HAWKE'S BAY
REGIONAL COUNCIL

Wairoa and Northern Catchments

State and Trends of River Water Quality and Ecology

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Environmental Science - Water Quality and Ecology

Wairoa and Northern Catchments

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Contents

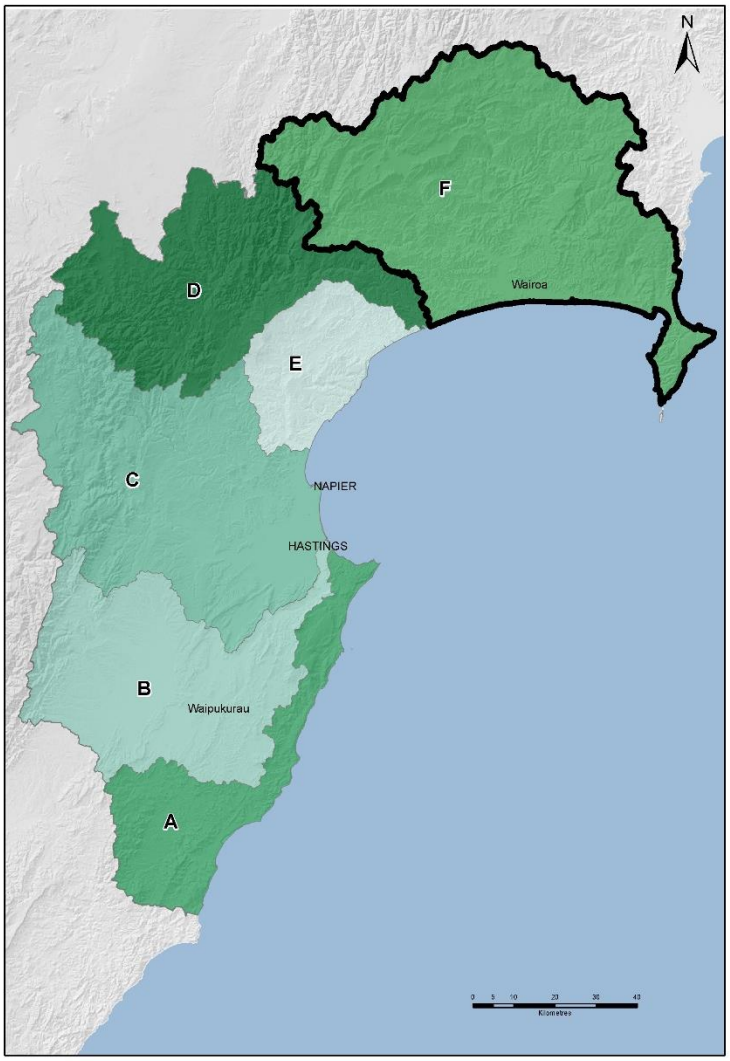
Tables

Figures

Executive summary

This report summarises states and trends in river water quality and ecology in the Wairoa River catchment. The report is 1 of 6 State of the Environment (SOE) reports for the Hawke's Bay region summarising river water quality and ecology data. These reports form the detailed regional 5 yearly review of surface water quality and ecology and are an update from the previous round of reports completed in 2009. The six SOE reports cover the following subregions:

- Porangahau River/Southern Coastal
- Tukituki River
- TANK (Tutaekuri River, Ahuriri Estuary, Ngaruroro River, Karamu Stream)
- Mohaka River
- Waikari River/Esk River/Aropaoanui River
- **This report**: Wairoa River/Northern Coastal (subregion "F", bordered in black in the map below).



The Wairoa River is located in the northern part of Hawke's Bay Region, draining to the sea at the township of Wairoa, and is Hawke's Bay's largest catchment at 3,670 km^2. The upper boundaries of the catchment lie in the indigenous forest of Te Urewera National Park, and include Lake Waikaremoana. The subregion also includes a number of coastal catchments, including those of the Waihua, Kopuawhara and Opoutama Streams and the Mahia Peninsula.

There are 12 SOE monitoring sites in the Wairoa River/Northern Coastal catchment. The water quality and ecological data collected at these sites form the basis for the analysis presented in this report.

Ten of the SOE sites are within the Wairoa River catchment. They consist of 3 small streams located in the upper catchment above Lake Waikaremoana in Te Urewera National Park (Mokau, Te Kumi and Aniwhaniwha), and another small stream (Te Iringaowhare), which contributes to the Waiau River. Four further sites are mid-sized rivers, with an upstream catchment size of approximately 500 km^2. Of these, the Waikaretaheke River is located below the outlet of Lake Waikaremoana, and the Ruakituri, Hangaroa and Mangapoike Rivers drain the north-eastern area of the Wairoa catchment. Further downstream is an SOE site located on the Wairoa River itself, upstream of the Wairoa Township. This site is influenced by the tide.

The 2 other monitoring sites are located on the Kopuawhara and the Opoutama Streams, which drain north and south of the tombolo which connects the Mahia peninsula to the rest of Hawke's Bay. These are small lowland streams with catchment areas of 68 km² (Kopuawhara), and 14.8 km² (Opoutama).

Water quality and ecological indicators monitored as part of the SOE monitoring programme may be considered in the following groups:

1. Microbiological water quality indicators, such as *E. coli*, which provides an indication of the level of health risk to recreational users of the water,
2. Basic physico-chemical indicators, such as temperature, dissolved oxygen and pH,
3. Indicators associated with the visual appearance of the water, such as visual water clarity and turbidity,
4. Toxicants, such as nitrate-nitrogen and ammoniacal nitrogen,
5. Nutrients, such as nitrogen and phosphorus, as controlling factors, or indicators of risk of eutrophication (excessive plant/algae growth),
6. Biological indicators of eutrophication (periphyton biomass) and ecological health (macroinvertebrate communities).

The various indicators were compared with appropriate guidelines to provide an indication of the state of water quality. Statistical analyses of trends through time were performed to determine whether the water quality indicators have been improving or degrading over time. For the relevant parameters, and where data were available, the various indicators were compared with the Regional Plan (RRMP) Guidelines, and with the National Policy Statement for Freshwater management (NPS-FM) (2014) Attribute States. Monitoring data collected during the 2009-2013 period indicates the following:

1. <u>Microbiological water quality:</u>

   All 12 monitoring sites fall into the NPSFM "A" Attribute State, indicating that water quality is generally suitable for secondary (e.g. wading, boating) contact recreation at all sites across the Wairoa and Northern Coastal catchments. In addition, 7 out of the 12 sites are suitable for primary contact recreation, with 6 sites presenting a low risk (NPSFM "A" grade), and one (the coastal

Kopuawhara Stream) presenting a moderate risk (NPSFM "B" grade) to water users. The microbiological water quality is at times unsuitable for primary contact recreation at the remaining 5 sites, including the Wairoa River main stem upstream of Wairoa and some of its tributaries (Ruakituri, Hangaroa and Mangapoike Rivers), and the coastal Opoutama Stream. Microbiological water quality was generally stable over time across the catchment.

2. Dissolved Oxygen

Data available do not point to any significant issues associated with dissolved oxygen (DO) concentration or saturation at any of the sites, although it should be noted that the data are limited to 'spot' measurements, which are unlikely to capture the daily minima.

3. Water clarity and turbidity

Water clarity is generally relatively low and turbidity relatively high in the Wairoa and Northern coastal catchments. Unsurprisingly, the sites within or close to the upper, forested reaches of the catchment in the Waikaremoana area present the best water clarity, and sites further down the catchment, in particular the Wairoa River main stem, the poorest water clarity. It is interesting to note that the Te Kumi stream does not meet the RRMP guideline of 1.6 m clarity approximately one third of the time, indicating that the guideline can regularly be breached even under natural conditions in a catchment dominated by tertiary sedimentary geology.

Compared with other SOE sites in the region, most sites rank relatively poorly, with half of the Wairoa and Northern Coastal catchment sites in the bottom 25% of the Hawke's Bay region for water clarity and turbidity.

No significant temporal trends were detected in water clarity, but declining (trends in turbidity i.e. an increase over time) were detected at three sites, including the Te Kumi and Aniwhaniwha Stream in the Waikaremoana area. The presence of temporal trends at 2 essentially undisturbed sites signals that natural factors such as climatic patterns may at least in part explain the trends detected.

4. Toxicants

Concentrations of nitrate nitrogen and ammoniacal nitrogen are always low at all sites, well below both trigger or guideline values, indicating that the risk of toxic effects from either nitrate or ammonia can be considered low at all SOE monitoring sites in the Wairoa and Northern Coastal catchments. All sites fall within the NPSFM "A" Attribute State for nitrate and "A" or "B" Attribute State for ammonia. Improving trends (i.e. a reduction over time) in nitrate concentrations were detected at 3 sites, including 2 sites in the Waikaremoana area and the Northern Coastal site on the Opoutama Stream. The presence of temporal trends at 2 essentially undisturbed sites signals that natural factors such as climatic patterns may at least in part explain the trends detected, although other factors such as changes in agricultural practices may also have played a role in the Opoutama catchment.

5. Nutrients

Nitrogen concentrations, both Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN), were generally relatively low and meet the ANZECC trigger values in the Wairoa and Northern Coastal catchments. The highest DIN concentrations were measured in the Opoutama Stream, followed by the Mangapoike River.

Similarly, phosphorus concentrations, both Total Phosphorus (TP) and Dissolved Reactive Phosphorus (DRP), were generally relatively low and meet the ANZECC trigger values and RRMP guidelines, except in the Te Iringaowhare Stream, a small tributary of the Waiau River.

Compared with other SOE sites in the region, the majority of Wairoa catchment sites rank highly, with 9 of the 12 sites in the top third of sites in the region for both DIN and DRP.

Nutrient concentrations were generally stable over time across the study area, although improvements in both DIN and DRP were detected in the Te Kumi Stream (in the Waikaremoana area) and Opoutama Stream. Significant improvements in TN and TP were also detected, but only in the Te Kumi Stream. As already indicated above, the presence of temporal trends at 2 essentially undisturbed sites signals that natural factors such as climatic patterns may at least in part explain the trends detected, although other factors such as changes in agricultural practise may also have played a role in the Opoutama catchment.

DIN/DRP ratios indicate that, with 4 exceptions (the Waiau and Mangapoike Rivers, and the 2 Northern Coastal streams), most sites in the Wairoa catchment have nutrient ratios indicative of co-limited conditions. Given that concentrations of both DIN and DRP are low to moderate at these sites, this means that both nutrients are likely to provide a degree of limitation to periphyton growth. The more elevated DIN/DRP ratios indicate a dominance of P-limited conditions in the Mangapoike River and the two Northern Coastal streams. By contrast, the nutrient ratios indicate that the Waiau River is dominated by N-limited conditions, this being the result of very low DIN but moderately elevated DRP concentrations.

6. Biological indicators

MCI scores at 5 of the 12 sites (the 3 Waikaremoana area sites, the Waiau and Ruakituri Rivers) are comparable with those measured at 'reference' sites, indicate reference or close to reference conditions. Scores at 3 additional sites (Waikaretaheke River, Te Iringaowhare and Kopuawhara Stream) indicate generally good water quality. The Hangaroa, Mangapoike and Opoutama Streams have generally lower MCI scores, indicative of "fair" water quality. The Wairoa River upstream of Wairoa is the only site with MCI scores indicating poor water quality, although interpretation of the MCI score at this site is complicated because the site is influenced by tides.

Periphyton biomass levels across the catchment are generally low, and with 2 exceptions, are below both the 120 mg/m^2 'recreational' and 50 mg/m^2 'biodiversity' thresholds. Data at the 2 sites where median biomass exceeds 50 mg/m^2 (Waiau and Ruakituri Rivers) are insufficient to provide a robust indication of periphyton biomass patterns at these sites, in particular if - or how often - "nuisance" levels of periphyton growth occur.

1 Introduction

Hawke's Bay Regional Council (HBRC) monitors water quality and river flow at a number of points across the Hawke's Bay Region and has produced a regional summary report on the state and trends of water quality for sites within these catchments (HBRC 2009-2013), based on data collected between 2009 and 2013.

This report provides detailed technical information from the Wairoa and Northern Coastal Catchments. It forms part of a series of technical reports covering all major catchments in the Hawke's Bay Region, which served as a base for the regional summary report.

Each technical report within the series aims to provide an analysis and summary of the water quality and biomonitoring data collected by HBRC up until 2013, covering in particular the following points:

- The state of water quality and aquatic ecology in the rivers and streams within the subregion or water management zone considered;
- Compliance of the sites with relevant guidelines that are stipulated in either the regional resource management plan (RRMP), the resource management act (RMA) or ANZECC (Australia and New Zealand Environment and Conservation Council) guidelines;
- Trends through time, *i.e.* are the water quality or the ecological indicators getting better or worse over time?
- Recommendations for further analysis of the data and future water quality monitoring in these catchments.

1.1 Physical Geography

The Wairoa River is located in the northern part of Hawke's Bay region, draining into the sea at the township of Wairoa and is Hawke's Bay's largest catchment at 3,670 km^2 (Figure 1-1). The river is formed by the confluence of the Hangaroa and the Ruakituri Rivers which meet at Te Reinga Falls. The upper part of the catchment is in the indigenous forest of Te Urewera National Park.

This report is based on water quality and ecological data collected at 12 State of the Environment (''SOE") monitoring sites (Figure 1-1).

Ten of these sites are within the Wairoa River catchment. They consist of 3 small streams located in the upper catchment above Lake Waikaremoana in Te Urewera National Park (Mokau, Te Kumi and Aniwhaniwha), and another small stream (Te Iringaowhare), which contributes to the Waiau River. Four further sites are mid-sized rivers, with an upstream catchment size of approximately 500 km^2. Of these, the Waikaretaheke River is located below the outlet of Lake Waikaremoana, and the Ruakituri, Hangaroa and Mangapoike Rivers drain the north-eastern region of the Wairoa catchment. Further downstream is an SOE site located on the Wairoa River itself, upstream of the Wairoa Township. This site is influenced by the tide.

The 2 other monitoring sites are located on the Kopuawhara and the Opoutama Streams, which drain north and south of the land bridge to the Mahia peninsula. These are small lowland streams with catchment areas of 68 km^2 (Kopuawhara), and 14.8 km^2 (Opoutama).

In this report, monitoring data relative to a number of water quality indicators are compared with ANZECC trigger values (as detailed in Section 2.2), which distinguish between 'upland' (elevation >150m) and 'lowland' elevation <150m) streams. Out of the 12 monitoring sites considered in this report, only the 3 Waikaremoana sites (Mokau, Te Kumi and Aniwhaniwha Streams) are classified as 'upland', and the remaining sites are classified as 'lowland'.

The upper part of the north-eastern catchments and the monitoring site at Hangaroa River are within the Gisborne District, but are reported on here for completeness because they drain to the coast via the Wairoa River.

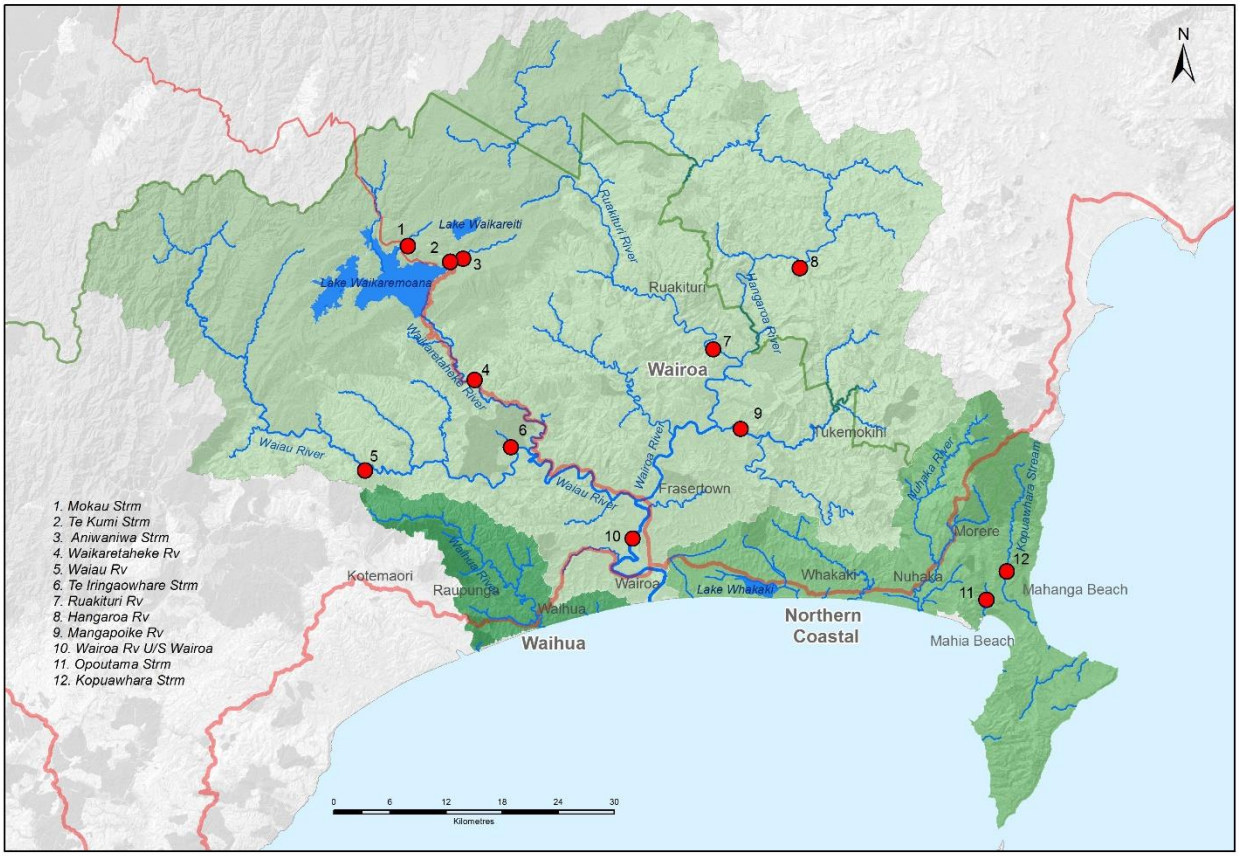


Figure 1-1: SOE sites of the Wairoa and Northern Coastal catchments referred to in this report. The green line is the Hawke's Bay regional boundary.

1.2 Land Use and Development

The physical and land cover characteristics of the Wairoa River catchment are summarised in Table 1-1. Information on flow and geology attributes is drawn from the River Environment Classification system (REC), which maps physical characteristics of New Zealand Rivers (Snelder et al., 2010). Also included are the proportions of individual land cover types in the catchment, derived from the Land Cover Database (New Zealand) version 4 (LCDB4) (refer Appendix A for LCDB4 and LUC descriptions).

Recreational activities such as tramping, swimming, boating and fishing are major attractions in the Wairoa catchment.

The climate in the upper Wairoa catchment is characterised by extremely high precipitation and cool temperatures. The lower catchments also receive considerable rainfall, but a warmer climate prevails.

The Wairoa catchment is dominated by fine, soft sedimentary geology. The north western headwaters of the Wairoa, including the catchments of Lake Waikaremoana, the Ruakituri River, and the upper parts of the Hangaroa River, flow through tertiary sandstone and siltstone. The only exception is the Waiau River in the furthest north western region, which has its sources in hard sedimentary greywacke and argillite. The eastern and middle reaches of the Wairoa catchment, including for example the Mangapoike River and the lower reaches of the Hangaroa River, consist of younger tertiary calcerous fine to medium sandstone, limestone, and siltstone. Only some small tributaries in the region of the Wairoa River mouth have alluvial deposits, with

gravels, sand and mud. Rain often comes in brief but extreme episodes, which together with the fact that the infiltration rate is comparably low in this catchment, results in a “peaky” hydrological regime, with relatively low base flows but high magnitude floods.

The upper western Wairoa catchment is located in the indigenous forest of Te Urewera National Park. This comprises the upper region of the Waiau River, the entire catchment of Lake Waikaremoana, and the northern reaches of the Ruakituri and Hangaroa rivers. Small areas of broadleaved indigenous hardwoods, shrubland, manuka/kanuka, and gorse/broom are distributed throughout the catchment outside the National Park. The greatest part of the catchment is in productive land use, with predominantly low to medium intensity hill country sheep and beef farming. A second important land use consists of plantation forest. Some areas of cropping are also present, predominantly in the lower parts of the catchment (**Error! Reference source not found.**).

Both the Kopuawhara and the Opoutama streams lie in soft sedimentary geology, and are influenced by a warm and wet climate. They drain north and south of the Mahia tombolo.

The upper Kopuawhara catchment, down to the SOE monitoring site, is primarily used for exotic forestry. Small patches of native cover and low producing exotic grassland are located directly upstream of the monitoring site. Downstream of the monitoring site the dominant land use is high producing exotic grassland.

The Opoutama catchment is dominated by high producing exotic grassland, with part of the lower-eastern catchment area covered in scrub.

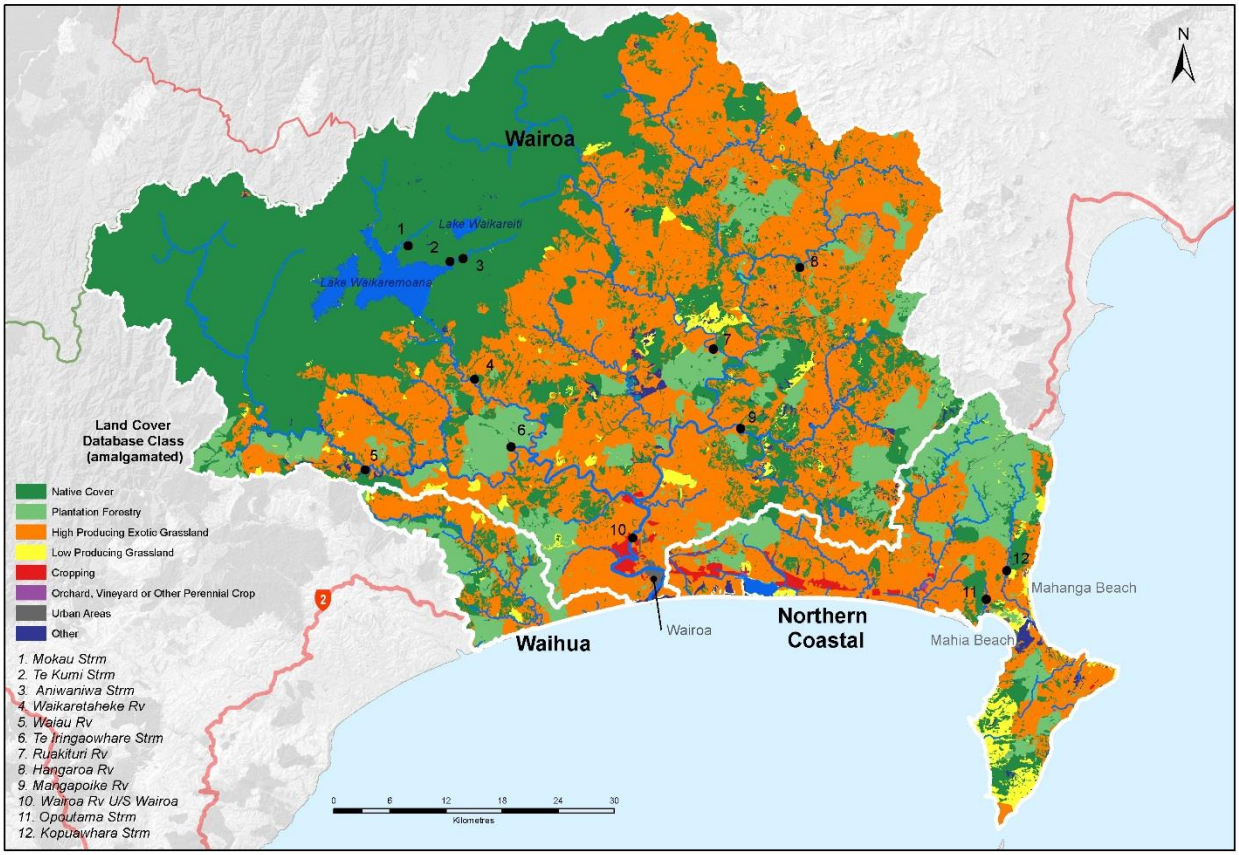


Figure 1-2: Wairoa and Northern Coastal land cover.

Table 1-1: Catchment characteristics of the Wairoa River, Northern Coastal and Waihua catchment zones. Information has been taken from the River Environment Classification (REC), the Land Cover Data Base (New Zealand) version 4 (LCDB4) and Agribase.

Zone	Source of flow (REC)	Geology (REC)	Land cover (LCDB4)	Land Use Capability Class (LUC)
Wairoa Catchment Total catchment area 367032 ha	Cool wet (1%)/ Warm wet (31%) climate with flow originating from lowland country, and Cool wet (40%)/ Cool extremely wet (21%)/ Warm wet (1%) climate with flow originating from hill country, and Cool extremely wet (4%) climate with flow originating from mountain country, and Cool extremely wet (2%) climate with flow originating from lakes.	Miscellaneous 3% Volcanic acidic 35% Soft sedimentary 55% Hard Sedimentary 7% Alluvium 0%	Native Cover 45% Plantation forestry 9% High producing 41% Low producing 1% Orchards/Vineyards 0% Cropping 0% Urban areas 0% (unaccounted categories amount to 3%, including: Lake/pond and gorse/broom)	Class 1 0% Class 2 0% Class 3 3% Class 4 2% Class 5 0% Class 6 46% Class 7 37% Class 8 9% Lake 2% River 0% Town 0%
Northern Coastal catchment Total catchment area 63897 ha	Warm dry (8%)/ Warm wet (60%) / Warm extremely wet (13 %) climate with flow originating from lowland country, and Cool extremely wet (13%)/ Warm extremely wet (4%) climate with flow originating from hill country, and	Miscellaneous 0.5% Volcanic acidic 3% Soft sedimentary 91% Hard sedimentary 0.5% Alluvium 6%	Native Cover 14% Plantation forestry 27% High producing 46% Low producing 7% Orchards/Vineyards 0% Cropping 3% Urban areas 0% (unaccounted categories amount to 3%, including: Lake/pond, gorse/broom and sand/gravel)	Class 1 0% Class 2 2% Class 3 10% Class 4 6% Class 5 0% Class 6 54% Class 7 54% Class 8 1% Lake 1% River 0%

	Warm wet (3%) climate with flow originating from lakes.			Town 0%
Waihua Catchment Total catchment area 18163 ha	Warm wet (96%) climate with flow originating from lowland country, and Cold wet (4%) climate with flow originating from hill country	Miscellaneous 8% Volcanic acidic 0% Soft sedimentary 92% Hard sedimentary 0% Alluvium 0%	Native Cover 21% Plantation forestry 32% High producing 45% Low producing 2% Orchards/Vineyards 0% Cropping 0% Urban areas 0%	Class 1 0% Class 2 0% Class 3 8% Class 4 1% Class 5 0% Class 6 51% Class 7 40% Class 8 0% Lake 0% River 0% Town 0%

2 Methodology and Rationale

2.1 Sampling

Water quality monitoring in the Wairoa River catchment has been carried out by HBRC since 1982 as part of the State of the Environment (SOE) programme. The SOE monitoring programme was undertaken on a quarterly basis until June 2012, when monthly sampling began across the whole region. Currently 12 sites are sampled in the Wairoa River / Northern Coastal catchment as part of the SOE monitoring programme. Figure 1-1 shows the location of the SOE monitoring sites that are discussed in this report.

Water quality indicators routinely measured across SOE monitoring sites include the following field-based measurements:

- Turbidity (NTU)
- Visual clarity (as black disc sighting distance)
- Dissolved oxygen (mg/l)
- Conductivity (μS/cm)
- pH
- Water temperature (^{o}C)

Macroinvertebrate samples were collected according to the Stark et. al. (2001) 'Protocol C2 – soft-bottomed, semi-quantitative' or 'Protocol C3 – hard bottomed, quantitative', depending on whether the sediment characteristics at a site were hard (e.g. gravels and cobbles) or soft bottomed (e.g. silt with macrophytes). Five replicate 0.1m surbers were taken at riffles in hard bottomed sites. A 0.3m^2 D-net, scooped 3 times through key habitat features, was used at soft bottomed sites. For calculating metrics, all samples were assessed according to the hard bottomed MCI taxon scores, because there is uncertainty around whether soft-bottomed metrics can be compared with the hard-bottomed metrics (Unwid and Larned, 2013). The vast majority of SOE sites in the region where macroinvertebrate samples are collected are hard-bottomed, and so hard bottomed metrics were used for consistency.

Visual periphyton assessments were introduced to the programme in 2011 and are undertaken at most sites, subject to flow conditions and substrate type. Periphyton biomass estimates (as chlorophyll-*a*) are made from rock scrapes that are collected during the visual assessment. The method is a modification of Biggs and Kilroy (2000), and involves using an underwater viewer to estimate the proportional cover of different algal growth forms in 20 quadrats haphazardly distributed in the wadeable, hard-bottomed sections of the sites. When possible, 5 quadrats are distributed along 4 transects that traverse the width of the waterway. However, for logistical reasons, the distribution of quadrats is adjusted at deeper and/or faster flowing sites. A single rock is taken from each of these 20 quadrats, and analysed for periphyton biomass following the QM-1B method outlined in Biggs and Kilroy (2000).

Water samples are collected at each site and kept in chilled containers while being freighted overnight to RJ Hill Laboratories in Hamilton, where they are analysed for total and dissolved nutrients (nitrogen and phosphorus), suspended solids, and faecal bacteria (as *E. coli*).

2.2 Water Quality Guidelines

Environmental guidelines are often used to describe the general state of a natural resource, even though they may not be directly applicable in a regulatory context. In the following analysis, selected environmental guidelines (Table 2-1) are used to provide context for the observations made in the Wairoa catchment. These guidelines are not intended to represent standards or limits for the quality of freshwater bodies. The various trigger values, guidelines and limits are discussed in the following paragraphs.

The ANZECC (2000) guidelines are used to indicate environmental conditions in 'baseline' (essentially unaffected) or 'pseudo-baseline' (lightly impacted) catchments (Davies-Colley, 2000). The 'trigger' values are based on water quality conditions taken from sites from the NIWA National River Water Quality Monitoring Network (NRWQMN) (Davies-Colley, 2000). The trigger values relate to 80th percentile or 20th percentile values for the data range taken from the NRWQMN. The main aim of the ANZECC guidelines is 'to provide an authoritative guide for setting water quality objectives required to sustain current, or likely future, environmental values for natural and semi-natural water resources in Australia and New Zealand' (ANZECC 2000).

In the development of the ANZECC (2000) trigger values, Davies-Colley (2000) states: 'running medians of water quality data measured in monitoring programmes may be compared with these trigger values. If the median value of a water quality variable for a particular site exceeds the trigger value, then it is intended to "trigger" a response on the part of water managers, which might be to initiate special sampling or carry out an investigation of reasons for the degraded water quality.'

The Biggs (2000) NZ periphyton guidelines are used nationally to set limits around periphyton biomass as well as identifying possible values for setting nutrient limits or targets to manage nuisance periphyton growth.

The Hickey (2013a) Nitrate Protection Guidelines represent the most up-to-date assessment of nitrate toxicity and provide guidance around nitrate concentration thresholds, both as annual median and annual concentration peaks (95th percentile), for managing nitrate toxicity risk.

Hay et al. (2006) identified several limits for the protection of trout fisheries in their report 'Water quality guidelines to maintain trout fishery values'. The report was produced on behalf of Horizons Regional Council in the development of their One Plan.

The MfE/MoH (2003) 'microbiological water quality guidelines for marine and freshwater areas' are used extensively to assess 'risk' in relation to contact recreation and exposure to bacteria present in aquatic environments.

The HBRC (2006) Regional Resource Management Plan (RRMP) identifies several water quality targets for nutrients and other water quality variables, including the limit for dissolved oxygen saturation (Table 2-2). This limit also aligns with the limit identified in the RMA 1991 for the protection of trout fisheries.

Table 2-1: Summary of water quality guidelines for attributes observed in the Wairoa catchment.

Variable[1]	Guideline / Trigger	Source
TN – ANZECC Lowland	0.614 mg/l	ANZECC (2000)
TN – ANZECC Upland	0.295 mg/l	ANZECC (2000)

[1] TN = total nitrogen; TP = total phosphorus; DIN = dissolved inorganic nitrogen; NOx-N = oxides of nitrogen or nitrate/nitrite- nitrogen; DRP= dissolved reactive phosphorus; NO_3-N = nitrate – nitrogen; Clarity = black disc sighting distance; *E. coli* = faecal bacteria levels measured as *E. coli* in colony forming units (CFU) / 100ml; MCI = Macroinvertebrate Community Index; DO% saturation = % dissolved oxygen saturation.

Variable[1]	Guideline / Trigger	Source
TP – ANZECC Lowland	0.033 mg/l	ANZECC (2000)
TP – ANZECC Upland	0.026 mg/l	ANZECC (2000)
DIN/NO_x-N - Tukituki Plan Change 6	0.800 mg/l	HBRC (2014)
DIN/NO_x-N – ANZECC Lowland	0.444 mg/l	ANZECC (2000)
DIN/NO_x-N – Periphyton growth 20 day accrual	< 0.295 mg/l	Biggs (2000)
DIN/NO_x-N – ANZECC Upland	0.167 mg/l	ANZECC (2000)
DRP – Periphyton growth 20 day accrual	< 0.010 mg/l	Biggs (2000)
DRP – ANZECC Lowland	0.010 mg/l	ANZECC (2000)
DRP – ANZECC Upland	0.009 mg/l	ANZECC (2000)
NO_3-N Toxicity '90% species protection'	< 3.8 mg/l	Hickey (2013)
NO_3-N Toxicity '95% species protection'	< 2.4 mg/l	Hickey (2013)
NO_3-N Toxicity '99% species protection'	< 1.0 mg/l	Hickey (2013)
Clarity – contact recreation	> 1.6 m	ANZECC (2000); HBRC RRMP (2006)
Clarity – 'Significant' trout fishery	> 3.5 m	Hay and Hayes (2006)
Clarity – 'Outstanding' trout fishery	> 5.0 m	Hay and Hayes (2006)
E. coli – Contact recreation (health) Red alert	> 550 (CFU/100ml)	MfE/MoH (2003)
E. coli – Contact recreation (health) Amber alert	> 260 (CFU/100ml)	MfE/MoH (2003)
Periphyton biomass - biodiversity	< 50 mg/m^2	Biggs (2000)
Periphyton biomass – aesthetic/recreation	< 120 mg/m^2	Biggs (2000)
MCI 'Outstanding' trout fishery; Excellent quality	> 120	Hay and Hayes (2006); Stark and Maxted (2007)
MCI 'Significant' trout fishery; Good quality	> 100	Hay and Hayes (2006); Stark and Maxted (2007)
DO % saturation – protection of trout fisheries	> 80%	RMA (1991); HBRC RRMP (2006)

Table 2-2: HBRC Regional Resource Management Plan (2006) water quality limits - "Environmental Guidelines – Surface Water Quality". These guidelines apply after reasonable mixing and disregarding the effect of any natural perturbations that may affect the water body, as set out in Policy 72 of the HBRC RRMP (2006) that states that the guidelines for the variables included in Table 2-2 apply "at or below median flows".

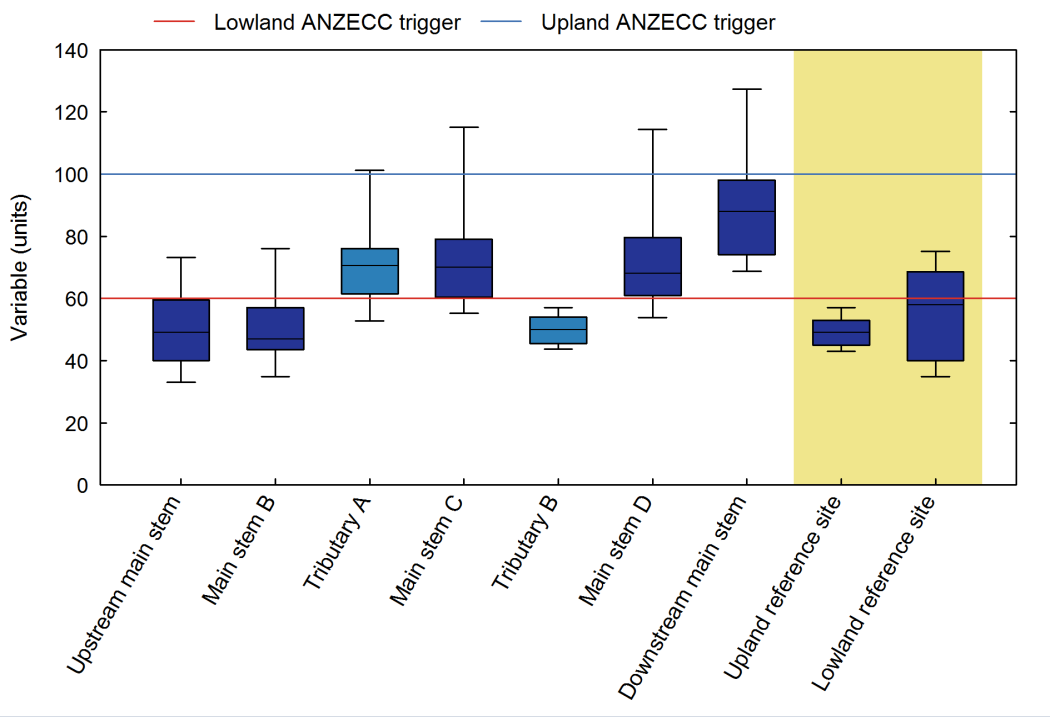
Variable	Guideline
Temperature	The temperature of the water should be suitable for sustaining the aquatic habitat
Dissolved oxygen	The concentration of dissolved oxygen should exceed 80% of saturation concentration
Ammoniacal nitrogen	The concentration of ammoniacal nitrogen (NH_4-N) should not exceed 0.1 mg/l
Dissolved reactive phosphorus	The concentration of dissolved reactive phosphorus should not exceed 0.015 mg/l

Variable	Guideline
Clarity	In areas used for recreation, the horizontal sighting range of a 200mm black disc should exceed 1.6m

2.3 Data Summaries and Visualisations

'Box and whiskers' plots are used throughout Section 3 to summarise water quality data. The sites are ordered from right to left in ascending order based on distance from the sea along the river channel. Sites are grouped by their position in the same major sub-catchment. For example, the Wairoa River upstream of Wairoa is closer to the sea than the Waiau River, so Wairoa River SOE monitoring sites appear to the right of the Waiau River monitoring sites in the graph.

KEY POINT: Box plots graph data as a box representing statistical values. The lower boundary of each box indicates the 25th percentile, a line within the box marks the median, and the higher boundary of each box indicates the 75th percentile (the box represents the interquartile range). The line at the end of the whiskers (error bars) above and below the box indicate the 90th and 10th percentiles respectively, i.e. the whiskers represent the interdecile range.



Water quality data are shown on catchment maps, based on the median value of observations taken over the last 5 years for the water quality variable in question (from January 2009 to December 2013). The catchment maps include arrows indicating the direction of statistically significant trends, with blue arrows for improvement and red arrows for deterioration of the variable in question. Sites with a horizontal dash did not exhibit a statistically significant trend. No symbol (arrow/horizontal dash) indicate sites where the required 8 years of data record between 2004 and 2013 were not available.

Tables of summary statistics are presented in Appendix B, to provide additional context to the changes in water quality variables under differing flow conditions. For example, the levels of faecal bacteria in rivers during high flows may not be relevant for bathing, because people will not be swimming during high flows. The conditions most likely to be experienced by bathers can be found in the < Lower Quartile Flow table (i.e. low flows).

Box plots, catchment water quality summary maps and statistical summaries of water quality variables all use the last 5 years of data to represent current conditions throughout the catchment. Data obtained from sites during all flow conditions were used for these comparisons.

2.4 Trend Analyses

Trend analysis of environmental monitoring data is important because environmental characteristics may exhibit trends which indicate particular issues are changing in significance. For example, if nitrate concentrations are increasing or decreasing at a particular site, the cause and significance of these changes may need to be identified.

Trend analyses in this report use non-parametric statistical approaches (seasonal Kendall trend tests), which is consistent with the approach used in recent nationwide water quality analyses undertaken for the Land and Water Aotearoa (LAWA) project (Ballantine, 2012). LAWA is a national initiative that collects and analyses environmental datasets from all regional councils around New Zealand, including river water quality. LAWA presents trend results for many of the same sites presented in this technical report, and so it was considered appropriate to duplicate the trend analyses approach it had used.

The seasonal Kendall tests help identify whether variability in the data is randomly distributed, or whether a significant trend exists over time. For example, did most of the higher ranked values occur in the last few years, or did higher values occur randomly over time? A 'significant' trend exists where there is a less than 5% probability ($p< 0.05$) that the observed data were obtained by chance.

Some sites had a long term monthly record, whereas others only had monthly sampling for the latter part of the record. For these latter sites, a quarterly sampling interval was applied to the entire time period using median quarterly values, to avoid biasing the trend analyses to the latter part of the period. January was used as the 'start' month, i.e. the seasons were: Jan-Mar; Apr-Jun, Jul-Sep; Oct-Dec, to be consistent with the LAWA project.

It is inappropriate to compare trends when datasets cover a different time period. For this reporting, we decided to adopt an 8 out of 10 year stipulation, whereby any dataset that had samples from at least 8 years of time period between January 2004 and December 2013 were considered comparable.

In some reporting of trend analyses, adjustment of the results is made to accommodate variation in river flow. This is known as flow adjustment, and changes the trend analyses to a parametric approach which complicates the statistical approach required. Flow adjustment was not completed on data hosted by LAWA when undertaking trend analyses, and there currently is no industry standard for flow adjustment for trend analyses of water quality in New Zealand. For these reasons, no flow adjustment was undertaken for the trend analyses presented here.

To estimate the strength of trends over time, an adaptation of the Theil-Sen slope estimator was used, the 'seasonal sen slope estimator' (SSSE). The SSSE estimates the median slope amongst lines through all pairs of points in the dataset, on a seasonal basis. This approach is effective at estimating the true slope in water quality data series because it is less sensitive to outliers. The values derived from the SSSE are given as

"Percent Annual Change" (PAC), which is the magnitude of the trend given as a percent of the median of observed values. A trend in PAC was considered meaningful if the PAC was greater than 1% per year.

For some variables, such as black disc distance, an increase in observed values is improvement (e.g., we can see further in the water). For other variables such as phosphorus concentration, an increase in observed values represents a deterioration (i.e. there is more phosphorus in the water).

In all tables that present trend results, the changes are represented in bold when they are significant (i.e., p value is less than 0.05). Given a significant trend for a particular variable, the PAC is highlighted in blue if there was a significant improvement in the water quality variable, and highlighted in red if there was a significant deterioration in the water quality variable.

The discussion around improvement and deterioration does not relate to natural enrichment of streams and rivers that occurs from the headwaters of the catchment to the coast, but instead to short-term site-specific increase or decrease in a water quality variable. The cause of water quality trends can be difficult to identify from SOE monitoring alone, but possible explanations of observed patterns are provided where appropriate. When possible, trends at impacted sites are compared to trends at reference sites. This is to explore whether any potentially concerning trends may be due to natural patterns, rather than assuming they are anthropogenic. But, trends detected during SOE analyses are often difficult to explain without further investigations being undertaken, and hence a concerning trend identified during analyses of SOE data serves as a prompt to undertake further work to identify the drivers of such trends.

The full details of trend analyses are presented in Appendix C, and a summary of trend results is presented in the sections on water quality variables that follow.

Only trend results for sites with 8 or more years of data are presented in the body of the report. Results of trend analyses for sites that contain less than eight years of data are presented in Appendix C, and the different time period noted.

3 Results and Discussion

3.1 Total Nutrients (TN and TP)

Nitrogen (N) and phosphorus (P) are key 'growth limiting' nutrients that influence the growth rate and biomass of algae (or periphyton) and aquatic plants. Low availability of these two nutrients often limits plant biomass development (Mathieson et al., 2012).

Eutrophication is the term used to describe the enrichment of water bodies by inorganic plant nutrients such as nitrate or phosphate. Eutrophication may occur naturally, but is often the result of human activity. Land-use change and intensification often give rise to elevated levels of nitrogen and phosphorus, particularly in areas where appropriate farming practices are not followed. Nuisance periphyton growth can be managed by reducing or eliminating inputs of N and P from point-source discharges and/or diffuse sources such as discharges from land-use (Biggs, 2000).

KEY POINT: Dissolved inorganic nitrogen (DIN) and dissolved reactive phosphorus (DRP) are dissolved inorganic forms of the nutrients nitrogen (N) and phosphorus (P) respectively. N and P are the two key macronutrients required for growth of plants and algae, occurring in all living cells – for example they are key elements in proteins and DNA. DIN includes nitrogen in the form of nitrate, nitrite and ammoniacal nitrogen. DRP includes orthophosphates, the filterable fraction of total phosphorus. Although numerous other forms of nitrogen and phosphorus exist and are commonly referred to in the field of water quality (e.g., organic and particulate forms), it is the dissolved forms DIN and DRP that are most readily available for uptake by plants and are thus most relevant for assessing effects on nuisance growths in rivers. The terms total nitrogen (TN) and total phosphorus (TP) refer to the sum total of all forms of N and P respectively in a sample. TN and TP are most relevant for assessments in lakes and coastal waters, because even the less 'available' forms of these nutrients can be recycled and become available in these slower flowing habitats, where there is more time for biology to act upon the total nutrient pool before it gets 'flushed' through the system. At sufficiently elevated concentrations, nitrate and ammonia forms of nitrogen can have toxic effects on aquatic biota (and on humans in the case of nitrate). This effect is independent of their significance as plant nutrients (Norton, 2012).

Figure 3-1 and Figure 3-2 are box-plots of total nitrogen (TN) and total phosphorus (TP) concentrations for SOE monitoring sites across the Wairoa catchment. ANZECC trigger values are included on the plots for upland (> 150 m altitude) and lowland sites (< 150 m altitude). Using the ANZECC guidelines criterion, 3 of the 12 SOE sites (Mokau, Te Kumi and Aniwhaniwha Streams) are classified lowland according to their elevation, with the remaining 9 sites classified as upland sites.

All sites in the Wairoa and Northern Coastal catchment have low to moderate TN concentrations, with median concentrations meeting their relevant ANZECC trigger value at all sites.

The three 'upland' sites (Mokau, Te Kumi and Aniwhaniwha Streams in the Waikaremoana area) are better than the ANZECC 'upland' trigger value of 0.295 mg/l, and have TN concentrations generally comparable with the Mohaka and Ngaruroro reference sites.

All 'lowland' sites of the Wairoa catchment are better than the 'lowland ANZECC trigger value of 0.614 mg/l. Among them, the Waiau River and the Waikaretaheke River presented median TN concentrations comparable to those measured at the reference sites, and well below the more stringent 'upland' trigger value. The tributaries of the Wairoa River all presented median concentrations in the 0.265 to 0.379 mg/l

range, i.e. close to the 'upland' trigger value, noting however that the TN concentrations were quite elevated at times in the Ruakituri, Hangaroa and Mangapoike Rivers, as evidenced by the extended interquartile (box) and interdecile (whisker) ranges. The main stem of the Wairoa River had relatively low TN concentrations, lower than several tributaries (Hangaroa and Mangapoike Rivers and Te Iringaowhare Stream).

The Kopuawhara Stream had relatively low TN concentrations, better than the 'upland' ANZECC trigger value. By contrast, Opoutama Stream had the highest median TN concentrations of all 12 SOE sites at 0.559 mg/l, although this was still better than the 'lowland ANZECC guidelines. Sites in the Waikaremoana area had the lowest TN concentrations, well below the upland ANZECC trigger value and comparable with the concentration measured at the Mohaka and Ngaruroro reference sites. These low concentrations are expected, given the predominantly undisturbed catchments above these sites.

The only significant and meaningful trend in TN concentrations was detected at Te Kumi Stream in the Waikaremoana area, where an average improvement of 2.6% per annum was identified (). This site and its catchment is fully within the conservation estate, thus the trend identified is unlikely to be the result of changes in any specific human activities, but could be associated with climatic patterns. Trends for sites on the Mokau Stream, Waiau River, Te Iringaowhare Stream and Mangapoike Stream are not shown, because fewer than the required minimum of 8 years data were available for analysis.

Median TN concentrations at sites in the Wairoa and Northern Coastal catchments catchment rank in the top 56% for the region, and in the top 33% for all but 3 sites (Hangaroa, Mangapoike Rivers and Opoutama Stream) (Refer Appendix D).

