

Recreational Swimming Water Quality in Northland

Summer 2015-2016



Putting Northland first



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1. Executive Summary

- < From November 2015 to February 2016, a total of 13 freshwater and 44 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), 40 coastal sites met the guideline values and were considered suitable for swimming 100 percent of the time. Three sites were suitable for swimming on all but one sampling occasion, and the remaining site was suitable for swimming on all but two sampling occasions.
- < In 2015-16, two freshwater sites met the suitable for swimming criteria 100 percent of the time. Six sites were suitable for swimming on all but one occasion, three sites on all but two sampling occasions and one site on all but three sampling occasions. The remaining site was classified as unsuitable for swimming on four sampling occasions, recording less than 75 percent of samples below the "Action" level specified in the MfE and MoH (2003) guidelines.
- < 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, 19 'Action' levels were recorded for 11 of the 13 freshwater sites, of which 58 percent were likely to have been related to rainfall. At the coast, five 'Action' levels were recorded for four of the 44 coastal sites, of which two were likely to have been related to rainfall.
- < Since 2007-08, a total of 27 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 23 sites – mostly ducks and/or gulls – 20 sites were contaminated by ruminant and four sites by dog faecal material. Human faecal contamination has been recorded at Ocean Beach, Pahi, and Raumanga. Weak human markers have also been detected at Ruakaka in 2014-15, and Victoria River during the 2012-13 and 2014-15 summer monitoring periods.
- < Monitoring and further investigation will continue at sites with consistently elevated bacteria levels where the source(s) of contamination have not yet been identified.
- < Seven of the 15 permanent monitoring sites for recreational shellfish gathering were within the Ministry for the Environment guidelines during summer 2015-16.

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5. 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 been identified at five 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

6. Programme Procedure

There are currently 44 coastal and 13 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 14 weeks – the programme runs from the end of November until the end of February 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 faecal indicator bacteria (FIB). Sites are graded according to their corresponding bacteria level recorded in 100 millilitres of water, in accordance with the MfE and MoH grading system (see section 8). Results are then distributed to key stakeholders including District Councils and the general public. District Councils are responsible for collecting follow-up samples if the initial samples return 'Action' bacteria levels. If results from the follow-up sampling remain at '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.

7. 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.

7.1 Acceptable risks

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.

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.

7.2 When to avoid contact recreation

In order to minimise the risk when using rivers or the coast for contact recreation, the following should be considered:

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 scum 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.

8. 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 monitored throughout the sampling season, based on single samples collected at weekly intervals. At the end of the season, sites are graded according to their compliance with the guidelines throughout the sampling season.

8.1 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: Suitable (green), Alert (yellow), or Action (red), as shown in Table 1.

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

<i>E. coli</i> concentration	Category	Suggested response
sample ≤ 260/100mL	Suitable	No response necessary – continue weekly sampling
260 < sample ≤ 550/100mL	Alert	Undertake catchment assessment and sanitary survey where applicable 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: Suitable (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)

<i>Ent.</i> concentration	Category	Suggested response
sample ≤ 140/100mL	Suitable	No response necessary – continue weekly sampling
140 < sample ≤ 280/100mL	Alert	Undertake catchment assessment and sanitary survey where applicable 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	<i>Enterococci</i> concentration	Category	Status
sample ≤ 150/100mL	sample ≤ 140/100mL	Suitable	Suitable + Suitable = Suitable
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.

8.2 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: End of season grading system

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

9. Methodology

9.1 Sampling technique

Samples are collected weekly at selected freshwater and coastal sites throughout the summer months. In 2015-16, sampling was carried out from 23 November 2015 to 23 February 2016 at 44 coastal and 14 freshwater sites. 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.

9.2 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).

10. 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 2015-16, and those included in the permanent monitoring sites list. Sites that have been removed from the programme are listed in Appendix 3.

10.1 Sampling sites 2015-16

In the 2015-16 sampling season, a total of 13 freshwater sites and 44 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 2015-16. BOI: Bay of Islands.

Coastal sites	Grid reference		Site No.	Area
Far North District Council				
Ahipara campground	1614114	6109386	109871	Far North
Cable Bay	1644302	6127973	105780	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
Tokerau Beach	1633974	6139217	109872	Far North
Waipapa Kauri	1615249	6122554	109873	Far North
Kaipara District Council				
Baylys Beach	1666750	6021176	109876	South-west

Coastal sites	Grid reference		Site No.	Area
Glinks Gully	1677301	6006503	100798	South-west
Mangawhai Heads Beach	1743817	6006166	109890	South-east
Mangawhai Heads motor camp*	1743147	6005606	101210	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
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
Ohawini Bay	1722090	6084082	105388	BOI
One Tree Point	1731539	6035180	109266	South-east
Onerahi playground*	1722792	6040203	101600	Whg heads
Otamure Bay	1732610	6071608	311666	Tutukaka
Pacific Bay	1738969	6057164	108313	Tutukaka
McLeod Bay	1735908	6035832	101254	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
Urquharts Bay	1738601	6031879	108311	Whg heads
Waipu Cove	1735915	6011855	108316	South-east
Wellingtons/Whangaumu Bay	1738576	6055370	109880	Tutukaka
Whananaki east beach	1733002	6069592	106938	Tutukaka
TOTAL COASTAL				44

Freshwater Sites	Grid Reference		Site No.	Area
Far North District Council				
Kerikeri River Stone Store	1687631	6102447	101530	BOI
Kerikeri at Rainbow Falls	1685773	6102740	308794	BOI
Lake Ngatu	1618033	6122885	100402	Far North
Tirohanga Stream	1699502	6084784	102252	BOI
Victoria River	1639482	6108122	104908	North-east
Waimamaku at Wekaweka Road	1644868	6064405	308844	North-west
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

Freshwater Sites	Grid Reference		Site No.	Area
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				13

10.2 Permanent monitoring sites

A core group of 18 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. Results for the permanent monitoring sites are presented in section 11.

Table 6: Permanent monitoring sites

Site name	Site No.
Church Bay	105448
Kerikeri – Stone Store	101530
Lake Waro – Hikurangi	107272
Lang’s Beach	108318
Matapouri – northern bridge*	100712
Onerahi – playground*	101600
Opononi	106011
Pacific Bay	108313
Pahi – jetty*	102579
Paihia – Waitangi bridge	101183
Raumanga stream	103246
Ruakaka – by motor camp	108314
Taipa	105777
Taurikura	101262
Teal Bay	101331
Waipapa River – Puketi	103248
Waipoua River	108613
Waipu Cove	108316

11. Results and Interpretation

The results for all sites sampled in 2015-16 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 2015-16 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.

