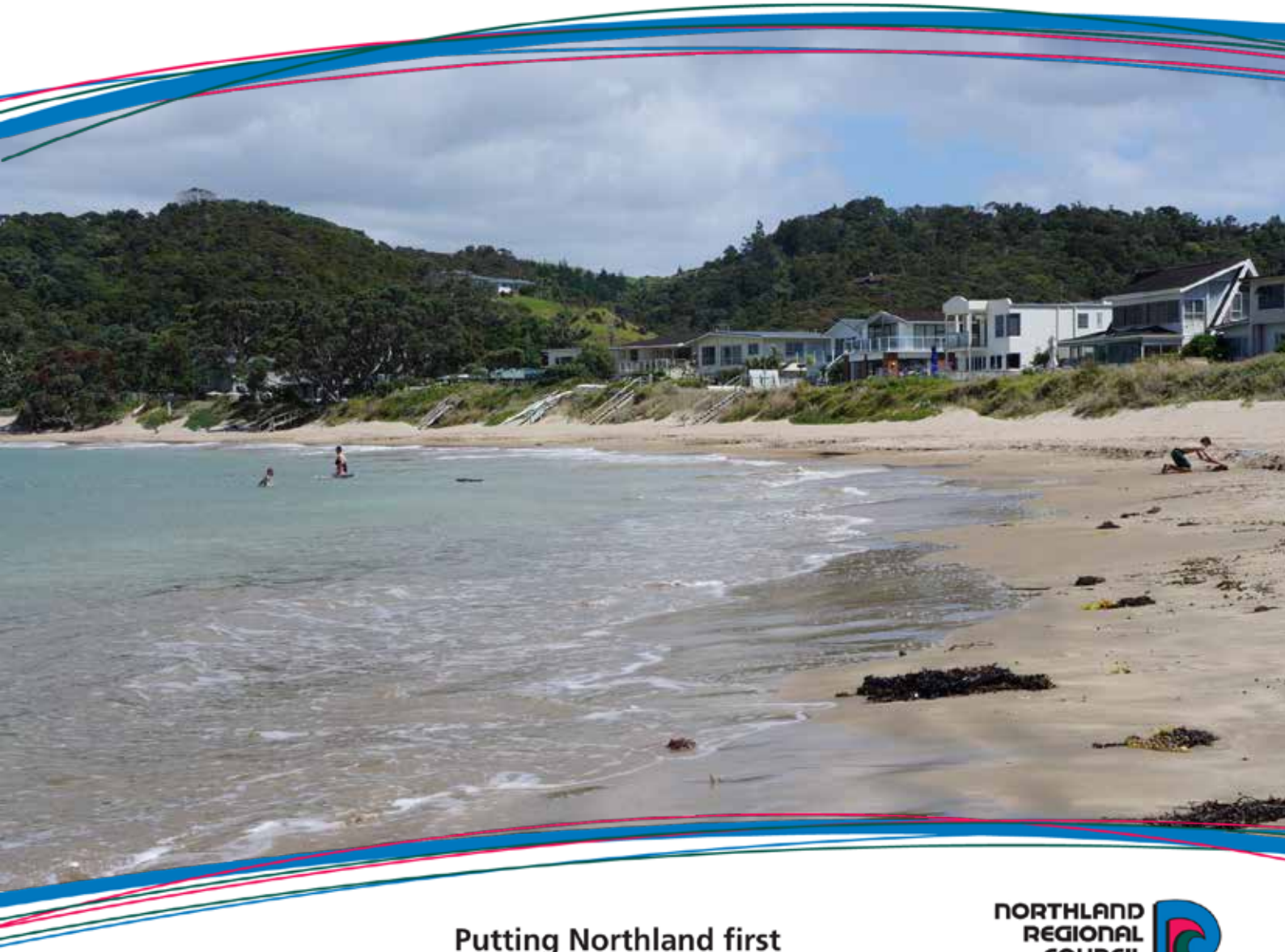
Recreational Swimming Water Quality in Northland

Summer 2013-2014



Putting Northland first

NORTHLAND REGIONAL COUNCIL

Recreational Swimming Water Quality in Northland

Summer 2013-2014

Jean-Charles Perquin

Executive Summary

- From November 2013 to February/March 2014, a total of 12 freshwater and 47 coastal sites were monitored through the Northland Regional Council's Recreational Swimming Water Quality Programme.

- In comparison to the microbiological water quality guidelines (MfE and MoH 2003), 29 coastal sites met the suitable for swimming criteria 100 percent of the time in 2013-14. A further 11 were suitable for swimming on all but one occasion, five were suitable for swimming on all but two occasions and two were suitable for swimming on all but three occasions.

- In 2013-14, three out of 12 freshwater sites met the suitable for swimming criteria 100 percent of the time. A further four were suitable for swimming on all but one occasion, and four were suitable for swimming on all but two sampling occasions. The remaining freshwater site was considered unsuitable for swimming on more than two occasions recording less than 75 percent of samples below the "Action" level specified in the MfE and MoH (2003) guidelines.

- The Ministry for the Environment grading levels were similar in 2013-14 and 2012-13 for both coastal and freshwater sites, most likely due to drought conditions. Coastal grades were similar to grades in 2009-10 when drought conditions also occurred. Freshwater grades were the best recorded since 2007-08.

- Results from sites recording elevated bacteria levels were cross referenced with rainfall data to indicate whether rainfall related runoff from land was contributing to elevated results. Overall, 18 'Action' levels were recorded for nine of the 12 freshwater sites, of which 67 percent were likely to have been related to rainfall. At the coast, 27 'Action' levels were recorded for 18 of the 47 coastal sites, of which 67 percent were likely to have been related to rainfall.

- Since 2007-08, a total of 29 sites have been studied as part of a Council initiative to investigate water quality issues at problem sites in the region. Results from microbial source tracking analyses indicated that contamination by wildfowl occurred at 22 sites – mostly ducks and/or gulls – 17 sites were contaminated by ruminant and four sites by dog faecal material. Contamination by a human source was previously recorded at Ocean Beach Stream, Pahi and Raumanga Stream.

- Monitoring and further investigation will continue at sites with consistently elevated bacteria levels where the source(s) of contamination have not yet been identified.

- Ten of the 15 permanent monitoring sites for recreational shellfish gathering were within the Ministry for the Environment guidelines during summer 2013-14.

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1. Introduction

The Recreational Swimming Water Quality Programme (RSWQP) is a joint project administered by the Northland Regional Council (the Council), in partnership with the Northland District Health Board (NDHB), the Far North District Council (FNDC), the Whangarei District Council (WDC) and the Kaipara District Council (KDC). The programme design is derived from the Ministry for the Environment (MfE) and Ministry of Health (MoH) *Microbiological Water Quality Guidelines* (2003). The aim of the programme is to provide information on microbiological contamination at popular freshwater and coastal swimming sites in Northland, to allow the public to make informed decisions about where to swim.

At times sampling has shown some sites, in particular freshwater sites or those with a freshwater influence such as harbours and estuaries, to be unsuitable for swimming, especially after heavy rainfall. Water can occasionally be contaminated by human or animal waste which can contain disease-causing microorganisms. These organisms, also called pathogens, can include bacteria and/or protozoa such as giardia (*Giardia lamblia*) and campylobacter (*Campylobacter jejuni*).

The most common sources of pathogenic contamination in water is animal manure from stock access to water and rural runoff, and human sewage which includes storm overflow, broken sewer pipes and poorly located and maintained septic tank systems (PCE 2012,Jarman 2002). In Northland, microbial source tracking has identified wildfowl (ducks and gulls) and ruminant (including cattle and sheep) as the most common sources of contamination. Human sources of contamination have only been identified at three sites.

While contamination from human sewage is relatively easy to identify and mitigate, contamination from storm water, rural run-off, and wildfowl is harder to identify and mitigate. No matter the source, the potential for causing disease remains the same (Jarman, 2002a).

Photo 1: Coopers Beach

2. Programme Procedure

There are currently 47 coastal and 12 freshwater sites monitored each year as part of the RSWQP. The Council is responsible for collecting samples weekly at each site for a total duration of 17 weeks – the programme runs from the end of November until the end of March each year. Every year the list of sites to be monitored is reviewed in consultation with key stakeholders at a pre-season meeting. Sites are selected based on usage and popularity, and whether historical bacteria levels are consistently elevated or not.

Samples collected at selected sites are analysed for predictors of gastro intestinal illnesses, also called faecal indicator bacteria (FIB). Sites are graded according to their corresponding bacteria level recorded in 100 millilitres of water, in line with the MfE and MoH (2003) grading system (described in section 4 below). Results are then distributed to key stakeholders including District Councils and the general public. District Councils are responsible for collecting follow-up samples if initial samples return 'Action/Red' bacteria levels. If results from the follow-up sampling are still above 'Action' level, then the District Councils are responsible for erecting warning signs which remain in place until further testing returns bacteria levels below 'Action' level. Once problem sites have been identified, the Regional and District Councils collectively identify the source of contamination and work towards improving water quality.

This programme, along with other State of the Environment monitoring programmes, contribute to the Council fulfilling its statutory obligations under section 35(2) (a) of the Resource Management Act 1991.

3. Health Risks

Photo 2: Health notice sign

Swimming in contaminated water can lead to skin, eye and ear infections; gastrointestinal and respiratory illnesses (Jarman 2002a). Most pathogens can infect individuals when contaminated water is swallowed, but inhalation of contaminated water has also been identified as a route of infection (MfE 2002). Pathogens may also enter the body through the mucus membranes in the nose and mouth and through open wounds.

Pathogenic organisms associated with contaminated water can cause significant ill health. Campylobacteriosis, for example, can cause fever, severe abdominal pain, nausea and diarrhoea, with symptoms lasting up to 10 days (Jarman, 2002b). Depending on the type of disease and the severity of the infection, hospitalisation may be required.

3.1 Acceptable risks

The amount of pathogens a person needs to ingest before becoming sick varies from many thousands to a single pathogen, and depends on a number of factors. Considering how small bacteria and viruses are, and how vast water bodies can be, it makes it impossible to ever guarantee any water body will be suitable for swimming.

Instead, when assessing a water body for its suitability for recreation, it is recommended to consider things in terms of maximum acceptable risk. For example, if only one person in a million became ill

after swimming at a site, it is unlikely to be of concern. On the other hand, if every swimmer got sick, the risks become unacceptable. The maximum acceptable risk falls somewhere between the two; some people may get sick from contact with the water but not so many as to become a strain on health resources, or pose a significant risk to human life.

For freshwater recreation in New Zealand, the Ministry for the Environment (MfE) and the Ministry of Health (MoH) have set the maximum acceptable risk at 8 in every 1000 users falling ill as a result of contact with contaminated water (MfE and MoH 2002 and 2003). For marine waters, the maximum acceptable risk is 19 in every 1000 users. These figures are based on both international and New Zealand research.

3.2 When to avoid contact recreation

In order to minimise the risk when using rivers or the coast for contact recreation, the following three simple rules should be followed:

Clarity

Stagnant and/or murky water contains more pathogens than clear and/or flowing water. The amount of suspended solids in water which reduces water clarity, and agricultural run-off which can contain elevated levels of pathogens, are often related. A simple way of reducing the risk of contamination is to only swim in water in which feet can be seen when standing knee deep.

Discolouration, foams and odour

Water can be unsuitable for swimming if it has an unpleasant smell, if it is discoloured, or if there is foam or a slick on the water's surface. Even if the water is relatively clear, foams, discolouration and/or odour are often a sign of contamination.

