RECREATIONAL SWIMMING WATER QUALITY IN NORTHLAND

SUMMER 2009-10

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NORTHLAND REGIONAL COUNCIL

EXECUTIVE SUMMARY

- During the summer of 2009-10, 23 freshwater and 63 coastal swimming sites were monitored though the Recreational Swimming Water Quality Programme. Water samples were collected from most sites on a weekly basis, starting on the 30 November 2009 and finishing on the 15 February 2010, with selected high priority sites sampled until 31 March 2010.

- Pollution indicator bacteria (*E. coli* in freshwater, enterococci in open coastal water and faecal coliforms in enclosed coastal water) counts were carried out on each sample and the results compared to the Ministry for the Environment (*MfE*) and Ministry of Health's **Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas**.

- Each site was given a weekly grading based on these results, indicating the sites suitability for recreational swimming – green for 'safe', amber for 'caution' or red for 'unsafe'. These gradings, along with the bacterial counts, were displayed on the Northland Regional Council (NRC) website – www.nrc.govt.nz/swimming - at the end of each week.

- Results were also forwarded to the District Councils and District Health Board at the end of each week. It is the responsibility of the relevant District Council to action any amber (alert to a problem) or red (action necessary) results, either by undertaking further investigative sampling or by erecting public warning signs.

- During the 2009-10 sampling season, six freshwater sites (26% of the total) complied with the relevant guidelines on all sampling occasions (100% compliance). In addition, 45 coastal sites (71% of the total) complied with the relevant guidelines on all sampling occasions.

- Of the freshwater sites sampled, nine had a compliance rate of less than 75%. These sites included Otamure Bay stream, Langs Beach stream (mid beach), Waipu Cove stream, Ocean beach stream, Pacific Bay stream, Whangarei Falls, Kapiro stream, Kerikeri at Stone Store and Coopers Beach stream.

- No coastal sites had a compliance rate of less than 75%.

- Samples taken from other sites in the programme complied with the guidelines on most sampling occasions however on some occasions, results were elevated above the recommended guidelines, particularly after rainfall.

- During 2009-10, further investigations were undertaken at seven sites with consistently poor water quality in order to try and isolate the source/s of contamination. Investigation work included collecting samples for faecal source tracking, undertaking sanitary surveys, collecting and analysing water samples from up the catchment and catchment land-use mapping.

- Results received to date indicate that the main source of contamination is from avian (bird) sources. One site, Coopers Beach stream, showed a source of contamination as dog faeces. One site, Otamure Bay stream, showed a source of contamination to be herbivore (livestock) faeces. One site, Pahi near the campground, showed a source of contamination to be human faeces.

- Fifteen sites were also graded for their suitability for recreational shellfish gathering. Only two sites, Oakura and Mcleod Bay, complied with the microbiological water quality guidelines during the summer months.

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1 INTRODUCTION

The Recreational Swimming Water Quality Programme is a joint project, administered by the Northland Regional Council (NRC), in partnership with the Northland District Health Board (DHB), and the Far North District Council (FNDC), Whangarei District Council (WDC) and Kaipara District Council (KDC). The aim of the programme is to provide information on water quality at popular freshwater and coastal swimming sites in Northland, to allow the public to make an informed decision about where is safe to swim.

In Northland, swimming sites, particularly freshwater sites or those with a freshwater influence (such as harbours and estuaries), are not always safe for recreational use. Water can sometimes be contaminated with human or animal effluent, which contains large numbers of illness causing organisms. These organisms, called pathogens, can include "bugs" such as giardia (*Giardia lamblia)* and campylobacter *(Campylobacter jejuni)*.

The most common sources of pathogenic contamination are human sewage (from sewage spills or leaking septic tanks), storm water and rural run-off (Jarman, 2002). In Northland, stock access to waterways and waterfowl are also significant contributing factors. Contamination from human sewage is perhaps the easiest to identify and 'fix'. However, the effects of storm water and rural run-off are not as easy to identify and mitigate. No matter what the source, the potential for causing illness is the same (Jarman, 2002a).

The objective of the programme is to facilitate 'safer' swimming in Northland, by identifying problem sites and informing the public of the implications of recreational contact with contaminated water. Once problem sites have been identified, the Regional and District Councils can also work together to identify the source of contamination and work towards improving water quality at these sites.

Photo: Ruakaka beach

2 HEALTH RISKS

Swimming in contaminated water can lead to skin, eye and ear infections; gastrointestinal and respiratory illnesses (Jarman, 2002a). Most pathogens are ingested 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 on the body.

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 ten days (Jarman, 2002b). Depending on the type of disease and the severity of the infection, hospitalisation may be required.

2.1 Acceptable risks

The amount of pathogens a person needs to ingest before becoming sick varies from many thousands to a single pathogen, and depends on a number of factors. When you consider how small bacteria and viruses are, and how big water bodies can be (including the sea), it makes it impossible to ever guarantee that any water is safe to swim in. This uncertainty is the reason that health authorities recommend you boil any untreated freshwater before consuming it.

Instead, when determining how safe a body of water is for recreation, it is better to consider things in terms of *maximum acceptable risk*. 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) has set the maximum acceptable risk at 8 in every 1000 users falling ill as a result of contact with contaminated water (MfE, 2002; MfE 2003). For marine waters, the maximum acceptable risk is 19 in every 1000 users. These figures are based on both international and New Zealand studies.

2.2 When to avoid contact recreation

In order to minimise the risk when using our coastal and fresh water sites for contact recreation, a number of simple rules should be followed:

CLARITY

Stagnant and/or murky water contains more pathogens than crystal clear and/or flowing water. Research has shown that there is a link between suspended solids in water (which reduce water clarity) and agricultural run-off (which can contain high levels of pathogens). **A good way to reduce your risk is to only swim[1] in water in which you can see your feet when you are standing knee deep.**

[1] The term 'swimming', when used in this report, refers to all contact recreational uses of a water body, for example, diving, water skiing and swimming.

