RECREATIONAL BATHING WATER QUALITY

AT NORTHLAND'S FRESHWATER BATHING SITES

SUMMER 2005-06

Prepared by Tanya Gray
Northland Regional Council
Private Bag 9021
Whangarei

NORTHLAND REGIONAL COUNCIL

EXECUTIVE SUMMARY

- Twenty popular swimming sites at eighteen of Northland's rivers, lakes and streams were sampled over a twelve week period, from the start of December 2005 through to the end of February 2006. Also three additional sites were monitored; one on Kaihu River, Waipoua River and Waiharakeke stream.

- Pollution indicator bacteria (*Escherichia coli*) counts were carried out on the samples, and the results were compared with the Ministry for the Environment and Ministry of Health's **Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas**.

- Results are forwarded on to the relevant district councils, as well as Northland Health, as they become available, for action when levels of *E. coli* are elevated above the MfE guidelines.

- The water quality of Lake Ngatu on the Aupouri Peninsula and Lake Taharoa in the Kai iwi lakes group, was generally excellent over the entire 2005-06 survey.

- Results for the rivers and streams were variable. The samples from the Kaihu River and Kapiro Stream met the guidelines for most of the sampling period, however samples taken from the Lake Waro and Langs Beach, Ocean Beach, Otiria and Wairoa Stream sites consistently contained *E. coli* well in excess of the recommended levels.

- Interim grades, based on the MfE guidelines, have been produced for sites with data stretching back over at least five summers. The process has tended to be conservative and have overstated the health risks at some sites.

- Faecal sterol analysis was carried out at three ongoing problematic sites to assist with identifying the source of contamination in 2005-2006. The results showed that the contamination was not of human or stock origin for Ocean Beach and Langs Beach Stream.

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1 INTRODUCTION

The Northland Regional Council, in conjunction with Northland Health and Northland's district councils, conducts a survey of the water quality at a number of the region's most popular freshwater bathing sites. Freshwater sites are not always safe for recreational activities, as waterways can sometimes become contaminated with human or animal effluent, effluent that contains large numbers of organisms capable of causing illness. These organisms, called pathogens, include such "bugs" as giardia (*Giardia lamblia),* and campylobacter *(Campylobacter jejuni)*.

The most common sources of pathogenic contamination are human sewage, stormwater and rural run-off (Jarman, 2002a). Human sewage is perhaps of most concern, particularly because it should be the easiest to remedy, by fixing broken or leaking pipes, maintaining septic tanks and minimising sewage system overflows. The effects stormwater and rural run-off are not as easy to mitigate. No matter what the source is though, the potential for causing illness is the same (Jarman, 2002a).

The purpose of the annual survey is to determine the relative environmental health of each site. The Northland Regional Council can then use this data to identify problem areas and, with the co-operation of Northland Health and the relevant district councils, work towards providing solutions.

1.1 ILLNESS

Swimming in contaminated water can lead to skin, eye or ear infections, or gastrointestinal or respiratory illnesses (Jarman, 2002a). Ingestion is the most common pathway for pathogens, but inhalation has been identified as a major route as well, particularly for activities such as water-skiing (MfE 2002).

The effects of recreational-bathing related illnesses can be quite unpleasant. 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 necessary. In 2001, 26 % of patients infected with shigellosis required some time in hospital (Jarman, 2002b)[1].

[1] Both Campylobacteriosis and Shigellosis, along with a host of other bathing-related illnesses, are common in Northland (Jarman, 2002b).

1.2 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 lakes and rivers can get, it makes it impossible to ever guarantee that any waterway is safe to swim in. This uncertainty is the reason that health authorities always recommend you boil untreated water 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 somewhere, it is unlikely that anyone would be overly worried. On the other hand, if every swimmer got sick, the risks become unacceptable. The maximum acceptable risk falls somewhere in between; some people may get sick, but not so many as to become a strain on health resources or present a threat to peoples' lives.

For freshwater recreation in New Zealand, the Ministry for the Environment and the Ministry of Health has set the maximum acceptable risk at 8 in every 1000 users falling ill as a result of freshwater recreation (MfE, 2002; MfE 2003). This number is based on a combination of local and international studies.

2 WHEN TO AVOID CONTACT RECREATION

In order to minimise the risk when using our waterways for contact recreation, a number of simple steps should be followed:

CLARITY

It may seem to be stating the obvious, but stagnant and murky water tends to contain many more pathogens than crystal clear and flowing water. There is a loose correlation between suspended solids (which reduce clarity) and agricultural run-off (high in potential pathogens), and a good way to reduce your risk is to only swim[2] in water in which you can see your feet when you are knee deep.

DISCOLOURATION, FOAMS AND ODOUR

Water can be unsafe for swimming in if it has an unpleasant or unusual smell, or if there is foam or slicks on the water's surface. Even if the water is relatively clear, foams and odour are often signs of upstream sewage discharges.

RAINFALL

Rainfall has a big impact on waterways. When it rains, run-off from farmland and urban areas can be washed into rivers, streams and lakes, carrying potentially substantial loads of pathogens into the water. After heavy rainfall, it is recommended to wait several days, to allow for any run-off to pass through, even if water passes the other tests.

[2] It is unwieldy to continually use the term "freshwater recreational contact use", so for the sake of brevity and clarity, swimming will be assumed to be synonymous, and any recommendations equally applicable to any other use, from jet skiing to diving.

3 RECREATIONAL CONTACT GUIDELINES

The Ministry for the Environment and Ministry of Health released national Microbiological Water Quality Guidelines in June 2003. The Northland Regional Council's monitoring programme has incorporated the recommendations presented in the guidelines where possible, and the NRC can therefore determine the quality of Northland's freshwater bathing sites using national standards. This section provides an outline and discussion of the key aspects of the Ministry's guidelines, available online at:

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

3.1 THE MICROBIOLOGICAL ASSESSMENT CATEGORY (MAC)

The Ministry for the Environment has grouped the possible range of microbiological results into four categories, ranging from A to D as presented in Table 1. These categories are determined using the 95th percentiles[3] of datasets with at least 100 data points stretching over 5 years. Where there is not enough data, all grading using the MfE guidelines should only be considered provisional.

Table 1: Microbiological Assessment Category (MAC) definitions (MfE 2003)

A	Sample 95th percentile ≤ 130 Escherichia coli per 100 mL
B	Sample 95th percentile 131-260 Escherichia coli per 100 mL
C	Sample 95th percentile 261-550 Escherichia coli per 100 mL
D	Sample 95th percentile > 550 Escherichia coli per 100 mL

3.2 THE SANITARY INSPECTION CATEGORY (SIC)

The **sanitary inspection category** is used to classify the likely dominant source of faecal contamination of a given water body. In order to determine the SIC for a river, stream or lake, the potential and probable suppliers of faecal bacteria are listed. In most cases, one source will dominate, such as run-off in agricultural catchments or stormwater in urban catchments. The Ministry for the Environment has grouped the most commonly occurring sources into five categories as shown in Table 2. Once the major source of faecal contamination into a body of water has been identified, a **sanitary inspection category** can be chosen.

[3] Calculated using the hazen method.

Table 2: Sanitary Inspection Category (SIC) Definitions (MfE 2003)

SANITARY INSPECTION CATEGORY	EXAMPLES OF SOURCE
VERY LOW	No significant source, indirect run-off from forests.
LOW	Indirect run-off horticulture or low-intensity agriculture, direct run-off from forests.
MODERATE	Stormwater (free of sewage), direct run-off from horticulture or low-intensity agriculture, indirect run-off from high-intensity agriculture, marina, or boat moorings, unrestricted access of stock to tributaries.
HIGH	Indirect discharge of untreated sewage or on-site waste treatment systems, urban stormwater, unrestricted access of stock to waterway, direct run-off from intensive agriculture, dense bird populations.
VERY HIGH	Direct discharge of untreated sewage or on-site waste treatment systems (including leaking septic tanks).

3.3 THE SUITABILITY FOR RECREATION GRADE (SFRG)

The **suitability for recreation grade** is determined by combining the MAC and SIC of a recreational bathing site. There are five grades, ranging from very good to very poor. As mentioned previously, if there is insufficient data to fulfil the basic assumptions of the MAC determination (100 data points over 5 years of sampling), then these grades should be considered interim grades rather than absolute ones. Table 3 show how the MAC and SIC categories combine, and an explanation of the various grade follows.

Table 3: Suitability for Recreation Grade Guidelines (MfE 2003)

SUSCEPTIBILITY TO FAECAL INFLUENCE		MICROBIOLOGICAL ASSESSMENT CATEGORY			
		A	B	C	D
SANITARY INSPECTION CATEGORY	VERY LOW	Very Good	Very Good	Follow Up♠	Follow Up♠
	LOW	Very Good	Good	Fair	Follow Up♠
	MODERATE	Follow Up♣	Good	Fair	Poor
	HIGH	Follow Up♣	Follow Up♣	Poor	Very Poor
	VERY HIGH	Follow Up♣	Follow Up♣	Follow Up♣	Very Poor

♣ Unexpected results, which require further investigation (either SIC or MAC needs to be reassessed).

♠ Implies non-sewage source of faecal contamination, and this needs to be verified.

SFRG = VERY GOOD
Without any significant sources of faecal contamination, a site with a "Very Good" SFRG may be considered suitable for contact recreation at all times. A site with a "Very Good" SFRG may not require regular sampling in the future.

SFRG = GOOD
While water quality is generally good at a "Good" site, potential sources of faecal contamination such as indirect agricultural run-off or non-sewage stormwater can make the site unsuitable for contact recreation during and after periods of significant rainfall. Regular monitoring of such sites is necessary as there is the possibility that the water quality could deteriorate with future development of the upstream catchment.

SFRG = FAIR
At sites with a "Fair" grade, water is usually suitable for contact recreation, but sources of contamination such as direct discharges from low-intensity agriculture and stormwater drains or indirect discharges from intensive agriculture mean that these sites should not be used during or immediately after rain events. The MfE recommends that such sites should be monitored weekly over loading periods (such as the summer school holidays).

SFRG = POOR
The water at sites with a "Poor" grade tends to breach alert guidelines (> 260 *E. coli* per 100 mL) more often than not. Because of direct discharges from intensive agriculture and tertiary treated sewage, or indirect discharges from leaking septic tanks and other untreated wastes, the site is generally unsuitable for swimming or other recreational activities, and that infants, the elderly, or the sick in particular should avoid using such sites for recreational contact. This recommendation applies even during dry periods, and territorial authorities may choose to erect permanent warning signs, especially if weekly sampling is discontinued at such sites.

SFRG = VERY POOR
Sites that receive a grade of "Very Poor" should not be used for recreational activities. Direct discharges of faecal material from sources such as leaking septic tanks or untreated wastewater mean that local authorities should erect permanent warning signs at such sites, advising that the water is categorically unsuitable for use.

3.4 SINGLE SAMPLE GUIDELINES

In addition to providing guidelines on how to handle information at the conclusion of freshwater contact surveys, the Ministry for the Environment has also set a recommended course of action for the treatment of data during surveys. Under the current guidelines, each sample will fall into one of three categories: Acceptable (green), Alert (yellow), or Action (red), as shown in Table 4.

Table 4: Single sample guidelines for contact recreational surveys (MfE 2003)

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

In practise, the Northland Regional Council undertakes the regular weekly sampling, and passes the results onto Northland Health, who in turn alert the relevant District Council (Far North, Whangarei or Kaipara), if results from a site are above the 260 *E. coli* per 100 mL threshold and further sampling is required. Sanitary surveys may be undertaken as solo or co-operative efforts between the relevant local bodies.