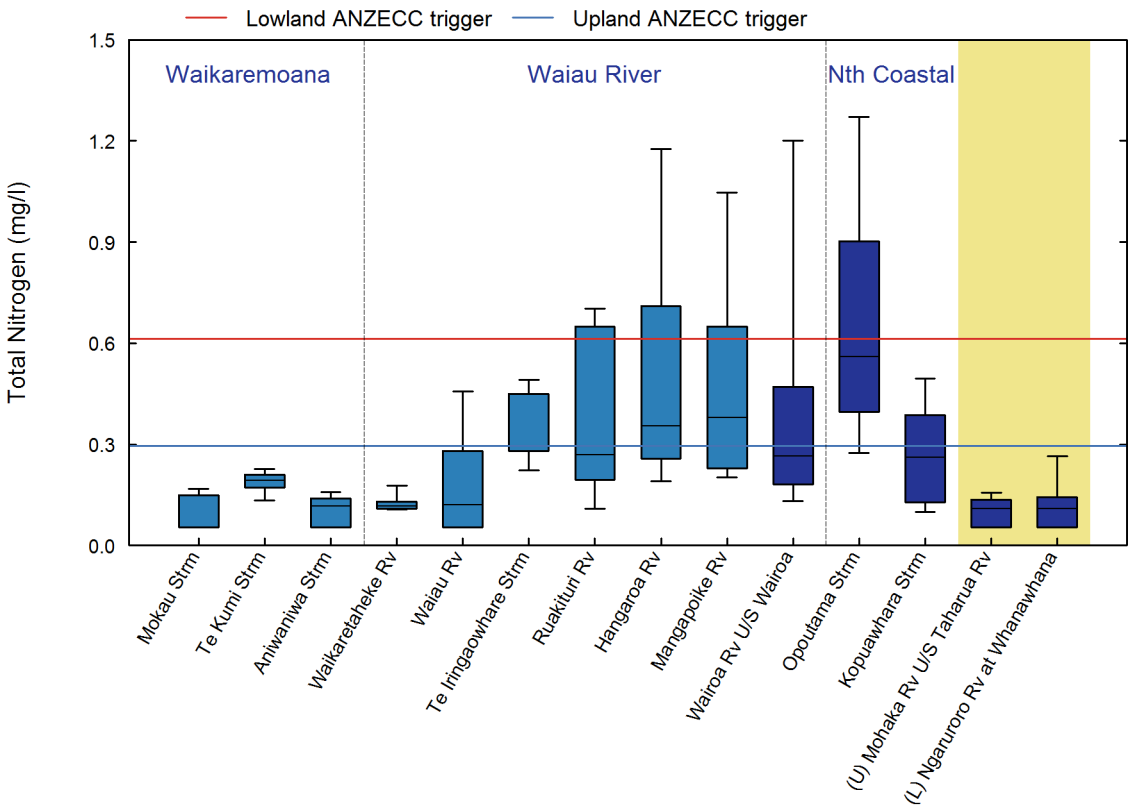


Figure 3-1: Total nitrogen (TN) levels at SOE monitoring sites. SOE sites for the Mohaka River upstream (U/S) Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison purposes. The blue line relates to the ANZECC (2000) 'Upland' TN trigger value; the red line the ANZECC (2000) 'Lowland' TN trigger value.

Median Total Phosphorus (TP) concentrations followed general patterns similar to those of TN. Median TP concentrations are better than the relevant ANZECC trigger values at all sites except in the Opoutama Stream (exceeded only marginally) and the Te Iringaowhare Stream (Figure 3-2).

All 3 upland sites in the Waikaremoana area presented very low TP concentrations, comparable with those measured at the Mohaka and Ngaruroro reference sites, and far better than the 'upland' ANZECC trigger value.

Apart from the Te Iringaowhare, TP at all 'lowland' sites in the Wairoa catchment is better than the 'lowland' ANZECC trigger value, including the main stem of the Wairoa River. However, TP concentrations were at times elevated at most sites, as indicated by the extended interquartile and interdecile ranges. Median TP concentration in the Te Iringaowhare Stream were largely worse than the 'lowland' ANZECC trigger value, and the causes may need to be investigated if there was evidence of ecological consequences of these moderately elevated TP concentrations.

The Kopuawhara Stream had among the lowest TP concentrations of all sites. By contrast, the median TP concentration in the Opoutama Stream just exceeded the 'lowland' ANZECC trigger value.

As seen for TN, improvements in TP concentrations over the 5 year period 2009-2013, were only seen at Te Kumi Stream in the Waikaremoana area (3.9% annual decrease) with no changes (improvements or deterioration) seen at any of the remaining sites in the Wairoa catchment (Appendix C). Again, trends for

sites on the Mokau Stream, Waiau River, Te Iringaowhare Stream and Mangapoike Stream are not shown, because fewer than the required minimum of 8 years data were available for analyses.

Sites in the Waikaremoana area and the Kopuawhara Stream had the lowest median TP concentrations (< 0.009 mg/l) and ranked in the top 15% of the region. Remaining sites had median TP concentrations ranging from 0.017 to 0.053 mg/l, and varied in their rankings across the region (from 35th to 89th, out of 104) (Refer Appendix D).

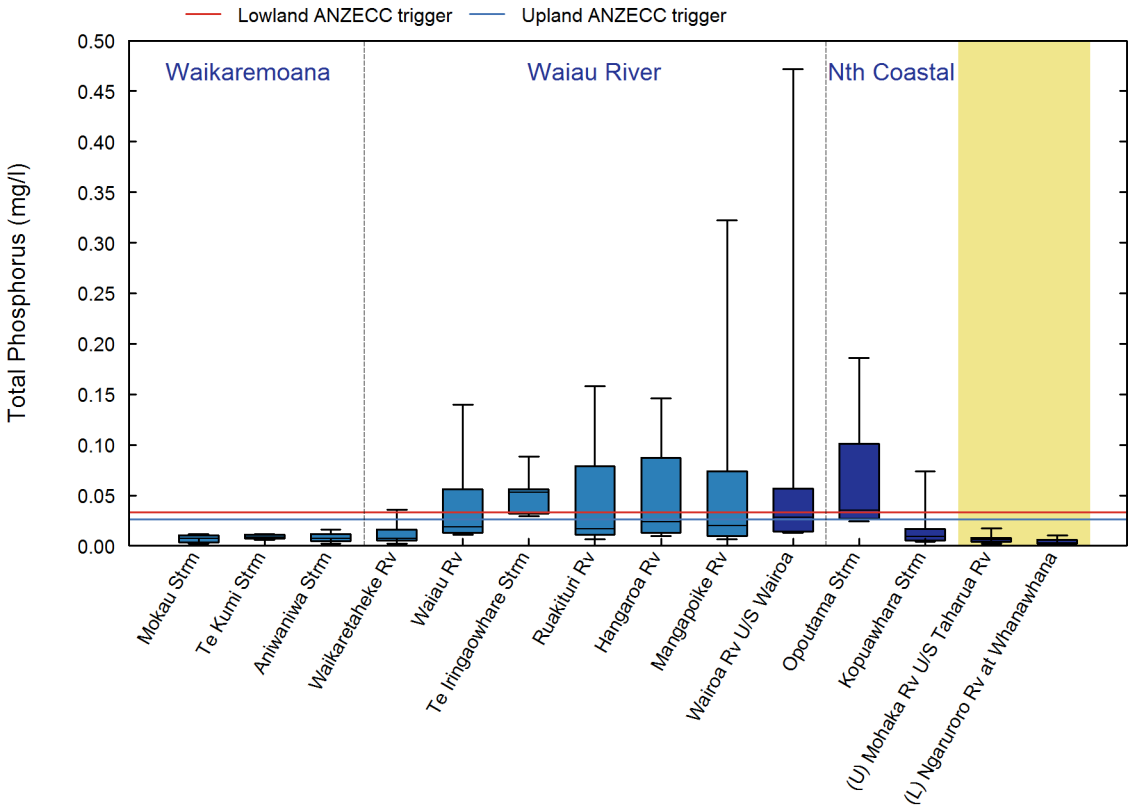


Figure 3-2: Total phosphorus (TP) concentrations at SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison purposes. The blue line relates to the ANZECC (2000) 'Upland' TP trigger value; the red line the ANZECC (2000) 'Lowland' TP trigger value.

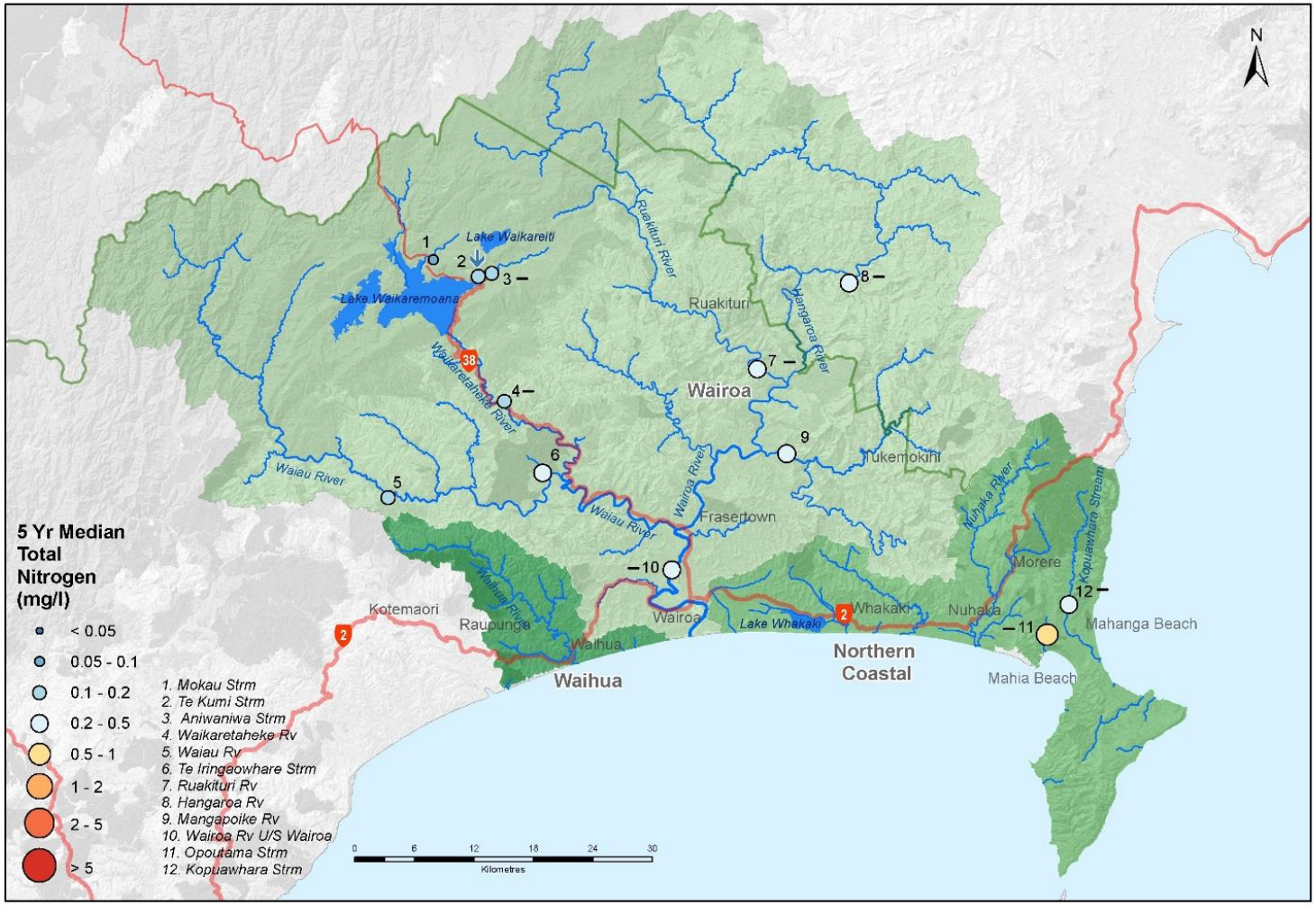


Figure 3-3: 5 year median and trends in total nitrogen (TN) concentrations at SOE monitoring sites. Arrows indicate direction of significant trends, with blue arrows for improvement and red arrows for deterioration of the variable in question. Sites with a horizontal dash did not exhibit a statistically significant trend. Trend results for sites 1, 5, 6 and 9 are not presented because they did not include the required 8 years of record between 2004 and 2013.

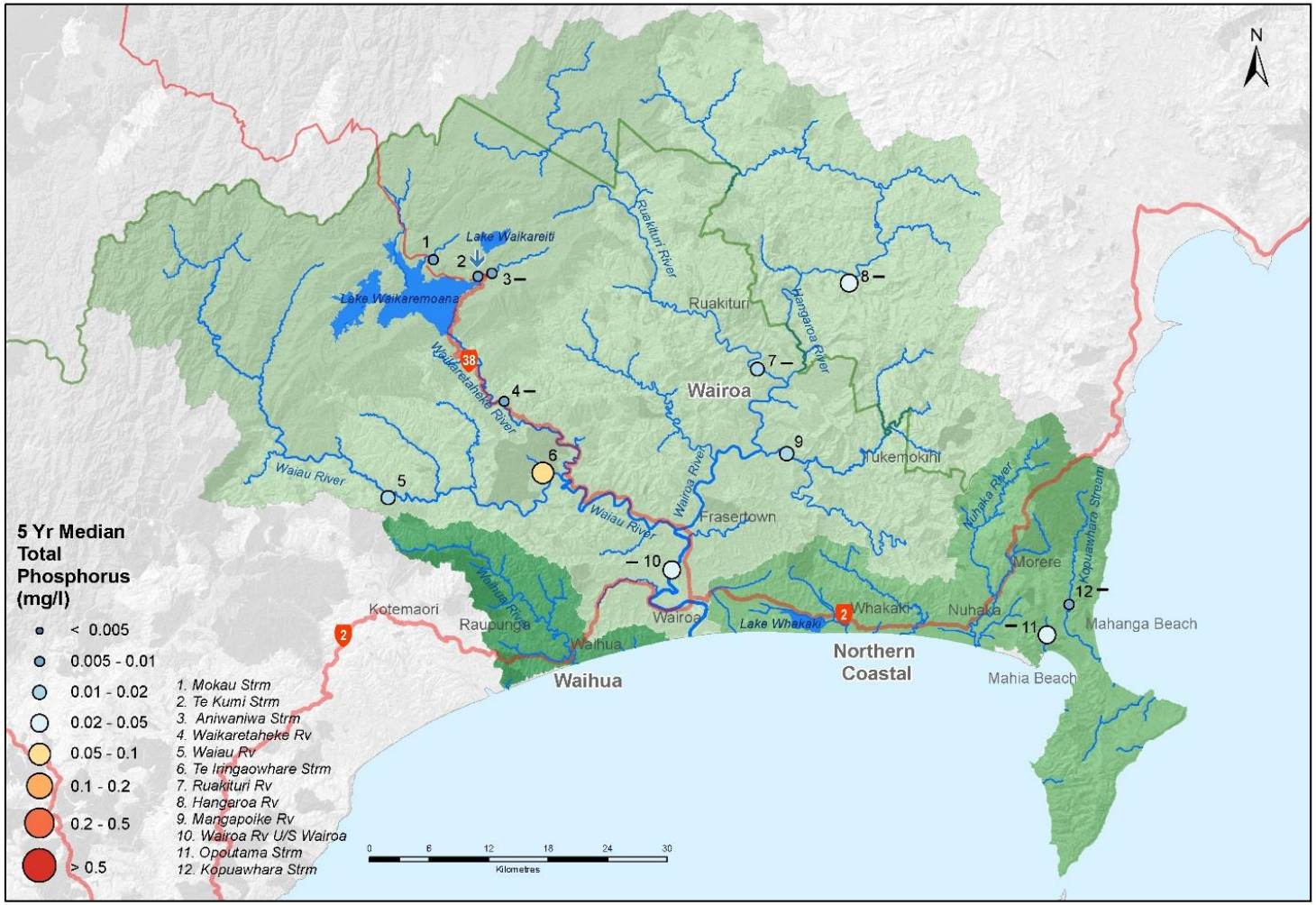


Figure 3-4: 5 year median and trends in total phosphorus (TP) levels at SOE monitoring sites. Arrows indicate direction of significant trends, with blue arrows for improvement and red arrows for deterioration of the variable in question. Sites with a horizontal dash did not exhibit a statistically significant trend. Trend results for sites 1, 5, 6 and 9 are not presented because they did not include the required 8 years of record between 2004 and 2013.

3.2 Dissolved Nutrients (DIN and DRP)

Dissolved inorganic nitrogen (DIN) and dissolved reactive phosphorus (DRP) concentrations were also analysed at SOE monitoring sites across the Wairoa and Northern coastal catchments.

As discussed in the 'Key Point' on Page 23, DIN and DRP are important because they represent the 2 most significant nutrients that stimulate or limit periphyton growth, since they are immediately available to fuel plant and algal growth (they are 'bioavailable'). By contrast, forms of nitrogen and phosphorus such as organic nitrogen and particulate phosphorus, are not immediately available to algae and plants and need to decompose through processes such as re-mineralisation to become bio-available.

In situations where other growth constraints such as long periods of low flow and high light availability are less significant, increases in DIN and DRP supply can lead to increased periphyton growth and eutrophication of a waterway. For this reason, setting nutrient concentration guidelines or standards is generally used as a way to guide the actions necessary to maintain periphyton growth to acceptable levels. However, because DIN and DRP are immediately available to plants, they can be removed from the water rapidly (e.g., during summer low flows). This means that concentrations of DIN and DRP at times provide a poor indicator of eutrophication.

It should also be noted that periphyton require hard substrate to attach to, which means that excessive periphyton growth is unlikely to develop in soft-bottomed rivers such as the lower Wairoa River, regardless of dissolved nutrient concentrations.

Median DIN concentration throughout the Wairoa and Northern Coastal catchments catchment followed a very similar pattern to that of TN. Median DIN concentrations met the relevant ANZECC trigger values at all sites.

All three upland sites, located in the Waikaremoana area had very low DIN concentrations (below or close to, 0.100 mg/l). However, the Te Kumi Stream had median DIN concentrations slightly more elevated than the Mokau and Aniwhaniwha Streams, or the Mohaka and Ngaruroro reference sites.

Median DIN concentration in the Opoutama Stream was the highest of all 12 SOE monitoring sites, although it remained well below the rest of the catchment, although better than the ANZECC trigger value for lowland rivers. This site was the only site where the Biggs (2000) suggested guideline for DIN for periphyton growth management for a 20 day accrual period (orange line on Figure 3-5) was exceeded.

All other sites had median DIN concentrations better than, or close to, the upland ANZECC trigger value, i.e. well below both the Biggs (2000) suggested guideline and the ANZECC trigger value for lowland rivers. Of particular note, the Waikaretaheke and Waiau Rivers had median DIN concentrations similar to those measured at reference sites.

Median DRP concentrations were low (less than 0.008 mg/l) and better than the ANZECC trigger value for upland rivers (Figure 3-6) at all but two sites (Waiau River and Te Iringaowhare Stream).

With regards to the upland sites, the Mokau and Aniwhaniwha Streams had very low DRP concentrations, very commonly below laboratory detection limits, and comparable to the Mohaka and Ngaruroro reference sites. However, DRP concentrations were higher in the Te Kumi Stream (median of 0.008 mg/l), although still better than the ANZECC trigger value for upland streams (0.009 mg/l).

Within the lowland streams, the Waikaretaheke River had very low DRP concentrations, similar to those measured at the reference sites. The Waiau River (0.012 mg/l) and Te Iringaowhare Stream (0.016 mg/l) had the highest median DRP concentrations of all 12 sites and were the only sites worse than the ANZECC trigger

value for lowland rivers. All other sites, including the two Northern Coastal catchment sites had relatively low median DRP concentrations, and were better than both the upland and lowland ANZECC trigger values.

Improvements in DIN concentrations over the 5 year period 2009-2013, were seen at two streams in the Waikaremoana area, the Te Kumi (3.9% annual decrease) and Aniwhaniwha (6.5% annual decrease). Improvement was also seen at the Northern Coastal site on the Opoutama Stream (7% annual decrease) (Appendix C). An improvement in DIN concentrations was observed in the Waiau River, however, this trend should be considered preliminary as only three years of data were available for analysis.

Improvements in DRP concentrations between 2009 and 2013 were also seen at Te Kumi Stream (6.3% annual decrease) in the Waikaremoana area, and at the Northern Coastal site on the Opoutama Stream (7% annual decrease) (Appendix C). Improvement in DRP concentrations were also observed in the Te Iringaowhare Stream, however this trend should also be considered preliminary as only six years of data were available for analysis.

No changes (improvements or deterioration) were seen in DIN or DRP at any of the remaining sites in the Wairoa catchment. Trends for sites on the Mokau Stream, Waiau River, Te Iringaowhare Stream and Mangapoike Stream are not shown as less than the required minimum of 8 years data were available for analysis.

Compared with other SOE sites in the region, the majority of Wairoa catchment sites rank highly, with 9 of the 12 sites in the top 28% for DIN and the top 33% for DRP (Refer Appendix D). The Opoutama Stream site, which had the highest DIN concentrations for the catchment, ranked 60th in the region; while the Te Iringaowhare Stream, which had the highest DRP concentrations for the catchment, ranked 63rd in the region.

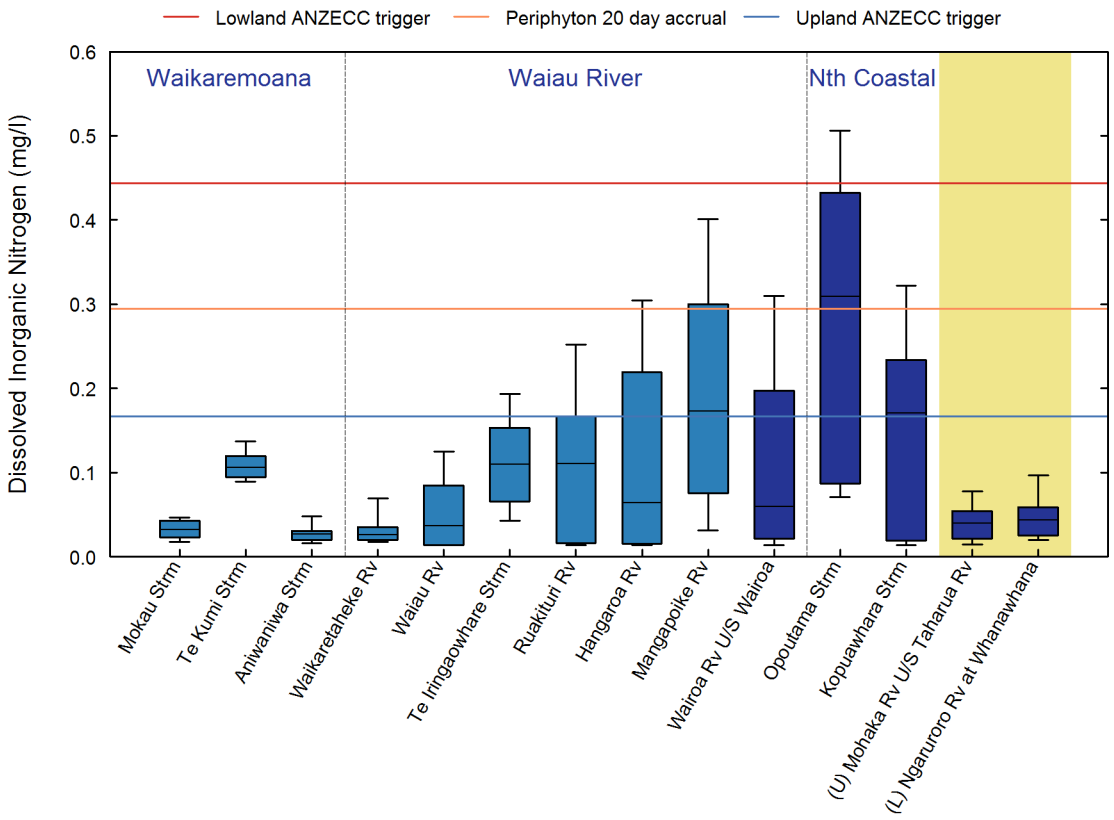


Figure 3-5: Dissolved inorganic nitrogen (DIN) concentrations at SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison purposes. The blue line relates to the ANZECC (2000) 'Upland' DIN trigger value; the orange line, the Biggs (2000) suggested limit for DIN for periphyton growth management for a 20 day accrual period; the red line relates to the ANZECC (2000) 'Lowland' DIN trigger value.

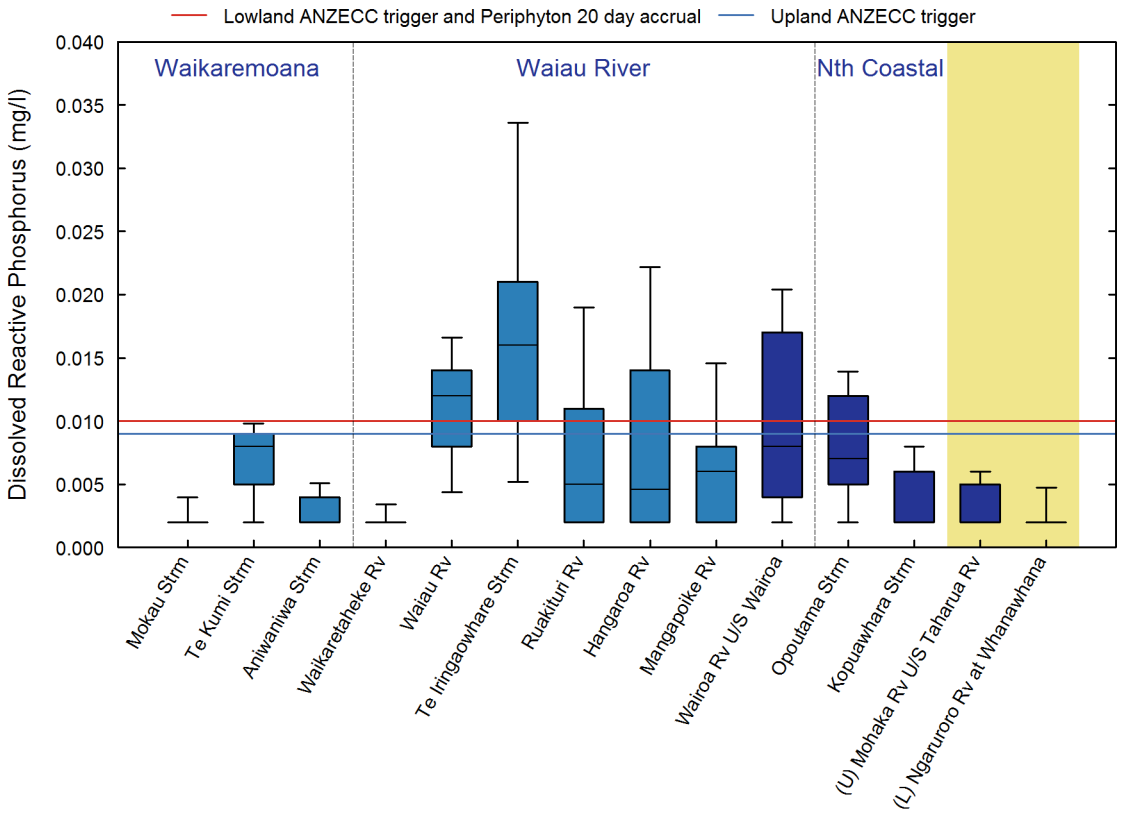


Figure 3-6: Dissolved reactive phosphorus (DRP) concentrations at SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison purposes. The blue line relates to the ANZECC (2000) 'Upland' DRP trigger value; the red line the ANZECC (2000) 'Lowland' DRP trigger value and the Biggs (2000) suggested limit for DRP for periphyton growth management for a 20 day accrual period.

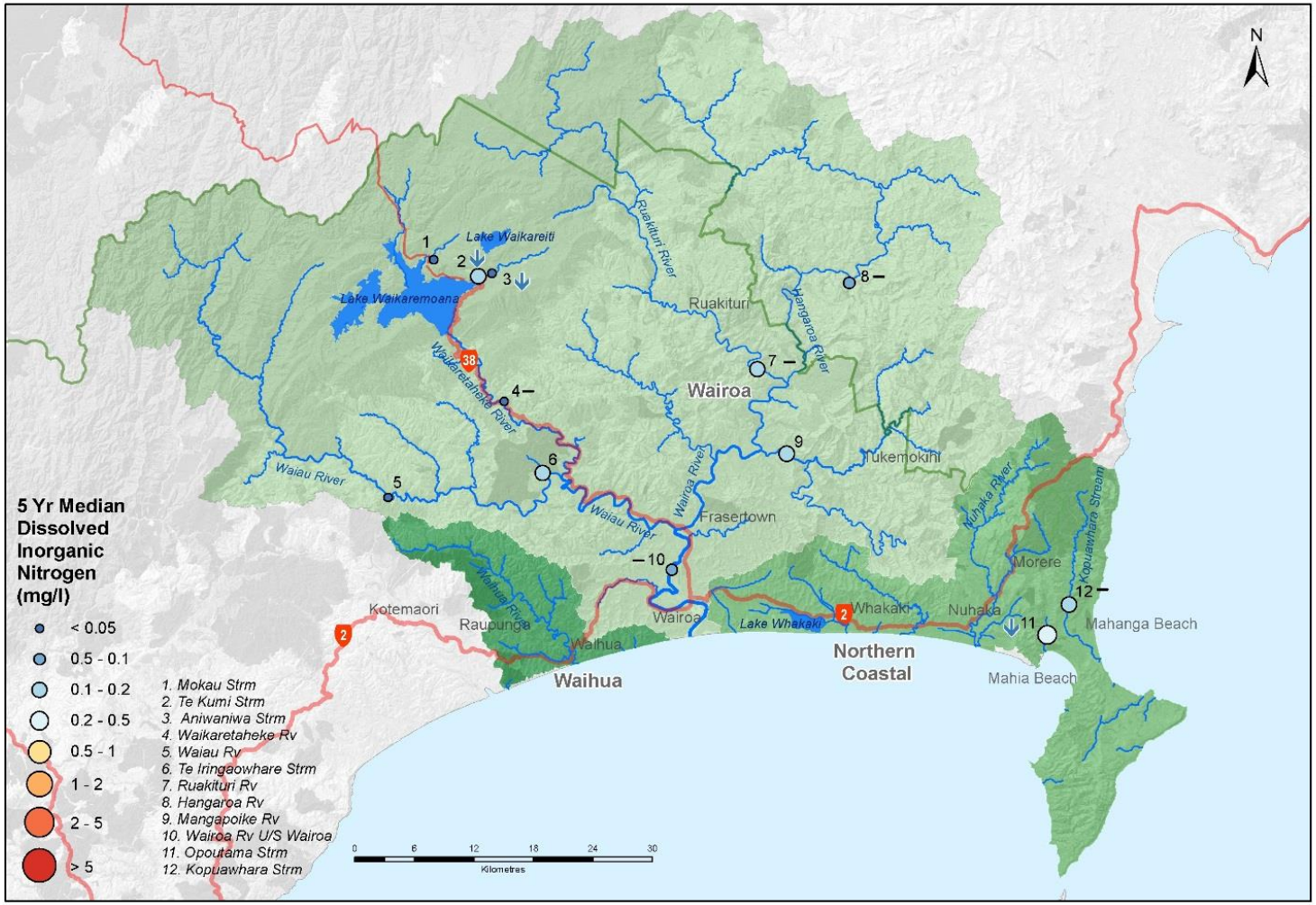


Figure 3-7: 5 year median and trends in dissolved inorganic nitrogen (DIN) concentrations at SOE monitoring sites. Arrows indicate direction of significant trends, with blue arrows for improvement and red arrows for deterioration of the variable in question. Sites with a horizontal dash did not exhibit a statistically significant trend. Trend results for sites 1, 5, 6 and 9 are not presented because they did not contain the required 8 years of record between 2004 and 2013.

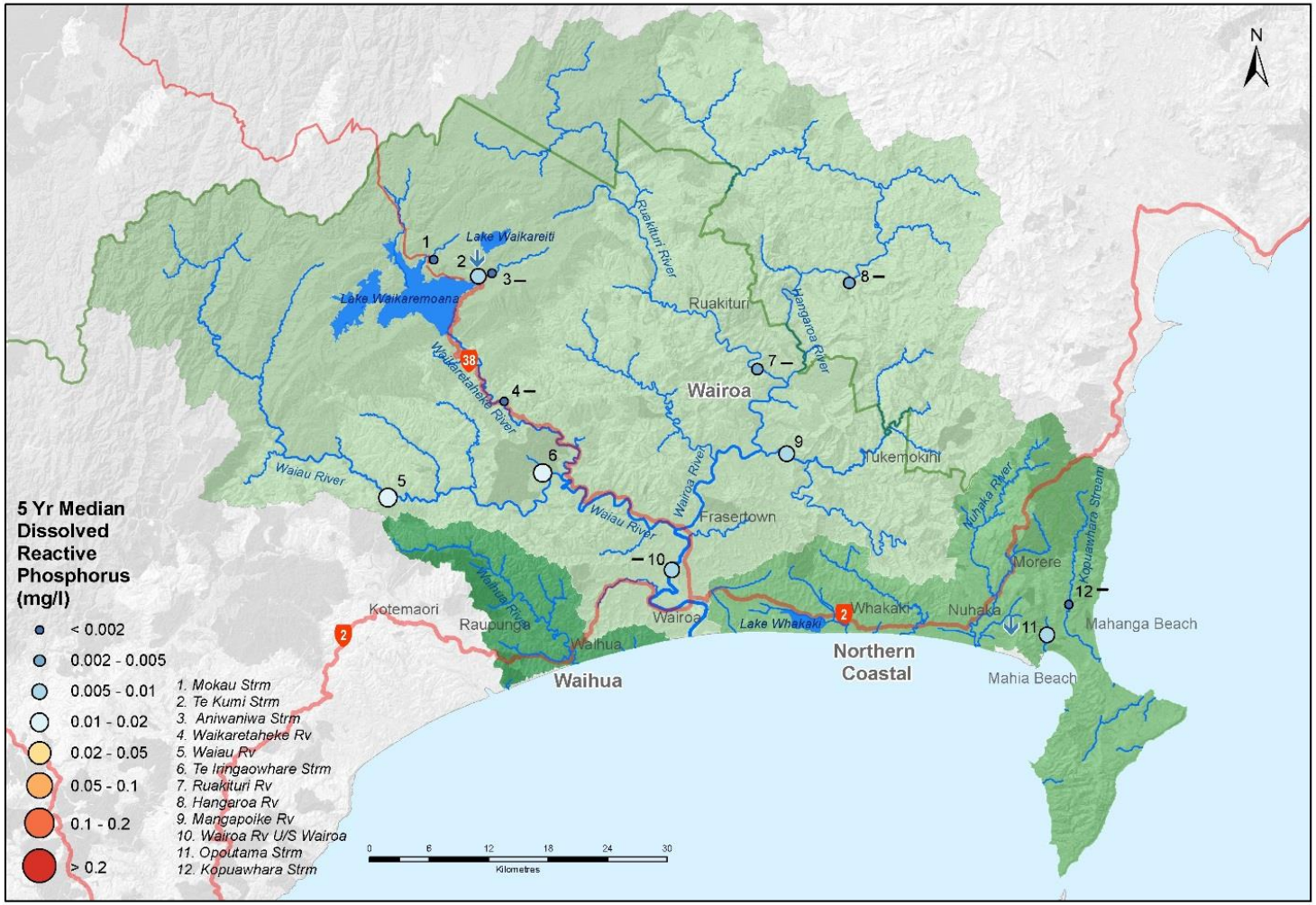


Figure 3-8: 5 year median and trends in dissolved reactive phosphorus (DRP) concentrations at SOE monitoring sites. Arrows indicate direction of significant trends, with blue arrows for improvement and red arrows for deterioration of the variable in question. Sites with a horizontal dash did not exhibit a statistically significant trend. Trend results for sites 1, 5, 6 and 9 are not presented because they did not contain the required 8 years of record between 2004 and 2013.

With 4 exceptions (the Waiau and Mangapoike Rivers, and the two Northern Coastal streams) - most sites in the Wairoa catchment have nutrient ratios indicative of co-limited conditions (Figure 3-9). Given that concentrations of both DIN and DRP are low to moderate at these sites, this means that both nutrients are likely to provide a degree of limitation to periphyton growth.

The more elevated DIN/DRP ratios indicate a dominance of P-limited conditions in the Mangapoike River and the two Northern Coastal streams. By contrast, the nutrient ratios indicate that the Waiau River is dominated by N-limited conditions, which is the result of very low DIN but moderately elevated DRP concentrations.

The above commentary does not take into account the suitability for, or sensitivity to, excessive periphyton growths in the different streams and rivers considered.

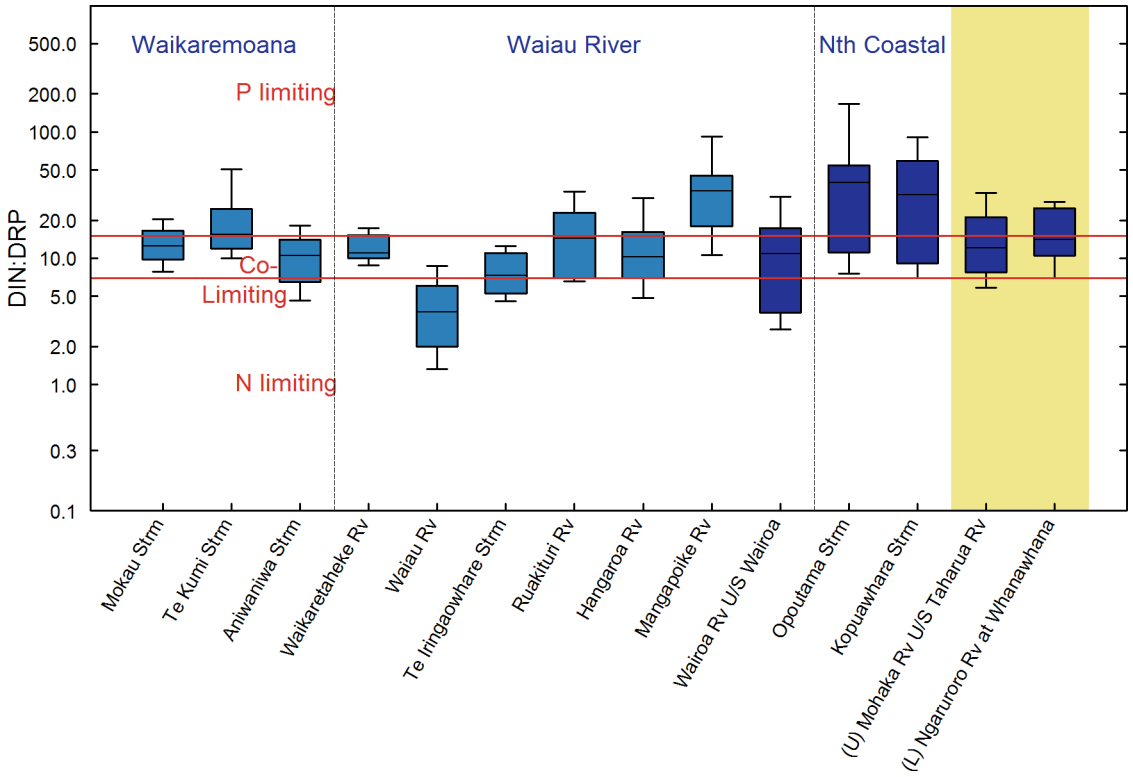


Figure 3-9: DIN/DRP ratio for SOE monitoring sites. Red lines indicate DIN:DRP ratios indicative of P-limiting conditions (above 20), N-limiting conditions (below 7.5). Ratios between 7.5 and 20 are generally inconclusive or may indicate that nutrient limitation may "switch" between the two nutrients at different times of the year/ flows.

3.3 Risk of toxic effects – Ammoniacal nitrogen

Ammoniacal nitrogen can be toxic to many aquatic species, and is a common pollutant in treated domestic, agricultural and industrial wastewater discharges. In aqueous solution, ammoniacal nitrogen exists in 2 chemical forms: the ammonium cation (NH_4^+) and un-ionised ammonia (NH_3). The respective proportion of these forms is determined by a chemical equilibrium governed by pH and temperature. The higher the pH and temperature, the higher the proportion of un-ionised ammonia. Un-ionised ammonia is the most toxic form to aquatic life, and ammonia toxicity increases with pH and temperature. The ANZECC (2000) guidelines define trigger values of 0.900 mg/l of total ammoniacal nitrogen for the 95% species protection level and 0.320 mg/l for the 99% species protection level. These trigger values are provided at pH 8 and temperature 20°C. The guidelines also provide tables and formulas to calculate the concentration of total ammoniacal nitrogen corresponding to this threshold under different temperature and pH conditions. The 95% species protection level is the "default" protection level defined in the ANZECC Guidelines, applicable to slightly to moderately disturbed systems, whilst the 99% protection level is applicable to "High conservation/ecological values" systems.

In the Wairoa and Northern Coastal catchments, the approach taken in this report is that the 99% species protection level should be applicable to monitoring sites within (i.e. Mokau, Te Kumi and Aniwhaniwha Streams) or closely downstream of the conservation estate (Waikaretaheke and Waiau Rivers), whilst the "default" 95% protection level should be applicable to all other sites.

Total ammoniacal nitrogen concentrations at all sites were always low, far better than both trigger values (refer to Appendix B), thus the risk of toxic effects from ammonia can be considered low at all SOE monitoring sites in the Wairoa and northern coastal catchments.

No significant and meaningful temporal trends in total ammoniacal nitrogen concentrations were identified in the Wairoa and Northern Coastal catchments.

3.4 Risk of toxic effects – Nitrate nitrogen

At high concentrations, nitrate can be toxic to aquatic animals (Hickey and Martin, 2009). The ANZECC (2000) nitrate toxicity guidelines were reviewed by NIWA for Environment Canterbury in 2009 (Hickey and Martin, 2009). Chronic toxicity thresholds derived in the 2009 review were based largely on aquatic species from outside New Zealand, although some of the species are now resident in New Zealand. No native New Zealand species were included in the 2009 review (Hickey, 2013b).

To assist with the development of a set of robust nitrate toxicity concentration guidelines, NIWA was engaged by HBRC in 2012/2013 to undertake the following:

- Nitrate toxicity trials using several New Zealand native species, including Inanga, *Deleatidium* mayfly and early life stages (eggs and early life stages) of New Zealand strains of introduced rainbow trout;
- Update the Hickey and Martin (2009) guidelines by including recent international data as well as data derived from the New Zealand trials;
- Support the development of nitrate-nitrogen toxicity guidelines applicable to the Hawke's Bay region.

DIN (discussed in the previous section) is made up of nitrate-nitrogen (NO_3-N), nitrite-nitrogen (NO_2-N) and ammoniacal-nitrogen (NH_4-N).

Nitrate-nitrogen is the dominant component of DIN in areas affected mainly by diffuse-source discharges and in catchments with limited areas of wetland with anoxic soils, as in the Wairoa catchment. Nitrate-

nitrogen concentrations in Wairoa catchment streams (Figure 3-10) were similar to DIN concentrations (Figure 3-5) with nitrate-nitrogen contributing to over 95% of the dissolved inorganic nitrogen.

All monitoring sites in the catchment had nitrate-nitrogen concentrations well below the lowest toxicity threshold defined by Hickey (2013a), i.e. a median concentration of 1.0 mg/l (Figure 3-10) and a 95th percentile concentration of 1.5 mg/l (Appendix B) for the 99% species protection level, indicating minimal risk of toxic effects to aquatic life.

Trend analyses showed nitrate-nitrogen trends were essentially the same as those of DIN, with improvements (decreases) in nitrate-nitrogen concentrations at two Waikaremoana sites (the Te Kumi and Aniwhaniwha Streams) and at the Northern Coastal site on the Opoutama Stream (Appendix C). The presence of time-based trends at two essentially undisturbed sites indicates that natural factors such as climatic patterns may at least in part explain the trends detected, although other factors such as changes in agricultural practise may also have played a role in the Opoutama catchment.

Comparison with other SOE monitoring sites in the Hawkes's Bay region showed Wairoa catchment sites to rank highly for nitrate-nitrogen with 9 of the 12 sites in the highest 25% and the remaining three sites in the highest 50%.

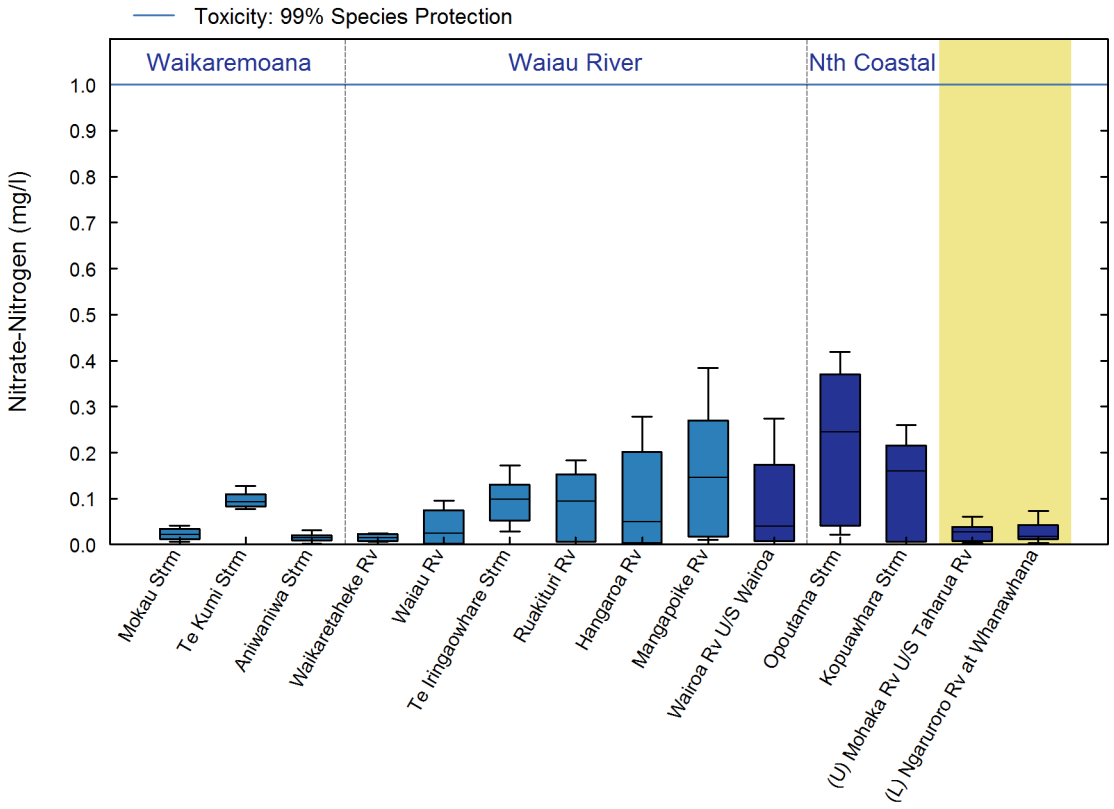


Figure 3-10: Nitrate-nitrogen (NO_3-N) concentrations at SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison purposes. The blue line relate to the Hickey (2013) nitrate toxicity limits for 99% species protection.