DISCOLOURATION, FOAMS AND ODOUR

Water can be unsafe for swimming if it has an unpleasant or unusual smell, if it is discoloured or if there is foam or a slick on the water's surface. Even if the water is relatively clear, foams, discolouration and/or odour are often a sign of contamination. **Do not swim in water where there is evidence of contamination.**

RAINFALL

Rainfall has a big impact on water quality in Northland, particularly in fresh water bodies. When it rains, some rainfall runs off the land, carrying contaminates from farmland and urban areas, including animal dung, fertiliser and chemicals. This run-off enters rivers, streams 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 contaminates for several days after heavy rainfall. Areas that have greater mixing, for example, open coastal sites where the tide flushes contaminates out to sea, are less susceptible to the effects of rainfall runoff.

In Northland, it is recommended to wait for 48 hours after heavy rainfall before swimming in freshwater or semi-enclosed (harbours and estuaries) coastal sites.

Photo: Wataua stream below Whangarei Falls. A popular swimming site prone to poor water quality.

3 RECREATIONAL CONTACT GUIDELINES

The Ministry for the Environment (MfE) and Ministry of Health (MoH) released national *Microbiological Water Quality Guidelines* in June 2003. Where practicable, the Recreational Swimming Water Quality Programme has incorporated recommendations presented in these guidelines, and results from the programme can therefore be assessed against the national criteria. This section provides an outline and discussion of the key aspects of the guidelines, which are available online at:

www.mfe.govt.nz/publications/water/microbiological-quality-jun03/

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

3.1 Single sample guidelines

The MfE 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 bacteria present. For freshwater sites, levels of *E. coli* bacteria are measured and sites are graded: Acceptable (green), Alert (yellow), or Action (red), as shown in Table 1.

For open coastal sites, enterococci bacteria are counted. Sites are graded: Surveillance (green), Alert (amber), or Action (red), as shown in Table 2. Where a coastal site is influenced by a freshwater input, or is semi-enclosed (for example, harbours and estuaries), a combination of enterococci bacteria and faecal coliforms are used to grade each site, as shown in table 3.

Results are sent to the District Councils and District Health Board at the end of each sampling week. Any 'alert' or 'action' results are notified to the relevant District Council within 24 hours, so that they can instigate further investigative sampling or erect warning signs. All results are also advertised on the NRC website – www.nrc.govt.nz/swimming - at the end of each week.

***E. coli* count**	**Category**	**Suggested response**
Sample < 260 per 100 mL	Acceptable	▪ No response necessary – Continue weekly sampling
260 < Sample > 550 per 100 mL	Alert	▪ Increase sampling to daily ▪ Undertake sanitary survey to isolate source of faecal contamination
Sample > 550 per 100 mL	Action	▪ Increase sampling to daily ▪ Undertake sanitary survey ▪ Erect warning signs ▪ Inform public through the media that a public health risk exists

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

Enterococci count	Category	Suggested response
Sample < 140 per 100 mL	Surveillance	▪ No response necessary – Continue weekly sampling
140 < Sample > 280 per 100 mL	Alert	▪ Increase sampling to daily ▪ Undertake sanitary survey to isolate source of faecal contamination
Sample > 280 per 100 mL	Action	▪ Increase sampling to daily ▪ Undertake sanitary survey ▪ Erect warning signs ▪ Inform public through the media that a public health risk exists

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

Faecal coliform count	Category	Enterococci count	Category
Sample < 150 per 100 mL	Safe (acceptable)	Sample < 140 per 100 mL	Safe (surveillance)
150 < Sample > 600 per 100 mL	Caution (alert)	140 < Sample > 280 per 100 mL	Caution (alert)
Sample > 600 per 100 mL	Unsafe (action)	Sample > 280 per 100 mL	Unsafe (action)

Table 3: Single sample guidelines for enclosed coastal sites (harbours and estuaries) (MfE 2003)

3.2 Season compliance

At the end of the sampling season, a final spreadsheet of results is prepared. This spreadsheet includes all results for the season plus the season median and percentage compliance for each site. The percentage compliance is calculated following the method used by MfE and is based on the number of occasions where an 'unsafe' result (either >550 E. coli; >600 faecal coliforms or >280 enterococci) is recorded:

1 (blue) = 100% compliance with the guidelines (no 'unsafe' results)
2 (green) = 90-99% compliance
3 (orange) = 75-89% compliance
4 (red) = <75% compliance

Although the MfE guidelines recommend that a Suitability for Recreation Grade (SFRG) is also calculated for each site (which is a combination of previous year's results plus the likelihood that a site is contaminated based on possible sources of contamination), neither MfE or any other Regional Council appear to use this to system to grade sites. NRC therefore took the decision in 2009 not to use this system to grade its sites. This system is highly subjective and does not appear to accurately reflect the water quality at most sites in Northland.

4 METHODOLOGY

4.1 Sampling technique

Sampling is undertaken once a week, at selected freshwater and coastal sites, throughout the summer months. In 2009-10, sampling ran from 30 November 2009 to the 15 February 2010 at 63 coastal and 22 freshwater sites. Sampling continued at 40 coastal and 16 freshwater sites until 29 March 2010. Sampling is undertaken regardless of weather conditions but weather at the time of sampling is noted and water temperature is also recorded.

Each sample was collected following the methods in the '*Microbiological Water Quality Guidelines for Freshwater and Marine Recreational Bathing Areas'* (MfE, 2003). Samples are taken from the shore using a sampling pole at about 0.5m depth, from approximately 15cm below the surface.

Photo: NRC staff undertaking water quality sampling

4.2 Sample analysis

It is an expensive and difficult procedure to identify and count pathogens in water. Instead NRC uses indicator bacteria to grade water quality at each site, as recommended in the MfE guidelines. For freshwater sites, the indicator bacteria *Escherichia coli (E. coli)* is counted. This bacterium indicates faecal pollution and scientific studies have shown that where *E. coli* is present, we can safely assume there are pathogens in the water (MfE, 2002).