4 METHODS

4.1 TECHNIQUE

It is an expensive and difficult procedure to identify and count pathogens in water. Instead, the Council uses an indicator bacteria called *Escherichia coli*, which is much easier to measure. *E. coli* are the faecal pollution indicator recommended in the MfE guidelines, as scientific studies have shown that when we find *E. coli* in a river, we can safely assume that there will be pathogens in the water as well (MfE, 2002).

4.2 SITES

The Northland Regional Council does not have the resources to monitor every swimming hole in Northland, nor would it be practical to do so. The Council reviews the number of sites used in the annual surveys at the beginning of each summer, chooses sites based on popularity, and/or because of a specific request from the public.

Twenty sites were sampled in 18 different lakes and rivers throughout Northland for the 2005-2006 freshwater bathing survey, all continued on from last years survey. The locations of these sites are shown overleaf as Figure 1 and in Table 5.

In addition three extra sites were sampled for most of the 2005-2006 summer due to being popular swimming spots and at the request from the public and Northland Health; Kaihu River by the rugby club, Waipoua River at the DOC camping ground and Waiharakeke Stream behind the Marae (Moerewa).

4.3 PROTOCOLS

The Northland Regional Council collected 12 samples per site over the course of the summer of 2005-06, with the exception of a few sites, which had the odd sampling occasion missed due to staff availability. Sampling was conducted once per week.

For each visit, three replicate samples were taken on site, which were later mixed into one composite sample. This composite sample was analysed for *E. coli* and total coliforms using Colilert™. Temperature was noted at each site using handheld YSI meters and turbidity was measured in the Laboratory.

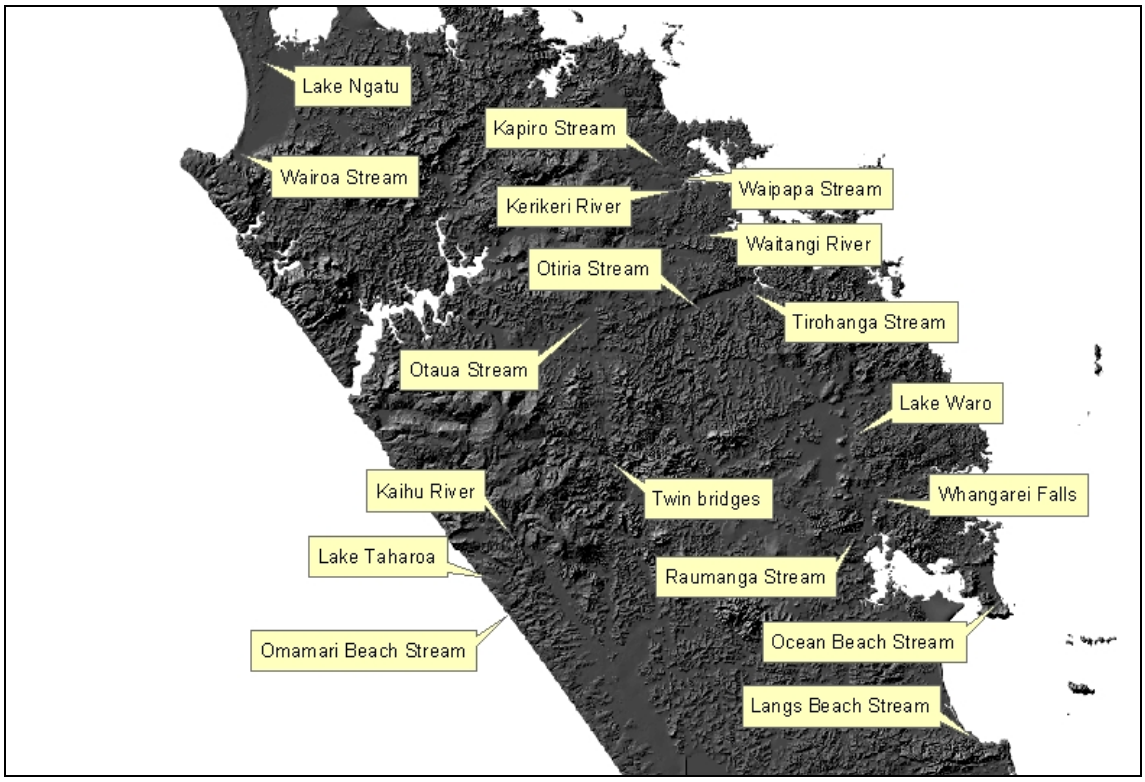

Figure 1: Sites sampled during the 2005-06 Freshwater Recreational Contact Survey

Table 5: Details of the sites used in the 2005-06 Survey

WATER BODY	LOCATION	DISTRICT
Lake Ngatu	DoC Reserve South End	Far North
Wairoa Stream	Ahipara Bridge	
Kapiro Stream	Parerua Swimming Hole	
Waipapa River	Waipapa Landing	
Kerikeri River	Kerikeri Basin	
Waitangi River	Lily Pond Reserve	
Tirohanga Stream	Tirohanga Road	
Otaua Stream	Kaikohe	
Otiria Stream	Otiria Falls	
Ocean Beach Stream	Ocean beach	
Mangakahia River	Twin Bridges Reserve	Whangarei
Waitaua Stream	Whangarei Falls	
Lake Waro	Hikurangi	
Raumanga Stream	Raumanga Valley Reserve	
Langs Beach stream	Langs Beach	
Kaihu River	Motor Camp	
Lake Taharoa	Promenade Point Camp Ground	Kaipara
Omamari Beach Stream	Omamari	

5 RESULTS & INTERPRETATIONS

5.1 LAKE NGATU

SIC: LOW **MAC: B** **SFRG: GOOD**

Lake Ngatu lies within the Aupouri Peninsula, north of Kaitaia. With no permanent streams flowing into or out of Lake Ngatu, rainfall is the predominant input. Seepage and evaporation are the major outputs. There are very few potential sources of *E. coli* to the lake, although with heavy use over summer, the occasional contamination event has occurred.

Table 6: Collated results for the two Lake Ngatu sites

	2005-06 SURVEY	LAST FIVE SURVEYS
Median	< 10 *E. coli* per 100 mL	10 *E. coli* per 100 mL
95th Percentile	295 *E. coli* per 100 mL	134 *E. coli* per 100 mL
Alert Compliance	96 %	97 %
Action Compliance	96 %	98 %

As is obvious from Table 6 (above), and Figure 2 (below), the bacteriological water quality of Lake Ngatu was excellent for the bulk of the sampling period. There was only one spike in *E. coli* on 26 January, where it exceeded the action level at the launch site in the North end of the lake. Overall the lake was generally suitable for contact recreational use.

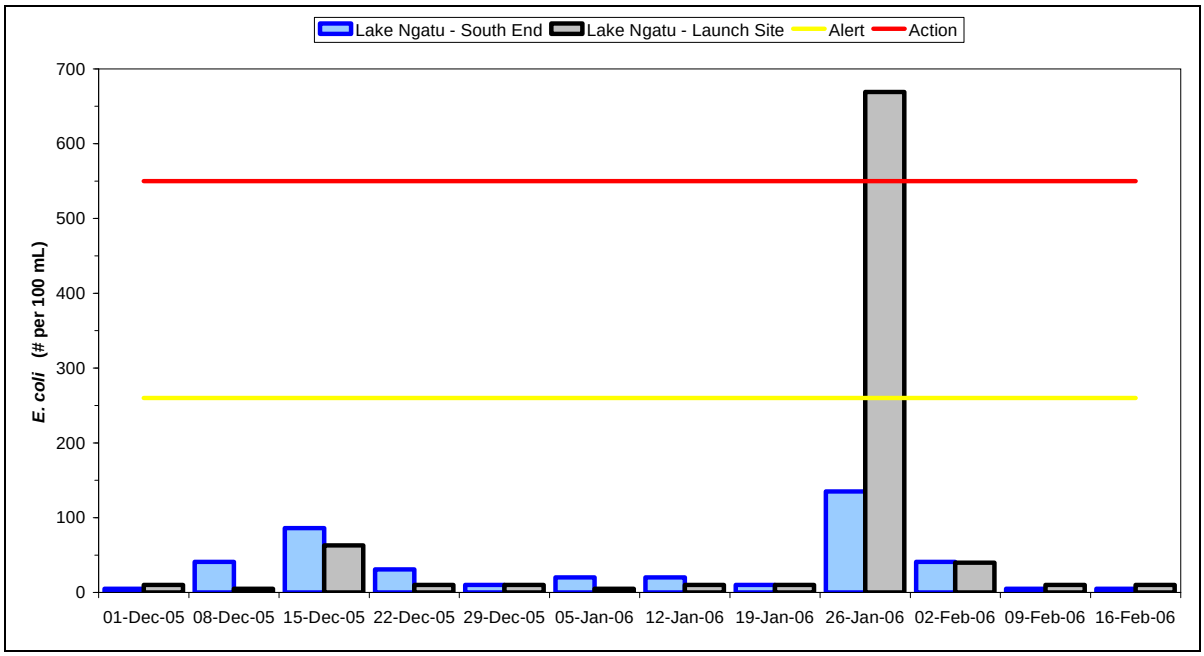

Figure 2: Results from the 2005-06 freshwater recreational contact sampling for the two Lake Ngatu sites

After a comparison between *E. coli* results and rainfall data (Figure 3), it is possible that surface run-off (as a result of the rainfall prior to sampling) is the source of the elevated *E. coli* levels detected on 26 January. With more years of sampling this is proven to be the case as similarly in the 2004-05 summer the peak above the action level at the South end of the lake was also attributed to surface run off. However the effect of this surface run-off during rainfall is also related to what is happening within the catchment at the time. In some rainfall events there is very little increase in bacterial levels and the elevated results are not consistently at the same site or at both site at once.

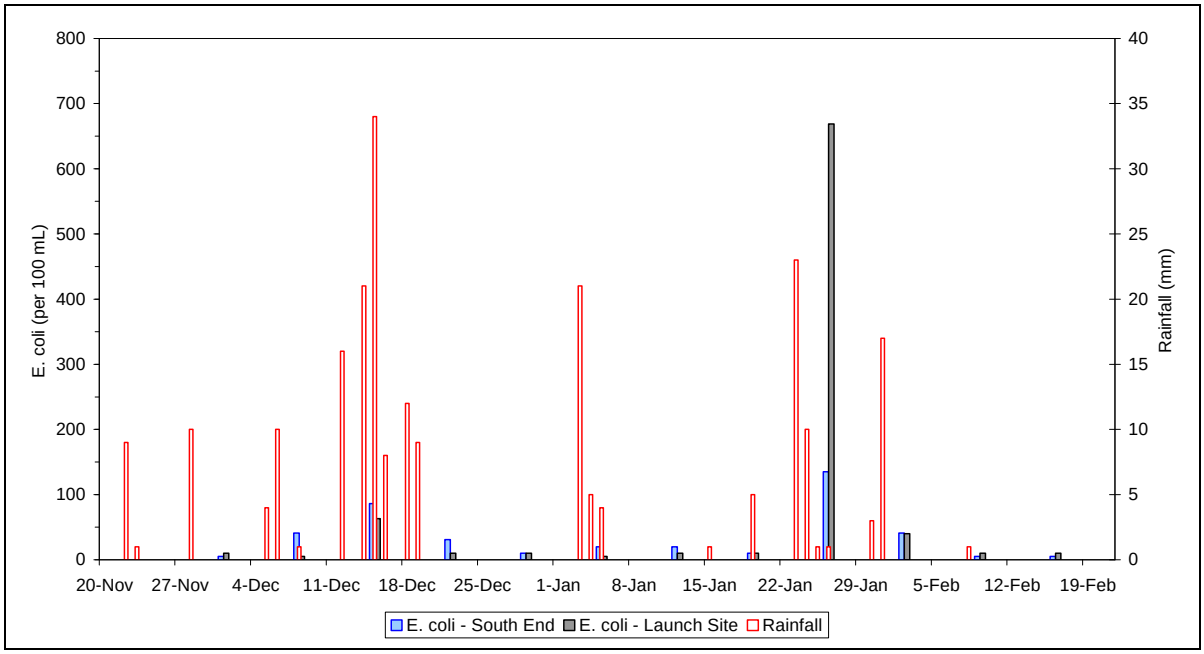

Figure 3: Rainfall and *E. coli* levels at the two Lake Ngatu sites over the 2005-06 summer

The alert and action compliance rates for the two Lake Ngatu sites have improved slightly with the addition of this year's results to the dataset at 97% and 98% respectively. With a significant drop in the Hazen 95th percentile for Lake Ngatu from 393 to 134 E. coli/100mL, the MAC assessment has improved from "C" to "B" and therefore the interim SFRG grade has improved from "Fair" to "Good".

