Title: **River water quality and ecological health in the Ruamāhanga Whaitua**

Purpose: To assist the Ruamāhanga Whaitua Committee to understand the current water quality and ecological health of rivers in the whaitua

Author: Tessa Bunny, Juliet Milne, Laura Keenan

Date: July 2014

Contact the Ruamāhanga Whaitua Committee
Masterton
PO Box 41

ruamahangawhaitua@gw.govt.nz

T 0800 496 734
F 06 378 2146

Contents

Executive summary

- River water quality and ecosystem health is excellent in the upper reaches of rivers from the forested Tararua, Remutaka and Aorangi ranges, such as the Ruamahanga, Waiohine and Waingawa Rivers. As pastoral land cover becomes predominant in the valley, macroinvertebrate health declines while periphyton and macrophyte growth increases. At Te Ore Ore there is a notable decrease in water quality with an increase in ammonia, phosphorus and nutrients. Here, the eastern tributaries; Whangaehu and Taueru rivers enter the Ruamahanga River, and discharge from Masterton Wastewater treatment plant and high nutrients from groundwater enter the river. At the lower reach of the Ruamahanga, Lake Wairarapa with poor water clarity, high suspended sediments and nutrients enters and influences the Ruamahanga River for a short time before outflowing into the sea.

- The key issues affecting water quality and stream health are nutrient (nitrogen and phosphorus) enrichment, poor water clarity, faecal contamination and habitat degradation (particularly a lack of riparian cover). Nitrate toxicity may be an issue in small, groundwater-fed lowland streams. Sedimentation and associated degraded habitat is an issue for lowland streams and eastern tributaries of the Ruamahanga River.

- Nitrogen can affect human and animal health drinking the water, and too much nitrogen is toxic to fish and other aquatic organisms. Nitrogen is very soluble and easily gets into water and flows across land and leaches through soil into groundwater. The main source of nitrogen in New Zealand's waterways is urine from farm animals. Plants are unable to take up all the nitrogen and when soil is waterlogged the nitrogen washes straight through the soil into the groundwater.

- Phosphorus is carried into waterways stuck to soil particles. Sewage and animal effluent is rich in phosphorus.

- Sediment is the particles of soil, silt or clay and this becomes mobile in rainfall and when this enters rivers, streams it makes water murky and smoothers aquatic life. Agriculture, with the historical removal of vegetation has contributed to the amount of sediment in our waterbodies. High rainfall and flood events wash soil off the land into the water, adding sediment and phosphorus and other nutrients bound within it.

- The main sources of nitrogen and phosphorus are agriculture runoff, urban storm water runoff and town wastewater plants.

- The main causes for the decrease in water clarity and significant increase in nutrient (nitrogen and phosphorus) are runoff from agricultural land, stormwater runoff from urban and rural areas, discharge from municipal wastewater treatment plants and poor water from the eastern tributaries.

- There have been few environmentally meaningful recent trends over time in catchment-wide river water quality.

The rivers and streams in the whaitua

- How much water and how fast it moves, and whether its flow is constant or fluctuates are key factors to how vulnerable the rivers and streams are to pollutants.

- The Parkvale Stream, a small lowland stream has poor water quality and ecosystem health. It experiences high water temperatures, has poor water clarity, high nutrient concentrations and sometimes severe periphyton proliferations. The stream is situated in an area of intensive agriculture, is prone to extreme low flows and has little riparian cover.

- The lower Mangatarere Stream has extremely poor water quality and degraded ecosystem health, failing guidelines for water clarity, bacteria and nutrient concentrations. Main contributors are agricultural discharges and runoff, Carterton wastewater plant (elevated phosphorus and ammonia concentrations.

- The lower Waipoua River generally has good water quality but during periods of prolonged low flows it can experience high water temperatures, excessive periphyton and cyanobacteria proliferations. Water quality significantly declines after rainfall.

- The eastern hill country tributaries Kopuaranga, Whangaehu and Taueru rivers have poor water quality and ecosystem health. The water quality of the Kopuaranga, Whangaehu and Taueru rivers is affected by high pastoral land use, soft sedimentary rock and occasional extreme and prolonged low flows. The catchments are mudstone and sandstone which is more erodible and carries high amount of particles of soil, silt or clay in the water (suspended sediment) which builds up on the river bed, making water murky and smothering aquatic life. These rivers have high nutrients concentration, bacterial counts and are prone to extreme periphyton and macrophyte proliferations and agricultural land use has made these worse.

- Intermittent waterbodies are those that have irregular flow and/or pools for the majority of the time and is confined in a channel with defined banks. In their natural state, water bodies such as the Waipoua and Mangatarere are intermittent. They often have distinctive aquatic invertebrate communities that contribute to the overall regional biodiversity. These streams and their importance are often poorly understood and are given less protection from the effects of nearby ground water abstraction than permanently flowing reaches.

Swimming in the rivers and streams

- Monitoring to assess suitability for swimming is undertaken between mid-November to the end of March, when swimming and other recreation activities are likely to occur.

- *E. coli* is used as an indicator for the likelihood of other pathogens being present. This relationship holds true, except where *E. coli* has been treated in town sewage treatment plants. Wastewater treatment plants can be effective at treating *E. coli*, but are less effective at treating pathogens and viruses. This is a problem as there are many popular swimming holes in the Ruamahanga River downstream of wastewater treatment plants and the *E. coli* results may not reflect the true health risk present to recreational users. The effectiveness of Wairarapa wastewater treatment plants to remove pathogens is unknown.

- The National Objective framework- Human health for recreation describes the level at which water quality should be managed to in order to keep people healthy while either swimming or wading in water. Every waterway is to be managed to meet secondary contact – this allows for wading, boating, fishing. Another requirement is the water quality must be maintained or improved overall within a region. More than half the sites currently monitored in the whaitua (mainly in the east and southern end of the whaitua) do not meet NOF standards for swimming (primary contact).

- How much water and how fast it moves, and whether its flow is constant or fluctuates are key factors to how vulnerable the rivers and streams are to pollutants.

Influences on water quality

1. **Eastern hill erodible sand stone and mudstone.**

The naturally erodible sandstone and mudstone in the eastern hills has been made worse by historic vegetation clearance for agriculture, making this country more prone to erosion and has led to an increase in sediment runoff. The eastern tributaries of the Ruamahanga River are more prone to extreme, prolonged low flows and experience higher water temperatures and prolific periphyton. Low flows in the Ruamāhanga catchment are also exacerbated at times by water abstraction.

2. **Agricultural and urban land use**

Agricultural and urban land use has led to the removal of natural vegetation cover and modification of water bodies which can result in direct effects on water quality, such as increasing light penetration and water temperatures, and indirect effects such as increased runoff. The trend for land use change in the last 15 years has been the intensification of land use rather than a major change in the type of land use, resulting in increased stocking rates and/or fertiliser inputs.

3. **Urban land use**

Urban areas occupy a very small proportion of the whaitua but have a proportionally larger impact on water quality than the area they occupy compared to other land uses. In urban areas, streams are often piped or artificially channelled with concrete edges, which decreases instream and riparian habitat.

3.a Stormwater is rainwater collected from roofs, driveways and roads is generally piped directly into rivers and streams without any treatment. The stormwater picks up sediment, rubbish and other contaminants, including metals, hydrocarbons, herbicides, pesticides, nutrients and pathogens. 3.b Town (municipal) wastewater discharges from all five townships in the whaitua.

3.b Henley Lake discharges to the Ruamahanga River and is likely to contain faecal material and nutrients from the large waterfowl population, toxic algae, and stormwater-related contaminants. The lake has higher water temperature, nutrient levels and bacteria counts, and lower dissolved oxygen levels than the Ruamahanga River.

3.c Masterton, Carterton and Greytown water treatment plants (WTPs) for drinking water which discharge waste products (suspended sediment and aluminium) into the Kaipaitangata Stream and Waingawa River.