Rainfall

Rainfall can have a significant impact on water quality, particularly in freshwater. When it rains, some rain flows off the land as runoff which carries contaminants into rivers and lakes, and eventually the sea.

In areas of limited mixing, such as lakes or slow-flowing rivers, this can result in elevated levels of contaminants for several days after heavy rainfall. Areas with greater mixing, for example, open coastal sites where the tide flushes contaminants out to sea, are less susceptible to the effects of rainfall related runoff.

Photo 3: Kapiro Stream

Higher flows in rivers and stormy conditions along the coast can cause re-suspension of contaminants attached to river bank or bed sediment. High intensity rainfall can also affect municipal sewage and septic tank systems, resulting in overflow of human waste into water.

As a rule, it is recommended to wait 48 hours after heavy rainfall before swimming in freshwater or semi-enclosed coastal sites.

4. Recreational Contact Guidelines

National *Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas* were released by the Ministry for the Environment and the Ministry of Health in June 2003. Where practicable, the RSWQP for Northland incorporated recommendations in the guidelines, and results from the programme can therefore be assessed against national criteria. This section provides an outline and discussion of the key aspects of the MfE and MoH guidelines, available online at: www.mfe.govt.nz/publications/water/microbiological-quality-jun03/

Sites in the programme are graded throughout the sampling season, based on single weekly samples. At the end of the season, sites are graded according to their compliance with the guidelines throughout the sampling season.

4.1 Single sample guidelines

The guidelines set a recommended course of action for the treatment of data collected during the survey season. Under the current guidelines, each sample falls into one of three categories depending on levels of faecal indicator bacteria present. At freshwater sites levels of *Escherichia coli* (*E. coli*) bacteria are measured and are graded as follow: Surveillance (green), Alert (yellow), or Action (red), as shown in Table 1.

Table 1: Single sample guidelines for freshwater sites (MfE and MoH 2003)

***E. coli* concentration**	**Category**	**Suggested response**
sample<260/100mL	Surveillance	No response necessary – Continue weekly sampling
260<sample<550/100mL	Alert	Undertake catchment assessment and sanitary survey to isolate source of faecal contamination
sample>550/100mL	Action	Collect follow-up sample Undertake sanitary survey when applicable Erect warning signs Inform public through the media that a public health risk exists

At open coastal sites levels of *Enterococci* (*Ent.*) bacteria are measured. Sites are graded as: Surveillance (green), Alert (amber), or Action (red), as shown in Table 2. Where a coastal site is influenced by river input, or is considered to be semi-enclosed, e.g. harbours and estuaries, a combination of *Enterococci* bacteria and faecal coliforms are used to grade each site (Table 3). This approach is particularly useful in places where mangroves are present as levels of the indicator bacteria *Enterococci* can naturally occur in these areas and therefore using *Enterococci* alone could provide misleading results.

Table 2: Single sample guidelines for open coastal sites (MfE and MoH 2003)

***Ent.* concentration**	**Category**	**Suggested response**
sample<140/100mL	Surveillance	No response necessary – Continue weekly sampling
140<sample<280/100mL	Alert	Undertake catchment assessment and sanitary survey to isolate source of faecal contamination
sample>280/100mL	Action	Collect follow-up sample Undertake sanitary survey when applicable Erect warning signs Inform public through the media that a public health risk exists

Table 3: Single sample guidelines for enclosed coastal sites (harbours and estuaries)

Faecal coliform concentration	*Enterococci* concentration	Category	Status
sample<150/100mL	sample<140/100mL	Surveillance	Surveillance+Surveillance =Surveillance
150<sample<600/100mL	140<sample<280/100mL	Alert	Any other combination =Alert
sample>600/100 mL	sample>280/100mL	Action	Action + Alert or Action+Action=Action

Results from the weekly sampling are sent to the District Councils and NDHB, and are published weekly on the Councils website – www.nrc.govt.nz/swimming. Any 'Alert' or 'Action' results are notified to the relevant District Council within 24 hours, so that further investigative sampling and/or erecting warning signs can be initiated.

4.2 End of season grading

The end of season grading at each site is determined by the percentage of samples which were below the 'Action' category (either above 550 *E. coli*; 600 faecal coliforms or 280 *Enterococci)*. Grades are presented in Table 4 below:

Table 4: MfE and MoH grading system

MfE and MoH grades	
1	95-100% samples within guidelines (no 'Action' result)
2	90-94% samples within guidelines
3	75-89% samples within guidelines
4	<75% samples within guidelines

5. Methodology

5.1 Sampling technique

Samples are collected weekly at selected freshwater and coastal sites throughout the summer months. In 2013-14, sampling was carried out from 25 November 2013 to 17 February 2013 at 47 coastal and 12 freshwater sites. It was then continued at 23 coastal and three freshwater sites until 25 March 2013. While some other councils choose not to sample after rainfall, the Council collects water samples regardless of weather conditions although weather, tide and water temperature are recorded to provide some context for interpretation of the results.

Photo 4: Council staff taking water sample at Lake Waro

Each sample is collected following the methods described in the MfE and MoH (2003) guidelines. Coastal water samples are taken from the shore using a sampling pole at about 0.5 metre depth, from approximately 15 centimetres below the surface. Freshwater samples are taken at approximately 30 centimetres below the surface, at approximately one metre depth. All samples are collected during

daylight hours and sites are sampled in the same order each week. This ensures that, where practicable, samples are collected at around the same time each week.

5.2 Sample analysis

It is both difficult and expensive to measure the levels of pathogens in water. Instead, like other agencies, the Council measures the levels of faecal indicator micro-organisms contained in 100 millilitres of water, in accordance with the MfE and MoH (2003) guidelines.
In freshwater, several epidemiological studies have demonstrated a positive relationship between the presence of *E. coli* and pathogen (MfE 2002).

The New Zealand Marine Bathing Study commissioned by MfE and MoH in 1994 showed *Enterococci* was the indicator most closely associated with health effects in New Zealand marine waters. Faecal coliforms are not as closely related to human health effects; however they are useful in specific environments, such as brackish or estuarine environments, where levels of *Enterococci* may be misleading.

All samples are analysed by an independent laboratory using analytical procedures from the *Standard Methods for the Examination of Water and Wastewater* (APHA *et. al* 2005).

6. Sampling Sites

Due to the large number of coastal and freshwater swimming sites in Northland, it is not practicable or economical to monitor them all and therefore the most popular sites were prioritised for monitoring. This section provides information on sites which were selected for monitoring in 2013-14, and those included in the permanent monitoring sites list. Sites that have been removed from the programme are listed in Appendix 3.

6.1 Sampling sites 2013-14

In the 2013-14 sampling season, a total of 12 freshwater sites and 47 coastal sites were monitored through the programme (Table 5). Sites with an asterisk indicate enclosed coastal sites throughout the report.

Table 5: Sites monitored in 2013-14. BOI: Bay of Islands.

Coastal sites	Grid reference		Site No.	Area
Far North District Council				
Ahipara camp ground	1614114	6109386	109871	Far North
Cable Bay	1644302	6127973	105780	North-east
Cooper's Beach	1646729	6127976	101066	North-east
Maitai Bay camp site	1637395	6145952	102326	Far North
Matauri Bay motor camp	1683324	6122702	102425	North-east
Omapere	1634874	6067432	102317	North-west
Opononi	1635376	6070804	106011	North-west
Paihia beside toilets	1699822	6094837	101194	BOI
Paihia Te Haumi	1700137	6093454	101195	BOI
Paihia Waitangi Bridge	1698267	6096116	101183	BOI
Rawene*	1646026	6083073	100236	North-west
Russell mid-north	1701762	6097524	105710	Far North
Taipa Estuary	1642856	6127391	105777	North-east

Coastal sites	Grid reference		Site No.	Area
Tokerau Beach	1633974	6139217	109872	Far North
Waipapa Kauri	1615249	6122554	109873	Far North
Kaipara District Council				
Baylys Beach	1666750	6021176	109876	South-west
Glinks Gully	1677301	6006503	100798	South-west
Mangawhai Heads Beach	1743817	6006166	109890	South-east
Mangawhai Heads motor camp*	1743147	6005606	101210	South-east
Mangawhai Picnic Bay*	1743636	6005784	110322	South-east
Omamari Beach	1659853	6030465	109875	South-west
Pahi - 150m NW jetty*	1710590	5998103	102198	South-west
Tinopai below creek*	1712122	5987100	101232	South-west
Tinopai below shops*	1712130	5987691	102310	South-west
Whangarei District Council				
Church Bay	1738528	6057429	105448	Tutukaka
Lang's Beach	1738350	6009900	108318	South-east
Matapouri southern bridge*	1736959	6062631	100711	Tutukaka
Matapouri northern bridge*	1736535	6063041	100712	Tutukaka
Ngunguru Estuary at Pakapaka Road*	1734960	6055124	100073	Tutukaka
Ngunguru Estuary at school	1737070	6056341	108320	Tutukaka
Oakura Bay	1722350	6083581	101345	BOI
Ocean Beach	1742107	6032989	109877	Whg heads
Ohawini Bay	1722090	6084082	105388	BOI
One Tree Point	1731539	6035180	109266	South-east
Onerahi playground*	1722792	6040203	101600	Whg heads
Pacific Bay	1738969	6057164	108313	Tutukaka
Pataua South beach	1738315	6046464	104986	Whg heads
Ruakaka Beach	1731913	6025221	108315	South-east
Ruakaka River	1731414	6025773	108314	South-east
Sandy Bay	1733651	6064285	109879	Tutukaka
Taurikura Bay	1737880	6034149	101262	Whg heads
Teal Bay	1723703	6077721	101331	BOI
Uretiti Beach	1732302	6019720	109888	South-east
Waipu Cove	1735915	6011855	108316	South-east
Wellingtons/Whangaumu Bay	1738576	6055370	109880	Tutukaka
Whananaki east beach	1733002	6069592	106938	Tutukaka
Woolleys Bay	1735097	6063676	109878	Tutukaka
TOTAL COASTAL				**47**

Freshwater Sites	Grid Reference		Site No.	Area
Far North District Council				
Kerikeri River Stone Store	1687631	6102447	101530	BOI
Lake Ngatu at south end	1618033	6122885	100402	Far North
Punakitere River	1675320	6075378	110927	North-west
Tirohanga Stream	1699502	6084784	102252	BOI
Victoria River	1639482	6108122	104908	North-east
Waipapa River at forest pools	1662099	6096027	103248	North-west
Waipoua River at DOC HQ	1650503	6054513	108613	North-west
Waitangi River at Wakelins	1695283	6095847	101752	BOI
Kaipara District Council				
Lake Taharoa pump house	1659736	1659736	105434	South-west
Whangarei District Council				
Lake Waro (Hikurangi)	1716716	6061100	107272	Tutukaka
Raumanga Stream	1717608	6044187	103246	South-east
Whangarei Falls	1720857	6050300	105972	Tutukaka
TOTAL FRESHWATER				**12**

6.2 Permanent monitoring sites

A core group of 20 sites to be monitored every year to constitute a permanent monitoring list was randomly selected in 2007. Having a permanent set of sites enables environmental performance to be assessed over time, irrespective of sites being added or removed. The permanent monitoring sites are listed in Table 6 with their respective results for the 2013-14 season. Results for the permanent monitoring sites are presented in section 7.