5.2 WAIROA STREAM

SIC: HIGH **MAC: D** **SFRG: VERY POOR**

Wairoa Stream is located just east of the Ahipara Township at the southern end of Ninety-Mile Beach. Intensive agriculture in the catchment means that the Wairoa Stream's water quality is historically poor, nonetheless, many people continue to swim at the site.

Table 7: Collated results for the Wairoa Stream

	2005-06 SURVEY	LAST FIVE SURVEYS
Median	631 *E. coli* per 100 mL	660 *E. coli* per 100 mL
95th Percentile	7192 *E. coli* per 100 mL	6723 *E. coli* per 100 mL
Alert Compliance	33 %	18 %
Action Compliance	42 %	36 %

The results presented in Figure 4 show that the Wairoa Stream's water quality over the summer was generally poor, exceeding the action level of 550 *E. coli* per 100 mL on 7 of the 12 sampling occasions. As summarised in Table 7, the median, alert and action compliance during 2005-06 were slightly better than previous years, however this is more likely related to the greater number of sampling occasions than an improvement in Water quality.

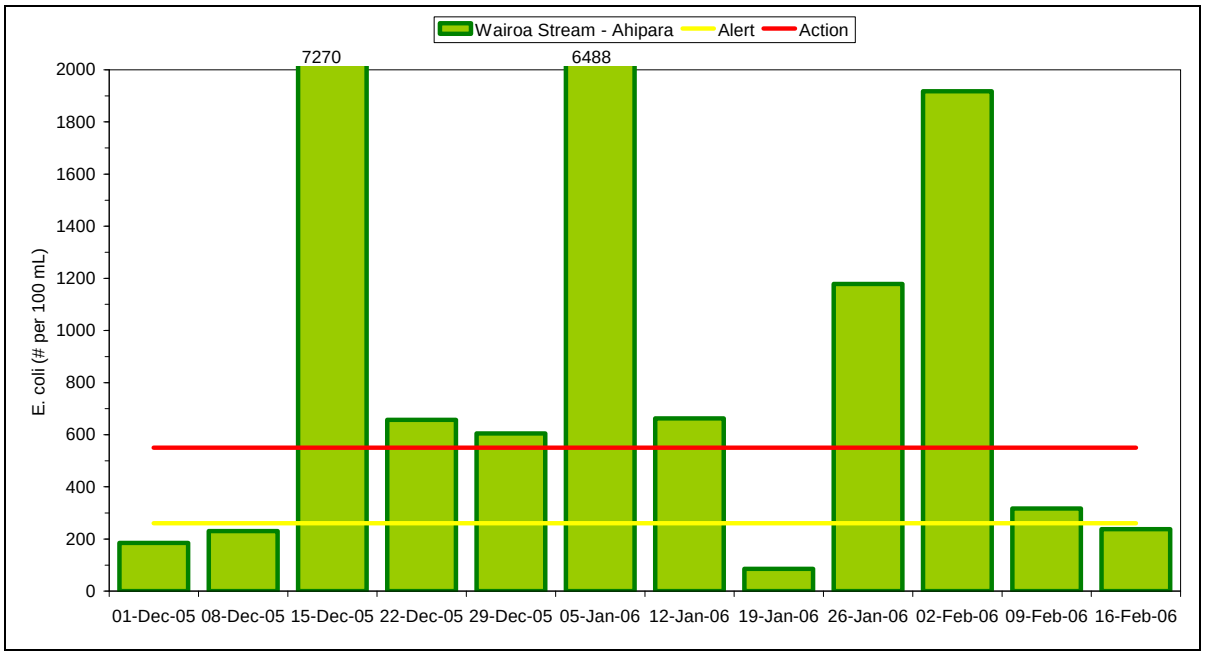

Figure 4: Results from the 2005-06 freshwater recreational contact sampling of Wairoa Stream, Ahipara

Figure 5 shows a comparison between rainfall and *E. coli* over the 2005-06 summer. The extreme peaks in *E. coli* levels in the Wairoa Stream are associated with rainfall events prior to sampling and therefore are most likely as a result of surface runoff. However *E. coli* levels are often elevated above the action level without any significant rainfall in the week prior to sampling such as on 29 December and 12 January. Therefore there is a source or sources of contamination within the catchment that are causing elevated bacterial levels, which are not related to run off during rainfall events.

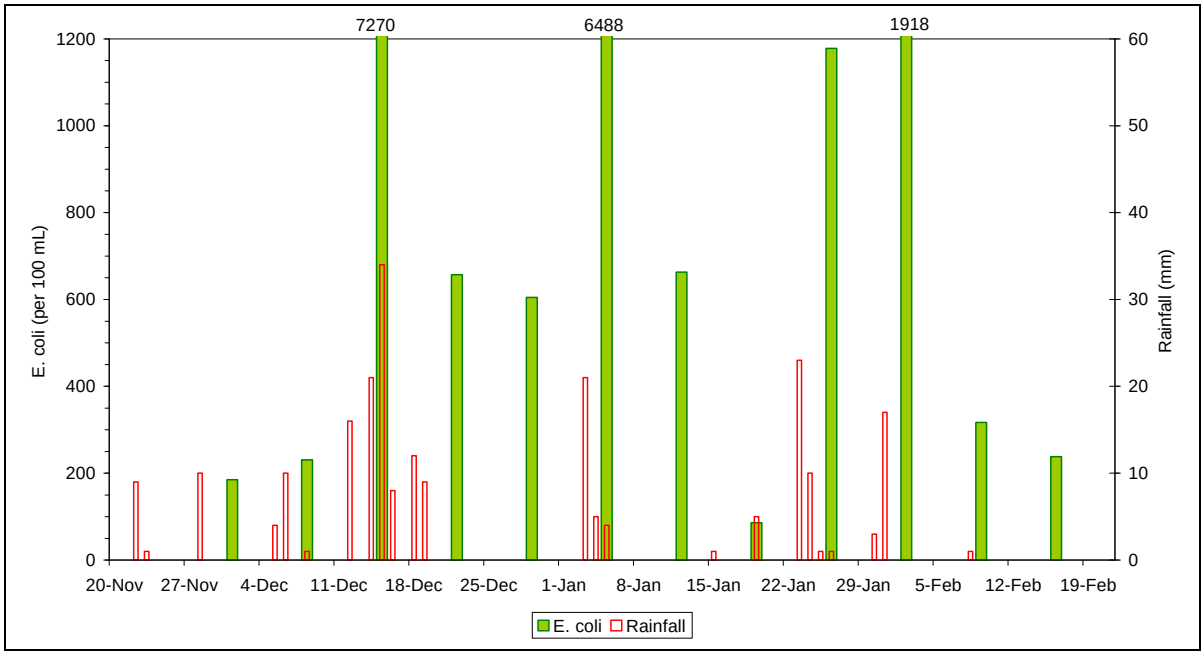

Figure 5: Rainfall and *E. coli* levels in Wairoa Stream over the 2005-06 summer

With a Hazen 95th percentile for the last 5 years of sampling in Wairoa Stream of 6723 E. coli/100mL, it is not surprising that the MAC category is "D" and the interim SFRG grade is "Very Poor". This stream consistently has bacterial levels inappropriate for recreational use and therefore Far North District Council leave a warning sign erected at this site for the majority of the summer, recommending people not to swim.

5.3 TIROHANGA STREAM

SIC: MODERATE **MAC: D** **SFRG: POOR**

The Tirohanga Stream is located east of the Kawakawa Township, and drains into the Bay of Islands. The sampling site is located 50 m downstream of the Far North District Council's water take for Kawakawa. Recreational users are a common sight at the sample area.

Table 8: Collated results for the Tirohanga Stream

	2005-06 SURVEY	LAST FIVE SURVEYS
Median	432 *E. coli* per 100 mL	277 *E. coli* per 100 mL
95th Percentile	3028 *E. coli* per 100 mL	1214 *E. coli* per 100 mL
Alert Compliance	33 %	48 %
Action Compliance	75 %	83 %

In general, the bacteriological quality of the water in Tirohanga Stream was poor in the 2005-06 summer, with E. coli levels only below the alert threshold of 260/100mL on 4 of the 12 sampling occasions (Figure 6). The median, 95th percentile and compliance levels were all worse in the 2005-06 summer when compared to the dataset for the last five years (Table 8).

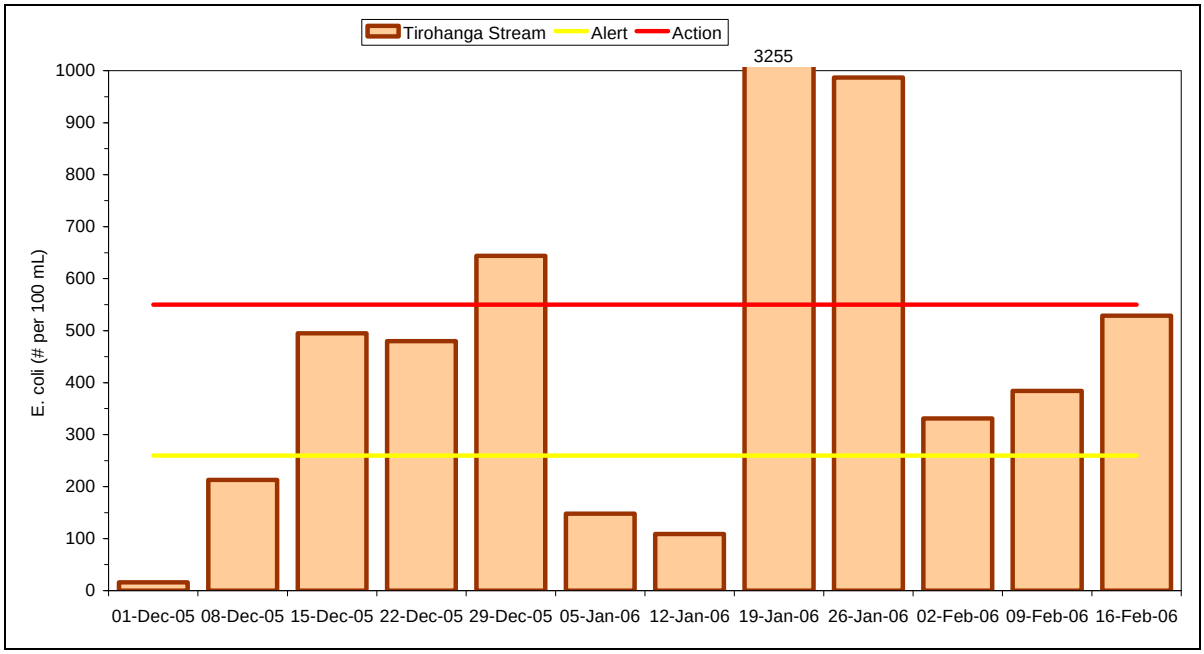

Figure 6: Results from the 2005-06 freshwater recreational contact sampling for Tirohanga Stream

There is no clear relationship between rainfall and elevated E. coli levels, especially with the extreme results of 3255 E. coli/100mL on 19 January which did not have any rain in the two weeks prior to sampling. Moderate to low intensity beef farming is the predominant land-use in the upstream catchment, but it is unlikely that runoff from those farms is the sole source of faecal contamination to the Tirohanga Stream.