4. **Water races**

Water races have poor water quality with poor water clarity and elevated nutrients and faecal bacteria), due to stock access and agricultural runoff inputs.

5. **Pumped water schemes and agricultural drain discharges**

An extensive network of agriculture drains nearby Lake Wairarapa and Lake Onoke have very high levels of nutrients, sediment and faecal bacteria.

6. **Groundwater discharge**

In many parts of the whaitua there is a high degree of connection between surface waters and groundwater. Shallow, unconfined aquifers can have elevated concentrations of nitrate and sulphate. Nitrate concentrations are particularly elevated in shallow aquifers in Te Ore Ore and around Carterton.

7. **River works**

Rivers are used for gravel extraction or gravel is removed to maintain channel alignment and reduce flood risk to adjacent or downstream property. These works can degrade instream habitat, increase sedimentation and reduce water clarity. Large-scale gravel extraction occurs:

- Ruamahanga River at Te Ore Ore
- Waingawa River confluence
- Waiohine River (at State Highway 2)
- Waipoua River (above Masterton)
- Tauherenikau River (State Highway 53)
- Huangarua River (above Ponatahi)

Factors affecting river water quality and ecological health in the Ruamāhanga Whaitua Natural influences

There are distinctive differences in climate, soils, land use, erosion and river flow in the west and east side of the whaitua.

West of the Ruamahanga River

- Waingawa, Waipoua, Waiohine, Tauherenikau rivers
- Greywacke rock
- High annual rainfall of 6,000 mm in the Tararua Range and 1,200 mm rainfall in Greytown.
- High rainfall means western tributaries have a high base flow and less flow variability across the seasons.
- Generally have clearer water because the particles are larger and heavy and do not transport as easily. These factors combined with a high flow mean these rivers are less turbid.

East of the Ruamahanga River

- Kopuaranga, Whangaehu, Taueru and Huangarua rivers
- Shallow and porous soils of soft mudstone, sandstone and limestone. These soft soils are prone to erosion.
- Low rainfall of 700-800 mm pa means low river flows and greater flow variability
- High suspended sediment load – mudstone and limestone soils are made of smaller particles that are light and mobile. These factors combined with low flows means it takes a long time for finer particles to settle and longer periods of turbidity.
- Taueru River, Kopuaranga River and Whangaehu River do not meet national guidelines - water clarity, *E. coli*, NNN and DRP (dissolved reactive phosphorus). These rivers also typically have high conductivities and pH.

Technical notes about base flow

The ultimate source of the high base flow is the consistently higher rainfall, without high rainfall it wouldn't matter if catchment forested or not, the base flow would be low.

In the west: High rainfall and forested upper catchments (which store and then steadily release water) means western tributaries have relatively high base flows and low flow variability across seasons.
In the east: Low rainfall of 700-800 mm pa combined with relatively sparse catchment vegetation (and therefore low storage) means low river base flows, especially in the summer. However, because the eastern catchments are still quite large, they can also experience big freshes and floods and therefore have high flow variability across seasons
.

1. Introduction

The purpose of this report is to provide information about the current state of water quality and ecosystem health in rivers and streams of the Ruamāhanga Whaitua.

2. A summary of different parts of the Ruamāhanga Whaitua

2.1 The upper reaches

The upper reaches of rivers emerging from the Tararua, Remutaka and Aorangi ranges (Ruamahanga, Waingawa, Waiohine, Tauherenikau and Tauanui rivers) have excellent water quality and ecosystem health. The catchments of these rivers are dominated by indigenous forest cover and as a result the rivers have healthy macroinvertebrate communities, little nuisance periphyton growth, low water temperatures, and low suspended sediment, nutrient and faecal bacteria levels.

2.2 Major rivers on the plains

As the major rivers fed from the Tararua Range (Waingawa, Waiohine and Tauherenikau rivers) and cross the Wairarapa plains water quality deteriorates.

There is less riparian cover and the rivers are subject to runoff from agricultural land, discharges (from stormwater drains) and river works. Water clarity tends to decline and nutrient concentrations increase. The rivers may experience periphyton proliferations.

These rivers generally have good water quality and ecosystem health, and are generally suitable for contact recreation in their lower reaches.

2.3 Rivers and streams from the foothills of the Tararua Range

The Waipoua River, Mangatarere Stream and their tributary streams have excellent water quality in their upper reaches and deteriorate as they cross the plains. These waterways are more prone to low flows than the larger rivers, and their smaller catchments have less native bush and a higher proportion of intensive agriculture.

- Waipoua – The lower reach generally has good water quality but at times (particularly during periods of prolonged low flows) it can experience high water temperatures, excessive periphyton and cyanobacteria proliferations. Generally good for dry weather swimming, but water quality significantly declines after rainfall.

- Mangatarere – The lower reach has extremely poor water quality, failing guidelines for water clarity, bacteria and nutrient concentrations. The MCI indicates a degraded ecosystem health. As well as agricultural discharges and runoff, the stream receives treated wastewater from Carterton township. The monitoring data indicates that the discharge is having a notable impact on water quality, with elevated DRP (dissolved reactive

phosphorus1) and ammonia concentrations. Mangatarere Stream in its lower reaches is the only western stream with poor water quality. All parameters fail to meet the guidelines with the exception of dissolved oxygen.

2.4 Tributaries of the eastern hill country

The Kopuaranga, Whangaehu and Taueru rivers- water quality is affected by: high pastoral land use, soft sedimentary rock and occasional extreme and prolonged low flows. Water quality in the upper reaches may be good. In the lower reaches where they enter the Ruamahanga River, water quality is poor. There is high suspended sediment loads, poor water clarity, high nutrient concentrations, high bacterial counts and are prone to extreme periphyton and macrophyte proliferations.

These Rivers do not meet national guidelines2 for water clarity, E. coli, NNN and DRP, and typically have high conductivities and pH.

2.5 Lowland streams

Parkvale, Papawai, Makoura and Otukura streams are lowland streams that feed into the Ruamahanga River and Lake Wairarapa.

Parkvale is the only lowland stream that is routinely monitored by GWRC. Parkvale Stream in its lower reaches has poor water quality and ecosystem health. It experiences high water temperatures, has poor water clarity, high nutrient concentrations and, at times, severe periphyton proliferations. As a result the macroinvertebrate community in the stream is dominated by species that are tolerant of these poor conditions. The Parkvale Stream is situated in an area of intensive agriculture, is prone to extreme low flows and has little riparian cover. A significant amount of flow is derived from groundwater (particularly during times of low flow) and these results in low dissolved oxygen. E coli and nutrient concentrations fail national guidelines.

2.6 Intermittent waterbodies

Intermittent waterbodies are those that have irregular flow and/or pools for the majority of the time and is confined in a channel with defined banks. In their natural state, water bodies such as the Waipoua and Mangatarere are intermittent, for parts of the year the flow runs beneath the surface of deep gravel substrates. These are different from ephemeral streams which are defined as an area of land where there is concentrated flow for short periods of time during and/or after rainfall, but is otherwise dry for most of the time.

In the Wairarapa there are two main types of intermittent streams, those that start in the headwaters, and those that are mid reach intermittent streams (downstream in the catchment). Intermittent streams are located in the headwaters because large rivers often have a large area of gravel which have dry areas.

The mid channel intermittent streams are most under pressure from development as they are less visible. They may have less species diversity but perform important services such as sediment retention, and lessen the impact of floods.

[1] This is the soluble phosphorus that is available to plants.
[2] NOF attributes are about minimum states/bottom lines and do not replace national guidelines

The intermittent streams in the headwaters in native forest such as those in the Tararua Range have high ecological value. They often have distinctive aquatic invertebrate communities that contribute to the overall regional biodiversity.

These streams and their importance are often poorly understood and are given less protection from the effects of nearby ground water abstraction than permanently flowing reaches.

3. A summary of the Ruamahanga River: from headwaters to the sea

The WQI and MCI, periphyton indices show a decline from pristine water quality in the headwaters to degraded water quality and ecosystem health in the middle and lower reach.