Table 6: Permanent monitoring sites

Site name	Site No.
Church Bay	105448
Kerikeri – Stone Store	101530
Lake Waro – Hikurangi	107272
Lang's Beach – mid beach	108318
Matapouri – northern bridge*	100712
Onerahi – play ground*	101600
Opononi	106011
Pacific Bay	108313
Pahi – jetty*	102579
Paihia – Waitangi bridge	101183
Pataua South – east of beach	104986
Raumanga Stream	103246
Ruakaka – by motor camp	108314
Taipa	105777
Taurikura	101262
Teal Bay	101331
Tinopai – below shops*	102310
Waipapa River – Puketi	103248
Waipoua River	108613
Waipu Cove	108316

7. Results and Interpretation

The results for all sites sampled in 2013-14 including both coastal and freshwater can be viewed in Appendix 1. Each 'Action' result has been cross-referenced with accumulated rainfall data recorded 72 hours prior to sampling at the nearest rainfall station, giving an indication of the influence of run-off on microbiological contamination. Northland monthly rainfall maps covering the 2013-14 summer period are presented in Appendix 2.

A brief summary of the results for relevant sites is given below. Detailed in section 8 is the investigation programme including sites listed for further analysis in order to identify the source of contamination. Sites with an asterisk indicate a coastal enclosed site and sites in bold designate a permanent monitoring site throughout the report.

7.1 End of season grading – coastal sites

Figure 1: Coastal end of season grading 2013-14

The map above summarises the end of season grading for samples taken from each of the 47 coastal sites monitored in Northland during the 2013-14 sampling season (25 November 2013 to 10 March 2014). The grades indicate the percentage of results below 'Action' level recorded at each site.
While there are occasional exceedances of the guideline at sites with significant freshwater inputs (estuaries), in general coastal water quality in Northland is excellent with the majority of sites suitable for swimming on all sampling occasions.

Coastal areas can occasionally return 'Action' results. However, determining the source of contamination is difficult because 24 hours are required to process a sample and by this time the source of contamination has often been flushed out by the sea.

FAR NORTH

Site name	No. samples	Surveillance/Alert	Action	Rainfall related (72h accumulated rainfall)
Ahipara	12	12	0	n/a
Maitai Bay	12	12	0	n/a
Tokerau Beach	12	11	1	ü (34.5mm)
Waipapa Kauri	12	12	0	n/a
Total	**48**	**47**	**1**	

The only 'Action' result at Tokerau Beach in 2013-14 was likely to have been related to 34.5mm of accumulated rainfall. This site has been monitored since 2009-10 and accounted for five 'Action' results on 56 sampling occasions within the same time frame. This means the site was considered suitable for swimming 91 percent of the time during the summer season in the last five years. Bacteria levels had returned to 'Surveillance' mode the week following the event.

NORTH EAST

Site name	No. samples	Surveillance/Alert	Action	Rainfall related (72h accumulated rainfall)
Cable Bay	12	12	0	n/a
Coopers Beach	12	11	1	ü (34.5mm)
Matauri Bay	12	12	0	n/a
Taipa estuary	12	12	0	n/a
Total	**48**	**47**	**1**	

The only 'Action' result at Coopers Beach in 2013-14 was likely to have been related to 34.5mm of accumulated rainfall. This site has been monitored since 2004-05 and accounted for six 'Action' results on 122 sampling occasions within the same time frame. This means the site was considered suitable for swimming 95 percent of the time during the summer season in the last 10 years. Bacteria levels had returned to 'Surveillance' mode the week following the event.

NORTH WEST

Site name	No. samples	Surveillance/Alert	Action	Rainfall related (72h accumulated rainfall)
Omapere	12	12	0	n/a
Opononi	12	11	1	û (no rain)
Rawene*	12	12	0	n/a
Total	**36**	**35**	**1**	

Only one 'Action' result was recorded at Opononi in 2013-14 which was not related to rainfall. This site has been monitored since 2004-05 and accounted for four 'Action' results on 117 sampling occasions within the same time frame. This means the site was considered suitable for swimming 97 percent of the time during the summer season in the last 10 years. Results from follow-up sampling showed bacteria levels had returned to 'Surveillance' mode two days after the event.

SOUTH WEST

Site name	No. samples	Surveillance/Alert	Action	Rainfall related (72h accumulated rainfall)
Baylys Beach	12	12	0	n/a
Glinks Gully	12	12	0	n/a
Omamari Beach	12	12	0	n/a
Pahi jetty*	12	12	0	n/a
Tinopai at shops	12	12	0	n/a
Tinopai at creek	12	12	0	n/a
Total	**72**	**72**	**0**	

SOUTH EAST

Site name	No. samples	Surveillance/Alert	Action	Rainfall related (72h accumulated rainfall)
One Tree Point	16	16	0	n/a
Langs Beach midway	16	15	1	û (no rain)
Mangawhai Harbour Picnic Bay*	16	16	0	n/a
Mangawhai Heads motor camp*	16	16	1	n/a
Mangawhai Heads	16	16	0	n/a
Ruakaka Beach	16	15	1	û (no rain)
Ruakaka River	16	15	1	ü (43mm)
Uretiti Beach	16	16	0	n/a
Waipu Cove Beach	16	16	0	n/a
Total	**144**	**141**	**3**	

Only one 'Action' result was recorded at Langs Beach, Ruakaka Beach and Ruakaka River sites in 2013-14. Action results for Langs Beach and Ruakaka Beach were not related to rainfall.

Langs Beach

This site has been monitored since 2004-05 and accounted for five 'Action' results on 143 sampling occasions within the same time frame. This means the site was considered suitable for swimming 96 percent of the time during the summer season in the last 10 years.
The site was part of the investigation programme in 2007-08 and 2009-10. Microbial source tracking analyses identified contamination caused by ruminant and wildfowl.

Ruakaka Beach

This site has been monitored since 2004-05 and accounted for three 'Action' results on 143 sampling occasions within the same time frame. This means the site was considered suitable for swimming 98 percent of the time during summer season in the last 10 years.

Ruakaka River

The result for Ruakaka River was likely to have been related to 43mm of accumulated rainfall. This site has been monitored since 2004-05 and accounted for 14 'Action' results on 143 sampling occasions

within the same time frame. This means the site was considered suitable for swimming 90 percent of the time during summer season in the last 10 years. Bacteria levels had returned to 'Surveillance' mode the week following the event.
The site was part of the investigation programme in 2012-13 and 2013-14. Microbial source tracking analyses identified contamination caused by ruminant.

BAY OF ISLANDS

Site name	No. samples	Surveillance/Alert	Action	Rainfall related (72h accumulated rainfall)
Oakura	12	12	0	n/a
Ohawini Bay	12	12	0	n/a
Paihia Te Haumi	12	12	0	n/a
Paihia Waitangi Bridge	12	10	2	û (no rain), ü (73mm)
Paihia toilets	12	11	1	û (no rain)
Russell mid-north	12	12	0	n/a
Teal Bay	12	12	0	n/a
Total	**84**	**81**	**3**	

One 'Action' result at Paihia Waitangi Bridge was likely to have been related to 73mm of accumulated rainfall. The other 'Action' result recorded at Paihia Waitangi Bridge and the one at Paihia Toilets were not related to rainfall. Results from follow-up sampling showed bacteria levels had returned to 'Surveillance' mode two days after the event at both sites.

Paihia Waitangi Bridge

This site has been monitored since 2004-05 and accounted for 10 'Action' results on 123 sampling occasions within the same time frame. This means the site was considered suitable for swimming 92 percent of the time during summer season in the last 10 years.
The site was part of the investigation programme in 2012-13 and 2013-14. Microbial source tracking analyses identified contamination caused by ruminant and wildfowl.

Paihia toilets

This site has been monitored since 2004-05 and accounted for seven 'Action' results on 122 sampling occasions within the same time frame. This means the site was considered suitable for swimming 94 percent of the time during summer season in the last 10 years.

TUTUKAKA

Site name	No. samples	Surveillance/Alert	Action	Rainfall related (72h accumulated rainfall)
Church Bay	16	14	2	ü (17.5mm), ü (97mm)
Matapouri Northern Bridge*	16	14	2	ü (17.5mm), ü (97mm)
Matapouri Southern Bridge*	16	13	3	ü (17.5mm), ü (97mm), û (no rain)
Ngunguru at Pakapaka Road*	16	15	1	ü (97mm)
Ngunguru at School	16	14	2	ü (97mm), û (no rain)
Pacific Bay	16	14	2	ü (8.5mm), ü (97mm)
Sandy Bay	16	16	0	n/a
Wellingtons Bay	16	13	3	ü (97mm), û (no rain), û (no rain)
Whananaki at east beach	16	15	1	ü (97mm)
Woolleys Bay	16	16	0	n/a
Total	**160**	**144**	**16**	

Most ‘Action’ results recorded were likely to have been related to rainfall within 72 hours prior to sampling. Some of them, recorded for Matapouri Southern Bridge, Ngunguru at school and Wellington Bay, were not related to rainfall. Bacteria levels for most of the follow-up samples collected three days following substantial rainfall (97mm) were still elevated. However, bacteria levels had returned to ‘Surveillance’ mode the week following the event at all sites.

Church Bay

Both results were likely to have been related to respectively 17.5mm and 97mm of accumulated rainfall. This site has been monitored since 2004-05 and accounted for 15 ‘Action’ results on 142 sampling occasions within the same time frame. This means the site was considered suitable for swimming 89 percent of the time during the summer season in the last 10 years.

*Matapouri Northern Bridge**

Both results were likely to have been related to 17.5mm and 97mm of accumulated rainfall respectively. This site has been monitored since 2004-05 and accounted for 13 ‘Action’ results on 142 sampling occasions within the same time frame. This means the site was considered suitable for swimming 91 percent of the time during the summer season in the last 10 years.
The site was part of the investigation programme in 2010-11, 2012-13 and 2013-14. Microbial source tracking analyses identified contamination caused by ruminant and wildfowl.

*Matapouri Southern Bridge**

One result was not related to rainfall. Results from follow-up sampling showed bacteria levels had returned to ‘Surveillance’ mode two days after the event.
The two other results were likely to have been related to respectively 17.5mm and 97mm of accumulated rainfall. This site has been monitored since 2004-05 and accounted for 14 ‘Action’ results on 142 sampling occasions within the same time frame. This means the site was considered suitable for swimming 90 percent of the time during summer season in the last 10 years.
The site was part of the investigation programme in 2010-11. Microbial source tracking analyses identified contamination caused by wildfowl.

Ngunguru at Pakapaka Road

One result was likely to have been related to 97mm of accumulated rainfall. This site has been monitored since 2004-05 and accounted for two ‘Action’ results on 142 sampling occasions within the same time frame. This means the site was considered suitable for swimming 99 percent of the time during summer season in the last 10 years.

Ngunguru at School

One result was not related to rainfall. Results from follow-up sampling showed bacteria levels had returned to ‘Surveillance’ mode two days after the event.
The other result was likely to have been related to 97mm of accumulated rainfall. This site has been monitored since 2004-05 and accounted for 20 ‘Action’ results on 142 sampling occasions within the same time frame. This means the site was considered suitable for swimming 86 percent of the time during summer season in the last 10 years.
The site was part of the investigation programme in 2010-11 and 2011-12. Microbial source tracking analyses identified contamination caused by wildfowl for both seasons.

Wellingtons Bay

For two consecutive weeks elevated bacteria levels were not related to rainfall. The tidal stream discharging at the bay was excavated on sampling day by the Whangarei District Council in response to public concerns around potential contamination of the stream which is commonly used by children. Bacteria levels had returned to ‘Surveillance’ mode the week following the event.