Septic tanks, stock access to the stream and feral animals from the areas of remnant bush within the catchment may also be influencing factors. Poorly maintained septic tanks could provide small amounts of contamination during dry periods, and a greater part in wetter conditions when soils are wet and seepage volumes are higher.

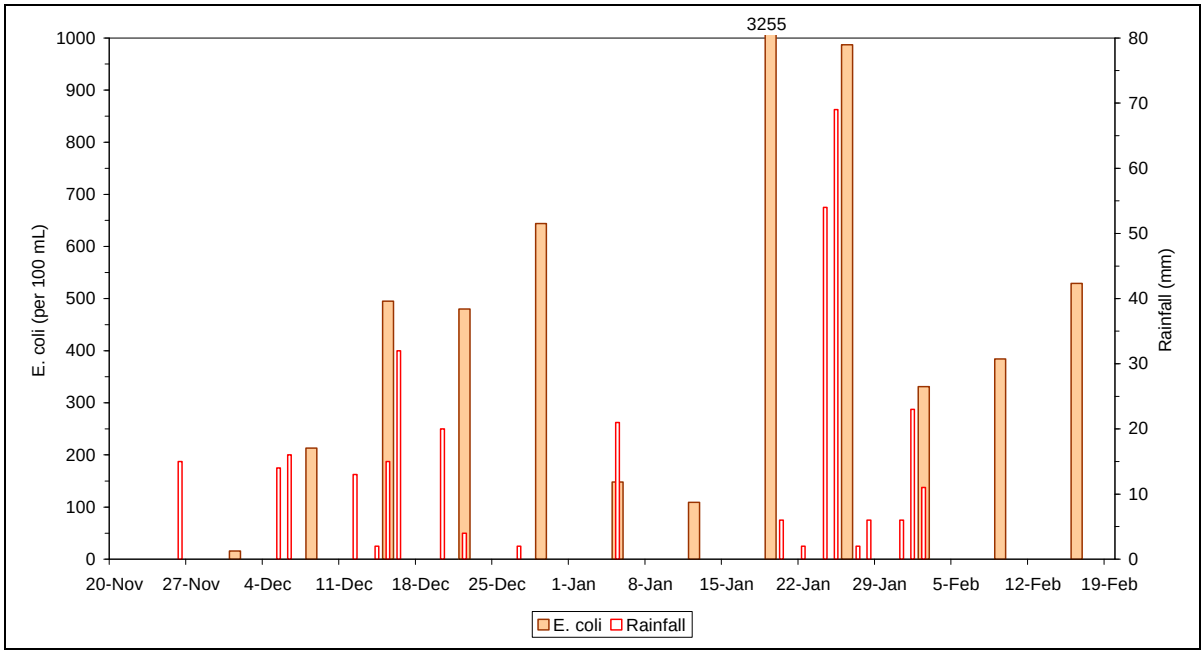

Figure 7: Rainfall and *E. coli* levels in Tirohanga Stream over the 2005-06 summer.

With a Hazen 95th percentile of 1484 E. coli/100mL for the last 5 seasons results the Tirohanga Stream is a MAC category “D” and has a SFRG interim grade of “Poor”. In last years report it was suggested that the grade is likely to improve to “Fair” as more data is obtained but after this year’s poor results it seems this is unlikely.

5.4 WAITANGI RIVER

SIC: HIGH **MAC: D** **SFRG: VERY POOR**

The Waitangi River flows from the middle of Northland (just to the east of Lake Omapere) through into the Bay of Islands, just north of Paihia. The sampling site is located in the middle reaches of the river catchment at a popular swimming hole known as lily pond. Upstream agricultural land use and increasing lifestyle block developments significantly impact upon this stony bottomed and fast flowing river.

Table 9: Collated results for the Waitangi River

	2005-06 SURVEY	LAST FIVE SURVEYS
Median	211 *E. coli* per 100 mL	189 *E. coli* per 100 mL
95th Percentile	2321 *E. coli* per 100 mL	2525 *E. coli* per 100 mL
Alert Compliance	58 %	60 %
Action Compliance	83 %	81 %

The bacterial water quality of the Waitangi River this summer was likeable to the last five surveys, other than last year (2004-05), when all results were unusually low (Table 9). It is not clear why water quality was so much better than usual in 2004-2005 or why it has deteriorated again in the 2005-06 summer. The *E. coli* results over the 2005-06 summer in the Waitangi River exceeded the alert level on three occasions and the action level on a further two occasions (Figure 8).

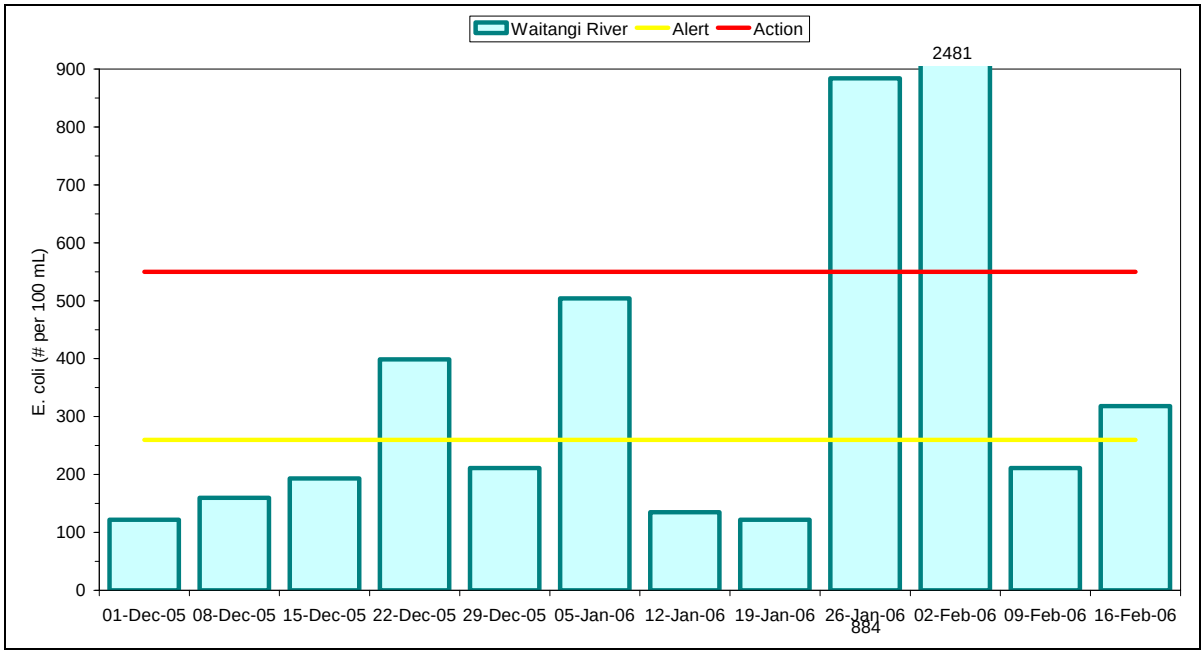

Figure 8: Results from the 2005-06 freshwater recreational contact sampling for Waitangi River

Surface runoff as a result of rainfall appears to be causing elevated *E. coli* levels, as breaches of the alert and action thresholds occur when it has rained prior to sampling (Figure 9). However rainfall cannot be the only factor influencing *E. coli* levels in the river, as *E. coli* levels appear to be slightly elevated even during dry periods (such as on 16 February).

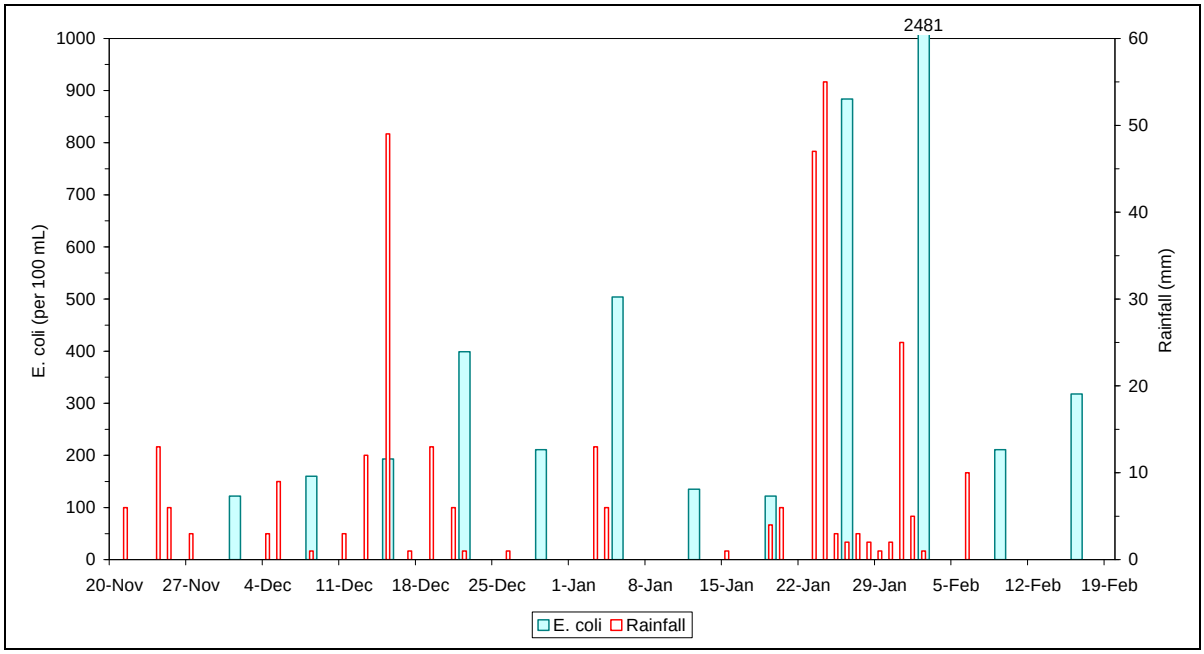

Figure 9: Rainfall and *E. coli* levels for Waitangi River over the 2005-06 summer

With historical compliance rate of only 60% with the alert threshold and a Hazen 95th Percentile of 2525 E. coli/100mL it is not surprising the Waitangi River site has a MAC assessment category of "D" and in turn a interim SFRG grading of "Very poor". It was suggested in the 2004-05 report that a grading of "Poor" would be fairer for this site, however with an increased frequency of threshold exceedences and of a much greater magnitude during the 2005-06 summer this is now under question. Future sampling is needed to confirm whether this deteriorating water quality is a trend.

5.5 KERIKERI RIVER

SIC: HIGH **MAC: D** **SFRG: VERY POOR**

The Kerikeri Basin lies at the base of the Kerikeri River, a river that drains from an intensive horticultural and agricultural catchment through a predominantly urban area. Some parts of the Kerikeri township remain on septic tanks, and these along with agricultural run-off and feral animals in bush remnants are the main potential sources of pathogenic bacteria into the basin. Stormwater discharges and sewage reticulation system failures may also have a significant influence.

