

# Recreational Swimming Water Quality in Northland

Summer 2018-19



Putting Northland first





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# 1. Executive Summary

- From December 2018 to March 2019, a total of 14 freshwater and 46 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), 26 coastal sites met the guideline values and were considered suitable for swimming 100 percent of the time, 14 sites were considered suitable for swimming on all but one sampling occasion and three sites on all but two occasions. The remaining three sites were considered unsuitable for swimming on three or more occasions.
- In 2018-19, two freshwater sites met the suitable for swimming criteria 100 percent of the time, one site on all but one occasion and one site on all but two sampling occasions. Ten freshwater sites were considered unsuitable for swimming on three or more occasions during the summer.
- 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, 44 'Action' level results were recorded for 10 of the 14 freshwater sites, of which 64 percent were likely to have been related to rainfall. At the coast, 14 'Action' level results were recorded for 10 of the 46 coastal sites, of which 64 percent were likely to have been related to rainfall.
- Since 2007-08, a total of 34 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 28 sites – mostly ducks and/or gulls – 26 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 has 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 2018-19.

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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 46 coastal and 14 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 early December until early March. 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 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.

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.

### 7.1 Acceptable risks

The number 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: <http://www.mfe.govt.nz/publications/fresh-water/microbiological-water-quality-guidelines-marine-and-freshwater-0>.

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)**

<b><i>E. coli</i> concentration</b>	<b>Category</b>	<b>Suggested response</b>
sample ≤ 260/100mL	Suitable	No response necessary – continue weekly sampling
260 < sample ≤ 540/100mL	Alert	Collect follow-up sample Undertake catchment assessment and sanitary survey where applicable to isolate source of faecal contamination
sample > 540/100mL	Action	Collect follow-up sample Undertake sanitary survey when applicable Erect warning signs Inform public through the media that a public health risk exists

*Enterococci* (*Ent.*) bacteria levels are measured at open coastal sites. Coastal 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)**

<b>Ent. concentration</b>	<b>Category</b>	<b>Suggested response</b>
sample ≤ 140/100mL	Suitable	No response necessary – continue weekly sampling
140 < sample ≤ 280/100mL	Alert	Collect follow-up sample 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)**

<b>Faecal coliform concentration</b>	<b>Enterococci concentration</b>	<b>Category</b>	<b>Status</b>
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 LAWA website – <https://www.lawa.org.nz/explore-data/swimming/>. Any 'Alert' or 'Action' results are notified to the relevant District Council within 24 hours so that further investigative sampling and/or health warning signs can be erected.

## 8.2 End of season grading

The end of season results at each site were graded according to the percentage of samples which fell within the "suitable" for swimming category for *E. coli* and enterococci concentrations (MfE/MoH, 2003) as shown in Table 4 below:

**Table 4: End of season grading system**

1	95-100% samples within guidelines
2	90-95% samples within guidelines
3	75-90% 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 2018-19, sampling was carried out from 3 December 2018 to 4 March 2019 at 46 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, Hikurangi**

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 councils, 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 online edition).

## 10. Sampling Sites

Due to the large number of 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 2018-19 as well as 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 2018-19

In the 2018-19 sampling season, a total of 14 freshwater sites and 46 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 2018-19**

Coastal sites	Grid reference		Site No.
Far North District Council			
Ahipara campground	1614114	6109386	109871
Cable Bay	1644302	6127973	105780
Maitai Bay camp site	1637395	6145952	102326
Matauri Bay motor camp	1683324	6122702	102425
Omapere	1634959	6067633	318360
Opononi	1635376	6070804	106011
Paihia beside toilets	1699822	6094837	101194
Paihia Te Haumi	1700137	6093454	101195
Paihia Waitangi Bridge	1698267	6096116	101183
Rawene*	1646026	6083073	100236
Russell mid-north	1701762	6097524	105710
Taipa Estuary	1642856	6127391	105777
Tokerau Beach	1633974	6139217	109872
Waipapa Kauri	1615249	6122554	109873
Kaipara District Council			
Baylys Beach	1666750	6021176	109876
Glinks Gully	1677301	6006503	100798
Mangawhai Heads Beach	1743817	6006166	109890
Mangawhai Heads motor camp*	1743147	6005606	101210
Omamari Beach	1659853	6030465	109875
Pahi - 150m NW jetty*	1710590	5998103	102198
Tinopai below creek*	1712122	5987100	101232
Tinopai below shops	1712130	5987691	102310
Whangarei District Council			
Church Bay	1738528	6057429	105448
Lang's Beach	1738350	6009900	108318
Matapouri southern bridge*	1736959	6062631	100711
Matapouri northern bridge*	1736535	6063041	100712
Ngunguru Estuary at Pakapaka Road*	1734960	6055124	100073
Ngunguru Estuary at school	1737070	6056341	108320
Oakura Bay	1722350	6083581	101345
Ocean Beach	1742107	6032989	109877
Ohawini Bay	1722090	6084082	105388
One Tree Point	1731539	6035180	109266
Onerahi playground*	1722792	6040203	101600
Otamure Bay	1732610	6071608	311666
Pacific Bay	1738969	6057164	108313
McLeod Bay	1735908	6035832	101254

<b>Coastal sites</b>	<b>Grid reference</b>		<b>Site No.</b>
Ruakaka Beach	1731913	6025221	108315
Ruakaka River	1731414	6025773	108314
Sandy Bay	1733651	6064285	109879
Taurikura Bay	1737880	6034149	101262
Teal Bay	1723703	6077721	101331
Uretiti Beach	1732302	6019720	109888
Urquharts Bay	1738601	6031879	108311
Waipu Cove	1735915	6011855	108316
Wellingtons/Whangaumu Bay	1738576	6055370	109880
Whananaki east beach	1733002	6069592	106938
<b>TOTAL COASTAL</b>			<b>46</b>

Freshwater Sites	Grid Reference		Site No.
Far North District Council			
Kerikeri River Stone Store	1687631	6102447	101530
Kerikeri at Rainbow Falls	1685773	6102740	308794
Lake Ngatu	1618033	6122885	100402
Tirohanga Stream	1699502	6084784	102252
Victoria River	1639482	6108122	104908
Waimamaku at Wekaweka Road	1644868	6064405	308844
Waipapa River at forest pools	1662099	6096027	103248
Waipoua River at DOC HQ	1650503	6054513	108613
Waitangi River at Wakelins	1695283	6095847	101752
Kaipara District Council			
Ahuroa at Piroa Falls	1725149	6007913	317597
Lake Taharoa pump house	1659736	6037045	105434
Whangarei District Council			
Lake Waro (Hikurangi)	1716716	6061100	107272
Raumanga Stream	1717608	6044187	103246
Whangarei Falls	1720857	6050300	105972
TOTAL FRESHWATER	14		

## 10.2 Permanent monitoring sites

A core group of 20 permanent monitoring sites 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 from the programme. The permanent monitoring sites are listed in Table 6. Swimming water quality 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
Ocean Beach	109877
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
Tinopai – below shops*	102310
Waipapa River – Puketi	103248
Waipoua River	108613
Waipu Cove	108316

## 11. Results and Interpretation

The swimming water quality results for all sites monitored in 2018-19 can be found in Appendix 1 – Results 2018-19. Northland monthly rainfall maps covering the 2018-19 summer period are presented in Appendix 2. The investigation programme including sites listed for further analysis to identify the source of contamination is detailed in section 12.

Figure 1 displays the end of season grades for samples taken from each of the 46 coastal sites monitored in Northland during the 2018-19 sampling season (3 December 2018 to 4 March 2019). The grades indicate the percentage of samples which fell within the “suitable” for swimming category at each site over the summer period.