The other result was likely to have been related to 97mm of accumulated rainfall. This site has been monitored since 2009-10 and accounted for six 'Action' results on 83 sampling occasions within the same time frame. This means the site was considered suitable for swimming 93 percent of the time during summer season in the last five years.

Whananaki at east beach

The 'Action' result was likely to have been related to 97mm of accumulated rainfall. This site has been monitored since 2006-07 and accounted for eight 'Action' results on 113 sampling occasions within the same time frame. This means the site was considered suitable for swimming 93 percent of the time during summer season in the last eight years. Bacteria levels had returned to 'Surveillance' mode the week following the event.

WHANGAREI HEADS

Site name	No. samples	Surveillance/Alert	Action	Rainfall related (72h accumulated rainfall)
Ocean Beach	16	15	1	ü (91.5mm)
Onerahi playground*	16	16	0	n/a
Pataua South east beach	16	15	1	ü (91.5mm)
Taurikura	16	16	0	n/a
Total	**64**	**62**	**2**	

The 'Action' results recorded at Ocean Beach and Pataua sites were both likely to have been related to 91.5mm of rainfall.

Ocean Beach

This site has been monitored since 2009-10 and accounted for one 'Action' results on 83 sampling occasions within the same time frame. This means the site was considered suitable for swimming 99 percent of the time during summer season in the last five years. Bacteria levels had returned to 'Surveillance' mode the week following the event.

Pataua South east beach

This site has been monitored since 2004-05 and accounted for five 'Action' results on 142 sampling occasions within the same time frame. This means the site was considered suitable for swimming 97 percent of the time during summer season in the last 10 years. Bacteria levels had returned to 'Surveillance' mode the week following the event.

7.2 Comparison of coastal results

Coastal results from 2013-14 compared to previous years are presented in Table 7 below.

Table 7: Annual coastal grades compared to national guidelines

Category	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
95-100% samples <280 *Ent.*/100mL	50	35	40	27	21	45	22	26	29	29
90-95% samples <280 *Ent.*/100mL	6	16	14	13	8	13	21	16	13	11
75-90% samples <280 *Ent.*/100mL	1	5	3	4	12	5	16	5	5	7
<75% samples <280 *Ent.*/100mL	0	1	0	1	2	0	2	1	0	0
Total number of sites	**57**	**57**	**57**	**45**	**43**	**63**	**61**	**48**	**47**	**47**

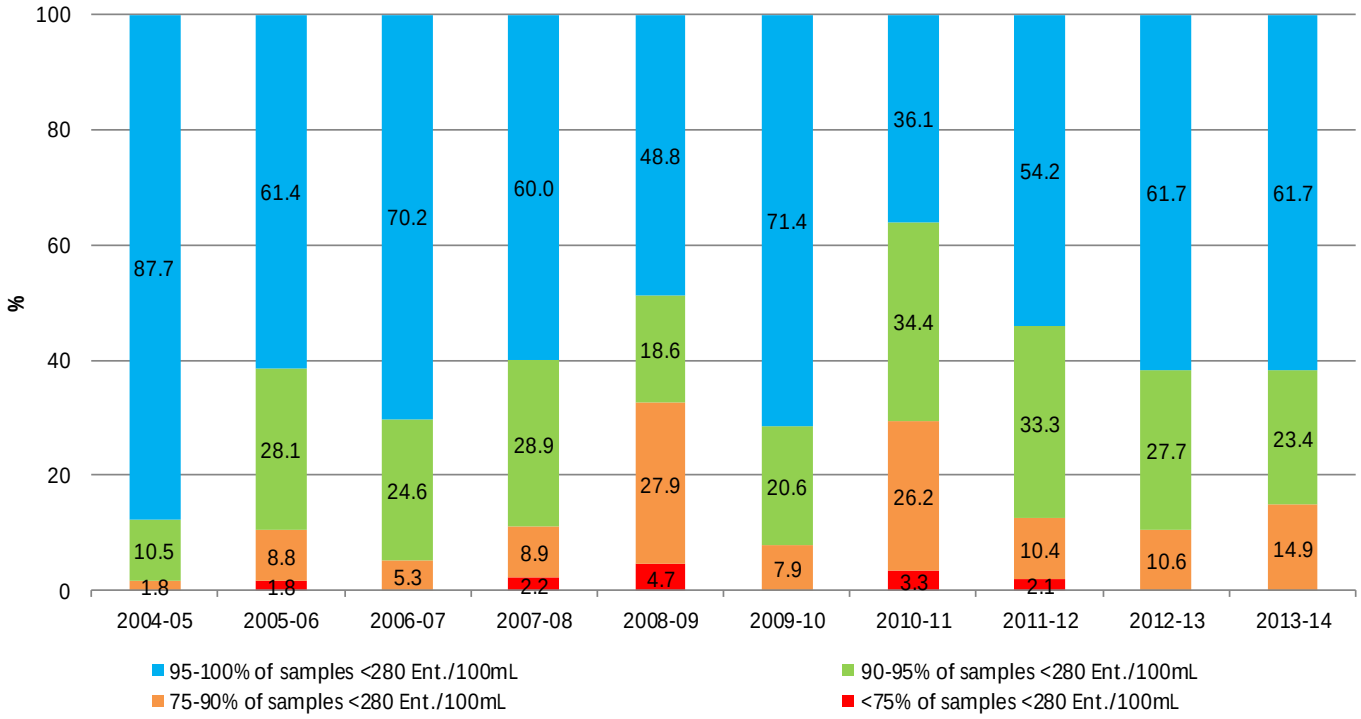

Figure 2: Yearly overall percentage of coastal sites with corresponding percentage of samples within each category from 2004 to 2014

The results from faecal indicator bacteria testing in 2013-14 were comparable to the 2012-13 season. No site recorded less than 75 percent of samples below the 'Action' level, i.e. 280 Enterococci per 100 millilitres. About 62 percent of coastal sites had more than 95 percent of samples below the 'Action level. Similar grades were recorded in summer 2009-10 as shown in Figure 2 above.

7.3 Results for coastal permanent monitoring sites

Results for coastal permanent monitoring sites from 2004-05 to 2013-14 are presented in Table 8 below.

Table 8: Results for coastal permanent monitoring sites 2013-2014

	Percentage of samples within guidelines									
Site Name	**2004 -05**	**2005 -06**	**2006 -07**	**2007 -08**	**2008 -09**	**2009 -10**	**2010 -11**	**2011 -12**	**2012 -13**	**2013 -14**
Church Bay	80	67	92	100	83	100	94	100	89	88
Langs Beach	100	83	100	100	100	100	94	100	94	94
Matapouri*	100	92	100	85	83	100	88	100	85	88
Onerahi*				100	100	100	89	100	94	100
Opononi	100	100	100	100	92	100	92	100	100	92
Pacific Bay	100	92	100	100	83	91	82	100	100	88
Pahi Jetty*	100	100	100	100	92	100	100	80	91	100
Paihia Beach	100	100	100	92	83	100	75	100	92	83
Pataua South	100	92	100	92	100	100	94	100	94	94
Ruakaka River	100	83	75	100	100	91	89	100	94	94
Taipa	100	100	100	92	100	100	92	100	100	100
Taurikura Bay	100	92	100	92	75	100	89	100	100	100
Teal Bay	100	92	100	92	92	100	100	88	100	100
Tinopai*	100	100	100	100	100	100	100	100	100	100
Waipu Cove	100	92	100	100	100	100	94	100	100	100

Overall, the coastal grades improved since 2010-11, culminating in 2011-12 when very high grades were recorded for most sites. Grades slightly declined the two following seasons, i.e. 2012-13 and 2013-14, although remaining generally very good.

7.4 End of Season Grading – freshwater Sites

Compared to the coast, river sites are more susceptible to rainfall related runoff from surrounding land. In summer Northland is often subject to intense sub-tropical storm events which, combined with soils dominated by clay – which have poor infiltration rates and therefore less capacity to absorb water – the result is rapid runoff. During dry periods contaminants build up on the land and when a storm hits, the result is a 'first flush' of contaminant laden water. For this reason, poorer grades are usually recorded at river sites compared to those located at the coast or in freshwater lakes.

Figure 3: Freshwater end of season grading 2013-14

The map above summarises the end of season grading for samples taken from each of the 12 freshwater sites monitored in Northland during the 2013-14 sampling season (25 November 2013 to the 10 March 2014). The grades indicate the percentage of results below 'Action' level recorded at each site.

FAR NORTH AREA

Site name	No. samples	Surveillance/Alert	Action	Rainfall related (72h accumulated rainfall)
Kerikeri River	12	10	2	ü (73mm), ü (8.5mm)
Lake Ngatu	12	12	0	n/a
Punakitere River	12	11	1	ü (55.5mm)
Tirohanga Stream	12	9	3	û (no rain) x 2, ü (55.5mm)
Victoria River	12	10	2	û (no rain), ü (39.5mm)
Waipapa River	12	11	1	ü (55.5mm)
Waipoua River	12	11	1	ü (10.5mm)
Waitangi River	12	10	2	û (no rain), ü (79mm)
Total	**96**	**84**	**12**	

Seven out of eight rivers in the far north recorded 'Action' results in 2013-14, most of which were likely to have been rainfall runoff. Only Tirohanga Stream, Victoria River and Waitangi River recorded 'Action' results not related to rainfall.

Kerikeri River

Both 'Action' results were likely to have been related to respectively 73mm and 8.5mm of rainfall. This site has been monitored since 2004-05 and accounted for 51 'Action' results on 123 sampling occasions within the same time frame. This means the site was considered suitable for swimming 59 percent of the time during the summer season in the last 10 years.

The site has been part of the investigation programme since 2010-11. Microbial source tracking analyses identified contamination caused by wildfowl including ducks, and ruminant over the three seasons. Microbiological contamination from wildfowl is commonly known at this site considering the number of birds present all year round. Bacteria levels had returned to 'Surveillance' mode the week following both events.

Punakitere River

The 'Action' result was likely to have been related to 55.5mm of rainfall. This site has been monitored since 2012-2013 and accounted for four 'Action' results on 23 sampling occasions within the same time frame. This means the site was considered suitable for swimming 83 percent of the time within the last two seasons. Bacteria levels had returned to 'Surveillance' mode the week following the event.

Tirohanga Stream

Two of the three 'Action' results were not related to rainfall. The other one was likely to have been related to 55.5mm of rainfall. This site has been monitored since 2004-05 and accounted for 53 'Action' results on 117 sampling occasions within the same time frame. This means the site was considered suitable for swimming 55 percent of the time during the summer season in the last 10 years.

The site was part of the investigation programme in 2013-14. Microbial source tracking analyses identified contamination caused by ruminant for each sampling occasion.

Victoria River

One 'Action' result was not related to rainfall. The other one was likely to have been related to 39.5mm of rainfall. This site has been monitored since 2007-08 and accounted for 36 'Action' results on 83 sampling occasions within the same time frame. This means the site was considered suitable for swimming 57 percent of the time during the summer season in the last seven years.

The site has been part of the investigation programme since 2011-12. Microbial source tracking analyses identified contamination caused by wildfowl and plant decay.

Waipapa River

One 'Action' result was likely to have been related to 55.5mm of rainfall. This site has been monitored since 2006-07 and accounted for 11 'Action' results on 91 sampling occasions within the same time frame. This means the site was considered suitable for swimming 88 percent of the time during the summer season in the last eight years.

Waipoua River

One 'Action' result was likely to have been related to 10.5mm of rainfall. This site has been monitored since 2005-06 and accounted for 16 'Action' results on 103 sampling occasions within the same time frame. This means the site was considered suitable for swimming 84 percent of the time during the summer season in the last nine years. Results from follow-up sampling showed bacteria levels had returned to 'Surveillance' mode two days after the event.