3.1 McLays to Te Ore Ore

'Excellent' WQI, MCI and periphyton rankings at the most upstream monitoring site which is surrounded in indigenous forest. However, by the time the river reaches Te Ore Ore the water quality and ecosystem health has declined to 'good' with a decline in water clarity (and associated increase in turbidity) and an increase in nitrite-nitrate nitrogen and *E. coli*.

Factors that will be influencing this:

- agricultural runoff
- discharges from the Rathkeale wastewater treatment plant and Henley Lake which have recently ceased.
- inflow from the Kopuaranga River which has a significant amount of dairy farming and has high E. coli counts and nitrite-nitrate nitrogen concentrations.

Te Ore Ore is generally suitable for swimming, but water quality declines following rainfall.

3.2 Te Ore Ore to Gladstone

Water quality declines from 'good' to 'fair'. There is an increase in levels of ammonia and DRP and nutrient concentrations tend to peak at Gladstone Bridge and decline slightly in the lower reaches of the Ruamahanga River.

The Waingawa River and two eastern tributaries with poor water quality – the Whangaehu and Taueru rivers – enter the Ruamahanga River as well as wastewater from the Masterton municipal wastewater treatment plant.

Factors that will be influencing the lower water quality grade:

- The main contributor of nutrients is runoff from agricultural land, and is highest in high rainfall (Winter and spring)
- Nutrient inputs from Masterton's wastewater discharge

- Nutrients (particularly nitrate) from groundwater from unconfined aquifers when soils are saturated, mainly in winter and spring.

The river is classed as 'poor' for contact recreation.

3.3 Gladstone Bridge to Pukio

The water quality is 'fair' with a subtle decline in water clarity, and an increase in E. coli counts. There is an improvement (decline) in nutrient concentrations (although median DRP concentrations still exceed guideline values). There are significant groundwater interactions in this part of the reach.

The Waiohine River with overall good water quality enters the Ruamahanga River doubling its flow provides some dilution effects.

The Huangarua River is the other major tributary that enters the Ruamahanga River which has good water quality.

There are significant interactions with groundwater systems throughout this reach. The river directly or indirectly via tributaries, receives discharges from the Carterton, Greytown and Martinborough municipal wastewater treatment plants. Due to these discharges the recreational sites are classed as 'fair' within this reach.

3.4 Pukio to Lake Onoke

'Pukio' is the most downstream monitoring site on the Ruamahanga River and has at times increased salinity from the backflow of water from Lake Onoke, when the mouth of Lake Onoke is blocked. Lake Wairarapa, which has high suspended sediment and nutrient concentrations, feeds into the Ruamahanga River when the Barrage is open.

3.5 What are the trends in river water quality and ecological health?

There were few environmentally meaningful trends over time in water quality between 2006 and 2011.

4. Tools used by GWRC to measure water quality and ecological health

- A **Water Quality Index**, based on six key water quality variables (dissolved oxygen (DO), visual clarity, *E. coli*, nitrite-nitrate nitrogen (NNN), ammoniacal nitrogen (ammonia) and dissolved reactive phosphorus (DRP))

- A **periphyton class**, based on comparing periphyton cover and biomass results to national guidelines.

- A **Macroinvertebrate Community Index (MCI)**, based on comparing invertebrate abundance and diversity to national guidelines.

- A **Suitability for Recreation Grade (SFRG),** based on *E. coli* measurements over five years and an assessment of catchment faecal contamination risks.

4.1 Periphyton and cyanobacteria in the whaitua - why are they a problem?

Periphyton are algae and other slimes that grow on the bottom of a stream or river bed. The extensive growth of periphyton in rivers can adversely affect instream habitat and recreation values. Periphyton needs instream nutrients (nitrogen and phosphorus) and light to grow. It requires stable flow conditions to become prolific.

Benthic cyanobacteria are a type of bacteria rather than algae. Some cyanobacteria produce toxins which are harmful to humans and animals, particularly dogs.

4.2 Macroinvertebrate communities

Macroinvertebrates are small animals that live in the water for all or a part of their lives, and include insects, crustaceans such as koura, molluscs, and worms. The macroinvertebrate community can be used as a measure of stream health as it reflects the habitat state and a longer-term state of water quality than a single 'spot' water sample. Macroinvertebrate health is assessed using the Macroinvertebrate Community Index (MCI). The MCI looks at which species are found in a stream and also the sensitivity of each species to water and habitat quality degradation. For example, most stonefly larvae are considered to be sensitive to water quality and habitat degradation, whereas many types of aquatic snail are considered tolerant of degradation. These different sensitivities determine which species will be found where.

4.3 Recreational Water Quality monitoring

Twelve popular river recreational sites in the Ruamāhanga catchment are monitored on a weekly basis over summer. The aim is to identify risks to public health from disease-causing organisms and the following is monitored:

- *E. coli* are a bacteria used to indicate the presence of harmful pathogens such as campylobacter and giardia.
- nuisance periphyton and benthic cyanobacteria ("toxic algae") cover across the riverbed
- turbidity/water clarity and water temperature

Note: *E. coli* is not an indicator for ecological health, as fish/invertebrates are not affected by *E. coli*.

4.3.1 *E. coli* and wastewater treatment plants

E. coli is used as an indicator for the likelihood of other pathogens being present. This relationship holds true, except where *E. coli* has been treated in town sewage (wastewater) treatment plants. Wastewater treatment plants are effective at treating *E. coli*, but are generally less effective at treating pathogens and viruses. This is a problem for the Ruamahanga River as there are many popular swimming holes downstream of wastewater

treatment plants. The SFRGs for this river are therefore conservative because the effectiveness of Wairarapa wastewater treatment plants in removing pathogens is unknown.

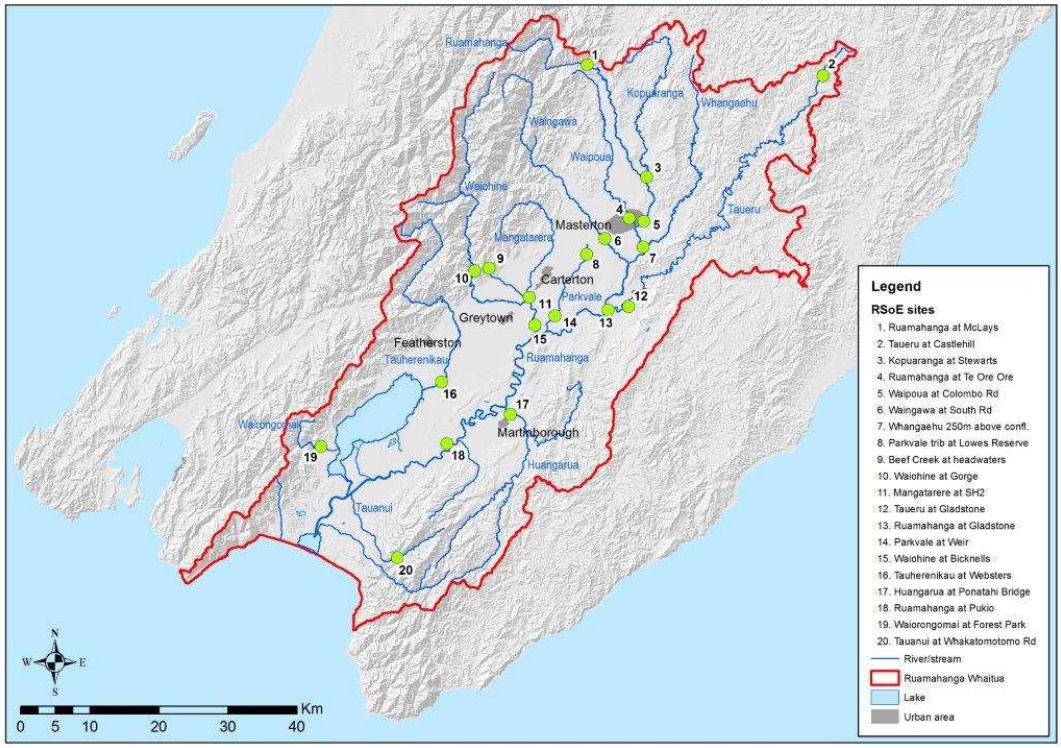


Figure 1: Sites monitored monthly as part of the Rivers State of Environment (RSoE) monitoring programme

Do these monitoring sites give the community enough information to know here they can swim?