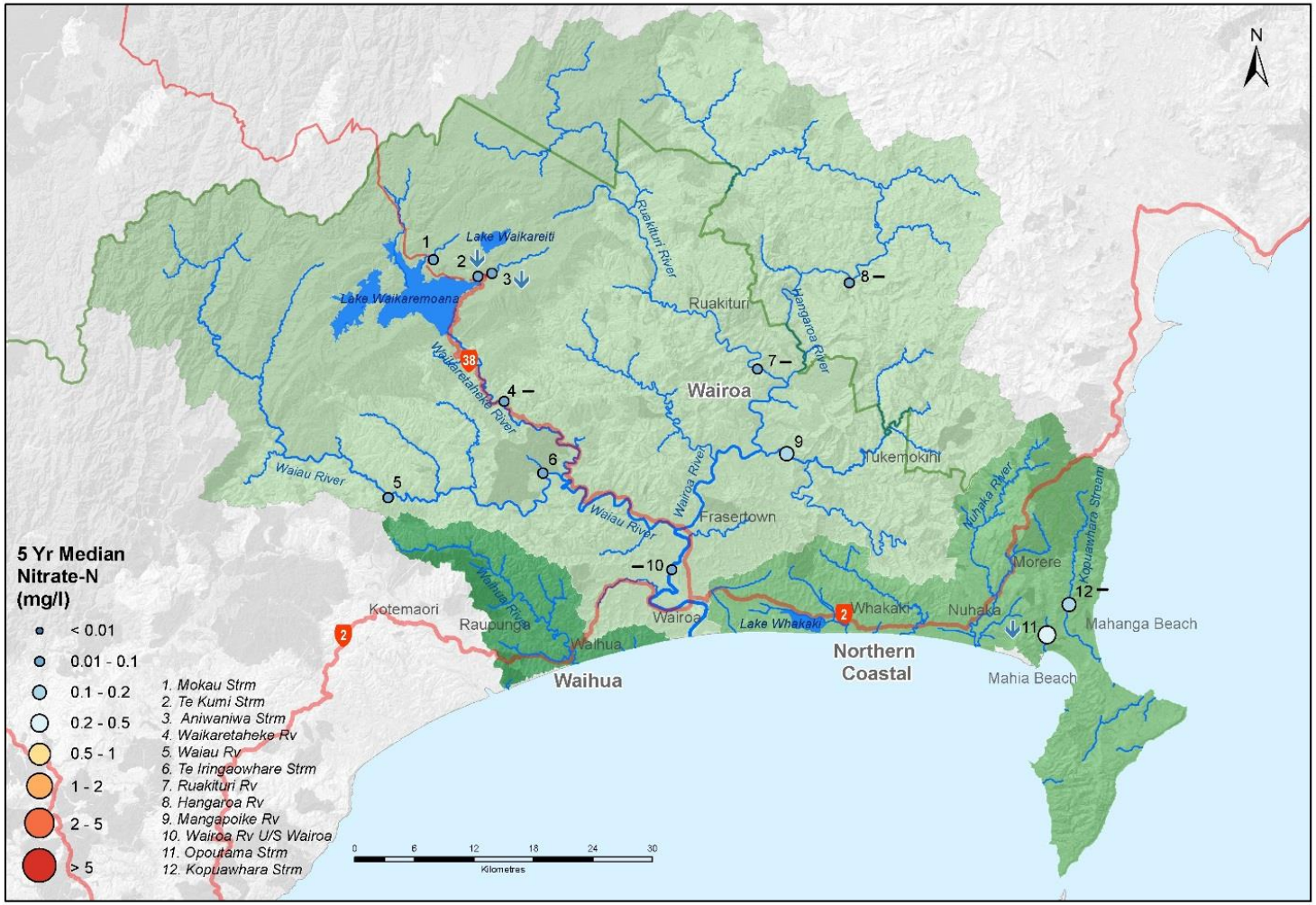


Figure 3-11: 5 year median and trends in nitrate-nitrogen (NO_3-N) concentrations at SOE monitoring sites. Arrows indicate direction of significant trends, with blue arrows for improvement and red arrows for deterioration of the variable in question. Sites with a horizontal dash did not exhibit a statistically significant trend. Trend results for sites 1, 5, 6 and 9 are not presented because the required 8 years of record between 2004 and 2013 were not available at these sites.

3.5 Water Clarity – Black Disc and Turbidity

Water clarity is measured as the proportion of light transmitted through water. The concept has two important aspects, which are (1) visual clarity (sighting range for humans and aquatic animals), and (2) light penetration for growth of aquatic plants (Davies-Colley et al., 2003, Davies-Colley and Smith, 2001).

Water clarity is of considerable importance for the protection of contact recreation values, because it is perceived by recreational water users to directly affect the aesthetic quality of the water. In addition, adequate visual clarity allows swimmers to estimate depth and to identify subsurface hazards (ANZECC 2000).

Changes (generally reductions) in water clarity can also affect the foraging ability of fish, such as trout, by reducing their ability to see food drifting in the water column (Shearer and Hays, 2010). Trout are visual predators and drift feeding is their main foraging behaviour in most rivers (Hay et al., 2006). Reduced visual clarity (or equivalent increases in water turbidity), reduces foraging efficiency (i.e. more energy is spent consuming the same amount of prey, or fewer prey are consumed).

Visual water clarity was measured using a black disc. The measurement consists of measuring the horizontal distance that a black disc of standard size can be distinguished under water (Figure 3-12). Where the size of streams allow, black disc measurements are carried out routinely on a monthly basis across all HBRC SOE monitoring sites.

The ANZECC (2000) defined a minimum water clarity of 1.6 m for contact recreation waters. However, to maintain the foraging efficiency of drift feeding trout, Hay et al. (2006) recommended a minimum water clarity of 5 m for ‘outstanding trout fisheries’ and 3.5 m for ‘significant trout fisheries’.

Figure 3-12: Hawke's Bay Regional Council staff measuring black disc sighting distance in the field.

Apart from the 3 sites in the Waikaremoana area, water clarity in the Wairoa and Northern Coastal catchments was generally poor, with median black disc sighting distances at 7 of the 9 sites worse than (and sometimes considerably worse than) the ANZECC guideline for recreational waters of 1.6 m. Visual clarity in the Kopuawhara Stream and the Waikaretaheke Rivers is above the 1.6 m median water clarity guideline, but only by a relatively small margin (1.8 m and 2.1 m, respectively).

Sites in the Waikaremoana area had better water clarity, with median black disc sighting distances ranging from 2.5 m to 3.5 m (Figure 3-13). This was significantly better than the 1.6 m ANZECC guideline for recreational waters, but still less than the recommended 3.5 m for 'significant trout fisheries' and well below that recommended 5m for 'outstanding trout fisheries'.

Figure 3-14 shows turbidity measurements across SOE monitoring sites throughout the Wairoa catchment. Turbidity is a measure of the degree of light scattering of the water, which is caused by suspended particles present in the water column. The greater the concentration or number of suspended particles, the higher the turbidity. There is a direct, although not 'straight line', relationship between water clarity and turbidity: the higher the turbidity the lower the water clarity.

Unsurprisingly, the pattern of turbidity across the Wairoa and Northern Coastal catchments was similar to that of water clarity (black disc). The lowest median turbidity readings were measured at the three Waikaremoana area sites, the Waikaretaheke River and the Kopuawhara Stream SOE monitoring sites, with all 5 sites meeting the 'upland' ANZECC trigger value. Of the remaining sites, the Mangapoike River and the Wairau River main stem presented the highest median turbidity, far worse than the ANZECC 'lowland' trigger value of 5.6 NTU.

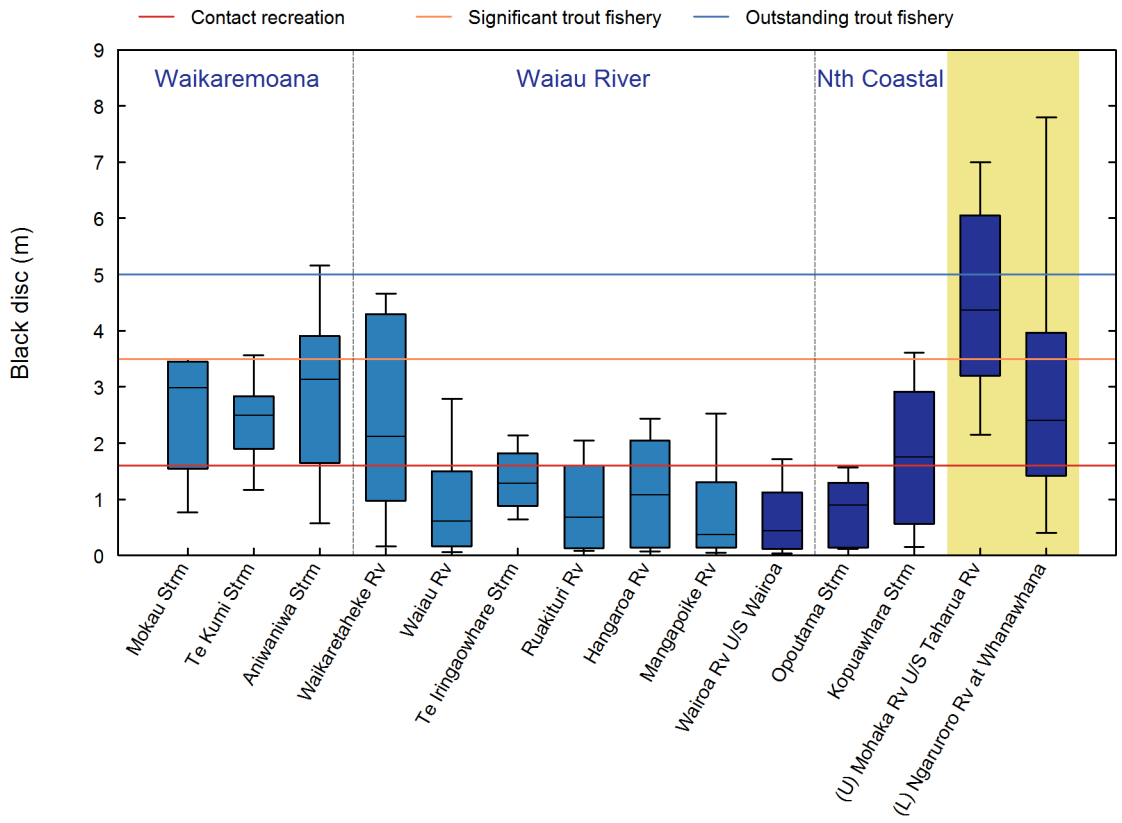


Figure 3-13: Water clarity measured as black disc horizontal sighting distance for SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison purposes. The blue line relates to the Hay and Hayes (2006) 'Outstanding trout fishery' limit; the orange line the 'Significant trout fishery' limit. The red line relates to the ANZECC (2000)/ HBRC RRMP (2006) recreational amenity limit.

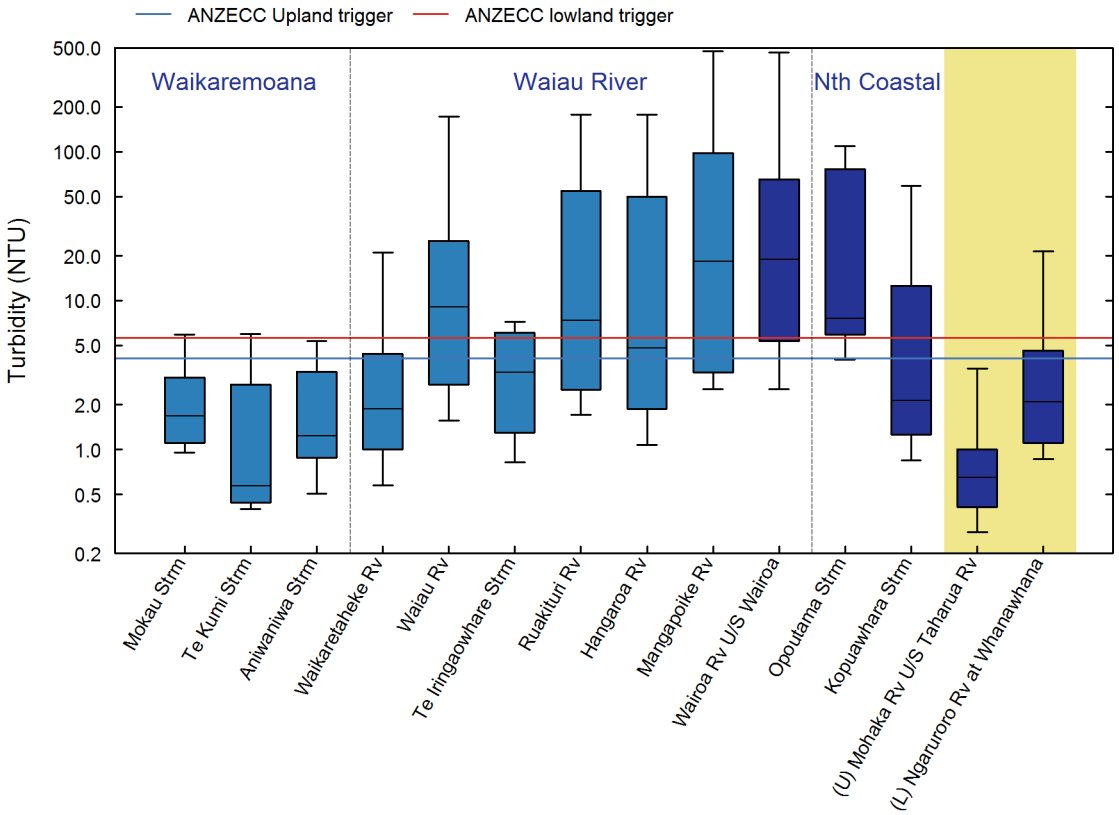


Figure 3-14: Water clarity measured as turbidity (NTU) for SOE monitoring sites. NTU stands for Nephelometric Turbidity Units. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison purposes. The blue line relates to the ANZECC (2000) 'Upland' turbidity trigger value; the red line the ANZECC (2000) 'Lowland' turbidity trigger value.

Trend analysis results for black disc clarity showed no changes (improvements or deterioration) in water clarity at any of the sites over the 10 year period ending in 2013 (Appendix C). Turbidity on the other hand showed a decline at 3 sites (the Te Kumi and Aniwhaniwha streams in the Waikaremoana area and Ruakituri River) and no change at the remaining SOE sites (Appendix C). The presence of temporal trends at 2 essentially undisturbed sites suggests that natural factors such as climatic patterns may at least in part explain the trends detected.

When compared with the rest of the region's SOE sites, it is interesting to note that Te Kumi Stream ranked first (best) in the region for median turbidity, with the Aniwhaniwha Stream 14th and the Mokau Stream 28th. These three sites also ranked within the top 20 in the region for black disc water clarity. The Waikaretaheke River and Kopuawhara Stream ranked within the top half for both water clarity and turbidity, but all the other sites were within the bottom quarter. In particular, the Wairoa River main stem, as well as the Waiau, Ruakituri and Mangapoike River and the Opoutama Stream ranked within the bottom 10 sites in the region for both water clarity and turbidity.

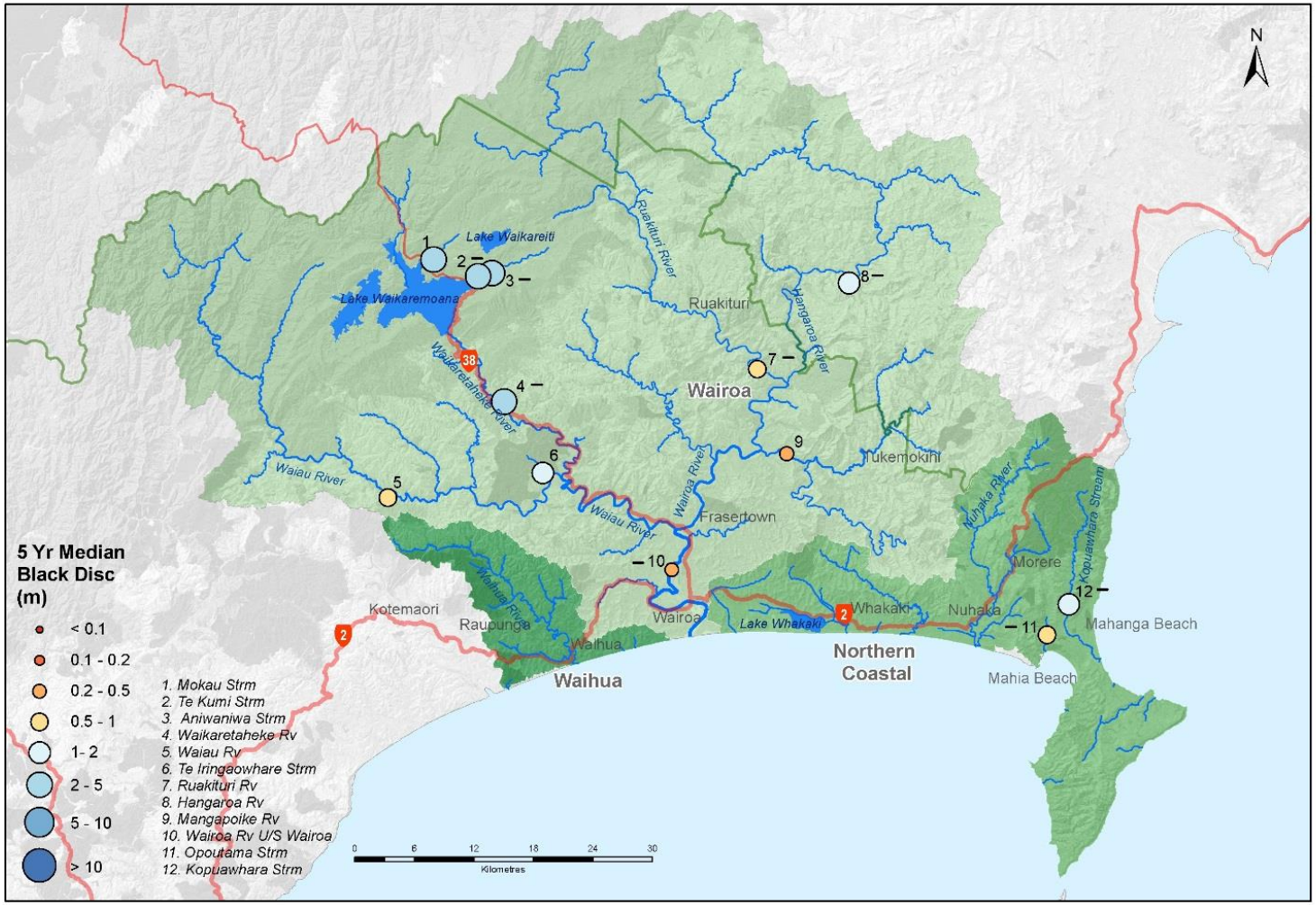


Figure 3-15: 5 year median and trends Black Disc (BD) water clarity at SOE monitoring sites. Arrows indicate direction of significant trends, with blue arrows for improvement and red arrows for deterioration of the variable in question. Sites with a horizontal dash did not exhibit a statistically significant trend. Trend results for sites 1, 5, 6 and 9 are not presented because they did not contain the required 8 years of record between 2004 and 2013.

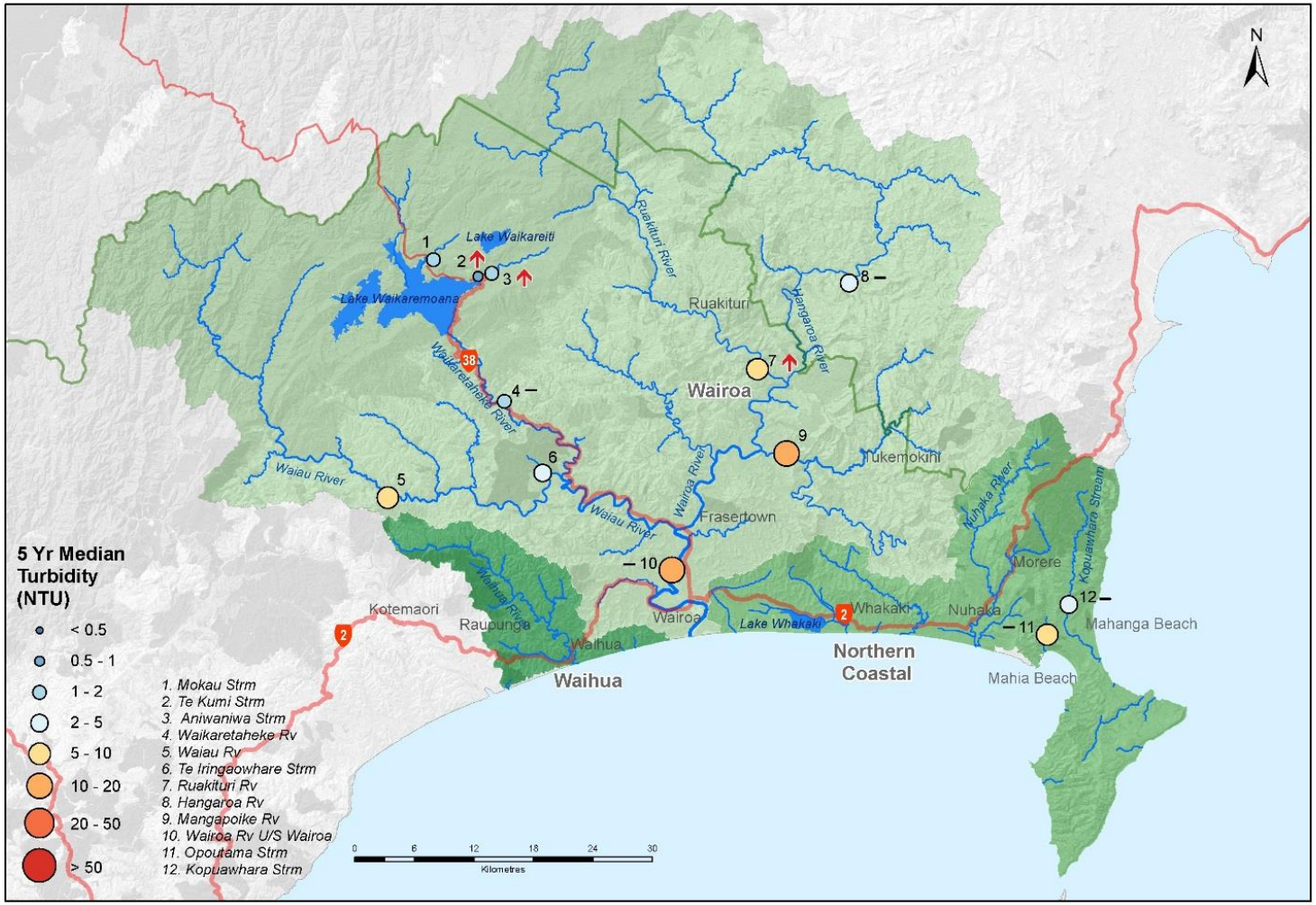


Figure 3-16: 5 year median and trends in turbidity at SOE monitoring sites. Arrows indicate direction of significant trends, with blue arrows for improvement and red arrows for deterioration of the variable in question. Sites with a horizontal dash did not exhibit a statistically significant trend. Trend results for sites 1, 5, 6 and 9 are not presented because they did not contain the required 8 years of record between 2004 and 2013.

3.6 Microbiological Water Quality Indicators – *E. coli*

Escherichia coli (commonly abbreviated *E. coli*) concentrations have been routinely monitored throughout the Wairoa catchment as an indicator of microbiological water quality. *E. coli* is a bacterium commonly found in the lower intestine of warm-blooded animals and is an important indicator of the presence of pathogens of faecal origin in the water. *E. coli* is used to assess the level of health risk to water users having direct contact with water.

The New Zealand microbiological water quality guidelines (MfE/MoH, 2003) define a three-mode risk management system for recreational freshwaters: Acceptable/Green (*E. coli* < 260/100 ml); Alert/Amber (*E. coli* 260/100 ml to 550/100 ml) and Action/Red (*E. coli* > 550/100 ml).

The red mode indicates an unacceptable level of health risk to contact recreational water users such as swimmers. These are single-value criteria, designed to trigger further investigation and additional sampling (amber mode) and positive action to identify the source(s) of contamination and warn recreational users (red mode). The amber mode (260 to 550 *E. coli*/100 ml) has been used in this report to assess suitability for swimming at all river flows.

Figure 3-17 show *E. coli* concentrations at monitoring sites across the Wairoa catchment. Median concentrations at all sites were better than both the 260 and the 550 *E. coli*/100 ml. Six of the 12 sites showed consistently low concentrations of *E. coli*, and were suitable for contact recreation at least 90% of the time. These sites are the 3 Waikaremoana sites, the Waikaretaheke River, the Waiau River and the Te Iringaowhare Stream. However, data indicate that the 7 remaining sites were unsuitable for contact recreation (i.e. in the red mode, above 550 *E. coli* /100 ml) at least 10% of the time, as evidenced by the top 'whisker' exceeding the orange line (550 *E. coli* /100 ml) on Figure 3-17. Among these, 4 sites were unsuitable for contact recreation at least a quarter of the time, as evidenced by the top of the 'box' exceeding the 550 *E. coli* /100 ml guideline on Figure 3-17.

Generally most sites showed no significant increase in *E. coli* numbers and that levels were therefore remaining low (Appendix C). The exception is the Aniwhaniwha Stream in Waikaremoana, which returned a significant increasing trend in *E. coli* (9.6% annual decrease). In spite of this increasing trend, *E. coli* concentrations at this site remained very low, well below the 'amber' alert level of 260/100 ml) meaning the risk for contact recreation is negligible.

When compared with other SOE sites across the region, sites in the Wairoa and Northern Coastal catchments showed *E.coli* rankings across the range of regional sites with the Te Kumi, Mokau and Aniwhaniwha Streams in Waikaremoana within the 7 best in the region and the Opoutama Stream 85th out of 96 sites. The Wairoa River main stem ranked 69th out of 96 regional sites (Appendix C).

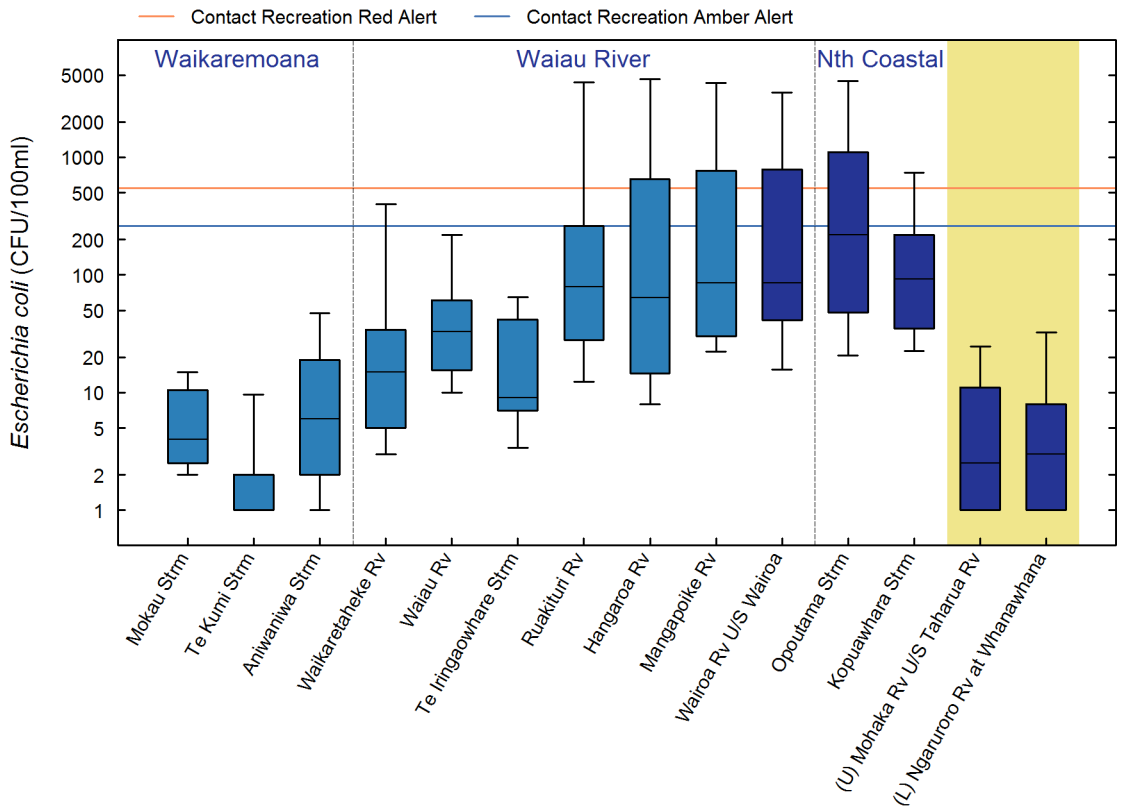


Figure 3-17: *Escherichia coli* concentrations (*E. coli*/100mL) at SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison purposes. The blue line relates to the MfE and MoH (2003) amber alert level. The orange line relates to the MfE and MoH (2003) red alert level.

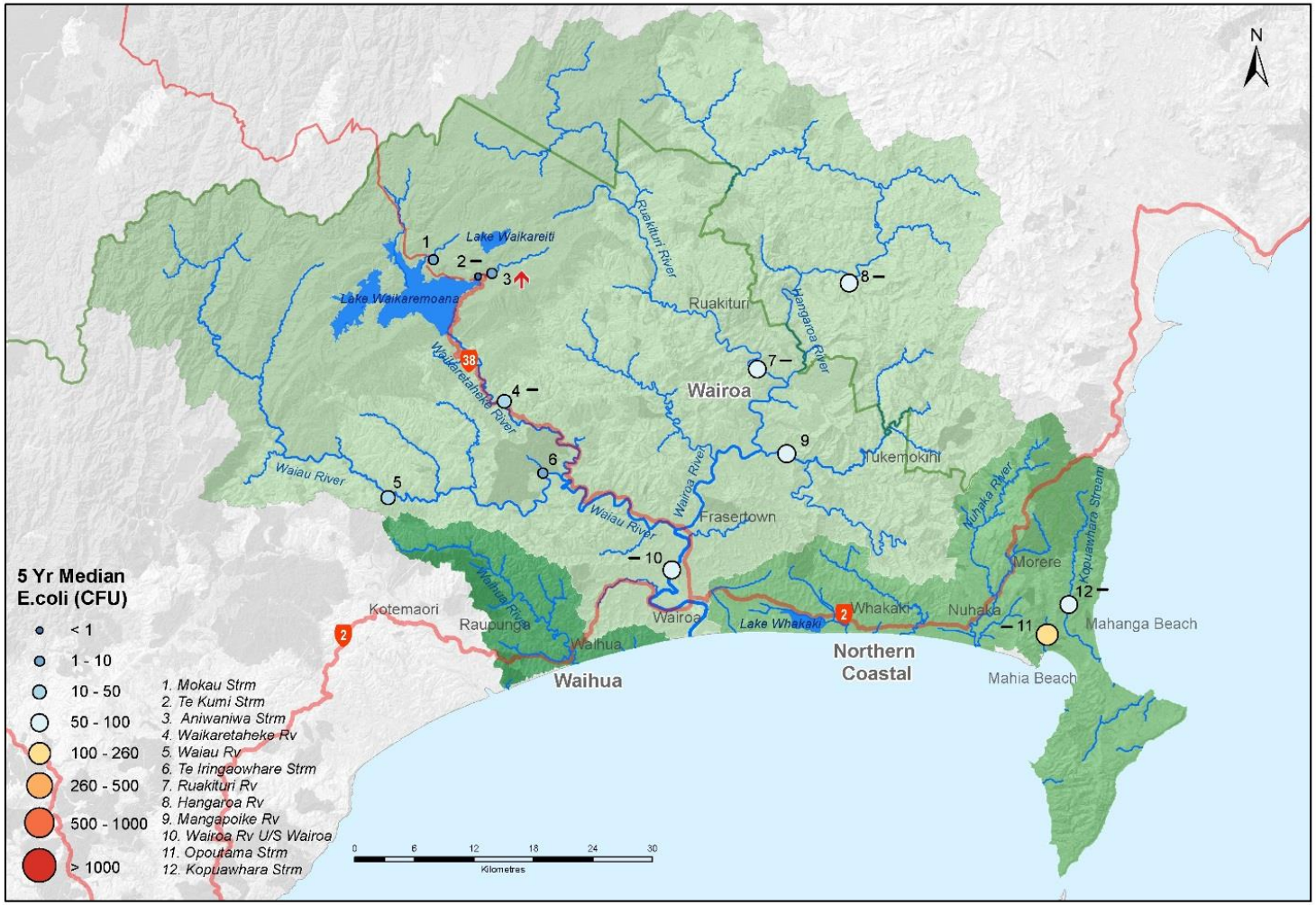


Figure 3-18: 5 year median and trends for *E. coli* concentrations at SOE monitoring sites. Arrows indicate direction of significant trends, with blue arrows for improvement and red arrows for deterioration of the variable in question. Sites without an arrow did not exhibit a statistically significant trend. . Trend results for sites 1, 5, 6 and 9 are not presented because they did not contain the required 8 years of record between 2004 and 2013.

3.7 Biological Indicators – Macroinvertebrate Community Index

Benthic macroinvertebrate communities are the assemblages of insects, crustaceans, worms and molluscs that live on the bottom of streams and rivers. Macroinvertebrate communities are commonly used as state indicators of water quality and ecosystem health. The macroinvertebrate community of a stream adjusts to conditions in the aquatic environment, including naturally induced changes and stressors affecting ecosystem health. The macroinvertebrates collected at a site are exposed to changes in conditions at that site for periods of months, to a year or even several years, depending on their life cycle. When under stress, the community composition changes as sensitive species are lost and more tolerant species appear, which leads to a community dominated by more tolerant species. Both human activities and natural changes such as drought and floods, or natural variations in stream bed substrate type and water temperature may affect macroinvertebrate communities. Assessing the composition of macroinvertebrate communities provides a long-term and integrated view of stream ecological health.

The Macroinvertebrate Community Index (MCI) was developed by Stark (1985) as a biomonitoring tool to assess stream health based on the presence or absence of certain invertebrate species. A higher MCI score indicates that more pollution 'intolerant' or sensitive species are present, which indicates better water quality. The MCI of a site can be used to assess the likely level of ecosystem degradation. The MCI also has the potential to provide an indication of the relative availability of trout food species since many taxa that score highly in the MCI are also important prey for drift feeding trout (Hay et al. (2006)). As an indicator the MCI signals changes in the stream environment that may warrant further investigation. One important limitation is that the MCI/QMCI were developed, and are particularly suited, as indicators of organic enrichment. They have since been shown to be useful indicators of the effects of fine sediment deposition, but are not reliable indicators of chemical (e.g. metals) contamination, or habitat size or quantity.

The MCI summarises many aspects of stream health including habitat and water quality and provides a single numeric value that can be affected by a wide range of factors. The MCI is the most commonly used indicator of macroinvertebrate community health in large-scale monitoring and reporting in New Zealand, such as State of the Environment monitoring and reporting undertaken by regional councils and other territorial authorities.

The quality classes indicated by the MCI score are included in Table 3-1.

Table 3-1: MCI quality classes as defined by Stark and Maxted (2007).

≥120	Excellent quality, clean water
100-119	Good quality, possible mild pollution
80 – 99	Fair quality, probable moderate pollution
< 80	Poor quality, probable severe pollution

Figure 3-19 and Appendix B summarise MCI scores for the Wairoa catchment SOE monitoring sites.

The three 'upland' sites in the Waikaremoana area have very high MCI scores (>125), better than, or comparable to those at the 'upland' reference site (Mohaka River). These scores are indicative of excellent water quality.

The MCI scores for the Waiau and Ruakituri rivers are comparable to those measured at the 'lowland' reference site (Ngaruroro River), and thus indicative of close to reference conditions. Somewhat lower MCI scores in the Waikaretaheke River are also indicative of good quality water. MCI scores in the Te Iringaowhare

and Kopuawhara Stream are generally around the 100 threshold, indicative of good water quality. The Hangaroa, Mangapoike and Opoutama Streams have generally lower MCI scores, indicative of fair water quality. The Wairoa River upstream of Wairoa is the only site with MCI scores indicative of poor water quality. However, the MCI was developed for freshwater habitats, and the tidal Wairoa site can be influenced by saltwater. This potentially confounding influence makes it difficult to interpret the MCI score for this site, but it is included here for reference purposes.

MCI scores, and their regional rankings, generally decrease from the upper parts of the catchment to the coast. Scores for the Waikaremoana sites range from 126 to 136, with the Te Kumi and Mokau Streams having the first and third highest MCI scores across the region, and the Aniwhaniwha Stream the 9th highest (Appendix C). MCI scores for the Waiau River sites and the Ruakituri River range from 100 to 116, and rank 20th and 24th out of 90 regional sites. The Mangapoike Stream (64th), Opoutama Stream (66th) and Wairoa River (78th) sites rank in the bottom third regionally.

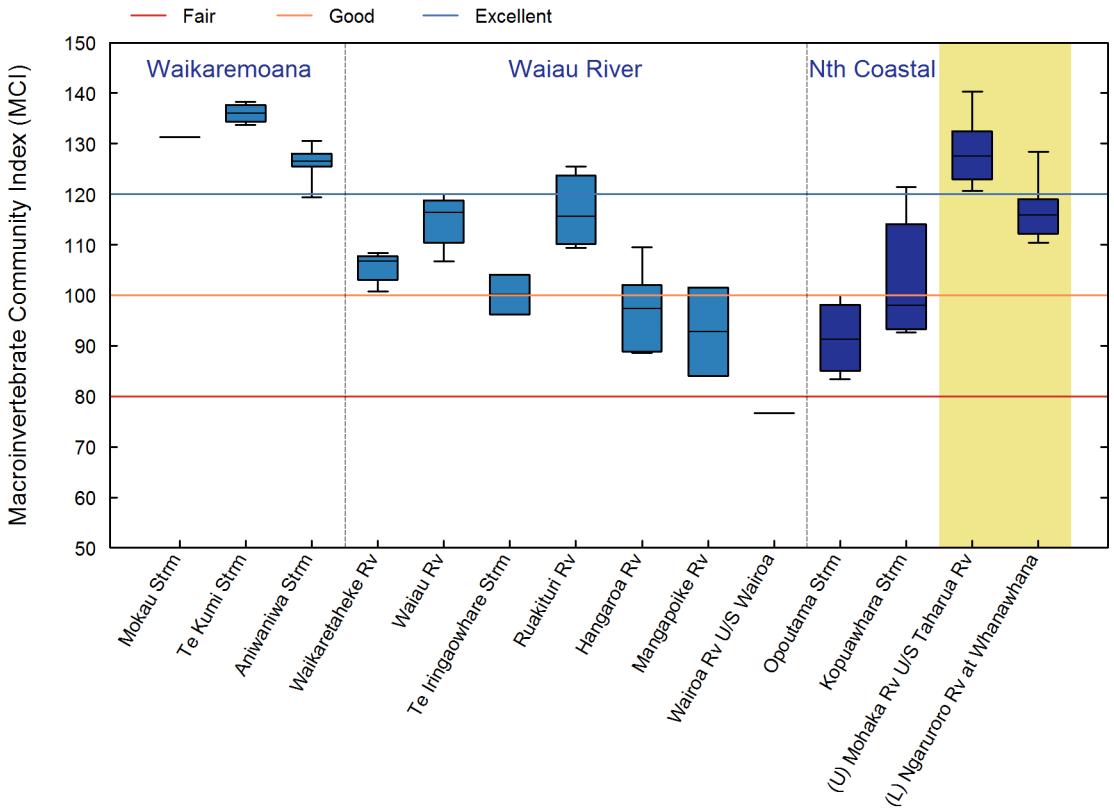


Figure 3-19: Median MCI scores measured at SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison purposes. The blue line relates to the Hay *et al.* (2006) 'Outstanding trout fishery' limit or the Stark and Maxted (2007) 'Excellent health' indicator level; the orange line the 'Significant trout fishery' limit or 'Good health' indicator level.

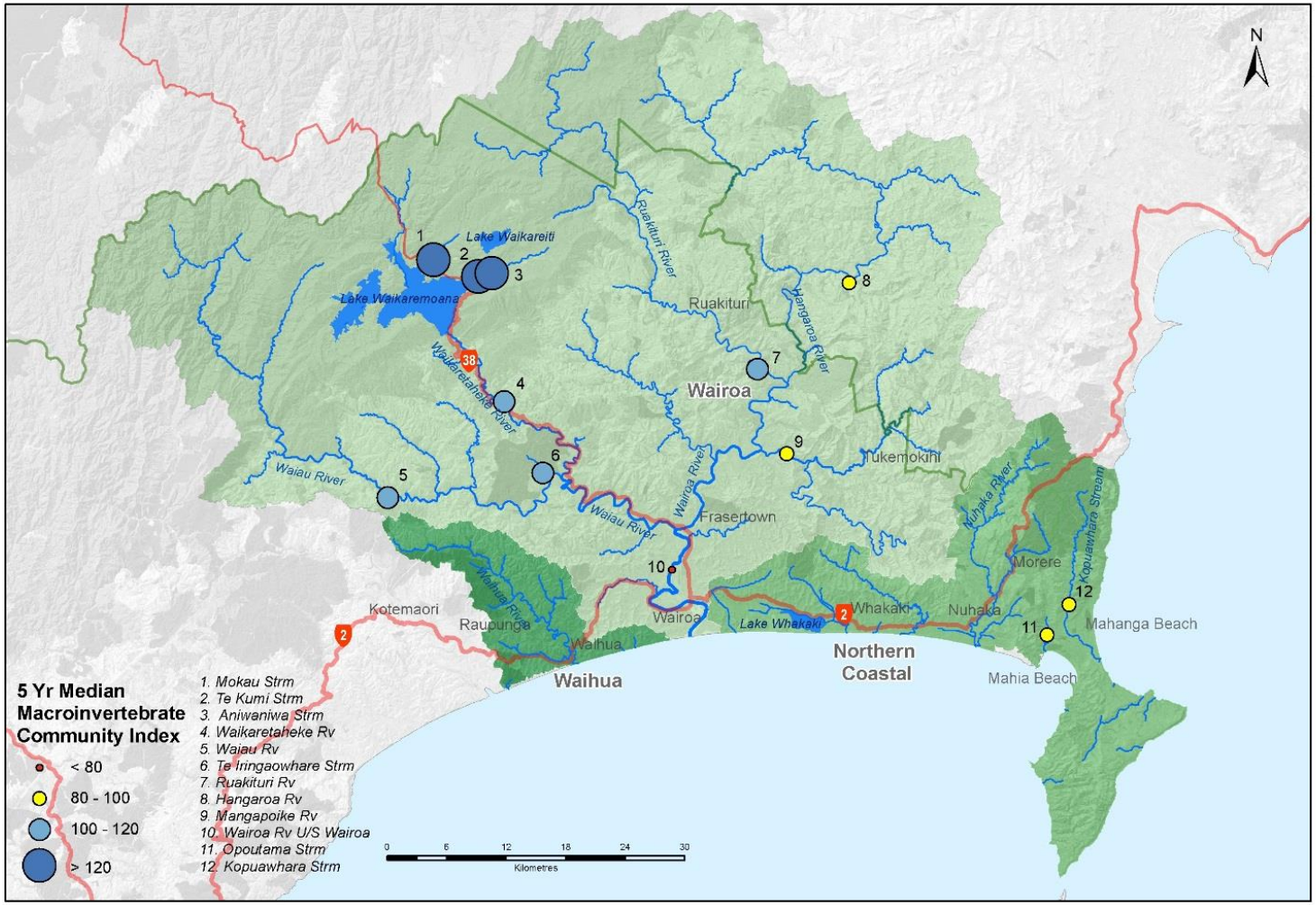


Figure 3-20: 5 year median Macroinvertebrate Community Index (MCI) levels at SOE monitoring sites.

3.8 Biological Indicators – Periphyton Biomass

Aquatic plants such as algae or periphyton are natural components of riverine environments. Periphyton is the brown or green slime or filamentous material coating stones, wood, or other stable surfaces in streams and rivers. It is a living community composed of a large number of different algae, bacteria and fungi species. As the main primary producers in streams and rivers, periphyton communities are fundamental to the functioning of aquatic ecosystems (Biggs and Kilroy, 2000). However, abundant growths can be problematic, affecting both human use of the river and ecological values (Mathieson et al., 2012). As a result, excessive growths are often termed "nuisance growths".

Excessive periphyton growth can have detrimental effects on benthic habitat quality and macroinvertebrates, which can in turn affect native fish and trout growth, since macroinvertebrates are a food source for native fish and trout. Excessive growth can also cause wide daily variation in pH and dissolved oxygen concentrations, which can also have detrimental effects on aquatic life (Biggs, 2000). This is distinct from the health risk posed by the benthic cyanobacteria *Phormidium* as it can produce toxins.

Excessively long filamentous algae and thick mats are unsightly and can also have a direct effect on the amenity/aesthetic values of a river, as well as on the quality of the fishing experience for the angler (by fouling fishing lures and lines) (Biggs, 2000, Wilcock et al., 2007).

Since periphyton and algae respond to changes in nutrient availability in streams, periphyton biomass or algal biomass limits are used to assess the effects of increased in-stream nutrient concentrations. Biggs (2000) developed the 'New Zealand Periphyton Guidelines', a document that identifies suitable limits of in-stream periphyton biomass and cover to support biodiversity and recreational amenity values. The guideline values are as follows:

- A maximum biomass of 120 mg chlorophyll *a*/m^2 of filamentous algae for the protection of aesthetic/recreation values, trout habitat and angling; and
- A maximum periphyton biomass of 50 mg chlorophyll *a*/m^2 for the protection of aquatic biodiversity values.

Periphyton biomass measured at SOE sites in the Wairoa catchment are shown in Figure 3-21. It should be noted that only a small number of monitoring results are available at each site (between 1 and 4). This means that the results obtained to date are unlikely to provide a robust representation of the range of conditions at each site, and that the calculated descriptive statistics (median, interquartile and interdecile ranges) should be taken with caution

Based on the data available, periphyton biomass at the Wairoa and northern catchments was generally low, and with a couple of exceptions, remained better than both the 120 mg/m^2 'recreational' and 50 mg/m^2 'biodiversity' thresholds.

Only 2 samples were available for the Waiau River, one with very low biomass (4 mg/m^2) and the other (108 mg/m^2) which was worse than the more stringent 50 mg chlorophyll *a*/m^2 for high aquatic biodiversity values, but was still better than the recreational/trout habitat guideline of 120 mg/m^2. Similarly, only 3 samples were available for the Ruakituri River, with one very high result (760 mg/m^2) and 2 low to moderate results (13 and 73 mg/m^2). Data at both sites were insufficient to provide a robust indication of periphyton biomass patterns at these sites, in particular if, or how often "nuisance" levels of periphyton growth occur.

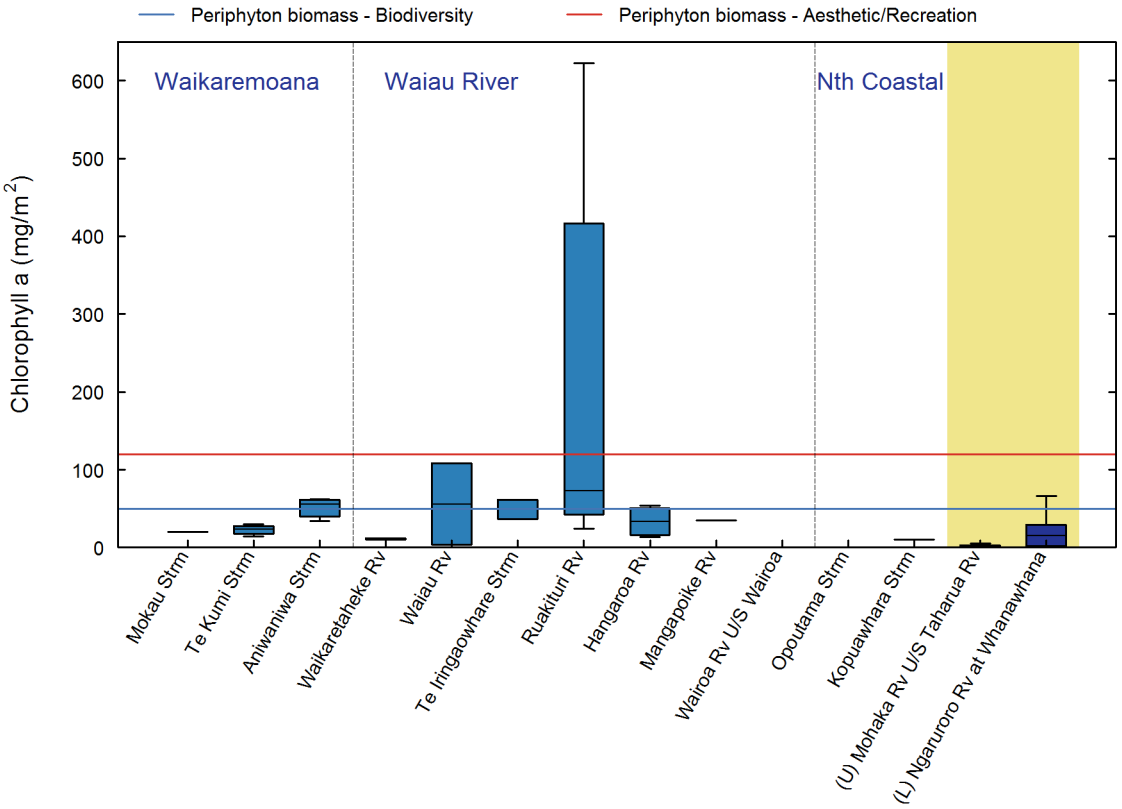


Figure 3-21: Periphyton biomass levels measured at SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison purposes. The blue line relates to the Biggs (2000) 'Biodiversity' protection limit; the red line the 'Recreational amenity' limit for filamentous algae.