Waitangi River

One 'Action' result was not related to rainfall. The other one was likely to have been related to 79mm of rainfall. This site has been monitored since 2012-13 and accounted for five 'Action' results out of 23 sampling occasions within the same time frame. This means the site was considered suitable for swimming 78 percent of the time within the last two seasons. Bacteria levels had returned to 'Surveillance' mode the week following the event.

WHANGAREI AREA

Site name	No. samples	Surveillance/Alert	Action	Rainfall related (72h accumulated rainfall)
Lake Waro	16	16	0	n/a
Raumanga Stream	16	15	1	ü (10.5mm)
Whangarei Falls	16	11	5	û (3mm), ü (10mm), û (4mm), ü (71.5mm), ü (19mm)
Total	**38**	**32**	**6**	

Raumanga Stream

One 'Action' result was related to 10.5mm of rainfall. This site has been monitored since 2004-05 and accounted for 53 'Action' results on 143 sampling occasions within the same time frame. This means the site was considered suitable for swimming 63 percent of the time during the summer season in the last 10 years.

The site was part of the investigation programme in 2007-08, 2012-13 and 2013-14. Microbial source tracking analyses identified contamination caused by wildfowl and human respectively. The strong positive human marker detected was due to a sewage spill which occurred the week prior to sampling and caused very high bacteria levels at the site. The problem was addressed by the District Council and bacteria levels in the water had returned to 'Surveillance' mode by the following week. In 2013-14, microbial source tracking analyses identified contamination caused by ruminant, wildfowl and plant decay, all indicated by weak markers.

Whangarei Falls

All 'Action' results were potentially likely to have been related to rainfall. This site has been monitored since 2004-05 and accounted for 110 'Action' results on 143 sampling occasions within the same time frame. This means the site was considered suitable for swimming 23 percent of the time during summer season in the last 10 years.

The site was part of the investigation programme from 2007-08 to 2010-11. Microbial source tracking analyses identified contamination caused by wildfowl, ruminant and dog with wildfowl being the main source of contamination for all three seasons. Permanent signage was erected at the site by District Council.

KAIPARA AREA

Site name	No. samples	Surveillance/Alert	Action	Rainfall related (72h accumulated rainfall)
Lake Taharoa	12	12	0	n/a
Total	**12**	**12**	**0**	

7.5 Comparison of freshwater results

Freshwater results from 2013-14 compared to previous years are presented in Table 9 below.

Table 9: Annual freshwater grades compared to national guidelines

Category	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
95-100% samples <550 *E. coli*/100mL	8	3	8	1	2	6	4	2	4	3
90-95% samples <550 *E. coli*/100mL	2	2	2	2	5	2	2	3	0	4
75-90% samples <550 *E. coli*/100mL	4	7	8	6	7	6	9	3	6	4
<75% samples <550 *E. coli*/100mL	6	11	7	12	5	9	9	2	2	1
Total number of sites	**20**	**23**	**25**	**21**	**19**	**23**	**24**	**10**	**12**	**12**

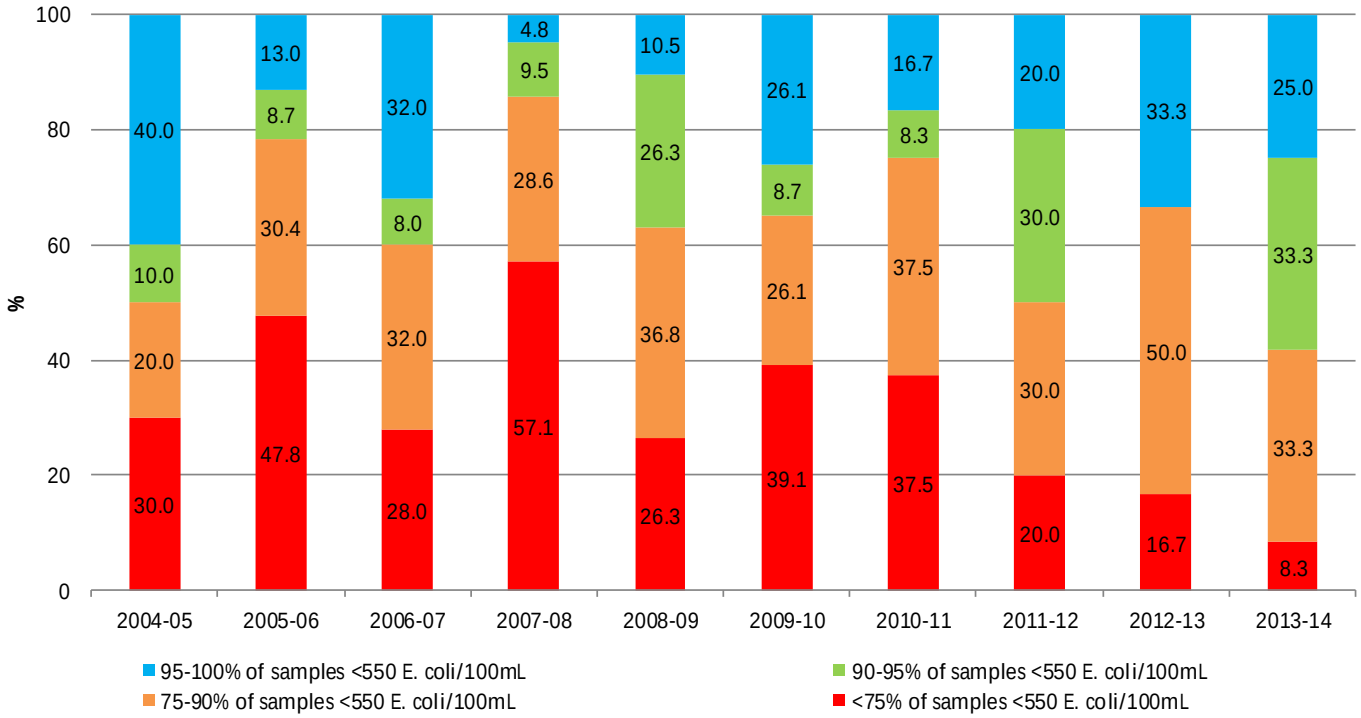

Figure 4: Yearly overall percentage of freshwater sites with corresponding percentage of samples within each category from 2004 to 2014

The results from faecal indicator bacteria testing in 2013-14 were marked by the higher proportion of sites, i.e. 58 percent compared to 33 percent in 2012-13, which recorded between 90 to 100 percent of samples collected below 'Action' level. Also, only 8.3 percent of monitored freshwater sites had less than 75 percent of samples collected below 'Action' level compared to 17 percent in 2012-13. Overall, end of season grades for freshwater sites in 2013-14 were the best recorded to date.

7.6 Results for freshwater permanent monitoring sites

Results for freshwater permanent monitoring sites from 2004-05 to 2013-14 are presented in Table 10 below.

Table 10: Results for freshwater permanent monitoring sites 2004-2014

	Percentage of samples within guidelines									
Site Name	**2004 -05**	**2005 -06**	**2006 -07**	**2007 -08**	**2008 -09**	**2009 -10**	**2010 -11**	**2011 -12**	**2012 -13**	**2013 -14**
Kerikeri River	90	67	83	77	67	72	67	73	55	83
Lake Waro						100	82	94	100	100
Raumanga Stream	70	75	67	54	92	100	82	81	88	94
Waipapa River			92	92	92	100	100	90	82	92
Waipoua River		90	100	85	92	83	92	89	100	92

Overall, grades for freshwater permanent monitoring sites in 2013-14 were the best recorded to date.

It should be noted that even in rivers which originate in pristine forested catchments, e.g. Waipapa and Waipoua rivers, high counts of the indicator bacteria *E. coli* have been observed after rainfall. The likely source of contamination is plant decay, or possibly wild animals like possums, pigs or goats. As a general rule, the council recommends swimming should be avoided for two to three days after rainfall.

8. Site Investigation

As a result of water quality testing undertaken through this programme, at times some swimming sites have been considered unsuitable for swimming. These sites have results which regularly fall outside the guidelines. Other sites with generally good water quality, but suffer from occasionally elevated bacteria levels have also been investigated although in most cases the source of contamination is not immediately obvious. The results from this work help inform management decisions when attempting to improve water quality at these sites.

More details about the investigation strategy implemented for the 2013-14 summer are available in the *Problem Sites Investigation – Update and On-Going Strategy*, document reviewed and published yearly, and accessible on the Council's website at www.nrc.govt.nz/swimming.

8.1 Methodology

Investigative work includes taking samples for microbial source tracking, catchment profiling, and undertaking sanitary surveys where microbial source tracking returned a positive result from human source, or where specific toilets/septic tank systems were suspected to be faulty.

8.1.1 Microbial source Tracking

Several analytic techniques are used to assist in identifying the source of bacterial contamination in water. These include faecal sterol ratio (FSR) analysis, fluorescent whitening agents (FWAs) and polymerase chain reaction (PCR) markers.

Faecal Sterols Ratio Analysis

Sterols are neutral lipids that have important biological functions in plants and animals, such as for cell membrane structure, e.g. cholesterol. The sterol profile in faeces depends on the animal's diet, internally produced sterols and the bacteria in the animal's gut. Consequently, analysis of sterol composition of animal faeces can generate distinctive faecal sterol fingerprints. The ratio of different sterols in a water sample can be used to narrow down the potential source(s) of bacterial

contamination to either humans, herbivores (animals whose main diet consists of vegetation, including cattle, sheep, deer and goats), and plant decay and/or run-off from vegetation.

Fluorescent Whitening Agents

Fluorescent whitening agents (FWAs) are common constituents of washing powders and only one is used in New Zealand. In most households effluent from toilets is mixed with grey water from washing machines and therefore FWAs are usually associated with human faecal contamination in both septic tanks and community wastewater systems.

Polymerase chain reaction Markers

Polymerase chain reaction (PCR) markers show the difference between closely related bacteria using DNA sequencing. In some cases, this bacterium is highly host specific, i.e. only associated with the faecal material of one animal or animal group. Therefore the type of animal that the bacteria came from can sometimes be identified.

PCR markers for the following host groups have been developed: human, ducks (wildfowl), ruminants (includes sheep, cattle, deer and goats), possums and pigs, as well as a general indicator for faecal contamination.

8.1.2 Catchment Profiling

Catchment profiling involves mapping catchment land-use around problem sites so that potential sources of contamination can be identified, such as pastoral farming or septic tank soakage fields. Therefore, this is carried out only if the first microbial source tracking result returns a contamination source(s) from ruminant or human.

Once catchment land-use has been mapped for each site, water samples are collected from key locations within each catchment to identify where bacterial levels are at their lowest and highest. This information provides an indication of where contamination is originating from, and in some cases, can point to a specific source of pollution.

8.1.3 Sanitary Surveys

A sanitary survey involves inspecting the septic tank and associated soakage field of each property in order to identify any failing or poorly maintained systems, which could be contributing to the water body contamination. Sanitary surveys will only be completed by the relevant District Council if results from microbial source tracking indicate the presence of FWAs or human markers.

8.2 Site investigation results

In order to carry out microbial source tracking analyses, FIB levels need to be above the 'Action' level criteria for swimming, i.e. above 550 *E. Coli*/100mL for freshwater and 280 *Enterococci*/100mL for coastal water. Microbial source tracking analytic techniques are a constantly evolving science and markers are now detected with different strengths. Since 2012-13 results include demarcation between weak positive, positive and strong positive markers.