Are the sites where the people swim?

5. National Objectives Framework – Human health for recreation

There is a set of measurable attributes provided in the National Objectives Framework (NOF) for managing fresh water for 'human health for recreation'. These become a way of describing the level at which water quality should be managed to in order to keep people healthy while either swimming or wading in water (typically known as contact recreation).

5.1 Tools to be used by GWRC

The relevant parts of the NPS-FM for contact recreation are:

- The requirement that every water way is managed for secondary contact recreation as a 'compulsory value' (Objective A1)
- The requirement that all water quality is maintained or improved overall within a region (Objective A2)
- The NOF attribute table for both primary and secondary contact recreation in lakes and rivers:
    - For primary contact recreation (e.g. swimming): E.coli count (95th percentile) with bottom line of 540cfu/100mL
    - For secondary contact recreation (e.g. boating, wading, fishing): E.coli count (annual median), with bottom line of 1000 cfu/100mL

Together these mean that water quality in rivers and lakes should be maintained at its current state. The new compulsory value for secondary contact recreation means that all rivers and lakes must also meet, as a minimum, the C band in the NOF attribute as an annual median. The use of the median value statistic for secondary contact recreation means that only 50% of the sampling occasions need to meet the C band outcome.

Any rivers that are identified for primary contact recreation, an optional value under the NPS-FM, should be managed to meet the B band in the NOF attribute table as a 95th percentile.

5.2 Secondary contact recreation

All monitored rivers in the Ruamāhanga Whaitua meet at least the NOF C band for secondary contact recreation, meaning that all our rivers are safe to wade in according to the NOF.

Table 1. RSoE sites in the Ruamāhanga E.coli count/100mL (2012/13 annual median). The site must score A, B or C to provide for secondary contact recreation

Site	E.coli	NOF band
Ruamahanga River at McLays	2.5	A
Ruamahanga River at Te Ore Ore	105	A
Ruamahanga River at Gladstone Bridge	33	A
Ruamahanga River at Pukio	73	A
Taueru River at Castlehill	180	A
Taueru River at Gladstone	77.5	A
Kopuaranga River at Stuarts	275	B
Whangaehu River at 250m from Confluence	305	B
Waipoua River at Colombo Rd Bridge	51	A
Waingawa River at South Rd	25.5	A
Parkvale tributary at Lowes Reserve	14	A
Parkvale Stream at Weir	470	B

Waiohine River at Gorge	8	A
Waiohine River at Bicknells	43.5	A
Beef Creek at headwaters	11	A
Mangatarere River at State Highway 2	190	A
Huangarua River at Ponatahi Bridge	105	A
Tauanui River at Whakatomotomo Rd	7	A
Tauherenikau River at Websters	18	A
Waiorongomai River at Forest Park	12.5	A
Enaki Stream D/S site for Riparian	120	A

5.3 Primary contact recreation

Of the four rivers in the Ruamāhanga Whaitua that are part of GWRC's Recreational Water Quality monitoring network, two fail to meet the NOF bottom line for primary contact recreation. These are the Ruamahanga and Waipoua Rivers, with the Ruamahanga River failing at five of the six monitoring sites on its length.

Of the 20 monitored river sites in the Ruamāhanga Whaitua as part of GWRC's State of the Environment monitoring network, 11 fail to meet the NOF bottom line for primary contact recreation (see Table 1).

Table 2. RSoE sites in the Ruamāhanga E.coli count/100mL (2008-2013 95th percentile). Site must score A or B to provide for primary contact recreation

Site	E.coli	NOF band
Ruamahanga River at McLays	50.5	A
Ruamahanga River at Te Ore Ore	2405	D
Ruamahanga River at Gladstone Bridge	1910	D
Ruamahanga River at Pukio	1815	D
Taueru River at Castlehill	1585	D
Taueru River at Gladstone	1800	D
Kopuaranga River at Stuarts	6080	D
Whangaehu River at 250m from Confluence	5420	D
Waipoua River at Colombo Rd Bridge	1100	D
Waingawa River at South Rd	171	A
Parkvale tributary at Lowes Reserve	88.2	A
Parkvale Stream at Weir	4055	D
Waiohine River at Gorge	46.5	A
Waiohine River at Bicknells	453	B
Beef Creek at headwaters	158	A
Mangatarere River at State Highway 2	1205	D
Huangarua River at Ponatahi Bridge	2310	D
Tauanui River at Whakatomotomo Rd	51.2	A
Tauherenikau River at Websters	120	A
Waiorongomai River at Forest Park	32.4	A
Enaki Stream D/S site for Riparian	1000	C

How do we want to manage freshwater for recreation (swimming, gathering kai, fishing, boating, kite surfing)?

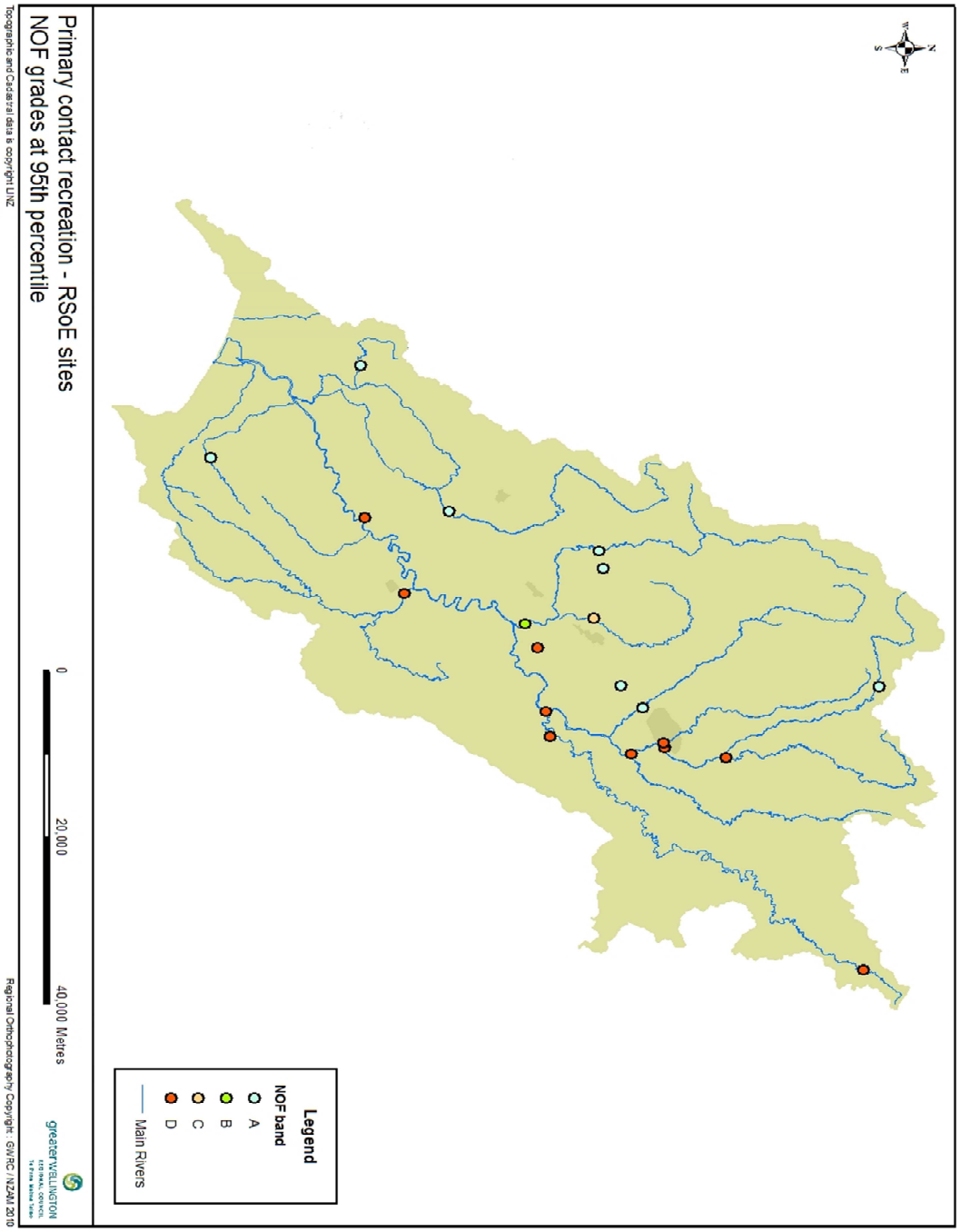
Are the NOF benchmarks to be met everywhere or in identified sites?