For coastal waters, both enterococci and faecal coliforms are counted. The New Zealand Marine Bathing Study showed that enterococci are the indicator most closely correlated with health effects in New Zealand marine waters. Faecal coliforms are not as closely related to human health effects however they are useful in environmental circumstances, such as brackish or estuarine environments, where levels of enterococci may be misleading (for example, naturally occurring enterococci are known to reproduce successfully in organic matter contained within mangrove forests).

All samples are analysed in the NRC laboratory using the procedures in the '*Standard Methods for the Examination of Water and Wastewater*' (APHA *et. al* 2005).

5 SAMPLING SITES

Due to the large number of coastal and freshwater swimming sites in Northland, it is not practical or economically viable to monitor every one. NRC, along with key stakeholders, reviews sites to be monitored at the start of each swimming season and selects sites based on popularity, and/or because of a specific request from the public or if there is a suspected human health risk associated with microbiological contamination.

In the 2009-10 sampling season, a total of 23 freshwater sites and 63 coastal sites were monitored through the programme, as shown in Table 4 (below). Sites highlighted in orange were added for the 2009-10 season. Twenty additional coastal sites were added in 2009-10 in order to demonstrate how safe Northland's coastal waters are for recreational use.

Freshwater Site	Location	Site number	District
Otamure Bay Stream	Otamure Bay, Whananaki	108859	Whangarei
Lake Waro	Hikurangi	107272	
Waitaua Stream	Whangarei Falls	105972	
Ocean Beach Stream	Beach drain	102077	
Raumanga Stream	Raumanga reserve	103246	
Langs Beach Stream	Near toilets	100686	
Langs Beach Stream	Middle of Langs Beach	104539	
Waipu Beach Stream	By beach	101207	
Pacific Bay Stream	By beach	103017	
Victoria River	At DOC Reserve	104908	Far North
Waipapa River	Puketi Forest	103248	
Waipapa River	Waipapa Landing	105706	
Kerikeri River	Stone Store	101530	
Waitangi River	Lily Pond Reserve	104830	
Tirohanga Stream	Tirohanga Road	102252	
Kapiro Stream	Pururua Road bridge	102838	
Waipoua River	DOC camping site	108613	
Mangakahia River	Twin Bridges	105973	
Kanekane Stream	Coopers Beach	101870	
Otaua Stream	Kaikohe	108510	
Kaihu River	Motor camp	102221	Kaipara
Lake Taharoa	Kai Iwi Lakes	105434	
Omamari Beach Stream	Omamari Beach	102305	
Coastal Site	**Location**	**Site number**	**District**
McLeod Bay	By toilets	101254	Whangarei
Taurikura	By toilets	101262	
Urquharts Bay	Before rock wall	108311	
Pataua South	Footbridge	102217	
Pataua South	East end of beach	104986	
Onerahi	Foreshore	101600	
Whananaki	Footbridge	103147	
Whananaki	East end of bay	106938	
Oakura	North end of beach	101345	
Ohawini Bay	From beach	105388	
Teal Bay	From beach	101331	
Langs beach	Mid way along beach	108318	
Langs beach	North end of beach	108317	
Waipu Cove	From beach	108316	
Ruakaka	Near surf club	108315	
Ruakaka	By motor camp	108314	
Ngunguru	Motor camp	100073	

Ngunguru	By Norfolk Pine	100076	
Ngunguru	By toilet	108320	
Church Bay	From beach	105448	
Kowharewa Bay	From beach	106444	
Pacific Bay	From beach	108313	
Matapouri	First bridge	100711	
Matapouri	Second bridge	100712	
Ocean Beach	Beach	109877	
Pataua South	Frogtown beach	109887	
Woolleys Bay	Beach	109878	
Sandy Bay	Beach	109879	
Wellingtons Bay	In front of toilets	109880	
Uretiti Beach	In front of motor camp	109888	
One Tree Point	By boat ramp	109266	
Bland Bay	Beach	109889	
Coastal Site	**Location**	**Site number**	**District**
Taupo Bay	Beach	109868	
Tauranga Bay	Beach	109869	
Matauri Bay	Beach	102425	
Rarawa Beach	Beach	109874	
Russell	Mid-north beach	105710	
Shipwreck Bay	Beach	109870	
Ahipara	In front of camp ground	109871	
Tokerau Beach	Beach	109872	
Waipapa Kauri	Beach	109873	
Maitai Bay	In front of camp ground	102326	
Opua	Foreshore	101418	**Far North**
Paihia	Te Haumi	101195	
Paihia	Beside toilets	101194	
Paihia	Waitangi bridge	101183	
Kerikeri	Skudders beach	100974	
Coopers Beach	Foreshore	101066	
Cable Bay	Beach	105780	
Taipa	Beach	105777	
Rawene	Boat ramp	100236	
Opononi	Beach	106011	
Omapere	Beside jetty	102317	
Coastal Site	**Location**	**Site number**	**District**
Omamari Beach	Beach	109875	
Baylys Beach	Beach	109876	
Glinks Gully	Beach	100798	
Mangawhai Heads	Front of surf club	109890	
Pahi	Broken rocky groyne	102579	
Pahi	North west of jetty	102198	**Kaipara**
Tinopai	Below shops	102310	
Tinopai	Below creek	101232	
Mangawhai	At macrocarpa tree	101830	
Mangawhai	Above motor camp	100709	
Mangawhai	Opposite Norfolk pine	101832	

Table 4: Sites monitored in 2009-10

5.1 Permanent monitoring sites

For the purposes of monitoring NRC's performance, performance targets are laid out in the Long Term Council Community Plan (LTCCP) 2009-2019. For the Recreational Swimming Water Quality Programme the performance target is:

Annual Median % compliance of 20 representative bathing sites complies with Ministry of the Environment guidelines.

The baseline for this target is the median % compliance for these sites in 2007-08, which was 93%.

