Recreational Waters Surveillance Report 2014/15

Bay of Plenty Regional Council
Environmental Publication 2015/06

5 Quay Street
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NEW ZEALAND

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BAY OF PLENTY REGIONAL COUNCIL
TOI MOANA

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Acknowledgements

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Date: 17/08/2015

Executive summary

The Bay of Plenty Regional Council undertakes annual water quality surveys of popular recreational (bathing) sites and shellfish beds over the warmer months (October to March). The surveys assist in identifying the risk to public health from faecal contamination in these areas. This information is then used by public health and local authorities to advise the community on the suitability of water for bathing or shellfish consumption.

The objective of this report is to report the bathing suitability of approximately 70 river, lake and marine sites over the 2014/2015 bathing season (October to March). A three tiered management framework has been adopted to help signal when recreational waters are potentially at risk to users. The system uses the colours green (safe mode), orange (cautionary mode) and red (unsafe mode) to denote risk to bathers.

Two indicator bacteria are used to assess the risk of faecal contamination in recreational waters. These are:

- Freshwaters – *Escherichia coli* (*E.coli*); and
- Marine waters – Enterococci.

The results from the 2014/2015 bathing surveys show that most sites in the Bay of Plenty are generally suitable for bathing. However, the Suitability for Recreation Grading (SFRG) system, highlights that there is some risk to bathers using rivers and streams, as they are more vulnerable to pathogen loading from runoff after rainfall events. For example, 81.8% of lake sites were graded 'very good' or 'good', while 7.1% of river sites are graded 'very good' or 'good'.

The table below shows the status of monitored bathing sites against the New Zealand Microbiological Water Quality Guidelines (Red/Action Mode). Generally, lake sites show the highest quality overall against this guideline, followed by marine and river sites.

Table 1: Percentage of samples from monitored bathing sites with indicator bacteria levels less than the Red/Action Mode, as defined by the NZ Microbiological Water Quality Guidelines (MfE/MoH 2003)

		Rivers	Lakes	Marine
Samples less than the Red/Action Mode	2014/15	93.0%	100%	98.6%
	last 5 Years	94.1%	99.8%	98.2%

River and stream sites indicate improved levels of faecal contamination compared to previous seasons, with only 2.3% of results above the Orange/Alert Mode and 2.3% above the Red/Action Mode.

Open coastal sites typically have excellent water quality with zero sites reaching the Red/Action Mode in 2014/2015. Eleven of the 18 estuarine sites reached the Orange/Alert Mode in 2014/2015, and only 7.1% of the estuarine sites are graded 'poor' (none were graded 'very poor').

The 2014/2015 *E.coli* data was compared with the National Policy Statement (NPS) for Freshwater National Objective Framework (NOF) attributes for human health. All sites rate highly (i.e. very safe) for secondary contact recreation activities, however 12 sites are rated below the minimal acceptable standard for primary contact recreation.

Faecal coliform concentrations from popular shellfish gathering sites revealed that 45% of sites did not meet Microbiological Water Quality guideline levels for safe consumption of shellfish. These sites include Otumoetai, Waiotahi Estuary, Waihī Estuary, Pilot Bay and Maketū.

Water monitored at Waiotahi Estuary was found to have *E.coli* levels above safe consumption guidelines. Monitoring shows elevated bacteria levels occurred after rainfall.

Observations of toxin producing benthic algae *Phormidium* in rivers and streams were also made over summer. No sites reached alert levels as prescribed by the Cyanobacteria in Recreational Fresh Waters Interim Guidelines.

Results from the bathing and shellfish monitoring programme do not specifically identify the factors causing faecal contamination. However, it does highlight areas where more detailed investigation should be carried out. Targeted studies would be used to address more specific water quality issues. One recommendation from this programme is to investigate faecal contamination sources in the catchment, that do not meet the NOF minimum acceptance state for faecal contamination. Further, the use of microbial source tracking techniques may help delineate potential sources (i.e human, avian or livestock), but modelling and loading investigation are also likely to be required to ascertain relative contribution within these catchments.

A further recommendation is to develop a predictive warning system for high risk sites, rather than rely on weekly monitoring, which is often out of date before a warning can be initiated. A predictive model can be developed by undertaking event sampling and analyses of sites with adjacent flow/level and rainfall monitoring. A model would then be used to provide an early warning system of elevated pathogen levels in rivers.

Contents

Part 1: Introduction

1.1 Overview

The Bay of Plenty Regional Council undertakes annual water quality surveys of popular recreational (bathing) sites and shellfish beds over the warmer months (October to March). The surveys assist in identifying the risk to public health from faecal contamination at these areas. The information is then used by public health and local authorities, to advise the community on the suitability of water for bathing or shellfish consumption.

There are a number of regional plans that have objectives based on a contact recreation standard, these are:

- On-site Effluent Treatment (OSET) Regional Plan.
- Regional Water and Land Plan.
- Regional Coastal Environmental Plan.
- Regional Policy Statement.

Due to the public health risk from cyanobacteria (blue-green algae) the programme also includes the monitoring of benthic cyanobacteria (*Phormidium*) in rivers and streams. This report summarises the annual recreational waters survey monitoring results for the 2014/2015 season and also presents recent shellfish monitoring results.

1.2 Legislative framework and responsibilities

The National Policy Statement (NPS) for Freshwater Management (2014) has the objective to safeguard the health of people and communities. The NPS has a National Objectives Framework (NOF) which sets thresholds for numeric attributes, ranked into four bands (A-D), defining water quality for "human" (and "ecosystem") health (MfE, 2014) (Table 1).

Table 1 The National Objective Framework – values and related attributes for lakes and rivers (summarised from MfE, 2014)

Value	Attribute state (E.coli/100 ml)			
	A	B	C (Bottom-line)	D
Numeric state	≤260	>260 and ≤ 540	>540 and ≤1000	>1000
Human health for secondary* contact (annual median)	Very low risk of infection (<0.1%) secondary exposure	Low risk of infection (up to 1%) secondary exposure	Moderate risk of infection (<5.0%) from secondary exposure	High risk of infection (>5.0%) from secondary exposure
Human health for primary** contact (95th Percentile)	Low risk of infection (up to 1%) primary exposure	Moderate risk of infection (<5.0%) from primary exposure. **Minimum Acceptable State**		

*Secondary activity occasional immersion and some ingestion: e.g. boating; wading. **Primary likely to involve full immersion.

The agencies responsible for relating recreational water quality to the community are the regional council, district councils, district health boards and the medical officer of health. There is no legislation dictating which agency is responsible for recreational bathing monitoring, but under the Health Act (1956) and the Resource Management Act (1991), local agencies and the health authority have defined responsibilities.

The Microbiological Guidelines (MfE/MoH 2003) provides a recommended framework of roles and responsibilities of the agencies involved in recreational water quality monitoring. Based on this framework, a protocol for monitoring and reporting has been developed.

1.3 Recreational water quality objectives

The objectives of the Bay of Plenty Regional Council's recreational water quality monitoring programme are to:

- Assess the suitability of approximately 70 river, lake and marine sites in the Bay of Plenty for contact recreation.
- Provide information on the suitability of shellfish for human consumption.
- Assist in safeguarding the life-supporting capacity of water, including public health.
- Provide a mechanism to determine the effectiveness of regional plans.
- Provide information for State of the Environment monitoring, regionally and nationally.
- Assist in identifying areas of poor water quality to help identify the causes so remedial action can be initiated.
- Set the foundation for water quality accounting in freshwater management units and assist in the identification of values of each freshwater management unit.

The bathing surveillance monitoring sites are shown in the map that follows (Figure 1.1).

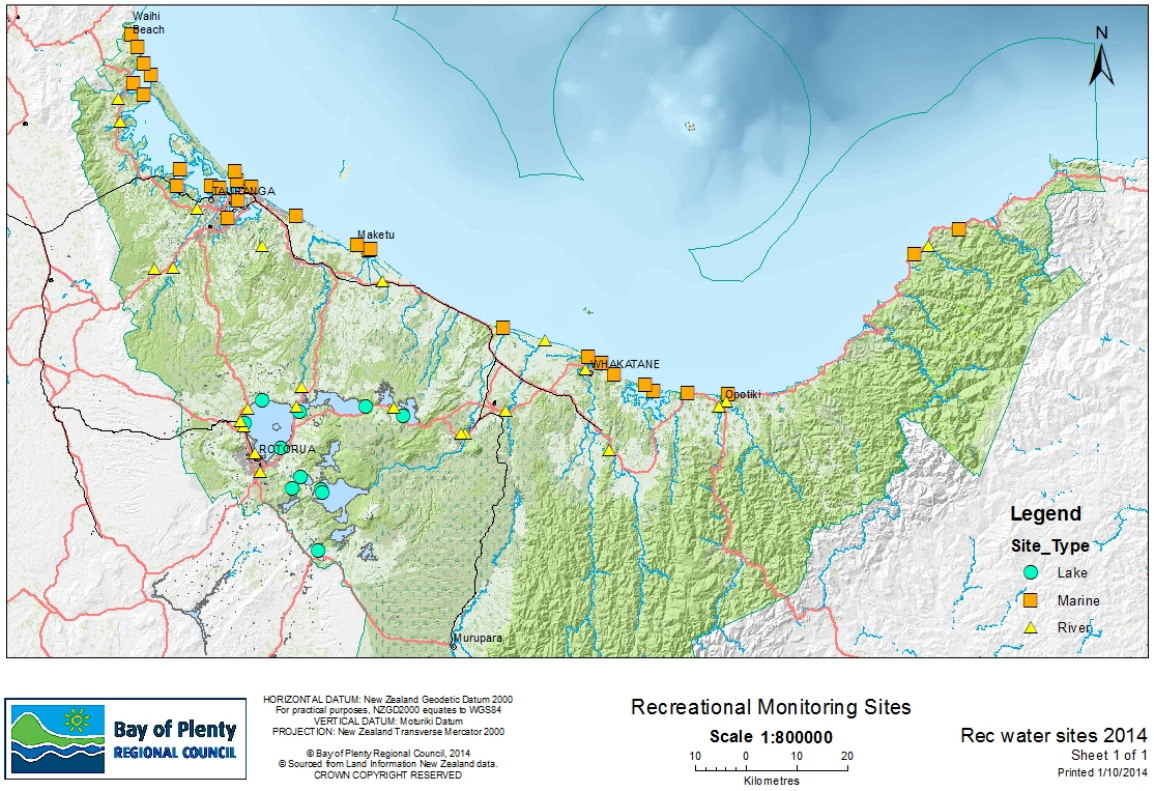

Figure 1.1 Bathing surveillance sites for the 2014/15 season, Bay of Plenty

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Part 2: Microbiological guidelines, indicators and grading

2.1 Introduction

If human or animal faecal matter finds its way into waters of recreational value, there is a risk that water users will be exposed to a diverse range of pathogenic (disease causing) micro-organisms. A variety of organisms are present in faecal matter such as viruses, bacteria, protozoa (single cell organisms), and helminths (nematodes). These can reach water bodies via a variety of pathways and in varying concentrations.

The impacts of pathogenic micro-organisms on human health are commonly manifested as gastro-enteritis, but other common illnesses include respiratory problems and skin rashes. Serious illness can also be attributed to infection from pathogens contained in waters, for example, hepatitis A, giardiasis, cryptosporidiosis, campylobacteriosis, and salmonellosis (MfE/MoH, 2003).

Indicator micro-organisms are used to assess recreational water quality. It is difficult and impractical to measure all potentially pathogenic micro-organisms in water. Indicator micro-organisms give an indirect measure of pathogen levels. The bacteriological indicators chosen are associated with the gut of warm blooded animals and are common in faecal matter. While these indicator bacteria are not generally harmful themselves, they do indicate the presence of harmful pathogens. Two indicator bacteria are commonly used in recreational waters:

- freshwaters – *Escherichia coli* (*E.coli*), and
- marine waters – Enterococci.

