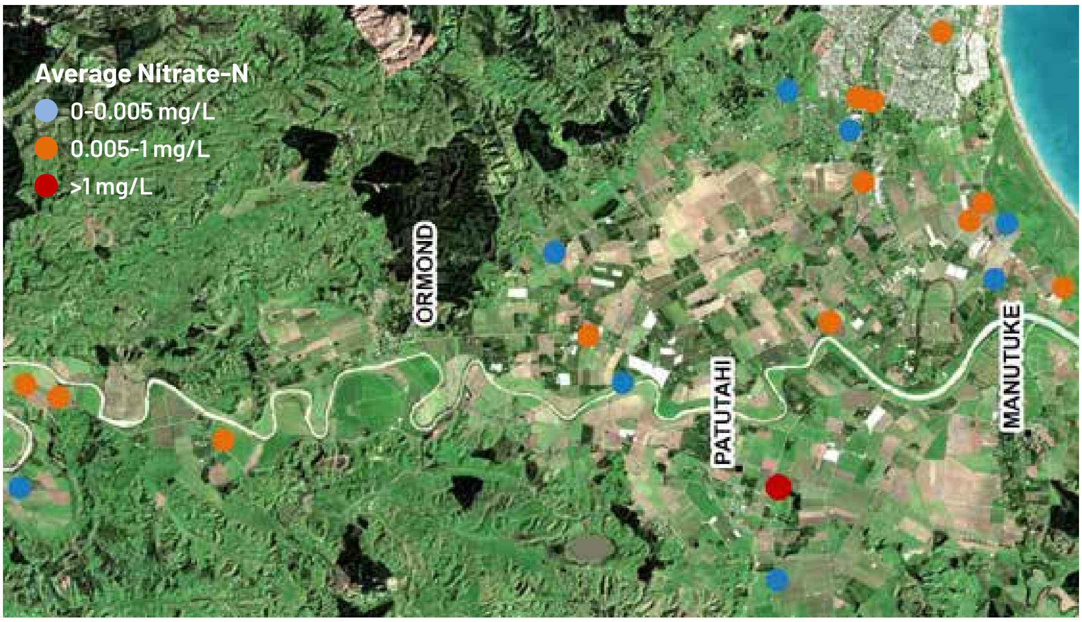
E.coli and nitrogen in shallow bores on the Poverty Bay Flats

Monitoring of water quality in shallow bores shows that 11 bores out of 21 (52%) monitored regularly have E.coli detected and are unsafe for drinking. These bores are shown as red dots on the map below. In the case of one bore, all water-quality samples had E.coli detected and this bore also records exceedingly high levels of nitrate. While E.coli levels are low, this indicates that in general water from the shallow aquifers should not be drunk without adequate treatment such as chlorination.

Some shallow groundwater bores on the Poverty Bay Flats also show elevated levels of nitrate.

E.coli hits in Poverty Bay Flats shallow groundwater (Te Hapara Sands + Waipaoa Gravel + Shallow Fluvial aquifers) 2014-April 2020

Nitrate-N in Poverty Bay Flats shallow groundwater (Te Hapara Sands + Waipaoa Gravel + Shallow Fluvial aquifers) 2014-April 2020