Due to the large number of sites monitored through the programme, and as some sites may be removed or added each year (which would effect overall % compliance if all sites were used) 20 sites have been randomly selected from the programme to be monitored every year to measure performance. These sites are listed in Table 5 below.

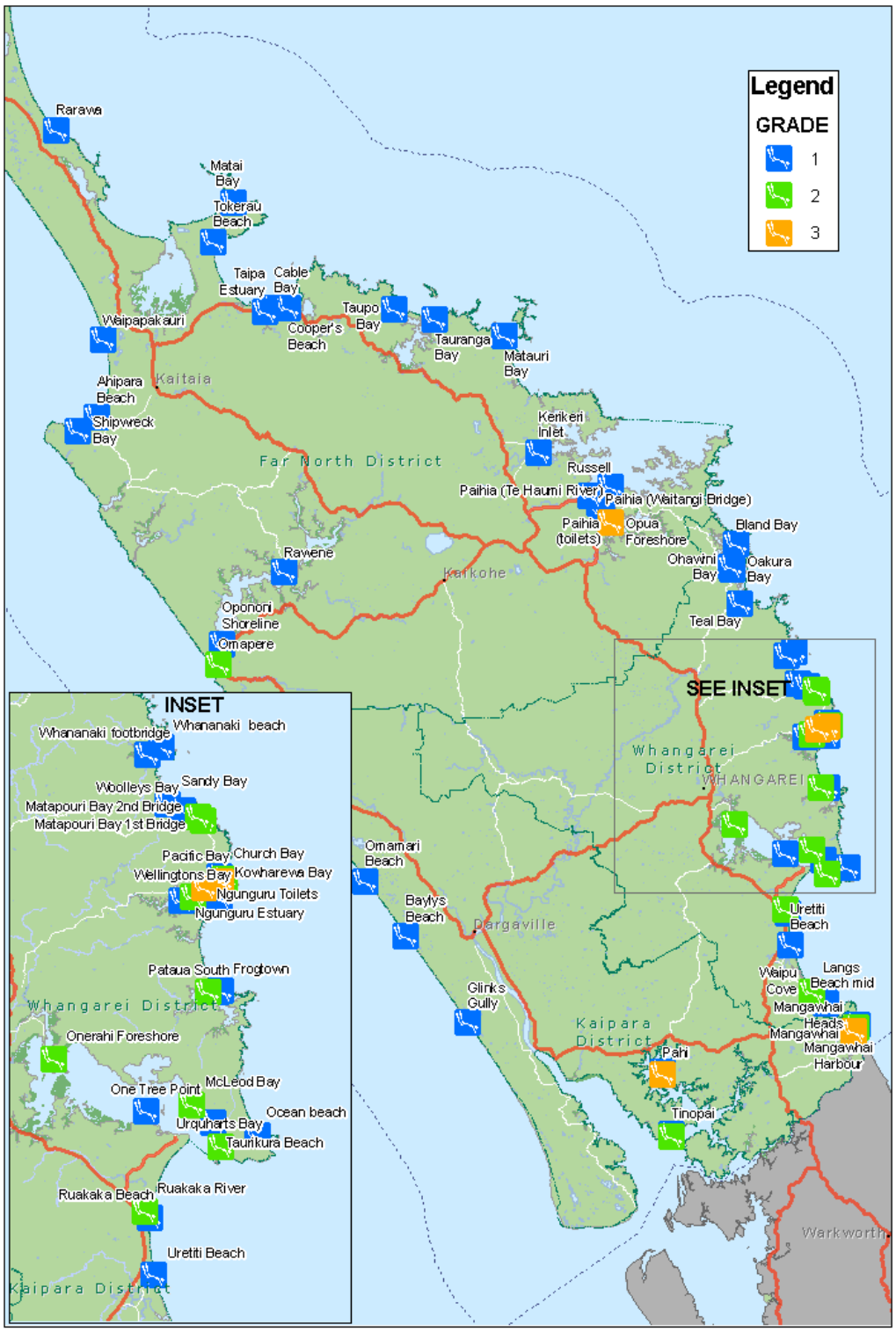
Site Name	Site Number	% compliance in 2007-08
Opononi	106011	100
Taipa	105777	92
Paihia – Waitangi bridge	101183	92
Pahi – rocky groyne	102579	100
Tinopai – below shops	102310	100
Taurikura	101262	92
Matapouri – second bridge	100712	85
Church Bay	105448	100
Pacific Bay	108313	100
Pataua South – east of beach	104986	92
Onerahi – play ground	101600	100
Ruakaka – by motor camp	108314	100
Lang's beach – mid beach	108318	100
Teal Bay	101331	92
Waipu Cove	108316	100
Kerikeri – Stone Store	101530	77
Waipoua River	108613	85
Waipapa River – Puketi	103248	92
Lake Waro – Hikurangi	107272	100
Raumanga Stream	103246	54

Table 5: Permanent monitoring sites

6 RESULTS & INTERPRETATION

The results for all sites sampled in 2009-10 can be viewed in Appendix 1.

6.1 Coastal sites



Map 1: Coastal Compliance 2009-10

The map above summarises the compliance rates for samples taken from each coastal site in Northland during the 2009-10 summer season. Results are grouped below by the sampling run they are included in.

FAR NORTH

The following coastal sites were sampled in the Far North - Shipwreck Bay, Ahipara, Tokerau Beach and Waipapa Kauri. These sites were sampled over nine weeks during peak summer (December to February). All four sites recorded 100% compliance over the sampling period. The results from 2009-10 indicate that water quality is consistently 'safe' for swimming at these locations.

NORTH EAST

The following coastal sites were sampled in the North-east – Maitai Bay, Tokerau Beach, Cable Bay, Taipa estuary, Coopers Beach, Matauri Bay, Taupo Bay and Tauranga Bay. Coopers Beach, Cable Bay and Taipa were sampled over 17 weeks and the remaining sites were sampled over 10 or 11 weeks over peak summer.