The use of these two indicators is stipulated in the New Zealand microbiological water quality guidelines (MfE/MoH 2003). Research that relates illness to indicator bacterial levels has been used to develop guideline levels which are a tolerable risk to healthy people. The Microbiological Guidelines provide a method to grade recreational waters (see section 2.4) and trigger levels which can be used by water managers and the public, to assess the potential risk of using recreational waters. Single water sample results can then be compared to guideline values to help determine if a health alert or other action should be undertaken.

2.2 Sampling and analysis

Water sampling and analyses were performed in accordance with established internal procedures. Most analyses were performed by the Regional Council laboratory.

Table 2.1 Methods used for analysis of water samples

Parameter (abbreviation)	Method	Detection limit/units
Escherichia coli (E.coli)	Membrane filtration (APHA 2005)	1 cfu/100 ml
Faecal coliform (FC)	Membrane filtration (APHA 2005)	1 cfu/100 ml
Enterococci (Ent)	Method No 1600, USEPA 1986 EPA-821-R-97-004	1 cfu/100 ml

Sampling occurred between 8:00 am and 3:30 pm and was completed by either wading or by use of a sample pole. Sterile 200 ml polyethylene bottles were used to sample water at a representative location in the water column. Water quality analyses were completed using the methods in Table 2.1. All samples were stored and returned within the time period stipulated by the methods.

Shellfish were collected by hand and placed in plastic bags and stored in a chilly bin. The samples were then transported to the laboratory within six hours.

Shellfish were analysed for escherichia coli, enterococci and faecal coliforms. The most probable number (MPN) method was used for faecal coliform and enterococci analysis (APHA 2005), and *E.coli* analysis (APHA 1985).

2.3 Microbiological water quality guidelines

A comparison of monitoring results with the microbiological guidelines over a bathing season, provides water managers with a tool for water quality assessment, which are used in conjunction with site grades. Site grading provides an analysis of the suitability for recreation over time, using a combination of information from microbiological bathing survey results and catchment characteristics.

A three-tiered management framework has been adopted to help signal when recreational waters are potentially at risk to users. The system uses the colours green (safe mode, 'surveillance'), orange (cautionary mode, 'alert') and red (unsafe mode, 'action') to denote the level of risk to users. The indicator bacteria levels and recommended management responses to these different modes are listed in Table 2.2.

Table 2.2 Surveillance, alert and action levels for fresh and marine waters (MfE/MoH, 2003)

Mode	Guideline - freshwaters (*E.coli* count in colony forming units per 100 mL)	Recommended management response
Green/Surveillance	Single sample ≤ 260	Routine monitoring
Orange/Alert	Single sample > 260 and ≤ 550	Increased monitoring, identify possible sources
Red/Action	Single sample > 550	Public warnings, increased monitoring, source investigation

Mode	Guideline - marine (Enterococci count in colony forming units per 100 mL)	Recommended management response
Green/Surveillance	Single sample ≤ 140	Routine monitoring
Orange/Alert	Single sample > 140 and ≤ 280	Increased monitoring, identify possible sources
Red/Action	Two consecutive single samples > 280	Public warnings, increased monitoring, source investigation

Surveillance mode (green) indicates there is an acceptable risk to recreational water users. Should waters be found to be in *Alert Mode* (*orange)* then there is an increased risk of illness if contact is made with recreational waters. *Action Mode (red)* indicates waters pose an unacceptable health risk to recreational water users. In such a case, the health authority will assess the risk to public health and if necessary, issue health warnings in conjunction with local authorities. Use of microbiological guidelines and the issuing of health warnings are dependent on the circumstances surrounding any contamination event.

2.4 Bathing surveillance grading

The New Zealand Microbiological Water Quality Guideline (2003) outlines a process to grade the suitability of marine and fresh waters for recreational use. A 'Suitability for Recreation Grade' (SFRG) is generated through a combination of qualitative assessment of susceptibility of recreational sites to faecal contamination and by direct measurement of appropriate bacteriological indicators at the site. The SFRG then describes the general risk of faecal contamination at a given site at any time.

The beach grading is made up of two components:

- The *Sanitary Inspection Category (SIC)*, composed of five ratings from very low to very high, which are dependent upon the presence and potential effect of faecal contaminant sources. It generates a measure of susceptibility of a water body to faecal contamination from potential water quality risk factors close to swimming spots, such as sewage outfalls, stormwater drains, stock in waterways and run-off from land; and

- Historical microbiological results, which generate a *Microbiological Assessment Category (MAC)*, which provides a measurement of actual water quality over time.

These two combined give an overall Suitability for Recreation Grade (SFRG) (Figure 2.1), which describes the general condition of a site at any given time, based on both risk and indicator bacteria counts. The five grades in the SFRG range from 'Very Good' to 'Very Poor'. Grades help determine whether ongoing monitoring is required, and provide the basis for telling people whether or not water is suitable for recreational use from a public health perspective. If there is an incompatibility between the SIC and the MAC, (this may be due to limited data) then a 'Follow Up' grade is given.

The Sanitary Inspection Category is developed from a Catchment Assessment Checklist (CAC) (see MfE & MoH, 2003) which explores land use, water use and characteristics, microbiological hazards, discharges, littoral drift, climatic influences, and other influences present in the catchment of the beach under analysis. Once a CAC is completed, a Sanitary Inspection Category (SIC) can be allocated. Catchment checklists have been surveyed by respective councils and the Regional Council in 2014 to update the SIC. The SIC have been calculated using the Bathewatch software developed by MfE.

The grading system developed by MfE and MoH is prescriptive with a view to keeping the grading system uncomplicated and user friendly. The only room for interpretation is within the CAC when determining microbiological hazards.

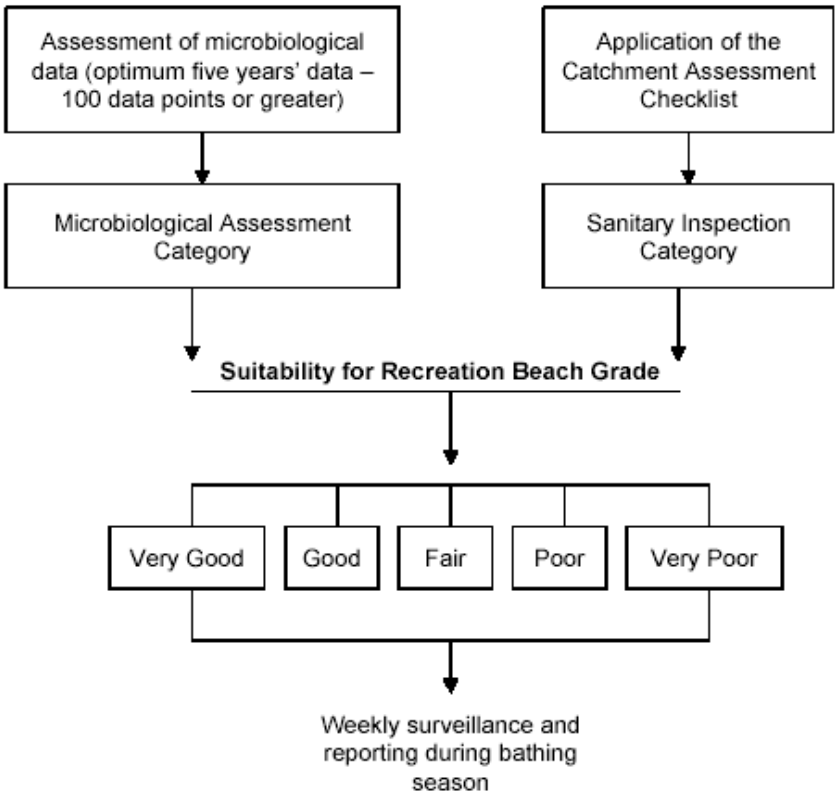

Figure 2.1 Components used to grade a beach (from MfE and MoH, 2003)

The MAC is calculated as the 95 percentile of the last five years of historic faecal bacteria indicator data. Enterococci are the preferred indicator bacteria for marine waters and *Escherichia coli* (*E.coli*) are the indicator bacteria for freshwaters. Ideally, at least 20 samples taken weekly over a bathing season, over a five year period to provide at least 100 sample points for the MAC assessment. This has not occurred for all Bay of Plenty sites, so MAC evaluations are based on available data.

The SFRG's have been determined for recreational sites in the Bay of Plenty region since 2005. Updated SFRG's incorporating the 2014/2015 microbiological water quality results are summarised in Appendix 1 which are based on the last five years data.

2.5 Additional risk to recreational users

The Bay of Plenty Regional Council monitors a number of freshwater sites that experience blooms of potentially toxic blue-green algae. These include several of the Rotorua Lakes and the Kaituna River. When monitoring indicates a high risk to water users, a health warning or health advisory is issued for the affected area. Media releases, websites and recorded telephone messages also provide the public with information on the status of these sites.

Monitoring for the mat-forming cyanobacteria *Phormidium,* occurs in a number of Bay of Plenty rivers, including the Rangitāiki, Whakatāne, Otara and Waimana, Uretara Stream and Te Rereatukahia streams. The beds of these rivers and streams can support substantial mats of this toxin producing algae, particularly during times

of low flow. The mats contain neurotoxins that are highly toxic to humans and animals. New Zealand studies have shown that at times of high biomass, *Phormidium* can also produce high levels of free floating toxins in the water (Heath 2009).

The Microbiological Water Quality Guidelines does not include guidance on the risk posed by potentially toxic algal blooms. Interim New Zealand Guidelines for cyanobacteria are given in MfE/MoH (2009).

Part 3: Recreational waters surveillance and grading results 2014/2015

3.1 Recreational surveillance monitoring

Before the start of the bathing season, a monitoring plan was designed and circulated for comment to Toi Te Ora Public Health and district councils. The criteria for selection of sites included whether they were high-use bathing locations and whether there was known contamination risk. Other sites have been included at the request of the community.

Monitoring began in late October 2014 and ran until the end of March 2015. Approximately 70 sites across the Bay of Plenty region were monitored with sites sampled weekly or once every two weeks.

Results of the water quality analyses are generally available after 24-hours and these are then posted onto the Bay of Plenty Regional Council website[1]. Media releases also help keep the public informed of the situation in regards to recreational water quality.

If 'orange' or 'red' modes are flagged, these results are directly communicated to Toi Te Ora Public Health and the relevant district council. Follow-up sampling then occurs within a 24-hour period. Should a water quality problem be found to recur, Toi Te Ora Public Health has the responsibility to decide if a public health warning needs to be issued. If a warning, is required Toi Te Ora Public Health will initiate media releases and inform the district council of the need for warning signs and any further monitoring.

3.2 Results

The detailed results of the monitoring are presented in tabular form in Appendix 1. These tables give information on the 95 percentile value, MAC score, SIC score, SFRG, and a conservative interim grade where applicable. The Suitability for Recreation Grades (SFRG's) are presented in Figure 3.1 and 3.2.

The grading system illustrates that 81.8% of lake sites are graded 'very good' or 'good' and 9% 'poor'. 60% of river sites are graded 'poor', but only 7.1% of estuarine sites were graded 'poor' and 50.0% 'fair'. Most (85.7%) of the open coastal sites were graded as 'good' or 'very good', with only one site graded as 'poor' and one as 'follow up'.