While there are occasional exceedances of the swimming water quality guidelines (particularly at sites with significant freshwater inputs e.g. estuaries), generally coastal water quality in Northland is excellent with the majority of sites suitable for swimming on most sampling occasions. Determining the source of contamination at coastal sites is often 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.



## 11.1 End of season grading – coastal sites

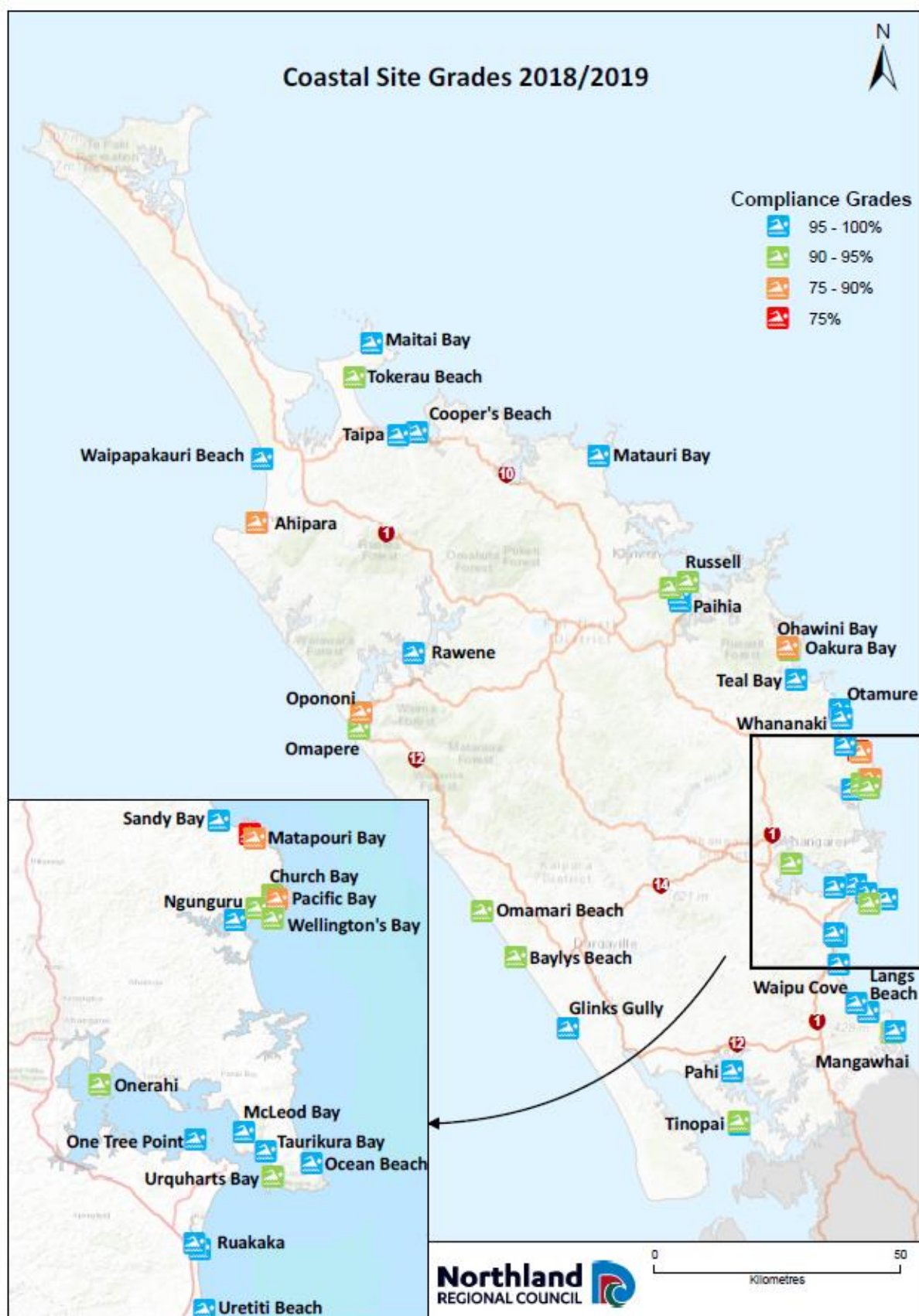


Figure 1: Coastal end of season grading 2018-19

Each 'Action' result has been cross-referenced with accumulated rainfall data collected 72 hours prior to sampling, indicating whether rainfall related runoff from land was contributing to elevated results (refer to tables below). Overall, 14 'Action' level results were recorded for 10 of the 46 coastal sites, of which 64 percent were likely to have been related to rainfall.

## FAR NORTH

Site name	No. samples	Suitable/Alert	Action	Rainfall related (mm, 72h accumulated rainfall)
Ahipara	13	11	2	49mm, 0.5mm
Maitai Bay	13	13	0	n/a
Tokerau Beach	13	12	1	0mm
Waipapakauri	13	13	0	n/a
<b>Total</b>	<b>52</b>	<b>49</b>	<b>3</b>	

## NORTH EAST

Site name	No. samples	Suitable/Alert	Action	Rainfall related (mm, 72h accumulated rainfall)
Coopers Beach	13	13	0	n/a
Matauri Bay	14	14	0	n/a
Taipa estuary	13	13	0	n/a
<b>Total</b>	<b>40</b>	<b>40</b>	<b>0</b>	

## NORTH WEST

Site name	No. samples	Suitable/Alert	Action	Rainfall related (mm, 72h accumulated rainfall)
Omapere	14	13	1	54mm
Opononi	14	13	1	0mm
Rawene*	14	14	0	n/a
<b>Total</b>	<b>42</b>	<b>40</b>	<b>2</b>	

## SOUTH WEST

Site name	No. samples	Suitable/Alert	Action	Rainfall related (mm, 72h accumulated rainfall)
Baylys Beach	14	14	0	n/a
Glinks Gully	14	14	0	n/a
Omamari Beach	14	13	1	0mm
Pahi jetty*	14	14	0	n/a
Tinopai at creek	14	14	0	n/a
Tinopai at school	14	14	0	n/a
<b>Total</b>	<b>84</b>	<b>83</b>	<b>1</b>	

## SOUTH EAST

Site name	No. samples	Suitable/Alert	Action	Rainfall related (mm, 72h accumulated rainfall)
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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
<b>Total</b>	<b>112</b>	<b>112</b>	<b>0</b>	

## BAY OF ISLANDS

Site name	No. samples	Suitable/Alert	Action	Rainfall related (mm, 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	14	14	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
<b>Total</b>	<b>98</b>	<b>98</b>	<b>0</b>	

## TUTUKAKA

Site name	No. samples	Suitable/Alert	Action	Rainfall related (mm, 72h accumulated rainfall)
Church Bay	14	13	1	33mm
Matapouri Northern Bridge*	14	11	3	33mm, 0mm, 13.5mm
Matapouri Southern Bridge*	14	13	1	33mm
Ngunguru at Pakapaka Road*	14	14	0	n/a
Ngunguru at School	14	14	0	n/a
Otamure Bay	14	14	0	n/a
Pacific Bay	14	12	2	9mm, 23mm
Sandy Bay	14	14	0	n/a
Wellingtons Bay	14	13	1	23mm
Whananaki at east beach	14	14	0	n/a
<b>Total</b>	<b>140</b>	<b>132</b>	<b>8</b>	

## WHANGAREI HEADS

Site name	No. samples	Suitable/Alert	Action	Rainfall related (mm, 72h accumulated rainfall)
McLeods Bay	14	14	0	n/a
Ocean Beach	14	14	0	n/a
Onerahi	14	14	0	n/a
Taurikura	14	14	0	n/a
Urquharts Bay	14	14	0	n/a
<b>Total</b>	<b>70</b>	<b>70</b>	<b>0</b>	