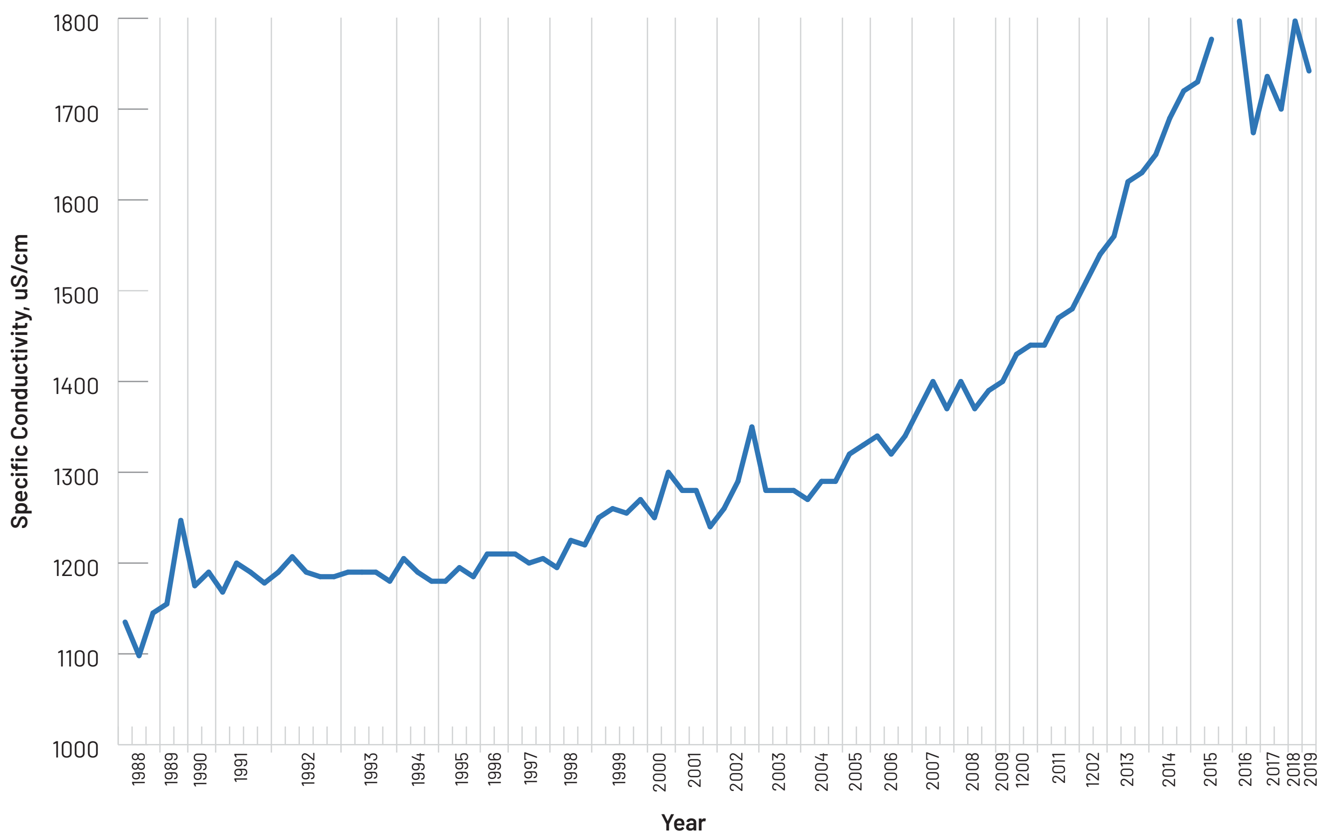
#08 CASE STUDY | HE TAUIRA

Increasing salinity at Eade Road Bore, Makauri Aquifer

The Eade Road Bore is located in the Makauri Aquifer, on the edge of the aquifer at Patutahi. Monitoring data since 1988 shows that conductivity (the amount of salts in the water) has increased steadily since 2008 at the rate of 1.3% per year. Alongside this the salinity of the bore has increased at 1.6% a year.

Salt water intrusion is normally a concern around intrusion from seawater, but in this case it is thought that the increased salinity is because saline water is being pulled into the edge of the Makauri Aquifer from the adjacent Western Saline Aquifer underneath the Patuhai area. It is important to do what we can to prevent saline intrusion from happening, as using water that is becoming increasingly salty can cause unhealthy crops and crop death.

Eade Road Bore Conductivity (1988-19)



MANAGING OUR WATER QUANTITY

Managed Aquifer Recharge Trial

The Makauri Aquifer is the largest underneath the Poverty Bay Flats, extending from Kaiteratahi down to Makaraka and spanning both sides of the Waipaoa River.