11.1 End of season grading – coastal sites

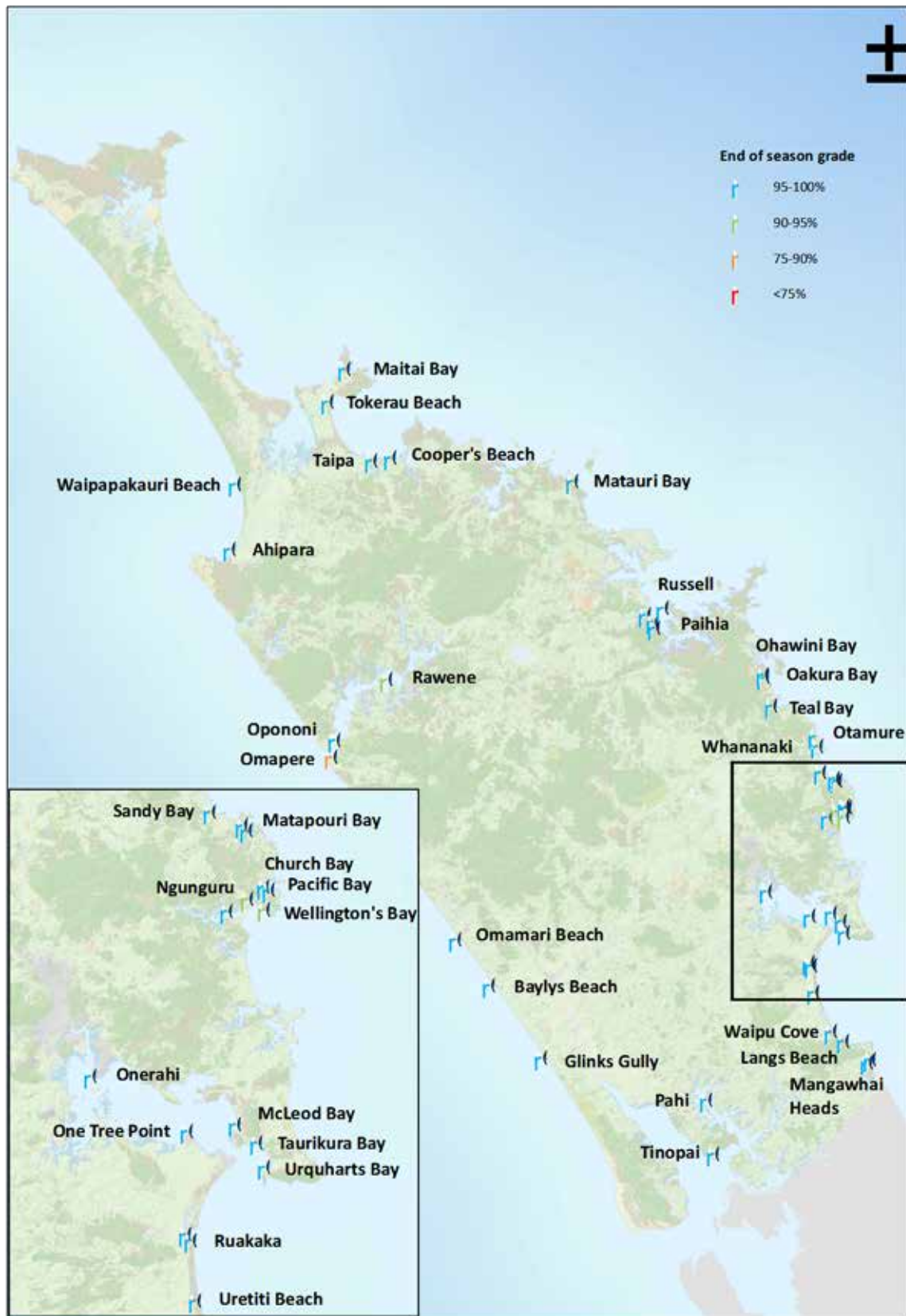


Figure 1: Coastal end of season grading 2015-16

The map above summarises the end of season grading for samples taken from each of the 44 coastal sites monitored in Northland during the 2015-16 sampling season (23 November 2015 to 23 February 2016). 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	Suitable/Alert	Action	Rainfall related (72h accumulated rainfall)
Ahipara	14	14	0	n/a
Maitai Bay	14	14	0	n/a
Tokerau Beach	14	14	0	n/a
Waipapa Kauri	14	14	0	n/a
Total	56	56	0	

NORTH EAST

Site name	No. samples	Suitable/Alert	Action	Rainfall related (72h accumulated rainfall)
Coopers Beach	14	14	0	n/a
Matauri Bay	14	14	0	n/a
Taipa estuary	14	14	0	n/a
Total	42	42	0	

NORTH WEST

Site name	No. samples	Suitable/Alert	Action	Rainfall related (72h accumulated rainfall)
Omapere	14	12	2	ü (16.5mm), û (no rain)
Opononi	14	14	0	n/a
Rawene*	14	13	1	û (no rain)
Total	42	39	3	

Two 'Action' results were recorded at Omapere in 2015-16, one of which may have been related to 16.5mm of rainfall. This site has been monitored since 2004-05 and accounted for eight 'Action' results on 143 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 11 years. Two consecutive weeks results returned elevated bacteria results as well as the follow-up sample collected two days following the last result. In January 2016 signs were posted warning swimmers that the site was unsuitable for swimming.

One 'Action' result was recorded at Rawene in 2015-16 which was not related to rainfall. Follow-up samples confirmed contamination and health warning signs were erected in January 2016. This site has been monitored since 2004-05 and accounted for nine 'Action' results on 143 sampling occasions within the same time frame. This means the site was considered suitable for swimming 94 percent of the time during the summer season in the last 11 years.

SOUTH WEST

Site name	No. samples	Suitable/Alert	Action	Rainfall related (72h accumulated rainfall)
Baylys Beach	14	14	0	n/a
Glinks Gully	13	13	0	n/a
Omamari Beach	14	14	0	n/a
Pahi jetty*	14	14	0	n/a
Tinopai at creek	14	14	0	n/a
Total	69	69	0	

SOUTH EAST

Site name	No. samples	Suitable/Alert	Action	Rainfall related (72h accumulated rainfall)
One Tree Point	14	14	0	n/a
Langs Beach midway	14	14	0	n/a
Mangawhai Heads motor camp*	14	14	0	n/a
Mangawhai Heads	14	14	0	n/a
Ruakaka Beach	14	14	0	n/a
Ruakaka River	14	14	0	n/a
Uretiti Beach	14	14	0	n/a
Waipu Cove Beach	14	14	0	n/a
Total	112	112	0	

BAY OF ISLANDS

Site name	No. samples	Suitable/Alert	Action	Rainfall related (72h accumulated rainfall)
Oakura	14	14	0	n/a
Ohawini Bay	14	14	0	n/a
Paihia Te Haumi	14	14	0	n/a
Paihia Waitangi Bridge	13	13	0	n/a
Paihia toilets	14	14	0	n/a
Russell mid-north	14	14	0	n/a
Teal Bay	14	14	0	n/a
Total	98	98	0	

TUTUKAKA

Site name	No. samples	Suitable/Alert	Action	Rainfall related (72h accumulated rainfall)
Church Bay	14	14	0	n/a
Matapouri Northern Bridge*	14	14	0	n/a
Matapouri Southern Bridge*	14	14	0	n/a
Ngunguru at Pakapaka Road*	14	14	0	n/a
Ngunguru at School	14	13	1	ü (32.5mm)
Otamure Bay	11	11	0	n/a
Pacific Bay	14	14	0	n/a
Sandy Bay	14	14	0	n/a
Wellingtons Bay	14	13	1	ü (no rain)
Whananaki at east beach	14	14	0	n/a
Total	137	135	2	

One 'Action' result was recorded at Ngunguru at school in 2015-16 which may have been related to rainfall. Results from follow-up samples collected two days following showed bacteria levels had returned to 'suitable' for swimming mode. This site has been monitored since 2004-05 and accounted for 22 'Action' results on 170 sampling occasions within the same time frame. This means the site was considered suitable for swimming 87 percent of the time during summer season in the last 11 years.