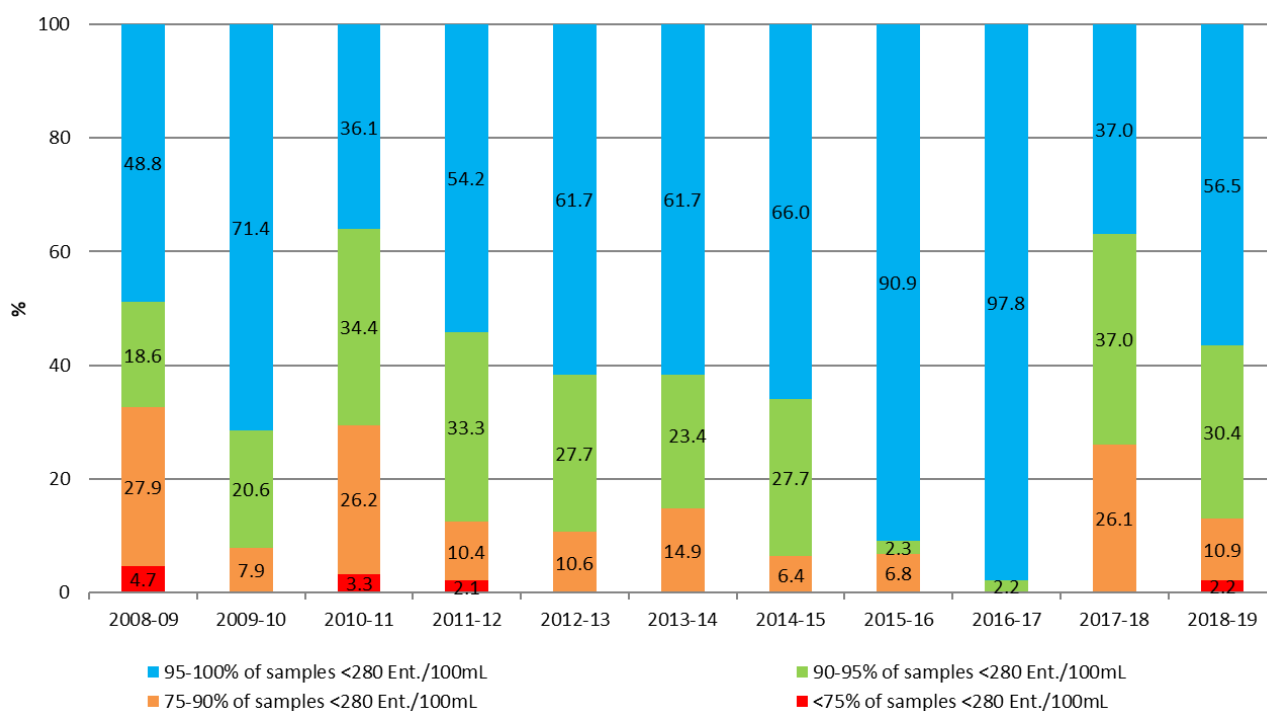
## 11.2 Comparison of coastal results

Coastal swimming water quality results from 2018-19 compared to previous years are presented in

Table 7 and Figure 2 below.

**Table 7: Annual coastal swimming water quality results compared to previous results.**

Category	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
95-100% samples <280/100mL Ent.	21	45	22	26	29	29	31	40	45	17	26
90-95% samples <280/100mL Ent.	8	13	21	16	13	11	13	3	1	17	14
75-90% samples <280/100mL Ent.	12	5	16	5	5	7	3	1	0	12	5
<75% samples <280/100mL Ent.	2	0	2	1	0	0	0	0	0	0	1
Total number of sites	43	63	61	48	47	47	47	44	46	46	46



**Figure 2: Yearly overall percentage of coastal sites with corresponding percentage of samples within each category from 2008 to 2019.**

Fifty-seven percent of sites monitored in 2018-19 had more than 95 percent of samples fall within "suitable" level guidelines. Two percent of sites had less than 75 percent compliance with the guidelines. Overall, the results from faecal indicator bacteria testing in 2018-19 were slightly better than 2017-18 which is likely attributed to less rainfall events during the summer.

## 11.3 End of season grades for permanent coastal monitoring sites

End of year grades (2008-09 to 2018-19) for permanent monitoring coastal sites are presented in Table 8 below.

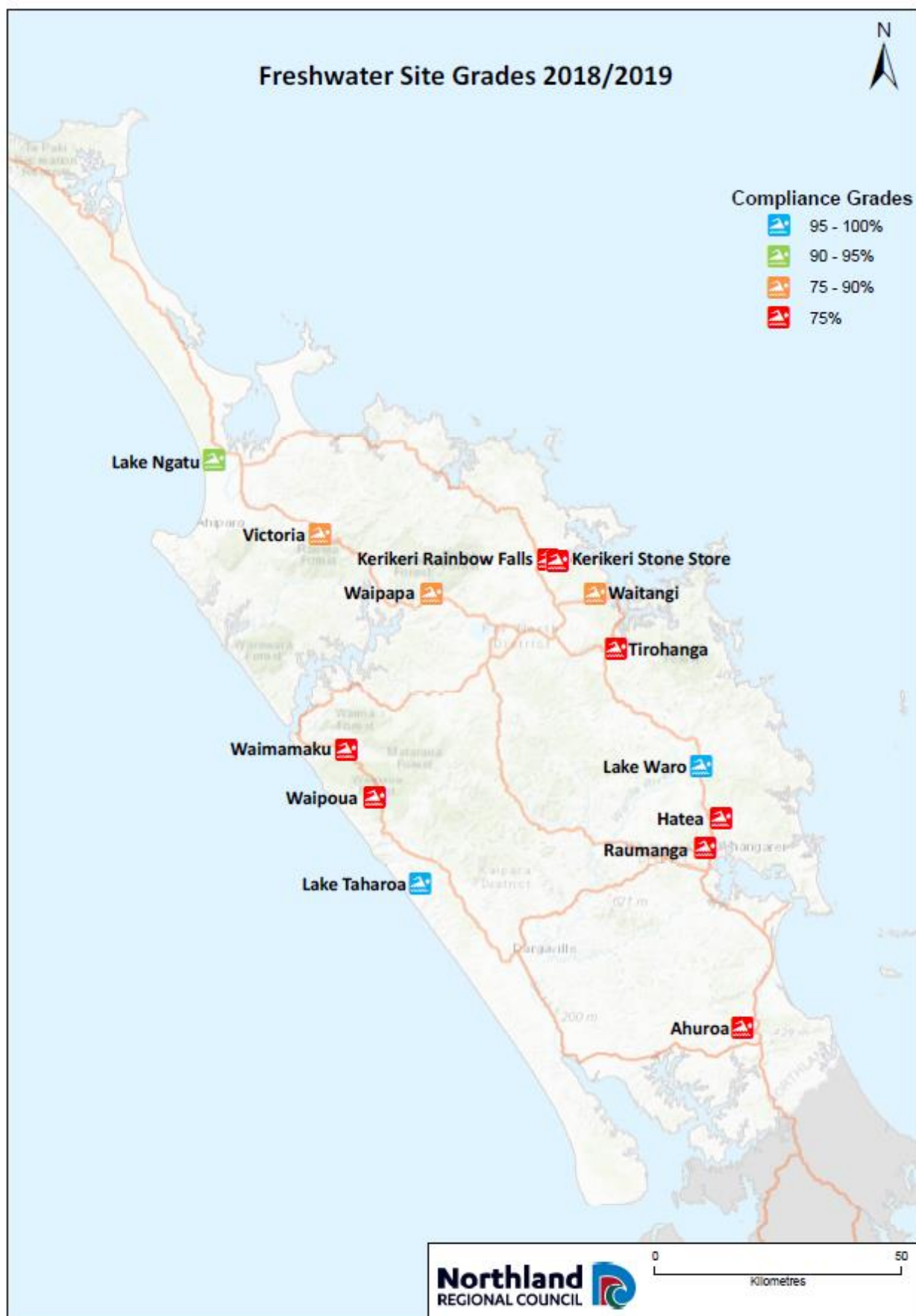
**Table 8: End of year grades for permanent coastal monitoring sites 2018-19.**