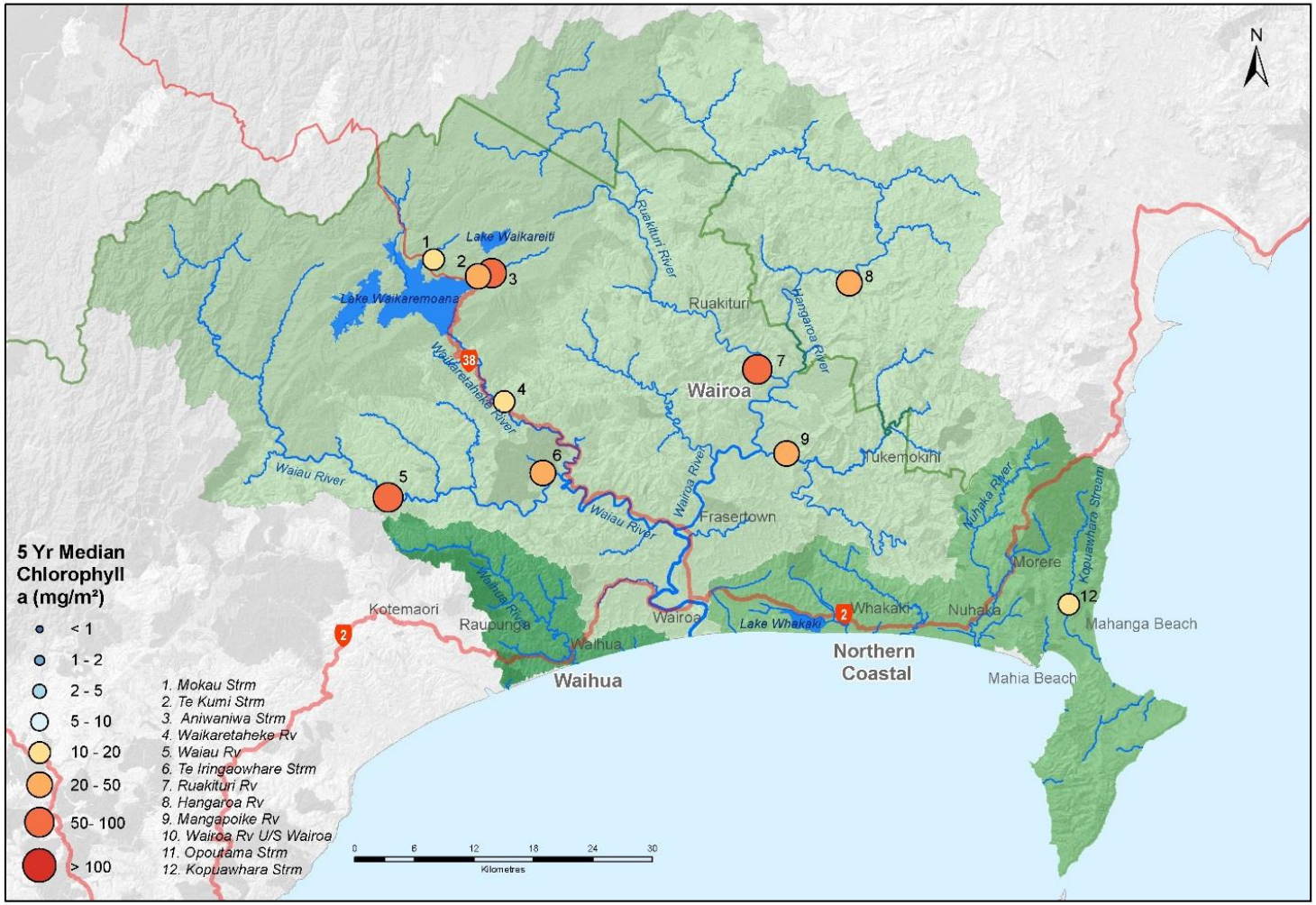


Figure 3-22: 5 year median Chlorophyll *a* (mg/m^2) levels at SOE monitoring sites.

3.9 Dissolved Oxygen

Dissolved oxygen is a vitally important component in the life supporting capacity of freshwater ecosystems. Humans absorb oxygen from the air through their lungs, while aquatic animals absorb oxygen from the water through their gills. Fish, invertebrates and other organisms are stressed when insufficient oxygen is dissolved in the water.

Various elements of aquatic systems either consume and/or produce oxygen. Plants and algae growing in the water produce oxygen as a by-product of photosynthesis. This supplements oxygen passively diffusing into the water from the atmosphere or being infused by turbulence or aeration in steeper or fast flowing streams, a process known as re-aeration (Figure 3-23). However, plants and algae also use oxygen when they respire, as do animals, fungus and bacteria living in the water. The breakdown of organic matter by aerobic micro-organisms also consumes oxygen and is termed the 'biochemical oxygen demand' (BOD). This process also occurs in the sediments and is termed the 'sediment oxygen demand' (SOD) as shown in Figure 3-23.

In slow-flowing un-shaded streams with high nutrient inputs, excessive growth of plants and algae can result in extremely high dissolved oxygen levels during the day (super-saturation) due to the oxygen production associated with photosynthesis, and/or low dissolved oxygen levels during the night or early morning, when these plants and algae consume more oxygen (respiration) than the re-aeration mechanism is capable of supplying. The low dissolved oxygen conditions mean there is little oxygen for fish and other organisms to use. Figure 3-23 is a schematic of the major processes that influence oxygen concentration in rivers and streams.

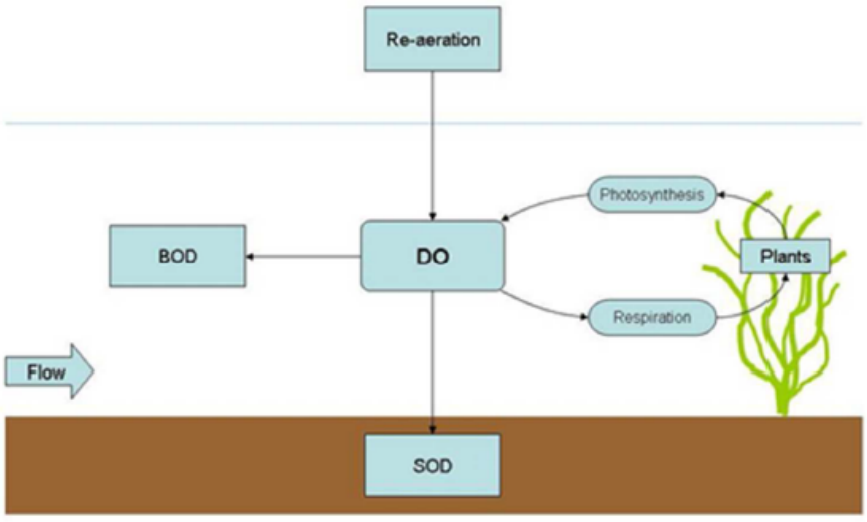


Figure 3-23: Schematic of the major processes influencing dissolved oxygen concentration in rivers. DO = dissolved oxygen; BOD = biochemical oxygen demand; SOD = sediment oxygen demand (Davies-Colley *et al.*, 2013).

A waterway with dissolved oxygen levels consistently below 5.0 mg/l is unable to support sensitive species and the ecological integrity of these systems is considered to be compromised. Dissolved oxygen levels that are greater than 8.0 mg/l are typically capable of supporting the full range of aquatic organisms (MfE, 2013).

Colder water can hold more oxygen than warmer water. Water warmer than 27°C cannot hold more than 8.0 mg/l of oxygen. Un-shaded systems that overheat during the day can also be depleted of oxygen.

The detrimental effects of increasing water temperature on trout are two-fold. First as water temperature increases, trout oxygen requirements also increase as they become more active (Elliott, 1994). At the same time, increasing water temperatures decrease the oxygen-carrying capacity of water.

Rainbow trout are more sensitive to low dissolved oxygen concentrations than most New Zealand native fish species (Dean and Richardson, 1999). Free swimming trout can tolerate DO concentrations of 5 to 5.5 mg/l, but the saturation should be at least 80% (Hay et al., 2006). The RMA Schedule 3 states that "*The concentration of dissolved oxygen shall exceed 80% saturation concentration*" in Class AE (Aquatic Ecosystems), F (Fishery) and FS (Fish Spawning) waters".

As stated previously, rainbow trout are typically more sensitive to low dissolved oxygen levels than native fish. Research into the oxygen requirements of native fish is limited, but Dean and Richardson (1999) demonstrated that 7 native species of fish were less sensitive to low levels of DO than juvenile rainbow trout. This included longfin elvers and juvenile torrentfish, which are the life stages of species expected to be particularly sensitive, given their preference for fast water habitats with typically higher DO concentrations. Landman et al. (2005) more recently found that the whitebait stage of inanga was more sensitive than juvenile rainbow trout (parr).

The contrast of inanga sensitivity between the studies of Landman et al. (2005) and Dean and Richardson (1999) may be related to experimental conditions that denied inanga the opportunity for aquatic surface respiration. When dissolved oxygen levels are low, inanga are able to obtain oxygen directly from the air, which allows them to survive in low oxygen waters (Urbina et al., 2011). Although more research into the effects of low oxygen on native fish communities would be beneficial, a common assumption in New Zealand (also made here) is that if conditions satisfy the oxygen requirements of the well-studied rainbow trout, they should also satisfy the requirements of native species (Dean and Richardson, 1999, Franklin, 2013).

The ANZECC (1992) guidelines recommend a minimum DO concentration of 6 mg/l and 80% saturation. Hay et al. (2006) suggests these limits should be seen as short-term exposure levels (i.e. occurring only for a few days), as data suggest that long-term exposure to DO levels of 6 mg/l can impair the growth of salmonids, which include trout species (CCME, 1997).

In river reaches where substantial upwelling of potentially low-oxygen or anoxic groundwater occurs, in-stream dissolved oxygen concentrations after mixing may also be low. Likewise, in wetland systems where bacterial respiration levels are high, oxygen levels can be very low. This is consequence of natural background conditions and is independent of human influences.

Figure 3-24 to 3-27 provide a summary of available dissolved oxygen saturation measured at SOE sites in the Wairoa and Northern Coastal catchments. Spot samples indicated high median concentrations (>9 mg/l) at all sites. The interdecile range indicates that DO concentrations were above 8 mg/l and DO saturations were above 80% at least 90% of the time at all sites except the Wairoa River, where the lower decile concentration was still >7 mg/l. Overall, the available data do not point to any significant issues associated with DO concentration or saturation at any of the sites.

It should be noted however that the data analysed in this report are limited to 'spot' measurements taken on site at the same time as water samples are collected. Such spot measurement data present severe limitations because generally they are collected during daylight, and are unlikely to include daily DO minima, which typically occur before dawn.

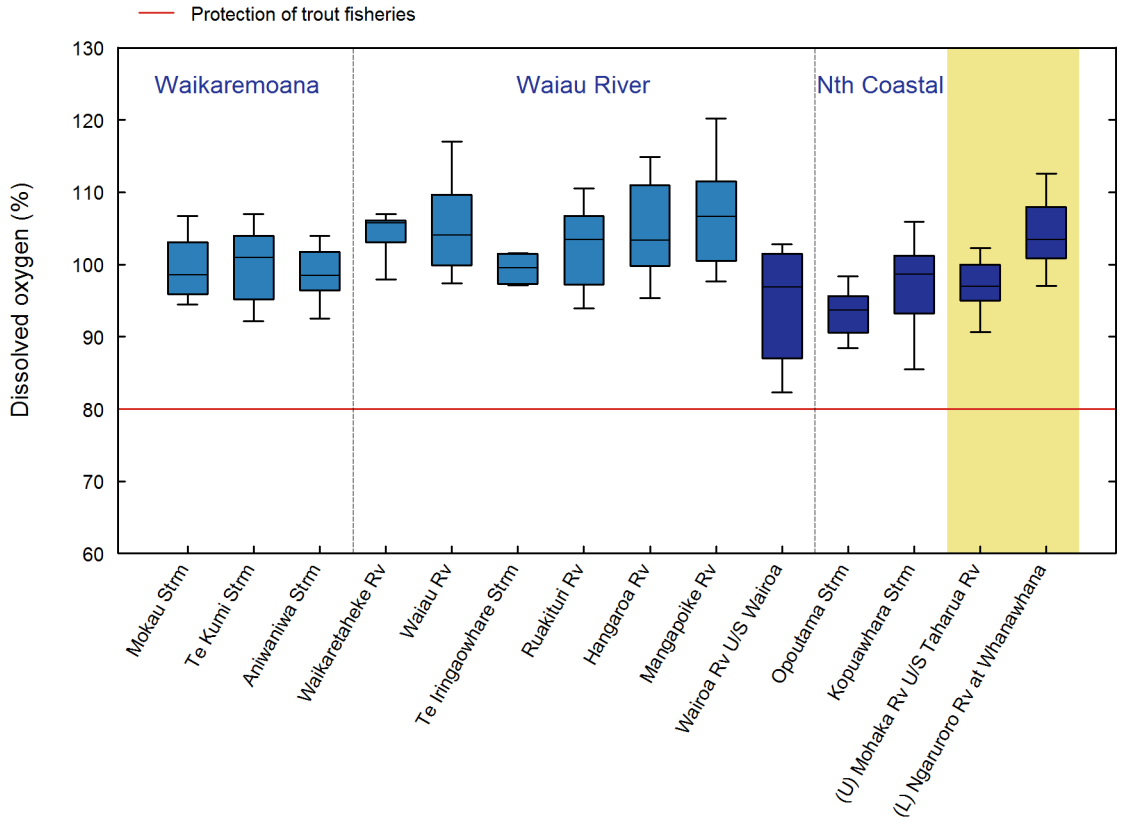


Figure 3-24: Dissolved oxygen % saturation at SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison purposes. The red line relates to the RMA (1991) Schedule 3 lower limit of 80% for supporting salmonid (trout) fisheries.

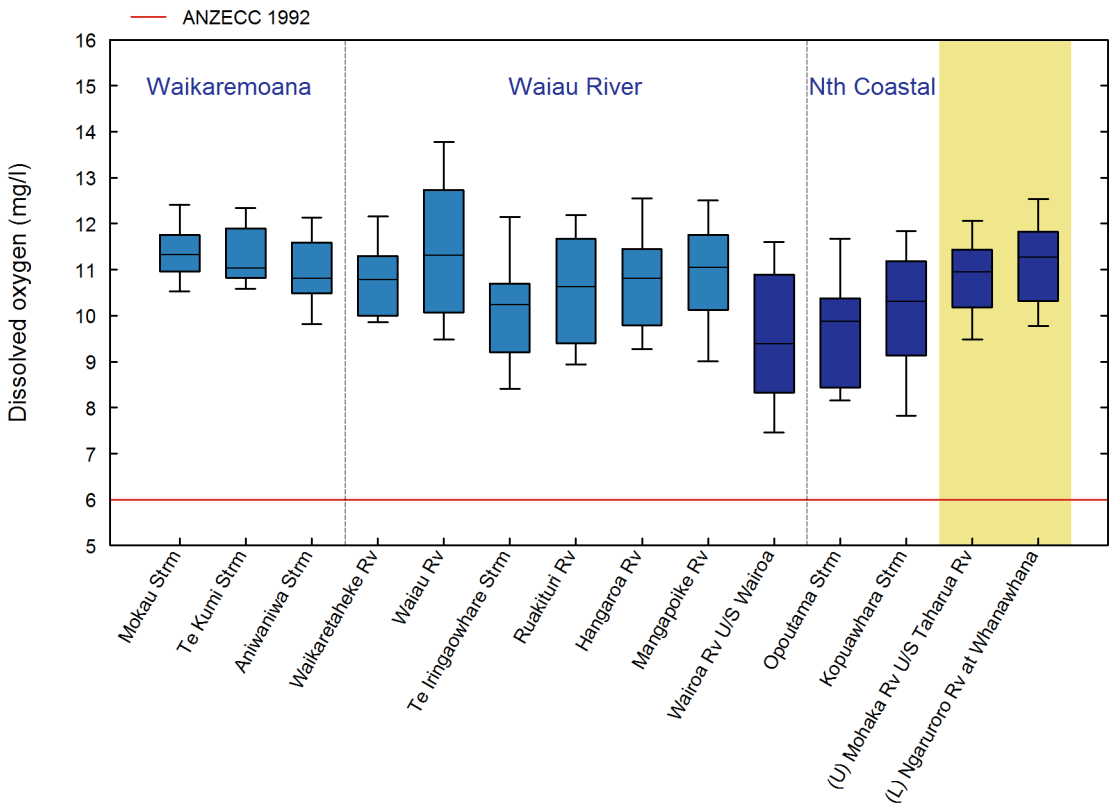


Figure 3-25: Dissolved oxygen concentrations at SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison purposes. The red line relates to the ANZECC (1992) guideline minimum DO concentration of 6 mg/l.

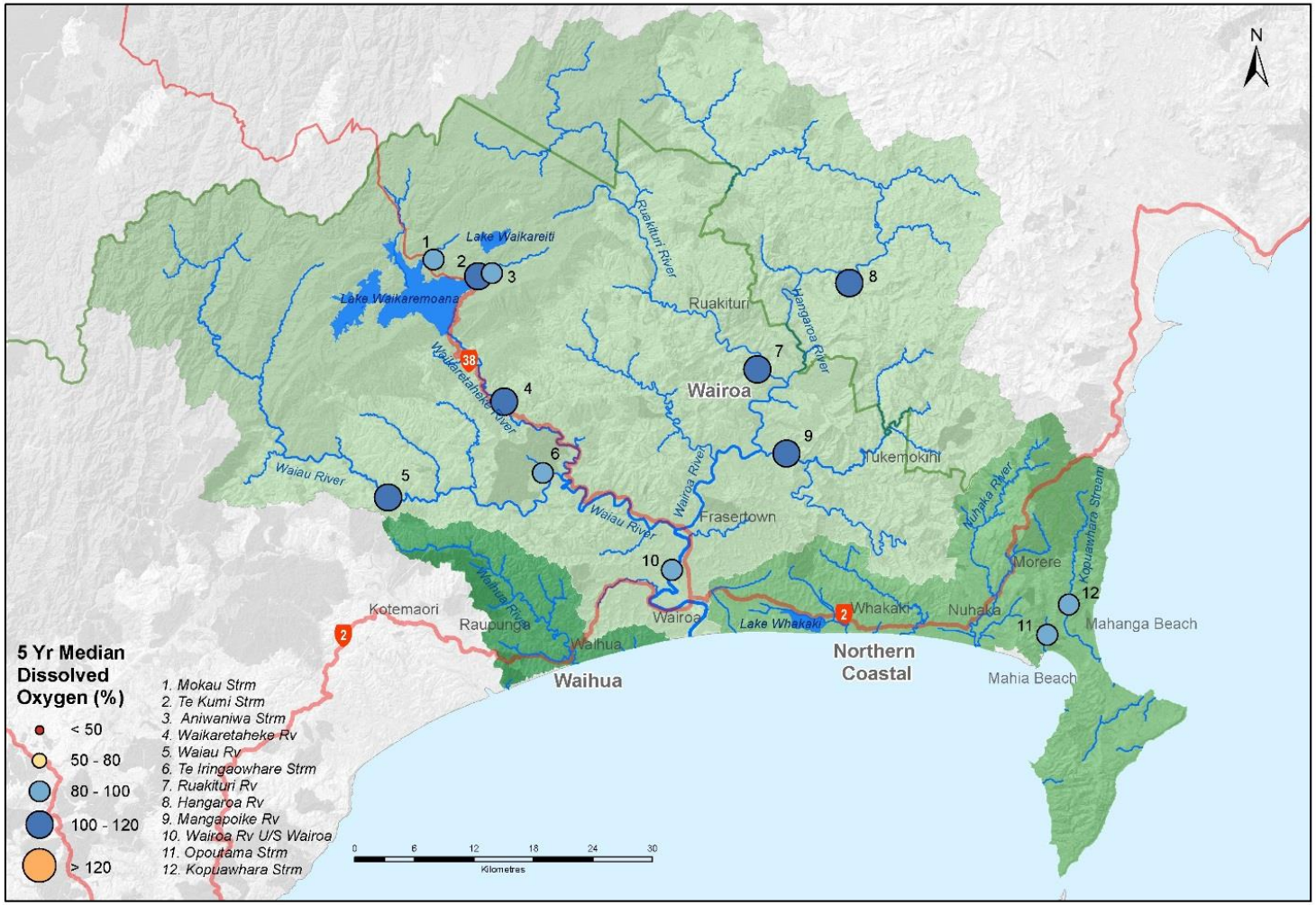


Figure 3-26: 5 year median dissolved oxygen % saturation levels at SOE monitoring sites.

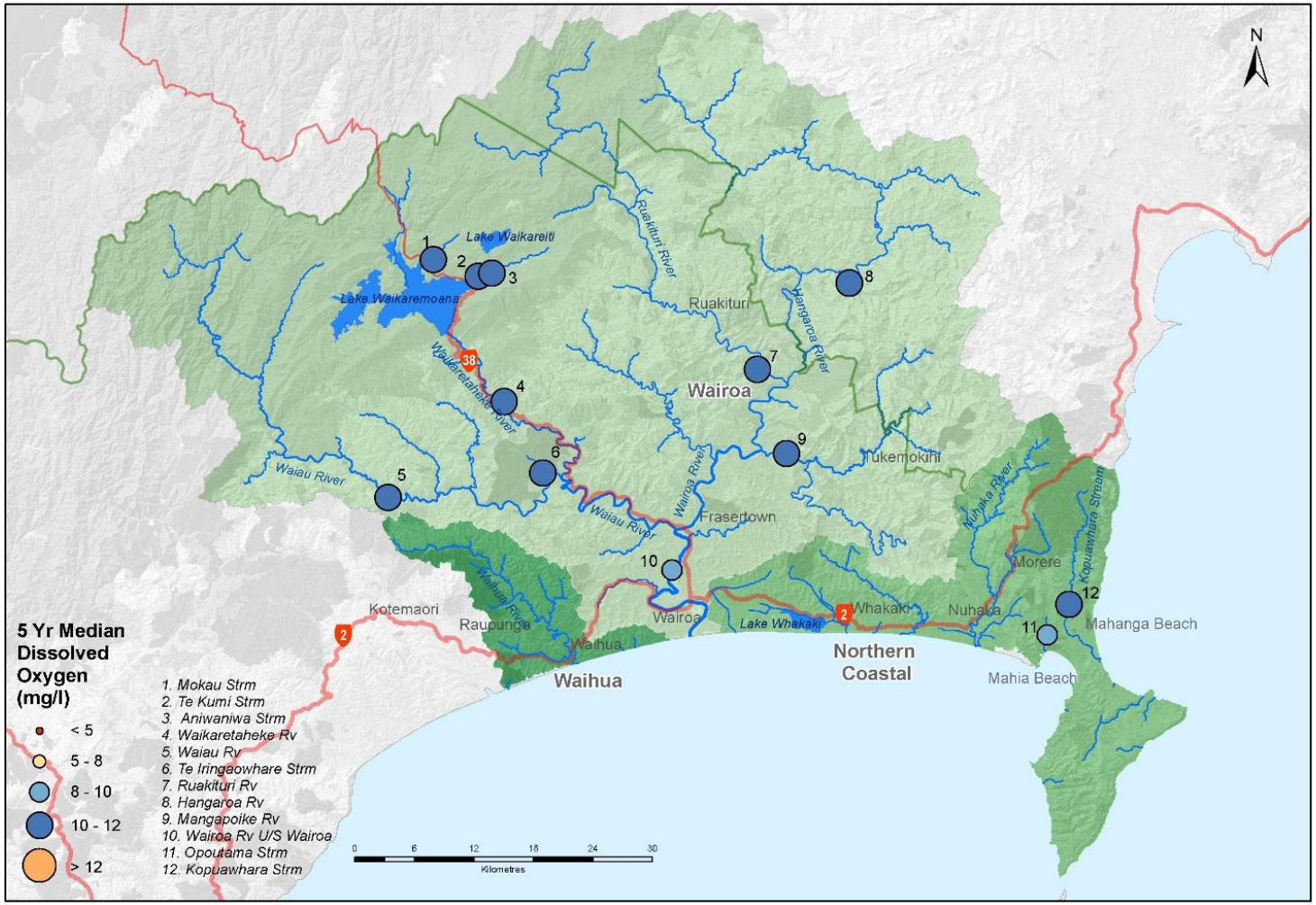


Figure 3-27: 5 year median dissolved oxygen concentration levels at SOE monitoring sites.

4 Assessment against NOF the NPS-FM (2014) attribute bands

The National Policy Statement for Freshwater Management 2014 (NPS-FM (2014)) sets out the objectives and policies for freshwater management under the Resource Management Act 1991. The NPS-FM (2014) came into effect on 1 August 2014 and is one of the initiatives developed as part of the Government's Fresh Start for Fresh Water programme of water reform.

The NPS-FW (2014) includes a National Objectives Framework (NOF) aimed at providing "an approach to establish freshwater objectives and national values, and any other values that: a) is nationally consistent; and b) recognises regional and local circumstances." (Objective CA1).

Appendix 2 of the NOF outlines a number of attribute tables. An attribute "is a measureable characteristic of freshwater, including physical, chemical and biological properties, which supports particular values". The NOF includes river-related attributes for periphyton (as number of chlorophyll-*a*/m^2), nitrate-nitrogen (mg/l), ammoniacal-nitrogen (mg/l), dissolved oxygen (mg/l – applicable downstream of point-source discharges only), and *E. coli* (number of *E. coli*/100ml - for secondary contact recreation only). Targets have been proposed within the NOF attributes that include 'national bottom lines' (D band) – thresholds of water quality attributes that good management should prevent waterways from crossing. A 'bottom line' is the minimum water quality level that all water bodies must achieve.

Each attribute table sets out the attribute and the unit in which it is to be measured (Appendix E). It then sets out A, B, C and D states and defines these in narrative and numeric terms, with A being the highest/best quality and D being below the national bottom line.

The data for DO and periphyton biomass could not be assessed against the attribute standards because there was insufficient monitoring data. Where adequate monitoring data existed for *E. coli*, nitrate and ammoniacal nitrogen concentrations, NOF attribute states were calculated at each monitoring site and are presented in tables in Appendix F, together with a general summary of overall bands in Table 4-1.

Table 4-1: NPS-FW (2014) NOF band summary for freshwater river attributes for Wairoa River and Northern Coastal catchment monitoring sites for the period 2009 to 2013.

Site		*E. coli*		Nitrate (toxicity)		Ammonia (toxicity)	
		Median	95th percentile	Median	95th percentile	Median	Maximum
1	Mokau Strm	A	A	A	A	A	A
2	Te Kumi Strm	A	A	A	A	A	A
3	Aniwhaniwha Strm	A	A	A	A	A	A
4	Waikaretaheke Rv	A	A	A	A	A	B
5	Waiau Rv	A	A	A	A	A	B
6	Te Iringaowhare Strm	A	A	A	A	A	A
7	Ruakituri Rv	A	<B	A	A	A	B
8	Hangaroa Rv	A	<B	A	A	A	A
9	Mangapoike Rv	A	<B	A	A	A	B
10	Wairoa Rv U/S Wairoa	A	<B	A	A	A	B
11	Opoutama Strm	A	<B	A	A	B	B
12	Kopuawhara Strm	A	B	A	A	A	B

4.1 Escherichia coli

Secondary contact is defined under the NPS-FM 2014 as 'people's contact with fresh water that involves only occasional immersion and includes wading or boating (except boating where there is a high likelihood of immersion)'. In areas where the community values activities that result in more frequent immersion in water such as swimming, white-water rafting or water skiing, the NPS-FW (2014) states that 'the risk of infection will be no more than moderate'. In these areas a more stringent 95th percentile value may be used to assess the risk of infection (NPS-FM 2014).

When considering overall median *E. coli* concentrations (i.e. calculated over the whole reporting period), all 12 sites fall within the A band. Median concentrations calculated over individual years also fall into the A band, except the Mangapoike River in 2010 (D band), the Opoutama Stream in 2010 (C band) and the Wairoa River in 2011 (C band) (refer to Appendix F).

The 95th percentile concentrations were only calculated on the basis of the whole dataset available (up to five years). Six out of the 12 sites fall within the A band, with the Kopuawhara Stream classified in the B band. The 95th percentiles calculated at the remaining 5 sites were all above 540 counts/100mL, which is above the minimum acceptable state for full immersion activities. These sites are unsuitable for primary contact, and are effectively D band if graded against primary contact recreation standards.

The narrative Attribute State for the A band classification means that 'people are exposed to a very low risk of infection from contact with water activities with occasional immersion and some ingestion of water'.

At the 5 sites graded A for primary contact recreation, people will be exposed to a low (<1%) risk of infection, and to a moderate risk (<5% risk) in the Kopuawhara Stream (graded B). Microbiological water quality at the other 6 sites do not meet the minimum acceptable state for primary contact recreation.

4.2 Nitrate (Toxicity) Attribute

The Nitrate (Toxicity) attribute helps assess chronic toxicity risk for aquatic animals. Chronic exposure typically includes a biological response of relatively slow progress and long continuance, often affecting a life stage (Hickey, 2013b). Such a response may be reduced growth rate or reduced gonad development, compared to optimum growth conditions (a control). It does not relate to acute toxicity effects that result in the death of an animal. The narratives for each nitrate attribute band are included in Appendix E. Further reading on nitrate toxicity and guidelines for New Zealand can be found in Hickey (2013b), Hickey (2013a).

Median and 95th percentile nitrate-nitrogen concentrations for all Wairoa catchment sites (where data are available) are in the A band overall, and when considering individual calendar years from 2009 to 2013 (Appendix F). The narrative Attribute state for this band states there is "unlikely to be effects even on sensitive species" (Appendix E). The A band reflects a low level of risk from nitrate toxicity to any aquatic species.

4.3 Ammonia (Toxicity) Attribute

The Ammonia (Toxicity) attribute helps assess chronic ammonia toxicity risk to aquatic animals. The attribute bands for a site are based on annual median and maximum concentrations (Appendix E).

Median ammonia concentrations for all Wairoa catchment monitoring sites, except the Opoutama Stream, are in the A band for years 2009 to 2013 (Refer Appendix F). The Opoutama Stream has a B grading consistently over the 4 years of record.

When considering annual maximums, only 5 sites retain the ”A” grade on every year of record, whilst 6 sites are graded B due to one or two annual exceedances of the annual maximum threshold. The Opoutama Stream is the only site consistently graded B on all individual years of the period.

The A band reflects an extremely low level of risk from ammonia toxicity for any aquatic species with a narrative that states ’no observed effect on any species tested. The B band narrative states that ammonia “starts impacting occasionally on the 5% most sensitive species’ (NPS-FW 2014; Appendix E).

Table 4-1: NPS-FW (2014) NOF band summary for freshwater river attributes for Wairoa River and Northern Coastal catchment monitoring sites for the period 2009 to 2013.

Site		*E. coli*		Nitrate (toxicity)		Ammonia (toxicity)	
		Median	95th percentile	Median	95th percentile	Median	Maximum
1	Mokau Strm	A	A	A	A	A	A
2	Te Kumi Strm	A	A	A	A	A	A
3	Aniwhaniwha Strm	A	A	A	A	A	A
4	Waikaretaheke Rv	A	A	A	A	A	B
5	Waiau Rv	A	A	A	A	A	B
6	Te Iringaowhare Strm	A	A	A	A	A	A
7	Ruakituri Rv	A	<B	A	A	A	B
8	Hangaroa Rv	A	<B	A	A	A	A
9	Mangapoike Rv	A	<B	A	A	A	B
10	Wairoa Rv U/S Wairoa	A	<B	A	A	A	B
11	Opoutama Strm	A	<B	A	A	B	B
12	Kopuawhara Strm	A	B	A	A	A	B

5 Compliance with HBRC Regional Resource Management Plan (2006) surface water quality and environmental guidelines

Two types of data summary have been prepared to compare existing water quality values to RRMP (2006) Environmental Guideline values:

(1) For samples collected at flows less than median flow, comparison of mean DO saturation, mean black disc clarity, mean DRP, and mean/max ammoniacal nitrogen (a toxicant) with RRMP (2006) guideline values (Table 5-1);

(2) For samples collected at flows less than median flow, the total number of samples taken and the number of samples being non-compliant with RRMP (2006) Environmental Guideline levels (Table 5-2).

Surface water quality compliance throughout the Wairoa River was very good when mean values (Table 5-1) were compared to Environmental Guideline values listed in the HBRC Regional Resource Management Plan (2006), with the exception of 3 sites not meeting the 1.6m black disc clarity guideline, and one site (the Te Iringaowhare Stream) exceeding the DRP guideline. It should be noted that the data at this site were limited to 3 samples, 2 meeting the guideline and the third one exceeding it, which is insufficient data to draw any firm conclusions.

When considering individual samples, dissolved oxygen saturation levels were fully compliant at all sites, except in the Wairoa River and the Kopuawhara Stream where individual DO readings fell below 80% saturation, on 2 out of 14 and 1 out of 12 sampling occasions respectively (Table 5-2).

Four sites had high levels of compliance with the 1.6m black disc clarity guideline, these being the Mokau, Aniwhaniwha, Te Iringaowhare and Kopuawhara Streams. Four sites met the guideline between 50 and 75% of the time. Interestingly, this includes the Te Kumi Stream, showing that the guideline can regularly be breached even under natural conditions in catchment dominated by tertiary sedimentary geology. The last 4 sites met the guideline less than half of the time. In particularly the Wairoa River and Opoutama Stream only met the guideline 13% of the time (Table 5-2). These sites showed no significant trends (improving or deteriorating) in black disc clarity (Section 3.4).

The DRP guideline of 0.015 mg/l was met most of the time (86% or more) at all sites, with the exception of the Te Iringaowhare Stream, where insufficient data were available (Table 5-2).

All sites are fully compliant for ammoniacal nitrogen (NH_4-N) with maximum concentrations being well below the RRMP (2006) guideline of 0.1 mg/l (see maximum concentrations in Table 5-1).

Overall, the RRMP guidelines are generally met in the Wairoa and Northern coastal catchments, with the exception of the visual clarity guideline. However, the guideline can be regularly exceeded under natural conditions in catchments dominated by soft-sediment geology.

Table 5-1: Comparison of measured dissolved oxygen, black disc, dissolved reactive phosphorus (DRP) and ammoniacal nitrogen levels with HBRC RRMP (2006) Environmental Guideline levels. The data summarised in the table are for samples taken between January 2009 and December 2013 during times that flows in the river were below median flow as prescribed in Policy 72 of the HBRC RRMP (2006). Green cells are compliant, red cells are non-compliant.

Site name	Mean DO (%)	Mean Black Disc Clarity (m)	Mean DRP (mg/l)	Mean / Max NH_4-N (mg/l)
Mokau Stream	100.7	3.10	0.003	0.005 / 0.005
Te Kumi Stream	98.9	2.18	0.007	0.006 / 0.010
Aniwaniwa Stream	99.2	3.48	0.003	0.006 / 0.013
Waikaretaheke River	106.0	3.28	0.003	0.005 / 0.005
Waiau River	105.0	1.81	0.009	0.006 / 0.015
Te Iringaowhare Stream	99.0	2.35	0.018	0.010 / 0.021
Ruakituri River	104.2	1.64	0.005	0.008 / 0.016
Hangaroa River	108.5	1.88	0.004	0.006 / 0.015
Mangapoike River	106.0	1.49	0.005	0.023 / 0.056
Wairoa River U/S Wairoa	90.8	0.97	0.006	0.009 / 0.035
Opoutama Stream	92.6	1.11	0.007	0.050 / 0.085
Kopuawhara Stream	94.6	2.91	0.002	0.006 / 0.014
HBRC RRMP (2006) guideline level	**80%**	**1.6 m**	**0.015 mg/l**	**0.100 mg/l**
Number of sites compliant	12/12	9/12	11/12	12/12
% site compliant	100%	75%	92%	100%

Table 5-2: Comparison of measured DO, BD clarity and DRP values with HBRC RRMP (2006) Environmental Guideline levels. The data summarised in the table are for samples taken between January 2009 and December 2013 at times that flows in the river were below median flow as prescribed in Policy 72 of the HBRC RRMP (2006). Sites with more than 80% of observations being compliant with guideline levels are shaded GREEN; between 50% and 80% compliant are shaded ORANGE; and less than 50% compliant are shaded RED.

Site name	*Dissolved Oxygen Saturation*			*Black Disc Clarity*			*Dissolved Reactive Phosphorus*		
	No. Samples	**No. Samples < 80% saturation**	**% Compliance**	**No. Samples**	**No. Samples < 1.6m**	**% Compliance**	**No. Samples**	**No. Samples > 0.015 mg/l**	**% Compliance**
Mokau Stream	9	0	100%	9	1	89%	8	0	100%
Te Kumi Stream	7	0	100%	9	3	67%	9	0	100%
Aniwhaniwha Stream	13	0	100%	14	1	93%	15	0	100%
Waikaretaheke River	4	0	100%	4	1	75%	4	0	100%
Waiau River	13	0	100%	13	7	46%	13	1	92%
Te Iringaowhare Stream	2	0	100%	1	0	100%	3	1	67%
Ruakituri River	13	0	100%	13	6	54%	14	2	86%
Hangaroa River	15	0	100%	16	4	75%	16	0	100%
Mangapoike River	11	0	100%	10	6	40%	11	0	100%
Wairoa River U/S Wairoa	14	2	86%	15	13	13%	16	1	94%
Opoutama Stream	6	0	100%	8	7	13%	8	0	100%
Kopuawhara Stream	12	1	92%	13	1	92%	14	0	100%

6 Summary and Conclusions

1. Microbiological water quality:

   All 12 monitoring sites fall into the NPSFM A Attribute State, indicating that water quality is generally suitable for secondary (e.g. wading, boating) contact recreation at all sites across the Wairoa and Northern Coastal catchments. In addition, 7 out of the 12 sites are suitable for primary contact recreation, with 6 sites presenting a low risk (NPSFM A grade), and one (the coastal Kopuawhara Stream) presenting a moderate risk (NPSFM B grade) to water users. The microbiological water quality is at times unsuitable for primary contact recreation at the remaining 5 sites, including the Wairoa River main stem upstream of Wairoa and some of its tributaries (Ruakituri, Hangaroa and Mangapoike Rivers) and the coastal Opoutama Stream. Microbiological water quality was generally stable over time across the catchment.

2. Dissolved Oxygen

   Data available do not point to any significant issues associated with DO concentration or saturation at any of the sites, although it should be noted that the data are limited to 'spot' measurements which are unlikely to capture the daily minima before dawn.

3. Water clarity and turbidity

   Water clarity is generally relatively low and turbidity relatively high in the Wairoa and Northern coastal catchments. Unsurprisingly, the sites within or close to the upper, forested reaches of the catchment in the Waikaremoana area have the best water clarity, and sites further down the catchment, in particular the Wairoa River main stem, the poorest water clarity. The Te Kumi stream does not meet the RRMP guideline of 1.6 m clarity approximately one third of the time, indicating that the guideline can regularly be breached even under natural conditions in a catchment dominated by tertiary sedimentary geology.

   Compared with other SOE sites in the region, most sites rank relatively poorly, with half of the Wairoa and Northern Coastal catchment sites in the bottom 25% of the Hawke's Bay region for water clarity and turbidity.

   No significant trends were detected in water clarity through time, but declining trends in turbidity (i.e. an increase over time) were detected at 3 sites, including the Te Kumi and Aniwhaniwha Stream in the Waikaremoana area. The presence of trends through time at 2 essentially undisturbed sites signals that natural factors such as climatic patterns may at least in part explain the trends detected.

4. Toxicants

   Concentrations of nitrate nitrogen and ammoniacal nitrogen are always low at all sites, far better than both trigger or guideline values indicating that the risk of toxic effects from either nitrate or ammonia can be considered low at all SOE monitoring sites in the Wairoa and Northern Coastal catchments. All sites fall within the NPSFM A Attribute State for nitrate and A or B Attribute State for ammonia. Improving trends (i.e. a reduction over time) in nitrate concentrations were detected at 3 sites, including 2 sites in the Waikaremoana area and the Northern Coastal site on the Opoutama Stream. The presence of trends through time at 2 undisturbed sites signals that natural factors such as climatic patterns may at least in part explain the trends detected, although other factors such as changes in agricultural practices may also have played a role in the Opoutama catchment.

5. Nutrients

Nitrogen concentrations, both Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN), were generally relatively low and better than the ANZECC trigger values in the Wairoa and Northern Coastal catchments. The highest DIN concentrations were measured in the Opoutama Stream, followed by the Mangapoike River.

Similarly, phosphorus concentrations, both Total Phosphorus (TP) and Dissolved Reactive Phosphorus (DRP), were generally relatively low and better than the ANZECC trigger values and RRMP guidelines, except in the Te Iringaowhare Stream, a small tributary of the Waiau River.

Compared with other SOE sites in the region, the majority of Wairoa catchment sites rank highly, with 9 of the 12 sites in the top third of sites in the region for both DIN and DRP.

Nutrient concentrations were generally stable over time across the study area, although improvements in both DIN and DRP were detected in the Te Kumi Stream (in the Waikaremoana area) and Opoutama Stream. Significant improvements in TN and TP were also detected, but only in the Te Kumi Stream. As already indicated above, the presence of temporal trends at two essentially undisturbed sites signals that natural factors such as climatic patterns may at least in part explain the trends detected, although other factors such as changes in agricultural practise may also have played a role in the Opoutama catchment.

DIN/DRP ratios indicate that, with 4 exceptions (the Waiau and Mangapoike Rivers, and the 2 Northern Coastal streams), most sites in the Wairoa catchment have nutrient ratios indicative of co-limited conditions. Given that concentrations of both DIN and DRP are low to moderate at these sites, this means that both nutrients are likely to partially limit periphyton growth. The more elevated DIN/DRP ratios indicate a dominance of P-limited conditions in the Mangapoike River and the 2 Northern Coastal streams. By contrast, the nutrient ratios indicate that the Waiau River is dominated by N-limited conditions, this being the result of very low DIN but moderately elevated DRP concentrations.

6. Biological indicators

MCI (macroinvertebrate community index) scores at 5 of the twelve sites (the 3 Waikaremoana area sites, the Waiau and Ruakituri Rivers) are comparable with those measured at 'reference' sites, and indicative of reference or close to reference conditions. Scores at 3 additional sites (Waikaretaheke River, Te Iringaowhare and Kopuawhara Stream) are indicative of generally good water quality. The Hangaroa, Mangapoike and Opoutama Streams have generally lower MCI scores, indicating fair water quality. The Wairoa River upstream of Wairoa is the only site with MCI scores indicating poor water quality, although interpretation of the MCI score at this site is complicated because the site is influenced by the tides.

Periphyton is the brown or green slime or filamentous material coating stones, wood, or other stable surfaces in streams and rivers. It is a natural component of riverine environments, however, excessive ('nuisance') growths can affect both human use of the river and ecological values.

Periphyton biomass levels across the catchment are generally low, and with a couple of exceptions, are below both the 120 mg/m^2 'recreational' and 50 mg/m^2 'biodiversity' thresholds. Data at the 2 sites where median biomass exceeds 50 mg/m^2 (Waiau and Ruakituri Rivers) are insufficient to provide a robust indication of periphyton biomass patterns at these sites, in particular if, or how often "nuisance" levels of periphyton growth occur.

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Appendix A Land Cover (LCDB4) and Land Use Capability (LUC) descriptions

Table A1: LCDB4 land cover categories and summary principle land cover categories The principal landcover categories have been adapted from Thompson et al. 2003 and Walker et al. 2007. (Thompson S, Grüner I, Gapare N, Ministry for the Environment 2003. New Zealand Landcover Database Version 2, Illustrated Guide to Target Classes. Walker S, Ciegaard E, Grove P, Lloyd K, Myers S, Park T, Porteous T 2007. Guide for the Users of the Threatened Environment Classification Version 1.1, August 2007. Landcare Research Manaaki Whenua (p 35).

Principal landcover category	LCDB4 Landuse Category Name_2012	Comment
Native Cover	Broadleaved Indigenous Hardwoods Depleted Grassland Fernland Herbaceous Freshwater Vegetation Herbaceous Saline Vegetation Indigenous Forest Manuka and/or Kanuka Matagouri or Grey Scrub Sub Alpine Shrubland Tall Tussock Grassland	These LCDB4 land use categories have all been classified as indigenous (Walker et al. 2007). The assessment whether a land cover class is indigenous or exotic is based on a subjective examination of vegetation cover and whether it is mainly exotic or indigenous. Many of the cover classes, such as depleted grassland, contain a mixture of exotic and indigenous species (Walker et al. 2007). For the purposes of this report, depleted grassland has been classified as indigenous.
Plantation forestry	Deciduous Hardwoods Exotic Forest Forest - Harvested	As well as including willow and poplar species, deciduous hardwoods have been included in this category, as this class, also includes planted exotic hardwoods (Thompson et al. 2003)

High producing grassland	High Producing Exotic Grassland	Land that is intensively managed and grazed for wool, lamb, beef, dairy or deer production.
Low producing grassland	Low Producing Grassland	Exotic and indigenous grasslands, grazed for wool, sheep or beef. Usually found on steep hill country.
Orchards/Vineyards	Orchard, Vineyard or Other Perennial Crop	Land used for perennial vines, areas cultivated less than annually and tree crops such as pip, stone and citrus fruit, olives and nuts as well as climbing plants such as berries, and kiwifruit.
Cropping	Short-rotation Cropland	Includes land used for cereal, root, annual seed and annual vegetable crops, hops, strawberries, flower crops and open ground nurseries.
Urban areas	Built-up Area (settlement) Transport Infrastructure Urban Parkland/Open Space Surface Mine or Dump	Surfaces with high run off rates. Includes land associated with hard urban manmade surfaces, infrastructure and mown grass, and bare surfaces associated with gravel pits, quarries and dumps.
Unaccounted, <1% of total catchment area	Estuarine Open Water Gorse and/or Broom Gravel or Rock Lake or Pond Landslide Mixed Exotic Shrubland River Sand or Gravel	These categories have not been included in the land use summary tables in this report. They account for less than 1% of total catchment area and are perceived to have little or no contribution to eutrophication of water bodies.

Table A2: LUC Class descriptions (Lynn IH, Manderson AK, Page MJ, Harmsworth GR, Eyles GO, Douglas GB, Mackay AD, Newsome PJF 2009. Landuse Capability Survey Handbook - a New Zealand handbook for the classification of land, 3rd ed. Hamilton, AgResearch; Lincoln, Landcare Research; Lower Hutt, GNS Science. P8-11, 48-75).

Class	LUC Description
Class 1	Versatile arable land for multiple land uses
Class 2	Arable land with only slight physical limitations to land uses
Class 3	Arable land with moderate physical limitation to land uses
Class 4	Arable land with severe physical limitation to land uses
Class 5	High-producing land for pasture or forestry with minimal physical limitations
Class 6	Moderate-producing pastoral or forestry with moderate physical limitations
Class 7	Low-producing land for pastoral or forestry with severe physical limitations
Class 8	Severe to extreme physical limitations, unsuitable for arable, pastoral or forestry land uses
River /Town/Lake	River open water and urban areas unsuitable for arable land uses, pasture or forestry.