What is the cost? And what is an achievable timeframe to achieve these objectives?

The amount of change is needed, depends on the end goal

Factors to consider are:

- location
- time of year (e.g. summer swimming months only, or year round)
- time since rainfall (e.g. dry weather conditions only, or all weather)
- the nature or type of the waterway


Primary contact recreation - RSoE sites
NOF grades at 95th percentile
Legend
NOF band
A
B
C
D
Main Rivers
0
20,000
40,000 Metres
greaterWELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao
Topographic and Cadastral data is copyright LINZ
Regional Orthophotography Copyright: GWRC / NZAM 2010

6. Influences on water quality

6.1 Eastern hill erodible sand stone and mudstone.

This has been made worse by agriculture and pasture which has led to an increase in sediment runoff. The eastern tributaries of the Ruamahanga River are more prone to extreme, prolonged low flows and experience higher water temperatures and periphyton proliferation. Low flows in the Ruamāhanga catchment are also exacerbated at times by water abstraction.

6.2 Agricultural and urban land use

Agricultural and urban land use has led to the removal of natural vegetation cover and modification of water bodies which can result in direct effects on water quality, such as increasing light penetration and water temperatures, and indirect effects such as increased runoff. The trend for land use change in the last 15 years has been the intensification of land use rather than a major change in the type of land use, resulting in increased stocking rates and/or fertiliser inputs.

6.3 Urban land use

Urban areas occupy a very small proportion of the whaitua but have a proportionally larger impact on water quality than the area they occupy compared to other land uses. In urban areas, streams are often piped or artificially channelled with concrete edges, which decreases instream and riparian habitat.

Stormwater is rainwater collected from roofs, driveways and roads is generally piped directly into rivers and streams without any treatment. The stormwater picks up sediment, rubbish and other contaminants, including metals, hydrocarbons, herbicides, pesticides, nutrients and pathogens.

Town (municipal) wastewater discharges from all five townships in the whaitua.

Henley Lake discharges to the Ruamahanga River and is likely to contain faecal material and nutrients from the large waterfowl population, toxic algae, and stormwater-related contaminants. The lake has higher water temperature, nutrient levels and bacteria counts, and lower dissolved oxygen levels than the Ruamahanga River.

Masterton, Carterton and Greytown water treatment plants (WTPs) for drinking water which discharge waste products (suspended sediment and aluminium) into the Kaipaitangata Stream and Waingawa River.

6.4 Water races

Water races have poor water quality with poor water clarity and elevated nutrients and faecal bacteria), due to stock access and agricultural runoff inputs.

6.5 Pumped water schemes and agricultural drain discharges

An extensive network of agriculture drains nearby Lake Wairararapa and Lake Onoke have very high levels of nutrients, sediment and faecal bacteria.

6.6 Groundwater discharge

In many parts of the whaitua there is a high degree of connection between surface waters and groundwater. Shallow, unconfined aquifers can have elevated concentrations of nitrate and sulphate. Nitrate concentrations are particularly elevated in shallow aquifers in Te Ore Ore and around Carterton.

6.7 River works

Rivers are used for gravel extraction or gravel is removed to maintain channel alignment and reduce flood risk to adjacent or downstream property. These works can degrade instream habitat, increase sedimentation and reduce water clarity. Large-scale gravel extraction occurs:

- Ruamahanga River at Te Ore Ore
- Waingawa River confluence
- Waiohine River (at State Highway 2)
- Waipoua River (above Masterton)
- Tauherenikau River (State Highway 53)
- Huangarua River (above Ponatahi)

7. Key issues affecting river and stream health

Overall aquatic ecological health is a reflection of the cumulative impact of the various stressors present. The sites in poorest condition have one or more of the following stressors: nutrient enrichment, poor clarity, toxicity, microbiological contamination, and/or habitat degradation.

- **Nutrient enrichment**: contributes to algae growth (periphyton and macrophyte growth). Periphyton growth is strongly correlated with nutrient concentrations.

- **Toxicity:** Parkvale Stream and Mangatarere Stream have high levels of nitrate nitrogen above the chronic toxicity trigger value (1.7 mg/L). High nitrate is from the nutrient-rich groundwater from shallow, unconfined aquifers. Groundwater input to these streams is most significant during times of low flow.

- **Poor water clarity and sedimentation**: occurs in the lower Ruamahanga River and eastern tributaries. They prevent light and the ability of periphyton to grow. High suspended solids can also increase sediment deposition on the streambed, which degrades instream habitat.

- **Microbiological contamination:** the highest *E. coli* counts occur in the Parkvale Stream and in the lower Whangaehu and Kopuaranga rivers. The high *E. coli occurs* after rainfall and is linked to agriculture, highlighting the importance of vegetated riparian margins and excluding stock from streams.

- **Habitat degradation:** habitat quality is another strong driver of ecological health in rivers and streams. Degraded ecological health is linked with degraded instream and/or riparian habitat. The streams with poorest macroinvertebrate health tend to have a high amount of fine sediment on the streambed such as the lower Whangaehu River, and/or an absence of riparian shade such as Parkvale Stream at Weir.

- **Fish are affected and monitored** (see the biodiversity summary)

8. Knowledge gaps

- Quantitative information on nutrient contributions from different sources within the Ruamāhanga Whaitua is currently lacking. GWRC is planning future modelling work that will provide this information.

- A number of important aspects of stream health have not been monitored routinely to date, or have only recently been incorporated into the RSoE programme. These include fish community condition, macrophyte cover, instream sedimentation and stream habitat quality.

- Information is lacking on the effectiveness of the Wairarapa wastewater treatment plants to remove pathogens (such as viruses).

Report prepared by ***Tessa Bunny,*** ***Juliet Milne,*** ***Laura Keenan***	**Date**	**Report approved by** ***Alastair Smaill***	**Date**

For more information

Greenfield S, Ryan A and Milne J. 2012. *Recreational water quality in the Wellington region: State and trends.* Greater Wellington Regional Council, GW/EMI-T-12/142, Wellington.

Greenfield S, Milne JR and Ryan A. 2012b. *Will I get sick if I swim? Updated suitability for recreation grades for fresh and coastal waters in the Wellington region*. Greater Wellington Regional Council, Publication No. GW/EMI-T-12/146, Wellington.

Perrie A, Morar S, Milne JR and Greenfield S. 2012. *River and stream water quality and ecology in the Wellington region: State and trends*. Greater Wellington Regional Council, Publication No. GW/EMI-T-12/143, Wellington.

Glossary

Intermittent waterbodies - are those that have irregular flow and/or pools for the majority of the time and is confined in a channel with defined banks

Periphyton refers to the slime coating on a riverbed, composed largely of algae and cyanobacteria

Benthic cyanobacteria - is a type of bacteria that is found on the river bed, usually a blackish colour.