One 'Action' result was recorded at Wellington's Bay in 2015-16 and was not related to rainfall. Results from follow-up samples collected two days following showed bacteria levels had returned to 'suitable' for swimming mode. This site has been monitored since 2009-10 and accounted for seven 'Action' results on 111 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 six years.

WHANGAREI HEADS

Site name	No. samples	Suitable/Alert	Action	Rainfall related (72h accumulated rainfall)
McLeods Bay	14	14	0	n/a
Onerahi	14	14	0	n/a
Taurikura	14	14	0	n/a
Urquharts Bay	14	14	0	n/a
Total	56	56	0	

11.2 Comparison of coastal results

Coastal results from 2015-16 compared to previous years are presented in Table 7 below.

Table 7: Annual coastal grades compared to national guidelines

Category	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
95-100% samples <280/100mL Ent.	35	40	27	21	45	22	26	29	29	31	40
90-95% samples <280/100mL Ent.	16	14	13	8	13	21	16	13	11	13	3
75-90% samples <280/100mL Ent.	5	3	4	12	5	16	5	5	7	3	1
<75% samples <280/100mL Ent.	1	0	1	2	0	2	1	0	0	0	0
Total number of sites	57	57	45	43	63	61	48	47	47	47	44

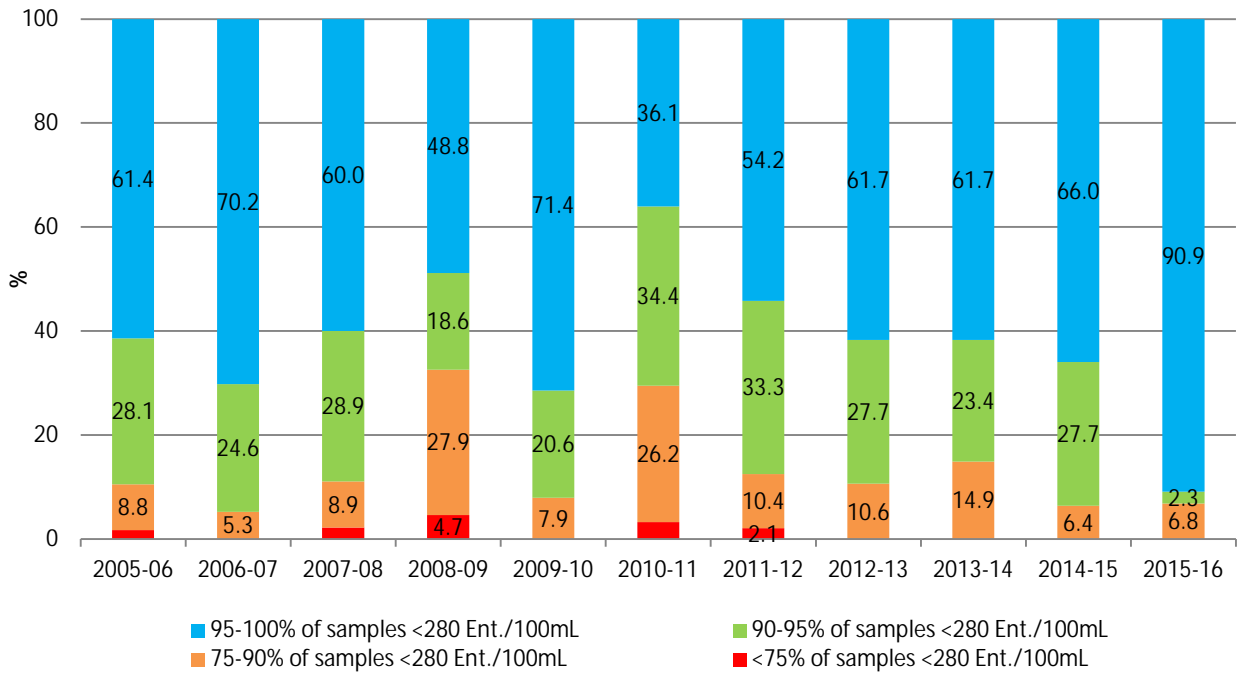


Figure 2: Yearly overall percentage of coastal sites with corresponding percentage of samples within each category from 2005 to 2016

Over 90 percent of sites monitored in 2015-16 had more than 95 percent of samples fall below the 'Action' level guidelines. No sites had less than 75 percent compliance with the guidelines. Overall, the results from faecal indicator bacteria testing in 2015-16 show a significant improvement compared to previous summer monitoring periods.

11.3 Results for coastal permanent monitoring sites

Results for coastal permanent monitoring sites from 2005-06 to 2015-16 are presented in Table 8 below.

Table 8: Results for coastal permanent monitoring sites 2015-2016

Site Name	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Church Bay	67	92	100	83	100	94	100	89	88	100	100
Langs Beach	83	100	100	100	100	94	100	94	94	100	100
Matapouri*	92	100	85	83	100	88	100	85	88	100	100
Onerahi*			100	100	100	89	100	94	100	93	100
Opononi	100	100	100	92	100	92	100	100	92	92	100
Pacific Bay	92	100	100	83	91	82	100	100	88	100	100
Pahi Jetty*	100	100	100	92	100	100	80	91	100	83	100
Paihia Beach	100	100	92	83	100	75	100	92	83	92	100
Ruakaka River	83	75	100	100	91	89	100	94	94	86	100
Taipa	100	100	92	100	100	92	100	100	100	92	100
Taurikura Bay	92	100	92	75	100	89	100	100	100	100	100
Teal Bay	92	100	92	92	100	100	88	100	100	100	100
Waipu Cove	92	100	100	100	100	94	100	100	100	100	100

All permanent coastal sites complied with guidelines 100 percent of the time in 2015-16. This is a significant improvement in results compared to the previous years' monitoring results.

11.4 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 2015-16

The map above summarises the end of season grading for samples taken from each of the 13 freshwater sites monitored in Northland during the 2015-16 sampling season (23 November 2015 to

the 23 February 2016). 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 Rainbow Falls	14	13	1	ü (10mm)
Kerikeri Stone Store	13	9	4	ü (42.5mm), ü (48mm), ü (4.5mm), ü (24mm)
Lake Ngatu	14	13	1	ü (5mm)
Tirohanga Stream	14	12	2	ü (no rain), ü (7mm)
Victoria River	14	12	2	ü (21mm), ü (8.5mm)
Waimamaku River	14	12	2	ü (13mm), ü (no rain)
Waipapa River	14	14	0	n/a
Waipoua River	14	13	1	ü (18.5mm)
Waitangi River	13	12	1	ü (24mm)
Total	124	110	14	

Eight out of nine rivers in the far north recorded 'Action' results in 2015-16, most of which were likely to have been related to rainfall runoff. Tirohanga stream reached 'Action' level on one occasion which was unrelated to rainfall.