Site Name	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Church Bay	83	100	94	100	89	88	100	100	100	93	93
Langs Beach	100	100	94	100	94	94	100	100	100	93	100
Matapouri*	83	100	88	100	85	88	100	100	100	86	79
Onerahi*	100	100	89	100	94	100	93	100	100	93	93
Opononi	92	100	92	100	100	92	92	100	100	100	86
Pacific Bay	83	91	82	100	100	88	100	100	100	86	79
Pahi Jetty*	92	100	100	80	91	100	83	100	100	100	100
Paihia Beach	83	100	75	100	92	83	92	100	100	86	93
Ruakaka River	100	91	89	100	94	94	86	100	100	93	100
Taipa	100	100	92	100	100	100	92	100	93	86	100
Taurikura Bay	75	100	89	100	100	100	100	100	100	93	100
Teal Bay	92	100	100	88	100	100	100	100	100	100	100
Waipu Cove	100	100	94	100	100	100	100	100	100	93	100

Six permanent coastal sites complied with guidelines 100 percent of the time in 2018-19, three sites complied 93 percent of the time, one sites 86 percent of the time and two sites 79 percent of the time.

## 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 2018-2019**



Figure 3 above displays the end of season grades for samples taken from each of the 14 freshwater sites monitored in Northland during the 2018-19 sampling season (3 December 2018 to 4 March 2019). The grades indicate the percentage of samples which fell within the "suitable" for swimming category at each site over the summer period.

## FAR NORTH AREA

Site name	No. samples	Suitable/Alert	Action	Rainfall related (mm, 72h accumulated rainfall)
Kerikeri Rainbow Falls	14	11	3	44mm, 0mm, 26mm
Kerikeri Stone Store	14	4	10	0mm, 29.5mm, 0mm, 0mm, 0mm, 26mm, 0.5mm, 0mm, 24mm, 0mm
Lake Ngatu	13	13	0	n/a
Tirohanga Stream	14	8	6	34mm, 39mm, 0mm, 5.5mm, 0mm, 49mm
Victoria River	13	12	1	5.5mm
Waimamaku River	14	11	3	54mm, 5.5mm, 22mm
Waipapa River	14	14	0	n/a
Waipoua River	14	12	2	42mm, 52mm
Waitangi River	14	12	2	0mm, 58mm
<b>Total</b>	<b>124</b>	<b>97</b>	<b>27</b>	

Seven rivers in the Far North recorded 'Action' results in 2018-19, of which 59% were likely to have been related to rainfall runoff. Kerikeri River, Tirohanga Stream and Waitangi River reached 'Action' level on occasions which was unrelated to rainfall.

### *Kerikeri Rainbow Falls*

Two of the three 'Action' results were likely to have been related to rainfall. This site has been monitored since 2013-14 and accounted for 12 'Action' results on 68 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 6 years.

This site has been included in the source tracking investigation programme since 2015-16. Microbial source tracking analyses has identified contamination caused by ruminant and possible wildfowl.

### *Kerikeri Stone Store*

Three of the 10 'Action' results were likely to have been related to rainfall. This site has been monitored since 2004-05 and accounted for 56 'Action' results on 189 sampling occasions within the same time frame. This means the site was considered suitable for swimming 70 percent of the time during the summer season in the last 14 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.

### *Tirohanga Stream*

Four of the six 'Action' results were likely to have been related to rainfall. This site has been monitored since 2004-05 and accounted for 31 'Action' results on 185 sampling occasions within the same time frame. This means the site was considered suitable for swimming 83 percent of the time during the summer season in the last 14 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.

#### *Victoria River*

The 'Action' result was likely to have been related to rainfall. This site has been monitored since 2007-08 and accounted for 25 'Action' results on 150 sampling occasions within the same time frame. This means the site was considered suitable for swimming 83 percent of the time during the summer season in the last 11 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 humans.

#### *Waimamaku River*

The three 'Action' level results were likely to have been related to rainfall. This site has been monitored since 2014-15 and accounted for 14 'Action' results on 68 sampling occasions within the same time frame. This means the site was considered suitable for swimming 79 percent of the time during the summer season in the last five years.

The site was part of the investigation programme in 2017-18. Microbial source tracking analyses has identified contamination caused by ruminant and wildfowl.

#### *Waipoua River*

The two 'Action' level results were likely to have been related to rainfall. This site has been monitored since 2005-06 and accounted for 14 'Action' results on 171 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 13 years.

The site was part of the investigation programme in 2017-18. Microbial source tracking analyses has identified contamination caused by ruminant and wildfowl.

#### *Waitangi River*

One of the two 'Action' results were likely to have been related to rainfall. This site has been monitored since 2012-13 and accounted for 11 'Action' results out of 90 sampling occasions within the same time frame. This means the site was considered suitable for swimming 88 percent of the time within the last six 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.

## WHANGAREI AREA

Site name	No. samples	Surveillance/Alert	Action	Rainfall related (72h accumulated rainfall)
Lake Waro	14	14	0	n/a
Raumanga Stream	14	12	2	75.2mm, 5.2mm
Whangarei Falls	14	9	5	24mm, 58mm, 3.5mm, 32mm, 21.5mm
<b>Total</b>	<b>42</b>	<b>35</b>	<b>7</b>	

### *Raumanga Stream*

Both 'Action' results were likely to have been related to rainfall. This site has been monitored since 2004-05 and accounted for 32 'Action' results out of 213 sampling occasions within the same time frame. This means the site was considered suitable for swimming 85 percent of the time within the last 15 years.

The site was part of the source tracking investigation programme in 2017-18. Microbial source tracking analyses identified contamination caused by ruminant and wildfowl.

### *Whangarei Falls*

Four of the five 'Action' results were likely to have been related to rainfall. This site has been monitored since 2004-05 and accounted for 71 'Action' results on 213 sampling occasions within the same time frame. This means the site was considered suitable for swimming 67 percent of the time during summer season in the last 14 years.

The site was part of the investigation programme from 2007-08 to 2010-11, 2015-16, 2016-17 and 2017-18. Microbial source tracking analyses identified contamination caused by wildfowl, ruminant and dog. Results from 2016-17 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)
Ahuroa River at Piroa Falls	14	4	10	36.5mm, 7.5mm, 60.5mm, 0mm, 0mm, 5.5mm, 0mm, 5mm, 0mm, 51mm
Lake Taharoa	14	14	0	n/a
<b>Total</b>	<b>28</b>	<b>18</b>	<b>10</b>	

### *Ahuroa River at Piroa Falls*

Six of the 10 'Action' results were likely to have been related to rainfall. This site has been monitored since 2017-18 and accounted for 21 'Action' results out of 28 sampling occasions within the same time frame. This means the site was considered suitable for swimming 21 percent of the time within the last two years.