References

Australian and New Zealand Environment and Conservation Council (ANZECC). 2000. *Australian and New Zealand guidelines for fresh and marine water quality, volume 1, the guidelines*. Agriculture and Resource Management Councils of Australia and New Zealand, Canberrra.

Ballantine D and Davies-Colley R. 2010. *Water quality trends at NRWQN sites for the period 1989-2007*. Report prepared for Ministry for the Environment. NIWA Client Report: HAM2009-026 (2nd edition). NIWA, Hamilton.

Hay J, Hayes J and Young R. 2007. *Water quality guidelines to protect trout fisheries values.* Report No. 1205 prepared for Horizons Regional Council by the Cawthron Institute, Nelson.

Milne JR and Perrie A. 2005. *Freshwater quality monitoring technical report.* Greater Wellington Regional Council, Publication No. GW/RINV-T-05/87, Wellington.

Ministry for the Environment. 2000. *New Zealand periphyton guideline: detecting, monitoring and managing enrichment of streams*. Ministry for the Environment, Wellington.

Ministry for the Environment and Ministry of Health. 2003. *Microbiological water quality guidelines for marine and freshwater recreational areas*. Ministry for the Environment, Wellington.

Morar S and Greenfield S. 2013. *On the Beaches 2012/13: Annual recreational water quality monitoring report for the Wellington region*. Greater Wellington Regional Council, Publication No. GW/ESCI-G-13/64, Wellington.

Quinn J and Hickey C. 1990. Characterisation and classification of benthic invertebrate communities in 88 New Zealand rivers in relation to environmental factors. *New Zealand Journal of Marine and Freshwater Research*, 24: 387–409.

Stark JD and Maxted JR. 2007. *A user guide for the Macroinvertebrate Community Index*. Report No. 1166 prepared for the Ministry for the Environment by the Cawthron Institute, Nelson.

Appendix 1. National context – how do our rivers and streams compare?

Making direct comparisons between GWRC data and other regional councils or nationally is problematic as there are differences in monitoring site networks. Bearing that in mind, comparison of visual clarity, E. coli and nutrients from the Rivers State of Environment (RSoE) data with national medians shows:

- RSoE sites on the upper reaches (ie, with indigenous forest land cover) of the rivers fed from the Tararua, Remutaka or Aorangi ranges are generally in a similar condition to the national average for rivers classed in 'upland forest'

- The mid and lower reaches of the Ruamahanga River have poorer water clarity and higher DRP concentrations than the national average for 'lowland' waterways

- The lower reaches of the eastern tributaries (Kopuaranga, Taueru and Whangaehu Rivers) have poorer water clarity, higher *E. coli* counts and higher nutrient concentrations than the national average

- Parkvale and Mangatarere streams generally have higher nutrient concentrations than the national average.

Overall, it appears the eastern tributary rivers (the Kopuaranga, Whangaehu and Taueru rivers) and the Mangatarere and Parkvale streams have poorer water quality than average for lowland streams in New Zealand.

Appendix 2. How does GWRC monitor water quality and ecosystem health of rivers?

The RSoE monitoring programme assesses water quality and ecosystem health.

Water quality and ecosystem health are currently monitored at 20 river and stream sites in the Ruamāhanga catchment (Figure 1). Water quality is assessed at monthly intervals by measuring a range of variables such as water temperature, dissolved oxygen, clarity, nutrients and faecal indicator bacteria. Ecosystem health is assessed through annual biological monitoring, incorporating assessments of periphyton (algal) biomass and macroinvertebrate communities.

Water Quality Index and physico-chemical water quality

The Water Quality Index (WQI) is an index that was developed by GWRC, used to describe water quality and allows comparison across the region. It compares six key water variables, (shown in Table 1) and allocates a water quality grade. The guidelines applied to the WQI were developed nationally.

- Excellent: median values for all 6 variables comply with guideline values
- Good: median values for 5 of the 6 variables comply with guideline values, of which dissolved oxygen (DO) is one variable that must comply[3]
- Fair: median values for 3 or 4 of the 6 variables comply with guideline values, of which DO is one variable that must comply
- Poor: median values for less than 3 of the 6 variables comply with guideline values and/or the median DO concentration does not comply with the guideline value.

[3] If the median DO concentration does not comply with the guideline value, then the WQI grade automatically drops to 'poor'. This reflects the fundamental importance of DO to aquatic life.

Table 1: Water Quality Index grades for the 20 RSoE sites in the Ruamāhanga catchment based on monthly monitoring results over the period July 2008 to June 2011

	Water Quality Index (median values)						Dominant catchment land cover
	DO%	Clarity	*E. coli*	NNN	Ammonia	DRP	
Excellent:							
Tauanui R at Whakatomotomo Rd	✔	✔	✔	✔	✔	✔	Ind. forest
Waiohine R at Gorge	✔	✔	✔	✔	✔	✔	Ind. forest
Waiorongomai R at Forest Park	✔	✔	✔	✔	✔	✔	Ind. forest
Ruamahanga R at McLays	✔	✔	✔	✔	✔	✔	Ind. forest
Beef Ck at Headwaters	✔	✔	✔	✔	✔	✔	Ind. forest
Waingawa R at South Rd	✔	✔	✔	✔	✔	✔	Ind. forest
Good:							
Tauherenikau R at Websters	✔	X	✔	✔	✔	✔	Pasture
Waipoua R at Colombo Rd Bridge	✔	✔	✔	X	✔	✔	Pasture
Huangarua R at Ponatahi Bridge	✔	X	✔	✔	✔	✔	Pasture
Taueru R at Castlehill	✔	X	✔	✔	✔	✔	Pasture
Ruamahanga R at Te Ore Ore	✔	X	✔	✔	✔	✔	Pasture
Waiohine R at Bicknells	✔	✔	✔	✔	✔	X	Pasture
Fair:							
Ruamahanga R at Gladstone Br	✔	X	✔	✔	✔	X	Pasture
Ruamahanga R at Pukio	✔	X	X	✔	✔	X	Pasture
Poor:							
Parkvale trib at Lowes Reserve	X	✔	✔	X	✔	X	Pasture
Taueru R at Gladstone	✔	X	X	X	✔	X	Pasture
Kopuaranga R at Stewarts	✔	X	X	X	✔	X	Pasture
Parkvale S at Weir	✔	X	X	X	✔	X	Pasture
Whangaehu R at 250m from conf.	✔	X	X	X	✔	X	Pasture
Mangatarere S at SH 2	✔	X	X	X	X	X	Pasture