Kerikeri Rainbow Falls

The 'Action' result was likely to have been related to 10mm of rainfall. This site has been monitored since 2013-14 and accounted for three 'Action' results on 26 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 3 years.

This site has been included in the source tracking investigation programme for 2015-16. Results are to be determined.

Kerikeri Stone Store

All 'Action' results were likely to have been related to rainfall. On all four occasions, follow-up results returned to 'Suitable' mode two days after the event.

This site has been monitored since 2004-05 and accounted for 39 'Action' results on 147 sampling occasions within the same time frame. This means the site was considered suitable for swimming 74 percent of the time during the summer season in the last 11 years.

The site was part of the source tracking investigation programme from 2010-11 to 2013-14. Microbial source tracking analyses identified contamination caused by wildfowl and ruminant.

Lake Ngatu

One 'Action' result may have been related to 5mm of rainfall. This site has been monitored since 2004-05 and accounted for two 'Action' results on 104 sampling occasions within the same time frame. This means the site was considered suitable for swimming 98 percent of the time during the summer season in the last 11 years.

Tirohanga Stream

One of the two 'Action' results was not related to rainfall. The other one was likely to have been related to 7mm of rainfall. This site has been monitored since 2004-05 and accounted for 20 'Action' results on 143 sampling occasions within the same time frame. This means the site was considered suitable for swimming 86 percent of the time during the summer season in the last 11 years.

The site was part of the source tracking investigation programme in 2013-14 and 2014-15. Microbial source tracking analyses identified contamination caused by ruminant.

Waimamaku River

One of the two 'Action' results was not related to rainfall. The other one was likely to have been related to 13mm of rainfall. This site has been monitored since 2014-15 and accounted for three 'Action' results on 26 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 two years.

Victoria River

All 'Action' results were likely to have been related to rainfall. This site has been monitored since 2007-08 and accounted for 20 'Action' results on 109 sampling occasions within the same time frame. This means the site was considered suitable for swimming 82 percent of the time during the summer season in the last eight years.

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

Waipoua River

One 'Action' result was likely to have been related to 18.5mm of rainfall. Follow-up results showed bacteria levels had returned to 'suitable' mode two days after the rain event. This site has been monitored since 2005-06 and accounted for 10 'Action' results on 129 sampling occasions within the same time frame. This means the site was considered suitable for swimming 92 percent of the time during the summer season in the last 10 years.

Waitangi River

One 'Action' result was likely to have been related to 24mm of rainfall. Follow-up results showed bacteria levels had returned to 'suitable' mode two days after the rain event. This site has been monitored since 2012-13 and accounted for six 'Action' results out of 48 sampling occasions within the same time frame. This means the site was considered suitable for swimming 88 percent of the time within the last three seasons.

The site was part of the source tracking investigation programme in 2013-14 and 2014-15. Microbial source tracking analyses identified contamination caused by ruminant.

WHANGAREI AREA

Site name	No. samples	Surveillance/Alert	Action	Rainfall related (72h accumulated rainfall)
Lake Waro	14	13	1	ü (6mm)
Raumanga Stream	14	13	1	ü (7.6mm)
Whangarei Falls	14	11	3	ü (3mm), ü (5mm), ü (19.5mm)
Total	42	37	5	

Lake Waro

One 'Action' result was likely to have been related to 6mm of rainfall. Follow-up results showed bacteria levels had returned to 'suitable' mode three days after the rain event. This site has been monitored since 2009-10 and accounted for five 'Action' results on 112 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 six years.

Raumanga Stream

One 'Action' result was related to 7.6mm of rainfall. This site has been monitored since 2004-05 and accounted for 28 'Action' results on 171 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 11 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. 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.

The site was part of the source tracking investigation programme in 2013-14 and 2014-15. Microbial source tracking analyses identified contamination caused by wildfowl.

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 59 'Action' results on 171 sampling occasions within the same time frame. This means the site was considered suitable for swimming 66 percent of the time during summer season in the last 11 years.

The site was part of the investigation programme from 2007-08 to 2010-11 and 2015-16. Microbial source tracking analyses identified contamination caused by wildfowl, ruminant and dog. Results from 2015-16 indicate ruminant and possible wildfowl contamination. Permanent signs are posted to warn the public of health risks from swimming at this site.

KAIPARA AREA

Site name	No. samples	Surveillance/Alert	Action	Rainfall related (72h accumulated rainfall)
Lake Taharoa	14	14	0	n/a
Total	14	14	0	

11.5 Comparison of freshwater results

Freshwater results from 2015-16 compared to previous years are presented in Table 9 below.

Table 9: Annual freshwater grades compared to national guidelines

Category	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
95-100% samples <550/100mL E.coli	3	8	1	2	6	4	2	4	3	4	2
90-95% samples <550/100mL E.coli	2	2	2	5	2	2	3	0	4	6	6
75-90% samples <550/100mL E.coli	7	8	6	7	6	9	3	6	4	2	4
<75% samples <550/100mL E.coli	11	7	12	5	9	9	2	2	1	1	1
Total number of sites	23	25	21	19	23	24	10	12	12	13	13

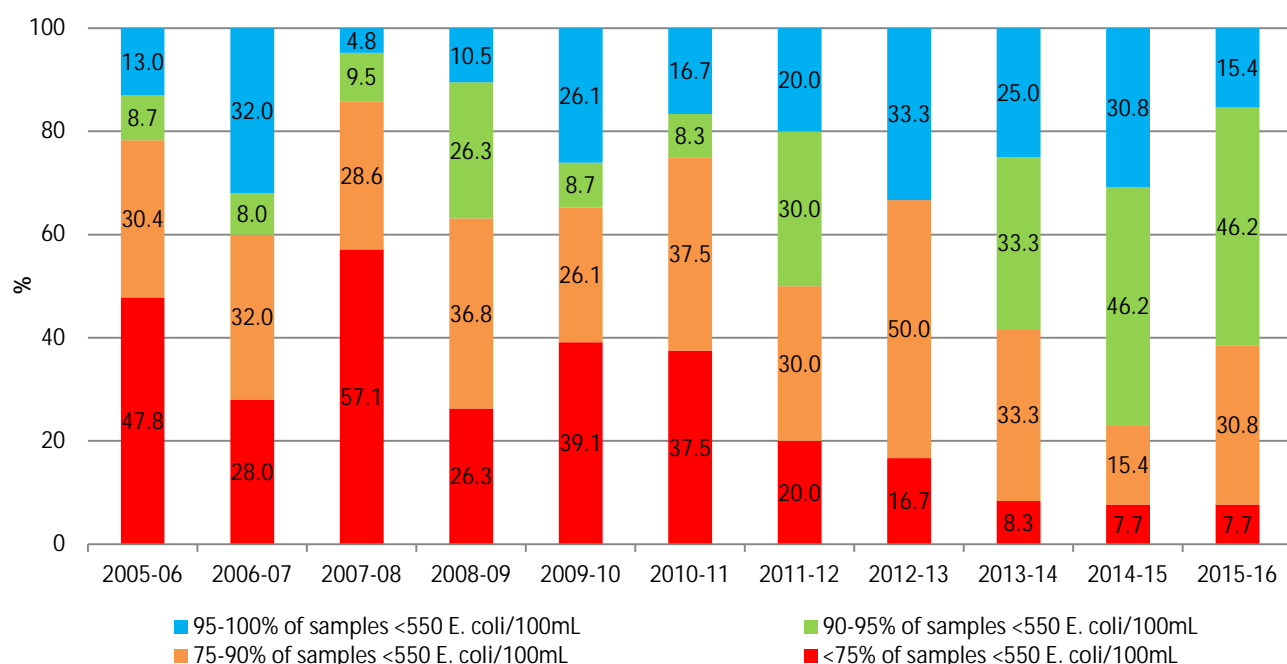


Figure 4: Yearly overall percentage of freshwater sites with corresponding percentage of samples within each category from 2005 to 2016