[1] http://www.boprc.govt.nz/environment/water/swimming-water-quality/

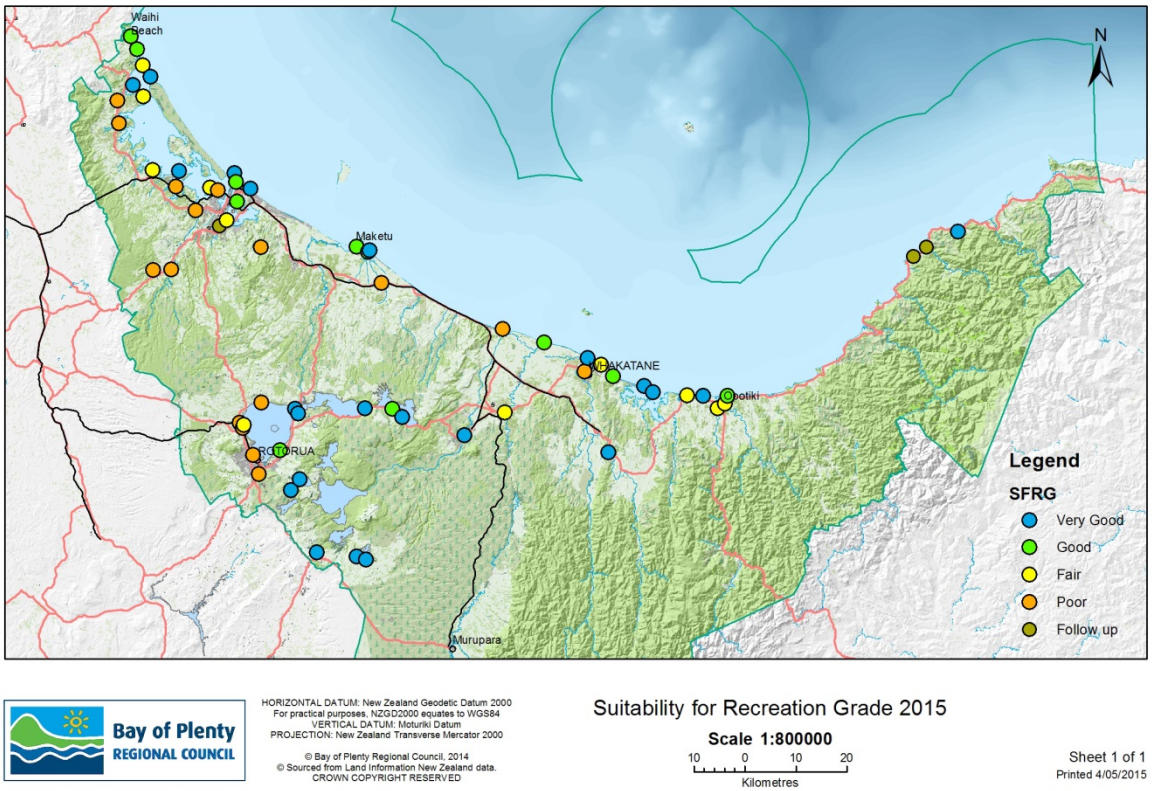

Figure 3.1 Suitability for Recreation Grades, 2014/15

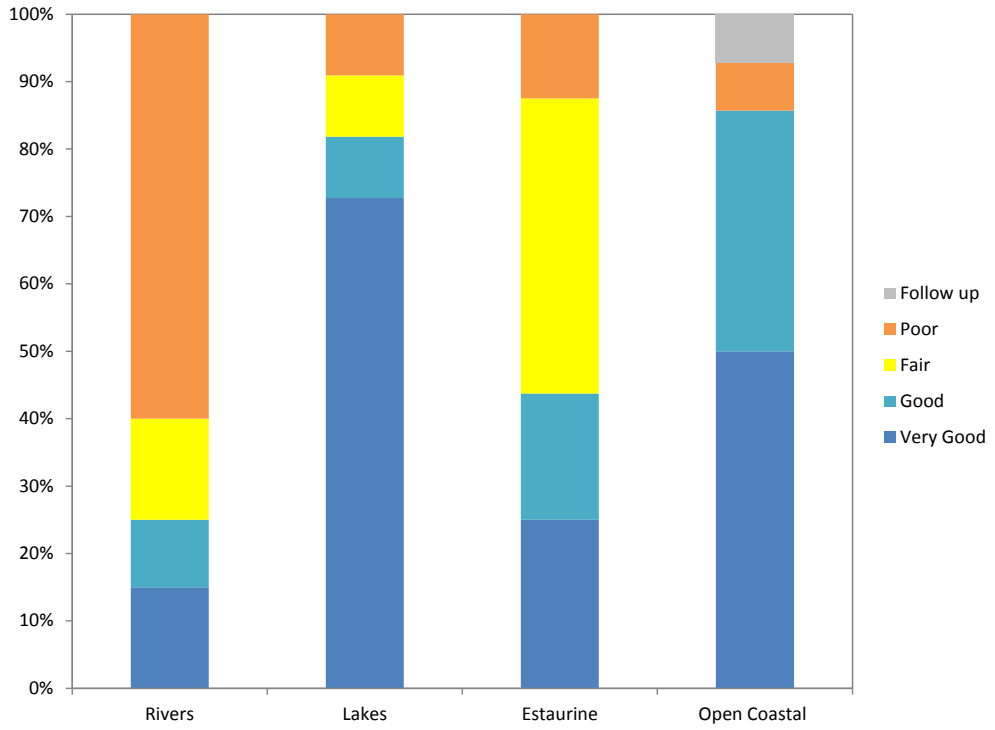

Figure 3.2 Comparison of the 2014/15 results for the Suitability for Recreation Grade (SFRG)

Table 3.1 also shows the status of monitored bathing sites in the Bay of Plenty against the New Zealand Microbiological Water Quality Guidelines (Red/Action Mode). Generally, lake sites showed the highest quality overall against this guideline, followed by marine and river sites.

Table 3.1 Percentage of samples from monitored bathing sites, with indicator bacteria levels less than the Red/Action Mode, as defined by the New Zealand Microbiological Water Quality Guidelines (MfE/MoH 2003).

		Rivers	Lakes	Marine
Samples less than the Red/Action Mode	2014/15	93.0%	100%	98.6%
	last 5 Years	94.1%	99.8%	98.2%

More detailed results are presented in the following sections, presenting the percentage of samples at each site that exceeded guideline levels throughout the 2014/2015 season. The five yearly 95-percentile and median (50-percentile) data are also presented to give a longer-term perspective.

3.3 River and stream sites

River and stream sites were monitored on a weekly or two-weekly basis. Figure 3.2 shows the range of *E.coli* results recorded at each site, ranked in order of percentage of samples over the Red/Action Mode for the 2014/15 season. Of the 22 sites monitored, 17 had instances where the Orange/Alert Mode was exceeded and 12 of these had results over 550 *E.coli* cfu/100 ml (Red/Action Mode). In comparison to last season, of the 29 sites monitored, only ten had instances where the Orange/Alert Mode was exceeded and eight of these had results over 550 *E.coli* cfu/100 mL (Red/Action Mode).

In the prior 2011/12 and 2012/13 seasons, the Rotorua Streams, Ngongotahā and Waiteti, topped the list of highest exceedances. Exceedances were generally lower in these streams this past season, thanks to two relatively dry summers. In Tauranga last season (2013/14), the Wairoa, Tuapiro and Uretara all had exceedance in early November 2013, thanks to a sizable rain event. Several small rainfall events are likely to have contributed to exceedances in the Waimapu but a Red/Action Mode exceedance that occurred at the end of March 2014 is unexplained.

This season, Kaiate Stream and the Wairoa River at McLarens Falls had the highest exceedances. Similar to previous years, the exceedences in the Wairoa generally followed significant rainfall events. Kaiate Stream, however, produced exceedances in the absence of rainfall events. The Kaiate Stream results are discussed more in Section 3.3.1.

Figure 3.3 shows that 12 sites' 95 percentile data are higher than the Red/Action Mode guideline. These can be classed as the highest priority sites for investigation and action, however, exceedances over the 95th percentile guideline predominantly occur with events that generate surface runoff, when swimming is less likely to occur. Median values are also plotted in Figure 3.3 and this gives a measure of the average risk of infection to water uses (particularly primary contact). No median values were over the Orange/Alert Mode, indicating that on average, all rivers over the 2014/15 season were suitable for swimming.

The comparison of data with the NOF attributes (Table shown in Appendix 1a) shows that all rivers meet the 'A' category (very low risk of infection) for activities with occasional immersion and some ingestion of water (such as wading and boating). Fifty four percent of sites do not meet the minimum acceptable criteria for full immersion activities (i.e. greater than five percent risk of infection), 23% rated 'A' and another 23% rated 'B'. In the previous 2013/2014 season, 29% of sites did not meet the minimum acceptable criteria for full immersion, 64% rated 'A' and seven percent rated 'B'.

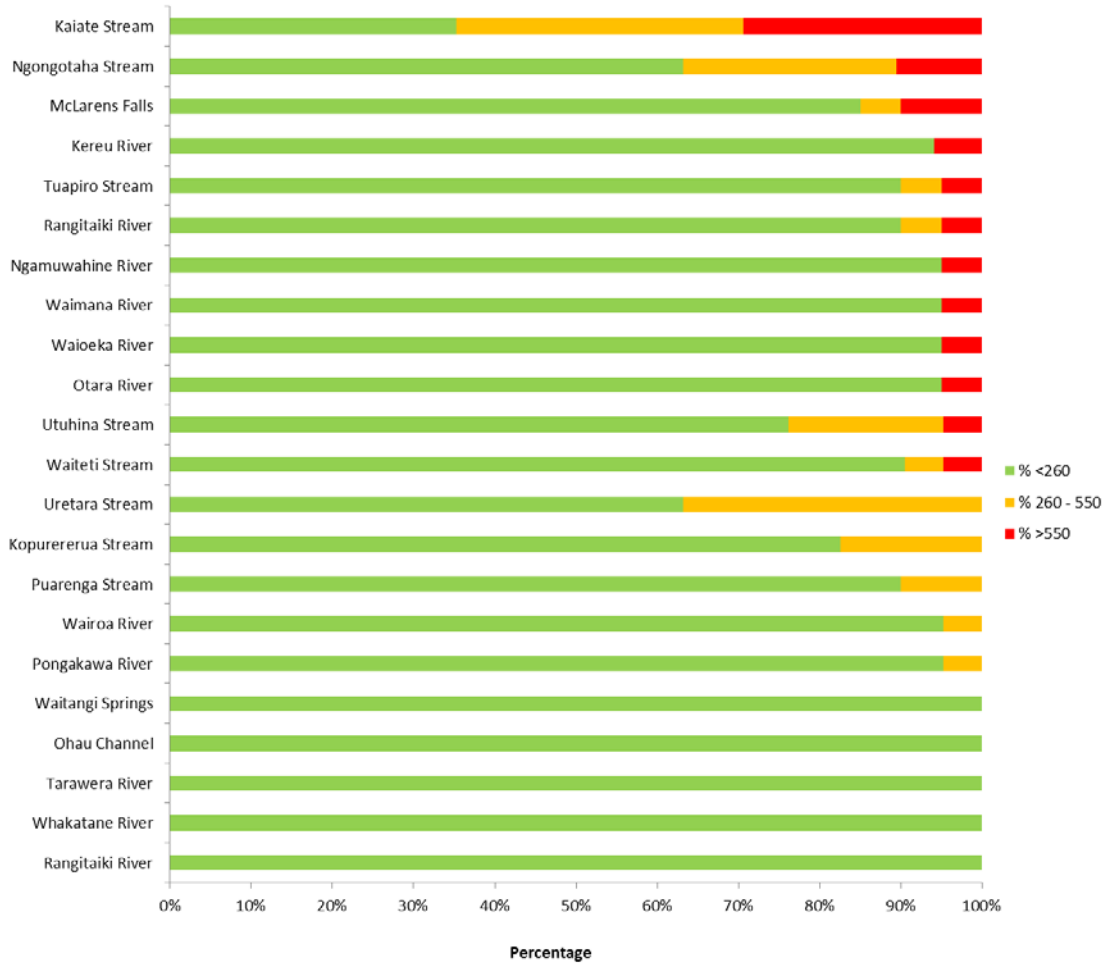

Figure 3.2 *River and stream E.coli levels compared against each of the modes in the NZ Microbiological Water Quality Guidelines (MfE/MoH 2003), 2014/2015 bathing season*