Table 10: Collated Results for the Kerikeri River

	2005-06 SURVEY	LAST FIVE SURVEYS
Median	254 *E. coli* per 100 mL	275 *E. coli* per 100 mL
95th Percentile	5793 *E. coli* per 100 mL	6593 *E. coli* per 100 mL
Alert Compliance	50 %	49 %
Action Compliance	67 %	70 %

As shown in Figure 10, there were two breaches of the alert level and a further four breaches of the action threshold. However the median and Hazen 95th Percentile were still lower for the 2005-06 survey than previous years (Table 10).

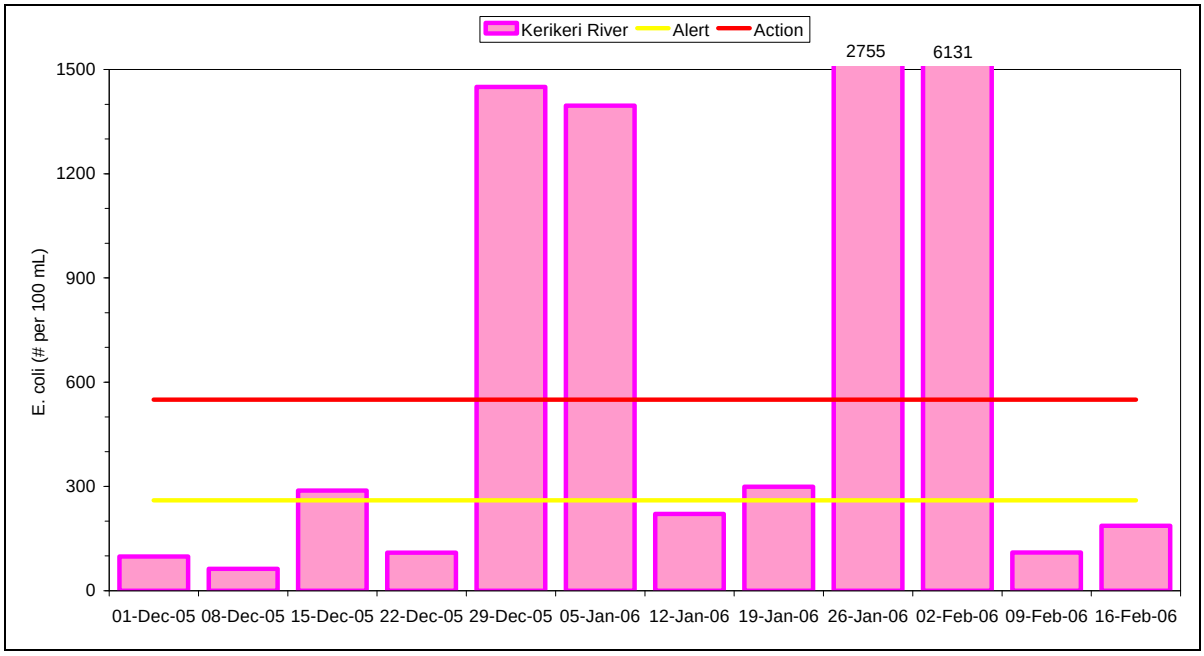

Figure 10: Results from the 2005-06 freshwater recreational contact sampling for Kerikeri River

There is no obvious correlation between rainfall and *E. coli* in the Kerikeri River (Figure 11), at least at the river basin. Several of the extreme spikes in bacterial contamination such as 29 December and 5 January did not have any rain prior to sampling. The likely source of these contamination events is excrement from waterfowl. Both NRC and FNDC sampling officers have noticed consistently high densities of waterfowl in the Kerikeri basin. Other possible sources of contamination during dry periods include septic tank or reticulated system failures and stock access upstream of the sampling site. As this part of the river

continues to have elevated E. coli levels most likely as a result of waterfowl, the shifting of the sampling site to below the rainbow falls approximately 3.5 kilometres upstream will be investigated next summer. The pool below the rainbow fall has a higher use by recreational bathers than the current sampling site located by the Stone Store (Prangley pers. comm..).

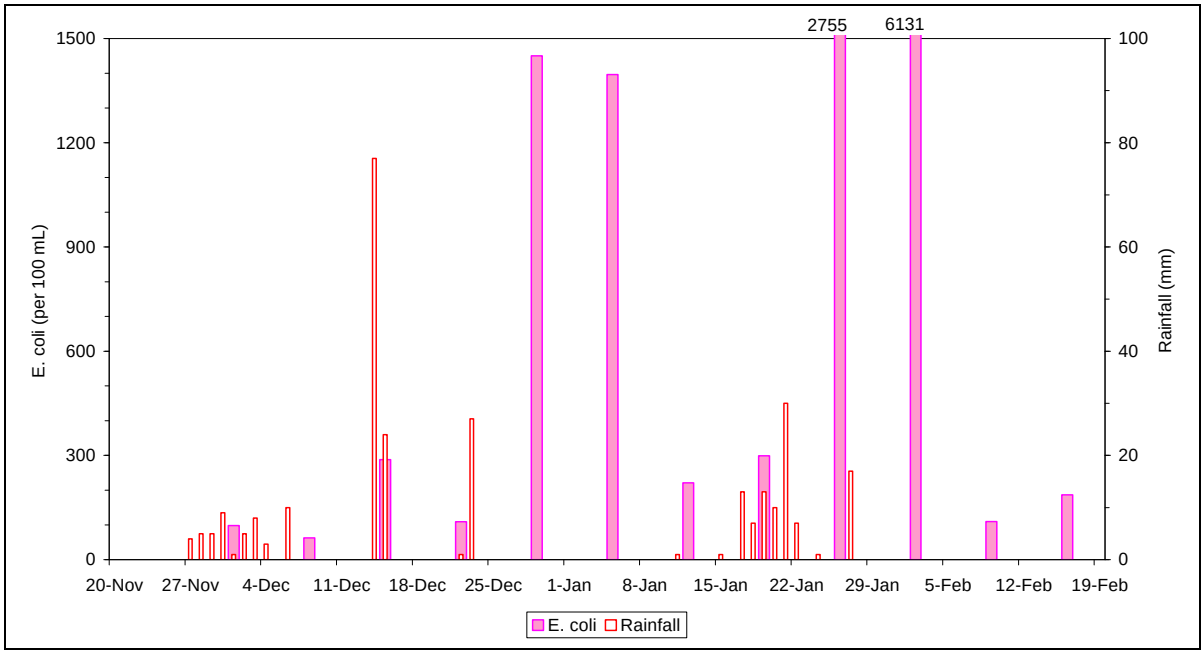

Figure 11: Rainfall and *E. coli* levels for the Kerikeri River over the 2005-06 summer

Like many our of river bathing sites in Northland the results for Kerikeri River produce a MAC category of "D". This coupled with a SIC assessment result indicating there is a "high" risk of faecal contamination, gives an interim SFRG grade for the Kerikeri River site at stone store of "Very Poor".

5.6 KAPIRO STREAM

SIC: MODERATE **MAC: D** **SFRG: POOR**

Kapiro Stream drains north of Kerikeri into the Bay of Islands through a predominantly agricultural and horticultural catchment. Local children frequently use the swimming hole at the Parerua Road Bridge in particular during the summer, and the site was added to the programme after public request was made to Northland Health in the middle of January 2004. There is now three seasons of data for this site, enough to calculate an interim SFRG grade.

Table 11: Collated results for the Kapiro Stream

	2005-06 SURVEY	LAST THREE SURVEYS
Median	153 *E. coli* per 100 mL	180 *E. coli* per 100 mL
95th Percentile	709 *E. coli* per 100 mL	739 *E. coli* per 100 mL
Alert Compliance	67 %	57 %
Action Compliance	83 %	89 %

Bacteriological results were slightly better in the 2005-06 season with a lower median and Hazen 95th percentile and higher alert compliance rate than the two previous summers (Table 11). Two samples exceeded the action threshold of 550 *E. coli* per 100 mL, and a further two samples contained *E. coli* above the alert threshold of 260 *E. coli* per 100 mL (Figure 12). However compared to many of the other river sites in Northland Kapiro Stream is relatively good even after heavy rain, with no extreme peaks of E. coli over 1000 cells/100mL and a 95th percentile of only 739 E. coli per 100mL for the last three summers.

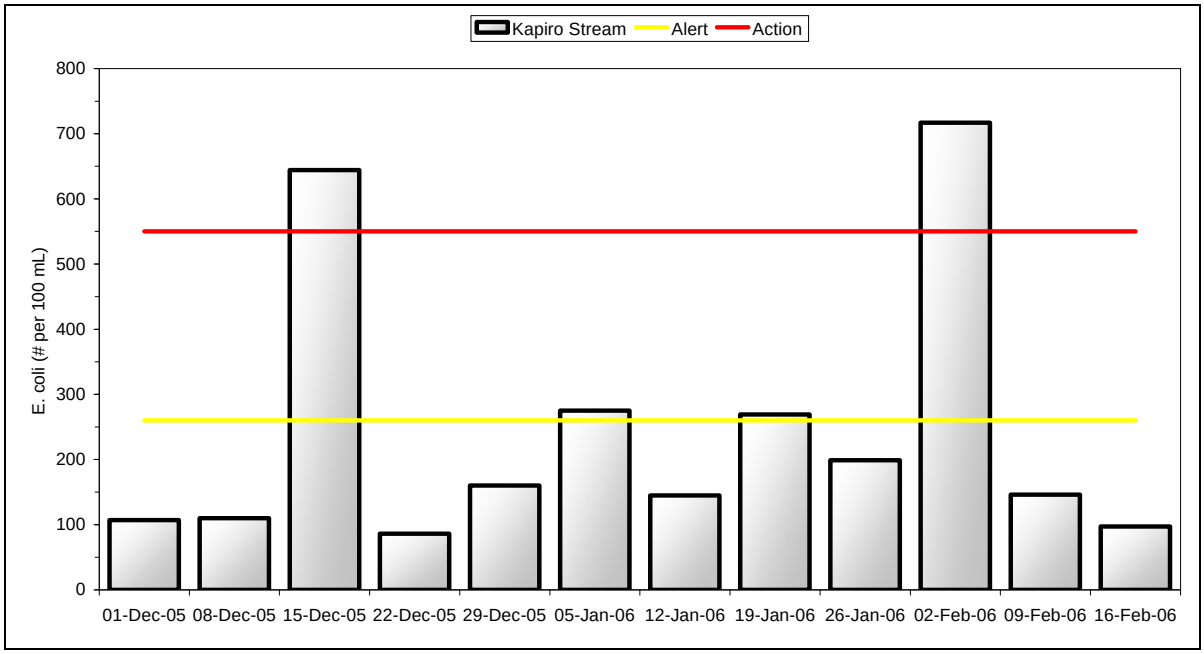

Figure 12: Results from the 2005-06 freshwater recreational contact sampling for Kapiro Stream

As the spikes in E. coli are relatively small and infrequent it is difficult to say whether there is a relationship between rainfall and *E. coli* populations in the Parerua swimming hole on Kapiro Stream (Figure 13). However based on the last three seasons data it is likely that

rainfall causes slight elevations in bacterial contamination if any. The elevated *E. coli* result on the 15th December could be linked to surface run off, however it should be noted that the spike was relatively small at 644 E. coli per 100mL when compared to spikes in E. coli found at other river sites after rainfall.