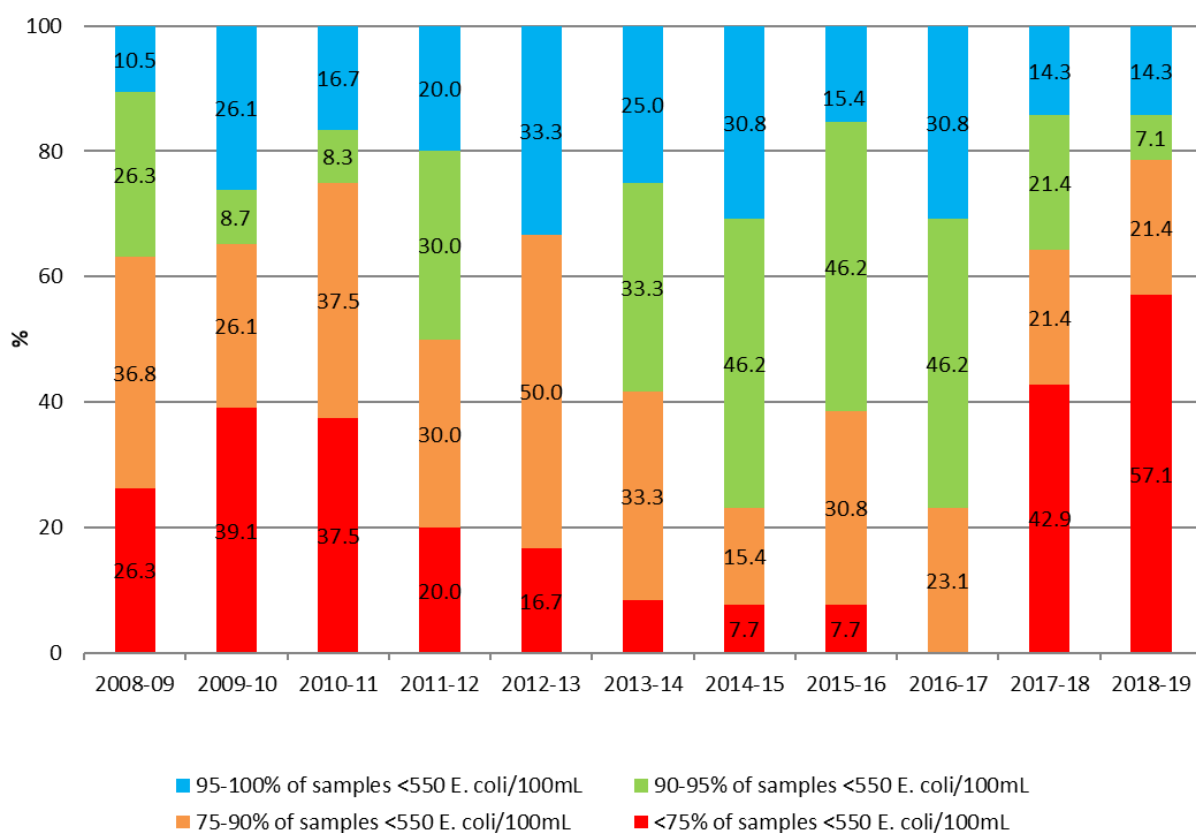
The site was part of the source tracking investigation programme in 2017-18. Microbial source tracking analyses identified contamination caused by ruminant and wildfowl.

## 11.5 Comparison of freshwater results

Freshwater swimming water quality results from 2018-19 compared to previous years are presented in Table 9 below.

**Table 9: Annual freshwater grades compared to previous results.**

Category	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
95-100% samples <550/100mL E.coli	2	6	4	2	4	3	4	2	4	2	2
90-95% samples <550/100mL E.coli	5	2	2	3	0	4	6	6	6	3	1
75-90% samples <550/100mL E.coli	7	6	9	3	6	4	2	4	3	3	3
<75% samples <550/100mL E.coli	5	9	9	2	2	1	1	1	0	6	8
Total number of sites	19	23	24	10	12	12	13	13	13	14	14



**Figure 4: Yearly overall percentage of freshwater sites with corresponding percentage of samples within each category from 2008 to 2019.**

Over 20 percent of sites in 2018-19 had more than 90 percent of samples fall within the "suitable" faecal indicator bacteria levels. This is lower in comparison to 2017-18 which recorded around 35 percent of sites. Around 57 percent of sites fell in the less than 75 percent compliance category in 2018-19 which is higher than many previous results.

## 11.6 End of season grades for permanent freshwater monitoring sites

End of year grades (2008-09 to 2018-19) for permanent freshwater monitoring sites are presented in Table 10 below.

**Table 10: Results for freshwater permanent monitoring sites 2008-2019**

Site Name	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Kerikeri River	67	72	67	73	55	83	82	69	86	57	14
Lake Waro		100	82	94	100	100	100	93	100	93	100
Raumanga Stream	92	100	82	81	88	94	93	93	100	86	64
Waipapa River	92	100	100	90	82	92	92	100	93	79	86
Waipoua River	92	83	92	89	100	92	100	93	93	86	64

It should be noted that high counts of the indicator bacteria *E. coli* are generally recorded after rainfall in rivers, including rivers which originate in pristine forested catchments (such as Waipapa and Waipoua rivers). The likely source of contamination in pristine forested catchments 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

Sites which consistently recorded elevated bacteria levels have been investigated using several techniques to identify the source(s) of contamination. Water quality testing undertaken through this programme has shown that some swimming sites have been considered unsuitable for swimming on a regular basis. These sites have results which regularly fall outside the swimming guidelines. Other sites with generally good water quality, but occasionally record 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 determine suitable management initiatives to improve water quality at these sites.

### 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 household's 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 540 *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. Investigations continued in 2018-19 at sites where results had been inconclusive in previous years.

A total of four sites were listed as part of the investigation programme in 2018-19. Three sites returned 'Action' level bacteria 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	2016/17	2017/18	2018/19
Ahuroa at Piroa Falls										R/W	R/W
Coopers Beach		<b>D/W</b>	<b>R/W/P</b>								
Hatea at Whangarei Falls	<b>R/W</b>	<b>W</b>	<b>D/R/W</b>					R/W	R/W	R/W	
Kaihu River			<b>R/W</b>								
Kapiro Stream			<b>R/W</b>								
Kerikeri at Rainbow Falls								R	R/W	<b>R/W</b>	
Kerikeri at Stone Store			<b>W</b>	<b>R</b>	<b>R/W</b>						
Kerikeri at Skudders Beach			R/W								
Langs Beach at Toilets	<b>R/W</b>	<b>W</b>	<b>D/R/W</b>								
Langs Beach (Midway)	<b>R/W</b>	<b>W</b>									
Mangawhai Motor Camp*			<b>W</b>	<b>W</b>							
Matapouri Northern Bridge*			<b>R/W</b>		R/W/P	<b>R/W/P</b>	R/W/P				
Matapouri Southern Bridge*			<b>W</b>				R/W/P			<b>W</b>	
Ngunguru at School			<b>W</b>	<b>W</b>							
Ocean Beach Stream	<b>W</b>		<b>H/R/W</b>								
Omamari Beach Stream			<b>R</b>								
Omapere at Pioneer Walk Road										<b>R/W</b>	R/W
Otamure Bay Stream	<b>R/W</b>	<b>R/W</b>	<b>R</b>								
Pacific Bay Stream		<b>W</b>									
Pahi at Jetty*		<b>H</b>		<b>W</b>	<b>W/P</b>						
Paihia at Te Haumi River					W/P						



Site	2007/08	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
Paihia at Waitangi Bridge					R/W	R/W	R			R/W	
Raumanga at Park	W				H	R/W/P	R	W		R/W	
Rawene Estuary										R	
Ruakaka Motor Camp					R	R	R/W/H			R	
Tirohanga						R/P	R				
Victoria at DOC Reserve				W	W/P/H	W/P	H	R/W	W	W	
Waimamaku at Wekaweka Road										R/W	
Waipapa at Waihou Valley										R/W	
Waipoua at Swimming Hole										R/W	
Waipu Cove		W	D/R/W								
Waitangi at Wakelins						R	R				
Wellington's Bay										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 popular shellfish gathering sites were 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 that 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 2018-19

The results for 15 permanent shellfish monitoring sites sampled during 2018-19 are presented in Table 12.