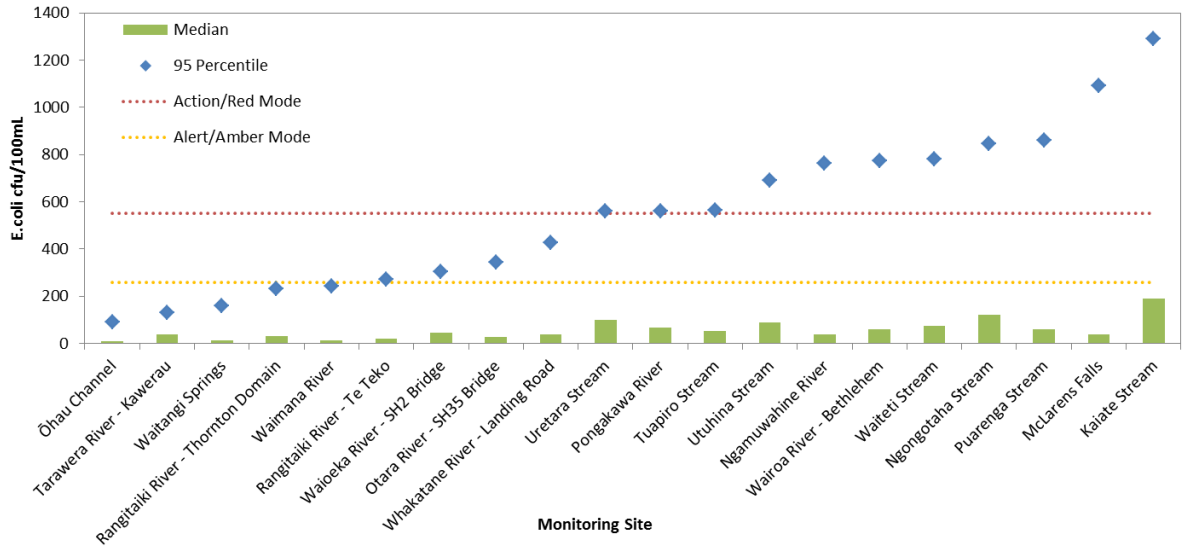

Figure 3.3 Ninety five-percentile and median E.coli concentrations, river and stream sites over the past five years. Note that Kereu River and Kopurererua Stream results have been excluded, as they are new sites as of 2014/15

3.3.1 Kaiate Stream

Background/History

The catchment above Kaiate Falls Road Bridge covers an area of approximately 798 ha, where 543 ha (68%) is covered in native vegetation, while the remaining 255 ha (32%) is used for predominately for pastoral farm land, mostly cattle. The Kaiate Stream at the monitoring location is a third-order stream, and its main tributaries are the second-order Owairoa Stream and the second-order Otawera Stream. The Owairoa drains a large proportion of the native bush area, while the Otawera drains both native bush and farmland (Figure 3.4).

In previous bathing seasons, Kaiate Stream samples have exhibited high 95 percentiles. In particular, last season's 95 percentile was 1360 cfu/100 mL, however, only five percent of samples taken, exceeded the Action/Red Mode guideline level.

Figure 3.4 *Map showing the Kaiate Stream monitoring location at Kaiate Falls Road Bridge (red marker), the catchment (shaded area), and tributaries*

Kaiate Steam Bathing Results 2014/15

Throughout the 2014/15 season, Kaiate Stream samples have consistently exceeded guideline values, with extreme values occurring sporadically (Figure 3.5). Although the 95 percentile decreased slightly to 1290 cfu/100 mL, 29% of samples were above the Action/Red Mode guideline, which is a significant increase in comparison to the previous season. As the 2014/15 rainfall totals were similar to that of the previous seasons, the apparent increase in *E.coli* concentration may indicate changes within the catchment.

Rainfall events recorded at Waimapu are also shown in Figure 3.5. *E.coli* concentrations appear to decrease after the relatively large December 2014 rainfall events. However, no significant relationship exists between *E.coli* levels in Kaiate Stream and rainfall at Waimapu, perhaps due to the local spatial variation of rainfall. A rain gauge and a hydrometric instrument at Kaiate Stream would be useful to determine if a relationship exists.

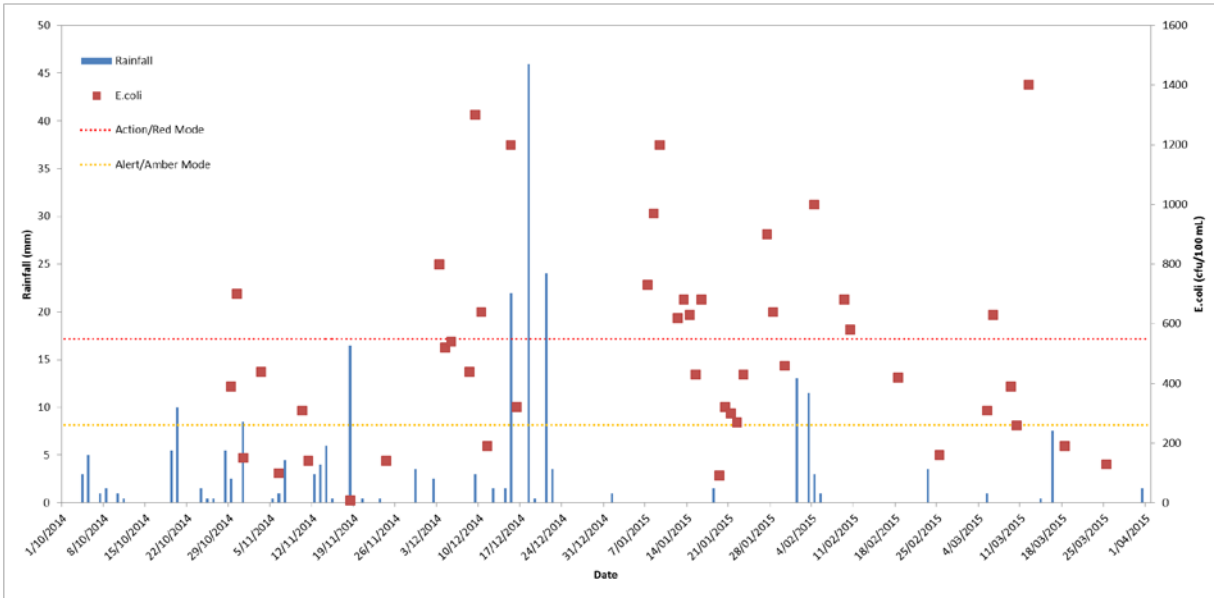

Figure 3.5 Graph of E.coli values and rainfall at Waimapu over the 2014/15 bathing season, with respect to the New Zealand Microbiological Water Quality Guidelines (MfE/MoH, 2003)

Microbial Source Tracking Results

In response to the high bacteria concentrations at Kaiate Falls Road Bridge, a catchment survey was conducted in conjunction with Microbial Source Tracking (MST) to determine sources of faecal contamination. Samples were taken at surrounding tributaries and various locations along Kaiate Stream. The results show that the dominant source was ruminant (Figure 3.6), which picks up cow, sheep, deer and goats, and can be influenced by possum. With respect to landuse in the catchment, cattle (and possibly deer also farmed locally) are the most likely influence. The MST also showed that there is an avian influence at multiple locations along Kaiate Stream, with one sample also indicating human faecal contamination.

Compared to previous years, the increase in faecal contamination could be a consequence of greater avian influence, increased stocking rates, land use change, and/or a septic system leak. There could also be a greater presence of feral animal in native bush in the upper catchment.

Implications

Further sampling is required to isolate problematic sub-catchments, and installation of hydrometric instruments would be useful to determine if flow is influencing contamination. Continued exclusion of stock from waterways, along with riparian fencing and planting to provide buffer zones, is the current best practice to reduce the risk of microbial contamination. In the interest of public health, pathogen monitoring for the presence of campylobacter or cryptosporidium would also be a suitable course of action. While there is risk to public health, especially during bathing seasons, media releases are useful to increase public awareness. An example article describing the situation at Kaiate Falls from the Bay of Plenty Times is shown in Appendix 2.

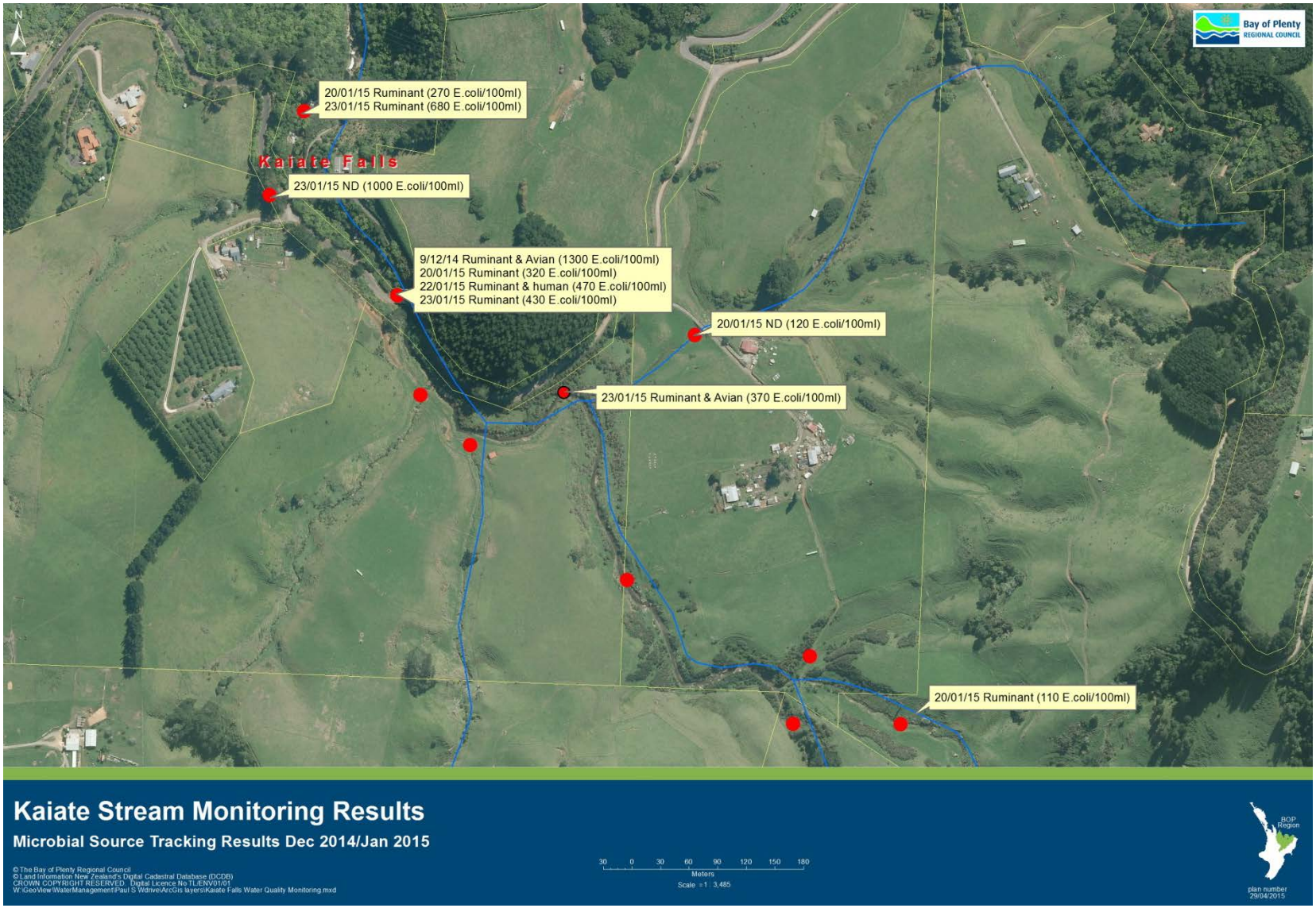

Figure 3.6 Kaiate Stream Microbial Source Tracking results, 2014/15.The site containing four results is Kaiate Falls Road Bridge

3.3.2 Lake sites

Sampling occurred at 11 lake sites once each week. One site, the beach of Lake Tikitapu, reached the Orange/Alert Mode during the 2014/15 season (Figure 3.7). At this site, no Red/Action Mode results occurred and the median was only2 cfu/100 ml.