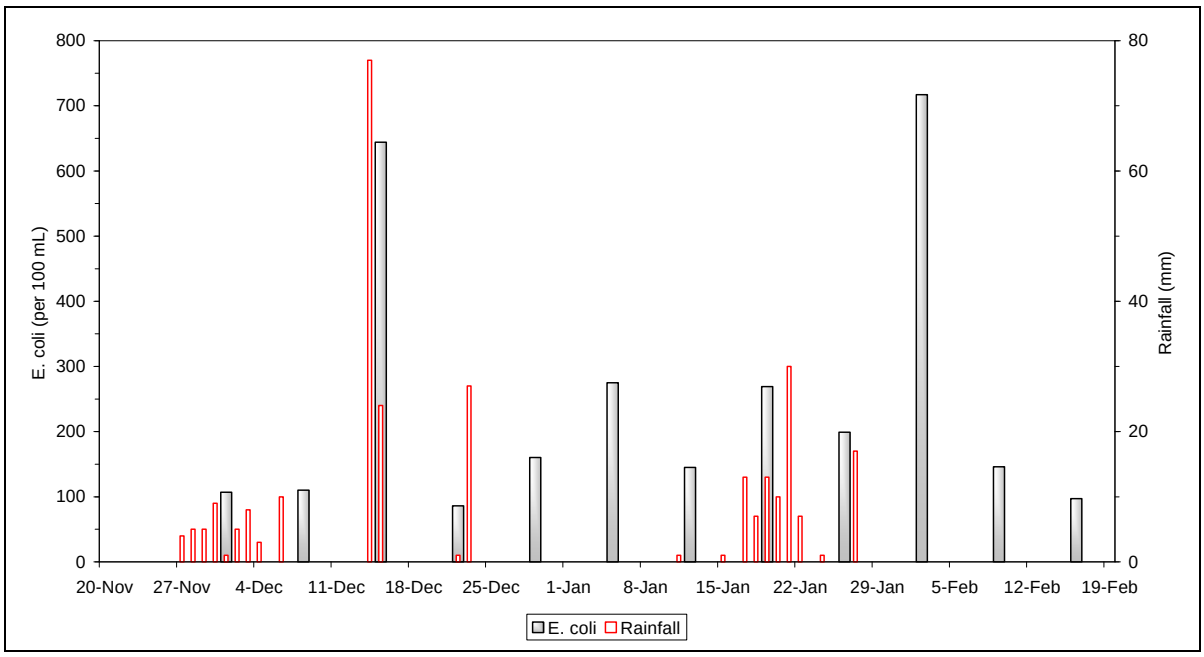

Figure 13: Rainfall and *E. coli* data for Kapiro Stream over the 2005-06 summer

As mentioned earlier there is now sufficient data to calculate the MAC and in turn the SFRG for this site. With a SIC assessment of "moderate" susceptibility to faecal contamination and a MAC category of "D" the interim SFRG grade for the Kapiro Stream site is "Poor". If bacterial water quality continues to be reasonably good in Kapiro Stream it is possible that the 95th percentile will continue to drop. Once the 95th percentile drops below 550 E. coli per 100mL the MAC category will shift to "C" and in turn the SFRG grade will shift from "Poor" to "Fair".

5.7 OTIRIA STREAM

SIC: VERY HIGH **MAC: D** **SFRG: VERY POOR**

The Otiria Waterfall is a popular swimming hole for people from Moerewa, but the water quality at the site is particularly poor. The Far North District Council has done some investigative sampling in the area, and agricultural effluent appears to be a major contributor, as well as some influence from a large natural wetland and lake (Prangley, pers. comm.). A combination of this intensive agricultural land use, along with the possibility of leaking septic tanks have made the Otiria Stream unfit for swimming all year round, regardless of weather conditions or water clarity for several years.

In light of the findings, local authorities have erected a permanent sign at the falls warning people of the elevated health risk. Northland Health and local community groups continue to work on improving the stream's health.

Table 12: Collated results for the Otiria Stream

	2005-06 SURVEY	LAST FIVE SURVEYS
Median	1475 *E. coli* per 100 mL	1122 *E. coli* per 100 mL
95th Percentile	5808 *E. coli* per 100 mL	3716 *E. coli* per 100 mL
Alert Compliance	0 %	0 %
Action Compliance	8 %	16 %

As expected, bacterial water quality at the Otiria Stream site was extremely poor over the entire summer. All samples exceeded the action threshold, except the 1st of December, which was still high with 419 *E. coli* per 100mL breaching the alert threshold, (Figure 14). The median, Hazen 95th percentile and action compliance rate were worse in the 2005-06 summer compared to previous surveys, suggesting that water quality at the site has deteriorated compared to historical records.

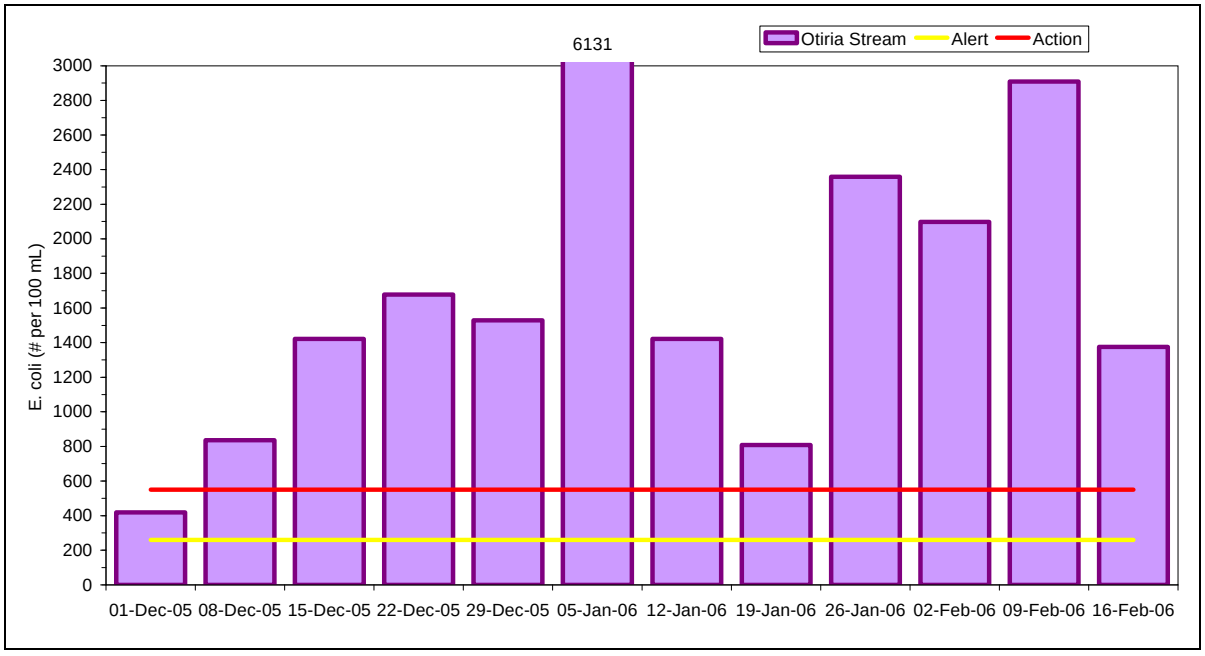

Figure 14: Results from the 2005-06 freshwater recreational contact sampling for Otiria Stream

The most disturbing aspect of a comparison between rainfall and *E. coli* information for the Otiria Falls swimming hole is that rain and therefore surface run-off appears to have no effect upon the situation (Figure 15). The highest peak in E. coli on 5 January had no rain prior to sampling and just over 20 mm on the day of sampling, likewise the second highest peak in E. coli on 9 February had no rain on the day of or prior to sampling.

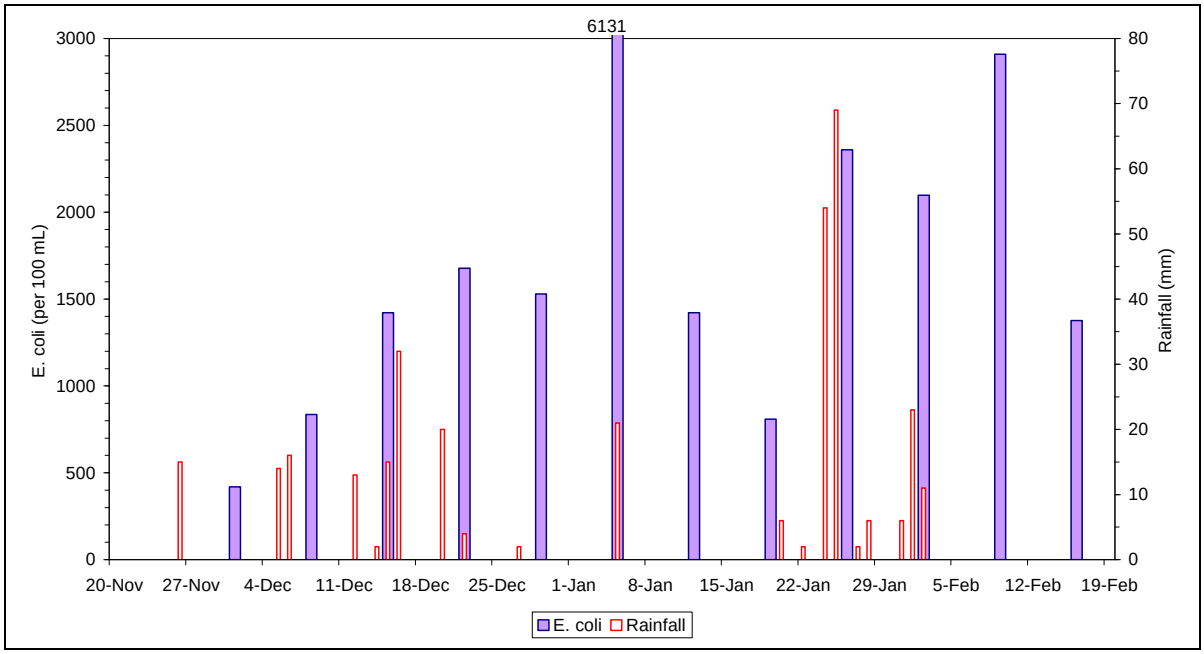

Figure 15: Rainfall and *E. coli* data for Otiria Stream over the 2005-06 summer

Otiria Stream continually has bacterial water quality making it the worst site of all sites sampled in Northland for recreational bathing. With a historical alert compliance rate of 0% and an extremely high 95th percentile of 3716 E. coli per 100mL for the last 5 years, it is no surprise that the interim SFRG grade is "Very Poor". Unless the mitigating circumstances improve dramatically, Otiria Stream will remain in extremely poor health, and should not be used for contact recreation until further notice.

There is potential to carry out faecal sterol analysis on samples with high *E. coli* results to investigate the likely source(s) of contamination i.e. humans, stock or birds. However this is a specialised and expensive test, which is not always conclusive, and therefore is only used when there is a significant need. Samples collected on 8 December were analysed for faecal sterols and the results indicate that there is no contamination from human sources, but there is some indication of contamination from sheep or cows. However nowhere near the levels found at this site, so therefore it is likely there is contamination from other sources that can not yet be identified using faecal sterol analysis, such as birds, possums, wild pigs and goats.

5.8 WAIPAPA RIVER

SIC: MODERATE **MAC: D** **SFRG: POOR**

Lake Manuwai, one of the Kerikeri irrigation dams, is the major source of water into the Waipapa River. From the lake, the river winds through an agricultural and horticultural catchment. Historically, the Waipapa landing on the Waipapa Stream has been a popular site for water users and picnickers.

Table 13: Collated results for the Waipapa Stream

	2005-06 SURVEY	LAST FIVE SURVEYS
Median	133 E. coli per 100 mL	140 E. coli per 100 mL
95th Percentile	1142 E. coli per 100 mL	1218 E. coli per 100 mL
Alert Compliance	83 %	74 %
Action Compliance	83 %	89 %

The Waipapa Stream site was suitable for recreational bathing for the majority of the 2005-06 summer, however levels exceeded the action threshold of 550 E. coli per 100ml on 2 occasions (Figure 16). The median, 95th percentile and alert compliance rate were better in the 2005-06 summer compared to the last five summers.