**Table 12: Results for recreational shellfish gathering permanent monitoring sites 2018-19**

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					
		3 Dec 18	10 Dec 18	17 Dec 18	24 Dec 18	31 Dec 18	7 Jan 19	14 Jan 19	21 Jan 19	28 Jan 19	4 Feb 19	11 Feb 19	18 Feb 19	25 Feb 19	4 Mar 19					
Baylys Beach at Sea View Road	109876	5	1.6	1.6	1.6	1.6	1.6	1.6	18	1.7	1.7	1.7	1.7	3.3	1.7	14	1	6.7%	2.0	Pass
Mangawhai Heads at Motor Camp	101210	9.8	1.6	1.6	1.6	9.8	13	13	240	20	82	20	27	12	1.7	14	2	13.3%	12.5	Fail
Matauri Bay at Campground	102425	6.6	3.3	1.6	15	1.6	1.6	3.3	20	1.7	280	1.7	25	5	1.7	14	1	7.1%	3.0	Pass
Ngunguru Estuary at School	108320	91	48	8.2	220	9.8	9.8	4.9	16	10	3.3	240	5	10	1.7	14	4	28.6%	10.0	Fail
Oakura Bay at North End	101345	4.9	1.6	1.6	4.9	1.6	1.6	1.6	1.6	1.7	3.3	350	1.7	1.7	1.7	14	1	7.1%	2.0	Pass
Ocean Beach at Mid Beach	109877	39	1.6	1.6	4.9	1.6	1.6	1.6	1.6	1.7	1.7	8.3	1.7	1.7	1.7	14	0	0.0%	2.0	Pass
Ohawini Bay	105388	30	44	4.9	1.6	28	100	1.6	54	1.7	76	210	13	6.7	1.7	14	5	33.3%	20.5	Fail
One Tree Point at Intertidal Beach	109266	9.8	3.3	3.3	800	23	3.3	18	28	5	1.7	3.3	12	54	1.7	14	2	14.3%	7.5	Fail
Paihia at Te Haumi	101195	90	4.9	3.3	15	13	1.6	320	25	1.7	15	12	3.3	1.7	5	14	2	14.3%	8.5	Fail
Ruakaka River at Below Motor Camp	108314	100	46	82	92	56	18	90	60	40	13	1.7	40	6.7	22	14	7	50.0%	43.0	Fail
Sandy Bay at Mid Beach	109879	23	1.6	1.6	1.6	3.3	1.6	1.6	3.3	1.7	25	50	5	3.3	1.7	14	1	7.1%	2.5	Pass
Taipa Estuary at Boat Ramp	105777	950	2		3	3	2	5	2	20	17	3.3	8.3	1.7	1.7	13	1	7.7%	3.0	Pass
Teal Bay	101331	200	1.6	3.3	21	13	1.6	1.6	18	1.7	1.7	44	10	5	1.7	14	2	14.3%	4.0	Fail
Tinopai at Below Shops	102310	1.6	1.6	1.6	15	1.6	1.6	8.2	1.6	3.3	20	1.7	10	3.3	60	14	1	6.3%	2.5	Pass
Urquharts Bay	108311	4.9	3.3	1.6	18	1.6	3.3	28	96	1.7		3.3	1.7	140	1.7	13	2	15.4%	3.0	Fail

Results indicated that seven out of 15 of the permanent sites monitored were within the MfE and MoH guidelines for shellfish gathering in 2018-19, 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 2018-19 indicate that 95.3 percent of the samples collected at coastal sites were considered suitable for recreational use throughout the season. While there are occasional exceedances of the "Action" level guidelines at sites with significant freshwater inputs (e.g. estuaries) and after heavy rainfall, generally coastal water quality in Northland is excellent with the majority of sites suitable for swimming on most sampling occasions.

In comparison to guidelines, 26 coastal sites met the guideline values and were considered suitable for swimming 100 percent of the time, 14 sites were considered suitable for swimming on all but one sampling occasion, three sites on all but two occasions. The remaining three sites were considered unsuitable for swimming on three or more occasions.

Many of the 'Action' results recorded for coastal sites can be attributed to frequent and heavy rainfall during the summer.

### 14.2 Freshwater sites

The results from 2018-19 indicate that 61.9 percent of the samples collected at freshwater sites were considered suitable for recreational use throughout the season.

In comparison to guidelines, two freshwater sites met the suitable for swimming criteria 100 percent of the time, one site on all but one occasion and one site on all but two sampling occasions. Ten freshwater sites were considered unsuitable for swimming on three or more occasions during the summer.

### 14.3 Site investigation

Four sites were listed in the investigation programme in 2018-19 and microbial source tracking analyses were carried out for each sample above 'Action' level. All results indicated ruminant and/or wildfowl contamination.

### 14.4 Shellfish gathering

The results for the 15 permanent monitoring sites sampled during 2018-19 for their suitability for recreational shellfish gathering indicated that seven sites were within the microbiological water quality guidelines.

## 15. Key Recommendations

- Continue to monitor a key group of sites on a weekly basis through the summer of 2019-20, 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.
- Continue investigating the source of water quality contamination at the following sites:
  - Omapere at Old Wharf Road
  - Rawene at Past Ramp
  - Urquharts Bay
  - Wellingtons Bay

## 16. References

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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 2018-19

#### Enterococci results for coastal swimming sites 2018-19

MfE guidelines 2003

Alert (orange) mode

Action (red) mode

FU

Single sample

Ent > 140

Ent > 280

Follow-up sample

Far North	Site No.	03-Dec-18	10-Dec-18	17-Dec-18	24-Dec-18	31-Dec-18	07-Jan-19	14-Jan-19	21-Jan-19	28-Jan-19	04-Feb-19	11-Feb-19	18-Feb-19	25-Feb-19	04-Mar-19
Ahipara at Kaka Street	109871	300	41		< 10	< 10	< 10	< 10	650	< 10	10	10	10	< 10	20
Waipapakauri Beach	109873	< 10	< 10		< 10	< 10	< 10	< 10	10	< 10	10	< 10	< 10	10	31

North East (Coopers Beach to Matauri Bay)	Site No.	03-Dec-18	10-Dec-18	17-Dec-18	24-Dec-18	31-Dec-18	07-Jan-19	14-Jan-19	21-Jan-19	28-Jan-19	04-Feb-19	11-Feb-19	18-Feb-19	25-Feb-19	04-Mar-19
Cooper's Beach	101066	20	< 10		< 10	< 10	41	< 10	140	< 10	62	52	63	20	< 10
Maitai Bay	102326	< 10	< 10		< 10	< 10	< 10	< 10	< 10	< 10	41	10	< 10	< 10	< 10
Matauri Bay	102425	< 10	< 10	< 10	< 10	< 10	< 10	31	41	< 10	31	< 10	10	10	< 10
Taipa Estuary	105777	74	< 10		< 10	< 10	< 10	< 10	< 10	52	31	< 10	< 10	< 10	< 10
Tokerau Beach	109872	52	41		< 10	< 10	10	< 10	390	< 10	10	< 10	52	10	< 10

North West (Hokianga Harbour)	Site No.	03-Dec-18	10-Dec-18	17-Dec-18	24-Dec-18	31-Dec-18	07-Jan-19	14-Jan-19	21-Jan-19	28-Jan-19	04-Feb-19	11-Feb-19	18-Feb-19	25-Feb-19	04-Mar-19
Omapere	318360	680	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	52	10
Opononi	106011	190	< 10	< 10	< 10	20	< 10	10	530	< 10	< 10	< 10	< 10	< 10	20
Rawene	100236	20	< 10	10	< 10	< 10	< 10	< 10	< 10	< 10	20	< 10	10	< 10	< 10