The median *E.coli* concentrations for lake sites were all below 15cfu/100 mL indicating a low level of faecal contamination overall (Figure 3.8). Lake Rotorua at Hamurana had the highest median *E.coli* concentrations of lake sites (13.5 cfu/100 mL), although the site did not reach the Orange/Alert Mode.

Comparison of the 2014/15 *E.coli* data with the NOF attributes (see Appendix Table 1b) shows that all lakes meet the 'A' category (very low risk of infection) for activities with occasional immersion and some ingestion of water, such as wading and boating). A similar result occurred for full immersion activities (primary activities, i.e. greater than 5% risk of infection), with two sites being in the 'B' category (Lake Rotorua at Ngongotahā and Hamurana).

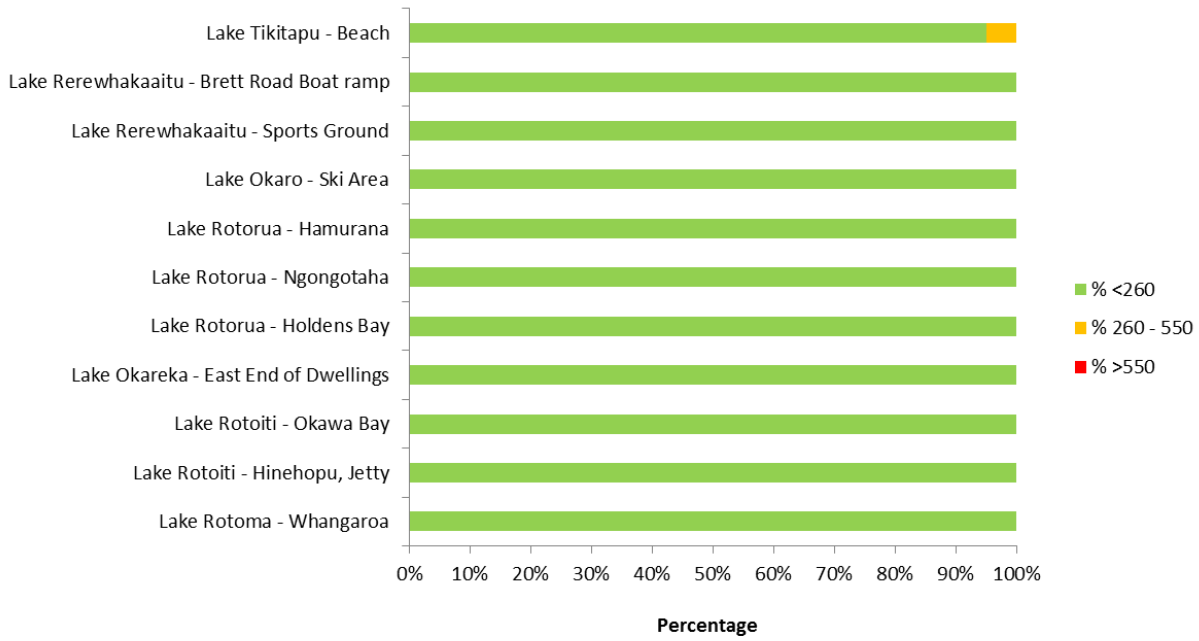

Figure 3.7 Lake E.coli levels compared against each of the modes in the NZ Microbiological Water Quality Guidelines (MfE/MoH 2003), 2014/2015 bathing season

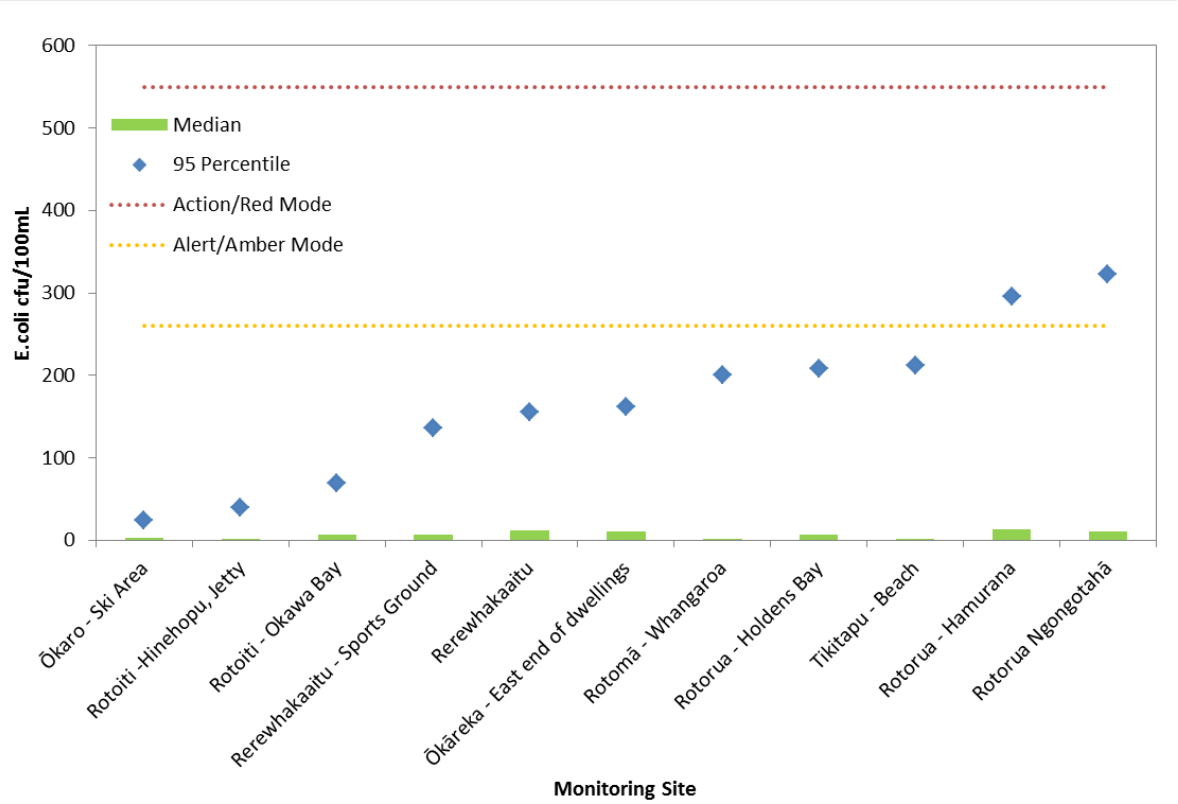

Figure 3.8 Ninety five-percentile and median results of E.coli concentrations, lake sites over the past five years

3.3.3 Marine sites

Open coastal

The open coastal marine monitoring sites were sampled on a weekly basis. Figure 3.9 shows the percentage enterococci concentrations at each site that exceeded the microbiological guideline levels ranked in order. No sites reached Red/Action Mode (two consecutive samples greater than 280 enterococci/100 ml). However, four sites reached the Orange/Alert Mode, including Whanarua Bay, Te Kaha Beach at Maraetai Bay, Ōhope Beach at Surf'n Sand Motor Camp, and Waihī Beach at 3 Mile Creek. The 3 mile creek site receives a higher bacterial loading from the creek.

Maraetai Bay near Te Kaha still has the highest 95th percentile, potential due to a contamination event several years ago, but since this time the water quality has been good.

All 12 open coastal sites had median enterococci concentrations below 5 cfu/100 ml in both 2014/2015 and the last five years. This indicates overall a low level of enterococci indicator bacteria contamination for marine coastal waters in the Bay of Plenty (Figure 3.10).

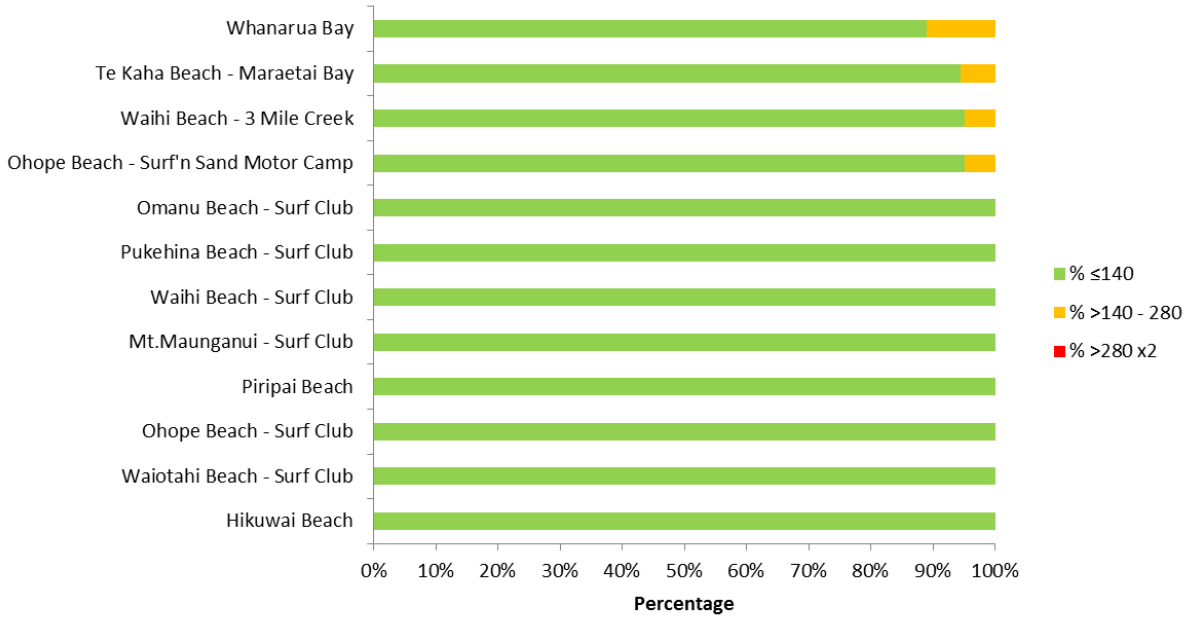

Figure 3.9 *Coastal marine enterococci levels compared against each of the modes in the NZ Microbiological Water Quality Guidelines (MfE/MoH 2003), 2014/2015 bathing season.*

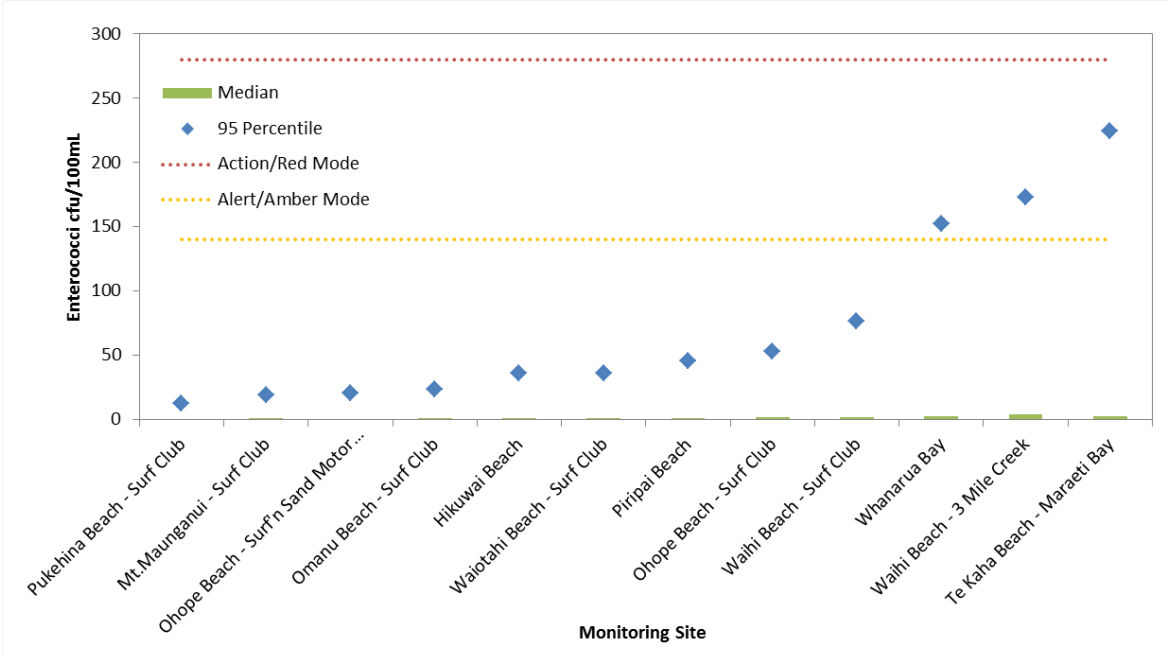

Figure 3.10 *Ninety five-percentile and median results of enterococci concentrations, coastal marine sites over the past five years*

Estuarine

Eleven of the 18 estuarine sites reached the Orange/Alert Mode during the 2014/15 season (Figure 3.11), with no sites reaching Red/Action Mode. Median enterococci concentrations were generally well below the Orange/Alert Mode, with the highest median level of 39 cfu/100 mL at Tarawera River Estuary (Figure3.12).