All sites recorded 100% compliance over the sampling period. The results from 2009-10 indicate that water quality is consistently 'safe' for swimming at these locations.

NORTH WEST

The following coastal sites were sampled in the Hokianga Harbour - Omapere, Opononi and Rawene. These sites were sampled over 12 weeks during peak summer.

During 2009-10, both Rawene and Opononi recorded 100% compliance. However, the site at Omapere recorded one 'unsafe' result during the 2009-10 sampling season. This site therefore returned a compliance rate of 90-99%.

SOUTH WEST

Sites sampled in the south-west include Omamari Beach, Baylys Beach, Glinks Gully and two sites each at Pahi and Tinopai. Samples were taken from Omamari, Baylys and Glinks over 12 weeks and from the four sites at Pahi and Tinopai over 18 weeks.

Five sites – Omamari Beach, Baylys Beach, Glinks Gully, Pahi NW of jetty and Tinopai below shops - recorded 100% compliance during the 2009-10 sampling season indicating that these sites are consistently 'safe' for swimming. Tinopai below creek had one 'unsafe' result during 2009-10 (90-99% compliance), which was a significant improvement on 2008-09, when it only had a compliance rate of 50% (NRC 2008). Pahi at broken rocky groyne recorded two 'unsafe' results (75-89% compliance) during 2009-10. This site was subject to further investigation during the year, the results of which can be seen in section 7.0 below.

SOUTH EAST

Ten sites were sampled in the south east, from One Tree Point to Mangawhai Heads. Samples were taken from One Tree Point and Uretiti beach over 12 weeks. Samples were taken from Ruakaka beach and estuary, Waipu Cove, two sites at Langs Beach, Mangawhai Heads and two sites in the Mangawhai Harbour over 18 weeks.

Seven sites in this run recorded 100% compliance during 2009-10, indicating that these sites are consistently 'safe' or swimming. Ruakaka River and Mangawhai Harbour opposite Norfolk Pine recorded one 'unsafe' result during 2009-10 (90-99% compliance). Mangawhai Harbour in front of motor camp recorded two 'unsafe' results during 2009-10. More sites will be added in Mangawhai Harbour in 2010-11 to track contamination in this area.

BAY OF ISLANDS

Sites sampled in the Bay of Islands during 2009-10 included Bland Bay, Oakura Bay, Ohawini Bay, Teal Bay, Kerikeri Skudders Bay, Opua Foreshore, Russell mid-north, and three sites in Paihia – Waitangi bridge, in front of toilets and Te Haumi River. Sites at Bland Bay, Ohawini, Oakura and Teal Bay and Russell were sampled for 12 weeks over peak summer and the remaining sites were sampled for 18 weeks.

Nine sites sampled in the Bay of Islands had 100% compliance during 2009-10, indicating that they are consistently 'safe' for swimming. One site, Opua Foreshore, recorded three incidents of non-compliance during the sampling period (75-89% compliance).

TUTUKAKA

Sites sampled in the Tutukaka run included Woolleys and Sandy Bays, Matapouri at first and second bridge, Church Bay, Kowharewa Bay, Pacific Bay, Wellingtons Bay and three sites in Ngunguru estuary – opposite toilets, opposite Norfolk Pine and in front of motor camp. All sites in this run were sampled over 18 weeks.

Five sites – Woolleys and Sandy Bay, Wellingtons Bay, Church Bay and Ngunguru in front of motor camp – recorded 100% compliance during 2009-10 indicating that these sites are consistently 'safe' for swimming.

Ngunguru estuary opposite Norfolk Pine, Matapouri first and second bridge and Pacific Bay each recorded one 'unsafe' result (90-99% compliance), indicating that these sites are generally 'safe' for swimming. Kowharewa Bay recorded two 'unsafe' results and Ngunguru estuary opposite toilets recorded four incidents of non-compliance (75-89% compliance) during 2009-10. Ngunguru opposite toilets had the lowest rate of compliance of all coastal sites during 2009-10. This site will be investigated further in 2010-11.