Over 60 percent of sites in 2015-16 had more than 90 percent of samples fall below 'Action' faecal indicator bacteria levels. This is lower in comparison to 2014-15 which recorded 77 percent of sites with more than 90 percent compliance with the guidelines. The number of sites with less than 75 percent of samples below 'Action' level in 2015-16 was similar to the 2014-15 monitoring period. Overall, the last three summer monitoring periods have recorded the most comparable results for each compliance category.

11.6 Results for freshwater permanent monitoring sites

Results for freshwater permanent monitoring sites from 2004-05 to 2015-16 are presented in Table 10 below.

Table 10: Results for freshwater permanent monitoring sites 2004-2016

Site Name	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Kerikeri River	67	83	77	67	72	67	73	55	83	82	69
Lake Waro					100	82	94	100	100	100	93
Raumanga Stream	75	67	54	92	100	82	81	88	94	93	93
Waipapa River		92	92	92	100	100	90	82	92	92	100
Waipoua River	90	100	85	92	83	92	89	100	92	100	93

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.

12. 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 2015-16 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.

12.1 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.

12.1.1 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.

12.1.2 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.

12.1.3 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.

12.2 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.

An overview of results from microbial source tracking work undertaken since 2007 is presented in Table 11 below. In 2015-16 investigations continued at sites where results had been inconclusive. Additional sites with recurrent water quality issues were also added to the programme and included:

- § Hatea at Whangarei Falls
- § Kerikeri at Rainbow Falls

In the 2015-16 season a total of nine sites were listed as part of the investigation programme and four sites returned 'Action' level bacterial concentrations (Table 11).

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	2014/15	2015/16
Church Bay								
Coopers Beach		D/W	R/W/P					
Kaihu River			R/W					
Kapiro Stream			R/W					
Kerikeri River Rainbow Falls								R
Kerikeri River Stone Store			W	R	R/W			
Kerikeri at Skudders Beach			R/W					
Lake Waro								
Langs Beach at Toilets	R/W	W	D/R/W					
Langs Beach	R/W	W						
Mangawhai Motor Camp*			W	W				
Matapouri at Northern Bridge*			R/W		R/W/P	R/W/P	R/W/P	
Matapouri at Southern Bridge*			W				R/W/P	
Ngunguru at School			W	W				
Ocean Beach Stream	W		H/R/W					
Omamari Beach Stream			R					
One Tree Point								
Otamure Bay Stream	R/W	R/W	R					
Pacific Bay								
Pacific Bay Stream		W						
Pahi at Jetty*		H		W	W/P			
Pahia at Te Haumi River					W/P			
Paihia at Waitangi Bridge					R/W	R/W	R	
Raumanga at Raumanga Valley Park	W				H	R/W/P	R	W
Ruakaka below Motor Camp					R	R	R/W/H	
Teal Bay								
Tirohanga at Tirohanga Road						R/P	R	
Victoria at DOC Reserve Crossing				W	W/P/H	W/P	H	R/W
Waipu Cove		W	D/R/W					
Waitangi at Wakelins						R	R	
Wellington's Bay								
Hatea at Whangarei Falls	R/W	W	D/R/W					R/W
Woolley's Bay						W/P		

13. 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.

13.1 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.

13.2 Results 2015-16

The results for 15 permanent shellfish monitoring sites sampled during 2015-16 are presented in Table 12.

Table 12: Results for recreational shellfish gathering permanent monitoring sites 2015-16

Permanent shellfish monitoring sites	Site No.	Week														Samples	Exceedance	% Exceedance	Median	Pass/Fail
		1	2	3	4	5	6	7	8	9	10	11	12	13	14					
Baylys beach at Sea View Rd	109876	10	10	10	10	10	10	10	10	10	10	10	10	10	10	14	0	0	10	Pass
Mangawhai Heads at motor camp	101210	10	140	10	70	10	10	10	10	30	10	10	220	10	10	14	3	21	10	Fail
Matauri Bay at camp ground	102425	10	10	10	10	10	10	10	10	60	10	10	10	10	10	14	1	7	10	Pass
Ngunguru Estuary at school	108320	10	10	10	10	10	10	20	960	10	20	10	110	10	10	14	2	14	10	Fail
Oakura Bay at beach	101345	10	10	10	10	10	10	10	10	10	10	10	10	10	10	14	0	0	10	Pass
Ohawini Bay at Parutahi Beach	105388	10	10	10	10	10	10	10	10	10	50	10	10	80	10	14	2	15	10	Fail
One Tree Point at Intertidal beach	109266	10	10	10	10	10	10	10	10	10	10	10	110	10	14	1	7	10	Pass	
Paihia at Te Haumi River	101195	10	50	10	10	10	10	10	10	90	10	10	130	10	10	14	3	21	10	Fail
Ruakaka River at motor camp	108314	10	30	20	20	10	10	270	10	10	10	10	40	30	220	14	2	14	15	Fail
Sandy Bay at beach	109879	10	10	10	10	10	10	10	10	10	10	10	10	10	10	14	0	0	10	Pass
Taipa estuary at motor camp	105777	10	10	20	10	10	10	30	10	70	10	50	10	50	10	14	3	21	10	Fail
Teal Bay at beach	101331	20	40	10	10	10	10	60	10	10	10	10	60	20	60	14	3	21	10	Fail
Tinopai at below Puapua Creek	101232	10	10	10	10	10	10	10	10	10	10	10	10	30	10	14	0	0	10	Pass
Urquharts Bay	108311	10	10	10	10	20	10	10	10	10	10	10	20	10	10	14	0	0	10	Pass
Whananaki at East Beach	106938	10	10	10	10	10	10	80	10	83	10	20	40	70	80	14	4	29	10	Fail
Average median																		10.3333		

Results indicated that eight out of 15 of the permanent sites monitored were within the MfE and MoH guidelines for shellfish gathering in 2015-16. 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.

14. Summary and Conclusions

14.1 Coastal sites

The results from 2015-16 indicate that 99 percent of the samples collected at coastal sites 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. The overall grading of the coastal sites improved compared to 2014-15.

In comparison to guidelines, 40 coastal sites met the suitable for swimming criteria 100 percent of the time in 2013-14. Three sites had bacteria concentrations within the guideline values on all but one sampling occasion, and the remaining site on all but two sampling occasions.