Appendix B Summary statistics by flow

All flows

All flows																					
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO_3-N (mg/l)	NH_4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (µS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (^oC)	Chla (mg/m^2)	MCI (Unit)	% EPT taxa
Aniwaniwa Strm	Minimum	0.4	1.5	1	0.3	0.002	0.002	0.055	0.008	2	0.001	0.005	8.6	88	39	7.4	1.6	13.9	5.4	25.7	115.4	58.1
	5%'ile	0.4	1.5	1	0.3	0.002	0.002	0.055	0.013	4	0.001	0.005	9.7	91	46	7.5	1.7	14.0	6.0	no data	no data	no data
	25%'ile	0.9	1.5	2	1.6	0.005	0.002	0.055	0.020	6	0.009	0.005	10.4	96	71	7.8	2.3	39.0	7.7	39.8	123.0	59.5
	Median	1.2	1.5	6	3.1	0.007	0.002	0.117	0.027	11	0.015	0.005	10.8	99	100	8.0	2.6	43.0	9.8	55.9	126.5	62.5
	75%'ile	3.5	3.0	21	3.9	0.012	0.004	0.142	0.032	14	0.020	0.005	11.6	102	123	8.1	4.2	49.0	12.7	61.2	129.1	69.0
	95%'ile	15.1	28.0	283	6.1	0.032	0.006	0.250	0.064	25	0.051	0.014	12.6	105	143	8.4	9.3	60.0	15.5	no data	no data	no data
	Maximum	18.2	36.0	1100	6.4	0.039	0.008	0.283	0.068	34	0.056	0.017	12.9	106	144	8.5	9.3	61.0	17.1	64.3	132.2	72.0
	Mean	2.9	4.4	58	3.0	0.010	0.003	0.113	0.029	11	0.017	0.006	10.9	99	97	8.0	3.8	40.4	10.4	50.5	125.5	64.1
	Std. Dev.	4.2	7.9	205	1.7	0.009	0.002	0.057	0.014	7	0.013	0.003	0.9	4	30	0.3	2.5	14.5	3.2	17.0	6.2	5.8
	Count	27	30	29	29	30	30	29	29	29	28	30	29	27	29	28	13	14	31	4	5	5
Hangaroa Rv	Minimum	0.7	1.5	1	0.0	0.007	0.002	0.120	0.012	1	0.001	0.005	7.7	89	139	7.8	3.4	60.0	6.0	9.6	88.3	33.3
	5%'ile	0.9	1.5	7	0.0	0.008	0.002	0.129	0.014	3	0.001	0.005	8.7	93	160	7.9	3.4	61.2	7.3	no data	no data	no data
	25%'ile	1.9	1.5	15	0.1	0.013	0.002	0.258	0.015	7	0.004	0.005	9.8	100	229	8.1	4.1	78.8	11.0	16.3	88.8	36.5
	Median	4.8	4.3	64	1.1	0.024	0.005	0.355	0.064	10	0.050	0.005	10.8	103	263	8.5	5.0	108.0	13.8	33.0	97.3	45.0
	75%'ile	50.0	91.5	650	2.1	0.092	0.015	0.710	0.220	16	0.202	0.012	11.5	111	285	8.7	6.8	116.3	20.4	50.7	105.1	46.6
	95%'ile	325.9	693.0	8510	2.8	0.456	0.028	1.499	0.471	57	0.445	0.027	13.4	121	317	8.9	12.6	131.9	24.8	no data	no data	no data
	Maximum	730.0	750.0	14000	3.3	0.560	0.034	2.120	0.875	93	0.850	0.028	13.4	133	324	9.1	12.9	134.0	25.0	58.5	114.5	50.0
	Mean	66.3	100.7	1403	1.1	0.078	0.009	0.544	0.145	16	0.130	0.009	10.7	105	255	8.4	5.9	100.8	15.0	33.5	98.2	42.3
	Std. Dev.	148.1	195.8	3188	1.0	0.127	0.009	0.467	0.186	19	0.183	0.007	1.4	9	45	0.3	2.8	22.4	5.7	21.5	10.8	6.7
	Count	28	29	28	29	29	29	28	28	28	28	29	29	28	29	29	12	13	30	4	5	5
Kopuawhara Strm	Minimum	0.6	1.5	1	0.1	0.002	0.002	0.055	0.014	3	0.001	0.005	7.0	79	110	7.3	2.0	37.0	7.4	10.5	92.2	33.3
	5%'ile	0.6	1.5	18	0.1	0.002	0.002	0.055	0.014	7	0.001	0.005	7.4	84	123	7.6	2.0	39.3	7.4	no data	no data	no data
	25%'ile	1.2	1.5	35	0.6	0.005	0.002	0.127	0.019	9	0.006	0.005	9.1	93	192	7.9	2.3	68.0	10.4	no data	93.0	34.6
	Median	2.1	1.5	92	1.8	0.009	0.002	0.261	0.171	32	0.159	0.005	10.3	99	264	8.0	2.9	90.0	12.5	10.5	98.0	38.9
	75%'ile	14.2	28.0	220	2.9	0.017	0.006	0.391	0.234	60	0.217	0.010	11.2	101	308	8.1	3.7	99.3	17.5	no data	117.2	61.0
	95%'ile	86.9	327.2	1500	3.8	0.119	0.013	0.574	0.349	111	0.330	0.055	12.1	110	372	8.2	12.7	118.0	22.1	no data	no data	no data
	Maximum	270.0	340.0	7700	4.6	0.300	0.033	1.220	0.361	126	0.340	0.062	13.0	120	399	8.4	14.3	120.0	22.4	10.5	126.4	77.3
	Mean	20.6	35.3	453	1.8	0.028	0.005	0.296	0.149	40	0.133	0.010	10.1	98	257	8.0	3.9	84.2	13.6	10.5	104.8	48.0
	Std. Dev.	52.0	84.8	1407	1.3	0.057	0.006	0.230	0.117	36	0.113	0.014	1.4	8	76	0.2	3.2	24.0	4.4	0.0	14.9	18.6
	Count	29	31	30	30	31	31	31	31	31	31	31	30	29	31	31	14	15	31	1	5	5
Mangapoike Rv	Minimum	1.2	1.5	3	0.0	0.004	0.002	0.140	0.014	1	0.001	0.005	8.5	89	104	7.8	2.3	71.0	7.6	35.1	84.0	40.0
	5%'ile	1.3	1.5	14	0.0	0.005	0.002	0.163	0.022	5	0.005	0.005	8.8	92	147	7.8	no data	no data	8.1	no data	no data	no data
	25%'ile	3.3	1.5	30	0.1	0.010	0.002	0.228	0.071	17	0.018	0.005	10.1	100	204	8.1	2.5	75.8	10.5	no data	84.0	40.0
	Median	18.3	10.0	85	0.4	0.020	0.006	0.379	0.173	34	0.146	0.016	11.1	107	247	8.3	4.5	93.0	14.1	35.1	92.8	45.0
	75%'ile	98.3	96.5	765	1.3	0.082	0.009	0.680	0.301	50	0.275	0.026	11.8	112	335	8.5	8.5	99.8	18.3	no data	101.5	50.0
	95%'ile	1045.5	1292.5	11000	2.9	0.672	0.020	1.365	0.550	155	0.532	0.054	13.9	128	380	8.8	no data	no data	23.4	no data	no data	no data
	Maximum	1140.0	1510.0	11000	3.3	1.130	0.030	1.530	0.588	171	0.570	0.056	14.1	132	406	8.9	11.1	115.0	24.1	35.1	101.5	50.0
	Mean	147.2	167.7	1395	0.9	0.116	0.007	0.513	0.204	45	0.182	0.018	11.0	107	265	8.3	5.5	90.0	14.6	35.1	92.8	45.0
	Std. Dev.	310.8	386.5	3161	1.0	0.246	0.007	0.373	0.159	42	0.162	0.015	1.4	10	77	0.3	3.4	15.0	4.9	0.0	12.4	7.1
	Count	24	25	24	24	25	25	25	25	25	25	25	25	25	25	24	8	9	25	1	2	2

All flows

All flows																					
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO_3-N (mg/l)	NH_4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (µS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (^oC)	Chla (mg/m^2)	MCI (Unit)	% EPT taxa
Mokau Strm	Minimum	0.8	1.5	1	0.5	0.002	0.002	0.055	0.014	7	0.001	0.005	10.4	89	59	7.7	no data	no data	4.5	20.0	131.3	56.3
	5%'ile	0.8	1.5	1	0.5	0.002	0.002	0.055	0.014	7	0.001	0.005	10.4	89	60	7.7	no data	no data	4.5	no data	no data	no data
	25%'ile	1.1	1.5	2	1.6	0.003	0.002	0.055	0.022	9	0.013	0.005	11.0	96	75	8.1	no data	no data	7.2	no data	no data	no data
	Median	1.7	1.5	4	3.0	0.007	0.002	0.055	0.032	13	0.021	0.005	11.3	99	116	8.2	no data	no data	9.4	20.0	131.3	56.3
	75%'ile	3.0	6.8	12	3.5	0.011	0.002	0.150	0.044	17	0.034	0.005	11.8	103	138	8.4	no data	no data	11.3	no data	no data	no data
	95%'ile	8.6	15.6	210	5.6	0.015	0.006	0.278	0.054	27	0.051	0.011	13.7	107	150	8.5	no data	no data	11.6	no data	no data	no data
	Maximum	8.6	16.0	220	5.8	0.015	0.006	0.290	0.054	27	0.052	0.011	13.9	108	151	8.5	no data	no data	11.6	20.0	131.3	56.3
	Mean	2.7	4.3	25	2.7	0.007	0.003	0.100	0.033	14	0.024	0.006	11.5	99	108	8.2	no data	no data	9.0	20.0	131.3	56.3
	Std. Dev.	2.5	4.6	65	1.5	0.004	0.001	0.075	0.013	6	0.015	0.002	0.9	5	34	0.2	no data	no data	2.5	0.0	0.0	0.0
	Count	10	11	11	12	11	11	12	11	11	12	11	12	12	12	10	no data	no data	12	1	1	1
Opoutama Strm	Minimum	3.0	1.5	1	0.0	0.015	0.002	0.250	0.017	3	0.004	0.005	7.6	85	263	6.8	1.8	44.0	6.3	no data	80.9	11.1
	5%'ile	3.1	1.5	9	0.1	0.017	0.002	0.257	0.033	4	0.008	0.005	7.8	86	263	7.0	2.0	49.2	7.5	no data	no data	no data
	25%'ile	5.9	4.0	48	0.1	0.027	0.005	0.396	0.087	11	0.041	0.042	8.4	91	408	7.4	3.5	111.0	11.1	no data	85.1	14.7
	Median	7.6	11.6	220	0.9	0.035	0.007	0.559	0.309	40	0.245	0.048	9.9	94	677	7.5	4.4	137.5	13.0	no data	91.3	27.9
	75%'ile	77.3	131.0	1100	1.3	0.101	0.012	0.903	0.432	55	0.370	0.062	10.4	96	904	7.7	5.2	181.0	17.7	no data	98.1	43.8
	95%'ile	573.4	996.0	21000	2.1	0.561	0.020	2.740	0.836	185	0.774	0.096	11.9	110	1328	8.0	13.7	242.0	23.2	no data	no data	no data
	Maximum	804.0	1520.0	29000	2.3	0.810	0.023	3.580	1.022	195	0.950	0.104	12.0	114	1500	8.1	14.6	250.0	24.3	no data	102.9	50.0
	Mean	76.4	127.4	2549	0.8	0.103	0.008	0.787	0.297	55	0.242	0.049	9.7	94	689	7.5	5.1	141.1	14.3	no data	91.6	29.2
	Std. Dev.	192.0	353.4	6931	0.7	0.185	0.006	0.777	0.251	60	0.240	0.028	1.3	6	332	0.3	3.3	57.0	5.0	no data	9.1	17.8
	Count	17	18	18	18	18	18	18	18	18	18	18	17	16	18	18	13	14	18	no data	4	4
Ruakituri Rv	Minimum	1.4	1.5	1	0.0	0.004	0.002	0.055	0.014	3	0.001	0.005	7.9	88	107	7.6	1.9	42.0	6.0	12.6	108.3	50.0
	5%'ile	1.5	1.5	1	0.0	0.004	0.002	0.104	0.014	5	0.001	0.005	8.2	92	109	7.8	2.0	42.2	6.7	no data	no data	no data
	25%'ile	2.5	1.5	26	0.1	0.011	0.002	0.195	0.016	7	0.006	0.005	9.4	97	152	7.9	2.8	71.0	10.1	27.7	110.2	51.8
	Median	7.3	10.5	79	0.7	0.017	0.005	0.269	0.111	14	0.094	0.005	10.6	103	181	8.2	3.8	78.5	12.8	73.0	115.7	53.9
	75%'ile	56.7	97.0	263	1.7	0.079	0.011	0.650	0.167	23	0.153	0.013	11.7	107	209	8.4	5.8	95.0	18.5	588.3	123.7	58.9
	95%'ile	1241.3	770.0	11050	2.5	0.470	0.021	1.398	0.279	43	0.240	0.071	12.9	115	242	8.6	12.2	103.2	22.2	no data	no data	no data
	Maximum	3600.0	2300.0	31000	2.9	1.520	0.021	2.759	0.452	84	0.440	0.102	13.5	118	246	8.9	12.9	105.0	25.0	760.0	128.2	63.6
	Mean	193.7	148.5	1853	0.9	0.103	0.007	0.463	0.115	18	0.096	0.013	10.6	103	180	8.2	4.8	76.6	14.2	281.9	117.0	55.4
	Std. Dev.	699.7	434.1	6016	0.9	0.283	0.006	0.519	0.104	16	0.098	0.021	1.4	7	39	0.3	3.1	19.7	5.3	415.2	8.8	5.8
	Count	27	30	29	29	30	30	30	30	30	30	30	30	29	30	30	13	14	31	3	4	4
Te Iringaowhare Strm	Minimum	0.5	1.5	1	0.5	0.028	0.002	0.187	0.027	4	0.013	0.005	7.9	97	395	8.2	2.5	150.0	5.7	36.8	96.2	38.1
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	1.1	1.5	6	0.7	0.031	0.008	0.257	0.056	5	0.042	0.005	8.9	97	449	8.3	3.5	180.0	10.2	36.8	96.2	38.1
	Median	3.3	5.2	9	1.3	0.053	0.016	0.295	0.110	7	0.098	0.011	10.2	100	467	8.3	4.8	190.0	13.7	49.1	100.1	39.1
	75%'ile	6.6	20.3	52	2.1	0.070	0.026	0.468	0.170	12	0.148	0.022	11.3	101	636	8.3	5.7	215.0	17.8	61.4	104.0	40.0
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	8.0	30.0	80	2.4	0.110	0.042	0.520	0.221	14	0.200	0.023	13.1	102	714	8.4	5.8	230.0	20.0	61.4	104.0	40.0
	Mean	3.8	11.0	28	1.4	0.056	0.018	0.346	0.115	8	0.099	0.013	10.2	99	531	8.3	4.5	194.0	13.5	49.1	100.1	39.1
	Std. Dev.	3.2	12.4	33	0.9	0.033	0.015	0.135	0.076	4	0.072	0.009	1.9	2	129	0.1	1.4	29.7	5.2	17.4	5.5	1.3
	Count	5	5	5	3	5	5	5	5	5	5	5	5	4	5	5	5	5	6	2	2	2

All flows

All flows																					
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO_3-N (mg/l)	NH_4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (µS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (^oC)	Chla (mg/m^2)	MCI (Unit)	% EPT taxa
Te Kumi Strm	Minimum	0.2	1.5	1	0.9	0.004	0.002	0.055	0.069	9	0.057	0.005	9.5	90	92	7.9	0.8	60.0	6.9	12.3	132.7	56.7
	5%'ile	0.3	1.5	1	1.0	0.005	0.002	0.078	0.074	9	0.062	0.005	9.9	90	109	7.9	0.8	61.8	6.9	no data	no data	no data
	25%'ile	0.4	1.5	1	1.9	0.007	0.005	0.169	0.095	12	0.084	0.005	10.8	95	161	8.1	1.3	76.0	7.8	15.1	134.3	59.4
	Median	0.6	1.5	1	2.5	0.009	0.008	0.193	0.106	15	0.093	0.005	11.0	101	172	8.2	1.6	84.0	8.4	23.4	136.1	62.3
	75%'ile	3.0	1.5	2	2.8	0.011	0.009	0.210	0.120	28	0.110	0.005	11.9	104	189	8.2	2.1	89.3	9.9	30.0	137.7	64.0
	95%'ile	14.0	3.0	31	5.2	0.013	0.010	0.332	0.242	58	0.237	0.017	12.7	110	201	8.4	4.3	95.0	11.1	no data	no data	no data
	Maximum	17.9	3.0	40	5.8	0.014	0.010	0.382	0.292	60	0.280	0.020	12.8	111	202	8.4	4.5	95.0	11.5	32.2	139.2	65.4
	Mean	2.5	1.7	5	2.5	0.009	0.007	0.191	0.116	23	0.105	0.006	11.3	100	169	8.2	1.8	82.3	8.7	22.6	136.0	61.7
	Std. Dev.	4.4	0.5	10	1.2	0.003	0.003	0.065	0.049	16	0.050	0.004	0.8	6	27	0.1	1.0	10.2	1.3	10.0	2.7	3.6
	Count	17	17	17	18	17	17	17	17	17	16	17	18	16	18	17	12	13	18	3	4	4
Waiau Rv	Minimum	1.3	1.5	5	0.0	0.008	0.002	0.055	0.014	1	0.001	0.005	9.3	96	80	7.5	1.4	28.0	4.4	4.0	104.3	43.5
	5%'ile	1.4	1.5	6	0.0	0.009	0.004	0.055	0.014	1	0.001	0.005	9.4	97	81	7.5	no data	no data	5.4	no data	no data	no data
	25%'ile	2.7	1.5	16	0.2	0.013	0.008	0.055	0.014	2	0.002	0.005	10.0	100	91	7.7	2.1	32.5	8.6	4.0	107.3	45.1
	Median	9.1	15.0	33	0.6	0.019	0.012	0.120	0.037	4	0.025	0.005	11.3	104	105	7.9	3.3	36.0	10.9	56.0	116.4	50.0
	75%'ile	25.2	65.8	61	1.5	0.060	0.014	0.281	0.087	6	0.074	0.005	12.7	110	111	8.2	4.6	42.0	15.3	108.0	119.9	55.3
	95%'ile	324.6	602.5	1298	3.6	0.346	0.020	0.781	0.174	10	0.148	0.028	15.0	121	131	8.4	no data	no data	18.4	no data	no data	no data
	Maximum	550.0	1180.0	3300	4.1	0.920	0.024	1.130	0.229	12	0.197	0.052	15.2	125	137	8.6	9.5	48.0	20.9	108.0	121.0	57.1
	Mean	55.4	103.8	200	1.1	0.077	0.011	0.220	0.057	5	0.042	0.008	11.5	106	104	7.9	3.8	37.3	11.8	56.0	113.9	50.2
	Std. Dev.	122.3	247.4	668	1.1	0.182	0.005	0.244	0.056	3	0.050	0.010	1.7	8	16	0.3	2.6	6.5	4.2	73.5	8.6	6.8
	Count	24	25	24	25	25	25	25	25	25	25	25	25	24	25	23	8	9	25	2	3	3
Waikaretaheke Rv	Minimum	0.3	1.5	1	0.1	0.002	0.002	0.107	0.017	9	0.004	0.005	9.7	91	97	7.3	0.5	42.0	8.7	10.4	99.3	42.9
	5%'ile	0.3	1.5	1	0.1	0.002	0.002	0.107	0.017	9	0.004	0.005	9.8	92	97	7.3	0.6	42.0	9.0	no data	no data	no data
	25%'ile	1.0	1.5	5	0.8	0.005	0.002	0.110	0.020	10	0.008	0.005	10.0	102	103	7.9	2.1	44.0	11.6	10.4	101.2	43.1
	Median	1.9	4.3	15	2.1	0.007	0.002	0.116	0.026	11	0.014	0.005	10.8	106	106	8.0	2.7	45.0	12.9	11.3	106.7	43.8
	75%'ile	4.4	11.0	34	4.4	0.016	0.002	0.137	0.035	16	0.023	0.005	11.3	106	113	8.0	3.3	50.0	16.4	12.3	108.3	51.6
	95%'ile	150.0	306.6	654	5.4	0.200	0.008	0.433	0.128	36	0.109	0.043	12.7	111	138	8.3	4.1	56.2	18.7	no data	no data	no data
	Maximum	181.0	370.0	680	5.5	0.240	0.009	0.477	0.137	39	0.124	0.052	12.7	112	142	8.3	4.1	57.0	18.8	12.3	108.8	54.2
	Mean	16.9	34.6	102	2.4	0.027	0.003	0.152	0.037	14	0.022	0.008	10.8	104	109	7.9	2.6	46.7	13.6	11.3	104.9	47.0
	Std. Dev.	47.7	97.5	219	1.8	0.062	0.002	0.100	0.034	8	0.031	0.013	0.9	5	12	0.3	1.0	4.5	3.2	1.3	5.0	6.3
	Count	14	14	14	13	14	14	13	13	13	13	14	14	13	14	14	13	14	15	2	3	3
Wairoa Rv U/S Wairoa	Minimum	1.8	1.5	1	0.0	0.009	0.002	0.114	0.014	1	0.001	0.005	6.8	71	125	7.6	2.7	66.0	6.9	no data	76.7	0.0
	5%'ile	2.1	1.5	5	0.0	0.011	0.002	0.125	0.014	1	0.001	0.005	7.0	78	148	7.7	2.7	66.2	7.4	no data	no data	no data
	25%'ile	5.3	5.0	41	0.1	0.014	0.004	0.179	0.021	4	0.007	0.005	8.3	87	180	7.9	3.0	74.8	10.9	no data	no data	no data
	Median	18.9	20.0	85	0.4	0.028	0.008	0.265	0.060	11	0.040	0.005	9.4	97	201	8.0	3.3	79.0	14.6	no data	76.7	0.0
	75%'ile	65.0	70.3	785	1.2	0.060	0.017	0.475	0.203	18	0.174	0.020	11.0	102	268	8.3	6.2	92.5	19.7	no data	no data	no data
	95%'ile	1374.0	2330.0	12200	2.1	1.231	0.022	2.089	0.371	35	0.342	0.050	12.1	107	2195	8.4	12.4	429.5	22.0	no data	no data	no data
	Maximum	1510.0	2900.0	14000	2.2	2.200	0.029	2.879	0.606	37	0.580	0.119	12.6	111	4790	8.6	12.8	470.0	22.4	no data	76.7	0.0
	Mean	170.3	246.2	1483	0.7	0.186	0.010	0.512	0.131	13	0.109	0.015	9.6	94	561	8.1	4.9	118.5	14.8	no data	76.7	0.0
	Std. Dev.	393.3	672.9	3567	0.7	0.464	0.008	0.647	0.147	11	0.138	0.023	1.7	9	959	0.2	3.1	111.2	4.8	no data	0.0	0.0
	Count	26	29	28	27	29	29	27	27	27	27	29	27	26	28	27	12	13	28	no data	1	1

< 3 X Median flow

< 3 x Median Flow																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO_3-N (mg/l)	NH_4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (µS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (^oC)	Chla (mg/m^2)	MCI (Unit)	% EPT taxa
Aniwaniwa Strm	Minimum	0.4	1.5	1	0.4	0.002	0.002	0.055	0.008	4	0.001	0.005	8.6	88	53	7.4	1.6	21.0	5.4	25.7	115.4	58.1
	5%'ile	0.4	1.5	1	0.6	0.002	0.002	0.055	0.013	4	0.002	0.005	9.6	90	58	7.5	1.6	22.8	5.9	no data	no data	no data
	25%'ile	0.7	1.5	2	2.6	0.005	0.002	0.055	0.020	7	0.009	0.005	10.2	97	90	7.8	2.2	41.0	7.5	39.8	123.0	60.3
	Median	1.2	1.5	6	3.3	0.006	0.002	0.110	0.028	10	0.016	0.005	10.7	99	103	8.0	2.6	44.5	9.9	55.9	126.5	65.3
	75%'ile	2.2	1.5	17	4.1	0.011	0.004	0.131	0.033	15	0.022	0.005	11.6	102	123	8.2	3.5	51.0	13.2	61.2	129.1	70.0
	95%'ile	5.2	8.6	79	6.1	0.018	0.006	0.158	0.065	26	0.052	0.014	12.7	105	143	8.4	4.3	60.5	15.7	no data	no data	no data
	Maximum	6.1	12.0	240	6.4	0.032	0.008	0.160	0.068	34	0.056	0.017	12.9	106	144	8.5	4.3	61.0	17.1	64.3	132.2	72.0
	Mean	1.8	2.3	19	3.2	0.008	0.003	0.101	0.030	12	0.018	0.006	10.9	99	103	8.0	2.8	44.8	10.4	50.5	125.5	65.2
	Std. Dev.	1.5	2.4	46	1.6	0.006	0.002	0.040	0.014	7	0.014	0.003	1.0	4	26	0.3	0.9	10.1	3.3	17.0	6.2	6.1
	Count	24	27	26	26	27	27	26	26	26	25	27	26	25	26	25	11	12	28	4	5	4
Hangaroa Rv	Minimum	0.7	1.5	1	0.1	0.007	0.002	0.120	0.012	1	0.001	0.005	7.7	89	199	7.9	3.4	78.0	7.3	9.6	88.3	33.3
	5%'ile	0.9	1.5	5	0.1	0.008	0.002	0.126	0.013	2	0.001	0.005	8.4	91	213	8.0	no data	78.0	7.4	no data	no data	no data
	25%'ile	1.5	1.5	11	0.3	0.012	0.002	0.230	0.014	7	0.002	0.005	9.7	99	252	8.3	3.7	106.0	10.8	16.3	88.8	36.5
	Median	4.5	1.5	38	1.6	0.018	0.004	0.292	0.028	7	0.016	0.005	10.8	104	267	8.6	4.7	110.0	14.6	33.0	97.3	45.0
	75%'ile	18.0	19.8	130	2.2	0.043	0.009	0.476	0.183	13	0.151	0.005	11.5	113	289	8.7	5.2	120.0	21.7	50.7	105.1	46.6
	95%'ile	209.5	209.5	5320	3.0	0.114	0.019	0.697	0.245	55	0.232	0.020	13.0	125	319	9.0	no data	134.0	24.9	no data	no data	no data
	Maximum	281.0	240.0	7900	3.3	0.128	0.022	0.850	0.262	93	0.250	0.028	13.4	133	324	9.1	5.4	134.0	25.0	58.5	114.5	50.0
	Mean	27.7	27.7	610	1.4	0.033	0.006	0.343	0.081	14	0.067	0.007	10.6	106	270	8.5	4.5	108.0	15.7	33.5	98.2	42.3
	Std. Dev.	65.9	61.8	1798	1.0	0.034	0.006	0.172	0.088	19	0.086	0.006	1.4	10	30	0.3	0.8	17.5	6.0	21.5	10.8	6.7
	Count	23	23	22	23	23	23	22	22	22	22	23	23	22	23	23	9	10	24	4	5	5
Kopuawhara Strm	Minimum	0.6	1.5	1	0.2	0.002	0.002	0.055	0.014	3	0.001	0.005	7.0	79	178	7.3	2.0	62.0	7.4	10.5	92.2	33.3
	5%'ile	0.6	1.5	12	0.2	0.002	0.002	0.055	0.014	6	0.001	0.005	7.3	83	187	7.5	2.0	64.4	7.5	no data	no data	no data
	25%'ile	1.0	1.5	30	1.6	0.005	0.002	0.115	0.015	8	0.004	0.005	9.1	93	244	7.9	2.2	88.5	10.1	no data	93.0	34.6
	Median	1.8	1.5	57	2.2	0.008	0.002	0.204	0.100	15	0.087	0.005	10.2	99	296	8.0	2.6	91.5	12.9	10.5	98.0	38.9
	75%'ile	2.2	4.5	125	3.0	0.011	0.004	0.288	0.185	83	0.172	0.007	11.1	102	321	8.1	3.2	100.0	18.7	no data	117.2	61.0
	95%'ile	46.0	45.4	798	4.0	0.049	0.010	0.443	0.285	116	0.267	0.018	12.3	114	381	8.2	3.9	119.2	22.3	no data	no data	no data
	Maximum	77.3	79.0	1500	4.6	0.074	0.013	0.496	0.361	126	0.330	0.029	13.0	120	399	8.2	3.9	120.0	22.4	10.5	126.4	77.3
	Mean	6.5	7.0	152	2.3	0.011	0.003	0.216	0.110	40	0.096	0.007	10.0	97	286	8.0	2.7	93.9	14.2	10.5	104.8	48.0
	Std. Dev.	16.6	16.5	309	1.2	0.015	0.003	0.125	0.100	41	0.098	0.005	1.6	9	57	0.2	0.6	14.3	4.7	0.0	14.9	18.6
	Count	22	24	23	23	24	24	24	24	24	24	24	23	22	24	24	11	12	24	1	5	5
Mangapoike Rv	Minimum	1.2	1.5	3	0.1	0.004	0.002	0.140	0.014	1	0.001	0.005	8.5	89	210	8.0	2.3	77.0	9.8	35.1	84.0	40.0
	5%'ile	1.2	1.5	8	0.1	0.005	0.002	0.151	0.018	3	0.003	0.005	8.6	91	215	8.0	no data	no data	9.8	no data	no data	no data
	25%'ile	2.8	1.5	24	0.4	0.008	0.002	0.220	0.044	17	0.012	0.005	9.1	100	246	8.2	2.3	93.0	10.5	no data	84.0	40.0
	Median	4.2	4.0	42	1.0	0.012	0.002	0.310	0.125	38	0.090	0.010	10.9	107	311	8.4	2.6	95.5	14.1	35.1	92.8	45.0
	75%'ile	18.3	13.5	85	2.1	0.020	0.006	0.398	0.227	69	0.212	0.029	11.8	114	345	8.6	8.7	105.0	19.9	no data	101.5	50.0
	95%'ile	471.5	464.4	4040	3.1	0.454	0.013	0.992	0.327	164	0.316	0.055	13.6	130	394	8.9	no data	no data	23.8	no data	no data	no data
	Maximum	590.0	660.0	5300	3.3	0.520	0.015	1.197	0.342	171	0.330	0.056	14.1	132	406	8.9	11.1	115.0	24.1	35.1	101.5	50.0
	Mean	56.4	50.6	470	1.2	0.061	0.004	0.357	0.138	51	0.113	0.020	10.8	108	304	8.4	5.2	96.8	15.5	35.1	92.8	45.0
	Std. Dev.	150.0	158.9	1320	1.1	0.141	0.004	0.248	0.104	49	0.109	0.018	1.6	12	57	0.3	4.1	12.8	5.2	0.0	12.4	7.1
	Count	16	17	16	16	17	17	17	17	17	17	17	17	17	17	16	5	6	17	1	2	2

< 3 X Median flow

< 3 x Median Flow																					
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO_3-N (mg/l)	NH_4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (µS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (^oC)	Chla (mg/m^2)	MCI (Unit)	% EPT taxa
Mokau Strm	Minimum	0.8	1.5	1	0.5	0.002	0.002	0.055	0.014	7	0.001	0.005	10.4	89	59	7.7	no data	no data	4.5	20.0	131.3	56.3
	5%'ile	0.8	1.5	1	0.5	0.002	0.002	0.055	0.014	7	0.001	0.005	10.4	89	60	7.7	no data	no data	4.5	no data	no data	no data
	25%'ile	1.1	1.5	2	1.6	0.003	0.002	0.055	0.022	9	0.013	0.005	11.0	96	75	8.1	no data	no data	7.2	no data	no data	no data
	Median	1.7	1.5	4	3.0	0.007	0.002	0.055	0.032	13	0.021	0.005	11.3	99	116	8.2	no data	no data	9.4	20.0	131.3	56.3
	75%'ile	3.0	6.8	12	3.5	0.011	0.002	0.150	0.044	17	0.034	0.005	11.8	103	138	8.4	no data	no data	11.3	no data	no data	no data
	95%'ile	8.6	15.6	210	5.6	0.015	0.006	0.278	0.054	27	0.051	0.011	13.7	107	150	8.5	no data	no data	11.6	no data	no data	no data
	Maximum	8.6	16.0	220	5.8	0.015	0.006	0.290	0.054	27	0.052	0.011	13.9	108	151	8.5	no data	no data	11.6	20.0	131.3	56.3
	Mean	2.7	4.3	25	2.7	0.007	0.003	0.100	0.033	14	0.024	0.006	11.5	99	108	8.2	no data	no data	9.0	20.0	131.3	56.3
	Std. Dev.	2.5	4.6	65	1.5	0.004	0.001	0.075	0.013	6	0.015	0.002	0.9	5	34	0.2	no data	no data	2.5	0.0	0.0	0.0
	Count	10	11	11	12	11	11	12	11	11	12	11	12	12	12	10	no data	no data	12	1	1	1
Opoutama Strm	Minimum	3.0	1.5	1	0.1	0.015	0.002	0.250	0.017	3	0.004	0.005	7.6	85	527	7.4	1.8	111.0	6.3	no data	80.9	18.2
	5%'ile	3.0	1.5	4	0.1	0.016	0.002	0.253	0.023	4	0.006	0.005	7.7	85	528	7.4	1.8	111.3	6.7	no data	no data	no data
	25%'ile	5.1	4.0	23	0.8	0.026	0.002	0.331	0.079	9	0.028	0.035	8.3	90	642	7.4	3.0	131.3	10.4	no data	85.1	23.0
	Median	6.4	5.7	210	1.0	0.031	0.006	0.440	0.117	40	0.050	0.046	9.5	93	741	7.5	3.9	140.0	13.9	no data	91.3	37.5
	75%'ile	7.9	14.5	280	1.5	0.039	0.011	0.585	0.345	54	0.323	0.060	11.0	96	1002	7.7	4.6	192.3	21.2	no data	98.1	46.9
	95%'ile	35.4	56.1	1695	2.2	0.111	0.013	0.664	0.469	191	0.380	0.083	12.0	113	1435	8.1	6.1	248.0	23.9	no data	no data	no data
	Maximum	38.2	63.0	1800	2.3	0.123	0.013	0.670	0.475	195	0.380	0.085	12.0	114	1500	8.1	6.1	250.0	24.3	no data	102.9	50.0
	Mean	8.9	11.7	343	1.1	0.037	0.007	0.454	0.199	50	0.150	0.044	9.6	95	834	7.6	3.9	162.1	14.9	no data	91.6	35.2
	Std. Dev.	9.5	16.3	526	0.6	0.027	0.004	0.144	0.160	61	0.152	0.024	1.6	8	271	0.2	1.2	43.6	5.6	no data	9.1	16.0
	Count	12	13	13	13	13	13	13	13	13	13	13	12	11	13	13	10	11	13	no data	4	3
Ruakituri Rv	Minimum	1.4	1.5	1	0.0	0.004	0.002	0.055	0.014	3	0.001	0.005	7.9	88	141	7.6	1.9	71.0	6.6	12.6	108.3	50.0
	5%'ile	1.5	1.5	1	0.0	0.004	0.002	0.084	0.014	4	0.001	0.005	8.1	90	147	7.7	no data	71.0	7.8	no data	no data	no data
	25%'ile	2.2	1.5	15	0.4	0.009	0.002	0.140	0.015	7	0.003	0.005	9.3	97	171	8.2	2.6	74.0	9.7	27.7	109.3	50.9
	Median	5.1	3.8	49	1.3	0.014	0.002	0.230	0.041	8	0.025	0.005	10.2	104	196	8.2	2.9	83.5	15.0	73.0	112.1	53.6
	75%'ile	10.2	14.0	140	2.0	0.019	0.006	0.446	0.151	23	0.139	0.013	12.0	109	210	8.5	4.2	96.0	20.6	588.3	117.4	54.1
	95%'ile	1922.5	1100.0	16000	2.7	0.705	0.020	1.538	0.265	59	0.178	0.083	12.8	116	243	8.7	no data	105.0	23.2	no data	no data	no data
	Maximum	3600.0	2300.0	31000	2.9	1.520	0.021	2.759	0.279	84	0.182	0.102	12.9	118	246	8.9	8.3	105.0	25.0	760.0	119.2	54.2
	Mean	203.4	133.3	1917	1.2	0.095	0.006	0.401	0.083	18	0.063	0.014	10.5	103	195	8.2	3.7	85.1	15.0	281.9	113.2	52.6
	Std. Dev.	801.7	489.8	6660	0.9	0.321	0.006	0.563	0.082	18	0.068	0.024	1.5	8	30	0.3	1.9	12.3	5.7	415.2	5.5	2.3
	Count	20	22	22	21	22	22	22	22	22	22	22	22	21	22	22	9	10	23	3	3	3
Te Iringaowhare Strm	Minimum	0.5	1.5	1	0.5	0.028	0.002	0.187	0.027	4	0.013	0.005	7.9	97	395	8.2	2.5	150.0	5.7	36.8	96.2	38.1
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	1.1	1.5	6	0.7	0.031	0.008	0.257	0.056	5	0.042	0.005	8.9	97	449	8.3	3.5	180.0	10.2	36.8	96.2	38.1
	Median	3.3	5.2	9	1.3	0.053	0.016	0.295	0.110	7	0.098	0.011	10.2	100	467	8.3	4.8	190.0	13.7	49.1	100.1	39.1
	75%'ile	6.6	20.3	52	2.1	0.070	0.026	0.468	0.170	12	0.148	0.022	11.3	101	636	8.3	5.7	215.0	17.8	61.4	104.0	40.0
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	8.0	30.0	80	2.4	0.110	0.042	0.520	0.221	14	0.200	0.023	13.1	102	714	8.4	5.8	230.0	20.0	61.4	104.0	40.0
	Mean	3.8	11.0	28	1.4	0.056	0.018	0.346	0.115	8	0.099	0.013	10.2	99	531	8.3	4.5	194.0	13.5	49.1	100.1	39.1
	Std. Dev.	3.2	12.4	33	0.9	0.033	0.015	0.135	0.076	4	0.072	0.009	1.9	2	129	0.1	1.4	29.7	5.2	17.4	5.5	1.3
	Count	5	5	5	3	5	5	5	5	5	5	5	5	4	5	5	5	5	6	2	2	2

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< 3 x Median Flow																					
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO_3-N (mg/l)	NH_4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (µS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (^oC)	Chla (mg/m^2)	MCI (Unit)	% EPT taxa
Te Kumi Strm	Minimum	0.2	1.5	1	0.9	0.004	0.002	0.055	0.069	9	0.057	0.005	9.5	90	92	7.9	0.8	60.0	6.9	12.3	132.7	56.7
	5%'ile	0.3	1.5	1	1.0	0.005	0.002	0.078	0.074	9	0.062	0.005	9.9	90	109	7.9	0.8	61.8	6.9	no data	no data	no data
	25%'ile	0.4	1.5	1	1.9	0.007	0.005	0.169	0.095	12	0.084	0.005	10.8	95	161	8.1	1.3	76.0	7.8	15.1	134.3	59.4
	Median	0.6	1.5	1	2.5	0.009	0.008	0.193	0.106	15	0.093	0.005	11.0	101	172	8.2	1.6	84.0	8.4	23.4	136.1	62.3
	75%'ile	3.0	1.5	2	2.8	0.011	0.009	0.210	0.120	28	0.110	0.005	11.9	104	189	8.2	2.1	89.3	9.9	30.0	137.7	64.0
	95%'ile	14.0	3.0	31	5.2	0.013	0.010	0.332	0.242	58	0.237	0.017	12.7	110	201	8.4	4.3	95.0	11.1	no data	no data	no data
	Maximum	17.9	3.0	40	5.8	0.014	0.010	0.382	0.292	60	0.280	0.020	12.8	111	202	8.4	4.5	95.0	11.5	32.2	139.2	65.4
	Mean	2.5	1.7	5	2.5	0.009	0.007	0.191	0.116	23	0.105	0.006	11.3	100	169	8.2	1.8	82.3	8.7	22.6	136.0	61.7
	Std. Dev.	4.4	0.5	10	1.2	0.003	0.003	0.065	0.049	16	0.050	0.004	0.8	6	27	0.1	1.0	10.2	1.3	10.0	2.7	3.6
	Count	17	17	17	18	17	17	17	17	17	16	17	18	16	18	17	12	13	18	3	4	4
Waiau Rv	Minimum	1.3	1.5	5	0.1	0.008	0.002	0.055	0.014	1	0.001	0.005	9.3	96	80	7.5	1.4	28.0	4.4	4.0	104.3	43.5
	5%'ile	1.4	1.5	6	0.1	0.009	0.003	0.055	0.014	1	0.001	0.005	9.4	97	81	7.5	no data	no data	5.2	no data	no data	no data
	25%'ile	2.7	1.5	16	0.3	0.013	0.008	0.055	0.014	2	0.001	0.005	9.9	99	91	7.7	2.0	33.0	8.5	4.0	107.3	45.1
	Median	7.3	11.0	33	0.6	0.018	0.012	0.120	0.018	4	0.007	0.005	11.3	103	105	7.9	3.2	37.5	10.6	56.0	116.4	50.0
	75%'ile	14.1	45.8	60	1.6	0.031	0.013	0.226	0.078	6	0.061	0.005	12.7	109	113	8.0	3.8	43.0	15.8	108.0	119.9	55.3
	95%'ile	143.0	239.4	1584	3.6	0.136	0.018	0.564	0.148	10	0.113	0.031	15.0	121	132	8.5	no data	no data	18.8	no data	no data	no data
	Maximum	200.0	320.0	3300	4.1	0.146	0.019	0.665	0.156	12	0.132	0.052	15.2	125	137	8.6	5.1	48.0	20.9	108.0	121.0	57.1
	Mean	25.0	43.7	207	1.2	0.036	0.011	0.173	0.048	4	0.033	0.008	11.5	106	105	7.9	3.0	37.9	11.8	56.0	113.9	50.2
	Std. Dev.	48.5	77.9	697	1.1	0.041	0.004	0.155	0.043	3	0.039	0.010	1.8	8	17	0.3	1.3	6.8	4.4	73.5	8.6	6.8
	Count	22	23	22	23	23	23	23	23	23	23	23	23	22	23	21	7	8	23	2	3	3
Waikaretaheke Rv	Minimum	0.3	1.5	1	0.1	0.002	0.002	0.107	0.017	9	0.004	0.005	9.7	91	97	7.3	0.5	42.0	8.7	10.4	99.3	42.9
	5%'ile	0.3	1.5	1	0.1	0.002	0.002	0.107	0.017	9	0.004	0.005	9.8	92	97	7.3	0.6	42.0	9.0	no data	no data	no data
	25%'ile	1.0	1.5	5	0.8	0.005	0.002	0.110	0.020	10	0.008	0.005	10.0	102	103	7.9	2.1	44.0	11.6	10.4	101.2	43.1
	Median	1.9	4.3	15	2.1	0.007	0.002	0.116	0.026	11	0.014	0.005	10.8	106	106	8.0	2.7	45.0	12.9	11.3	106.7	43.8
	75%'ile	4.4	11.0	34	4.4	0.016	0.002	0.137	0.035	16	0.023	0.005	11.3	106	113	8.0	3.3	50.0	16.4	12.3	108.3	51.6
	95%'ile	150.0	306.6	654	5.4	0.200	0.008	0.433	0.128	36	0.109	0.043	12.7	111	138	8.3	4.1	56.2	18.7	no data	no data	no data
	Maximum	181.0	370.0	680	5.5	0.240	0.009	0.477	0.137	39	0.124	0.052	12.7	112	142	8.3	4.1	57.0	18.8	12.3	108.8	54.2
	Mean	16.9	34.6	102	2.4	0.027	0.003	0.152	0.037	14	0.022	0.008	10.8	104	109	7.9	2.6	46.7	13.6	11.3	104.9	47.0
	Std. Dev.	47.7	97.5	219	1.8	0.062	0.002	0.100	0.034	8	0.031	0.013	0.9	5	12	0.3	1.0	4.5	3.2	1.3	5.0	6.3
	Count	14	14	14	13	14	14	13	13	13	13	14	14	13	14	14	13	14	15	2	3	3
Wairoa Rv U/S Wairoa	Minimum	1.8	1.5	1	0.1	0.009	0.002	0.114	0.014	1	0.001	0.005	6.8	71	125	7.6	2.7	74.0	7.5	no data	76.7	0.0
	5%'ile	2.0	1.5	3	0.1	0.010	0.002	0.121	0.014	1	0.001	0.005	6.9	75	143	7.7	no data	74.0	8.4	no data	no data	no data
	25%'ile	2.8	5.0	27	0.4	0.014	0.002	0.158	0.017	3	0.003	0.005	7.9	86	190	7.9	2.9	76.0	11.4	no data	no data	no data
	Median	7.0	7.1	60	0.8	0.018	0.005	0.223	0.024	8	0.012	0.005	8.9	95	203	8.1	3.1	79.0	15.3	no data	76.7	0.0
	75%'ile	20.4	33.5	130	1.4	0.038	0.010	0.283	0.113	20	0.097	0.010	10.6	99	580	8.3	3.5	103.0	20.5	no data	no data	no data
	95%'ile	145.0	94.1	1540	2.1	0.085	0.019	0.469	0.248	36	0.231	0.027	11.5	103	3060	8.5	no data	470.0	22.2	no data	no data	no data
	Maximum	225.0	137.0	1900	2.2	0.114	0.022	0.480	0.324	37	0.300	0.035	11.9	103	4790	8.6	6.2	470.0	22.4	no data	76.7	0.0
	Mean	24.5	23.9	222	0.9	0.030	0.007	0.235	0.072	12	0.057	0.009	9.1	92	663	8.1	3.5	131.8	15.7	no data	76.7	0.0
	Std. Dev.	49.5	32.6	464	0.7	0.025	0.006	0.099	0.082	11	0.080	0.008	1.5	9	1063	0.3	1.1	124.9	4.8	no data	0.0	0.0
	Count	20	23	22	21	23	23	21	21	21	21	23	21	20	22	22	9	10	22	no data	1	1

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Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO_3-N (mg/l)	NH_4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (µS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (^oC)	Chla (mg/m^2)	MCI (Unit)	% EPT taxa
Aniwaniwa Strm	Minimum	0.4	1.5	1	0.7	0.002	0.002	0.055	0.014	6	0.001	0.005	8.6	91	59	7.6	2.0	42.0	6.0	53.8	115.4	58.1
	5%'ile	0.4	1.5	1	0.9	0.002	0.002	0.055	0.015	6	0.001	0.005	8.8	92	61	7.6	no data	no data	6.6	no data	no data	no data
	25%'ile	0.6	1.5	2	2.6	0.004	0.002	0.055	0.020	7	0.008	0.005	10.2	98	101	8.0	2.1	43.5	8.7	54.8	121.0	60.6
	Median	1.2	1.5	6	3.7	0.006	0.002	0.105	0.024	10	0.011	0.005	10.6	100	122	8.0	2.4	49.0	11.7	58.0	127.3	68.0
	75%'ile	2.0	1.5	17	4.1	0.010	0.004	0.127	0.030	12	0.018	0.005	10.9	102	132	8.4	3.4	57.3	14.2	62.7	130.1	71.0
	95%'ile	5.8	9.8	26	5.9	0.028	0.005	0.145	0.046	17	0.033	0.011	12.4	103	144	8.5	no data	no data	16.6	no data	no data	no data
	Maximum	6.1	12.0	26	6.1	0.032	0.005	0.146	0.049	18	0.036	0.013	12.6	104	144	8.5	4.2	61.0	17.1	64.3	132.2	72.0
	Mean	1.7	2.3	10	3.5	0.009	0.003	0.094	0.026	10	0.013	0.006	10.6	99	114	8.1	2.8	50.4	11.6	58.7	125.5	66.0
	Std. Dev.	1.7	2.7	9	1.4	0.008	0.001	0.037	0.009	3	0.009	0.002	0.9	3	26	0.3	1.0	8.0	3.2	5.3	7.2	7.2
	Count	13	15	15	14	15	15	14	14	14	14	15	14	13	14	14	4	5	16	3	4	3
Hangaroa Rv	Minimum	0.7	1.5	1	0.1	0.007	0.002	0.120	0.012	1	0.001	0.005	7.7	93	221	8.2	3.4	79.0	7.5	9.6	88.3	33.3
	5%'ile	0.8	1.5	3	0.3	0.007	0.002	0.122	0.013	2	0.001	0.005	8.2	94	229	8.2	no data	no data	7.7	no data	no data	no data
	25%'ile	1.2	1.5	9	1.5	0.010	0.002	0.205	0.014	6	0.001	0.005	9.6	102	257	8.5	3.7	108.5	11.8	16.3	88.6	35.4
	Median	2.4	1.5	15	1.9	0.013	0.003	0.268	0.016	7	0.005	0.005	9.9	109	276	8.6	4.3	110.0	17.6	33.0	93.1	41.3
	75%'ile	4.6	3.5	61	2.3	0.018	0.004	0.309	0.032	9	0.019	0.005	11.5	113	301	8.7	5.2	118.8	22.6	50.7	99.7	47.5
	95%'ile	198.2	137.5	438	3.2	0.101	0.011	0.740	0.175	27	0.154	0.015	13.1	130	322	9.0	no data	no data	24.9	no data	no data	no data
	Maximum	281.0	193.0	550	3.3	0.107	0.013	0.850	0.206	29	0.184	0.015	13.4	133	324	9.1	5.4	134.0	25.0	58.5	102.0	50.0
	Mean	19.9	14.3	64	1.9	0.024	0.004	0.291	0.036	9	0.023	0.006	10.5	108	277	8.6	4.4	110.9	17.3	33.5	94.1	41.5
	Std. Dev.	69.6	47.7	138	0.8	0.029	0.003	0.173	0.051	7	0.048	0.003	1.5	10	28	0.2	0.9	16.6	6.0	21.5	6.7	7.5
	Count	16	16	15	16	16	16	15	15	15	15	16	16	15	16	16	6	7	17	4	4	4
Kopuawhara Strm	Minimum	0.6	1.5	20	1.1	0.002	0.002	0.055	0.014	3	0.001	0.005	7.0	79	243	7.9	2.0	87.0	9.2	10.5	92.2	33.3
	5%'ile	0.6	1.5	21	1.2	0.002	0.002	0.055	0.014	4	0.001	0.005	7.1	80	244	7.9	no data	no data	9.3	no data	no data	no data
	25%'ile	0.9	1.5	28	2.6	0.004	0.002	0.100	0.014	7	0.001	0.005	7.8	85	297	8.0	2.1	90.0	11.1	no data	92.8	34.2
	Median	1.3	1.5	80	2.9	0.006	0.002	0.123	0.017	8	0.005	0.005	9.1	94	309	8.0	2.1	98.5	16.6	10.5	95.7	37.0
	75%'ile	1.9	1.5	130	3.6	0.009	0.002	0.219	0.089	45	0.075	0.005	10.0	103	348	8.1	2.8	112.0	18.9	no data	106.1	47.3
	95%'ile	2.1	5.3	382	4.4	0.016	0.004	0.364	0.246	123	0.234	0.013	11.2	109	394	8.2	no data	no data	22.4	no data	no data	no data
	Maximum	2.1	6.3	420	4.6	0.017	0.005	0.364	0.252	126	0.240	0.014	11.3	110	399	8.2	3.0	120.0	22.4	10.5	114.1	55.6
	Mean	1.4	1.8	109	2.9	0.007	0.002	0.165	0.065	32	0.052	0.006	9.1	95	318	8.0	2.4	101.0	16.1	10.5	99.4	40.7
	Std. Dev.	0.6	1.3	108	0.9	0.004	0.001	0.108	0.086	43	0.086	0.003	1.3	10	43	0.1	0.4	12.8	4.5	0.0	10.1	10.2
	Count	14	14	14	13	14	14	14	14	14	14	14	13	12	14	14	5	6	14	1	4	4
Mangapoike Rv	Minimum	1.2	1.5	3	0.1	0.004	0.002	0.140	0.014	1	0.001	0.005	8.5	89	243	8.1	11.1	98.0	11.8	no data	84.0	40.0
	5%'ile	1.2	1.5	3	0.1	0.004	0.002	0.143	0.015	1	0.001	0.005	8.5	89	246	8.1	no data	no data	11.8	no data	no data	no data
	25%'ile	2.5	1.5	23	0.2	0.008	0.002	0.220	0.031	13	0.010	0.005	9.0	98	314	8.4	no data	98.0	14.3	no data	no data	no data
	Median	3.3	4.0	36	1.3	0.010	0.002	0.230	0.057	21	0.017	0.024	10.1	107	341	8.6	11.1	106.5	18.9	no data	84.0	40.0
	75%'ile	23.0	19.3	80	2.7	0.021	0.007	0.398	0.161	36	0.143	0.030	11.0	112	362	8.7	no data	115.0	22.3	no data	no data	no data
	95%'ile	195.0	97.4	1100	3.3	0.315	0.015	0.605	0.337	167	0.325	0.055	11.8	127	404	8.9	no data	no data	24.1	no data	no data	no data
	Maximum	195.0	101.0	1100	3.3	0.330	0.015	0.612	0.342	171	0.330	0.056	11.8	127	406	8.9	11.1	115.0	24.1	no data	84.0	40.0
	Mean	27.7	15.9	197	1.5	0.043	0.005	0.308	0.107	39	0.080	0.023	10.0	106	335	8.6	11.1	106.5	18.2	no data	84.0	40.0
	Std. Dev.	59.7	29.9	364	1.2	0.096	0.004	0.143	0.107	49	0.111	0.017	1.2	12	43	0.2	0.0	12.0	4.4	no data	0.0	0.0
	Count	10	11	10	10	11	11	11	11	11	11	11	11	11	11	10	1	2	11	no data	1	1