The aquifer is an underground area of gravel and sand that's saturated with water. It naturally recharges as water percolates from the river and higher aquifers through the gravel into it, a slow process that happens over several decades.

Since the horticultural boom in the 1980s, crop irrigation has remained at a constant level leading to the decline of the aquifer. It has very little natural recharge from rain water and river water because of changes such as flood control, vegetation clearance, rainfall and climate change.

The Poverty Bay Flats is an area of 18,000ha and is the single largest area of highly fertile soil in the country. It's among the most productive horticultural areas thanks to a combination of high sunshine, fertile soils and mild temperatures.

Currently about one million cubic metres is taken from the aquifer each year.

Modelling shows that 660,000m3 per year is required to go back into the aquifer to stabilise it, with even more required to enable any expansion of irrigation.

Irrigation would need to be reduced by two-thirds of current use to equal natural recharge.

The Managed Aquifer Recharge (MAR) project aims to inject water from the Waipaoa River into the Makauri Aquifer for use on 3,000ha of irrigated horticultural farmland. Once complete, the trial will show if it's possible to increase water in the aquifer with minimal impact on water quality and the environment.

The trial began in 2017, jointly funded by Council, Ministry for Primary Industries and Eastland Community Trust (now Trust Tairāwhiti). During stage one of the trial (winter 2017), 75,000m3 of water was successfully injected into the aquifer, without showing any adverse side effects on the quality of the existing groundwater.

Work to fully investigate all potential risks started in winter 2019 and will run for two injection seasons – winter 2019 and winter 2020 – and aims to inject up to 360,000m3 per year, depending on river flows and clarity of water. Winter 2019 was severely impacted by river clarity and approximately 40,000m3 was injected. An increased monitoring programme based on recommendations from iwi was undertaken to look at the mauri and cultural impacts of the river and the aquifer.

The stage two trial will generate hydrological data needed to determine the number and location of injection bores in a wider MAR scheme. It will also look at the volume of injection water needed to sustain and then grow irrigation on the Poverty Bay Flats.

The information gained during the trial will be available to any party seeking to develop a MAR scheme.

A company, MAR Limited, has been set up by horticultural interests, including Mangatu Blocks, Kaiaponi Farms, Leaderbrand and some smaller firms. This group is planning how they can use the findings of the MAR trial for future development.

For further information, please visit **www.gdc.govt.nz**.

Pesticides and emerging contaminants in our groundwater

Council has participated in national groundwater quality sampling programmes for a number of years aimed at detecting and monitoring the extent and trends of pesticide and herbicide contamination in New Zealand's groundwater. Research has shown that shallow unconfined aquifers are more vulnerable to contamination than deeper aquifers and as such Council has sampled around six wells from the shallow aquifers of the Poverty Bay Flats.

The testing covers around 80 parameters used in both pesticide and herbicide application. Most detections to date have been of herbicide residues, but two pesticides residues were detected in 1990. The majority show no detection of contamination, but where contaminants that have been detected they are detailed in the table. The 2018 round of sampling also included testing for glyphosate and AMPA (a glyphosate).

In particular, atrazine is a herbicide that has repeatedly been detected in some wells, particularly in well GPF032. The first result from 1990 from this well was very high, but a subsequent re-sampling in 1991 showed significantly lower levels. The magnitude of these results seems to be reducing over time.