South West (Kaipara District)	Site No.	03-Dec-18	10-Dec-18	17-Dec-18	24-Dec-18	31-Dec-18	07-Jan-19	14-Jan-19	21-Jan-19	28-Jan-19	04-Feb-19	11-Feb-19	18-Feb-19	25-Feb-19	04-Mar-19
Baylys Beach	109876	200	< 10	< 10	< 10	< 10	< 10	< 10	10	< 10	< 10	< 10	10	10	< 10
Glinks Gully	100798	< 10	< 10	41	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	31	< 10
Omamari Beach	109875	< 10	31	20	< 10	20	< 10	52	1100	< 10	< 10	< 10	< 10	20	< 10
Pahi at Jetty	102198	20	< 10	< 10	< 10	< 10	31	< 10	41	< 10	10	< 10	< 10	52	< 10
Tinopai at Below Puapua Creek	101232	< 10	< 10	< 10	< 10	20	< 10	< 10	110	< 10	10	63	< 10	< 10	41
Tinopai at Below Shops	102310	< 10	< 10	150	< 10	10	< 10	< 10	10	< 10	< 10	< 10	< 10	10	10

South East (One Tree Point to Mangawhai)	Site No.	03-Dec-18	10-Dec-18	17-Dec-18	24-Dec-18	31-Dec-18	07-Jan-19	14-Jan-19	21-Jan-19	28-Jan-19	04-Feb-19	11-Feb-19	18-Feb-19	25-Feb-19	04-Mar-19
Langs Beach	108318	10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	20	< 10	< 10	< 10	< 10
Mangawhai Heads at Motor Camp	101210	< 10	30	< 10	< 10	20	< 10	< 10	250	< 10	20	< 10	10	10	< 10
Mangawhai Heads at Open Coast	109890	< 10	< 10	< 10	< 10	< 10	31	< 10	20	< 10	< 10	< 10	< 10	< 10	< 10
One Tree Point	109266	< 10	20	< 10	< 10	10	< 10	10	< 10	< 10	< 10	< 10	63	52	< 10
Ruakaka Beach at Surf Club	108315	31	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	20	< 10
Ruakaka River at Motor Camp	108314	85	10	10	< 10	10	10	20	20	20	20	20	20	< 10	20
Uretiti Beach	109888	< 10	< 10	< 10	< 10	10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Waipu Cove	108316	10	< 10	< 10	< 10	20	< 10	< 10	73	< 10	< 10	< 10	10	< 10	< 10

Bay of Islands	Site No.	03-Dec-18	10-Dec-18	17-Dec-18	24-Dec-18	31-Dec-18	07-Jan-19	14-Jan-19	21-Jan-19	28-Jan-19	04-Feb-19	11-Feb-19	18-Feb-19	25-Feb-19	04-Mar-19
Oakura Bay	101345	10	10	< 10	< 10	< 10	10	< 10	< 10	< 10	10	220	< 10	10	< 10
Ohawini Bay	105388	< 10	< 10	< 10	< 10	41	10	< 10	190	< 10	31	240	20	10	10
Paihia at Te Haumi River	101195	74	< 10	< 10	< 10	10	74	74	10	< 10	30	< 10	20	< 10	10
Paihia at Seaview Road	101194	10	10	20	< 10	< 10	20	< 10	10	30	73	< 10	< 10	< 10	< 10
Paihia at Waitangi Bridge	101183	31	< 10	< 10	< 10	< 10	30	< 10	20	< 10	31	160	10	10	< 10
Russell	105710	10	< 10	< 10	< 10	< 10	31	< 10	10	< 10	150	10	< 10	20	< 10
Teal Bay	101331	74	41	< 10	< 10	30	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10

Tutukaka	Site No.	03-Dec-18	10-Dec-18	17-Dec-18	24-Dec-18	31-Dec-18	07-Jan-19	14-Jan-19	21-Jan-19	28-Jan-19	04-Feb-19	11-Feb-19	18-Feb-19	25-Feb-19	04-Mar-19
Church Bay	105448	390	10	< 10	< 10	10	10	< 10	< 10	< 10	< 10	63	< 10	10	< 10
Matapouri Bay at Northern Bridge	100712	2000	10	< 10	< 10	51	20	< 10	12000	10	310	30	20	180	< 10
Matapouri Bay at Southern Bridge	100711	2400	41	20	< 10	98	20	10	200	< 10	150	20	73	< 10	74
Ngunguru Estuary at Motor Camp	100073	10	< 10	< 10	< 10	< 10	31	52	< 10	< 10	< 10	30	< 10	10	< 10
Ngunguru Estuary at School	108320	41	10	< 10	< 10	< 10	10	< 10	10	10	10	41	< 10	150	< 10
Otamure Bay	311666	110	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	61	< 10
Pacific Bay	108313	270	< 10	560	< 10	< 10	< 10	< 10	10	< 10	< 10	510	10	< 10	10
Sandy Bay	109879	20	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	10	20	< 10	< 10	< 10
Wellingtons Bay	109880	< 10	10	< 10	< 10	20	10	73	< 10	< 10	< 10	310	< 10	10	< 10
Whananaki	106938	< 10	< 10	< 10	< 10	10	< 10	< 10	120	< 10	10	< 10	< 10	< 10	< 10

Whangarei Heads (including Onerahi and Pataua)	Site No.	03-Dec-18	10-Dec-18	17-Dec-18	24-Dec-18	31-Dec-18	07-Jan-19	14-Jan-19	21-Jan-19	28-Jan-19	04-Feb-19	11-Feb-19	18-Feb-19	25-Feb-19	04-Mar-19
McLeod Bay at Toilets	101254	< 10	20	< 10	< 10	10	< 10	10	10	< 10	< 10	10	< 10	41	< 10
Ocean Beach at Mid Beach	109877	10	< 10	< 10	< 10	10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Onerahi	101600	31	< 10	31	< 10	41	20	180	< 10	130	110	31	10	120	41
Taurikura Bay	101262	86	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	10	41	10	31	< 10
Urquharts Bay	108311	< 10	< 10	< 10	< 10	20	41	20	10	< 10		10	< 10	220	< 10