WHANGAREI HEADS

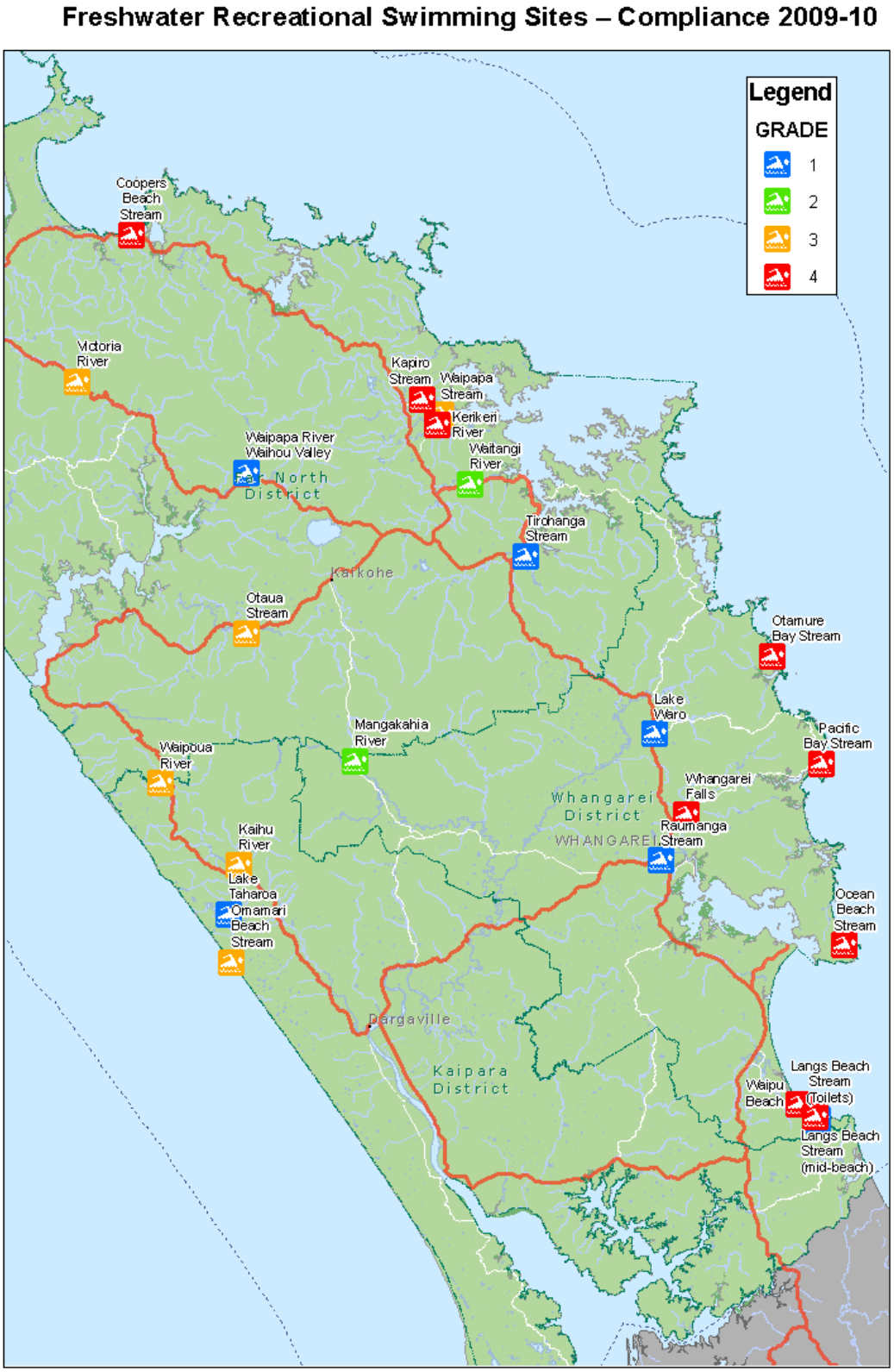
Eight sites were sampled in the Whangarei Heads area – Ocean Beach, Urquharts Bay, Taurikura, Mcleod Bay, Onerahi opposite playground and three sites in Pataua – footbridge, east beach and frogtown beach. All eight sites were sampled over 18 weeks.

Four sites – Ocean Beach, Pataua frogtown, Pataua east beach and Taurikura – recorded 100% compliance during 2009-10, indicating that these sites are consistently 'safe' for swimming. The remaining five sites each recorded one 'unsafe' result (90-99% compliance), indicating that these sites are generally 'safe' for swimming.

CENTRAL

Two sites at Whananaki - east beach and by the footbridge - were sampled during 2009-10. Both sites recorded 100% compliance during the sampling period, indicating that these sites are consistently ‘safe’ for swimming.

6.2 Freshwater sites



Map 2: Freshwater Compliance 2009-10

The map above provides a summary of compliance rates for samples taken from freshwater sites during 2009-10. As can be seen, freshwater sites in Northland generally recorded a lower level of compliance than coastal sites in 2009-10.

Freshwater sites have less 'flush' than open coastal sites, particularly during the summer months when flows are lower and there is less rainfall, and are therefore more sensitive to inputs from surrounding land-use and human activity. When it does rain, rainfall runoff carries contaminates off the land, which also influences water quality in freshwater systems.

In 2009-10, nine sites recorded a compliance rate of less than 75% - Otamure Bay stream, Langs Beach stream (midway), Pacific Bay stream, Kerikeri at Stone Store, Kapiro stream, Waipu Cove stream, Ocean Beach stream, Whangarei Falls and Cooper's Beach stream. The majority of these sites are consistently unsafe and have recorded poor results over a number of years. However, Kapiro stream recorded elevated results for the first time this year. Further work is currently being undertaken to try and establish the source of contamination at this site.

Most of these sites are small coastal streams with low flow during the summer months. Water in these streams is prone to ponding during the summer and it is possible that bacteria reproduce in these 'ponds' as temperatures rise and the water stagnates. More research is currently being undertaken to explore this theory in Northland. In addition, seven of these sites were subject to further investigation in 2009-10 to try and establish the source of contamination. Results from this investigation are discussed in section 7.0.

In comparison, six freshwater sites recorded a compliance rate of 100%, two sites recorded a compliance rate of 90-99% (one incidence of non-compliance) and six sites recorded a compliance rate of 75-89% compliance (two or three incidents of non-compliance).

Overall, more freshwater sites had a compliance rate of 100% in 2009-10 compared to 2008-09. This may be attributable to lower rainfall over the summer this year, which in turn reduced the amount of contamination entering freshwater systems from rainfall run-off.

6.3 Compliance for permanent monitoring sites 2009-10

The performance target for compliance for the twenty permanent monitoring sites chosen from the recreational swimming water quality programme is the median percentage compliance for 2007-08, which was 96%.

In 2009-10, the median percentage compliance was 100%. This means that the performance target for the recreational swimming water quality programme was exceeded in 2009-10.

In 2009-10, eight of the permanent monitoring sites recorded a higher rate of compliance than in 2007-08 (seen in green below), eight recorded a lower level of compliance (seen in orange below) and four recorded the same level of compliance.

Site Name	Site Number	% Compliance 2007-08	% Compliance 2009-10
Opononi	106011	100	100
Taipa	105777	92	100
Paihia – Waitangi bridge	101183	92	100

Pahi – rocky groyne	102579	100	89
Tinopai – below shops	102310	100	100
Taurikura	101262	92	100
Matapouri – second bridge	100712	85	94
Church Bay	105448	100	100
Pacific Bay	108313	100	94
Pataua South – east of beach	104986	92	100
Onerahi – play ground	101600	100	94
Ruakaka – by motor camp	108314	100	94
Lang's beach – mid beach	108318	100	100
Teal Bay	101331	92	100
Waipu Cove	108316	100	94
Kerikeri – Stone Store	101530	77	72
Waipoua River	108613	85	83
Waipapa River – Puketi	103248	92	100
Lake Waro – Hikurangi	107272	100	100
Raumanga Stream	103246	54	100

Table 6: Permanent monitoring sites compliance rates 2009-10

7 SITE INVESTIGATIONS

In previous years, a number of popular swimming sites have been highlighted through the recreational swimming water quality programme as having continually poor water quality. Permanent warning signs are erected at these sites to inform the public about the 'unsafe' water quality.