Athenree and Otumoetai were the only sites with 95th percentiles over the Red/Action mode over the last five years (Figure 3.12). This indicates a greater than five percent risk of contact with infectious organisms. The source of bacteria load at Athenree is unclear as the sewerage system, for the community is reticulated. However, the Waiau Stream enters the harbour nearby and may contribute to the bacteria load, particularly during times of flood. Otumoetai is influenced by the Wairoa River which can also have elevated bacterial levels when in flood. This site can also be influenced by sewage overflows which occur on occasion.

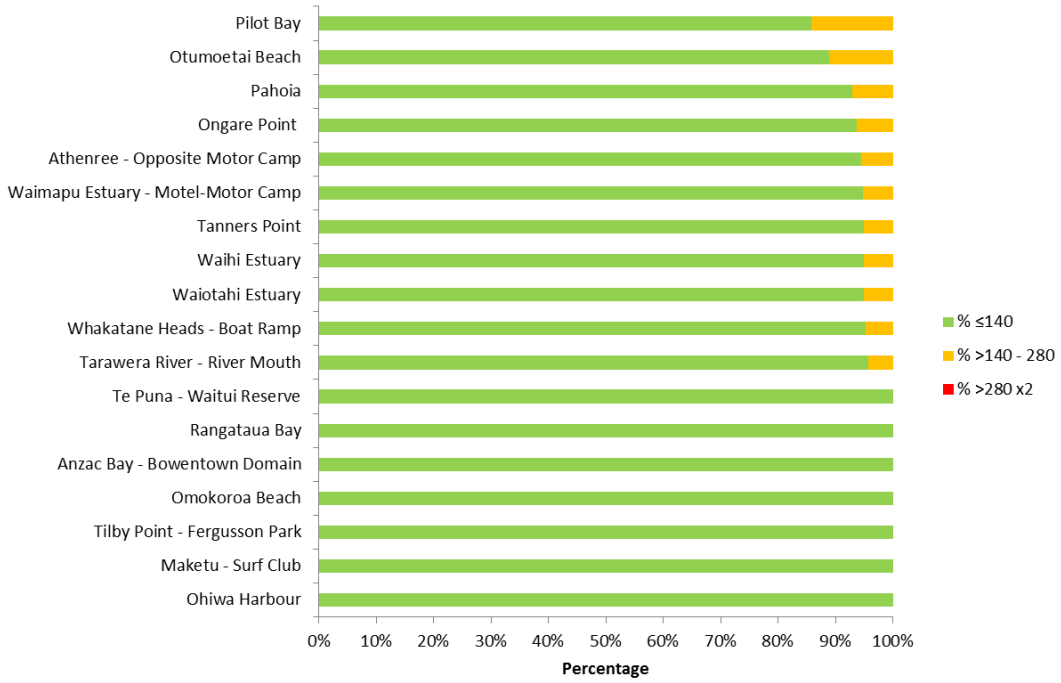

Figure 3.11 Estuarine marine enterococci levels compared against each of the modes in the New Zealand Microbiological Water Quality Guidelines (MfE/MoH 2003), 2014/2015 bathing season

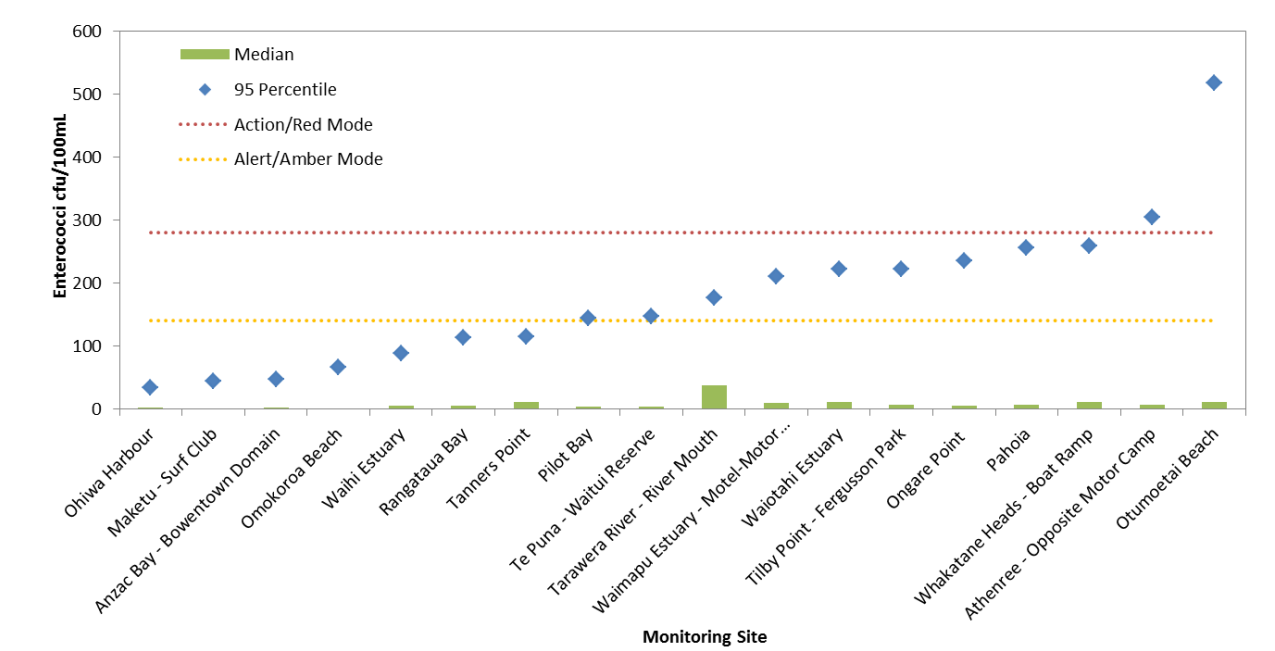

Figure 3.9 Ninety five-percentile and median results of enterococci concentrations, estuarine marine sites over the past five years

Part 4: Shellfish and Recreational Gathering Waters

4.1 Guidelines, sampling and analysis

Of the 30 open coastal and estuarine surveillance sites, 11 sites are regarded by communities as desirable shellfish gathering locations. Accordingly, water samples from these sites are additionally analysed for Faecal Coliforms (FC), which are suitable microbiological indicators for sanitary safety with regards to public shellfish consumption. The FC values in accordance with the microbiological water-quality guidelines. indicate the presence of pathogenic bacteria, protozoa and viruses. Furthermore, faecal coliforms have a stronger correlation with health risks associated with eating shellfish than that of enterococci (MfE/MoH, 2003), making them a useful indicator.

The guidelines for safe shellfish consumption are as follows:

- The median FC content should not exceed a Most Probable Number (MPN) of 14/100 mL.
- No more than 10% of samples should exceed a MPN of 43/100 mL.

Compliance with these guidelines does not ensure that shellfish in the waters will be safe for consumption, as they do not account for biotoxins. However, they do provide a useful management tool to measure change from prevalent conditions. The sampling and analysis for FC is described in Section 2.2.

4.2 Results

Results for the FC sampling over the 2014/15 bathing season are presented in Figure 4.1. The median faecal coliform concentrations were found to be over the MoH safe consumption guideline of 14 MPN/100 mL at Waiotahi Estuary, Maketū and Otumoetai Beach. Figure 4.2 shows the percentage of samples with FC concentrations above 43 cfu/100 mL, with reference to the 10% limit. It reveals that Otumoetai, Waiotahi Estuary, Waihī Estuary, Pilot Bay, and Maketū all exceed the guideline. Most other sites were within safe consumption limits. Every sample taken at Pukehina Beach, Ōmanu Beach, and Waihī Beach at the Surf Club had FC concentrations below 43 cfu/100 mL.

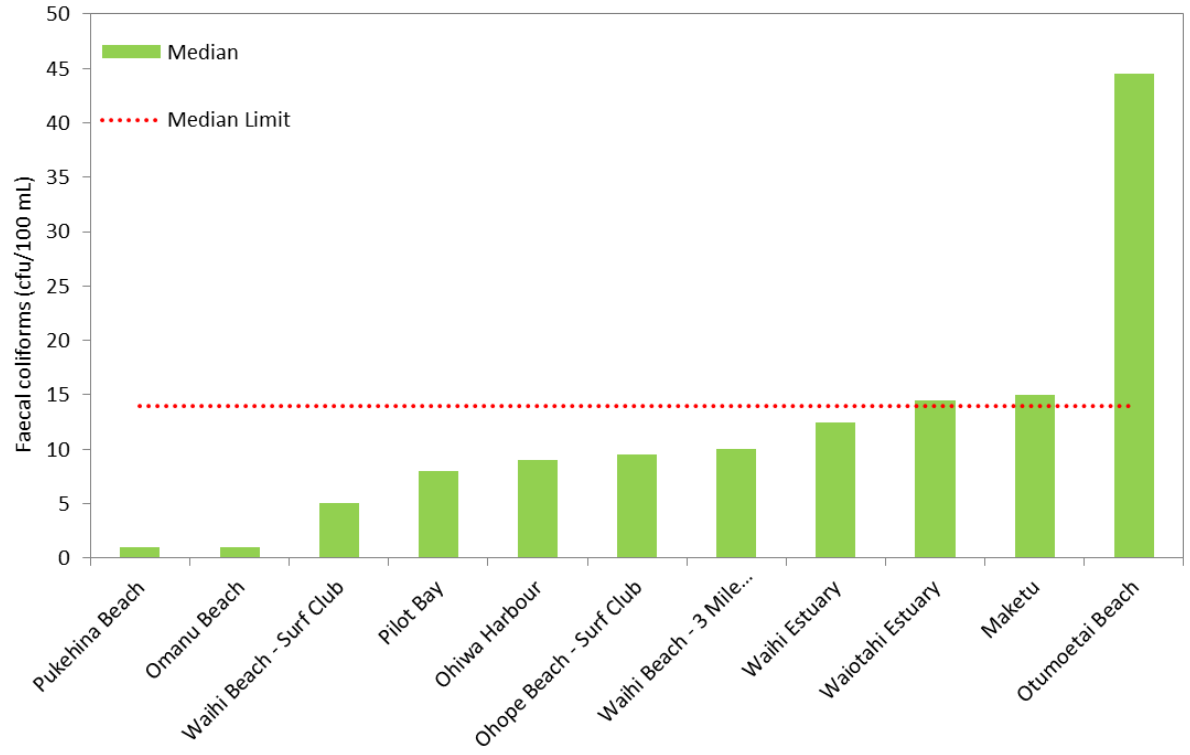

Figure 4.1 *Median faecal coliform concentrations at several shellfish gathering locations, with the 14 cfu/100 mL MPN limit from the New Zealand Microbiological Water Quality Guidelines (MfE/MoH 2003)*