## E.coli Results for freshwater swimming sites 2018-19

### MfE guidelines 2003

Alert (orange) mode

Action (red) mode

FU

### Single sample

E.coli > 260

E.coli > 540

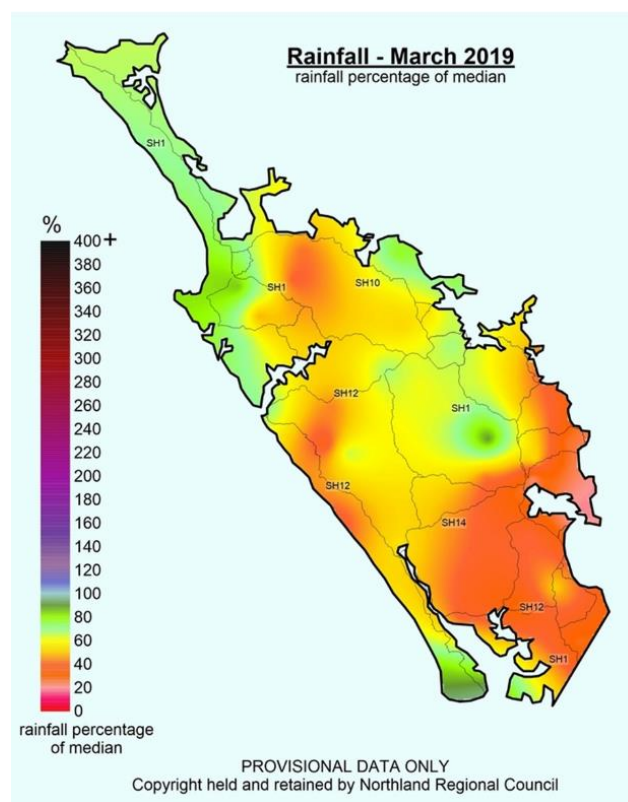
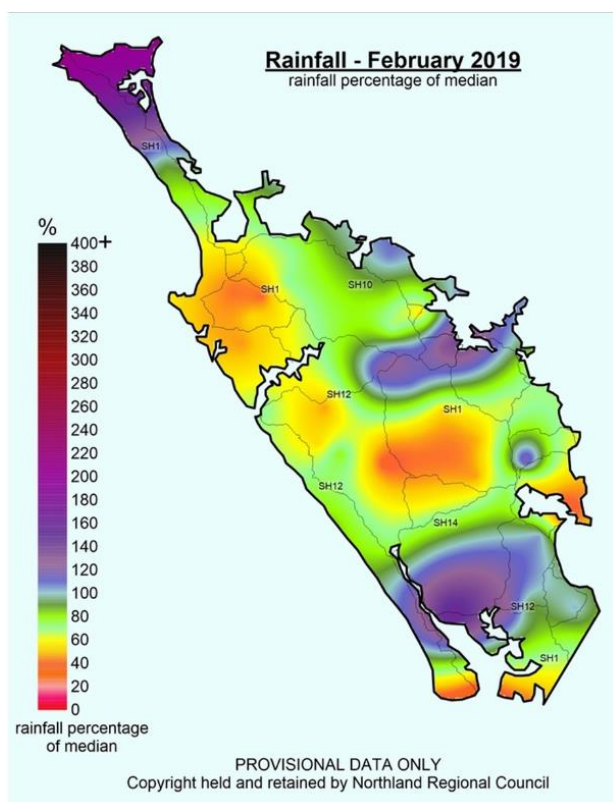
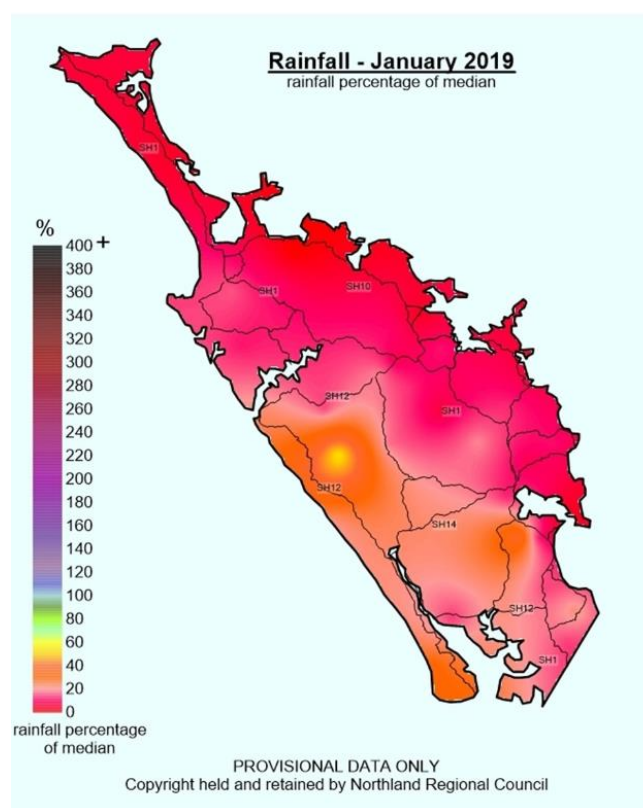
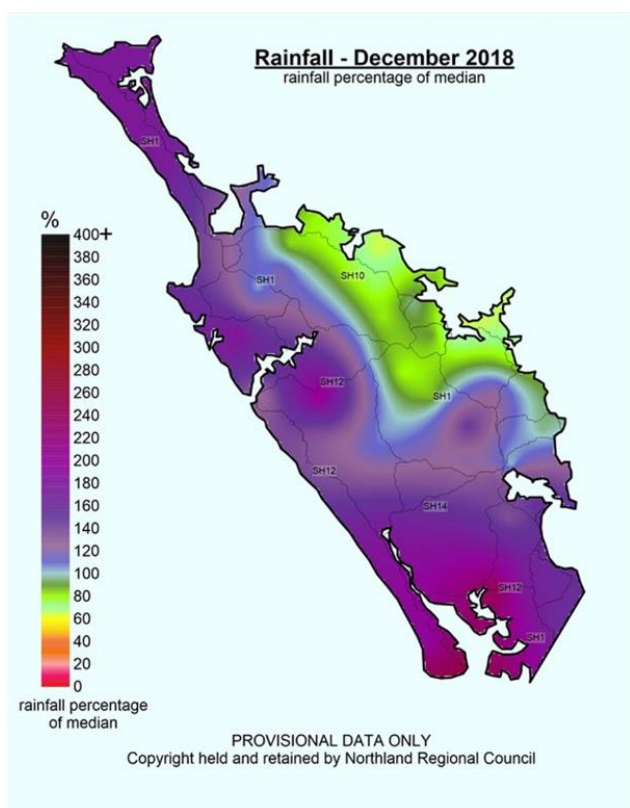
Follow-up sample

Whangarei Area	Site No.	03-Dec-18	10-Dec-18	17-Dec-18	24-Dec-18	31-Dec-18	07-Jan-19	14-Jan-19	21-Jan-19	28-Jan-19	04-Feb-19	11-Feb-19	18-Feb-19	25-Feb-19	04-Mar-19
Lake Waro	107272	37	33	41	40	9.8	20	41	17	31	39	19	7.4	19	26
Raumanga Stream	103246	170	110	490	1200	180	150	580	91	240	290	190	330	170	150
Whangarei Falls	105972	980	460	390	980	310	330	6800	310	410	550	410	330	9600	460

Far North Area	Site No.	03-Dec-18	10-Dec-18	17-Dec-18	24-Dec-18	31-Dec-18	07-Jan-19	14-Jan-19	21-Jan-19	28-Jan-19	04-Feb-19	11-Feb-19	18-Feb-19	25-Feb-19	04-Mar-19
Kerikeri River Rainbow Falls	308794	3100	220	650	440	160	130	200	190	160	1000	130	190	340	260
Kerikeri River Stone Store	101530	440	150	820	610	260	1100	390	5800	690	2800	820	1700	2400	1300
Lake Ngatu	100402	170	< 1		4.1	93	7.4	12	3.1	690	19	7.4	3	1	3
Tirohanga Stream	102252	1300	100	150	730	230	1600	580	160	770	1300	160	130	210	59
Victoria River	104908	460	130		340	250	220	1400	130	160	150	96	140	99	76
Waimamaku at Wekaweka Road	308844	7800	160	290	190	86	64	920	60	93	77	130	150	550	86
Waipapa at Waihou Valley	103248	150	46	310	440	46	39	29	31	31	110	34	37	60	18
Waipoua River	108613	2400	140	310	340	170	120	410	170	110	86	68	72	820	77
Waitangi River	101752	300	260	200	250	93	650	50	110	96	820	160	100	170	86

Kaipara Area	Site No.	03-Dec-18	10-Dec-18	17-Dec-18	24-Dec-18	31-Dec-18	07-Jan-19	14-Jan-19	21-Jan-19	28-Jan-19	04-Feb-19	11-Feb-19	18-Feb-19	25-Feb-19	04-Mar-19
Ahuroa at Piroa Falls	317597	2400	460	980	2400	870	690	1300	340	580	490	650	730	730	390
Lake Taharoa	105434	2	< 1	< 1	1	< 1	4.1	4.1	2	1	< 1	< 1	< 1	< 1	< 1

## 18.2 Appendix 2 – Rainfall Maps Summer 2018-19





## 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 ●
Matauhi 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 ●
Pataua South	104986	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](mailto:mailroom@nrc.govt.nz) | **Website:** [www.nrc.govt.nz](http://www.nrc.govt.nz)

**LinkedIn:** [www.linkedin.com/companies/northland-regional-council](http://www.linkedin.com/companies/northland-regional-council)

**Facebook:** [www.facebook.com/NorthlandRegionalCouncil](http://www.facebook.com/NorthlandRegionalCouncil)

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