An overview of results from microbial source tracking work undertaken since 2007 is presented in Table 11 below. In 2013-14 investigations continued at sites where results had been inconclusive.

Additional sites with recurrent water quality issues were also added to the programme and included:

- Tirohanga Stream
- Waitangi River

Two additional sites, Wellington Bay and Woolleys Bay Stream were added during the season following requests from the public. Results were inconclusive for Wellington Bay site and wildfowl was identified as the main source of contamination at Woolleys Bay Stream.

In the 2013-14 season a total of 9 sites were listed as part of the investigation programme, but only seven returned 'Action' level bacterial concentrations. Two sites – Pahi 150m NW of jetty and Paihia at Te Haumi – did not return any 'Action' results and therefore microbial source tracking analyses were not performed.

Table 11: Overview of results from microbial source tracking work undertaken since 2007. Sources in bold indicate a strong positive marker. Source in plain designate a positive or a weak positive marker. Site names in bold are permanent monitoring sites and sites with an asterisk indicate an enclosed coastal site. D: Dog, H: Human, R: Ruminant, W: Wildfowl, P: Plant decay.

Site	2007-08	2009-10	2010-11	2011-12	2012-13	2013-14
Coopers Beach stream		**D/W**	**R/W**			
Kaihu River			**R/W**			
Kapiro Stream			**R/W**			
Kerikeri River			**W**	**R**	**R/W**/P	
Lake Waro						
Langs Beach stream (car park)	**R/W**	**W**	**D/R/W**			
Langs Beach stream (midway)	**R/W**	**W**				
Mangawhai motor camp*			**W**	**W**		
Matapouri Northern bridge*			**R/W**		R/**W**/P	**R/W/P**
Matapouri Southern bridge*			**W**			
Ngunguru by school			**W**	**W**		
Ocean Beach stream	**W**		**H/R/W**			
Omamari Beach stream			**R**			
One Tree Point at intertidal beach						
Otamure Bay stream	**R/W**	**R/W**	**R/W**			
Pacific Bay stream		**W**				
Pahi 150m NW of jetty*		**H**		**W**	**W**/P	
Pahia at Te Haumi River					W/P	
Pahia at Waitangi Bridge					**R**/W	**R/W**
Raumanga Stream	**W**				**H**	R/W/P
Ruakaka River below motor camp					**R**	**R**
Teal Bay at beach						
Tirohanga Stream						**R**/P
Victoria River				**W**	W/P/H	W/**P**
Waipu Cove stream		**W**	**D/R/W**			
Waitangi River						**R/W/P**
Wellington Bay						
Whangarei Falls	**R/W**	**W**	**D/R/W**			
Woolleys Bay Stream						**W**/P

9. Water Quality for Recreational Shellfish Gathering

In addition to assessing sites for their suitability for swimming, results from sites also popular for shellfish gathering are compared to the MfE and MoH microbiological guidelines for shellfish gathering. The guidelines are based on those used by the shellfish industry and are globally recognised. The guidelines use faecal coliforms in the water as an indicator of the potential presence of pathogens and viruses in shellfish; they do not intend to measure bacteria levels in the shellfish directly.

Although the Council uses these guidelines to grade sites for recreational shellfish gathering, the method used to count the number of faecal coliforms present in a water sample differs from the one recommended in the guidelines. The Council uses colony forming units (CFU), which is a direct measure of bacteria grown on an agar plate used in microbiology. This means results may differ slightly when compared to the most probable number (MPN) method. Despite this the two methods give results that are close enough for comparing to the guidelines.

9.1 Guideline values

There are two guideline values for assessing water quality for shellfish gathering:

- The median faecal coliform content of samples taken over the entire shellfish gathering season shall not exceed a most probable number (MPN) of 14/100mL;

And

- No more than 10 percent of samples should exceed an MPN of 43/100mL.

9.2 Results 2013-14

The results for 15 permanent shellfish monitoring sites sampled during 2013-14 are presented in Table 12 below.

Table 12: Results for recreational shellfish gathering permanent monitoring sites 2013-14

		Week																				
Permanent shellfish monitoring sites	**Site No.**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**Samples**	**Over Guidelines**	**% Over Guidelines**	**Median**	**Pass/Fail**
Baylys beach @ Sea View Rd	109876	2	2	2	2	2	2	2	2	12	10	10	10					12	0	0	2	Pass
One Tree Point @ intertidal beach	109266	2	2	14	8	2	24	32	2	66	10	10	10	50	10	10	10	16	2	13	10	Fail
Mangawhai Heads @ motor camp	101210	2	2	2	6	2	18	2	2	2	10	10	10	10	10	10	30	16	0	0	8	Pass
Matauri Bay @ camp ground	102425	26	16	2	2	2	2	8	2	2	10	10	20					12	0	0	5	Pass
Ngunguru Estuary @ school	108320	2	144	2	10	2	400	30	10	240	30	10	10	10	200	130	40	16	5	31	20	Fail
Oakura Bay @ beach	101345	2	2	6	2	2	12	4	2	2	10	10	10					12	0	0	3	Pass
Ocean Beach	109877	2	4	2	2	2	400	4	2	10	10	10	10	10	10	10	10	16	1	6	10	Pass
Ohawini Bay @ Parutahi Beach	105388	30	2	4	4	2	114	20	2	2	10	10	10					12	1	8	7	Pass
Paihia @ Te Haumi River	101195	2	10	32	10	3	230	30	2	2	10	30	10					12	1	8	10	Pass
Pataua South @ east end of beach	104986	24	66	10	4	2	400	2	2	40	10	10	10	10	10	20	20	16	2	13	10	Fail
Ruakaka River @ motor camp	108314	2	50	20	56	2	2000	5	13	96	10	120	30	20	150	30	40	16	6	38	30	Fail
Sandy Bay @ beach	109879	20	24	2	2	24	206	2	2	10	10	10	10	10	10	10	10	16	1	6	10	Pass
Taipa estuary @ motor camp	105777	2	2	2	2	2	28	2	2	2	10	10	20					12	0	0	2	Pass
Teal Bay @ beach	101331	2	44	10	18	2	320	6	4	34	10	10	10					12	2	17	10	Fail
Tinopai @ below shops	102310	2	2	2	2	2	2	2	2	12	10	10	10					12	0	0	2	Pass

Results indicated that 10 out of 15 of the permanent sites monitored were within the MfE and MoH guidelines for shellfish gathering in 2013-14, However, it is important to note that samples were only collected over the summer months rather than for the entire shellfish gathering season, which excluding scallops, is all year round in Northland. Therefore, these results can only be used as an indication of the suitability for shellfish gathering at a site.

10. Summary and Conclusions

10.1 Coastal sites

The results from 2013-14 indicated that about 85 percent of the 47 coastal sites sampled were considered suitable for recreational use throughout the season. All sites had generally excellent or very good results with a few returning occasional elevated bacteria levels. In general, those sites were affected by rainfall and tended to be located in estuaries or harbours. The overall grading of coastal sites was similar to the one obtained in 2012-13, most likely due to similar weather conditions for both seasons when droughts occurred.

In comparison to guidelines, 29 coastal sites met the suitable for swimming criteria 100 percent of the time in 2013-14. A further 11 were suitable for swimming on all but one occasion, and five were suitable for swimming on all but two occasions. Only two sites were suitable for swimming on all but three occasions.

Three 'Action' results were recorded for Wellington Bay and Matapouri at southern bridge – an estuarine site.
Two of the high bacteria levels recorded at Wellington Bay were related to the tidal stream excavation undertaken on the same days of sampling. The other high result was likely to have been related to heavy rainfall.
Two out of three 'Action' results recorded at Matapouri at southern bridge were likely to have been related to rainfall.
The remaining elevated result could not be attributed to a specific source and results from follow-up sampling showed bacteria levels had returned to 'Surveillance' mode two days after the event. The site was part of the investigation programme in 2010-11 and microbial source tracking identified contamination caused by wildfowl.

Other sites such as Church Bay, Matapouri at northern bridge, Ngunguru estuary at school, Pacific Bay and Paihia at Waitangi bridge returned two 'Action' results, most of which were likely to have been related to heavy rainfall.
Matapouri at northern bridge and Paihia at Waitangi bridge sites were part of the investigation programme in 2013-14. Microbial source tracking identified contamination caused by ruminant, wildfowl and plant decay at Matapouri at northern bridge, and ruminant and wildfowl at Paihia at Waitangi bridge.

10.2 Freshwater sites

Four out of 12 freshwater sites met the suitable for swimming criteria 100 percent of the time, and three sites were suitable for swimming on all but two sampling occasions. A further two freshwater sites were considered unsuitable for swimming on more than two occasions, recording less than 75 percent of samples collected below 'Action' level.

These two sites – Tirohanga Stream and Whangarei Falls – recorded three and five 'Action' results respectively.
Positive markers for ruminant and a weak marker for plant decay were recorded at Tirohanga Stream site.
Whangarei Falls was part of the investigation programme from 2007-08 to 2010-11, and ruminant and wildfowl were identified as the sources of contamination in all three seasons. As the site is prone to

recurrent contamination, a permanent sign was erected to inform the public about the risk and stating the source of the contamination.

Overall, 18 ‘Action’ levels were recorded for nine of the 12 freshwater sites, of which 67 percent were likely to have been related to rainfall.

10.3 Site investigation

Nine sites were listed in the investigation programme in 2013-14 and microbial source tracking analyses were carried out for each sample above ‘Action’ level. Results indicated contamination occurring at most sites was coming from ruminant including cows and wildfowl including ducks and/or seagulls. Enclosed coastal sites like estuaries and harbours were occasionally contaminated by plant decay.

10.4 Shellfish gathering

The results for the 15 permanent monitoring sites sampled during 2013-14 for their suitability for recreational shellfish gathering indicated that 10 sites were within the microbiological water quality guidelines.