Well name	Year of survey	Contaminant	Herbicide or pesticide	Result (µg/L)
GPF032	1990	Atrazine	Herbicide	37
GPF032	1991	Atrazine	Herbicide	2.1
GPF052	1990	Diazinon	Pesticide	0.03
GPF052	1990	Chlorpyrifos	Pesticide	0.03
GPF032	1991	2,4,5 T	Herbicide	0.1
GPE015	1994	Atrazine	Herbicide	0.05
GPF032	1994	Atrazine	Herbicide	0.9
GPM007	1994	Atrazine	Herbicide	0.09
GPF032	1994	Alachlor	Herbicide	0.1
GPF032	1994	Metolachlor	Herbicide	0.1
GPF032	1998	Atrazine	Herbicide	0.04
GPM007	1998	Alachlor	Herbicide	0.02
GPM007	1998	Desethyl Atrazine (DEA)	Herbicide	0.03
GPM007	1998	Atrazine	Herbicide	0.02
GPM007	2002	Desethyl Atrazine (DEA)	Herbicide	0.046
GPF032	2002	Atrazine	Herbicide	0.035
GPF032	2006	Atrazine	Herbicide	0.094
GPE015	2010	Atrazine	Herbicide	0.022
GPF032	2010	Atrazine	Herbicide	0.042
GPM007	2014	Acetochlor	Herbicide	0.021
GPM004	2014	Terbuthylazine	Herbicide	0.024
GPF032	2014	Atrazine	Herbicide	0.017
GPF032	2018	Atrazine	Herbicide	0.22

Atrazine detections from shallow groundwater in Gisborne (data from national pesticides 4 yearly sampling)

CHANGES IN RIVERBEDS

Our riverbed levels have been surveyed from 1956 until now. Bed levels increase when large amounts of gravel and silt erode into the bed. They decrease when storms scour the bed, transporting the gravel downstream. The analysis of riverbed levels shows for the first time since Cyclone Bola that riverbed levels are no longer continuing to rise in all monitored locations. This is likely to be because erosion plantings are starting to be effective, as well as the lack of substantial erosion events since the 1980s.

River	Bed trend level	Implication
Waiapu River	Upper catchment gradually increasing	Erosion is continuing at rates where more gravel is deposited than naturally moved by the river
Mata River	Upper catchment decreasing, lower catchment increasing	Erosion plantings have stabilized the upper catchment, this means gravel is moving downstream
Tapuaeroa River	Increasing	Erosion is still very widespread in the catchment
Karakatuwhero River	No significant trend	The harder geology means a stable stream bed, with limited new material being created
Mangatu River	Gradually increasing	Erosion is continuing at rates where more gravel is deposited than naturally moved by the river

Waiapu River at Ruatoria

RAINFALL SITES

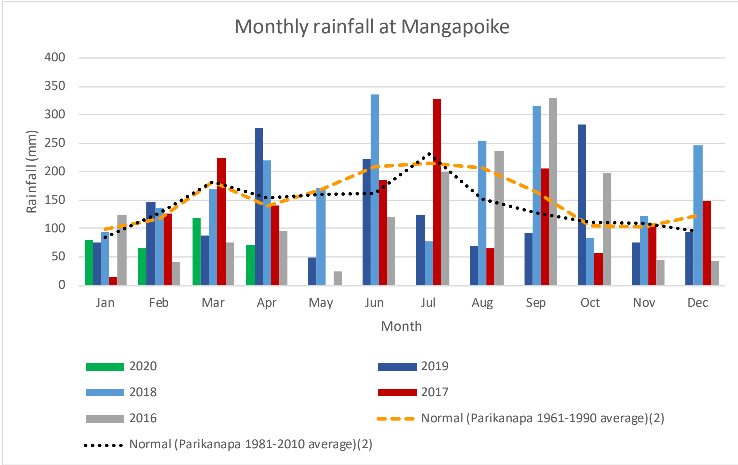
Council is responsible for over 60 rainfall sites; the map on **page 89** shows their location.