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Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO_3-N (mg/l)	NH_4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (µS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (^oC)	Chla (mg/m^2)	MCI (Unit)	% EPT taxa
Mokau Strm	Minimum	0.8	1.5	1	0.5	0.002	0.002	0.055	0.014	7	0.001	0.005	10.5	95	59	7.9	no data	no data	4.5	20.0	131.3	56.3
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	1.2	1.5	2	2.4	0.002	0.002	0.055	0.023	9	0.011	0.005	11.1	97	102	8.1	no data	no data	7.2	no data	no data	no data
	Median	1.7	1.5	4	3.4	0.005	0.002	0.055	0.032	14	0.020	0.005	11.4	99	126	8.2	no data	no data	8.8	20.0	131.3	56.3
	75%'ile	2.6	4.3	9	3.5	0.010	0.002	0.081	0.041	17	0.037	0.005	12.1	105	143	8.4	no data	no data	11.4	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	8.6	16.0	15	5.8	0.015	0.006	0.290	0.054	27	0.052	0.005	13.9	108	151	8.5	no data	no data	11.6	20.0	131.3	56.3
	Mean	2.5	4.0	6	3.1	0.006	0.003	0.093	0.032	14	0.023	0.005	11.6	101	120	8.2	no data	no data	9.1	20.0	131.3	56.3
	Std. Dev.	2.5	5.2	5	1.4	0.005	0.001	0.082	0.013	6	0.017	0.000	1.0	5	31	0.2	no data	no data	2.5	0.0	0.0	0.0
	Count	8	8	9	9	8	8	9	8	8	9	8	9	9	9	8	no data	no data	9	1	1	1
Opoutama Strm	Minimum	3.3	1.5	21	0.2	0.015	0.002	0.250	0.017	3	0.004	0.005	7.6	85	706	7.4	2.9	140.0	6.3	no data	80.9	18.2
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	5.1	2.8	36	0.9	0.023	0.004	0.314	0.068	7	0.019	0.042	8.1	90	814	7.5	3.0	173.0	9.6	no data	83.0	18.2
	Median	6.4	4.4	220	1.0	0.027	0.006	0.418	0.083	28	0.035	0.048	9.4	92	950	7.6	3.6	188.5	13.3	no data	89.2	27.9
	75%'ile	7.4	6.9	765	1.3	0.035	0.009	0.545	0.199	43	0.133	0.065	11.1	97	1045	7.8	4.7	210.0	21.5	no data	92.3	37.5
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	8.2	14.0	1800	2.3	0.043	0.013	0.670	0.475	55	0.380	0.085	12.0	100	1500	8.1	6.1	250.0	24.3	no data	93.3	37.5
	Mean	6.2	5.4	483	1.1	0.028	0.007	0.434	0.149	27	0.095	0.050	9.5	93	978	7.7	4.0	191.7	14.9	no data	87.8	27.9
	Std. Dev.	1.6	4.1	640	0.6	0.009	0.004	0.147	0.155	20	0.134	0.024	1.7	5	247	0.2	1.3	37.1	6.8	no data	6.3	13.6
	Count	8	8	8	8	8	8	8	8	8	8	8	7	6	8	8	5	6	8	no data	3	2
Ruakituri Rv	Minimum	1.4	1.5	1	0.0	0.004	0.002	0.055	0.014	3	0.001	0.005	7.9	88	165	7.6	1.9	71.0	8.5	12.6	108.3	50.0
	5%'ile	1.4	1.5	1	0.1	0.004	0.002	0.065	0.014	4	0.001	0.005	7.9	89	166	7.7	no data	no data	8.9	no data	no data	no data
	25%'ile	1.7	1.5	13	1.3	0.007	0.002	0.113	0.014	7	0.001	0.005	9.0	98	181	8.2	2.4	71.0	11.4	27.7	109.3	50.9
	Median	2.3	1.5	38	1.8	0.010	0.002	0.201	0.015	8	0.005	0.005	10.0	105	209	8.4	2.8	90.5	16.8	73.0	112.1	53.6
	75%'ile	5.1	6.0	120	2.1	0.016	0.002	0.446	0.051	15	0.036	0.013	11.2	110	231	8.5	4.3	96.0	21.6	588.3	117.4	54.1
	95%'ile	3241.1	1842.8	24866	2.8	1.220	0.021	2.341	0.166	32	0.150	0.016	12.6	117	245	8.8	no data	no data	24.3	no data	no data	no data
	Maximum	3600.0	2300.0	31000	2.9	1.520	0.021	2.759	0.169	34	0.153	0.016	12.7	118	246	8.9	8.3	96.0	25.0	760.0	119.2	54.2
	Mean	303.1	167.8	2277	1.6	0.119	0.005	0.424	0.044	11	0.030	0.008	10.1	104	206	8.4	3.7	85.8	16.8	281.9	113.2	52.6
	Std. Dev.	1038.3	613.7	8267	0.8	0.403	0.007	0.694	0.052	8	0.052	0.004	1.4	9	27	0.3	2.6	12.1	5.2	415.2	5.5	2.3
	Count	12	14	14	13	14	14	14	14	14	14	14	14	13	14	14	5	6	15	3	3	3
Te Iringaowhare Strm	Minimum	0.5	1.5	1	2.4	0.028	0.002	0.187	0.027	5	0.013	0.005	7.9	97	467	8.2	2.5	190.0	10.2	36.8	96.2	38.1
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	0.7	1.5	3	no data	0.034	0.004	0.253	0.048	7	0.034	0.005	8.5	97	503	8.2	2.8	195.0	11.8	36.8	96.2	38.1
	Median	1.3	1.5	7	2.4	0.053	0.010	0.450	0.110	11	0.098	0.005	10.2	99	610	8.3	3.8	210.0	13.7	49.1	100.1	39.1
	75%'ile	4.9	22.9	33	no data	0.096	0.034	0.503	0.193	13	0.175	0.017	10.6	101	688	8.4	5.3	225.0	17.0	61.4	104.0	40.0
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	6.1	30.0	42	2.4	0.110	0.042	0.520	0.221	14	0.200	0.021	10.7	101	714	8.4	5.8	230.0	20.0	61.4	104.0	40.0
	Mean	2.6	11.0	17	2.4	0.064	0.018	0.386	0.119	10	0.104	0.010	9.6	99	597	8.3	4.0	210.0	14.4	49.1	100.1	39.1
	Std. Dev.	3.0	16.5	22	0.0	0.042	0.021	0.176	0.097	4	0.094	0.009	1.5	3	124	0.1	1.7	20.0	4.1	17.4	5.5	1.3
	Count	3	3	3	1	3	3	3	3	3	3	3	3	2	3	3	3	3	4	2	2	2

< Median flow

< Median Flow																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO_3-N (mg/l)	NH_4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (µS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (^oC)	Chla (mg/m^2)	MCI (Unit)	% EPT taxa
Te Kumi Strm	Minimum	0.4	1.5	1	1.1	0.004	0.002	0.055	0.069	9	0.057	0.005	9.5	90	134	7.9	0.8	60.0	7.0	23.4	132.7	56.7
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	0.5	1.5	1	1.5	0.007	0.005	0.149	0.092	12	0.081	0.005	10.8	94	163	8.1	1.1	79.5	7.8	23.4	133.6	58.2
	Median	0.7	1.5	1	2.6	0.008	0.008	0.193	0.103	17	0.093	0.005	11.0	99	181	8.2	1.4	88.0	8.4	27.8	136.2	62.5
	75%'ile	2.4	1.9	5	2.8	0.012	0.008	0.217	0.127	28	0.117	0.006	11.8	102	198	8.2	2.8	94.5	10.4	32.2	138.5	64.7
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	17.9	3.0	40	3.0	0.014	0.009	0.382	0.292	60	0.280	0.010	12.2	111	202	8.4	4.5	95.0	11.5	32.2	139.2	65.4
	Mean	3.2	1.8	7	2.2	0.009	0.007	0.193	0.125	23	0.114	0.006	11.1	99	176	8.2	2.0	85.0	9.0	27.8	136.0	61.5
	Std. Dev.	6.0	0.7	13	0.7	0.003	0.002	0.090	0.067	16	0.066	0.002	0.8	7	23	0.1	1.4	12.7	1.6	6.2	3.3	4.4
	Count	8	9	9	9	9	9	9	9	9	9	9	9	7	9	9	6	7	9	2	3	3
Waiau Rv	Minimum	1.3	1.5	7	0.2	0.008	0.002	0.055	0.014	1	0.001	0.005	9.3	97	93	7.5	1.4	36.0	7.5	4.0	104.3	43.5
	5%'ile	1.3	1.5	8	0.2	0.008	0.002	0.055	0.014	1	0.001	0.005	9.3	97	94	7.5	no data	no data	7.6	no data	no data	no data
	25%'ile	1.7	1.5	16	1.2	0.011	0.005	0.055	0.014	1	0.001	0.005	9.6	100	104	7.8	1.6	37.5	8.8	4.0	104.3	43.5
	Median	2.8	1.5	24	1.5	0.013	0.008	0.104	0.014	2	0.002	0.005	10.8	103	109	8.0	2.1	40.0	12.2	56.0	112.7	50.3
	75%'ile	4.7	6.0	40	2.4	0.017	0.012	0.127	0.017	4	0.005	0.005	12.3	108	116	8.2	3.0	43.0	17.4	108.0	121.0	57.1
	95%'ile	11.7	47.5	61	4.0	0.028	0.015	0.601	0.085	9	0.069	0.013	13.9	118	129	8.6	no data	no data	20.4	no data	no data	no data
	Maximum	12.2	50.0	61	4.1	0.029	0.016	0.665	0.092	9	0.075	0.015	14.0	119	129	8.6	3.3	45.0	20.9	108.0	121.0	57.1
	Mean	3.9	8.9	30	1.8	0.014	0.009	0.140	0.023	3	0.010	0.006	11.1	105	110	8.0	2.3	40.3	13.2	56.0	112.7	50.3
	Std. Dev.	3.2	15.0	18	1.1	0.005	0.004	0.166	0.023	2	0.022	0.003	1.7	7	11	0.3	1.0	3.8	4.6	73.5	11.8	9.6
	Count	13	13	12	13	13	13	13	13	13	13	13	13	13	13	12	3	4	13	2	2	2
Waikaretaheke Rv	Minimum	0.4	1.5	3	0.3	0.002	0.002	0.108	0.018	9	0.007	0.005	10.0	105	105	7.9	2.8	48.0	12.1	10.4	106.7	43.8
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	0.8	1.5	5	1.5	0.004	0.002	0.108	0.018	9	0.007	0.005	10.0	105	109	8.0	2.9	49.0	13.0	10.4	106.7	43.8
	Median	2.8	6.3	17	3.6	0.009	0.002	0.110	0.020	9	0.008	0.005	10.6	106	114	8.1	3.2	50.5	14.0	11.3	107.8	49.0
	75%'ile	6.8	12.0	42	5.1	0.014	0.003	0.144	0.031	10	0.019	0.005	11.2	107	118	8.3	3.6	52.0	16.6	12.3	108.8	54.2
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	9.3	13.0	57	5.5	0.016	0.004	0.155	0.035	10	0.023	0.005	11.2	107	122	8.3	3.7	53.0	17.1	12.3	108.8	54.2
	Mean	3.8	6.8	23	3.3	0.009	0.003	0.124	0.024	9	0.013	0.005	10.6	106	113	8.1	3.2	50.5	14.6	11.3	107.8	49.0
	Std. Dev.	4.0	6.1	25	2.3	0.006	0.001	0.027	0.009	1	0.009	0.000	0.7	1	7	0.2	0.5	2.1	2.1	1.3	1.5	7.4
	Count	4	4	4	4	4	4	3	3	3	3	4	4	4	4	4	3	4	5	2	2	2
Wairoa Rv U/S Wairoa	Minimum	1.8	1.5	1	0.1	0.009	0.002	0.114	0.014	1	0.001	0.005	6.8	71	125	7.7	2.7	74.0	9.0	no data	76.7	0.0
	5%'ile	1.8	1.5	2	0.1	0.010	0.002	0.117	0.014	1	0.001	0.005	6.8	73	134	7.7	no data	no data	9.7	no data	no data	no data
	25%'ile	2.7	4.5	21	0.4	0.013	0.002	0.135	0.014	3	0.001	0.005	7.7	85	195	7.9	2.9	75.5	13.2	no data	no data	no data
	Median	5.6	6.7	52	1.0	0.016	0.005	0.182	0.021	5	0.008	0.005	8.7	92	217	8.1	3.2	79.0	16.1	no data	76.7	0.0
	75%'ile	18.8	21.0	88	1.4	0.036	0.009	0.223	0.025	9	0.013	0.009	9.5	100	1304	8.3	3.3	169.8	20.8	no data	no data	no data
	95%'ile	57.4	112.4	1068	2.2	0.097	0.015	0.296	0.104	29	0.085	0.031	11.6	103	3925	8.5	no data	no data	22.3	no data	no data	no data
	Maximum	65.0	137.0	1300	2.2	0.114	0.016	0.300	0.107	30	0.092	0.035	11.9	103	4790	8.6	6.2	470.0	22.4	no data	76.7	0.0
	Mean	13.1	20.7	161	1.0	0.029	0.006	0.187	0.033	8	0.018	0.009	8.8	91	838	8.1	3.6	150.6	16.7	no data	76.7	0.0
	Std. Dev.	17.2	34.3	330	0.7	0.027	0.004	0.057	0.031	9	0.027	0.009	1.5	10	1209	0.2	1.3	148.2	4.4	no data	0.0	0.0
	Count	14	16	15	15	16	16	14	14	14	14	16	15	14	16	16	6	7	16	no data	1	1

LQ flows

LQ Flows																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO_3-N (mg/l)	NH_4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (µS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (^oC)	Chla (mg/m^2)	MCI (Unit)	% EPT taxa
Aniwaniwa Strm	Minimum	0.5	1.5	1	0.7	0.002	0.002	0.055	0.014	6	0.001	0.005	8.6	97	59	7.6	2.2	42.0	6.0	53.8	115.4	58.1
	5%'ile	no data	1.5	1	no data	0.002	0.002	0.055	0.014	6	0.001	0.005	no data	no data	no data	no data	no data	no data	6.1	no data	no data	no data
	25%'ile	1.1	1.5	3	2.4	0.005	0.002	0.055	0.021	7	0.009	0.005	10.0	98	94	8.0	2.2	42.0	9.0	54.8	118.2	58.1
	Median	1.2	1.5	6	3.6	0.008	0.002	0.110	0.025	11	0.013	0.005	10.6	99	130	8.1	3.2	51.5	12.0	58.0	126.5	63.1
	75%'ile	1.9	1.5	16	4.4	0.014	0.004	0.130	0.031	12	0.019	0.005	11.0	102	136	8.4	4.2	61.0	14.3	62.7	130.8	68.0
	95%'ile	no data	12.0	25	no data	0.032	0.005	0.146	0.049	18	0.036	0.013	no data	no data	no data	no data	no data	no data	17.0	no data	no data	no data
	Maximum	6.1	12.0	25	6.1	0.032	0.005	0.146	0.049	18	0.036	0.013	12.6	104	144	8.5	4.2	61.0	17.1	64.3	132.2	68.0
	Mean	1.9	2.7	10	3.4	0.010	0.003	0.098	0.027	11	0.014	0.006	10.6	100	115	8.1	3.2	51.5	11.7	58.7	124.7	63.1
	Std. Dev.	1.8	3.3	8	1.7	0.009	0.001	0.039	0.010	4	0.010	0.003	1.1	3	31	0.3	1.4	13.4	3.4	5.3	8.5	7.0
	Count	8	10	10	9	10	10	10	10	10	10	10	9	8	9	9	2	2	11	3	3	2
Hangaroa Rv	Minimum	0.7	1.5	8	0.1	0.007	0.002	0.120	0.012	3	0.001	0.005	7.7	93	250	8.2	3.7	79.0	11.0	9.6	88.3	33.3
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	11.0	no data	no data	no data
	25%'ile	1.0	1.5	10	1.8	0.009	0.002	0.216	0.014	6	0.002	0.005	9.7	96	266	8.5	4.0	86.8	14.1	13.0	88.5	34.4
	Median	1.4	1.5	15	2.2	0.013	0.002	0.263	0.015	7	0.004	0.005	9.9	105	285	8.6	4.8	110.0	17.5	23.0	88.9	37.5
	75%'ile	2.7	1.5	24	2.5	0.018	0.004	0.363	0.018	9	0.008	0.005	10.9	116	299	8.7	5.1	128.0	24.5	49.6	98.7	43.1
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	25.0	no data	no data	no data
	Maximum	281.0	193.0	63	3.3	0.087	0.007	0.850	0.206	29	0.184	0.015	12.2	133	324	9.1	5.2	134.0	25.0	58.5	102.0	45.0
	Mean	32.6	22.8	21	2.1	0.021	0.003	0.332	0.039	9	0.026	0.006	10.1	108	283	8.6	4.6	107.7	18.4	30.4	93.1	38.6
	Std. Dev.	93.2	63.8	19	0.9	0.025	0.002	0.226	0.068	8	0.064	0.003	1.2	14	23	0.2	0.8	27.6	5.6	25.2	7.7	5.9
	Count	9	9	8	9	9	9	8	8	8	8	9	9	8	9	9	3	3	10	3	3	3
Kopuawhara Strm	Minimum	0.9	1.5	28	2.9	0.002	0.002	0.055	0.014	7	0.001	0.005	7.0	79	348	8.0	2.7	120.0	18.6	10.5	93.3	33.3
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	1.0	1.5	49	2.9	0.005	0.002	0.083	0.014	7	0.001	0.005	7.2	81	351	8.0	no data	no data	18.7	no data	93.3	33.3
	Median	1.1	1.5	90	3.3	0.009	0.002	0.159	0.016	8	0.003	0.005	7.4	85	364	8.1	2.7	120.0	20.5	10.5	95.7	34.2
	75%'ile	1.3	1.5	170	3.7	0.010	0.002	0.286	0.121	61	0.108	0.005	7.6	85	386	8.1	no data	no data	22.3	no data	98.0	35.0
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	1.3	1.5	230	3.7	0.010	0.002	0.364	0.224	112	0.210	0.005	7.9	85	399	8.2	2.7	120.0	22.4	10.5	98.0	35.0
	Mean	1.1	1.5	110	3.3	0.008	0.002	0.184	0.068	34	0.054	0.005	7.4	83	368	8.1	2.7	120.0	20.5	10.5	95.7	34.2
	Std. Dev.	0.2	0.0	87	0.4	0.004	0.000	0.136	0.104	52	0.104	0.000	0.3	3	23	0.1	0.0	0.0	2.1	0.0	3.3	1.2
	Count	4	4	4	4	4	4	4	4	4	4	4	4	3	4	4	1	1	4	1	2	2
Mangapoike Rv	Minimum	1.4	1.5	18	0.1	0.006	0.002	0.140	0.029	7	0.007	0.005	9.0	89	333	8.4	11.1	115.0	11.8	no data	84.0	40.0
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	2.2	1.5	23	1.0	0.008	0.002	0.220	0.036	15	0.010	0.005	9.2	101	341	8.4	no data	no data	14.1	no data	no data	no data
	Median	2.7	2.8	27	1.3	0.009	0.002	0.282	0.086	19	0.053	0.022	10.2	111	347	8.6	11.1	115.0	20.5	no data	84.0	40.0
	75%'ile	51.5	4.0	55	2.8	0.020	0.006	0.474	0.173	87	0.161	0.028	11.1	123	365	8.7	no data	no data	22.5	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	195.0	101.0	600	3.3	0.330	0.007	0.612	0.342	171	0.330	0.031	11.8	127	372	8.9	11.1	115.0	24.1	no data	84.0	40.0
	Mean	41.1	18.9	125	1.7	0.064	0.004	0.335	0.125	53	0.103	0.019	10.3	110	351	8.6	11.1	115.0	18.9	no data	84.0	40.0
	Std. Dev.	86.1	40.2	233	1.3	0.131	0.002	0.178	0.121	65	0.127	0.011	1.1	14	15	0.2	0.0	0.0	4.9	no data	0.0	0.0
	Count	5	6	6	5	6	6	6	6	6	6	6	6	6	6	6	1	1	6	no data	1	1

LQ flows

LQ Flows																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO_3-N (mg/l)	NH_4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (µS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (^oC)	Chla (mg/m^2)	MCI (Unit)	% EPT taxa
Mokau Strm	Minimum	0.8	1.5	1	0.5	0.002	0.002	0.055	0.014	7	0.001	0.005	10.5	95	59	7.9	no data	no data	4.5	20.0	131.3	56.3
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	1.2	1.5	2	2.3	0.002	0.002	0.055	0.022	9	0.009	0.005	11.0	97	105	8.1	no data	no data	8.0	no data	no data	no data
	Median	1.7	1.5	4	3.3	0.005	0.002	0.055	0.031	13	0.020	0.005	11.3	100	130	8.2	no data	no data	9.9	20.0	131.3	56.3
	75%'ile	2.8	5.6	6	3.5	0.011	0.002	0.055	0.043	16	0.039	0.005	12.0	106	145	8.4	no data	no data	11.5	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	8.6	16.0	15	5.8	0.015	0.006	0.160	0.054	27	0.052	0.005	13.9	108	151	8.5	no data	no data	11.6	20.0	131.3	56.3
	Mean	2.7	4.4	5	3.1	0.006	0.003	0.068	0.032	14	0.023	0.005	11.6	101	121	8.2	no data	no data	9.3	20.0	131.3	56.3
	Std. Dev.	2.7	5.5	5	1.5	0.005	0.002	0.037	0.014	7	0.018	0.000	1.1	5	32	0.2	no data	no data	2.5	0.0	0.0	0.0
	Count	7	7	8	8	7	7	8	7	7	8	7	8	8	8	8	no data	no data	8	1	1	1
Opoutama Strm	Minimum	7.6	4.7	23	0.9	0.028	0.005	0.507	0.017	3	0.004	0.005	8.2	no data	1500	8.1	6.1	250.0	21.3	no data	93.3	no data
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Median	7.6	4.7	23	0.9	0.028	0.005	0.507	0.017	3	0.004	0.005	8.2	no data	1500	8.1	6.1	250.0	21.3	no data	93.3	no data
	75%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	7.6	4.7	23	0.9	0.028	0.005	0.507	0.017	3	0.004	0.005	8.2	no data	1500	8.1	6.1	250.0	21.3	no data	93.3	no data
	Mean	7.6	4.7	23	0.9	0.028	0.005	0.507	0.017	3	0.004	0.005	8.2	no data	1500	8.1	6.1	250.0	21.3	no data	93.3	no data
	Std. Dev.	0.0	0.0	0	0.0	0.000	0.000	0.000	0.000	0	0.000	0.000	0.0	no data	0	0.0	0.0	0.0	0.0	no data	0.0	no data
	Count	1	1	1	1	1	1	1	1	1	1	1	1	no data	1	1	1	1	1	no data	1	no data
Ruakituri Rv	Minimum	1.4	1.5	1	0.3	0.004	0.002	0.055	0.014	3	0.001	0.005	7.9	88	192	8.1	1.9	86.0	8.5	12.6	108.3	50.0
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	1.5	1.5	13	1.4	0.009	0.002	0.142	0.014	7	0.001	0.005	8.5	94	205	8.3	2.1	88.3	14.4	27.7	109.3	50.9
	Median	2.0	1.5	23	2.0	0.011	0.002	0.201	0.014	7	0.002	0.005	9.5	106	214	8.4	2.6	95.0	21.1	73.0	112.1	53.6
	75%'ile	2.2	3.8	100	2.3	0.016	0.004	0.343	0.024	8	0.010	0.009	10.0	110	233	8.5	6.9	95.8	22.2	588.3	117.4	54.1
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	11.4	14.0	330	2.9	0.022	0.021	0.670	0.153	16	0.140	0.015	12.7	115	242	8.9	8.3	96.0	25.0	760.0	119.2	54.2
	Mean	3.4	3.6	75	1.8	0.012	0.005	0.262	0.034	8	0.021	0.007	9.6	103	217	8.4	4.3	92.3	18.7	281.9	113.2	52.6
	Std. Dev.	3.9	4.5	111	0.8	0.006	0.007	0.201	0.048	4	0.048	0.004	1.5	10	17	0.2	3.5	5.5	5.4	415.2	5.5	2.3
	Count	6	8	8	8	8	8	8	8	8	8	8	8	7	8	8	3	3	9	3	3	3
Te Iringaowhare Strm	Minimum	6.1	30.0	42	no data	0.110	0.010	0.520	0.110	11	0.098	0.005	7.9	no data	714	8.2	5.8	210.0	14.0	36.8	96.2	38.1
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	14.0	36.8	96.2	38.1
	Median	6.1	30.0	42	no data	0.110	0.010	0.520	0.110	11	0.098	0.005	7.9	no data	714	8.2	5.8	210.0	17.0	49.1	100.1	39.1
	75%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	20.0	61.4	104.0	40.0
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	6.1	30.0	42	no data	0.110	0.010	0.520	0.110	11	0.098	0.005	7.9	no data	714	8.2	5.8	210.0	20.0	61.4	104.0	40.0
	Mean	6.1	30.0	42	no data	0.110	0.010	0.520	0.110	11	0.098	0.005	7.9	no data	714	8.2	5.8	210.0	17.0	49.1	100.1	39.1
	Std. Dev.	0.0	0.0	0	no data	0.000	0.000	0.000	0.000	0	0.000	0.000	0.0	no data	0	0.0	0.0	0.0	4.2	17.4	5.5	1.3
	Count	1	1	1	no data	1	1	1	1	1	1	1	1	no data	1	1	1	1	2	2	2	2

LQ flows

LQ Flows																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO_3-N (mg/l)	NH_4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (µS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (^oC)	Chla (mg/m^2)	MCI (Unit)	% EPT taxa
Te Kumi Strm	Minimum	0.4	1.5	1	1.2	0.004	0.002	0.173	0.083	9	0.073	0.005	9.5	94	134	7.9	0.8	60.0	7.8	23.4	132.7	56.7
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	0.4	1.5	1	1.6	0.007	0.006	0.193	0.103	13	0.093	0.005	10.5	95	168	8.0	1.0	87.0	8.1	23.4	133.6	58.2
	Median	0.5	1.5	1	2.3	0.009	0.007	0.210	0.120	22	0.110	0.005	11.0	99	181	8.2	1.2	90.5	10.2	27.8	136.2	62.5
	75%'ile	3.6	3.0	2	2.8	0.012	0.008	0.238	0.148	37	0.136	0.010	11.1	106	198	8.2	2.3	95.0	10.5	32.2	138.5	64.7
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	17.9	3.0	40	3.0	0.012	0.009	0.382	0.292	60	0.280	0.010	12.2	111	202	8.2	4.5	95.0	11.5	32.2	139.2	65.4
	Mean	3.9	2.0	8	2.2	0.009	0.007	0.234	0.144	27	0.134	0.007	10.9	100	177	8.1	1.8	86.3	9.7	27.8	136.0	61.5
	Std. Dev.	7.0	0.8	16	0.7	0.003	0.002	0.075	0.075	19	0.075	0.003	0.9	8	25	0.1	1.5	13.4	1.5	6.2	3.3	4.4
	Count	6	6	6	6	6	6	6	6	6	6	6	6	4	6	6	5	6	6	2	3	3
Waiau Rv	Minimum	1.3	1.5	14	1.4	0.008	0.004	0.055	0.014	1	0.001	0.005	9.3	97	105	7.5	3.3	39.0	9.0	4.0	104.3	43.5
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	1.4	1.5	22	1.5	0.012	0.005	0.055	0.014	2	0.001	0.005	9.4	99	105	7.7	no data	39.0	14.5	4.0	104.3	43.5
	Median	1.6	2.8	29	2.7	0.013	0.007	0.112	0.014	2	0.001	0.005	9.6	101	116	7.9	3.3	42.0	17.4	56.0	112.7	50.3
	75%'ile	2.8	4.0	39	3.4	0.017	0.010	0.147	0.015	4	0.003	0.005	10.1	104	128	8.4	no data	45.0	17.6	108.0	121.0	57.1
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	4.3	5.0	61	4.1	0.018	0.012	0.665	0.047	4	0.036	0.005	12.0	107	129	8.6	3.3	45.0	20.9	108.0	121.0	57.1
	Mean	2.2	2.9	32	2.6	0.013	0.008	0.191	0.020	3	0.007	0.005	10.0	101	116	8.0	3.3	42.0	16.1	56.0	112.7	50.3
	Std. Dev.	1.2	1.6	17	1.1	0.004	0.003	0.235	0.013	1	0.014	0.000	1.0	4	12	0.4	0.0	4.2	4.0	73.5	11.8	9.6
	Count	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	1	2	6	2	2	2
Waikaretaheke Rv	Minimum	1.1	1.5	6	0.3	0.006	0.002	0.110	0.020	9	0.008	0.005	10.0	105	105	7.9	2.8	50.0	13.4	10.4	106.7	54.2
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	1.1	1.5	6	0.3	0.006	0.002	0.110	0.020	9	0.008	0.005	10.0	105	105	7.9	no data	50.0	13.4	no data	no data	no data
	Median	5.2	7.3	32	1.5	0.011	0.003	0.133	0.028	9	0.015	0.005	10.6	106	109	8.0	2.8	50.5	15.2	10.4	106.7	54.2
	75%'ile	9.3	13.0	57	2.7	0.016	0.004	0.155	0.035	10	0.023	0.005	11.2	107	114	8.0	no data	51.0	17.1	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	9.3	13.0	57	2.7	0.016	0.004	0.155	0.035	10	0.023	0.005	11.2	107	114	8.0	2.8	51.0	17.1	10.4	106.7	54.2
	Mean	5.2	7.3	32	1.5	0.011	0.003	0.133	0.028	9	0.015	0.005	10.6	106	109	8.0	2.8	50.5	15.2	10.4	106.7	54.2
	Std. Dev.	5.8	8.1	36	1.7	0.007	0.001	0.032	0.011	1	0.011	0.000	0.8	2	7	0.1	0.0	0.7	2.7	0.0	0.0	0.0
	Count	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	1	1	1
Wairoa Rv U/S Wairoa	Minimum	1.8	1.5	16	0.1	0.009	0.002	0.114	0.014	3	0.001	0.005	6.8	71	125	7.8	2.9	75.0	11.7	no data	76.7	0.0
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	2.4	1.5	44	0.7	0.013	0.002	0.139	0.014	4	0.001	0.005	7.7	84	181	8.0	3.0	75.5	13.8	no data	no data	no data
	Median	2.8	5.0	52	1.0	0.015	0.004	0.175	0.021	4	0.004	0.005	8.7	95	293	8.0	3.2	77.0	19.1	no data	76.7	0.0
	75%'ile	6.8	14.5	83	1.5	0.025	0.007	0.198	0.022	7	0.010	0.005	9.7	98	1600	8.3	5.5	371.8	21.8	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	26.8	137.0	1300	2.2	0.114	0.009	0.300	0.025	11	0.013	0.018	10.7	103	4790	8.4	6.2	470.0	22.4	no data	76.7	0.0
	Mean	7.0	22.2	193	1.1	0.028	0.005	0.181	0.019	6	0.006	0.006	8.7	91	1082	8.1	4.1	207.3	17.7	no data	76.7	0.0
	Std. Dev.	8.9	44.5	416	0.6	0.033	0.003	0.061	0.005	3	0.005	0.004	1.4	11	1534	0.2	1.8	227.5	4.4	no data	0.0	0.0
	Count	7	9	9	9	9	9	7	7	7	7	9	9	8	9	9	3	3	9	no data	1	1

Appendix C Trend analysis results for water quality variables

Site	Variable	Sample Period	n	Min	Median	Max	Trend p	Trend PAC
Aniwaniwa Strm	TN (mg/l)	9/2/04-16/11/13	39	0.055	0.121	0.283	0.023	-2.20
	TP (mg/l)	9/2/04-16/11/13	39	0.002	0.007	0.039	0.743	0.00
	DIN (mg/l)	9/2/04-16/11/13	39	0.013	0.031	0.092	**0.023**	**-6.47**
	DRP (mg/l)	9/2/04-16/11/13	39	0.002	0.002	0.014	0.387	0.00
	NO_3-N (mg/l)	9/2/04-16/11/13	38	0.001	0.018	0.056	**0.006**	**-9.60**
	Black Disc	15/8/05-16/11/13	32	0.3	3.5	6.4	0.221	-6.75
	Turbidity (NTU)	9/2/04-16/11/13	39	0.3	0.9	18.2	**0.026**	**10.05**
	E. Coli (cfu/100mL)	30/8/04-16/11/13	38	1	4	1100	**0.023**	**9.62**
	DIN:DRP	9/2/04-16/11/13	38	2.2	12.8	46.0	0.413	-5.15
	NH_4-N (mg/l)	9/2/04-16/11/13	40	0.005	0.005	0.050	0.223	0.00
	SS (mg/l)	9/2/04-16/11/13	40	1.5	1.5	36.0	0.068	0.00
	TOC (mg/l)	9/2/04-5/6/12	33	0.3	3.1	22.6	0.953	-0.65
	TON (mg/l)	9/2/04-16/11/13	40	0.050	0.090	0.270	**0.048**	**0.00**
	Conductivity (µS/cm)	9/2/04-16/11/13	40	39	106	144	0.152	-1.24
	HDT (mg/l)	9/2/04-5/6/12	34	14	45	61	0.498	-0.82
Hangaroa Rv	TN (mg/l)	9/2/04-16/11/13	38	0.201	0.372	2.120	0.775	0.40
	TP (mg/l)	9/2/04-16/11/13	39	0.009	0.030	0.560	0.354	-2.85
	DIN (mg/l)	9/2/04-16/11/13	38	0.012	0.071	0.594	0.293	-3.30
	DRP (mg/l)	9/2/04-16/11/13	39	0.002	0.005	0.050	0.596	0.00
	NO_3-N (mg/l)	9/2/04-16/11/13	38	0.001	0.057	0.570	0.315	-2.33
	Black Disc	9/2/04-16/11/13	39	0.0	0.5	3.0	0.610	-1.43
	Turbidity (NTU)	9/2/04-16/11/13	37	0.5	6.5	730.0	0.464	6.72
	E. Coli (cfu/100mL)	31/8/04-16/11/13	37	1	56	14000	0.484	7.99
	DIN:DRP	9/2/04-16/11/13	38	0.6	11.6	93.0	0.848	-0.48
	NH_4-N (mg/l)	9/2/04-16/11/13	39	0.005	0.005	0.100	0.078	0.00
	SS (mg/l)	9/2/04-16/11/13	39	1.5	9.0	750.0	0.510	2.78
	TOC (mg/l)	9/2/04-5/6/12	32	3.2	5.2	12.9	1.000	0.00
	TON (mg/l)	9/2/04-16/11/13	39	0.100	0.280	1.860	0.674	0.45
	Conductivity (µS/cm)	9/2/04-16/11/13	39	139	251	370	0.889	0.19
	HDT (mg/l)	9/2/04-5/6/12	33	60	102	142	0.318	2.10

Site	Variable	Sample Period	n	Min	Median	Max	Trend p	Trend PAC
Kopuawhara Strm	TN (mg/l)	10/2/04-16/11/13	40	0.090	0.259	1.220	0.263	-2.23
	TP (mg/l)	10/2/04-16/11/13	40	0.002	0.010	0.300	0.192	-5.36
	DIN (mg/l)	10/2/04-16/11/13	40	0.014	0.158	0.350	0.531	-0.70
	DRP (mg/l)	10/2/04-16/11/13	40	0.002	0.002	0.033	0.231	0.00
	NO_3-N (mg/l)	10/2/04-16/11/13	40	0.002	0.144	0.340	0.325	-0.46
	Black Disc	10/2/04-16/11/13	39	0.1	1.9	4.2	0.711	-1.40
	Turbidity (NTU)	10/2/04-16/11/13	39	0.6	2.0	270.0	0.379	4.02
	E. Coli (cfu/100mL)	31/8/04-16/11/13	38	1	68	7700	0.084	10.02
	DIN:DRP	10/2/04-16/11/13	40	1.5	27.0	126.0	0.447	1.21
	NH_4-N (mg/l)	10/2/04-16/11/13	40	0.005	0.005	0.062	0.910	0.00
	SS (mg/l)	10/2/04-16/11/13	40	1.5	2.3	340.0	0.958	0.00
	TOC (mg/l)	10/2/04-6/6/12	33	0.8	3.2	14.3	0.093	-3.18
	TON (mg/l)	10/2/04-16/11/13	40	0.050	0.113	0.898	0.258	-3.95
	Conductivity (µS/cm)	10/2/04-16/11/13	40	110	279	399	0.893	0.28
	HDT (mg/l)	10/2/04-6/6/12	34	37	92	120	0.910	0.11
Mangapoike Rv	TN (mg/l)	26/5/10-16/11/13	15	0.220	0.355	1.310	0.271	-22.37
	TP (mg/l)	26/5/10-16/11/13	15	0.006	0.021	1.130	1.000	-45.18
	DIN (mg/l)	26/5/10-16/11/13	15	0.024	0.190	0.440	0.463	-16.30
	DRP (mg/l)	26/5/10-16/11/13	15	0.002	0.005	0.030	0.254	40.53
	NO_3-N (mg/l)	26/5/10-16/11/13	15	0.011	0.161	0.420	0.463	-29.47
	Black Disc	26/5/10-16/11/13	14	0.0	0.6	2.7	0.159	35.09
	Turbidity (NTU)	26/5/10-16/11/13	15	2.5	23.0	1140.0	1.000	-51.02
	E. Coli (cfu/100mL)	26/5/10-16/11/13	15	18	90	11000	0.271	-221.95
	DIN:DRP	26/5/10-16/11/13	15	9.7	38.0	171.0	0.271	-28.22
	NH_4-N (mg/l)	26/5/10-16/11/13	15	0.005	0.005	0.053	0.838	0.00
	SS (mg/l)	26/5/10-16/11/13	15	1.5	15.3	1510.0	1.000	-98.24
	TOC (mg/l)	26/5/10-6/6/12	7	2.3	4.5	11.1	0.281	-48.48
	TON (mg/l)	26/5/10-16/11/13	15	0.090	0.244	1.007	0.852	-16.37
	Conductivity (µS/cm)	26/5/10-16/11/13	15	181	243	365	0.463	6.39
	HDT (mg/l)	26/5/10-6/6/12	9	71	93	115	0.420	17.98

Site	Variable	Sample Period	n	Min	Median	Max	Trend p	Trend PAC
Opoutama Strm	TN (mg/l)	10/2/04-8/11/12	36	0.264	0.570	3.580	0.639	-1.56
	TP (mg/l)	10/2/04-8/11/12	36	0.015	0.043	0.810	0.272	-3.72
	DIN (mg/l)	10/2/04-8/11/12	36	0.017	0.281	1.022	**0.003**	**-7.08**
	DRP (mg/l)	10/2/04-8/11/12	36	0.002	0.008	0.019	**0.051**	**-7.07**
	NO_3-N (mg/l)	10/2/04-8/11/12	36	0.004	0.212	0.950	**0.001**	**-4.79**
	Black Disc	10/2/04-8/11/12	35	0.0	0.9	2.3	0.515	-1.10
	Turbidity (NTU)	10/2/04-8/11/12	34	3.0	7.8	804.0	0.159	5.68
	E. Coli (cfu/100mL)	31/8/04-8/11/12	33	1	130	29000	0.637	10.53
	DIN:DRP	10/2/04-8/11/12	36	3.2	39.4	195.0	0.715	2.98
	NH_4-N (mg/l)	10/2/04-8/11/12	36	0.005	0.060	0.130	0.228	-4.37
	SS (mg/l)	10/2/04-8/11/12	36	1.5	8.6	1520.0	0.084	8.58
	TOC (mg/l)	10/2/04-6/6/12	33	1.8	4.5	14.6	0.767	-0.68
	TON (mg/l)	10/2/04-8/11/12	36	0.110	0.274	3.215	0.433	2.69
	Conductivity (µS/cm)	10/2/04-8/11/12	36	34	677	1500	0.602	1.33
	HDT (mg/l)	10/2/04-6/6/12	34	44	143	250	0.498	1.51
Ruakituri Rv	TN (mg/l)	9/2/04-16/11/13	40	0.080	0.234	2.759	0.118	4.60
	TP (mg/l)	9/2/04-16/11/13	40	0.004	0.020	1.520	0.621	-2.57
	DIN (mg/l)	9/2/04-16/11/13	40	0.012	0.093	0.280	0.591	-0.91
	DRP (mg/l)	9/2/04-16/11/13	40	0.002	0.005	0.030	0.502	0.00
	NO_3-N (mg/l)	9/2/04-16/11/13	39	0.001	0.081	0.270	0.711	-0.41
	Black Disc	9/2/04-16/11/13	39	0.0	0.7	2.9	0.817	-1.26
	Turbidity (NTU)	9/2/04-16/11/13	37	1.0	7.1	3600.0	**0.042**	**14.99**
	E. Coli (cfu/100mL)	31/8/04-16/11/13	38	1	55	31000	0.067	11.79
	DIN:DRP	9/2/04-16/11/13	40	3.0	13.2	120.5	0.561	2.69
	NH_4-N (mg/l)	9/2/04-16/11/13	40	0.005	0.010	0.071	0.171	0.00
	SS (mg/l)	9/2/04-16/11/13	40	1.5	9.0	2300.0	0.142	8.13
	TOC (mg/l)	9/2/04-5/6/12	33	1.9	3.8	12.9	0.407	-3.34
	TON (mg/l)	9/2/04-16/11/13	40	0.050	0.125	2.590	**0.006**	**10.09**
	Conductivity (µS/cm)	9/2/04-16/11/13	39	110	172	256	0.817	-0.14
	HDT (mg/l)	9/2/04-5/6/12	34	42	75	107	0.955	0.13

Site	Variable	Sample Period	n	Min	Median	Max	Trend p	Trend PAC
Te Iringaowhare Strm	TN (mg/l)	9/2/04-10/2/10	25	0.184	0.328	1.482	0.187	-6.25
	TP (mg/l)	9/2/04-10/2/10	25	0.028	0.047	0.221	0.596	-2.93
	DIN (mg/l)	9/2/04-10/2/10	25	0.027	0.110	0.418	0.333	-5.20
	DRP (mg/l)	9/2/04-10/2/10	25	0.002	0.031	0.045	**0.021**	**-12.94**
	NO_3-N (mg/l)	9/2/04-10/2/10	25	0.001	0.098	0.395	0.538	-2.19
	Black Disc	9/2/04-10/2/10	21	0.1	1.0	2.9	0.151	14.01
	Turbidity (NTU)	9/2/04-10/2/10	25	0.5	2.8	139.0	0.187	-12.87
	E. Coli (cfu/100mL)	30/8/04-10/2/10	23	1	42	540	0.234	-7.06
	DIN:DRP	9/2/04-10/2/10	25	0.9	4.4	19.3	0.187	13.77
	NH_4-N (mg/l)	9/2/04-10/2/10	25	0.005	0.010	0.070	0.577	0.00
	SS (mg/l)	9/2/04-10/2/10	25	1.5	5.0	172.0	0.255	-3.76
	TOC (mg/l)	9/2/04-10/2/10	25	2.3	5.0	25.1	0.860	1.48
	TON (mg/l)	9/2/04-10/2/10	25	0.090	0.190	1.290	0.477	-3.19
	Conductivity (µS/cm)	9/2/04-10/2/10	25	340	467	714	0.217	3.90
	HDT (mg/l)	9/2/04-10/2/10	25	127	190	230	0.325	1.38
Te Kumi Strm	TN (mg/l)	9/2/04-7/11/12	35	0.055	0.205	0.382	**0.011**	**-2.64**
	TP (mg/l)	9/2/04-7/11/12	35	0.004	0.010	0.020	**0.029**	**-3.94**
	DIN (mg/l)	9/2/04-7/11/12	35	0.069	0.115	0.292	**0.008**	**-3.89**
	DRP (mg/l)	9/2/04-7/11/12	35	0.002	0.008	0.018	**0.027**	**-6.26**
	NO_3-N (mg/l)	9/2/04-7/11/12	34	0.057	0.104	0.280	**0.023**	**-4.00**
	Black Disc	9/2/04-7/11/12	36	0.9	2.8	5.8	0.076	-5.32
	Turbidity (NTU)	9/2/04-7/11/12	35	0.2	0.5	17.9	**0.039**	**9.03**
	E. Coli (cfu/100mL)	30/8/04-7/11/12	33	1	1	45	0.876	0.00
	DIN:DRP	9/2/04-7/11/12	35	6.4	15.7	66.0	0.357	2.89
	NH_4-N (mg/l)	9/2/04-7/11/12	35	0.005	0.005	0.050	0.202	0.00
	SS (mg/l)	9/2/04-7/11/12	35	1.5	1.5	3.0	0.218	0.00
	TOC (mg/l)	9/2/04-5/6/12	32	0.3	1.8	4.6	**0.018**	**-11.91**
	TON (mg/l)	9/2/04-7/11/12	35	0.050	0.090	0.090	0.141	0.00
	Conductivity (µS/cm)	9/2/04-7/11/12	36	92	181	202	0.602	-0.28
	HDT (mg/l)	9/2/04-5/6/12	33	55	84	95	0.812	0.09