In 2009, MfE published a report that summarised the results of the previous two years water quality data for the country. This report showed that Northland had the highest number of non-compliant freshwater sites in the country.

In 2009, the Council requested that a strategy be drawn up to investigate problem recreational swimming sites in Northland, in order to identify possible sources of contamination and work towards resolving water quality issues at these sites.

In total, nine sites were chosen for investigation:

Whangarei Falls
Langs Beach stream (mid-way)
Langs Beach stream (toilets)
Coopers Beach stream
Ocean beach stream
Otaua stream
Tinopai below Creek
Pacific Bay stream
Otamure Bay stream

During 2009-10, Investigative work undertaken at most of these sites included taking samples for faecal source tracking, catchment profiling (mapping catchment land-use and taking microbiological samples up the catchment to determine where bacterial levels are at their highest) and undertaking sanitary surveys.

The results (to date) from this work are discussed below. No further work was undertaken at Otaua stream or Tinopai below creek during 2009-10 as water quality had improved at these sites during the season however work will be undertaken in the future if water quality declines again.

In addition to the above work, some ad-hoc investigation was undertaken at Pahi below creek, Waipu Cove stream and Kapiro Stream in 2009-10, in response to water quality issues raised at these sites.

7.1 Identifying the source of contamination

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

FAECAL STEROLS

Sterols are lipids that relate to both plants and animals, for example, 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 the sterol composition of animal faeces can generate distinctive faecal sterol fingerprints. Therefore, 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 ingredients of washing powders and only one is used in New Zealand. In most households, the effluent from toilets is mixed with grey water from washing machines and therefore FWAs are usually linked to human faecal contamination in both septic tanks and community wastewater systems.

PCR 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.

7.2 Results of investigative sampling

Results received to date for samples sent away for faecal source tracking are summarised in Table 7 below.

Site	FWA	Human	Herbivore	Dog	Avian	Possum	Pig
Otamure Bay stream			✓		✓		
Coopers Beach stream				✓	✓		
Langs Beach stream (mid)					✓		
Langs beach stream (toilets)					✓		
Pacific Bay stream					✓		
Whangarei Falls					✓		
Waipu Cove stream					✓		
Pahi at stormwater	✓	✓					

Table 7: Results received to date for faecal source tracking investigations

Otamure Bay stream

Faecal sterol analysis on five samples taken from the Otamure Bay catchment indicate that faecal contamination is present in the water. Ratios of faecal sterols present in three samples suggest herbivore faecal contamination. PCR analysis on the same three samples returned no result. Faecal sterol analysis of the remaining two samples suggest wildfowl faecal contamination, whilst FWA, and PCR analyses returned no results.

Catchment profiling of the site shows that there are two tributaries that flow into the stream before it reaches the beach. Both of these tributaries have been tested for *E. coli* on two separate occasions to determine where levels are at their highest. On both occasions, levels of *E. coli* were high in both tributaries. Both tributaries run through areas that are heavily stocked however the stream is fenced to prevent livestock access. The eastern tributary is adjacent to a stock yard. NRC's Land Management team is liaising with landowners with regards to environment fund and land management options

Coopers Beach stream

Faecal source tracking work undertaken on samples taken from the stream in December 2009 showed a very low level of fluorescent whitening agents (which are indicative of wastewater contamination). This indicates that contamination is not from a wastewater source.

Results from faecal sterol analysis show possible avian faecal pollution from wildfowl. Results from PCR markers indicate that both wildfowl and dogs are a possible source of contamination, with dogs returning a strong positive correlation. Faecal sterol and PCR analyses of two additional samples collected in February 2010 were positive for wildfowl faecal contamination.

NRC's Land Management team are liaising with landowners in the catchment to discuss management options.

Langs Beach streams

Initial results from PCR markers indicated the possible source of contamination was from wildfowl. Subsequent PCR analyses were inconclusive, however faecal sterols present in the samples were consistent with wildfowl contamination. No FWA's were detected in any of the Langs Beach stream samples.

A sanitary survey undertaken January 2010 and catchment profile sampling was undertaken March 2010. *E. coli* levels were too low in the March samples to enable any further faecal source tracking.

Auckland University are investigating Langs Beach stream (by toilets) as part of study into bacterial reproduction in stagnant pools. Two samples have been collected as part of this study and results are expected at the end of 2010.

Pacific Bay stream

Faecal sterol analysis of the single sample taken from Pacific Bay to date does not indicate contamination from either human or herbivore faecal inputs. The sterol ratio is suggestive of avian faecal pollution from wildfowl. PCR analysis of the same sample returned no result and therefore this result cannot be confirmed. Catchment profile

sampling undertaken Dec 2009 and a sanitary survey was completed in January 2010. Two additional samples were collected and sent away for faecal source tracking. However, a technical error with the contracting laboratory has meant the results are not available.

This site will be investigated further next season.

Ocean Beach stream

All but two results from this site up to the second week of January exceeded the MfE guidelines of 550 *E. coli* per 100ml. After a sanitary survey was conducted by the Council, in association with Whangarei District Council, in the third week of January, there was a marked drop in the level of bacteria in the stream. Since this time, there has been only one exceedance of the guideline value. The water level in the stream has also fluctuated from dry to flooded over the past six weeks, which may have had some influence on the results.

No samples have been sent away for faecal source tracking as levels of bacteria have been too low over the last few months for analysis.

Catchment profile sampling will be undertaken if high results are returned in future.