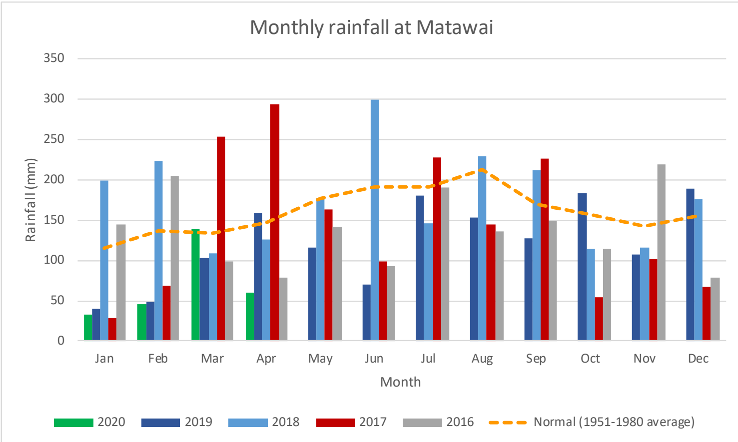
The coverage of the sites across our region (and across a catchment) is important, taking in a range of elevations, land uses and aspects. Data from a number of sites feeds into the flood forecasting model. Some sites are strategic and provide an "early warning" when a weather front is coming through. Rainfall data are also vital in assessing storm events and periods of drought.

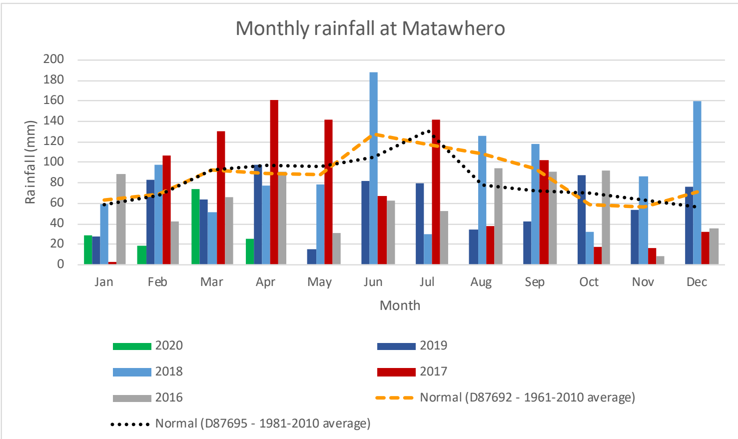
The adjacent charts show monthly rainfall at three sites for the years 2016, 2017 and 2018. The sites are Matawai Telemetry Station, Waipaoa River at Matawhero Bridge and Ruatoria Telemetry Station at Barry Avenue. The "monthly normals" are also shown. The monthly normals are a "best estimate of station's data over a 30-year period" (National Institute of Water and Atmospheric Research (NIWA), 2019) and come from the National Climate Database (https://cliflo.niwa.co.nz/).

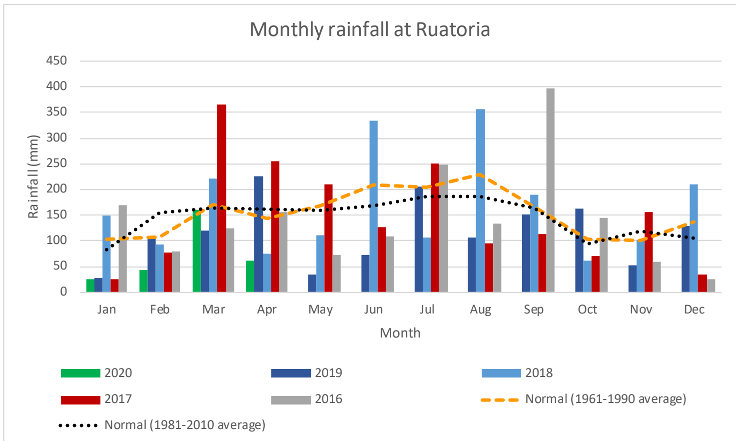
The monthly normals show the expected rainfall pattern – with rainfall peaking during the winter months (June, July and August) and reaching a minimum during spring and summer.

The actual rainfall for 2016, 2017 and 2018 does not always follow this expected pattern. There is huge variability in rainfall – from month to month, year to year, and also location to location. Summer months can be relatively wet (for example January and February 2018 at Matawai) and winter months can be relatively dry (for example May and June 2016 at Ruatoria).









Location of rainfall sites