Site	Variable	Sample Period	n	Min	Median	Max	Trend p	Trend PAC
Waiau Rv	TN (mg/l)	25/5/10-16/11/13	15	0.055	0.141	1.130	0.271	-23.49
	TP (mg/l)	25/5/10-16/11/13	15	0.008	0.019	0.920	0.271	-65.53
	DIN (mg/l)	25/5/10-16/11/13	15	0.014	0.036	0.229	**0.040**	**-46.02**
	DRP (mg/l)	25/5/10-16/11/13	15	0.002	0.012	0.024	0.128	-19.70
	NO_3-N (mg/l)	25/5/10-16/11/13	15	0.001	0.024	0.197	0.057	-48.86
	Black Disc	25/5/10-16/11/13	15	0.0	0.6	3.4	0.271	24.36
	Turbidity (NTU)	25/5/10-16/11/13	14	1.3	7.8	550.0	0.840	-13.40
	E. Coli (cfu/100mL)	25/5/10-16/11/13	15	7	36	440	0.463	-68.35
	DIN:DRP	25/5/10-16/11/13	15	1.3	3.8	9.5	0.066	-24.80
	NH_4-N (mg/l)	25/5/10-16/11/13	15	0.005	0.005	0.052	**0.049**	**0.00**
	SS (mg/l)	25/5/10-16/11/13	15	1.5	17.0	1180.0	0.463	-90.82
	TOC (mg/l)	25/5/10-5/6/12	7	1.4	3.3	9.5	0.281	-58.66
	TON (mg/l)	25/5/10-16/11/13	15	0.090	0.100	0.901	0.846	0.00
	Conductivity (µS/cm)	25/5/10-16/11/13	15	83	104	129	1.000	2.47
	HDT (mg/l)	25/5/10-5/6/12	9	28	36	48	0.540	-5.08
Waikaretaheke Rv	TN (mg/l)	9/2/04-5/6/12	33	0.023	0.117	0.688	0.320	-0.98
	TP (mg/l)	9/2/04-5/6/12	34	0.002	0.006	0.371	0.954	0.00
	DIN (mg/l)	9/2/04-5/6/12	33	0.015	0.027	0.137	0.520	-3.17
	DRP (mg/l)	9/2/04-5/6/12	34	0.002	0.002	0.016	**0.026**	**0.00**
	NO_3-N (mg/l)	9/2/04-5/6/12	32	0.004	0.015	0.124	0.196	-6.34
	Black Disc	9/2/04-5/6/12	28	0.1	2.2	5.5	0.547	1.34
	Turbidity (NTU)	9/2/04-5/6/12	33	0.3	1.1	304.0	0.161	8.84
	E. Coli (cfu/100mL)	30/8/04-5/6/12	32	1	11	700	0.950	0.00
	DIN:DRP	9/2/04-5/6/12	33	1.9	11.0	39.0	0.243	3.78
	NH_4-N (mg/l)	9/2/04-5/6/12	34	0.005	0.005	0.060	0.191	0.00
	SS (mg/l)	9/2/04-5/6/12	34	1.5	1.5	575.0	0.471	0.00
	TOC (mg/l)	9/2/04-5/6/12	33	0.3	2.9	22.0	0.194	-3.16
	TON (mg/l)	9/2/04-5/6/12	34	0.048	0.090	0.570	0.652	0.00
	Conductivity (µS/cm)	9/2/04-5/6/12	34	97	108	143	**0.037**	**-1.37**
	HDT (mg/l)	9/2/04-5/6/12	34	39	45	59	0.688	0.00

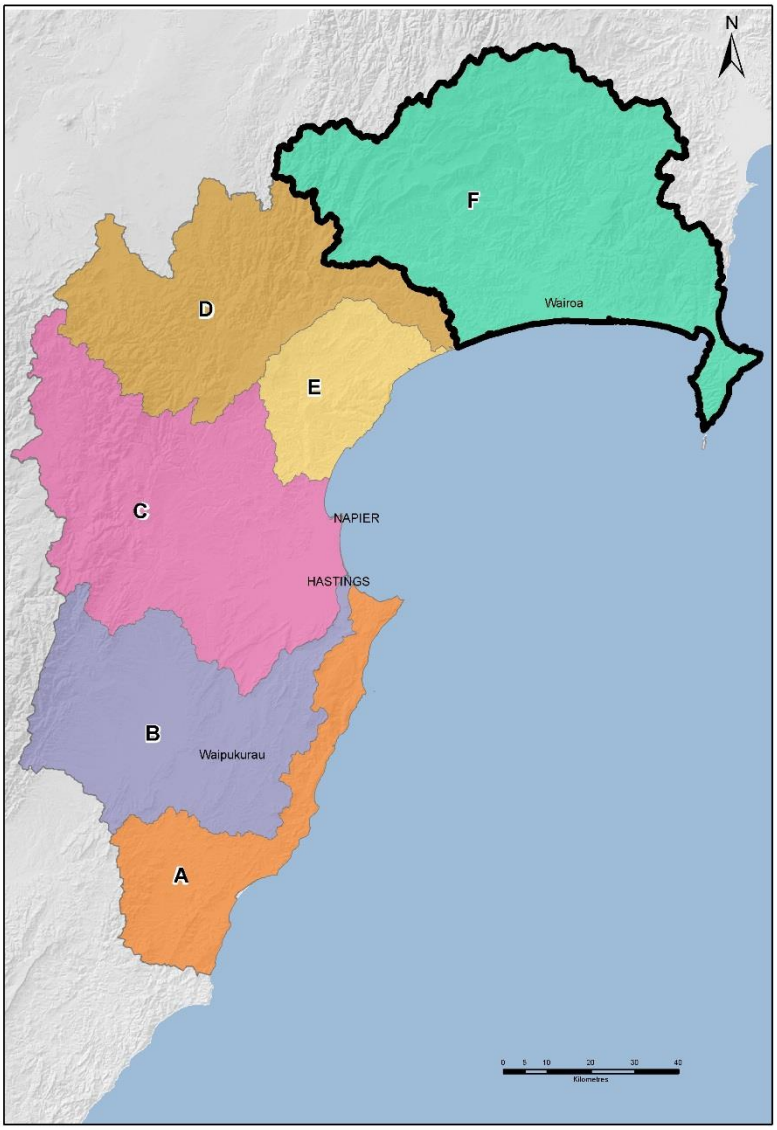
Site	Variable	Sample Period	n	Min	Median	Max	Trend p	Trend PAC
Wairoa Rv U/S Wairoa	TN (mg/l)	10/2004-16/11/13	37	0.107	0.225	2.879	0.395	2.17
	TP (mg/l)	10/2004-16/11/13	39	0.004	0.026	2.200	0.781	3.20
	DIN (mg/l)	10/2004-16/11/13	37	0.014	0.060	0.660	0.342	-1.67
	DRP (mg/l)	10/2004-16/11/13	39	0.002	0.006	0.043	0.452	3.72
	NO_3-N (mg/l)	10/2004-16/11/13	37	0.001	0.040	0.373	0.162	-3.09
	Black Disc	11/2009-16/11/13	18	0.0	0.6	2.1	0.325	-27.30
	Turbidity (NTU)	10/2004-16/11/13	36	2.0	9.3	1510.0	0.087	12.20
	E. Coli (cfu/100mL)	30/8/04-16/11/13	37	1	46	14000	0.007	19.98
	DIN:DRP	10/2004-16/11/13	37	1.1	10.5	137.0	0.617	-1.61
	NH_4-N (mg/l)	10/2004-16/11/13	39	0.005	0.010	0.119	0.052	0.00
	SS (mg/l)	10/2004-16/11/13	39	1.5	13.5	2900.0	0.817	4.46
	TOC (mg/l)	10/2004-6/6/12	32	2.5	3.8	12.8	0.215	-4.28
	TON (mg/l)	10/2004-16/11/13	39	0.080	0.170	2.581	0.511	1.50
	Conductivity (µS/cm)	10/2004-16/11/13	39	125	203	4790	0.105	-2.38
	HDT (mg/l)	10/2004-6/6/12	33	56	76	470	0.813	0.50

The tables presented in Appendix C present the state and trend of water quality variables from sites within the Wairoa catchment. The minima, medians and maxima are given for each variable at each site for the sample period indicated. Sample periods in amber indicate the time period covered less than 8 out of the 10 years from Jan 2004 to Dec 2013, and caution should be exercised when comparing these results to other sites with longer records. We explored whether any trends over time were evident by using Seasonal Kendall tests with a significance level (α) of 0.05. Sen slope was used to estimate the Percent Annual Change (PAC) and gives an indication of the magnitude of change over time. A statistically significant ($p < 0.05$, in bold) change of 1% or more was considered "meaningful". Cells are coloured blue when a meaningfully significant improvement in water quality was observed ("sig better"), and are coloured red when a meaningfully significant deterioration in water quality was observed ("sig worse"). Cells are shaded grey when the direction of change in the variable of interest is neither intuitively good nor bad (e.g. conductivity, DIN/DRP).

Appendix D **Regional ranking tables for select water quality variables**

Tables in the following pages are coloured and coded in line with the major regional water management zones identified below. Letters relate to:

- (A) Porangahau River/Southern Coastal
- (B) Tukituki River
- (C) TANK (Tutaekuri River, Ahuriri Estuary, Ngaruroro River, Karamu Stream)
- (D) Mohaka River (bordered in black)
- (E) Waikari River/Esk River/Aropaoanui River
- (F) Wairoa River/Northern Coastal



Sites ranked by median Total Nitrogen (TN, mg/l), 2009-2013, with colours signifying reporting zone. Lower ranks are 'better'. Medians generated from sample sizes of at least 30 are considered robust (Snelder pers. comm. 2014). Medians generated from sample sizes less than 30 should be treated with caution.

Site	Median TN	Sample size (n)	Rank	Catchment	Reporting Zone
Ngaruroro Rv at Kuripapango (NIWA)	0.046	60	1	Ngaruroro	C
Taruarau Rv	0.055	14	2	Ngaruroro	C
Mokau Strm	0.055	12	2	Wairoa	F
Makaroro Rv (NIWA)	0.086	60	4	Tukituki	B
Tutaekuri Rv at Lawrence Hut	0.102	34	5	Tutaekuri	C
Mohaka Rv U/S Taharua Rv	0.109	61	6	Mohaka	E
Ngaruroro Rv at Whanawhana	0.110	33	7	Ngaruroro	C
Waikaretaheke Rv	0.116	13	8	Wairoa	F
Aniwaniwa Strm	0.117	29	9	Wairoa	F
Waiau Rv	0.120	25	10	Wairoa	F
Ripia Rv U/S Mohaka Rv	0.134	36	11	Mohaka	E
Mokomokonui Rv	0.136	28	12	Mohaka	E
Ngaruroro Rv U/S HB Dairies	0.141	16	13	Ngaruroro	C
Ngaruroro Rv at Chesterhope (NIWA)	0.173	60	14	Ngaruroro	C
Tukituki Rv at SH50	0.175	64	15	Tukituki	B
Ngaruroro Rv D/S HB Dairies	0.180	33	16	Ngaruroro	C
Tutaekuri Rv at Puketapu	0.180	13	16	Tutaekuri	C
Anaura Strm	0.189	15	18	Waikari	D
Te Kumi Strm	0.193	17	19	Wairoa	F
Ngaruroro Rv at Fernhill	0.212	32	20	Ngaruroro	C
Ngaruroro Rv at Ohiti	0.213	16	21	Ngaruroro	C
Tukituki Rv at Waipukurau Ongaonga Rd	0.219	14	22	Tukituki	B
Waipawa Rv at SH50	0.220	58	23	Tukituki	B
Mangaone Rv at Dartmoor	0.240	13	24	Tutaekuri	C
Ngaruroro Rv at Motorway	0.240	17	24	Ngaruroro	C
Mohaka Rv at Raupunga (NIWA)	0.244	60	26	Mohaka	E
Tutaekuri Rv at Brookfields Br	0.250	31	27	Tutaekuri	C
Tutaekuri Rv U/S Mangaone Rv	0.251	32	28	Tutaekuri	C
Kopuawhara Strm	0.261	31	29	Northern Coastal	F
Wairoa Rv U/S Wairoa	0.265	27	30	Wairoa	F
Ruakituri Rv	0.269	30	31	Wairoa	F
Makaretu Rv at SH50	0.278	59	32	Tukituki	B
Aropaoanui Rv	0.290	31	33	Aropoanui	D
Waipunga Rv at Pohokura Rd	0.293	24	34	Mohaka	E
Mohaka Rv at Willowflat	0.295	35	35	Mohaka	E
Te Iringaowhare Strm	0.295	5	35	Wairoa	F
Mohaka Rv at Raupunga	0.298	42	37	Mohaka	E
Mangaorapa Strm	0.300	31	38	Porangahau	A
Mangakuri Rv	0.310	31	39	Southern Coastal	A
Makaretu Rv U/S Maharakeke Strm	0.327	14	40	Tukituki	B
Porangahau Rv	0.332	29	41	Porangahau	A
Mohaka Rv D/S Waipunga Rv	0.332	52	41	Mohaka	E
Waitio Strm	0.337	32	43	Ngaruroro	C
Mohaka Rv at SH5 (NIWA)	0.342	60	44	Mohaka	E
Waikari Rv	0.353	31	45	Waikari	D
Hangaroa Rv	0.355	28	46	Wairoa	F
Tutaekuri-Waimate Strm	0.368	29	47	Ngaruroro	C
Esk Rv at Waipunga Br	0.370	30	48	Esk	D
Mohaka Rv D/S Ripia Rv	0.372	43	49	Mohaka	E
Mangapoike Rv	0.379	25	50	Wairoa	F
Esk Rv at Berry Rd	0.406	26	51	Esk	D
Makara Strm	0.414	13	52	Tukituki	B

Site	Median TN	Sample size (n)	Rank	Catchment	Reporting Zone
Mangatewai Strm at SH50	0.440	14	53	Tukituki	B
Mangatutu Strm	0.460	18	54	Tutaekuri	C
Mangaone Rv at Rissington	0.470	37	55	Tutaekuri	C
Mangamahaki Strm	0.524	12	56	Tukituki	B
Mangarau Strm at Keirunga Rd	0.534	17	57	Karamu/Clive	C
Opoutama Strm	0.559	18	58	Northern Coastal	F
Maraetotara Rv at Te Awanga	0.586	31	59	Maraetotara / Waimarama	A
Taurekaitai Strm	0.620	31	60	Porangahau	A
Maraekakaho Strm	0.646	14	61	Ngaruroro	C
Herehere Strm	0.660	32	62	Karamu/Clive	C
Mahiaruhe Strm	0.670	11	63	Aropoanui	D
Waiarua Strm	0.670	34	63	Mohaka	E
Poporangi Strm	0.688	14	65	Ngaruroro	C
Waipawa Rv 50m U/S oxi pond	0.695	44	66	Tukituki	B
Sandy Ck	0.700	35	67	Aropoanui	D
Waipawa Rv U/S Tukituki Rv	0.705	44	68	Tukituki	B
Mohaka Rv D/S Taharua Rv	0.721	64	69	Mohaka	E
Waipawa Rv at SH2	0.740	58	70	Tukituki	B
Waipawa Rv 400m D/S oxi pond	0.750	44	71	Tukituki	B
Tukituki Rv at Black Br	0.783	58	72	Tukituki	B
Tukituki Rv at Red Br	0.783	64	72	Tukituki	B
Ohiwa Strm	0.785	13	74	Ngaruroro	C
Ruahapia Strm	0.850	17	75	Karamu/Clive	C
Tukituki Rv at Red Br (NIWA)	0.874	60	76	Tukituki	B
Pouhokio Strm	0.937	32	77	Maraetotara / Waimarama	A
Mangatarata Strm	0.978	58	78	Tukituki	B
Taipo Strm	0.980	31	79	Karamu/Clive	C
Tukipo Rv at SH50	1.008	62	80	Tukituki	B
Clive Rv	1.034	31	81	Karamu/Clive	C
Maraetotara Rv at Waimarama Rd	1.039	31	82	Maraetotara / Waimarama	A
Tukituki Rv at Tamumu Br	1.100	57	83	Tukituki	B
Tukituki Rv at SH2	1.220	78	84	Tukituki	B
Mangarau Strm at Te Aute Rd	1.260	23	85	Karamu/Clive	C
Papanui Strm	1.345	35	86	Tukituki	B
Tukipo Rv U/S Makaretu Rv	1.370	13	87	Tukituki	B
Taharua Rv at Red Hut	1.450	62	88	Mohaka	E
Tukituki Rv at Tapairu Rd	1.460	49	89	Tukituki	B
Poukawa Strm	1.460	39	89	Karamu/Clive	C
Tukituki Rv 50m U/S oxi pond	1.540	44	91	Tukituki	B
Porangahau Strm	1.780	63	92	Tukituki	B
Taharua Rv at Poronui Stn	1.852	42	93	Mohaka	E
Maharakeke Strm U/S Makaretu Rv	1.864	14	94	Tukituki	B
Tukituki Rv 400m D/S oxi pond	1.950	44	95	Tukituki	B
Mangaonuku Strm	2.072	57	96	Tukituki	B
Maharakeke Strm at Limeworks Station Rd	2.087	14	97	Tukituki	B
Awanui Strm	2.100	39	98	Karamu/Clive	C
Waingongoro Strm	2.117	32	99	Southern Coastal	A
Taharua Rv at Henry's Br	2.302	17	100	Mohaka	E
Karewarewa Strm	2.800	33	101	Karamu/Clive	C
Kahahakuri Strm	2.988	27	102	Tukituki	B
Taharua Rv at Wairango	3.403	58	103	Mohaka	E
Taharua Rv at Twin Culv	3.700	60	104	Mohaka	E

Sites ranked by median Total Phosphorus (TP, mg/l), 2009-2013, with colours signifying reporting zone. Lower ranks are 'better'. Medians generated from sample sizes of at least 30 are considered robust (Snelder pers. comm. 2014). Medians generated from sample sizes less than 30 should be treated with caution.

Site	Median TP	Sample size (n)	Rank	Catchment	Reporting Zone
Taruarau Rv	0.002	14	1	Ngarururo	C
Ngarururo Rv at Whanawhana	0.003	34	2	Ngarururo	C
Ngarururo Rv at Kuripapango (NIWA)	0.004	60	3	Ngarururo	C
Tutaekuri Rv at Lawrence Hut	0.005	34	4	Tutaekuri	C
Ngarururo Rv U/S HB Dairies	0.006	17	5	Ngarururo	C
Mohaka Rv U/S Taharua Rv	0.006	65	5	Mohaka	E
Waipawa Rv at SH50	0.007	59	7	Tukituki	B
Aniwaniwa Strm	0.007	30	7	Wairoa	F
Mokau Strm	0.007	11	7	Wairoa	F
Waikaretaheke Rv	0.007	14	7	Wairoa	F
Makaroro Rv (NIWA)	0.008	60	11	Tukituki	B
Tukituki Rv at SH50	0.008	67	11	Tukituki	B
Ngarururo Rv at Ohiti	0.008	17	11	Ngarururo	C
Ngarururo Rv D/S HB Dairies	0.008	34	11	Ngarururo	C
Mohaka Rv D/S Ripia Rv	0.008	48	11	Mohaka	E
Tukituki Rv at Waipukurau Ongaonga Rd	0.009	14	16	Tukituki	B
Anaura Strm	0.009	17	16	Waikari	D
Kopuawhara Strm	0.009	31	16	Northern Coastal	F
Te Kumi Strm	0.009	17	16	Wairoa	F
Ngarururo Rv at Fernhill	0.010	33	20	Ngarururo	C
Mohaka Rv at SH5 (NIWA)	0.010	60	20	Mohaka	E
Mohaka Rv D/S Taharua Rv	0.010	68	20	Mohaka	E
Ripia Rv U/S Mohaka Rv	0.010	36	20	Mohaka	E
Mangaorapa Strm	0.012	31	24	Porangahau	A
Taharua Rv at Henry's Br	0.012	17	24	Mohaka	E
Pouhokio Strm	0.013	32	26	Maraetotara / Waimarama	A
Ngarururo Rv at Motorway	0.013	17	26	Ngarururo	C
Taharua Rv at Red Hut	0.014	64	28	Mohaka	E
Waiarua Strm	0.014	34	28	Mohaka	E
Waipunga Rv at Pohokura Rd	0.014	24	28	Mohaka	E
Mohaka Rv D/S Waipunga Rv	0.015	53	31	Mohaka	E
Waipawa Rv 50m U/S oxi pond	0.016	43	32	Tukituki	B
Waipawa Rv at SH2	0.016	58	32	Tukituki	B
Tutaekuri Rv U/S Mangaone Rv	0.016	32	32	Tutaekuri	C
Mangakuri Rv	0.017	31	35	Southern Coastal	A
Maraetotara Rv at Te Awanga	0.017	32	35	Maraetotara / Waimarama	A
Porangahau Rv	0.017	31	35	Porangahau	A
Makaretu Rv U/S Maharakeke Strm	0.017	14	35	Tukituki	B
Tukituki Rv at Black Br	0.017	58	35	Tukituki	B
Ruakituri Rv	0.017	30	35	Wairoa	F
Maraetotara Rv at Waimarama Rd	0.018	31	41	Maraetotara / Waimarama	A
Makaretu Rv at SH50	0.018	62	41	Tukituki	B
Mangaonuku Strm	0.018	59	41	Tukituki	B
Tukituki Rv at Red Br	0.018	64	41	Tukituki	B
Ngarururo Rv at Chesterhope (NIWA)	0.018	60	41	Ngarururo	C
Mohaka Rv at Raupunga (NIWA)	0.018	60	41	Mohaka	E
Mokomokonui Rv	0.018	30	41	Mohaka	E
Taharua Rv at Wairango	0.018	58	41	Mohaka	E
Taharua Rv at Twin Culv	0.019	59	49	Mohaka	E
Waiau Rv	0.019	25	49	Wairoa	F
Tukituki Rv at SH2	0.020	77	51	Tukituki	B
Mangapoike Rv	0.020	25	51	Wairoa	F
Tutaekuri Rv at Puketapu	0.021	13	53	Tutaekuri	C
Taharua Rv at Poronui Stn	0.021	46	53	Mohaka	E
Tukituki Rv at Red Br (NIWA)	0.022	60	55	Tukituki	B
Waipawa Rv U/S Tukituki Rv	0.023	43	56	Tukituki	B
Tutaekuri Rv at Brookfields Br	0.023	31	56	Tutaekuri	C
Tukipo Rv U/S Makaretu Rv	0.024	13	58	Tukituki	B
Tukituki Rv 50m U/S oxi pond	0.024	43	58	Tukituki	B
Mangatutu Strm	0.024	18	58	Tutaekuri	C
Mohaka Rv at Raupunga	0.024	45	58	Mohaka	E
Hangaroa Rv	0.024	29	58	Wairoa	F
Tukituki Rv at Tamumu Br	0.025	58	63	Tukituki	B
Esk Rv at Berry Rd	0.026	27	64	Esk	D
Waikari Rv	0.026	32	64	Waikari	D
Mangaone Rv at Rissington	0.027	38	66	Tutaekuri	C
Tukipo Rv at SH50	0.028	63	67	Tukituki	B
Wairoa Rv U/S Wairoa	0.028	29	67	Wairoa	F
Maraekakaho Strm	0.029	14	69	Ngarururo	C
Aropaoanui Rv	0.029	31	69	Aropoanui	D
Waitio Strm	0.031	31	71	Ngarururo	C
Mangamahaki Strm	0.032	12	72	Tukituki	B
Poporangi Strm	0.032	14	72	Ngarururo	C
Esk Rv at Waipunga Br	0.032	30	72	Esk	D
Mohaka Rv at Willowflat	0.032	40	72	Mohaka	E
Waingongoro Strm	0.033	32	76	Southern Coastal	A
Tukituki Rv at Tapairu Rd	0.033	48	76	Tukituki	B
Maharakeke Strm U/S Makaretu Rv	0.035	14	78	Tukituki	B
Opoutama Strm	0.035	18	78	Northern Coastal	F
Kahahakuri Strm	0.036	27	80	Tukituki	B
Mangaone Rv at Dartmoor	0.038	13	81	Tutaekuri	C
Waipawa Rv 400m D/S oxi pond	0.040	42	82	Tukituki	B
Porangahau Strm	0.043	63	83	Tukituki	B
Maharakeke Strm at Limeworks Station Rd	0.046	14	84	Tukituki	B
Tutaekuri-Waimate Strm	0.046	28	84	Ngarururo	C
Taurekaitai Strm	0.049	31	86	Porangahau	A
Makara Strm	0.050	13	87	Tukituki	B
Mangatewai Strm at SH50	0.051	14	88	Tukituki	B
Te Iringaowhare Strm	0.053	5	89	Wairoa	F
Mahiaruhe Strm	0.058	12	90	Aropoanui	D
Mangarau Strm at Keirunga Rd	0.060	17	91	Karamu/Clive	C
Ruahapia Strm	0.069	17	92	Karamu/Clive	C
Tukituki Rv 400m D/S oxi pond	0.070	43	93	Tukituki	B
Sandy Ck	0.072	35	94	Aropoanui	D
Herehere Strm	0.074	32	95	Karamu/Clive	C
Mangarau Strm at Te Aute Rd	0.084	23	96	Karamu/Clive	C
Ohiwa Strm	0.114	13	97	Ngarururo	C
Clive Rv	0.142	32	98	Karamu/Clive	C
Karewarewa Strm	0.171	33	99	Karamu/Clive	C
Poukawa Strm	0.188	37	100	Karamu/Clive	C
Papanui Strm	0.192	35	101	Tukituki	B
Awanui Strm	0.215	38	102	Karamu/Clive	C
Mangatarata Strm	0.260	59	103	Tukituki	B
Taipo Strm	0.410	31	104	Karamu/Clive	C

Sites ranked by median Dissolved Inorganic Nitrogen (DIN, mg/l), 2009-2013, with colours signifying reporting zone. Lower ranks are 'better'. Medians generated from sample sizes of at least 30 are considered robust (Snelder pers. comm. 2014). Medians generated from sample sizes less than 30 should be treated with caution.

Site	Median DIN	Sample size (n)	Rank	Catchment	Reporting Zone
Ngaruroro Rv at Kuripapango (NIWA)	0.009	60	1	Ngaruroro	C
Mangamahaki Strm	0.018	12	2	Tukituki	B
Taruarau Rv	0.026	14	3	Ngaruroro	C
Waikaretaheke Rv	0.026	13	3	Wairoa	F
Tutaekuri Rv at Lawrence Hut	0.027	32	5	Tutaekuri	C
Aniwaniwa Strm	0.027	29	5	Wairoa	F
Mokau Strm	0.032	11	7	Wairoa	F
Anaura Strm	0.036	16	8	Waikari	D
Waiau Rv	0.037	25	9	Wairoa	F
Mohaka Rv U/S Taharua Rv	0.040	65	10	Mohaka	E
Taurekaitai Strm	0.041	31	11	Porangahau	A
Porangahau Rv	0.042	30	12	Porangahau	A
Ngaruroro Rv at Whanawhana	0.044	32	13	Ngaruroro	C
Mokomokonui Rv	0.050	30	14	Mohaka	E
Ngaruroro Rv U/S HB Dairies	0.052	16	15	Ngaruroro	C
Mangakuri Rv	0.053	31	16	Southern Coastal	A
Makara Strm	0.055	13	17	Tukituki	B
Makaroro Rv (NIWA)	0.056	60	18	Tukituki	B
Wairoa Rv U/S Wairoa	0.060	27	19	Wairoa	F
Hangaroa Rv	0.064	28	20	Wairoa	F
Mangatarata Strm	0.070	58	21	Tukituki	B
Ripia Rv U/S Mohaka Rv	0.079	37	22	Mohaka	E
Tukituki Rv at SH50	0.084	64	23	Tukituki	B
Tutaekuri Rv at Puketapu	0.091	13	24	Tutaekuri	C
Ngaruroro Rv at Chesterhope (NIWA)	0.106	60	25	Ngaruroro	C
Te Kumi Strm	0.106	17	25	Wairoa	F
Ngaruroro Rv D/S HB Dairies	0.107	33	27	Ngaruroro	C
Aropaoanui Rv	0.110	31	28	Aropoanui	D
Te Iringaowhare Strm	0.110	5	28	Wairoa	F
Ruakituri Rv	0.111	30	30	Wairoa	F
Mangaorapa Strm	0.120	31	31	Porangahau	A
Ngaruroro Rv at Ohiti	0.130	17	32	Ngaruroro	C
Tukituki Rv at Waipukurau Ongaonga Rd	0.132	14	33	Tukituki	B
Ngaruroro Rv at Fernhill	0.134	34	34	Ngaruroro	C
Waipawa Rv at SH50	0.135	59	35	Tukituki	B
Mangaone Rv at Dartmoor	0.139	13	36	Tutaekuri	C
Ngaruroro Rv at Motorway	0.140	17	37	Ngaruroro	C
Tutaekuri Rv at Brookfields Br	0.155	31	38	Tutaekuri	C
Mohaka Rv at Raupunga (NIWA)	0.161	60	39	Mohaka	E
Makaretu Rv at SH50	0.163	60	40	Tukituki	B
Tutaekuri Rv U/S Mangaone Rv	0.165	32	41	Tutaekuri	C
Kopuawhara Strm	0.171	31	42	Northern Coastal	F
Poukawa Strm	0.173	39	43	Karamu/Clive	C
Mangapoike Rv	0.173	25	43	Wairoa	F
Waikari Rv	0.180	32	45	Waikari	D
Mohaka Rv at Raupunga	0.188	46	46	Mohaka	E
Mohaka Rv at Willowflat	0.190	39	47	Mohaka	E
Mangarau Strm at Keirunga Rd	0.191	17	48	Karamu/Clive	C
Waipunga Rv at Pohokura Rd	0.206	25	49	Mohaka	E
Makaretu Rv U/S Maharakeke Strm	0.212	14	50	Tukituki	B
Mohaka Rv D/S Waipunga Rv	0.233	53	51	Mohaka	E
Waitio Strm	0.247	32	52	Ngaruroro	C
Tutaekuri-Waimate Strm	0.253	29	53	Ngaruroro	C
Mohaka Rv at SH5 (NIWA)	0.265	60	54	Mohaka	E
Esk Rv at Waipunga Br	0.271	30	55	Esk	D
Mohaka Rv D/S Ripia Rv	0.282	47	56	Mohaka	E
Mangatewai Strm at SH50	0.286	14	57	Tukituki	B
Herehere Strm	0.300	32	58	Karamu/Clive	C
Esk Rv at Berry Rd	0.305	27	59	Esk	D
Opoutama Strm	0.309	18	60	Northern Coastal	F
Mangatutu Strm	0.334	18	61	Tutaekuri	C
Mangaone Rv at Rissington	0.335	37	62	Tutaekuri	C
Mahiaruhe Strm	0.365	11	63	Aropoanui	D
Papanui Strm	0.393	35	64	Tukituki	B
Maraetotara Rv at Te Awanga	0.418	31	65	Maraetotara / Waimarama	A
Maraekakaho Strm	0.419	14	66	Ngaruroro	C
Sandy Ck	0.438	35	67	Aropoanui	D
Taipo Strm	0.471	32	68	Karamu/Clive	C
Ohiwa Strm	0.499	13	69	Ngaruroro	C
Poporangi Strm	0.538	14	70	Ngaruroro	C
Waipawa Rv 50m U/S oxi pond	0.582	44	71	Tukituki	B
Waipawa Rv U/S Tukituki Rv	0.583	44	72	Tukituki	B
Ruahapia Strm	0.588	17	73	Karamu/Clive	C
Waiarua Strm	0.598	34	74	Mohaka	E
Tukituki Rv at Black Br	0.601	58	75	Tukituki	B
Tukituki Rv at Red Br	0.604	64	76	Tukituki	B
Tukituki Rv at Red Br (NIWA)	0.607	60	77	Tukituki	B
Waipawa Rv 400m D/S oxi pond	0.620	44	78	Tukituki	B
Mohaka Rv D/S Taharua Rv	0.635	68	79	Mohaka	E
Waipawa Rv at SH2	0.652	58	80	Tukituki	B
Clive Rv	0.673	31	81	Karamu/Clive	C
Pouhokio Strm	0.734	32	82	Maraetotara / Waimarama	A
Tukipo Rv at SH50	0.737	62	83	Tukituki	B
Mangarau Strm at Te Aute Rd	0.817	23	84	Karamu/Clive	C
Maraetotara Rv at Waimarama Rd	0.830	31	85	Maraetotara / Waimarama	A
Tukituki Rv at Tamumu Br	0.867	57	86	Tukituki	B
Awanui Strm	0.887	39	87	Karamu/Clive	C
Tukituki Rv at SH2	1.014	78	88	Tukituki	B
Tukipo Rv U/S Makaretu Rv	1.180	13	89	Tukituki	B
Porangahau Strm	1.210	63	90	Tukituki	B
Tukituki Rv at Tapairu Rd	1.277	49	91	Tukituki	B
Tukituki Rv 50m U/S oxi pond	1.307	44	92	Tukituki	B
Taharua Rv at Red Hut	1.317	64	93	Mohaka	E
Maharakeke Strm U/S Makaretu Rv	1.560	14	94	Tukituki	B
Tukituki Rv 400m D/S oxi pond	1.608	44	95	Tukituki	B
Karewarewa Strm	1.706	33	96	Karamu/Clive	C
Taharua Rv at Poronui Stn	1.710	47	97	Mohaka	E
Maharakeke Strm at Limeworks Station Rd	1.761	14	98	Tukituki	B
Mangaonuku Strm	1.873	57	99	Tukituki	B
Waingongoro Strm	1.925	32	100	Southern Coastal	A
Taharua Rv at Henry's Br	2.212	19	101	Mohaka	E
Kahahakuri Strm	2.700	27	102	Tukituki	B
Taharua Rv at Wairango	3.311	58	103	Mohaka	E
Taharua Rv at Twin Culv	3.614	60	104	Mohaka	E

Sites ranked by median Dissolved Reactive Phosphorus (DRP, mg/l), 2009-2013, with colours signifying reporting zone. Lower ranks are 'better'. Medians generated from sample sizes of at least 30 are considered robust (Snelder pers. comm. 2014). Medians generated from sample sizes less than 30 should be treated with caution.

Site	Median DRP	Sample size (n)	Rank	Catchment	Reporting Zone
Mangakuri Rv	0.002	31	1	Southern Coastal	A
Mangaorapa Strm	0.002	31	1	Porangahau	A
Tukituki Rv at Waipukurau Ongaonga Rd	0.002	14	1	Tukituki	B
Waipawa Rv at SH50	0.002	60	1	Tukituki	B
Ngaruroro Rv at Kuripapango (NIWA)	0.002	60	1	Ngaruroro	C
Ngaruroro Rv at Whanawhana	0.002	34	1	Ngaruroro	C
Ngaruroro Rv U/S HB Dairies	0.002	17	1	Ngaruroro	C
Taruarau Rv	0.002	14	1	Ngaruroro	C
Mohaka Rv U/S Taharua Rv	0.002	66	1	Mohaka	E
Aniwaniwa Strm	0.002	30	1	Wairoa	F
Kopuawhara Strm	0.002	31	1	Northern Coastal	F
Mokau Strm	0.002	11	1	Wairoa	F
Waikaretaheke Rv	0.002	14	1	Wairoa	F
Porangahau Rv	0.004	31	14	Porangahau	A
Tukituki Rv at SH50	0.004	66	14	Tukituki	B
Tutaekuri Rv at Lawrence Hut	0.004	34	14	Tutaekuri	C
Mohaka Rv D/S Taharua Rv	0.004	68	14	Mohaka	E
Pouhokio Strm	0.005	32	18	Maraetotara / Waimarama	A
Makaroro Rv (NIWA)	0.005	60	18	Tukituki	B
Ngaruroro Rv at Ohiti	0.005	17	18	Ngaruroro	C
Ngaruroro Rv D/S HB Dairies	0.005	34	18	Ngaruroro	C
Mohaka Rv at SH5 (NIWA)	0.005	60	18	Mohaka	E
Mohaka Rv D/S Ripia Rv	0.005	48	18	Mohaka	E
Hangaroa Rv	0.005	29	18	Wairoa	F
Ruakituri Rv	0.005	30	18	Wairoa	F
Anaura Strm	0.006	17	26	Waikari	D
Mohaka Rv D/S Waipunga Rv	0.006	53	26	Mohaka	E
Ripia Rv U/S Mohaka Rv	0.006	37	26	Mohaka	E
Waiarua Strm	0.006	35	26	Mohaka	E
Mangapoike Rv	0.006	25	26	Wairoa	F
Ngaruroro Rv at Fernhill	0.007	33	31	Ngaruroro	C
Taharua Rv at Red Hut	0.007	64	31	Mohaka	E
Waipunga Rv at Pohokura Rd	0.007	25	31	Mohaka	E
Opoutama Strm	0.007	18	31	Northern Coastal	F
Ngaruroro Rv at Chesterhope (NIWA)	0.008	60	35	Ngaruroro	C
Ngaruroro Rv at Motorway	0.008	17	35	Ngaruroro	C
Mohaka Rv at Raupunga (NIWA)	0.008	60	35	Mohaka	E
Te Kumi Strm	0.008	17	35	Wairoa	F
Wairoa Rv U/S Wairoa	0.008	29	35	Wairoa	F
Tukituki Rv at Red Br	0.009	64	40	Tukituki	B
Mohaka Rv at Raupunga	0.009	46	40	Mohaka	E
Mohaka Rv at Willowflat	0.009	40	40	Mohaka	E
Maraetotara Rv at Te Awanga	0.010	32	43	Maraetotara / Waimarama	A
Maraetotara Rv at Waimarama Rd	0.010	31	43	Maraetotara / Waimarama	A
Makaretu Rv U/S Maharakeke Strm	0.010	14	43	Tukituki	B
Tukituki Rv at Black Br	0.010	58	43	Tukituki	B
Taharua Rv at Henry's Br	0.010	19	43	Mohaka	E
Mangamahaki Strm	0.011	12	48	Tukituki	B
Taharua Rv at Poronui Stn	0.011	46	48	Mohaka	E
Makaretu Rv at SH50	0.012	62	50	Tukituki	B
Tukituki Rv at Red Br (NIWA)	0.012	60	50	Tukituki	B
Waipawa Rv 50m U/S oxi pond	0.012	44	50	Tukituki	B
Waiau Rv	0.012	25	50	Wairoa	F
Tukituki Rv at SH2	0.013	76	54	Tukituki	B
Waipawa Rv at SH2	0.013	59	54	Tukituki	B
Tutaekuri Rv U/S Mangaone Rv	0.013	32	54	Tutaekuri	C
Taharua Rv at Twin Culv	0.013	60	54	Mohaka	E
Mangaonuku Strm	0.014	59	58	Tukituki	B
Tukipo Rv U/S Makaretu Rv	0.014	13	58	Tukituki	B
Mokomokonui Rv	0.014	30	58	Mohaka	E
Tutaekuri Rv at Puketapu	0.015	13	61	Tutaekuri	C
Taharua Rv at Wairango	0.015	59	61	Mohaka	E
Tutaekuri Rv at Brookfields Br	0.016	31	63	Tutaekuri	C
Te Iringaowhare Strm	0.016	5	63	Wairoa	F
Tukituki Rv 50m U/S oxi pond	0.017	43	65	Tukituki	B
Tukituki Rv at Tamumu Br	0.017	58	65	Tukituki	B
Waikari Rv	0.017	32	65	Waikari	D
Mangatutu Strm	0.018	18	68	Tutaekuri	C
Tukipo Rv at SH50	0.019	63	69	Tukituki	B
Mangaone Rv at Rissington	0.019	38	69	Tutaekuri	C
Aropaoanui Rv	0.019	31	69	Aropoanui	D
Makara Strm	0.020	13	72	Tukituki	B
Waipawa Rv U/S Tukituki Rv	0.020	44	72	Tukituki	B
Waingongoro Strm	0.021	32	74	Southern Coastal	A
Tukituki Rv at Tapairu Rd	0.022	49	75	Tukituki	B
Esk Rv at Berry Rd	0.022	27	75	Esk	D
Kahahakuri Strm	0.023	27	77	Tukituki	B
Taurekaitai Strm	0.024	31	78	Porangahau	A
Esk Rv at Waipunga Br	0.024	30	78	Esk	D
Maraekakaho Strm	0.025	14	80	Ngaruroro	C
Poporangi Strm	0.025	14	80	Ngaruroro	C
Waitio Strm	0.025	31	80	Ngaruroro	C
Maharakeke Strm U/S Makaretu Rv	0.026	14	83	Tukituki	B
Mahiaruhe Strm	0.026	12	83	Aropoanui	D
Porangahau Strm	0.028	63	85	Tukituki	B
Waipawa Rv 400m D/S oxi pond	0.028	44	85	Tukituki	B
Mangaone Rv at Dartmoor	0.028	13	85	Tutaekuri	C
Maharakeke Strm at Limeworks Station Rd	0.029	14	88	Tukituki	B
Tutaekuri-Waimate Strm	0.031	29	89	Ngaruroro	C
Ruahapia Strm	0.034	17	90	Karamu/Clive	C
Mangatewai Strm at SH50	0.040	14	91	Tukituki	B
Sandy Ck	0.044	34	92	Aropoanui	D
Mangarau Strm at Keirunga Rd	0.048	17	93	Karamu/Clive	C
Tukituki Rv 400m D/S oxi pond	0.051	44	94	Tukituki	B
Herehere Strm	0.057	32	95	Karamu/Clive	C
Mangarau Strm at Te Aute Rd	0.070	23	96	Karamu/Clive	C
Clive Rv	0.101	32	97	Karamu/Clive	C
Ohiwa Strm	0.111	13	98	Ngaruroro	C
Poukawa Strm	0.134	37	99	Karamu/Clive	C
Karewarewa Strm	0.140	33	100	Karamu/Clive	C
Papanui Strm	0.154	35	101	Tukituki	B
Mangatarata Strm	0.167	59	102	Tukituki	B
Awanui Strm	0.182	38	103	Karamu/Clive	C
Taipo Strm	0.270	31	104	Karamu/Clive	C

Sites ranked by median Nitrate-Nitrogen (NO_3-N, mg/l), 2009-2013, with colours signifying reporting zone. Lower ranks are 'better'. Medians generated from sample sizes of at least 30 are considered robust (Snelder pers. comm. 2014). Medians generated from sample sizes less than 30 should be treated with caution.

Site	Median NO_3-N	Sample size (n)	Rank	Catchment	Reporting Zone
Mangamahaki Strm	0.001	12	1	Tukituki	B
Taruarau Rv	0.010	14	2	Ngaruroro	C
Tutaekuri Rv at Lawrence Hut	0.014	32	3	Tutaekuri	C
Waikaretaheke Rv	0.014	13	3	Wairoa	F
Aniwaniwa Strm	0.015	28	5	Wairoa	F
Ngaruroro Rv at Whanawhana	0.018	32	6	Ngaruroro	C
Taurekaitai Strm	0.020	31	7	Porangahau	A
Mokau Strm	0.021	12	8	Wairoa	F
Anaura Strm	0.025	16	9	Waikari	D
Waiau Rv	0.025	25	9	Wairoa	F
Makara Strm	0.027	13	11	Tukituki	B
Mohaka Rv U/S Taharua Rv	0.028	65	12	Mohaka	E
Mangakuri Rv	0.031	31	13	Southern Coastal	A
Porangahau Rv	0.036	30	14	Porangahau	A
Mokomokonui Rv	0.037	30	15	Mohaka	E
Ngaruroro Rv U/S HB Dairies	0.040	16	16	Ngaruroro	C
Wairoa Rv U/S Wairoa	0.040	27	16	Wairoa	F
Hangaroa Rv	0.050	28	18	Wairoa	F
Mangatarata Strm	0.056	58	19	Tukituki	B
Tukituki Rv at SH50	0.066	64	20	Tukituki	B
Ripia Rv U/S Mohaka Rv	0.067	37	21	Mohaka	E
Tutaekuri Rv at Puketapu	0.078	13	22	Tutaekuri	C
Te Kumi Strm	0.093	16	23	Wairoa	F
Ruakituri Rv	0.094	30	24	Wairoa	F
Ngaruroro Rv D/S HB Dairies	0.095	33	25	Ngaruroro	C
Aropaoanui Rv	0.097	31	26	Aropoanui	D
Te Iringaowhare Strm	0.098	5	27	Wairoa	F
Mangaorapa Strm	0.113	31	28	Porangahau	A
Ngaruroro Rv at Motorway	0.120	17	29	Ngaruroro	C
Ngaruroro Rv at Ohiti	0.120	17	29	Ngaruroro	C
Ngaruroro Rv at Fernhill	0.121	34	31	Ngaruroro	C
Tukituki Rv at Waipukurau Ongaonga Rd	0.125	14	32	Tukituki	B
Waipawa Rv at SH50	0.126	59	33	Tukituki	B
Poukawa Strm	0.130	39	34	Karamu/Clive	C
Mangaone Rv at Dartmoor	0.132	13	35	Tutaekuri	C
Waikari Rv	0.141	32	36	Waikari	D
Tutaekuri Rv at Brookfields Br	0.143	31	37	Tutaekuri	C
Mangapoike Rv	0.146	25	38	Wairoa	F
Makaretu Rv at SH50	0.152	60	39	Tukituki	B
Tutaekuri Rv U/S Mangaone Rv	0.154	32	40	Tutaekuri	C
Kopuawhara Strm	0.159	31	41	Northern Coastal	F
Mohaka Rv at Willowflat	0.172	39	42	Mohaka	E
Mohaka Rv at Raupunga	0.174	46	43	Mohaka	E
Waipunga Rv at Pohokura Rd	0.194	25	44	Mohaka	E
Mangarau Strm at Keirunga Rd	0.199	17	45	Karamu/Clive	C
Makaretu Rv U/S Maharakeke Strm	0.200	14	46	Tukituki	B
Mohaka Rv D/S Waipunga Rv	0.220	53	47	Mohaka	E
Tutaekuri-Waimate Strm	0.230	29	48	Ngaruroro	C
Waitio Strm	0.235	32	49	Ngaruroro	C
Opoutama Strm	0.245	18	50	Northern Coastal	F
Esk Rv at Waipunga Br	0.260	29	51	Esk	D
Mohaka Rv D/S Ripia Rv	0.270	47	52	Mohaka	E
Herehere Strm	0.275	32	53	Karamu/Clive	C
Mangatewai Strm at SH50	0.280	14	54	Tukituki	B
Papanui Strm	0.280	35	54	Tukituki	B
Esk Rv at Berry Rd	0.290	24	56	Esk	D
Mangaone Rv at Rissington	0.310	37	57	Tutaekuri	C
Mangatutu Strm	0.320	18	58	Tutaekuri	C
Taipo Strm	0.320	32	58	Karamu/Clive	C
Mahiaruhe Strm	0.320	11	58	Aropoanui	D
Sandy Ck	0.390	35	61	Aropoanui	D
Maraetotara Rv at Te Awanga	0.400	31	62	Maraetotara / Waimarama	A
Maraekakaho Strm	0.405	14	63	Ngaruroro	C
Ruahapia Strm	0.420	17	64	Karamu/Clive	C
Ohiwa Strm	0.480	13	65	Ngaruroro	C
Poporangi Strm	0.525	14	66	Ngaruroro	C
Waipawa Rv 50m U/S oxi pond	0.575	44	67	Tukituki	B
Waipawa Rv U/S Tukituki Rv	0.575	44	67	Tukituki	B
Tukituki Rv at Black Br	0.580	58	69	Tukituki	B
Waiarua Strm	0.585	34	70	Mohaka	E
Tukituki Rv at Red Br	0.590	64	71	Tukituki	B
Waipawa Rv 400m D/S oxi pond	0.611	44	72	Tukituki	B
Clive Rv	0.620	31	73	Karamu/Clive	C
Mohaka Rv D/S Taharua Rv	0.620	68	73	Mohaka	E
Waipawa Rv at SH2	0.640	58	75	Tukituki	B
Pouhokio Strm	0.710	31	76	Maraetotara / Waimarama	A
Tukipo Rv at SH50	0.715	62	77	Tukituki	B
Mangarau Strm at Te Aute Rd	0.790	23	78	Karamu/Clive	C
Maraetotara Rv at Waimarama Rd	0.800	31	79	Maraetotara / Waimarama	A
Awanui Strm	0.840	39	80	Karamu/Clive	C
Tukituki Rv at Tamumu Br	0.850	57	81	Tukituki	B
Tukituki Rv at SH2	0.955	78	82	Tukituki	B
Tukipo Rv U/S Makaretu Rv	1.170	13	83	Tukituki	B
Porangahau Strm	1.200	63	84	Tukituki	B
Tukituki Rv at Tapairu Rd	1.230	49	85	Tukituki	B
Tukituki Rv 400m D/S oxi pond	1.235	44	86	Tukituki	B
Tukituki Rv 50m U/S oxi pond	1.260	44	87	Tukituki	B
Taharua Rv at Red Hut	1.300	64	88	Mohaka	E
Karewarewa Strm	1.520	33	89	Karamu/Clive	C
Maharakeke Strm U/S Makaretu Rv	1.540	14	90	Tukituki	B
Taharua Rv at Poronui Stn	1.700	47	91	Mohaka	E
Maharakeke Strm at Limeworks Station Rd	1.740	14	92	Tukituki	B
Mangaonuku Strm	1.860	57	93	Tukituki	B
Waingongoro Strm	1.910	31	94	Southern Coastal	A
Taharua Rv at Henry's Br	2.200	19	95	Mohaka	E
Kahahakuri Strm	2.600	27	96	Tukituki	B
Taharua Rv at Wairango	3.300	58	97	Mohaka	E
Taharua Rv at Twin Culv	3.600	60	98	Mohaka	E

Sites ranked by median Black Disk (m), 2009-2013, with colours signifying reporting zone. Lower ranks are 'better'. Medians generated from sample sizes of at least 30 are considered robust (Snelder pers. comm. 2014). Medians generated from sample sizes less than 30 should be treated with caution.