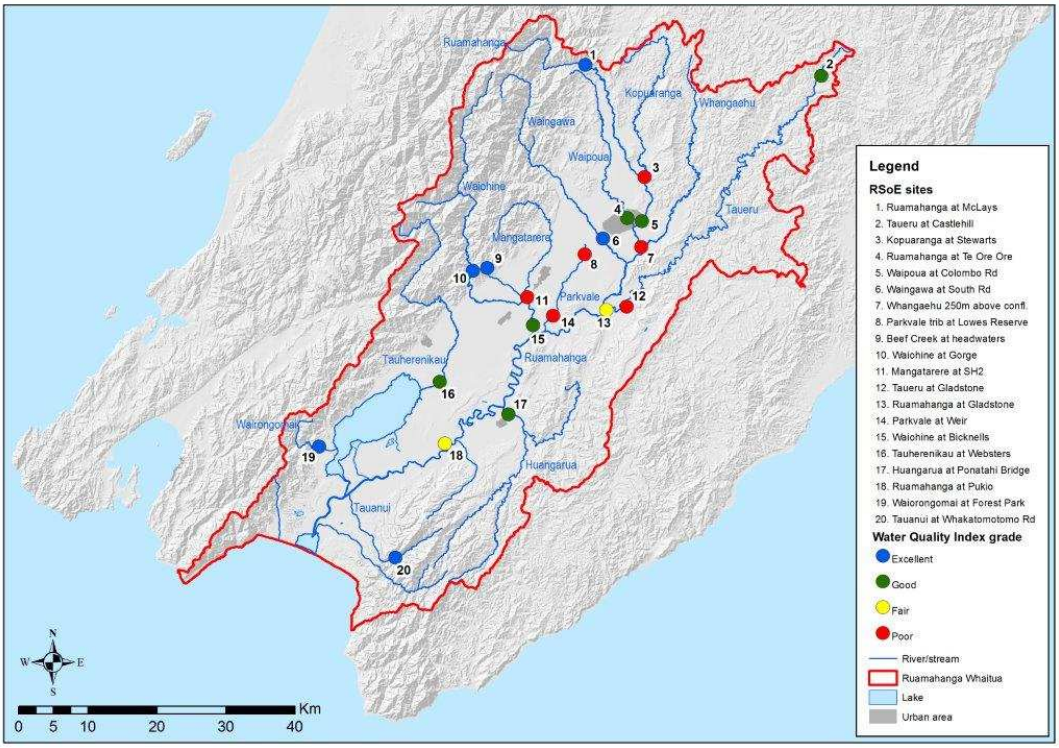


Figure 2: Water Quality Index grades for the Ruamāhanga Whaitua, for the period 2008 to 2011

The WQI grades show that water quality is excellent in the upper reaches of rivers draining the Tararua, Remutaka and Aorangi ranges in the west. As these rivers enter the valley the water quality declines from 'excellent' to 'good' due to poor water clarity that does not meet guidelines. Water temperatures typically increase ~ 2 to 3°C.

Notable sites in the Ruamāhanga Whaitua:

- Mangatarere Stream in its lower reaches is the only western stream with poor water quality. All parameters fail to meet the guidelines with the exception of dissolved oxygen.

- The lower reaches of the eastern hill country tributaries that enter the Ruamahanga River have 'poor' WQI water quality. Monitored sites on the Taueru River, Kopuaranga River and Whangaehu River do not meet national guidelines – water clarity, *E. coli*, NNN and DRP. These rivers also typically have high conductivities and pH.

- Lowland streams – Parkvale is the only monitored lowland stream and has a 'poor' WQI – poor water clarity, *E coli* and nutrient concentrations failing guidelines. Parkvale Tributary at Lowes Reserve site is a sluggish flowing small stream dominated by groundwater input, and this result in low dissolved oxygen.

- Decline in water quality at Te Ore Ore to 'good' from 'Excellent' at McLays.

- Decline in water quality at Gladstone Bridge and Pukio: WQI is 'fair'

- Median water temperatures increase by 2.6°C between the most upstream (McLays) and downstream (Pukio) monitoring sites, and significant changes occur in water clarity, *E. coli* counts, and nutrient concentrations (Table 1).

Table 2: Variables and guideline values used in GWRC's WQI

Variable	Guideline value	Reference
Dissolved oxygen (% saturation)	≥80	RMA 1991 Third Schedule
Visual clarity (m)	≥1.6	MfE (1994)
Nitrite-nitrate nitrogen (NNN) (mg/L)	≤0.444	ANZECC[4] & ARMCANZ[5] (2000)
Ammonia (mg/L)	≤0.021	ANZECC & ARMCANZ (2000)
Dissolved reactive phosphorus (DRP) (mg/L)	≤0.010	ANZECC & ARMCANZ (2000)
E. coli (cfu/100mL)	≤100	ANZECC & ARMCANZ (2000)

Note: *E. coli*, NNN, ammonia and DRP are 'trigger values' for either stock water or lowland aquatic ecosystems

Periphyton monitoring

Each RSoE site (except Taueru River at Castlehill and Whangaehu River 250 m from confluence that have soft streambed substrate) was categorised into one of four periphyton classes ranging from 'poor' to 'excellent' based on data from 2008 to 2011. The class 'poor' indicates periphyton growth covers a large area of the stream bed and does not meet national guidelines. 'Excellent' indicates periphyton cover very seldom reaches nuisance levels.

[4] ANZECC- Australian and New Zealand Environment and Conservation Council
[5] Agriculture and Resource Management Council of Australia and New Zealand

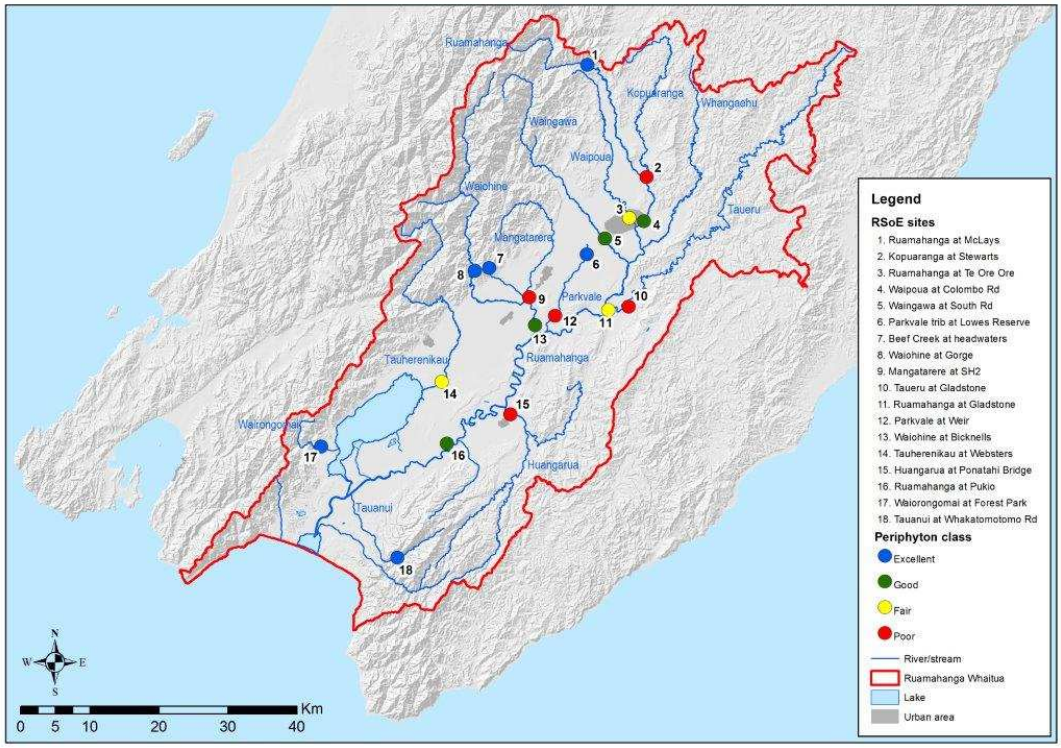


Figure 3: Periphyton classes for RSoE monitoring sites in the Ruamāhanga Whaitua, based on data for 2008 to 2011

Periphyton in the whaitua

- The western rivers flowing from the Tararua, Remutaka or Aorangi ranges have low levels of periphyton but as they enter the valley periphyton cover becomes more prolific.

- Waipoua River at Colombo Road has had widespread benthic cyanobacteria every summer since monitoring commenced in 2005/06 and has caused dogs to die.

- Cyanobacteria flourished on the middle and lower reaches of the Waipoua River during the prolonged low flows of 2006/07 and 2013.

- Periphyton is more prolific on lower reaches of rivers fed from the eastern side of the catchment (Kopuaranga River, Taueru River, Huangarua River), and the lower reaches of streams in the Ruamāhanga Valley (Parkvale Stream and Mangatarere Stream).

- Taueru River at Gladstone and Parkvale Stream at Weir have had extensive macrophyte (aquatic plant) growth on occasions.

- Whangehu River – extensive macrophyte cover is frequently present, as the soft silt and sand makes it more suitable for growth of macrophytes than periphyton.

Macroinvertebrate Community Index (MCI)

Macroinvertebrate Community Index (MCI) is an index which is used nationally. The MCI quality classes are based on the mean MCI of annual samples taken in 2009– 2011:

- Excellent: MCI ≥120
- Good: MCI 100 – 119
- Fair: MCI 80 – 99
- Poor: MCI <80.