11. Key Recommendations

- Continue to monitor a key group of sites on a weekly basis through the summer of 2014-15, including the 20 permanent monitoring sites.
- Continue to disseminate water quality information to the Territorial Local Authorities (TLAs) and the District Health Board (DHB), as per the guidelines, and display results from sampling on the Council and national reporting 'LAWA' websites.
- Reassess, in consultation with relevant stakeholders, the sites listed in the monitoring programme, including potential new sites and sites with consistent high and/or low bacteria levels.
- Design the investigation programme for 2014-15 season according to the following:
  - Remove the following sites from the investigation programme due to consistent low bacteria levels:
    - Pahi 150m NW of jetty
    - Paihia at Te Haumi River
  - Continue investigating water quality at the following sites:
    - Matapouri at northern bridge
    - Paihia at Waitangi Bridge
    - Raumanga Stream
    - Ruakaka River
    - Tirohanga Stream
    - Victoria River
    - Waitangi River
  - Start investigating water quality at the following sites due to the elevated bacteria levels recorded last season:
    - Church Bay
    - Matapouri at southern bridge
    - Pacific Bay

12. References

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13. Abbreviations

FIB: faecal indicator bacteria
FNDC: Far North District Council
KDC: Kaipara District Council
MfE: Ministry for the Environment
MoH: Ministry of Health
NDHB: Northland District Health Board
NIWA: National Institute of Water and Atmospheric research
PCE: Parliamentary Commissioner for the Environment
RSWQP: Recreational Swimming Water Quality Programme
TLAs: Territorial Local Authorities
WDC: Whangarei District Council

14. Appendices

14.1 Appendix 1 – Results 2013-14

Enterococci results for coastal swimming sites 2013-2014

MfE and MoH guidelines 2003	**Single sample**
Alert (orange) mode	Ent > 140
Action (red) mode	Ent > 280
FU	Follow-up sample

Far North	Site No.	25-Nov-13	2-Dec-13	9-Dec-13	FU	16-Dec-13	23-Dec-13	30-Dec-13	6-Jan-14	13-Jan-14	20-Jan-14	28-Jan-14	3-Feb-14	10-Feb-14
Ahipara	109871	< 10	20	< 10		10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	144
Maitai Bay	102326	< 10	< 10	< 10		< 10	< 10	10	< 10	< 10	51	20	41	< 10
Tokerau Beach	109872	< 10	10	< 10		10	< 10	< 10	< 10	< 10	537	< 10	31	< 10
Waipapa Kauri	109873	< 10	20	< 10		< 10	< 10	< 10	10	< 10	< 10	< 10	< 10	20

North East (Coopers Beach to Matauri Bay)	Site No.	25-Nov-13	2-Dec-13	9-Dec-13	FU	16-Dec-13	23-Dec-13	30-Dec-13	6-Jan-14	13-Jan-14	20-Jan-14	28-Jan-14	3-Feb-14	10-Feb-14
Cable Bay	105780	< 10	< 10	10		10	< 10	10	< 10	< 10	< 10	< 10	10	< 10
Cooper's Beach Foreshore	101066	< 10	10	10		63	< 10	< 10	10	74	1169	31	10	< 10
Matauri Bay	102425	75	< 10	< 10		< 10	< 10	< 10	10	10	< 10	< 10	10	< 10
Taipa estuary	105777	< 10	< 10	< 10		< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	20

North West (Hokianga Harbour)	Site No.	25-Nov-13	2-Dec-13	9-Dec-13	FU	16-Dec-13	23-Dec-13	30-Dec-13	6-Jan-14	13-Jan-14	20-Jan-14	28-Jan-14	3-Feb-14	10-Feb-14
Omapere	102317	10	223	73		< 10	< 10	20	10	< 10	10	< 10	10	< 10
Opononi Shoreline	106011	< 10	< 10	309	20	< 10	< 10	< 10	< 10	< 10	31	< 10	10	< 10
Rawene*	100236	< 10	< 10	20		< 10	10	109	< 10	< 10	52	158	20	< 10

South West (Kaipara District)	Site No.	25-Nov-13	2-Dec-13	9-Dec-13	FU	16-Dec-13	23-Dec-13	30-Dec-13	6-Jan-14	13-Jan-14	20-Jan-14	28-Jan-14	3-Feb-14	10-Feb-14
Baylys beach	109876	< 10	< 10	< 10		< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Glinks Gully	100798	< 10	< 10	< 10		< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Omamari Beach	109875	< 10	20	< 10		< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Pahi @ NW of jetty*	102198	< 10	< 10	10		< 10	< 10	< 10	10	31	10	10	< 10	< 10
Tinopai @ shops*	102310	< 10	< 10	< 10		10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Tinopai @ Puapua Creek*	101232	< 10	< 10	< 10		< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10

Enterococci results for coastal swimming sites 2013-2014 continued

MfE and MoH guidelines 2003	**Single sample**
Alert (orange) mode	Ent > 140
Action (red) mode	Ent > 280
FU	Follow-up sample

South East (One Tree Point to Mangawhai)	Site No.	25-Nov-13	FU	2-Dec-13	FU	9-Dec-13	FU	16-Dec-13	23-Dec-13	30-Dec-13	FU	6-Jan-14	FU	13-Jan-14	FU	20-Jan-14	28-Jan-14	3-Feb-14	10-Feb-14	17-Feb-14	24-Feb-14	3-Mar-14	FU	10-Mar-14
One Tree Point east cliffs	109266	< 10		< 10		41		< 10	< 10	< 10		31		10		197	< 10	71	< 10	72	< 10	10		41
Langs Beach	108318	< 10		< 10		< 10		< 10	< 10	161		< 10		< 10		< 10	< 10	< 10	< 10	< 10	31	< 10		538
Mangawhai Harbour @ Picnic Bay*	110322	< 10		20		< 10		< 10	< 10	10		10		< 10		< 10	10	173	< 10	< 10	< 10	< 10		10
Mangawhai Heads @ Motor Camp*	101210	< 10		10		< 10		< 10	< 10	31		< 10		< 10		< 10	< 10	10	< 10	10	< 10	< 10		20
Mangawhai Heads @ open coast	109890	< 10		< 10		< 10		< 10	< 10	10		< 10		< 10		20	10	20	< 10	< 10	10	< 10		< 10
Ruakaka Beach	108315	< 10		< 10		10		< 10	< 10	10		< 10		< 10		51	10	< 10	10	< 10	< 10	< 10		299
Ruakaka River @ Below Motor Camp	108314	< 10		41		20		10	< 10	3076		31		10		120	< 10	187	20	10	197	63		31
Uretiti Beach	109888	10		< 10		< 10		< 10	< 10	< 10		< 10		< 10		86	< 10	< 10	< 10	< 10	10	< 10		41
Waipu Cove	108316	20		< 10		< 10		< 10	10	10		< 10		< 10		84	< 10	< 10	< 10	10	20	< 10		20

Bay of Islands	Site No.	25-Nov-13	FU	2-Dec-13	FU	9-Dec-13	FU	16-Dec-13	23-Dec-13	30-Dec-13	FU	6-Jan-14	FU	13-Jan-14	FU	20-Jan-14	28-Jan-14	3-Feb-14	10-Feb-14
Oakura Bay	101345	< 10		< 10		20		< 10	< 10	< 10		< 10		< 10		10	< 10	20	10
Ohawini Bay	105388	10		< 10		< 10		< 10	< 10	10		< 10		20		< 10	< 10	10	< 10
Paihia @ Te Haumi River	101195	< 10		10		30		10	< 10	52		31		10		10	< 10	31	10
Paihia @ Waitangi Bridge	101183	10		< 10		301	20	10	20	2755		41		< 10		< 10	< 10	108	10
Paihia @ toilets	101194	< 10		< 10		< 10		< 10	10	41		313	10	< 10		10	20	10	10
Russell	105710	< 10		10		< 10		< 10	< 10	< 10		< 10		31		< 10	10	< 10	63
Teal Bay	101331	< 10		10		< 10		< 10	< 10	52		< 10		< 10		< 10	< 10	< 10	20

Tutukaka	Site No.	25-Nov-13	FU	2-Dec-13	FU	9-Dec-13	FU	16-Dec-13	23-Dec-13	30-Dec-13	FU	6-Jan-14	FU	13-Jan-14	FU	20-Jan-14	28-Jan-14	3-Feb-14	10-Feb-14	17-Feb-14	24-Feb-14	3-Mar-14	FU	10-Mar-14
Church Bay	105448	350	<10	< 10		< 10		< 10	10	17329	521	< 10		< 10		10	< 10	< 10	< 10	10	< 10	41		< 10
Matapouri Bay @ Northern Bridge*	100712	288	2014	228	561	10		20	10	> 24196	211	< 10		< 10		31	10	31	41	20	41	175		20
Matapouri Bay @ Southern Bridge*	100711	2613	2909	20	86	10		< 10	< 10	12997	63	< 10		417	< 10	< 10	98	20	132	< 10	< 10	41		20
Ngunguru Estuary @motor camp	100073	<10		41		< 10		< 10	< 10	9208	134	< 10		< 10		41	< 10	< 10	< 10	20	< 10	52		< 10
Ngunguru Estuary @ school	108320	<10		109		< 10		10	10	2909	121	31		< 10		161	31	< 10	< 10	< 10	31	481	10	10
Pacific Bay	108313	110		379	6867	< 10		< 10	< 10	19863	602	10		< 10		< 10	10	20	< 10	< 10	< 10	73		< 10
Sandy Bay	109879	20		10		< 10		< 10	31	85		< 10		< 10		96	10	< 10	10	< 10	< 10	< 10		< 10
Wellingtons Bay	109880	<10		< 10		< 10		< 10	< 10	3654	10	10		31		20	20	771	1664	< 10	< 10	246		20
Whananaki	106938	119		134		< 10		< 10	< 10	15531		< 10		10		135	10	10	< 10	< 10	10	135		< 10
Woolleys Bay	109878	<10		< 10		< 10		20	< 10	41		< 10		< 10		10	< 10	< 10	< 10	10	< 10	10		< 10

Enterococci results for coastal swimming sites 2013-2014 continued

MfE and MoH guidelines 2003	**Single sample**
Alert (orange) mode	Ent > 140
Action (red) mode	Ent > 280
FU	Follow-up sample

Whangarei Heads (including Onerahi and Pataua)	**Site No.**	**25-Nov-13**	**2-Dec-13**	**9-Dec-13**	**16-Dec-13**	**23-Dec-13**	**30-Dec-13**	**6-Jan-14**	**13-Jan-14**	**20-Jan-14**	**28-Jan-14**	**3-Feb-14**	**10-Feb-14**	**17-Feb-14**	**24-Feb-14**	**3-Mar-14**	**10-Mar-14**
Ocean beach	109877	<10	< 10	< 10	< 10	< 10	985	20	< 10	30	< 10	< 10	< 10	31	< 10	< 10	< 10
Onerahi*	101600	20	41	< 10	< 10	< 10	169	10	< 10	253	< 10	< 10	< 10	97	< 10	52	< 10
Pataua South	104986	<10	31	< 10	20	< 10	4884	< 10	< 10	62	< 10	20	< 10	10	< 10	63	< 10
Taurikura Beach	101262	20	20	< 10	63	< 10	10	< 10	< 10	41	< 10	20	< 10	< 10	< 10	20	< 10

*Sites where grades are calculated using a combination of *Enterococci* and Faecal Coliforms as they are usually estuaries and or harbours (considered enclosed marine sites).