Whangarei Falls

Catchment profile sampling undertaken in September 2009 and March 2010. Elevated levels of *E. coli* were found in four of seven major tributaries in March 2010. Samples were sent away for faecal source tracking, however, a technical error with the contracting laboratory has meant the results are not available.

Further catchment profiling will be undertaken during the 2010-11 season.

Waipu Cove stream

Faecal sterol analysis on one sample from Waipu Cove indicated the source of contamination was possibly wildfowl. No other investigation was warranted. Further investigations will be carried out if high results are returned in future.

Pahi at stormwater

Faecal source tracking work undertaken on samples taken from the stream in February 2010 returned positive for fluorescent whitening agents (which are indicative of wastewater contamination). PCR analysis was inconclusive, however, faecal sterol ratios were consistent with human source of faecal contamination.

The Council has been working with landowners in the area to identify (and remedy) the source of contamination.

Otaua Stream & Tinopai

No work undertaken in these catchments this season. Investigations will occur next season if bacterial counts are sufficiently high.

8 WATER QUALITY FOR RECREATIONAL SHELLFISH GATHERING

In addition to assessing sites for their suitability for contact recreation, results from sites popular for recreational shellfish gathering are analysed against the MfE microbiological guidelines for shellfish gathering. The guidelines are based on those used by the shellfish export sector and are internationally accepted. The guidelines use faecal coliforms as an indicator of the potential presence of pathogens and viruses.

8.1 Guideline values

There are two guidelines 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 14/100 mL;

And

- Not more than 10% of samples should exceed an MPN of 43/100 mL.

Compliance with these guidelines alone does not guarantee that shellfish grown in these waters will be safe for consumption.

8.2 Results 2009-10

The results for 15 sites from the 2009-10 sampling season are shown in Table 8 below. Results indicate that only two sites, Oakura and Mcleod Bay, complied with microbiological water quality guidelines for shellfish gathering for this year. However, samples were only taken over the summer months, not for the entire shellfish gathering season (which, excluding scallops, is all year in Northland). As such, these results can only be used as an indicator of likely suitability.

Site Name	No. of Samples	% Samples >43/100mL	Median Faecal Coliforms	Pass/Fail
Ngunguru - Norfolk pine	18	**11**	**5**	**Fail**
Whananaki - east end	10	**20**	**40**	**Fail**
Oakura – north end	12	**0**	**<2**	**Pass**
McLeod Bay	18	**6**	**9**	**Pass**
Taurikura Bay	18	**6**	**127**	**Fail**
Urquharts Bay	18	**17**	**127**	**Fail**
Pataua – foot bridge	18	**22**	**17**	**Fail**
Ruakaka – motor camp	18	**28**	**33**	**Fail**
Paihia - Waitangi bridge	18	**17**	**33**	**Fail**
Paihia - Te Haumi River	18	**6**	**21**	**Fail**
Taipa	17	**24**	**70**	**Fail**
Coopers Beach	17	**12**	**18**	**Fail**
Tinopai - below creek	18	**28**	**18**	**Fail**
Mangawhai – above camp	18	**39**	**19**	**Fail**
Pahi – NW of jetty	18	**50**	**35**	**Fail**

Table 8: Results for recreational shellfish gathering sites 2009-10

9 SUMMARY AND CONCLUSIONS

In summary, the results from 2009-10 indicate that most coastal sites sampled were consistently 'safe' for swimming. Some enclosed coastal locations did, however, record occasional 'unsafe' results, particularly after heavy or prolonged rainfall. The level of compliance for coastal sites was higher in 2009-10 compared to 2008-09. This is most probably related to the lower levels of rainfall received across the region during the summer of 2009-10.

For the second year, Ngunguru at toilets recorded the lowest level of compliance of all the coastal sites. Despite follow-up sampling and site investigation, it is not clear where contamination is coming from. This site will be investigated further in 2010-11.

Freshwater sites again recorded a lower rate of compliance than coastal sites. Nine sites had a compliance rate of less than 75% in 2009-10 – Otamure Bay stream, middle Lang's Beach stream, Waipu Cove stream, Ocean Beach stream, Kerikeri at Stone Store, Kapiro stream, Pacific Bay stream, Whangarei Falls and Cooper's Beach stream.

However, a greater percentage of freshwater sites recorded 100% compliance in 2009-10 compared to 2008-09. Again, this is probably related to the lower levels of rainfall received across Northland during the summer of 2009-10.

The results for 15 sites sampled during 2009-10 for their suitability for recreational shellfish gathering indicate that only two sites, Oakura and McLeod Bay, complied with microbiological water quality guidelines. However, samples were only taken over the summer months, not for the entire shellfish gathering season (which, excluding scallops, is all year in Northland). As such, these results can only be used as an indicator of likely suitability.

Seven sites were subject to investigation into poor water quality during 2009-10. Samples were collected from these sites for faecal source tracking analysis. Results received to date indicate that contamination at most sites is from waterfowl, such as ducks or seagulls. Only one site, Pahi at stormwater outlet, indicated pollution from a human source. One site, Otamure Bay stream, shows a source to be from herbivores and one site, Coopers beach stream, shows a source of contamination to be dog faeces.

Work will continue through the winter of 2010 and over the summer of 2010-11 at problem sites and a full, detailed report will be prepared once all results have been received. Once the source/s of contamination have been identified at each site, where possible, a strategy can be developed to try and improve water quality in these water bodies.

10 KEY RECOMMENDATIONS

- Continue with the Recreational Swimming Water Quality Programme, incorporating additional sites of interest or concern, and publishing the results for public information on the NRC website.
- Continue to improve warning signs at consistently non-compliant (unsafe) sites, in order to improve communication of the problem to potential recreational users.
- Continue to investigate consistently 'unsafe' sites. Undertake further faecal source tracking investigations to isolate the source/s of contamination and develop a strategy for improving water quality based on the results of this work.
- Work in specific catchments with land owners and the local community to improve water quality and increase awareness of water quality issues and safer swimming.

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