In the Ruamāhanga whaitua, 5 sites have an MCI of 'excellent', 9 sites 'good', 4 sites 'fair' and 2 sites 'poor' (Figure 4).

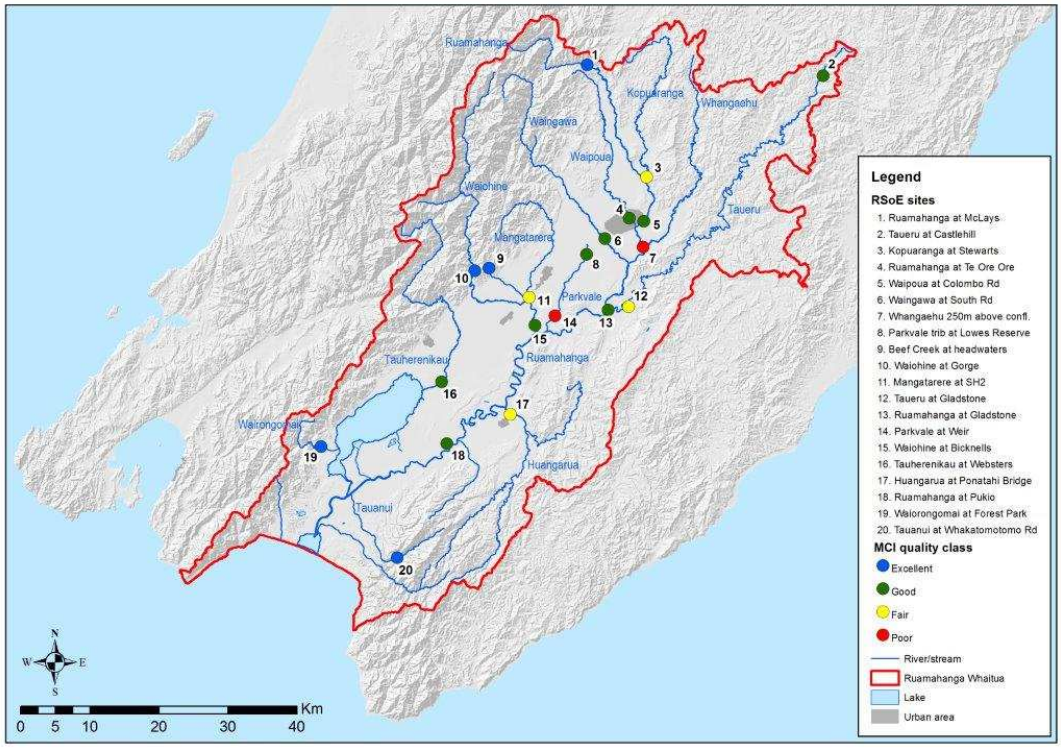


Figure 4: MCI quality classes for RSoE sites in the Ruamāhanga Whaitua, based on data for the period 2008 to 2011

Poor MCI (water quality and habitat state) – Parkvale Stream at Weir (MCI scores of 75.9)

The highest MCI (water quality and habitat state) of 146 was recorded at Ruamahanga River at McLays.

In the middle or lower reaches of the Ruamāhanga Valley MCI declines and the Mangatarere has a notably lower MCI score.

In the lower reaches of the eastern rivers (Taueru River, Kopuaranga River, Whangaehu River, Huangaru River), macroinvertebrate scores are lower.

Parkvale Stream, a lowland stream has a 'poor' MCI.

Suitability for Recreation

The Suitability for Recreation Grades (SFRGs) are derived using the national guidelines (MfE/MoH 2003) and are based on:

1. *E. coli* data collected from 2008/09 to 2012/13 summer seasons (November to March), and

2. An evaluation of the upstream catchment's susceptibility to faecal contamination (e.g. from stock, wildfowl, effluent discharges, etc.)

Suitability for recreation grades (SFRGs)

To date GWRC has been using SFRGs to assess water quality for recreation, but likely to be used in addition with the NOF Framework which uses E. Coli concentrations. The MfE/MoH (2003) guidelines are used to identify a Suitability for Recreation Grade (SFRG) for each site by combining the E. coli data with an assessment of faecal contamination risks in the catchment.

The timing of samples influences the results

The SFRG can be strongly influenced by a small number of high E. coli counts recorded following heavy rainfall. For this reason, any E. coli counts recorded during higher river flows are removed from the SFRG calculations to ensure that the grades are more indicative of conditions when contact recreation in the water is most likely to occur.

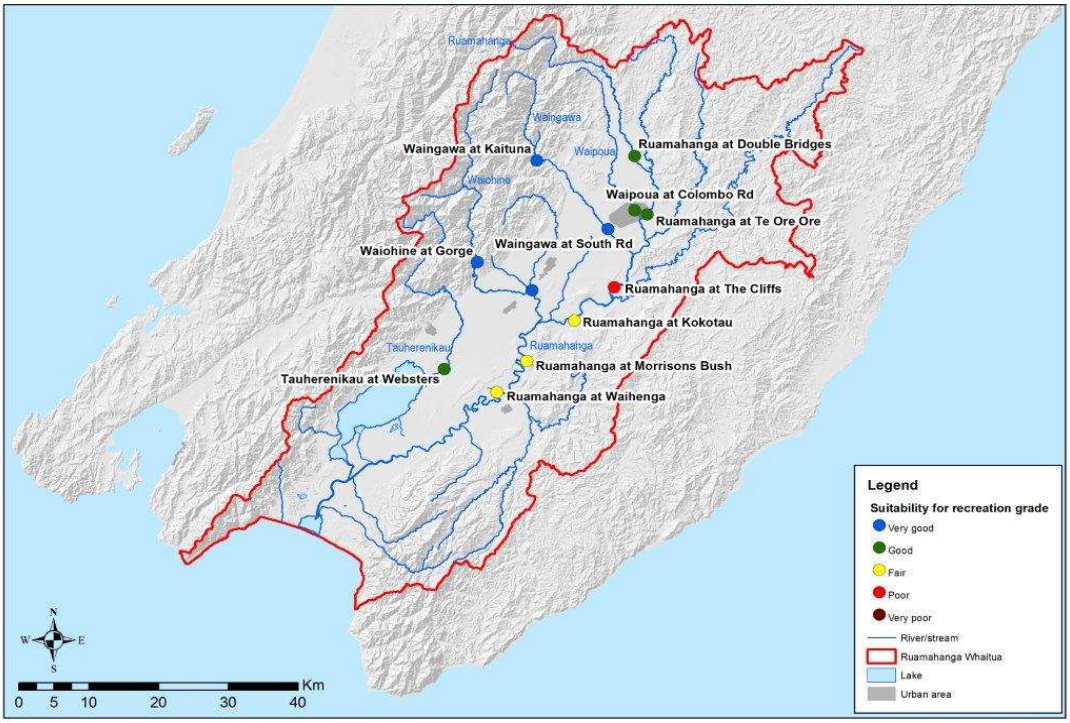


Figure 5: Dry weather SFRGs at recreational monitoring sites in the Ruamāhanga Whaitua

1. Areas with indigenous forest cover have a 'very good' SFRG - Waiohine and Waingawa rivers. 'Good' Double Bridges

2. The lower Waipoua River and Tauherenikau and Te Ore Ore site are 'Good' meaning the sites are generally suitable for swimming. However, following rainfall microbiological water quality at these sites declines significantly, primarily due to runoff from areas of agricultural land use in the upstream catchment.

3. Further downstream, low *E. coli* indicate low faecal contamination during dry weather conditions at The Cliffs, Kokotau, Morrison's Bush and Waihenga. However, as these sites are downstream of a waste water plant discharges they were assigned dry weather SFRGs of 'fair' or 'poor'. After heavy rain microbiological water quality declines even further at these sites due to runoff from agricultural areas in the catchment.