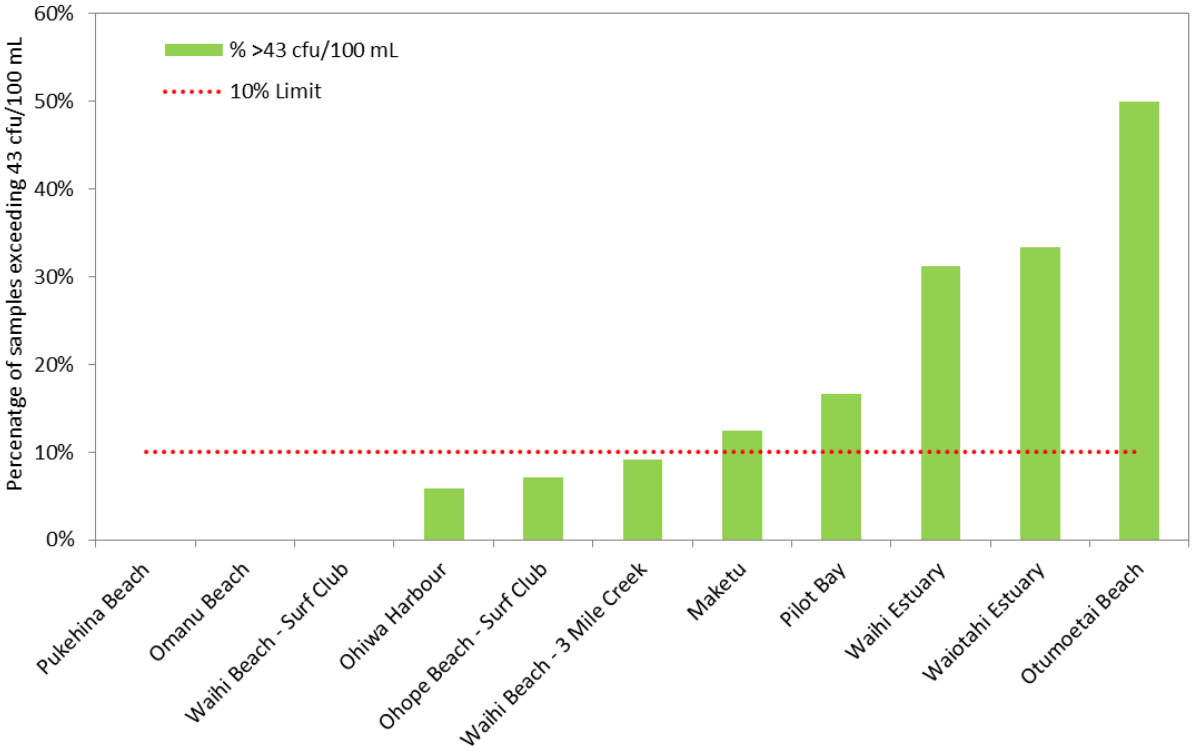

Figure 4.2 *Percentage of samples exceeding the limit of 43 cfu/100 mL stipulated by the NZ Microbiological Water Quality Guidelines (MfE/MoH 2003) for the 11 marine sites*

Part 5: Summary discussion and recommendations

The results of the 2014 to 2015 bathing surveys show that most sites in the Bay of Plenty are suitable for bathing. The Suitability for Recreation Grading (SFRG) results were improved over previous years due to the inclusion of the last three years data, which have had minimal influence from rainfall induced runoff. The grading system shows that 81.8% of lake sites are graded ‘very good’ or ‘good’ and 9% ‘poor’. Of river sites 54.5% are graded ‘poor’, but only 7.1% of estuarine sites were graded ‘poor’ and 50.0% ‘fair’. Most 85.7% of the open coastal sites have been graded as ‘good’ or ‘very good’, with only one site graded as ‘poor’ and one as ‘follow up’.

Suitability for Recreation Grades (SFRG) show that the highest risk to recreational water users continues to be in Bay of Plenty rivers, and only a low risk of encountering water borne pathogens in monitored lakes. Lakes sites graded ‘very good’ or ‘good’ 81.8% of the time, while 54.5% of river sites are graded ‘poor’ or ‘very poor’. This is consistent with previous monitoring years and reflects the greater vulnerability of rivers and streams to diffuse and point source discharges, due to contaminants sourced from faecal material.

Open coastal sites typically have excellent water quality with no sites reaching the Red/Action Mode in 2014/2015. Most (85.7%) of the open coastal sites were graded as ‘good’ or ‘very good’ under the SFRG system, with only one site graded as ‘poor’ and one as ‘follow up’. Eleven of the 18 estuarine sites reached the Orange/Alert Mode in 2014/15, but only 12.5% of the estuarine sites were graded ‘poor’ (zero are graded ‘very poor’) with higher faecal contamination levels, due to the enclosed nature of estuaries and river influences.

The 2014/15 season for the rivers in this relatively dry summer (see Figure 5.1) showed that 11.0% of samples reached the Orange/Alert Mode and 7.0% reached the Red/Action Mode. Of the total samples (1251) analysed for indicator bacteria, only 3.0% activated the Orange/Alert Mode and 2.5% the Red/Action Mode.

Note that some SFRG grades are provisional as the microbiological data has not reached an optimum level, according to the New Zealand Microbiological Water Quality Guidelines. The data does, however, provide useful information to allow an assessment of the risk to recreational users of waterways. Follow up grades are also assigned where not enough data has been collected or the catchment assessment is not consistent with the indicator bacteria results. The grading system can be biased by only one or two elevated results, as these push the percentile figures upwards. Such results can be more frequent in years where monitoring has coincided with rainfall events.

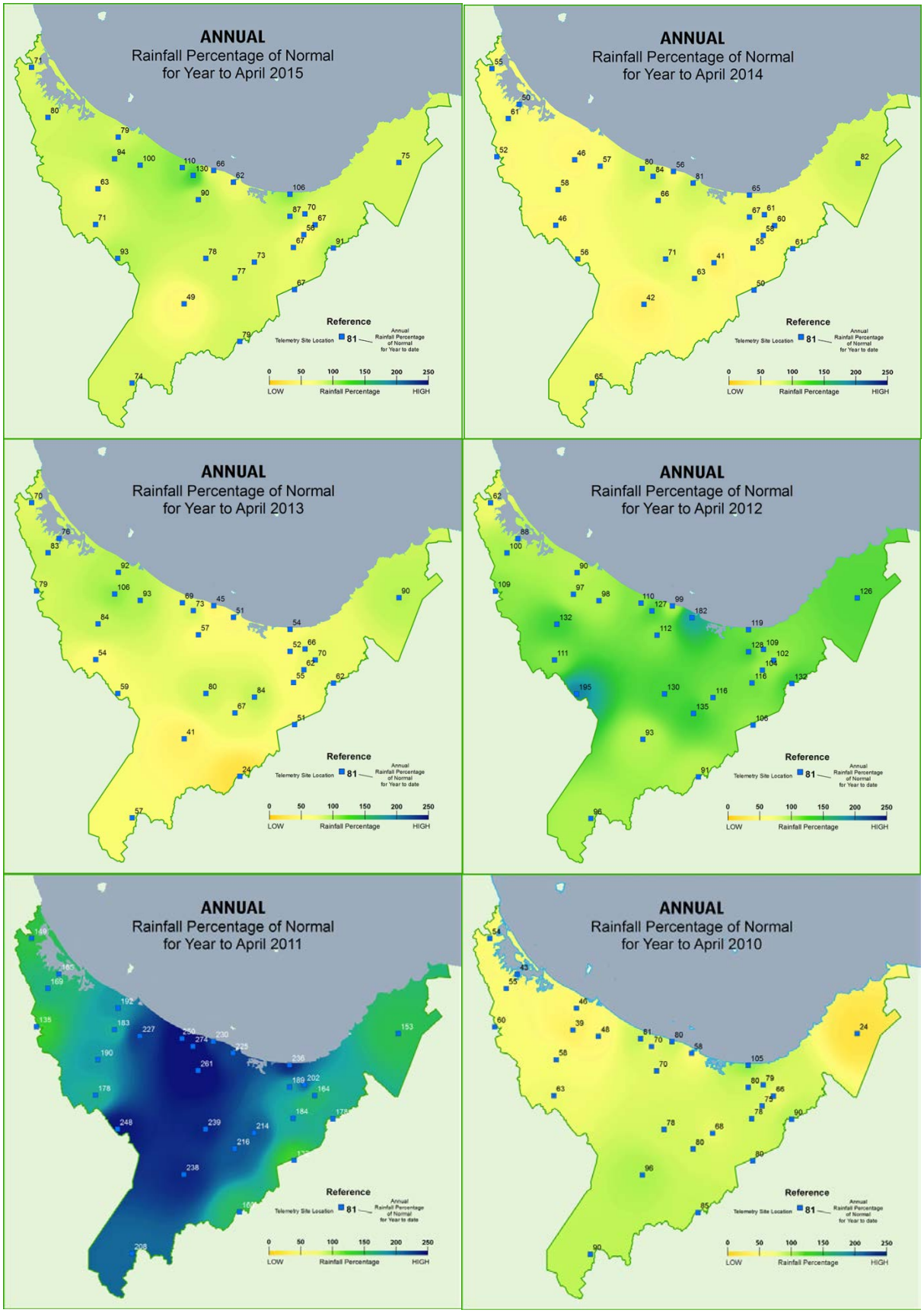

Figure 5.1 Annual rainfall percentage of normal for years 2010 to 2015

E.coli data from 2014/15 when compared with the NPS for NOF attributes for human health, indicate that all sites from rivers and lakes rate highly (i.e. very safe) for secondary contact recreation activities (Table 5.1). However, 12 river sites are below the minimal acceptable standard for primary contact recreation.

Table 6.1 Percentage river and lake sites in the National Objective Framework attributes banding, based on 2014/15 data

Value	Attribute State (*E.coli*/100 ml) for Rivers				
	A	B	C	(Bottom-line)	D
Numeric state	≤260	>260 and ≤ 540	>540 and ≤1000		>1000
Human health for secondary* contact (annual median)	100%	0%	0%		0%
Human health for primary** contact (95th Percentile)	23%	23%	55% **Below Minimum Acceptable State**		
	Attribute State (*E.coli*/100 ml) for Lakes				
Numeric state	≤260	>260 and ≤ 540	>540 and ≤1000		>1000
Human health for secondary* contact (annual median)	100%	0%	0%		0%
Human health for primary** contact (95th Percentile)	82%	18%	0% **Below Minimum Acceptable State**		

*Secondary: activity occasional immersion and some ingestion: e.g. boating; wading. **Primary: likely to involve full immersion.

Concerns have been raised by the public health sector and territorial authorities about using and reporting microbiological water quality risks with the SFRG. Potential issues include not taking into account cyanobacterial growths or risk of blooms, confusion with the grading and regular microbial results reporting, and consistency with other regions at the national reporting level.

The Ministry for the Environment are aware of some of these issues and will be looking at revising the Microbiological Water Quality Guidelines (2003). There is also now a requirement to compare attributes in the NOF as per the NPS for Freshwater. Further guidance is pending on how to apply the NOF for human health attributes. This, along with revised microbiological guidelines will guide future recreational water monitoring programmes.

Shellfish waters at Waiotahi Estuary were found to have faecal bacteria levels above safe consumption guidelines on some occasions. No other sites had *E.coli* results above guideline levels for safe consumption. However some sites did have elevated faecal coliform and enterococci levels which may indicate some risk to human health if these shellfish were ingested uncooked.

Phormidium was observed in several rivers (Whakatane, Waimana, and Rangitaiki) but at levels below alert thresholds. The season was marked by consistent low flow conditions but this did not appear increase the growth of *Phormidium*, which seems unusual as *Phormdium* is thought to be more prevalent under low flow conditions (McAllister, 2014).