'Action' results were recorded for Omapere, Rawene, Ngunguru estuary and Wellington's Bay. Two out of five of the elevated bacteria levels were likely to have been related to heavy rainfall. The remaining elevated results could not be attributed to any specific source and results from follow-up sampling showed bacteria levels had returned to 'Surveillance' mode two days after the event.

In the past, microbial source tracking results have identified wildfowl as the source of contamination at Ngunguru estuary.

14.2 Freshwater sites

The results from 2015-16 indicate that 89 percent of the samples collected at freshwater sites were considered suitable for recreational use throughout the season.

In comparison to guidelines, two out of 13 freshwater sites met the suitable for swimming criteria 100 percent of the time. Six sites had bacteria concentrations within the guideline values on all but one sampling occasion, three sites on all but two sampling occasions and one site on all but three sampling occasions. The remaining site, Kerikeri at Stone Store, was classified as unsuitable for swimming on four sampling occasions.

In the past, microbial source tracking results have identified ruminant and wildfowl as the source of contamination at Kerikeri at Stone Store.

Overall, 19 'Action' levels were recorded for 11 of the 13 freshwater sites, of which 89 percent were likely to have been related to rainfall.

14.3 Site investigation

Nine sites were listed in the investigation programme in 2015-16 and microbial source tracking analyses were carried out for each sample above 'Action' level. Results were inconclusive for all samples analysed.

14.4 Shellfish gathering

The results for the 15 permanent monitoring sites sampled during 2015-16 for their suitability for recreational shellfish gathering indicated that eight sites were within the microbiological water quality guidelines.

15. Key Recommendations

- n Continue to monitor a key group of sites on a weekly basis through the summer of 2016-17, including the 20 permanent monitoring sites.
- n 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.
- n 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.
- n Design the investigation programme for 2016-17 season according to the following:
 - < Remove the following sites from the investigation programme due to consistent low bacteria levels:
 - § Tokerau Beach at Melissa Road
 - § Matapouri at Northern Bridge
 - < Continue investigating water quality at the following sites:
 - § Paihia at Waitangi Bridge
 - § Raumanga Stream
 - § Ruakaka River
 - § Victoria River
 - § Waitangi River
 - < Start investigating water quality at the following sites due to the elevated bacteria levels recorded last season:
 - § Omapere at Pioneer Walk
 - § Wellington's Bay
 - § Ngunguru estuary at school

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17. 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

18. Appendices

18.1 Appendix 1 – Results 2015-16

Enterococci results for coastal swimming sites 2015-2016

MfE guidelines 2003
 Alert (orange) mode
 Action (red) mode
 FU

Single sample
 Ent > 140
 Ent > 280
 Follow-up sample

Far North	Site No.	23-Nov-15	30-Nov-15	7-Dec-15	14-Dec-15	21-Dec-15	29-Dec-15	5-Jan-16	11-Jan-16	FU	18-Jan-16	25-Jan-16	FU	2-Feb-16	9-Feb-16	FU	15-Feb-16	22-Feb-16
Ahipara at Kaka Street	109871	< 10	< 10	20	< 10	< 10	< 10	< 10	< 10		41	< 10		< 10	63		< 10	10
Waipapakauri Beach	109873	10	< 10	< 10	< 10	< 10	< 10	< 10	< 10		< 10	20		< 10	< 10		< 10	< 10

North East (Coopers Beach to Matauri Bay)	Site No.	23-Nov-15	30-Nov-15	7-Dec-15	14-Dec-15	21-Dec-15	29-Dec-15	5-Jan-16	11-Jan-16	FU	18-Jan-16	25-Jan-16	FU	2-Feb-16	9-Feb-16	FU	15-Feb-16	22-Feb-16
Cooper's Beach	101066	20	10	41	< 10	< 10	< 10	< 10	10		< 10	31		10	63		52	< 10
Maitai Bay	102326	< 10	10	< 10	< 10	< 10	31	< 10	< 10		< 10	10		< 10	41		< 10	< 10
Matauri Bay	102425	< 10	< 10	< 10	< 10	< 10	< 10	10	135		41	< 10		< 10	< 10		10	10
Taipa estuary	105777	10	< 10	< 10	< 10	< 10	< 10	< 10	< 10		199	< 10		41	< 10		52	< 10
Tokerau Beach	109872	10	< 10	< 10	< 10	< 10	< 10	< 10	85		< 10	10		< 10	20		< 10	10

North West (Hokianga Harbour)	Site No.	23-Nov-15	30-Nov-15	7-Dec-15	14-Dec-15	21-Dec-15	29-Dec-15	5-Jan-16	11-Jan-16	FU	18-Jan-16	25-Jan-16	FU	2-Feb-16	9-Feb-16	FU	15-Feb-16	22-Feb-16
Omapere	102317	< 10	< 10	< 10	< 10	< 10	< 10	< 10	75		565	1624	345	< 10	< 10		< 10	10
Opononi Shoreline	106011	< 10	< 10	< 10	< 10	< 10	10	10	< 10		< 10	< 10		< 10	< 10		< 10	< 10
Rawene	100236	10	< 10	< 10	10	63	984	41	10		52	706	687	< 10	10		< 10	20

South West (Kaipara District)	Site No.	23-Nov-15	30-Nov-15	7-Dec-15	14-Dec-15	21-Dec-15	29-Dec-15	5-Jan-16	11-Jan-16	FU	18-Jan-16	25-Jan-16	FU	2-Feb-16	9-Feb-16	FU	15-Feb-16	22-Feb-16
Baylys beach	109876	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10		< 10	173		< 10	< 10		< 10	10
Glinks Gully	100798	< 10	< 10	< 10	< 10	< 10	10	< 10	< 10		< 10	< 10		< 10	< 10		< 10	< 10
Omamari Beach	109875	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10		< 10	< 10		< 10	< 10		< 10	< 10
Pahi at Jetty	102198	10	< 10	< 10	< 10	< 10	< 10	10	52		< 10	41		< 10	63		< 10	10
Tinopai at Below Puapua Creek	101232	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10		< 10	< 10		< 10	10		10	86

Enterococci results for coastal swimming sites 2015-2016

MfE guidelines 2003

Alert (orange) mode

Action (red) mode

FU

Single sample

Ent > 140

Ent > 280

Follow-up sample

South East (One Tree Point to Mangawhai)	Site No.	23-Nov-15	30-Nov-15	7-Dec-15	14-Dec-15	21-Dec-15	29-Dec-15	5-Jan-16	11-Jan-16	FU	18-Jan-16	25-Jan-16	FU	2-Feb-16	9-Feb-16	FU	15-Feb-16	22-Feb-16
One Tree Point east cliffs	109266	< 10	< 10	< 10	10	< 10	< 10	< 10	10		< 10	10		< 10	10		20	< 10
Langs Beach	108318	< 10	< 10	< 10	< 10	30	< 10	< 10	< 10		< 10	< 10		< 10	41		< 10	20
Mangawhai Heads at Motor Camp	101210	< 10	95	< 10	20	< 10	< 10	< 10	< 10		10	< 10		< 10	63		10	20
Mangawhai Heads at Open Coast	109890	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10		< 10	< 10		< 10	195		< 10	< 10
Ruakaka Beach at Surf Club	108315	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10		< 10	< 10		< 10	< 10		< 10	< 10
Ruakaka River at Below Motor Camp	108314	< 10	< 10	< 10	< 10	< 10	< 10	30	< 10		10	< 10		< 10	75		10	41
Uretiti Beach	109888	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10		< 10	< 10		< 10	63		< 10	< 10
Waipu Cove	108316	< 10	10	< 10	< 10	< 10	< 10	< 10	< 10		< 10	< 10		< 10	63		< 10	31