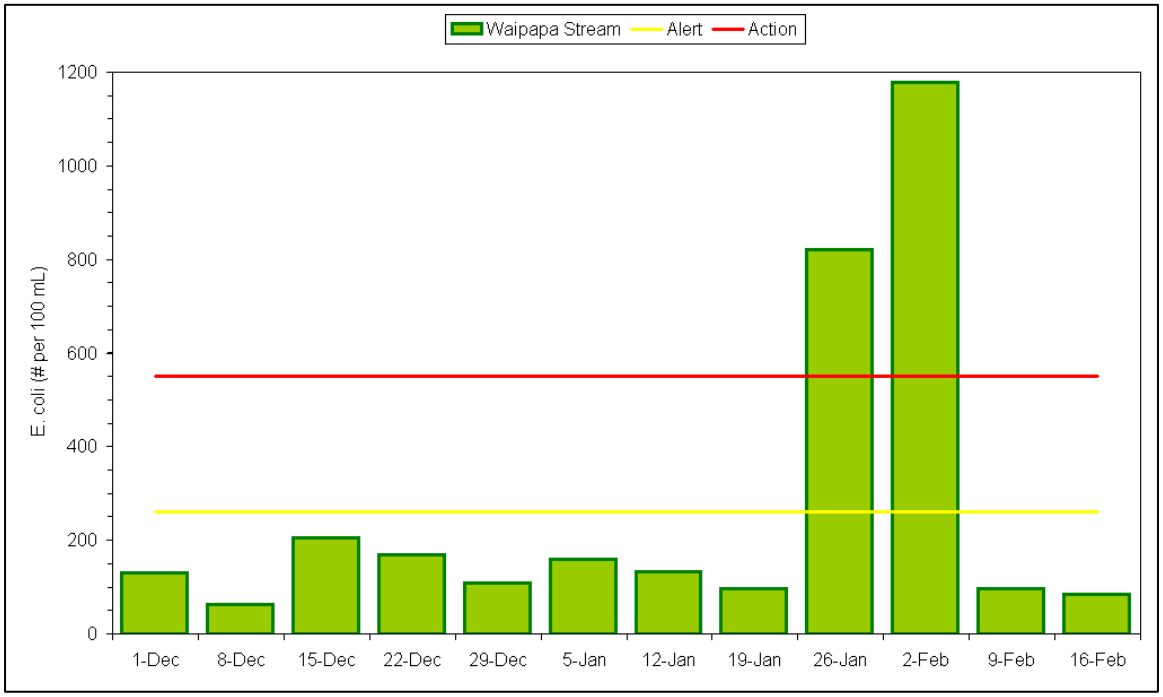

Figure 16: Results from the 2005-06 freshwater recreational contact sampling for Waipapa Stream

It is likely that bacteriological levels in Waipapa Stream are quite strongly related to rainfall (Figure 17), with the two breaches of the alert threshold occurring after periods of rain.

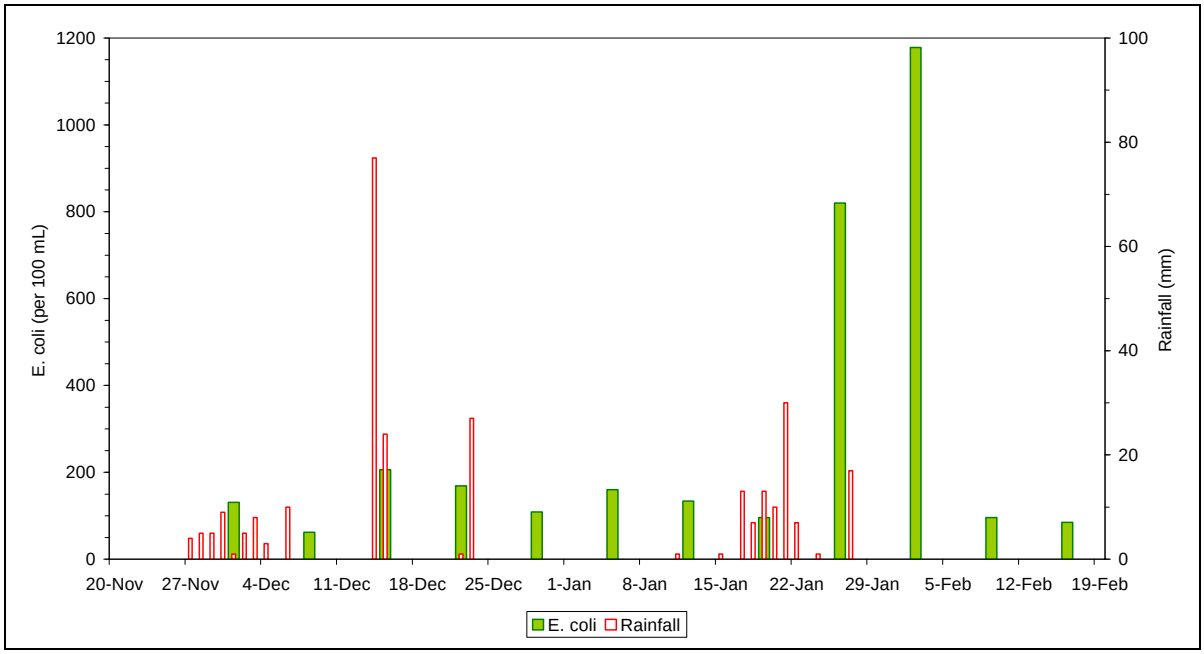

Figure 17: Rainfall and *E. coli* data for the Waipapa Stream over the 2005-06 summer

An interim SFRG of "Poor" is not an accurate reflection of the state of the Waipapa Stream. Spikes after heavy rainfall have created a "D" MAC category, but for the bulk of the summer the stream's water quality is good and with a SIC assessment of "Moderate", a grading of "Fair" would be a better assessment of the situation at Waipapa Landing. Therefore it is recommended that any public description of the site should explain this particular discrepancy. Such a site is a good example of where the MfE guidelines are perhaps too rigid, as any site that has significant rain for more than 5% of the time can potentially fail (i.e. be categorised as poor or very poor), even if for the rest of the time water quality is very good.

5.9 WAITAUA STREAM

SIC: HIGH **MAC: D** **SFRG: VERY POOR**

Waitaua Stream originates North of Whangarei, flows around the edge of an urban area on the East of Whangarei and eventually becomes the Hatea (Hotea) River. Unlike most of the sites sampled during the recreational bathing surveys, the Whangarei Falls site is largely unaffected by agriculture. While the upper catchment does contain some mixed beef farming, the catchment is predominately a mix of lifestyle blocks and urban areas. The mostly urban lower catchment has the potential for bacterial contamination if septic tanks are not well maintained or if problems arise with the reticulated sewage system.

Historically, *E. coli* populations have been consistently elevated, high enough that a permanent warning sign has been erected. In spite of the warning sign, children are frequently observed swimming at the site during sampling, and it can be assumed that usage is heavy throughout summer.

Table 14: Collated data for the Waitaua Stream

	2005-06 SURVEY	LAST FIVE SURVEYS
Median	379 E. coli per 100 mL	399 E. coli per 100 mL
95th Percentile	1392 E. coli per 100 mL	4788 E. coli per 100 mL
Alert Compliance	25 %	32 %
Action Compliance	67 %	72 %

According to Table 14, the water quality of the Waitaua Stream at the Whangarei Falls was worse over the 2005-06 summer than previous summers, with four breaches of the 550 *E. coli* per 100 mL action threshold. As shown in Figure 18, water quality at the site was variable throughout the summer, but generally very poor for the entire summer, with it only being suitable for bathing on three occasions (less than the alert threshold).

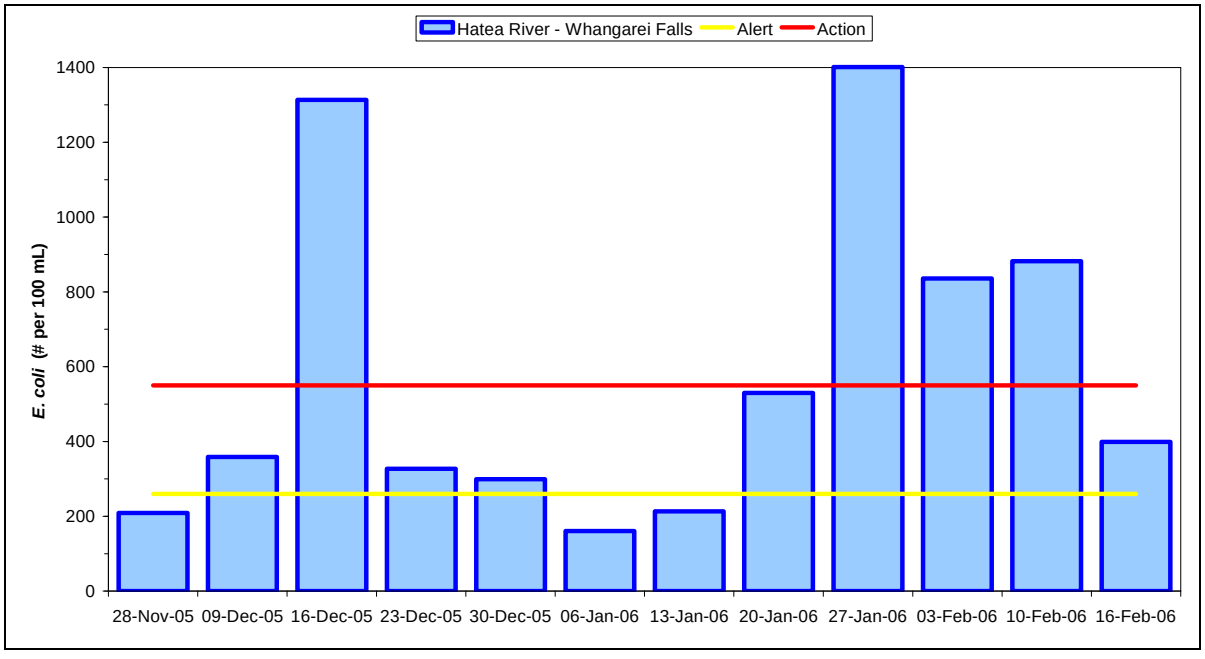

Figure 18: Results from the 2005-06 freshwater recreational contact sampling for Waitaua Stream at Whangarei Falls

Although in general bacterial water quality is consistently poor in Waitaua Stream irrelevant of rainfall, it seems that rainfall causes bacterial levels to rise even further, such as the four breaches of the action level which tended to coincide with periods of rain (Figure 19). This is consistent with last previous years results.

This indicates that there could be several factors influencing water quality in Waitaua Stream, including those that are not related to rainfall such as leakage from poorly maintained septic tanks, stock access or waterfowl and those that are such as stormwater discharges and agricultural run-off.