Site	Median Black Disk	Sample Size (n)	Rank	Catchment	Reporting Zone
Tutaekuri Rv at Lawrence Hut	5.9	33	1	Tutaekuri	C
Ngaruroro Rv at Kuripapango (NIWA)	5.3	59	2	Ngaruroro	C
Taharua Rv at Wairango	4.7	55	3	Mohaka	E
Taruarau Rv	4.7	13	4	Ngaruroro	C
Mohaka Rv U/S Taharua Rv	4.3	57	5	Mohaka	E
Taharua Rv at Henry's Br	4.3	9	6	Mohaka	E
Taharua Rv at Twin Culv	3.5	54	7	Mohaka	E
Maraekakaho Strm	3.4	12	8	Ngaruroro	C
Ngaruroro Rv at Whanawhana	3.4	31	9	Ngaruroro	C
Ohiwa Strm	3.4	12	9	Ngaruroro	C
Waitio Strm	3.4	30	9	Ngaruroro	C
Mangaonuku Strm	3.2	53	12	Tukituki	B
Aniwaniwa Strm	3.1	29	13	Wairoa	F
Mokau Strm	3.0	12	14	Wairoa	F
Mohaka Rv at SH5 (NIWA)	2.8	60	15	Mohaka	E
Tutaekuri Rv at Puketapu	2.8	14	16	Tutaekuri	C
Ngaruroro Rv U/S HB Dairies	2.8	16	17	Ngaruroro	C
Ripia Rv U/S Mohaka Rv	2.5	29	18	Mohaka	E
Te Kumi Strm	2.5	18	19	Wairoa	F
Makaroro Rv (NIWA)	2.3	60	20	Tukituki	B
Mohaka Rv D/S Ripia Rv	2.3	45	20	Mohaka	E
Mokomokonui Rv	2.3	29	20	Mohaka	E
Mohaka Rv D/S Taharua Rv	2.3	59	23	Mohaka	E
Tukituki Rv at Red Br (NIWA)	2.3	60	24	Tukituki	B
Maraetotara Rv at Waimarama Rd	2.2	29	25	Maraetotara / Waimarama	A
Maraetotara Rv at Te Awanga	2.2	31	26	Maraetotara / Waimarama	A
Waikaretaheke Rv	2.1	13	27	Wairoa	F
Maharakeke Strm U/S Makaretu Rv	2.1	13	28	Tukituki	B
Porangahau Strm	2.1	59	29	Tukituki	B
Mangaone Rv at Dartmoor	2.0	12	30	Tutaekuri	C
Tukipo Rv U/S Makaretu Rv	2.0	12	31	Tukituki	B
Mangaone Rv at Rissington	2.0	35	32	Tutaekuri	C
Maharakeke Strm at Limeworks Station Rd	1.9	13	33	Tukituki	B
Waikari Rv	1.9	31	34	Waikari	D
Tutaekuri Rv at Brookfields Br	1.9	32	35	Tutaekuri	C
Tukipo Rv at SH50	1.8	57	36	Tukituki	B
Taharua Rv at Red Hut	1.8	52	37	Mohaka	E
Tukituki Rv at Red Br	1.8	53	38	Tukituki	B
Kopuawhara Strm	1.8	30	39	Northern Coastal	F
Aropaoanui Rv	1.7	30	40	Aropoanui	D
Kahahakuri Strm	1.7	24	41	Tukituki	B
Poporangi Strm	1.7	13	42	Ngaruroro	C
Tukituki Rv at Tamumu Br	1.6	54	43	Tukituki	B
Makaretu Rv at SH50	1.6	58	44	Tukituki	B
Herehere Strm	1.6	22	45	Karamu/Clive	C
Tukituki Rv at Black Br	1.6	50	46	Tukituki	B
Waiarua Strm	1.6	28	47	Mohaka	E
Tukituki Rv at SH2	1.5	13	48	Tukituki	B
Anaura Strm	1.5	15	49	Waikari	D
Waipawa Rv at SH50	1.5	56	50	Tukituki	B
Esk Rv at Waipunga Br	1.5	26	51	Esk	D
Tutaekuri Rv U/S Mangaone Rv	1.5	31	52	Tutaekuri	C
Porangahau Rv	1.4	28	53	Porangahau	A
Makaretu Rv U/S Maharakeke Strm	1.4	14	54	Tukituki	B
Pouhokio Strm	1.4	31	55	Maraetotara / Waimarama	A
Tukituki Rv at Waipukurau Ongaonga Rd	1.4	13	55	Tukituki	B
Taharua Rv at Poronui Stn	1.4	46	57	Mohaka	E
Mangatutu Strm	1.4	18	58	Tutaekuri	C
Esk Rv at Berry Rd	1.4	26	59	Esk	D
Poukawa Strm	1.3	35	60	Karamu/Clive	C
Ngaruroro Rv at Chesterhope (NIWA)	1.3	60	61	Ngaruroro	C
Te Iringaowhare Strm	1.3	3	62	Wairoa	F
Mangarau Strm at Te Aute Rd	1.3	15	63	Karamu/Clive	C
Clive Rv	1.2	19	64	Karamu/Clive	C
Karewarewa Strm	1.2	28	65	Karamu/Clive	C
Mohaka Rv D/S Waipunga Rv	1.2	48	65	Mohaka	E
Tukituki Rv at SH50	1.2	58	67	Tukituki	B
Ngaruroro Rv D/S HB Dairies	1.2	30	68	Ngaruroro	C
Ngaruroro Rv at Fernhill	1.2	28	69	Ngaruroro	C
Sandy Ck	1.2	28	70	Aropoanui	D
Mahiaruhe Strm	1.2	12	71	Aropoanui	D
Awanui Strm	1.1	29	72	Karamu/Clive	C
Waipunga Rv at Pohokura Rd	1.1	18	73	Mohaka	E
Mangaorapa Strm	1.1	31	74	Porangahau	A
Mangakuri Rv	1.1	30	75	Southern Coastal	A
Ruahapia Strm	1.1	10	76	Karamu/Clive	C
Tutaekuri-Waimate Strm	1.1	24	77	Ngaruroro	C
Mangarau Strm at Keirunga Rd	1.1	11	78	Karamu/Clive	C
Hangaroa Rv	1.1	29	78	Wairoa	F
Ngaruroro Rv at Motorway	1.0	15	80	Ngaruroro	C
Mangatewai Strm at SH50	1.0	14	81	Tukituki	B
Mangamahaki Strm	1.0	11	82	Tukituki	B
Mohaka Rv at Raupunga (NIWA)	1.0	59	82	Mohaka	E
Papanui Strm	0.9	23	84	Tukituki	B
Waipawa Rv at SH2	0.9	12	84	Tukituki	B
Opoutama Strm	0.9	18	84	Northern Coastal	F
Waingongoro Strm	0.9	31	87	Southern Coastal	A
Ngaruroro Rv at Ohiti	0.8	15	88	Ngaruroro	C
Makara Strm	0.8	12	89	Tukituki	B
Mangatarata Strm	0.7	50	90	Tukituki	B
Taurekaitai Strm	0.7	21	91	Porangahau	A
Ruakituri Rv	0.7	29	92	Wairoa	F
Waiau Rv	0.6	25	93	Wairoa	F
Taipo Strm	0.5	19	94	Karamu/Clive	C
Wairoa Rv U/S Wairoa	0.4	27	95	Wairoa	F
Mangapoike Rv	0.4	24	96	Wairoa	F
Mohaka Rv at Raupunga	0.3	36	97	Mohaka	E
Mohaka Rv at Willowflat	0.3	37	98	Mohaka	E

Sites ranked by median Turbidity (NTU), 2009-2013, with colours signifying reporting zone. Lower ranks are 'better'. Medians generated from sample sizes of at least 30 are considered robust (Snelder pers. comm. 2014). Medians generated from sample sizes less than 30 should be treated with caution.

Site	Median Turbidity	Sample size (n)	Rank	Catchment	Reporting Zone
Te Kumi Strm	0.6	17	1	Wairoa	F
Taharua Rv at Wairango	0.7	57	2	Mohaka	E
Mohaka Rv U/S Taharua Rv	0.7	60	3	Mohaka	E
Maraekakaho Strm	0.7	13	4	Ngaruroro	C
Ngaruroro Rv at Kuripapango (NIWA)	0.8	60	5	Ngaruroro	C
Tutaekuri Rv at Lawrence Hut	0.8	32	6	Tutaekuri	C
Taharua Rv at Twin Culv	0.9	59	7	Mohaka	E
Mangaonuku Strm	1.0	58	8	Tukituki	B
Waipawa Rv 50m U/S oxi pond	1.0	44	9	Tukituki	B
Waipawa Rv U/S Tukituki Rv	1.1	44	10	Tukituki	B
Waipawa Rv 400m D/S oxi pond	1.1	44	11	Tukituki	B
Waipawa Rv at SH2	1.2	57	12	Tukituki	B
Maraetotara Rv at Te Awanga	1.2	30	13	Maraetotara / Waimarama	A
Waitio Strm	1.2	30	14	Ngaruroro	C
Mohaka Rv D/S Ripia Rv	1.2	46	14	Mohaka	E
Aniwaniwa Strm	1.2	27	14	Wairoa	F
Mohaka Rv at SH5 (NIWA)	1.3	60	17	Mohaka	E
Mohaka Rv D/S Taharua Rv	1.3	63	18	Mohaka	E
Taharua Rv at Henry's Br	1.3	13	19	Mohaka	E
Porangahau Strm	1.3	62	20	Tukituki	B
Taruarau Rv	1.4	14	21	Ngaruroro	C
Mokomokonui Rv	1.4	30	22	Mohaka	E
Maraetotara Rv at Waimarama Rd	1.5	30	23	Maraetotara / Waimarama	A
Tukituki Rv 50m U/S oxi pond	1.5	44	24	Tukituki	B
Poukawa Strm	1.5	35	24	Karamu/Clive	C
Maharakeke Strm U/S Makaretu Rv	1.6	14	26	Tukituki	B
Ripia Rv U/S Mohaka Rv	1.6	30	27	Mohaka	E
Mokau Strm	1.7	10	28	Wairoa	F
Tukituki Rv at Tapairu Rd	1.7	49	29	Tukituki	B
Tutaekuri Rv at Puketapu	1.8	13	30	Tutaekuri	C
Taharua Rv at Poronui Stn	1.8	45	31	Mohaka	E
Tukituki Rv at Red Br (NIWA)	1.8	60	32	Tukituki	B
Esk Rv at Waipunga Br	1.8	27	33	Esk	D
Taharua Rv at Red Hut	1.9	60	34	Mohaka	E
Waikaretaheke Rv	1.9	14	35	Wairoa	F
Ohiwa Strm	1.9	12	36	Ngaruroro	C
Tukituki Rv at Red Br	2.0	59	37	Tukituki	B
Mangaone Rv at Rissington	2.0	33	38	Tutaekuri	C
Aropaoanui Rv	2.0	29	39	Aropoanui	D
Poporangi Strm	2.1	14	40	Ngaruroro	C
Ngaruroro Rv at Whanawhana	2.1	32	41	Ngaruroro	C
Tukituki Rv 400m D/S oxi pond	2.1	44	42	Tukituki	B
Tukituki Rv at SH2	2.1	56	43	Tukituki	B
Maharakeke Strm at Limeworks Station Rd	2.1	13	44	Tukituki	B
Kopuawhara Strm	2.1	29	44	Northern Coastal	F
Herehere Strm	2.1	28	46	Karamu/Clive	C
Tukipo Rv at SH50	2.2	55	47	Tukituki	B
Ngaruroro Rv U/S HB Dairies	2.2	17	48	Ngaruroro	C
Makaroro Rv (NIWA)	2.2	60	49	Tukituki	B
Tutaekuri Rv at Brookfields Br	2.2	29	50	Tutaekuri	C
Tukituki Rv at Waipukurau Ongaonga Rd	2.2	14	51	Tukituki	B
Waipawa Rv at SH50	2.3	57	52	Tukituki	B
Kahahakuri Strm	2.3	25	53	Tukituki	B
Mangaone Rv at Dartmoor	2.3	11	53	Tutaekuri	C
Tukipo Rv U/S Makaretu Rv	2.4	13	55	Tukituki	B
Waipunga Rv at Pohokura Rd	2.4	20	55	Mohaka	E
Waiarua Strm	2.4	30	57	Mohaka	E
Tukituki Rv at Black Br	2.5	52	58	Tukituki	B
Makaretu Rv at SH50	2.5	61	59	Tukituki	B
Mangarau Strm at Te Aute Rd	2.5	23	59	Karamu/Clive	C
Esk Rv at Berry Rd	2.7	26	61	Esk	D
Tutaekuri Rv U/S Mangaone Rv	2.7	31	62	Tutaekuri	C
Anaura Strm	2.7	17	63	Waikari	D
Tukituki Rv at Tamumu Br	2.8	57	64	Tukituki	B
Awanui Strm	2.8	35	65	Karamu/Clive	C
Mangatutu Strm	2.8	17	66	Tutaekuri	C
Mangamahaki Strm	2.9	10	67	Tukituki	B
Porangahau Rv	2.9	29	68	Porangahau	A
Waikari Rv	2.9	30	69	Waikari	D
Ruahapia Strm	3.0	16	70	Karamu/Clive	C
Mangatewai Strm at SH50	3.2	14	71	Tukituki	B
Mangarau Strm at Keirunga Rd	3.3	16	72	Karamu/Clive	C
Te Iringaowhare Strm	3.3	5	73	Wairoa	F
Makaretu Rv U/S Maharakeke Strm	3.3	13	74	Tukituki	B
Ngaruroro Rv at Chesterhope (NIWA)	3.4	60	75	Ngaruroro	C
Mohaka Rv D/S Waipunga Rv	3.4	53	76	Mohaka	E
Pouhokio Strm	3.5	31	77	Maraetotara / Waimarama	A
Mahiaruhe Strm	3.8	12	78	Aropoanui	D
Clive Rv	3.8	26	79	Karamu/Clive	C
Sandy Ck	4.0	29	80	Aropoanui	D
Karewarewa Strm	4.0	29	81	Karamu/Clive	C
Papanui Strm	4.1	25	82	Tukituki	B
Tukituki Rv at SH50	4.2	61	83	Tukituki	B
Ngaruroro Rv D/S HB Dairies	4.5	32	84	Ngaruroro	C
Mohaka Rv at Raupunga (NIWA)	4.6	60	85	Mohaka	E
Hangaroa Rv	4.8	28	86	Wairoa	F
Ngaruroro Rv at Motorway	4.9	17	87	Ngaruroro	C
Mangatarata Strm	5.0	58	88	Tukituki	B
Waingongoro Strm	5.0	31	89	Southern Coastal	A
Tutaekuri-Waimate Strm	5.1	28	90	Ngaruroro	C
Ngaruroro Rv at Fernhill	5.2	30	91	Ngaruroro	C
Makara Strm	5.4	12	92	Tukituki	B
Mangaorapa Strm	5.7	29	93	Porangahau	A
Taipo Strm	5.8	30	94	Karamu/Clive	C
Taurekaitai Strm	6.3	29	95	Porangahau	A
Ngaruroro Rv at Ohiti	6.4	17	96	Ngaruroro	C
Ruakituri Rv	7.3	27	97	Wairoa	F
Opoutama Strm	7.6	17	98	Northern Coastal	F
Mangakuri Rv	7.8	27	99	Southern Coastal	A
Waiau Rv	9.1	24	100	Wairoa	F
Mohaka Rv at Raupunga	16.3	39	101	Mohaka	E
Mohaka Rv at Willowflat	17.5	37	102	Mohaka	E
Mangapoike Rv	18.3	24	103	Wairoa	F
Wairoa Rv U/S Wairoa	18.9	26	104	Wairoa	F

Sites ranked by median *E. coli* (CFU/100ml), 2009-2013, with colours signifying reporting zone. Lower ranks are 'better'. Medians generated from sample sizes of at least 30 are considered robust (Snelder pers. comm. 2014). Medians generated from sample sizes less than 30 should be treated with caution.

Site	Median *E. coli*	Sample size (n)	Rank	Catchment	Reporting Zone
Te Kumi Strm	1.0	17	1	Wairoa	F
Mohaka Rv U/S Taharua Rv	2.0	59	2	Mohaka	E
Ngaruroro Rv at Whanawhana	3.0	30	3	Ngaruroro	C
Waipunga Rv at Pohokura Rd	3.0	19	3	Mohaka	E
Ngaruroro Rv at Kuripapango (NIWA)	3.1	60	5	Ngaruroro	C
Mokau Strm	4.0	11	6	Wairoa	F
Aniwaniwa Strm	6.0	29	7	Wairoa	F
Ngaruroro Rv D/S HB Dairies	6.5	30	8	Ngaruroro	C
Ngaruroro Rv at Motorway	7.0	17	9	Ngaruroro	C
Ngaruroro Rv U/S HB Dairies	7.0	17	9	Ngaruroro	C
Mokomokonui Rv	7.0	30	9	Mohaka	E
Taharua Rv at Henry's Br	7.0	12	9	Mohaka	E
Taharua Rv at Wairango	7.0	58	9	Mohaka	E
Mohaka Rv D/S Taharua Rv	7.5	62	14	Mohaka	E
Mohaka Rv D/S Ripia Rv	8.0	48	15	Mohaka	E
Mohaka Rv D/S Waipunga Rv	8.0	53	15	Mohaka	E
Taharua Rv at Twin Culv	9.0	59	17	Mohaka	E
Te Iringaowhare Strm	9.0	5	17	Wairoa	F
Taharua Rv at Poronui Stn	9.5	46	19	Mohaka	E
Tukituki Rv at SH50	10.0	57	20	Tukituki	B
Anaura Strm	10.0	17	20	Waikari	D
Ripia Rv U/S Mohaka Rv	10.0	31	20	Mohaka	E
Tutaekuri Rv at Lawrence Hut	11.0	33	23	Tutaekuri	C
Tutaekuri Rv at Puketapu	11.0	13	23	Tutaekuri	C
Taruarau Rv	11.5	12	25	Ngaruroro	C
Waiarua Strm	12.0	29	26	Mohaka	E
Makaroro Rv (NIWA)	12.1	60	27	Tukituki	B
Taharua Rv at Red Hut	13.0	59	28	Mohaka	E
Mohaka Rv at Willowflat	14.0	39	29	Mohaka	E
Tutaekuri Rv U/S Mangaone Rv	14.5	32	30	Tutaekuri	C
Ngaruroro Rv at Ohiti	15.0	17	31	Ngaruroro	C
Tutaekuri Rv at Brookfields Br	15.0	31	31	Tutaekuri	C
Waikaretaheke Rv	15.0	14	31	Wairoa	F
Mohaka Rv at Raupunga (NIWA)	15.2	60	34	Mohaka	E
Mohaka Rv at Raupunga	16.0	39	35	Mohaka	E
Mohaka Rv at SH5 (NIWA)	16.6	60	36	Mohaka	E
Tukituki Rv at Tamumu Br	20.0	57	37	Tukituki	B
Esk Rv at Berry Rd	21.0	27	38	Esk	D
Waipawa Rv at SH50	22.0	57	39	Tukituki	B
Ngaruroro Rv at Fernhill	25.5	30	40	Ngaruroro	C
Ngaruroro Rv at Chesterhope (NIWA)	27.5	60	41	Ngaruroro	C
Tukituki Rv at Black Br	29.0	55	42	Tukituki	B
Tukituki Rv at Red Br	32.0	59	43	Tukituki	B
Waiau Rv	33.0	24	44	Wairoa	F
Tukituki Rv at Red Br (NIWA)	34.3	60	45	Tukituki	B
Waitio Strm	35.0	30	46	Ngaruroro	C
Waipawa Rv 50m U/S oxi pond	37.0	44	47	Tukituki	B
Mangaone Rv at Rissington	37.5	36	48	Tutaekuri	C
Waikari Rv	39.5	28	49	Waikari	D
Esk Rv at Waipunga Br	40.0	30	50	Esk	D
Waipawa Rv at SH2	40.5	58	51	Tukituki	B
Maraetotara Rv at Waimarama Rd	41.0	31	52	Maraetotara / Waimarama	A
Mangaonuku Strm	41.0	59	52	Tukituki	B
Mangatutu Strm	41.5	18	54	Tutaekuri	C
Waipawa Rv U/S Tukituki Rv	42.0	43	55	Tukituki	B
Aropaoanui Rv	43.0	29	56	Aropoanui	D
Makaretu Rv at SH50	45.0	57	57	Tukituki	B
Maraetotara Rv at Te Awanga	46.5	32	58	Maraetotara / Waimarama	A
Tukituki Rv at SH2	53.0	57	59	Tukituki	B
Mangaone Rv at Dartmoor	56.0	13	60	Tutaekuri	C
Tukituki Rv 50m U/S oxi pond	57.0	44	61	Tukituki	B
Poporangi Strm	57.5	12	62	Ngaruroro	C
Maraekakaho Strm	61.0	12	63	Ngaruroro	C
Hangaroa Rv	64.0	28	64	Wairoa	F
Tukituki Rv 400m D/S oxi pond	72.0	44	65	Tukituki	B
Waipawa Rv 400m D/S oxi pond	77.5	44	66	Tukituki	B
Tukituki Rv at Tapairu Rd	78.5	44	67	Tukituki	B
Ruakituri Rv	79.0	29	68	Wairoa	F
Mangapoike Rv	85.0	24	69	Wairoa	F
Wairoa Rv U/S Wairoa	85.0	28	69	Wairoa	F
Tutaekuri-Waimate Strm	87.0	27	71	Ngaruroro	C
Kahahakuri Strm	90.0	14	72	Tukituki	B
Kopuawhara Strm	91.5	30	73	Northern Coastal	F
Waingongoro Strm	105.0	32	74	Southern Coastal	A
Porangahau Rv	110.0	31	75	Porangahau	A
Porangahau Strm	110.0	57	75	Tukituki	B
Tukipo Rv at SH50	110.0	59	75	Tukituki	B
Pouhokio Strm	120.0	32	78	Maraetotara / Waimarama	A
Poukawa Strm	130.0	38	79	Karamu/Clive	C
Mangakuri Rv	140.0	31	80	Southern Coastal	A
Mahiaruhe Strm	149.0	10	81	Aropoanui	D
Mangaorapa Strm	160.0	31	82	Porangahau	A
Ohiwa Strm	180.0	11	83	Ngaruroro	C
Clive Rv	190.0	31	84	Karamu/Clive	C
Sandy Ck	220.0	27	85	Aropoanui	D
Opoutama Strm	220.0	18	85	Northern Coastal	F
Mangatarata Strm	235.0	54	87	Tukituki	B
Mangarau Strm at Keirunga Rd	240.0	17	88	Karamu/Clive	C
Awanui Strm	250.0	38	89	Karamu/Clive	C
Taurekaitai Strm	260.0	31	90	Porangahau	A
Mangarau Strm at Te Aute Rd	270.0	23	91	Karamu/Clive	C
Ruahapia Strm	280.0	17	92	Karamu/Clive	C
Papanui Strm	295.0	20	93	Tukituki	B
Karewarewa Strm	330.0	32	94	Karamu/Clive	C
Taipo Strm	330.0	31	94	Karamu/Clive	C
Herehere Strm	540.0	31	96	Karamu/Clive	C

Sites ranked by median Macroinvertebrate Community Index (MCI), 2009-2013, with colours signifying reporting zone. Lower ranks are 'better'. Medians generated from sample sizes of at least 30 are considered robust (Snelder pers. comm. 2014). Medians generated from sample sizes less than 30 should be treated with caution.

Site	Median MCI	Sample size (n)	Rank	Catchment	Reporting Zone
Te Kumi Strm	136.1	4	1	Wairoa	F
Mokomokonui Rv	132.6	5	2	Mohaka	E
Mokau Strm	131.3	1	3	Wairoa	F
Ngaruroro Rv at Kuripapango (NIWA)	130.0	5	4	Ngaruroro	C
Mohaka Rv D/S Ripia Rv	129.5	3	5	Mohaka	E
Taharua Rv at Henry's Br	129.2	1	6	Mohaka	E
Tutaekuri Rv at Lawrence Hut	127.8	5	7	Tutaekuri	C
Mohaka Rv U/S Taharua Rv	127.6	6	8	Mohaka	E
Ripia Rv U/S Mohaka Rv	127.3	5	9	Mohaka	E
Aniwaniwa Strm	126.5	5	10	Wairoa	F
Mohaka Rv at Willowflat	125.0	3	11	Mohaka	E
Taruarau Rv	120.7	1	12	Ngaruroro	C
Mohaka Rv D/S Taharua Rv	119.8	6	13	Mohaka	E
Waipunga Rv at Pohokura Rd	119.3	3	14	Mohaka	E
Waiarua Strm	119.1	5	15	Mohaka	E
Makaretu Rv at SH50	118.4	5	16	Tukituki	B
Taharua Rv at Poronui Stn	118.2	3	17	Mohaka	E
Mohaka Rv at SH5 (NIWA)	117.3	5	18	Mohaka	E
Makaroro Rv (NIWA)	116.6	5	19	Tukituki	B
Waiau Rv	116.4	3	20	Wairoa	F
Mohaka Rv D/S Waipunga Rv	116.3	3	21	Mohaka	E
Mangaone Rv at Rissington	116.0	5	22	Tutaekuri	C
Ngaruroro Rv at Whanawhana	115.8	5	23	Ngaruroro	C
Ruakituri Rv	115.7	4	24	Wairoa	F
Ngaruroro Rv U/S HB Dairies	113.2	4	25	Ngaruroro	C
Waipawa Rv at SH50	112.9	5	26	Tukituki	B
Mangatutu Strm	111.8	1	27	Tutaekuri	C
Anaura Strm	111.7	4	28	Waikari	D
Tukipo Rv at SH50	110.9	4	29	Tukituki	B
Waipawa Rv at SH2	110.7	1	30	Tukituki	B
Esk Rv at Berry Rd	110.5	4	31	Esk	D
Ngaruroro Rv D/S HB Dairies	110.0	5	32	Ngaruroro	C
Tukituki Rv at SH50	108.9	5	33	Tukituki	B
Poporangi Strm	108.9	1	33	Ngaruroro	C
Ngaruroro Rv at Ohiti	107.5	4	35	Ngaruroro	C
Maraekakaho Strm	107.4	1	36	Ngaruroro	C
Tutaekuri Rv U/S Mangaone Rv	107.2	3	37	Tutaekuri	C
Aropaoanui Rv	107.2	5	37	Aropoanui	D
Waikaretaheke Rv	106.7	3	39	Wairoa	F
Mohaka Rv at Raupunga (NIWA)	105.9	4	40	Mohaka	E
Esk Rv at Waipunga Br	104.6	5	41	Esk	D
Taharua Rv at Twin Culv	103.8	5	42	Mohaka	E
Mangaone Rv at Dartmoor	103.3	1	43	Tutaekuri	C
Ngaruroro Rv at Chesterhope (NIWA)	103.2	5	44	Ngaruroro	C
Mohaka Rv at Raupunga	102.0	5	45	Mohaka	E

Site	Median MCI	Sample size (n)	Rank	Catchment	Reporting Zone
Maraetotara Rv at Waimarama Rd	101.0	5	46	Maraetotara / Waimarama	A
Tukituki Rv at SH2	101.0	1	46	Tukituki	B
Te Iringaowhare Strm	100.1	2	48	Wairoa	F
Waitio Strm	99.1	5	49	Ngaruroro	C
Porangahau Strm	98.2	5	50	Tukituki	B
Sandy Ck	98.1	4	51	Aropoanui	D
Kopuawhara Strm	98.0	5	52	Northern Coastal	F
Tukituki Rv at Tamumu Br	97.9	5	53	Tukituki	B
Hangaroa Rv	97.3	5	54	Wairoa	F
Pouhokio Strm	96.7	5	55	Maraetotara / Waimarama	A
Mangaonuku Strm	96.7	4	55	Tukituki	B
Ngaruroro Rv at Motorway	96.6	4	57	Ngaruroro	C
Ngaruroro Rv at Fernhill	96.5	4	58	Ngaruroro	C
Kahahakuri Strm	96.3	1	59	Tukituki	B
Waikari Rv	95.8	5	60	Waikari	D
Taharua Rv at Wairango	95.4	5	61	Mohaka	E
Taharua Rv at Red Hut	95.2	5	62	Mohaka	E
Waingongoro Strm	94.1	5	63	Southern Coastal	A
Mangapoike Rv	92.8	2	64	Wairoa	F
Tukituki Rv at Red Br (NIWA)	92.3	5	65	Tukituki	B
Opoutama Strm	91.3	4	66	Northern Coastal	F
Tutaekuri Rv at Puketapu	88.0	1	67	Tutaekuri	C
Maraetotara Rv at Te Awanga	86.7	5	68	Maraetotara / Waimarama	A
Tutaekuri Rv at Brookfields Br	86.0	4	69	Tutaekuri	C
Mahiaruhe Strm	85.2	2	70	Aropoanui	D
Tukituki Rv at Red Br	84.2	5	71	Tukituki	B
Ohiwa Strm	84.2	1	71	Ngaruroro	C
Mangarau Strm at Keirunga Rd	82.7	4	73	Karamu/Clive	C
Tutaekuri-Waimate Strm	81.1	3	74	Ngaruroro	C
Mangakuri Rv	80.0	5	75	Southern Coastal	A
Mangaorapa Strm	79.2	5	76	Porangahau	A
Clive Rv	76.8	1	77	Karamu/Clive	C
Wairoa Rv U/S Wairoa	76.7	1	78	Wairoa	F
Porangahau Rv	76.0	5	79	Porangahau	A
Mangatarata Strm	75.9	4	80	Tukituki	B
Taurekaitai Strm	75.6	5	81	Porangahau	A
Tukituki Rv at Black Br	75.6	5	81	Tukituki	B
Mangarau Strm at Te Aute Rd	75.2	4	83	Karamu/Clive	C
Papanui Strm	72.5	1	84	Tukituki	B
Herehere Strm	68.9	5	85	Karamu/Clive	C
Karewarewa Strm	68.7	2	86	Karamu/Clive	C
Poukawa Strm	68.0	2	87	Karamu/Clive	C
Awanui Strm	67.7	2	88	Karamu/Clive	C
Taipo Strm	66.7	5	89	Karamu/Clive	C
Ruahapia Strm	62.7	4	90	Karamu/Clive	C

Sites ranked by median Total Suspended Solids (TSS, mg/l), 2009-2013, with colours signifying reporting zone. Lower ranks are 'better'. Medians generated from sample sizes of at least 30 are considered robust (Snelder pers. comm. 2014). Medians generated from sample sizes less than 30 should be treated with caution.

Site	Median TSS	Sample size (n)	Rank	Catchment	Reporting Zone
Mangaonuku Strm	1.5	59	1	Tukituki	B
Tukituki Rv at Waipukurau Ongaonga Rd	1.5	14	1	Tukituki	B
Maraekakaho Strm	1.5	14	1	Ngaruroro	C
Ohiwa Strm	1.5	12	1	Ngaruroro	C
Taruarau Rv	1.5	14	1	Ngaruroro	C
Tutaekuri Rv at Lawrence Hut	1.5	33	1	Tutaekuri	C
Waitio Strm	1.5	32	1	Ngaruroro	C
Mohaka Rv U/S Taharua Rv	1.5	64	1	Mohaka	E
Taharua Rv at Wairango	1.5	58	1	Mohaka	E
Te Kumi Strm	1.5	17	1	Wairoa	F
Taharua Rv at Henry's Br	1.9	17	11	Mohaka	E
Maharakeke Strm U/S Makaretu Rv	3.0	14	12	Tukituki	B
Aniwaniwa Strm	3.0	30	12	Wairoa	F
Mohaka Rv D/S Ripia Rv	3.3	48	14	Mohaka	E
Waipawa Rv 400m D/S oxi pond	3.3	44	15	Tukituki	B
Tutaekuri Rv at Puketapu	3.5	13	16	Tutaekuri	C
Porangahau Strm	3.7	63	17	Tukituki	B
Waikari Rv	4.0	32	18	Waikari	D
Maharakeke Strm at Limeworks Station Rd	4.3	13	19	Tukituki	B
Tukipo Rv U/S Makaretu Rv	4.3	13	19	Tukituki	B
Mangaone Rv at Dartmoor	4.3	13	19	Tutaekuri	C
Herehere Strm	4.5	31	22	Karamu/Clive	C
Ngaruroro Rv at Whanawhana	4.5	32	22	Ngaruroro	C
Ripia Rv U/S Mohaka Rv	4.5	36	22	Mohaka	E
Waipawa Rv 50m U/S oxi pond	4.8	44	25	Tukituki	B
Mangaone Rv at Rissington	4.8	35	25	Tutaekuri	C
Maraetotara Rv at Te Awanga	5.0	32	27	Maraetotara / Waimarama	A
Makaretu Rv U/S Maharakeke Strm	5.0	14	27	Tukituki	B
Poukawa Strm	5.0	39	27	Karamu/Clive	C
Tutaekuri Rv U/S Mangaone Rv	5.0	32	27	Tutaekuri	C
Mohaka Rv D/S Taharua Rv	5.0	66	27	Mohaka	E
Anaura Strm	5.1	17	32	Waikari	D
Ngaruroro Rv U/S HB Dairies	5.3	17	33	Ngaruroro	C
Mangarau Strm at Te Aute Rd	5.5	23	34	Karamu/Clive	C
Kahahakuri Strm	5.8	27	35	Tukituki	B
Mangatutu Strm	6.0	18	36	Tutaekuri	C
Aropaoanui Rv	6.0	31	36	Aropoanui	D
Taharua Rv at Twin Culv	6.0	59	36	Mohaka	E
Maraetotara Rv at Waimarama Rd	6.3	31	39	Maraetotara / Waimarama	A
Tutaekuri Rv at Brookfields Br	6.8	31	40	Tutaekuri	C
Mokau Strm	6.8	11	40	Wairoa	F
Waipawa Rv U/S Tukituki Rv	7.0	44	42	Tukituki	B
Mokomokonui Rv	7.0	30	42	Mohaka	E
Tukituki Rv at Tapairu Rd	7.5	44	44	Tukituki	B
Tukipo Rv at SH50	7.6	63	45	Tukituki	B
Taharua Rv at Red Hut	7.6	63	45	Mohaka	E
Makaretu Rv at SH50	8.0	62	47	Tukituki	B
Esk Rv at Berry Rd	8.0	27	47	Esk	D
Esk Rv at Waipunga Br	8.0	30	47	Esk	D
Tukituki Rv 50m U/S oxi pond	8.4	44	50	Tukituki	B
Mangamahaki Strm	8.5	12	51	Tukituki	B
Karewarewa Strm	8.5	33	51	Karamu/Clive	C
Mangatewai Strm at SH50	8.8	13	53	Tukituki	B
Awanui Strm	8.8	39	53	Karamu/Clive	C
Clive Rv	8.8	32	55	Karamu/Clive	C
Waipawa Rv at SH2	9.0	58	56	Tukituki	B
Waiarua Strm	9.0	34	56	Mohaka	E
Tukituki Rv at Tamumu Br	9.2	58	58	Tukituki	B
Tukituki Rv 400m D/S oxi pond	9.5	44	59	Tukituki	B
Tukituki Rv at Red Br	10.5	60	60	Tukituki	B
Waikaretaheke Rv	11.0	14	61	Wairoa	F
Ngaruroro Rv at Motorway	11.3	17	62	Ngaruroro	C
Ngaruroro Rv at Ohiti	11.8	17	63	Ngaruroro	C
Tukituki Rv at Black Br	12.0	58	64	Tukituki	B
Waipawa Rv at SH50	12.0	58	64	Tukituki	B
Ngaruroro Rv D/S HB Dairies	12.5	32	66	Ngaruroro	C
Sandy Ck	12.5	35	66	Aropoanui	D
Tukituki Rv at SH50	13.0	62	68	Tukituki	B
Ruahapia Strm	13.0	17	68	Karamu/Clive	C
Mahiaruhe Strm	13.0	12	68	Aropoanui	D
Mangarau Strm at Keirunga Rd	13.5	17	71	Karamu/Clive	C
Mangatarata Strm	13.8	59	72	Tukituki	B
Papanui Strm	13.8	33	72	Tukituki	B
Tukituki Rv at SH2	13.8	57	72	Tukituki	B
Waipunga Rv at Pohokura Rd	14.3	25	75	Mohaka	E
Waingongoro Strm	15.0	32	76	Southern Coastal	A
Mohaka Rv D/S Waipunga Rv	15.3	53	77	Mohaka	E
Tutaekuri-Waimate Strm	16.0	29	78	Ngaruroro	C
Ngaruroro Rv at Fernhill	16.5	32	79	Ngaruroro	C
Taurekaitai Strm	18.5	31	80	Porangahau	A
Te Iringaowhare Strm	20.3	5	81	Wairoa	F
Taharua Rv at Poronui Stn	22.0	46	82	Mohaka	E
Poporangi Strm	24.0	14	83	Ngaruroro	C
Taipo Strm	27.5	32	84	Karamu/Clive	C
Kopuawhara Strm	28.0	31	85	Northern Coastal	F
Mangaorapa Strm	31.5	31	86	Porangahau	A
Makara Strm	33.5	13	87	Tukituki	B
Pouhokio Strm	40.0	32	88	Maraetotara / Waimarama	A
Porangahau Rv	40.3	31	89	Porangahau	A
Mangakuri Rv	42.5	31	90	Southern Coastal	A
Waiau Rv	65.8	25	91	Wairoa	F
Mohaka Rv at Raupunga	68.0	45	92	Mohaka	E
Wairoa Rv U/S Wairoa	70.3	29	93	Wairoa	F
Mohaka Rv at Willowflat	84.0	40	94	Mohaka	E
Hangaroa Rv	91.5	29	95	Wairoa	F
Mangapoike Rv	96.5	25	96	Wairoa	F
Ruakituri Rv	97.0	30	97	Wairoa	F
Opoutama Strm	131.0	18	98	Northern Coastal	F

Appendix E NPS-FW (2014) NOF attribute tables

Periphyton NOF attribute table

Value	Ecosystem health		
Freshwater Body Type	Rivers		
Attribute	Periphyton (Trophic state)		
Attribute Unit	mg chl-a/m^2 (milligrams chlorophyll-a per square metre)		
Attribute State	**Numeric Attribute State (Default Class)**	**Numeric Attribute State (Productive Class[1])**	**Narrative Attribute State**
	Exceeded no more than 8% of samples[2]	**Exceeded no more than17% of samples[2]**	
A	≤ 50	≤ 50	Rare blooms reflecting negligible nutrient enrichment and/or alteration of the natural flow regime or habitat
B	>50 and ≤ 120	>50 and ≤ 120	Occasional blooms reflecting low nutrient enrichment and/or alteration of the natural flow regime or habitat
C	>120 and ≤ 200	>120 and ≤ 200	Periodic short-duration nuisance blooms reflecting moderate nutrient enrichment and/or alteration of the natural flow regime or habitat
National Bottom Line	**200**	**200**	
D	>200	>200	Regular and/or extended-duration nuisance blooms reflecting high nutrient enrichment and/or significant alteration of the natural flow regime or habitat

1. Classes are streams and rivers defined according to types in the River Environment Classification (REC). The Productive periphyton class is defined by the combination of REC "Dry" Climate categories (i.e. Warm-Dry (WD) and cool-Dry (CD)) and REC Geology categories that have naturally high levels of nutrient enrichment due to their catchment geology (i.e. Soft-Sedimentary (SS), Volcanic Acidic (VA) and Volcanic Basic (VB)). Therefore the productive category is defined by the following REC defined types: WD/SS, WD/VB, WD/VA, CD/SS, CD/VB, CD/VA. The default class includes all REC types not in the Productive class.
2. Based on monthly monitoring regime. The minimum record length for grading a site based on periphyton (chl-a) is 3 years.

Nitrate NOF attribute table

Value	Ecosystem health		
Freshwater Body Type	Rivers		
Attribute	Nitrate (Toxicity)		
Attribute Unit	mg NO_3-N/L (milligrams nitrate-nitrogen per litre)		
Attribute State	**Numeric Attribute State**		**Narrative Attribute State**
	Annual Median	**Annual 95th Percentile**	
A	≤ 1.0	≤ 1.5	High conservation value system. Unlikely to be effects even on sensitive species.
B	>1.0 and ≤ 2.4	>1.5 and ≤ 3.5	Some growth effect on up to 5% of species.
C	>2.4 and ≤ 6.9	>3.5 and ≤ 9.8	Growth effects on up to 20% of species (mainly sensitive species such as fish). No acute effects.
National Bottom Line	**6.9**	**9.8**	
D	>6.9	>9.8	Impacts on growth of multiple species, and starts approaching acute impact level (i.e. risk of death) for sensitive species at higher concentrations (> 20 mg/l).

Ammonia NOF attribute table

Value	Ecosystem health		
Freshwater Body Type	Lakes and Rivers		
Attribute	Ammonia (Toxicity)		
Attribute Unit	mg NH_4-N/L (milligrams ammoniacal-nitrogen per litre)		
Attribute State	**Numeric Attribute State**		**Narrative Attribute State**
	Annual Median*	**Annual Maximum***	
A	≤ 0.03	≤ 0.05	99% species protection level. No observed effect on any species.
B	>0.03 and ≤ 0.24	>0.05 and ≤ 0.40	95% species protection level. Starts impacting occasionally on the 5% most sensitive species.
C	>0.24 and ≤ 1.30	>0.40 and ≤ 2.020	80% species protection level. Starts impacting regularly on the 20% most sensitive species (reduced survival of most sensitive species).
National Bottom Line	**1.30**	**2.20**	
D	>1.30	>2.20	Starts approaching acute impact level (i.e. risk of death) for sensitive species.

*Based on pH 8 and temperature of 20°C
Compliance with the numeric attribute states should be undertaken after pH adjustment.

Dissolved Oxygen NOF attribute table

Value	Ecosystem health		
Freshwater Body Type	Rivers (below point sources)		
Attribute	Dissolved Oxygen		
Attribute Unit	mg/l (milligrams per litre)		
Attribute State	**Numeric Attribute State**		**Narrative Attribute State**
	7-day mean minimum[1] (Summer period: 1 November to 30th April)	1-day mean minimum[2] (Summer period: 1 November to 30th April)	
A	≥ 8.0	≥ 7.5	No stress caused by low dissolved oxygen on any aquatic organisms that are present at matched reference (near-pristine) sites.
B	≥ 7.0 and < 8.0	≥ 5.0 and < 7.5	Occasional minor stress on sensitive organisms caused by short periods (a few hours each day) of lower dissolved oxygen. Risk of reduced abundance of sensitive fish and macroinvertebrate species.
C	≥ 5.0 and < 7.0	≥ 4.0 and < 5.0	Moderate stress on a number of aquatic organisms caused by dissolved oxygen levels exceeding preference levels for periods of several hours each day. Risk of sensitive fish and and macroinvertebrate species being lost.
National Bottom Line	**5.0**	**4.0**	
D	< 5.0	< 4.0	Significant, persistent stress on a range of aquatic organisms caused by dissolved oxygen exceeding tolerance levels. Likelihood of local extinctions of keystone species and loss of ecological integrity.

1. The mean value of 7 consecutive daily minimum values.
2. The lowest daily minimum across the whole summer period.

Escherichia coli NOF attribute table

Value	Ecosystem health		
Freshwater Body Type	Lakes and Rivers		
Attribute	*E. coli* *		
Attribute Unit	*E. coli* /100 mL (number of *E.coli* per hundred millilitres)		
Attribute State	**Numeric Attribute State**	**Sampling Statistic**	**Narrative Attribute State**
A	≤ 260	Annual median	People are exposed to a very low risk of infection (less than 0.1% risk) from contact with water during activities with occasional immersion and some ingestion of water (such as wading and boating).
		95th percentile	People are exposed to a low risk of infection (less than 1% risk) when undertaking activities likely to involve full immersion.
B	>260 and ≤ 540	Annual median	People are exposed to a low risk of infection (less than 1% risk) from contact with water during activities with occasional immersion and some ingestion of water (such as wading and boating).
		95th percentile	People are exposed to a moderate risk of infection (less than 5% risk) when undertaking activities likely to involve full immersion. 540/100 ml is the **minimum acceptable state** for activities likely to involve full immersion.
C	>540 and ≤ 1,000	Annual median	People are exposed to a moderate risk of infection (less than 5% risk) from contact with water during activities with occasional immersion and some ingestion of water (such as wading and boating). People are exposed to a high risk of infection (greater than 5% risk) from contact with water during activities likely to involve full immersion.
National Bottom Line	**1,000**	Annual median	
D	>1,000	Annual median	People are exposed to a high risk of infection (greater than 5% risk) from contact with water during activities with occasional immersion and some ingestion of water (such as wading and boating).

Appendix F Summary of NOF bands for *Escherichia coli*, Nitrate nitrogen and Ammonia.

Table F1: NPS-FW (2014) NOF bands for the *E. coli* attribute for Wairoa River catchment monitoring sites. Cells are coloured as per the Attribute State gradings shown:

A	B	C	D

Site	Annual Medians					5 Year 95th percentile
	2009	2010	2011	2012	2013	
Mokau Strm	NA	NA	NA	3	4	15
Te Kumi Strm	1	2	9	1	NA	40
Aniwhaniwha Strm	1	5	10	12	6	26
Waikaretaheke Rv	11	31	9	31	NA	57
Waiau Rv	NA	117	71	22	39	61
Te Iringaowhare Strm	8	80	NA	NA	NA	42
Ruakituri Rv	8	79	100	84	48	31,000
Hangaroa Rv	8	63	322	40	30	550
Mangapoike Rv	NA	2,678	42	60	36	1,100
Wairoa Rv U/S Wairoa	10	128	661	75	75	1,300
Opoutama Strm	117	551	210	139	NA	1,800
Kopuawhara Strm	26	139	69	74	70	420

Table F2: NPS-FW (2014) NOF bands for the nitrate Attribute States for nitrate toxicity for the Wairoa River catchment monitoring sites. Gaps in table appear where no data were available. Cells are coloured as per the Attribute State gradings shown:

A	B	C	D

Site	Medians					95th percentiles				
	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
Mokau Strm	NA	NA	NA	0.001	0.022	NA	NA	NA	0.001	0.052
Te Kumi Strm	0.110	0.093	0.079	0.091	NA	0.120	0.093	0.095	0.280	NA
Aniwhaniwha Strm	0.026	0.018	0.007	0.015	0.014	0.050	0.030	0.056	0.029	0.023
Waikaretaheke Rv	0.008	0.024	0.016	0.011	NA	0.025	0.124	0.023	0.014	NA
Waiau Rv	NA	0.102	0.023	0.004	0.003	NA	0.197	0.062	0.083	0.130
Te Iringaowhare Strm	0.114	0.052	NA	NA	NA	0.200	0.052	NA	NA	NA
Ruakituri Rv	0.026	0.141	0.116	0.100	0.055	0.140	0.182	0.155	0.190	0.430
Hangaroa Rv	0.010	0.151	0.177	0.009	0.024	0.066	0.400	0.250	0.260	0.824
Mangapoike Rv	NA	0.161	0.192	0.090	0.146	NA	0.420	0.290	0.320	0.568
Wairoa Rv U/S Wairoa	0.023	0.142	0.170	0.013	0.026	0.092	0.270	0.174	0.280	0.580
Opoutama Strm	0.135	0.240	0.295	0.178	NA	0.380	0.950	0.380	0.510	NA
Kopuawhara Strm	0.042	0.180	0.176	0.008	0.182	0.099	0.340	0.260	0.250	0.330

Table F3 NPS-FW (2014) NOF bands for the ammonia toxicity attribute for Wairoa River catchment monitoring sites.

Gaps in table appear where no data were available. Cells are coloured as per the Attribute State gradings shown:

A	B	C	D

Site	Medians					Maxima				
	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
Mokau Strm	NA	NA	NA	0.005	0.005	NA	NA	NA	0.005	0.011
Te Kumi Strm	0.005	0.005	0.005	0.005	NA	0.010	0.020	0.010	0.005	NA
Aniwhaniwha Strm	0.009	0.005	0.005	0.005	0.005	0.014	0.017	0.010	0.005	0.010
Waikaretaheke Rv	0.005	0.005	0.005	0.005	NA	0.005	0.052	0.005	0.005	NA
Waiau Rv	NA	0.019	0.005	0.005	0.005	NA	0.052	0.020	0.005	0.015
Te Iringaowhare Strm	0.013	0.011	NA	NA	NA	0.023	0.011	NA	NA	NA
Ruakituri Rv	0.014	0.005	0.012	0.005	0.005	0.016	0.071	0.015	0.014	0.102
Hangaroa Rv	0.005	0.011	0.005	0.005	0.005	0.014	0.028	0.005	0.027	0.020
Mangapoike Rv	NA	0.020	0.005	0.019	0.016	NA	0.053	0.026	0.056	0.044
Wairoa Rv U/S Wairoa	0.016	0.013	0.005	0.005	0.005	0.020	0.119	0.028	0.046	0.035
Opoutama Strm	0.065	0.056	0.042	0.046	NA	0.085	0.104	0.085	0.060	NA
Kopuawhara Strm	0.008	0.005	0.005	0.005	0.005	0.014	0.056	0.062	0.010	0.029