Bay of Islands	Site No.	23-Nov-15	30-Nov-15	7-Dec-15	14-Dec-15	21-Dec-15	29-Dec-15	5-Jan-16	11-Jan-16	FU	18-Jan-16	25-Jan-16	FU	2-Feb-16	9-Feb-16	FU	15-Feb-16	22-Feb-16
Oakura Bay	101345	< 10	10	< 10	10	< 10	< 10	10	31		20	10		< 10	< 10		< 10	< 10
Ohawini Bay	105388	< 10	< 10	< 10	< 10	< 10	10	10	30		< 10	146		< 10	173	20	< 10	< 10
Paihia at Te Haumi River	101195	20	31	10	< 10	10	20	< 10	20		10	< 10		10	31		52	< 10
Paihia at Waitangi Bridge	101183	20	52	62	< 10	< 10		20	< 10		10	203		30	10		85	10
Paihia at toilets	101194	10	10	< 10	< 10	10	< 10	< 10	10		10	10		31	41		86	< 10
Russell	105710	< 10	< 10	< 10	10	< 10	< 10	< 10	20		< 10	272		< 10	85		< 10	< 10
Teal Bay	101331	< 10	< 10	< 10	< 10	< 10	< 10	10	< 10		< 10	30		< 10	41		< 10	30

Tutukaka	Site No.	23-Nov-15	30-Nov-15	7-Dec-15	14-Dec-15	21-Dec-15	28-Dec-15	4-Jan-16	11-Jan-16	FU	18-Jan-16	25-Jan-16	FU	1-Feb-16	8-Feb-16	FU	15-Feb-16	22-Feb-16
Church Bay	105448	< 10	< 10	< 10	< 10	< 10	< 10	< 10	20		< 10	75		< 10	63		10	< 10
Matapouri Bay at Northern Bridge	100712	10	< 10	< 10	< 10	10	< 10	< 10	158	41	62	31		< 10	63		< 10	52
Matapouri Bay at Southern Bridge	100711	30	< 10	30	< 10	10	20	41	20		31	10		41	41		< 10	30
Ngunguru Estuary at motor camp	100073	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10		< 10	31		< 10	< 10		20	< 10
Ngunguru Estuary at school	108320	< 10	< 10	< 10	< 10	< 10	< 10	< 10	556	< 10	< 10	41		< 10	414	20	< 10	< 10
Pacific Bay	108313	10	< 10	20	< 10	< 10	< 10	10	20		< 10	74		< 10	10		< 10	20
Sandy Bay	109879	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10		< 10	41		< 10	< 10		10	< 10
Wellingtons Bay	109880	< 10	< 10	< 10	< 10	< 10	10	< 10	231	52	< 10	1935	< 10	< 10	10		< 10	< 10
Whananaki	106938	< 10	< 10	< 10	< 10	< 10	10	< 10	52		52	10		< 10	41		< 10	20
Otamure Bay	311666			< 10		< 10	< 10	< 10	63		10	84		< 10	< 10		10	31

Whangarei Heads (including Onerahi and Pataua)	Site No.	23-Nov-15	30-Nov-15	7-Dec-15	14-Dec-15	21-Dec-15	28-Dec-15	4-Jan-16	11-Jan-16	FU	18-Jan-16	25-Jan-16	FU	1-Feb-16	8-Feb-16	FU	15-Feb-16	22-Feb-16
McLeod Bay at Toilets	101254	< 10	< 10	30	< 10	< 10	31	< 10	< 10		< 10	10		< 10	< 10		< 10	< 10
Onerahi at Opposite Playground	101600	< 10	20	< 10	< 10	< 10	31	< 10	41		< 10	41		10	75		< 10	10
Taurikura Bay	101262	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10		< 10	10		< 10	< 10		< 10	10
Urquharts Bay	108311	< 10	< 10	< 10	< 10	41	< 10	< 10	< 10		< 10	< 10		10	20		< 10	10

E.coli Results for freshwater swimming sites 2015-2016

MfE guidelines 2003

Alert (orange) mode

Action (red) mode

FU

Single sample

E.coli > 260

E.coli > 550

Follow-up sample

Whangarei Area	Site No.	23-Nov-15	30-Nov-15	7-Dec-15	FU	14-Dec-15	21-Dec-15	29-Dec-15	5-Jan-16	FU	11-Jan-16	FU	18-Jan-16	FU	25-Jan-16	1-Feb-16	8-Feb-16	FU	15-Feb-16	FU	22-Feb-16	FU
Lake Waro	107272	10	63	20		20	< 10	20	63		< 10		41		110	41	< 10		933	169	10	
Raumanga Stream	103246	520	160	228		74	73	144	187		41		529	49	98	131	121		2143	189	262	
Whangarei Falls	105972	223	1081	512		211	256	404	323		311		842		298	399	313		279		801	
Far North Area	Site No.	23-Nov-15	30-Nov-15	7-Dec-15		14-Dec-15	21-Dec-15	29-Dec-15	5-Jan-16		11-Jan-16		18-Jan-16		25-Jan-16	1-Feb-16	8-Feb-16		15-Feb-16		22-Feb-16	
Kerikeri River Rainbow Falls	308794	73	432	173		185	110	86	504		328		350		288	332	144		299		576	365
Kerikeri River Stone Store	101530	135	120			75	52	259	754	225	743	126	298		373	195	910	76	512		717	172
Lake Ngatu	100402	< 10	< 10	1267	< 10	10	20	< 10	10		10		41		175	20	20		31		10	
Tirohanga Stream	102252	512	345	414		256	168	706	471		399		359		199	148	417		173		683	387
Victoria River	104908	52	364	315		384	420	313	644	517	512		1376		317	495	221		145		185	
Waimamaku at Wekaweka Road	308844	331	327	63		246	86	31	195		238		4352		146	373	110		201		620	142
Waipapa at Waihou Valley	103248	145	109	20		41	41	< 10	161		199		201		63	201	317		134		292	
Waipoua River	108613	857	52	85		85	134	31	63		119		512		31	359	120		31		41	
Waitangi River	101752	262	216	364		142	109		309		355		135		187	120	211		63		591	365
Kaipara Area	Site No.	23-Nov-15	30-Nov-15	7-Dec-15		14-Dec-15	21-Dec-15	29-Dec-15	5-Jan-16		11-Jan-16		18-Jan-16		25-Jan-16	1-Feb-16	8-Feb-16		15-Feb-16		22-Feb-16	
Lake Taharoa	105434	< 10	< 10	< 10		< 10	< 10	< 10	< 10		< 10		< 10		< 10	< 10	< 10		< 10		< 10	