5.1 Recommendations

The bathing and shellfish waters monitoring programme does not specifically identify the factors causing faecal contamination. However, it does highlight areas where more detailed investigation should be carried out, such as Kaiate Stream for example. Targeted studies can be used to address more specific water quality issues. Recommendations for future targeted investigations and projects are made below:

- Develop predictive warning system through modelling for high risk sites. Undertake event sampling and analyses of sites with adjacent flow/level and rainfall monitoring. This will provide an early warning system of elevated pathogen levels in rivers.

- Investigate faecal contamination sources in the catchment that do not meet NOF minimum acceptance state: Kereu; Utuhina, Waitetī, Ngongotahā; Puarenga, Uretara; Tuapiro; Ngamuwahine; Wairoa; MclarensFalls; Kaiate; and Pongakawa. The use of microbial source tracking techniques may help delineate potential sources, but modelling and loading investigation are also likely to be required to ascertain relative contribution within these catchments.

The Proposed Regional Coastal Plan stipulates the use of indicator bacteria testing as per the Microbiological Water Quality Guidelines (2003), for assessing shellfish contamination or the health risk associated with consumption. Hence it is recommended that water testing in conjunction with the recreational surveillance waters programme, be undertaken together with, or instead of, shellfish flesh testing.

Part 6: References

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Ministry for the Environment (2014): National Policy Statement for Freshwater Management 2014.

New Zealand Food Safety Authority (2006): NZFSA Animal Products (Specifications for Bivalve Molluscan Shellfish) Notice 2006.

The Australian New Zealand Food Standards Code (2010).

Von Sperling, M. (2007): Wastewater Characteristics, Treatment and Disposal. Vol 1. Published by IWA Publishing , London.

Appendices

Appendix 1a – Suitability for recreation grading - Grades for river and stream sites

District	Site	Description	BOP Site Number	95 percentile	MAC	SIC	SFRG	% of samples less than Action/Red Mode	NOF Primary Contact Attribute	NOF Secondary Contact Attribute
Kawerau	Tarawera River	Boyce Park	BOP160110	130	A	Very Low	Very Good	100	A	A
Ōpōtiki	Waioeka River	SH2 Bridge	BOP160103	303	C	Moderate	Fair	95	B	A
Ōpōtiki	Otara River	d/s SH35 Bridge	BOP160101	342.5	C	Moderate	Fair	95	B	A
Ōpōtiki	Kereu River	SH 35 Bridge	BOP110165	842	D	N/A	Follow up	94	>MAS	A
Rotorua	Ohau Channel	SH 33 Bridge	BOP160119	91	A	Very Low	Very Good	100	A	A
Rotorua	Waitangi Springs	Lake Rotoehu	BOP160120	158	B	Moderate	Good	100	A	A
Rotorua	Utuhina Stream	Lake Road	BOP160117	690	D	Moderate	Poor	95	>MAS	A
Rotorua	Waiteti Stream	Ngongotaha	BOP160115	782	D	Moderate	Poor	95	>MAS	A
Rotorua	Ngongotaha Stream	Railway Bridge	BOP160114	846	D	Moderate	Poor	89	>MAS	A
Rotorua	Puarenga Stream	Whakarewarewa	BOP160113	860.5	D	Moderate	Poor	100	>MAS	A
Tauranga	Kopurererua Stream	McCord Ave Bridge	BOP291216	467	C	N/A	Follow up	100	B	A
WBOP	Uretara Stream	Henry Road Ford	BOP210004	560	D	Moderate	Poor	100	>MAS	A
WBOP	Pongakawa River	SH2 Bridge	BOP110030	560.5	D	Moderate	Poor	100	>MAS	A
WBOP	Tuapiro Stream	McMillan Road	BOP160126	565.5	D	Moderate	Poor	95	>MAS	A
WBOP	Ngamuwahine River	at Reserve	BOP160125	763.1	D	Moderate	Poor	95	>MAS	A
WBOP	Wairoa River	Bethlehem	BOP160122	774.5	D	Moderate	Poor	100	>MAS	A
WBOP	Wairoa River	below McLaren Falls Dam	BOP160124	1092	D	Moderate	Poor	90	>MAS	A
WBOP	Kaiate Stream	Kaiate Falls	BOP160130	1290	D	Moderate	Poor	71	>MAS	A
Whakatāne	Rangitaiki River	Thornton Domain	BOP160109	230	B	Moderate	Good	95	B	A
Whakatāne	Waimana River	Waimana Gorge Picnic Area	BOP160105	243	B	Very Low	Very Good	95	B	A
Whakatāne	Rangitaiki River	Te Teko	BOP110018	270	C	Low	Fair	100	B	A
Whakatāne	Whakatane River	Landing Road Bridge	BOP160106	426	C	High	Poor	100	B	A

>MAS = does not meet minimum criteria; N/A represents new sites added in the 2014/15 season, which currently do not have an assigned SIC.

Appendix 1b – Suitability for recreation grading - Grades for lake sites

Site	Description	BOP Site Number	Mean	Median	95 percentile	MAC	SIC	SFRG	% of samples less than Action/Red Mode	NOF Primary Contact Attribute	NOF Secondary Contact Attribute
Lake Okaro	Ski Area	BOP160073	7	3	25	A	Very Low	Very Good	100	A	A
Lake Rotoiti	Hinehopu, Jetty	BOP160053	7	1	40	A	Very Low	Very Good	100	A	A
Lake Rotoiti	Okawa Bay	BOP160056	17	7	70	A	Very Low	Very Good	100	A	A
Lake Rerewhakaaitu	Sports Ground	BOP160078	27	7	136	B	Very Low	Very Good	100	A	A
Lake Rerewhakaaitu	Brett Road Boat Ramp	BOP160079	31	12	155	B	Very Low	Very Good	100	A	A
Lake Okareka	East end of dwellings	BOP160061	29	11	162	B	Very Low	Very Good	100	A	A
Lake Rotoma	Whangaroa	BOP160052	24	1	200	B	Very Low	Very Good	100	A	A
Lake Rotorua	Holdens Bay	BOP160066	39	7	208	B	Moderate	Good	100	A	A
Lake Tikitapu	Beach	BOP160063	30	2	212	B	Very Low	Very Good	100	A	A
Lake Rotorua	Hamurana	BOP160070	52	14	296	C	High	Poor	100	B	A
Lake Rotorua	Ngongotaha	BOP160069	64	10	323	C	Low	Fair	100	B	A

Appendix 1c – Suitability for recreation grading - Grades for marine sites

District	Site	BOP Site Number	Mean	Median	95 percentile	MAC	SIC	SFRG	% of samples less than Action/Red Mode
Ōpōtiki	Whanarua Bay	BOP160002	27	3	153	B	Very Low	Very Good	100
Ōpōtiki	Te Kaha Beach - Maraeti Bay	BOP160003	51	3	225	C	Very Low	Follow up	100
Ōpōtiki	Hikuwai Beach	BOP160005	7	1	36	A	Moderate	Good*	100
Ōpōtiki	Waiotahi Beach - Surf Club	BOP160007	10	1	37	A	Low	Very Good	100
Ōpōtiki	Waiotahi Estuary	BOP160008	60	12	222	C	Moderate	Fair	100
Tauranga	Mt.Maunganui - Surf Club	BOP160025	4	1	19	A	Very Low	Very Good	100
Tauranga	Omanu Beach - Surf Club	BOP900096	8	1	24	A	Very Low	Very Good	100
Tauranga	Waimapu Estuary - Motel-Motor Camp	BOP160019	47	11	210	C	Low	Fair	100
Tauranga	Tilby Point - Fergusson Park	BOP160020	39	7	222	C	Moderate	Fair	100
Tauranga	Otumoetai Beach	BOP160021	71	11	518	D	Moderate	Poor	100
Tauranga	Pilot Bay	BOP160024	22	4	145	B	Moderate	Good	100
Tauranga	Maungatapu - Rangataua Bay	BOP160049	32	5	114	B	Moderate	Good	100
WBOP	Maketu - Surf Club	BOP160017	9	1	45	B	Moderate	Good	100
WBOP	Waihi Beach - Surf Club	BOP160027	15	2	77	B	Low	Good	100
WBOP	Pukehina Beach - Surf Club	BOP160170	4	1	13	A	Very Low	Very Good	100
WBOP	Waihi Beach - 3 Mile Creek	BOP900077	33	4	173	B	Moderate	Good	100
WBOP	Waihi Estuary	BOP160016	23	6	88	B	Moderate	Good	100
WBOP	Omokoroa Beach	BOP160022	12	1	66	B	Very Low	Very Good	100
WBOP	Pahoia	BOP160023	53	8	256	C	Low	Fair	100
WBOP	Anzac Bay - Bowentown Domain	BOP160028	17	2	48	B	Very Low	Very Good	100
WBOP	Athenree - Opposite Motor Camp	BOP160030	51	8	304	C	Low	Fair	100
WBOP	Tanners Point	BOP160031	27	12	114	B	Very low	Very Good	100
WBOP	Ongare Point	BOP160032	43	6	236	C	Low	Fair	100
WBOP	Te Puna - Waitui Reserve	BOP160293	23	4	147	B	High	Poor*	100
Whakatāne	Tarawera River - River Mouth	BOP110125	52	39	177	B	High	Poor*	100
Whakatāne	Ohope Beach - Surf'n Sand Motor Camp	BOP160010	11	1	21	A	Very Low	Very Good	100
Whakatāne	Ohope Beach - Surf Club	BOP160011	9	2	53	B	Moderate	Good	100
Whakatāne	Piripai Beach	BOP160014	9	1	46	B	Very Low	Very Good	100
Whakatāne	Ohiwa Harbour	BOP160009	12	2	35	A	Very Low	Very Good	100
Whakatāne	Whakatane Heads - Boat Ramp	BOP160013	57	12	260	C	Moderate	Fair	100

* indicates the sites originally graded as “Follow up” which have been assigned a conservative grade.

Appendix 2 – Kaiate Stream Article

Swimming holes still unsafe after contamination

By Kiri Gillespie
news@bayofplentytimes.co.nz

Tauranga health authorities are warning people to avoid one of the Bay's most popular swimming holes.

A public health warning at Kaiate Falls remains in place nearly a week after Toi Te Ora issued an advisory notice.

Medical officer of health Dr Jim Miller said the Welcome Bay waterfall registered elevated levels of faecal contamination and did so again when tested this week.

The high levels meant it was unsafe to swim but there was no ban in place.

"Obviously it's a health warning, it's not a ban. We just want to make sure people are aware of it, the risk to health."

Dr Miller said people could become ill with gastroenteritis after swimming in the water. People with cuts or scratches on the skin were at risk of infection.

A sign has been erected at the site and Dr Miller said he hoped people would take note.

"We haven't had any reports of anyone [becoming sick] from there. I think it's more about making people aware of the risk," he said.

Dr Miller said he was not aware of the exact cause of the contamination but areas like Kaiate Falls, which were in isolated areas with more animals and septic tanks, were more likely to register poorer water quality.

The Bay of Plenty Regional Council regularly monitors the district's water quality and results can be found on its website. Kaiate Falls is currently listed as unsafe for swimming.

The warning joins another health advisory to not consume shellfish from the Bay of Plenty coastline due to paralytic shellfish poisoning.

Shellfish such as mussels, toheroa, pipi, tuatua, cockles, oysters, scallops, catseyes, pupu and kina (sea urchin) remain unsafe to eat.

People could experience poisoning symptoms including numbness and tingling around the mouth or face; difficulty swallowing or breathing; and in severe cases, paralysis and respiratory failure.

Not sure where to swim?

- www.toiteorapublichealth.govt.nz/recreational_water
- www.boprc.govt.nz/environment/water/swimming-water-quality/tauranga/
- www.lawa.org.nz/explore-data/bay-of-plenty-region/
- www.boprc.govt.nz/environment/water/swimming-water-quality/monitoring-information/#grading

HEALTH RISK: The swimming holes at Kaiate Falls are no longer safe, tests show. PHOTO/FILE