E. coli Results for freshwater swimming sites 2013-2014

MfE and MoH guidelines 2003	**Single sample**
Alert (orange) mode	E.coli > 260
Action (red) mode	E.coli > 550
FU	Follow-up sample

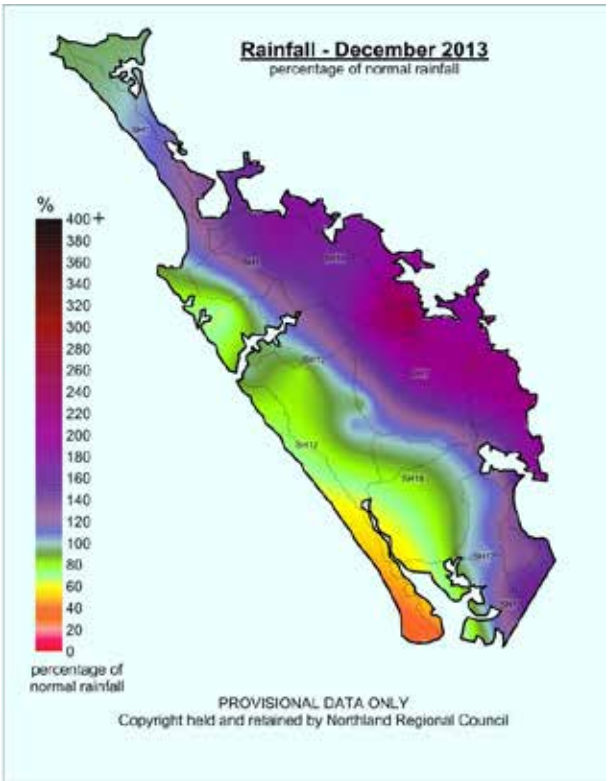
Whangarei Area	**Site No.**	**25-Nov-13**	**2-Dec-13**	**FU**	**9-Dec-13**	**FU**	**16-Dec-13**	**FU**	**23-Dec-13**	**30-Dec-13**	**6-Jan-14**	**13-Jan-14**	**20-Jan-14**	**28-Jan-14**	**3-Feb-14**	**10-Feb-14**	**17-Feb-14**	**24-Feb-14**	**3-Mar-14**	**10-Mar-14**
Lake Waro	107272	10	< 10		< 10		< 10		< 10	414	10	144	41	30	< 10	10	63	63	31	< 10
Raumanga Stream	103246	161	41		199		52		41	855	72	259	443	98	96	86	41	389	31	63
Whangarei Falls	105972	2755	794		282		583		213	24196	379	213	583	328	98	253	266	384	332	218

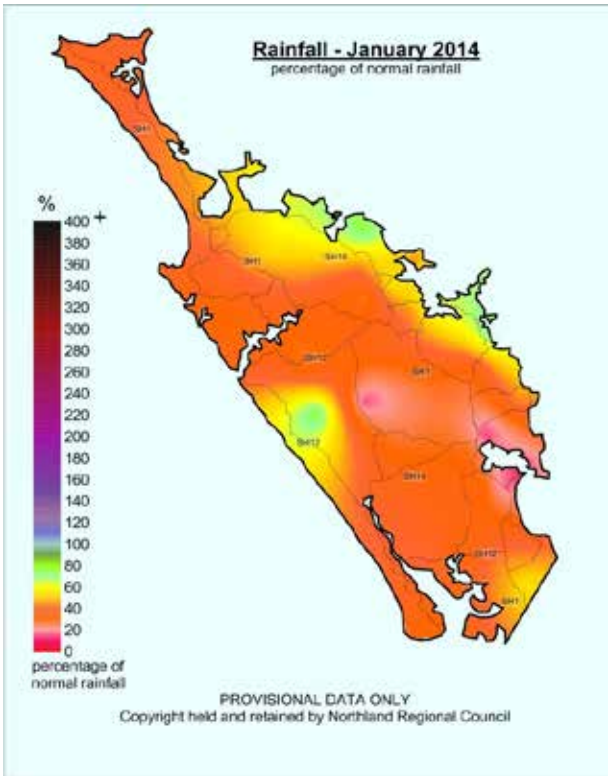
Far North Area	**Site No.**	**25-Nov-13**	**2-Dec-13**	**FU**	**9-Dec-13**	**FU**	**16-Dec-13**	**FU**	**23-Dec-13**	**30-Dec-13**	**6-Jan-14**	**13-Jan-14**	**20-Jan-14**	**28-Jan-14**	**3-Feb-14**	**10-Feb-14**
Kerikeri River	101530	30	97		197		189		243	19863	145	52	122	959	102	259
Lake Ngatu	100402	10	< 10		< 10		10		31	10	74	20	110	10	27	< 10
Punakitere River	110927	20	31		171		10		10	631	41	97	41	52	102	63
Tirohanga Stream	102252	160	657	12997	379		691	248	16	3076	495	323	211	455	172	323
Victoria River	104908	243	414		417		546		305	1314	301	328	1483	120	114	199
Waipapa River Waihou Valley	103248	20	20		253		135		97	4106	108	31	41	41	36	161
Waipoua River	108613	41	63		175		677	126	62	98	109	30	20	74	111	63
Waitangi River	101752	63	41		1842	218	122		122	6131	52	86	63	160	125	134

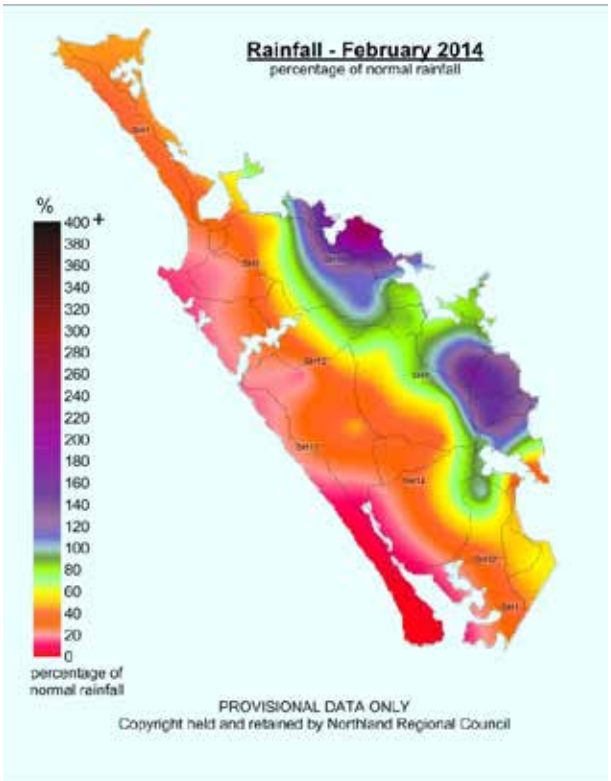
Kaipara Area	**Site No.**	**25-Nov-13**	**2-Dec-13**	**FU**	**9-Dec-13**	**FU**	**16-Dec-13**	**FU**	**23-Dec-13**	**30-Dec-13**	**6-Jan-14**	**13-Jan-14**	**20-Jan-14**	**28-Jan-14**	**3-Feb-14**	**10-Feb-14**
Lake Taharoa	105434	< 10	< 10		< 10		< 10		< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10

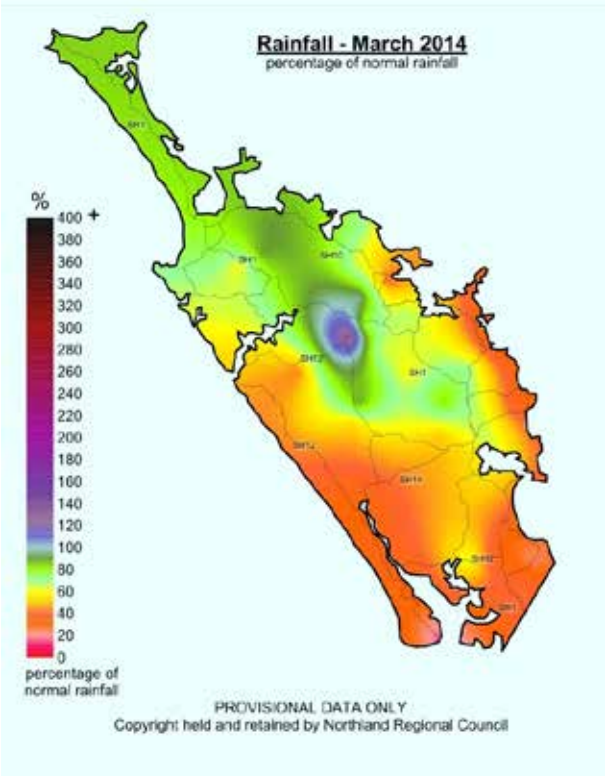
MfE and MoH guidelines 2003: Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas. Published by Ministry for the Environment.
Important note: Following a review of the recreational swimming water quality data in 2006/2007, several sites were removed from the programme because they have had consistently good or poor water quality over the last four summers. These sites are no longer monitored. These sites are listed on the Regional Council website at the following link: http://www.nrc.govt.nz/Living-in-Northland/At-the-beach/Swimming-water-quality/Sites-removed/
FNDC: Far North District Council, WDC: Whangarei District Council, KDC: Kaipara District Council.

14.2 Appendix 2 – Rainfall Maps Summer 2013-14









14.3 Appendix 3 – Sites removed from the monitoring programme since 2007

Site name	Site No.	Year removed	Reason for removal
Wairoa Stream (Ahipara)	105053	2007-08	Consistent high bacteria level ~
Lake Taharoa	100452	2007-08	Redundant site
Doves Bay	101537	2007-08	Consistent low bacteria level ~
Windsor Landing (Kerikeri)	105707	2007-08	Consistent low bacteria level ~
Opito Bay	101538	2007-08	Consistent low bacteria level ~
Russell mid-south	105711	2007-08	Consistent low bacteria level ~
Matauwhi Bay	102636	2007-08	Consistent low bacteria level ~
English Bay	100802	2007-08	Consistent low bacteria level ~
Kawakawa River	100643	2007-08	Consistent low bacteria level ~
Otiria Stream	105376	2007-08	Consistent high bacteria level ~
Ngunguru cable marker	100061	2007-08	Redundant site
Pataua North	105992	2007-08	Redundant site
Okiato Point	105712	2008-09	Consistent low bacteria level ~
Ngunguru boat ramp	101300	2008-09	Redundant site
Paihia below junction	101186	2008-09	Redundant site
Kaikou River	108919	2009-10	Staff safety concerns
Whakapirau	106100	2009-10	Staff safety concerns
Langs Beach stream middle	104539	2010-11	Consistent high bacteria level ~
Langs Beach north	108317	2010-11	Redundant site
Rarawa camp site	109874	2010-11	Consistent low bacteria level ~
Taupo Bay	109868	2010-11	Consistent low bacteria level ~
Tauranga Bay	109869	2010-11	Consistent low bacteria level ~
Coopers Beach stream	101870	2011-12	Consistent high bacteria level ~
Lake Coca Cola	110323	2011-12	Consistent low bacteria level ~
Aurere River Beach Road	110324	2011-12	Rationalisation
Waitangi River Lily Pond	110325	2011-12	Staff safety concerns
Kapiro Stream Purerua Road	102838	2011-12	Consistent high bacteria level ~
Waipapa Stream Charlies Rock	110348	2011-12	Not popular site
Mangakahia River Twin Bridges	105973	2011-12	Consistent high bacteria level ~
Otaua Stream	108510	2011-12	Consistent high bacteria level ~
Kaihu River at campground	102221	2011-12	Consistent high bacteria level ~
Omamari Beach Stream	102305	2011-12	Rationalisation
Ocean Beach Stream	102077	2011-12	Consistent high bacteria level ~
Langs Beach Stream	100686	2011-12	Consistent high bacteria level ~
Waipu Cove Stream	101207	2011-12	Rationalisation
Otamure Bay Stream	108859	2011-12	Consistent high bacteria level ~
Kerikeri Skudders Beach	100974	2011-12	Not popular site
Opua foreshore	101418	2011-12	Rationalisation
Shipwreck Bay	109870	2011-12	Consistent low bacteria level ~
Pahi rocky groyne	102579	2011-12	Redundant site
Mangawhai Harbour pontoon	110320	2011-12	Rationalisation
Urquart's Bay	108311	2011-12	Rationalisation

Site name	Site No.	Year removed	Reason for removal
McLeod Bay	101254	2011-12	Rationalisation
Pataua South footbridge	102217	2011-12	Consistent low bacteria level ~
Pataua South Frog Town	109887	2011-12	Consistent low bacteria level ~
Matapouri Beach	110321	2011-12	Consistent low bacteria level ~
Kowharewa Bay	106444	2011-12	Rationalisation
Ngunguru Norfolk pine	100076	2011-12	Consistent low bacteria level ~
Whananaki footbridge	103147	2011-12	Rationalisation
Bland Bay	109889	2011-12	Consistent low bacteria level ~
Pahi at rocky Groyne	102579	2012-13	Redundant site

NORTHLAND REGIONAL COUNCIL

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ŌPUA: Unit 10, Industrial Marine Park, Ōpua; Phone 09 402 7516, Fax 09 402 7510.

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