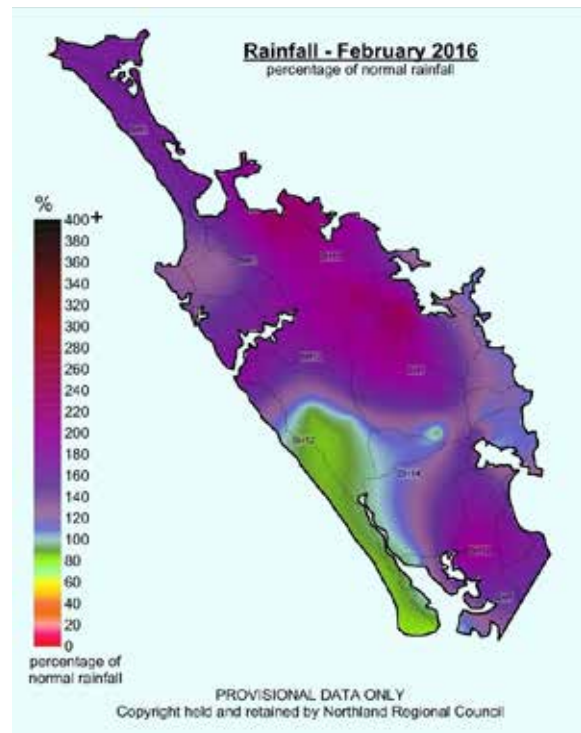
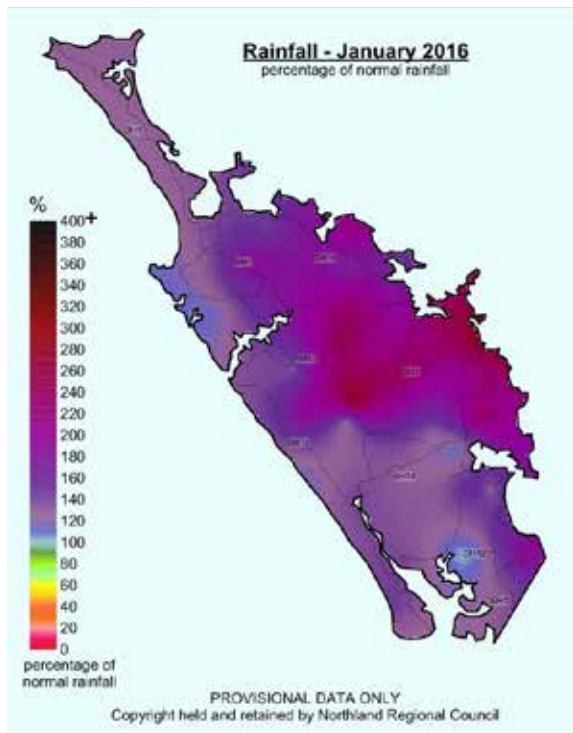
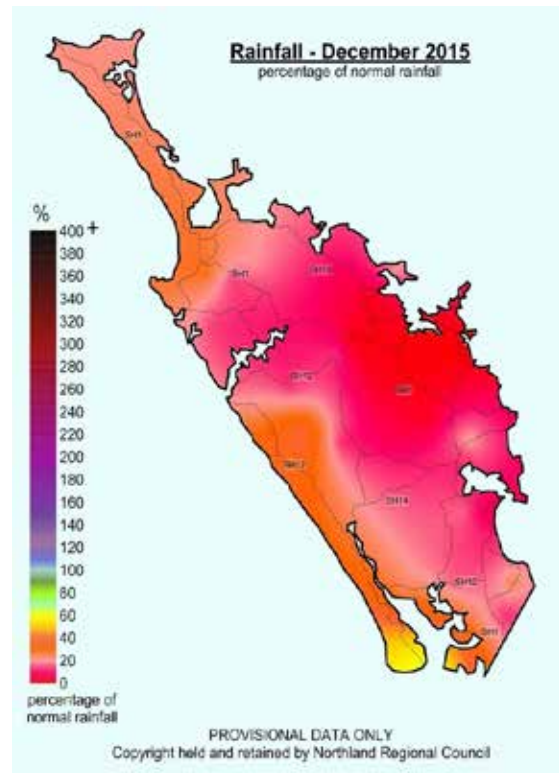
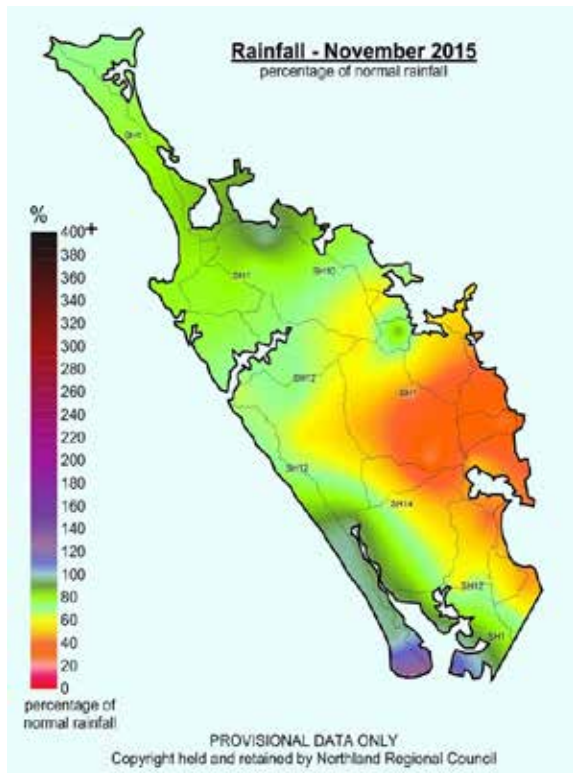
MfE and MoH guidelines 2003: Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas. Published by Ministry for the Environment.

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.

18.2 Appendix 2 – Rainfall Maps Summer 2015-16



18.3 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 ~
Matauwahi 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
Cable Bay	105780	2015-16	Consistent low bacteria level ~
Mangawhai Harbour at Picnic Bay	110322	2015-16	Consistent low bacteria level ~
Ocean Beach	109877	2015-16	Consistent low bacteria level ~
Pataua South	104986	2015-16	Consistent low bacteria level ~
Tinopai Below Shops	102310	2015-16	Consistent low bacteria level ~
Woolleys Bay	109878	2015-16	Consistent low bacteria level ~



WHĀNGĀREI: 36 Water Street, Private Bag 9021, Whāngārei Mail Centre,
Whāngārei 0148; Phone 09 470 1200, Fax 09 470 1202.

DARGAVILLE: 61B Victoria Street, Dargaville; Phone 09 439 3300, Fax 09 439 3301.

KAITĀIA: 192 Commerce Street, Kaitāia; Phone 09 408 6600, Fax 09 408 6601.

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

Freephone: 0800 002 004 | **24/7 Environmental Hotline:** 0800 504 639

E-mail: mailroom@nrc.govt.nz | **Website:** www.nrc.govt.nz

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Twitter: www.twitter.com/NRCExpress