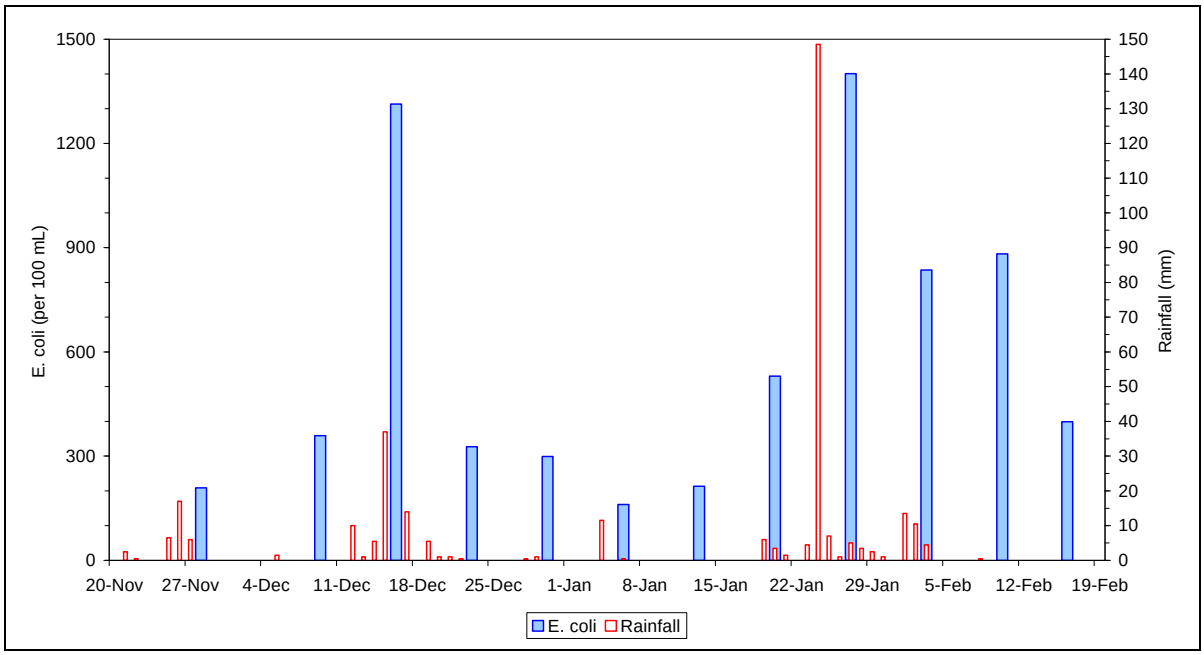

Figure 19: Rainfall and *E. coli* data for the Waitaua Stream at Whangarei Falls over the 2005-06 summer

Overall, *E. coli* populations were higher in the Waitaua Stream than at most sites around Northland, with a median above the 260 *E. coli* per 100 mL alert guideline. The interim Suitability for Recreation Grade for Waitaua Stream has been calculated as “Poor” with a Hazen 95th percentile of 4788 E. coli for the last five seasons. This is a realistic grading for Waitaua Stream when compared to other Northland freshwater bathing sites as it is often not suitable for swimming (only suitable 32% of the time over the last 5 summers) and has an extremely high median and 95th percentile.

5.10 RAUMANGA STREAM

SIC: MODERATE **MAC: D** **SFRG: POOR**

The Raumanga Stream flows through a similar catchment to the Waitaua Stream. The land use is chiefly urban so any problems with reticulated sewage will impact upon the stream, while lifestyle blocks and low-intensity agriculture in the upper catchment also present possible sources of contamination.

The Raumanga Stream is sampled at a swimming hole in the Raumanga Valley Reserve, a particularly popular park over summer. Water quality is variable, reflected in low compliances historically. Nonetheless, the swimming hole is very popular, especially for children. Stormwater is the likely source of most of the bacteriological contamination into the river.

Table 15: Collated results for the Raumanga Stream

	2005-06 SURVEY	LAST FIVE SURVEYS
Median	262 *E. coli* per 100 mL	265 *E. coli* per 100 mL
95th Percentile	6255 *E. coli* per 100 mL	5342 *E. coli* per 100 mL
Alert Compliance	50 %	50 %
Action Compliance	75 %	71 %

The results from the Raumanga Stream swimming hole did not deviate far in the 2005-06 summer from pervious summers and similarly to the Waitaua Stream site, median *E. coli* values have remained quite high at the Raumanga Stream site (Table 15). As shown in Figure 20, the *E. coli* results breached the action threshold three times over the summer months, and exceeded the alert level on a further three occasions.

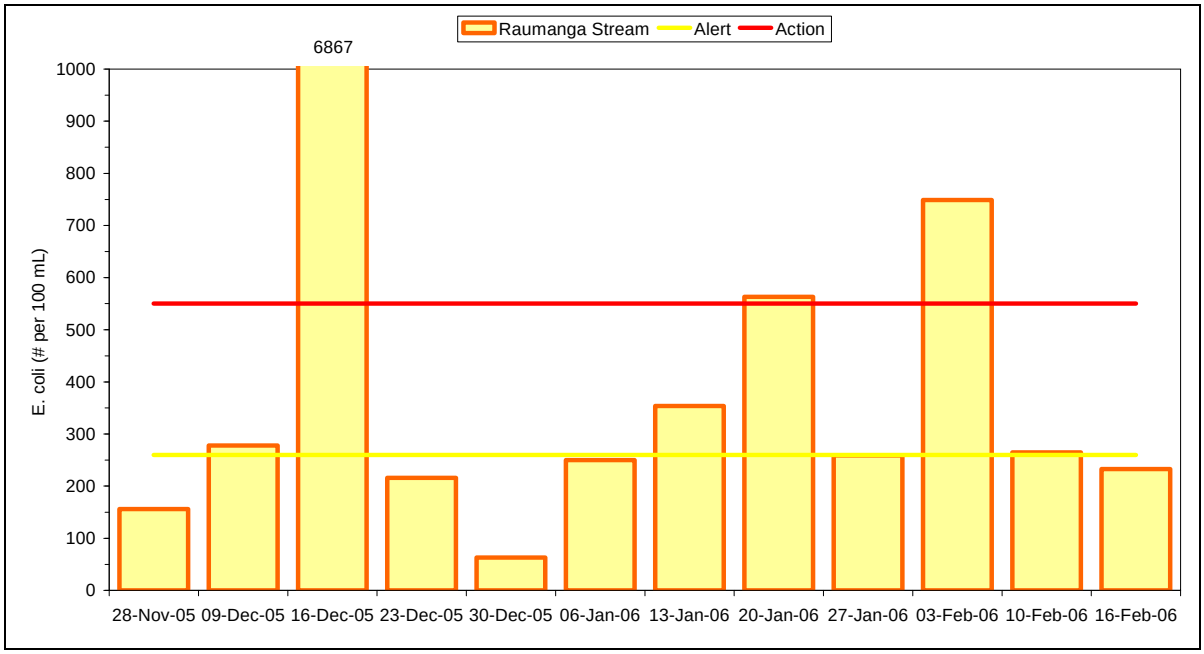

Figure 20: Results from the 2005-06 freshwater recreational contact sampling for Raumanga Stream

In the 2003-04 survey it was found that elevated *E. coli* results was related to rainfall, where more than 10mm of rain in the day preceding sampling appeared to flush high numbers of *E. coli* into the Raumanga Stream, and the greater the rainfall, the greater the number of *E. coli* (Wlson 2004). In the 2005-06 survey, rainfall up to 4 days prior to sampling appeared to cause elevated *E. coli* results in Raumanga Stream, however there were also sampling events had elevated *E. coli* results without rainfall prior to sampling such as 13th January.

Therefore the majority of bacterial contamination in Raumanga Stream is most likely related to sources associated with rainfall events such as agricultural runoff and stormwater.

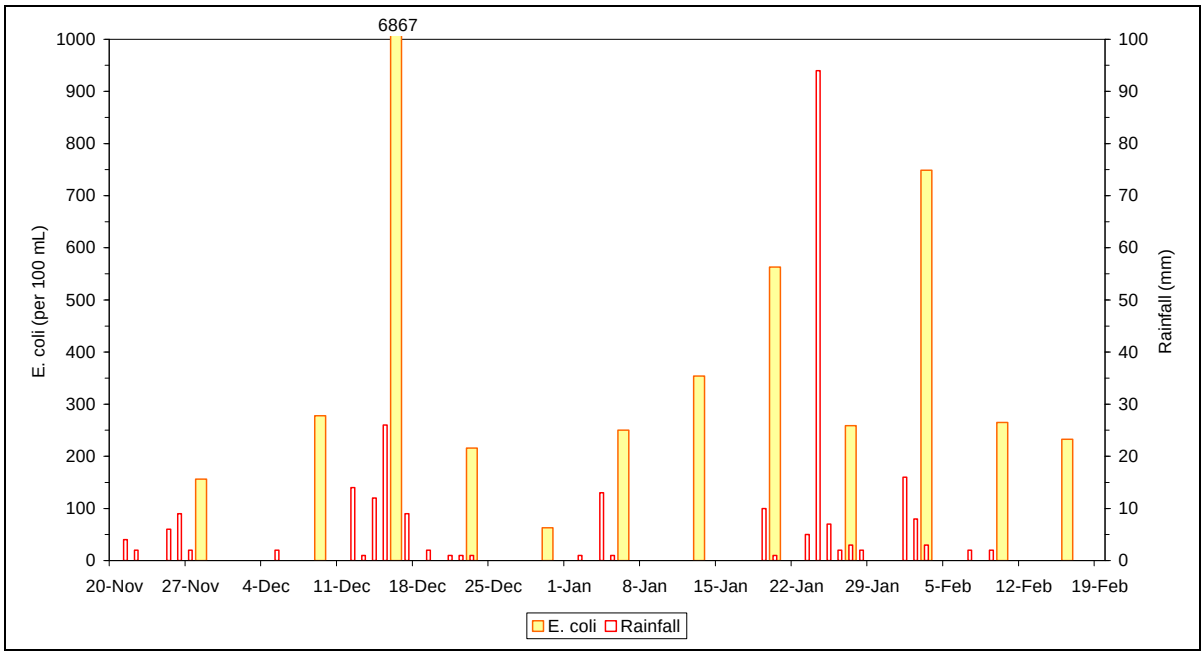

Figure 21: Rainfall and *E. coli* results for the Raumanga Stream over the 2005-06 summer

The probable relationship between rainfall and *E. coli* levels in the Raumanga Stream that causes extremely high *E. coli* spikes during rainfall events such as the 6867 *E. coli* per 100 ml that occurred on 16 December is causing the 95th percentile to be very high (5342 E. coli/100mL for the last five summers). This and the historic alert compliance of only 50% and an action compliance of 71% suggests that the interim SFRG grading of "Poor" for Raumanga Stream is realistic.

Whether or not a sign should be erected at this site is not clear-cut, and it may be that education, especially at local schools, about the basic rules of swimming[4] in rivers is the best way to minimise the occurrence of bathing-related illnesses.

[4] As outlined in the introduction of this document.

5.11 OTAUA STREAM

SIC: MODERATE **MAC: D** **SFRG: POOR**

The Otaua Stream swimming hole on Otaua Road west of Kaikohe was sampled for the first time this year due to its popularity and concerns over water quality after an outbreak of gastroenteritis in the community in November 2004 (Tahi Morton pers. comm.). The site is located just up the road from a marae and has predominantly agricultural land use in its upstream catchment.

There would be contamination risks associated with agricultural runoff and poorly maintained septic tanks in the rural areas upstream of the swimming hole. There is now adequate bacteriological data for this site to calculate an interim SFRG grade.

Table 16: Collated results for Otaua Stream, Kaikohe

	2005-06 SURVEY	LAST TWO SURVEYS
Median	593 *E. coli* per 100 mL	317 *E. coli* per 100 mL
95th Percentile	2853 *E. coli* per 100 mL	3586 *E. coli* per 100 mL
Alert Compliance	17 %	45 %
Action Compliance	42 %	64 %

Water quality at the Otaua Stream swimming hole was much worse in 2005-06 than the year before and it is not clear why. There were only two exceedances of the alert threshold in the 2004-05 sampling season (Cook 2005), while there were 10 exceedances this year (Figure 22). The 95th percentile dropped slightly this year but otherwise the median and compliance rates were worse than last year (Table 16).

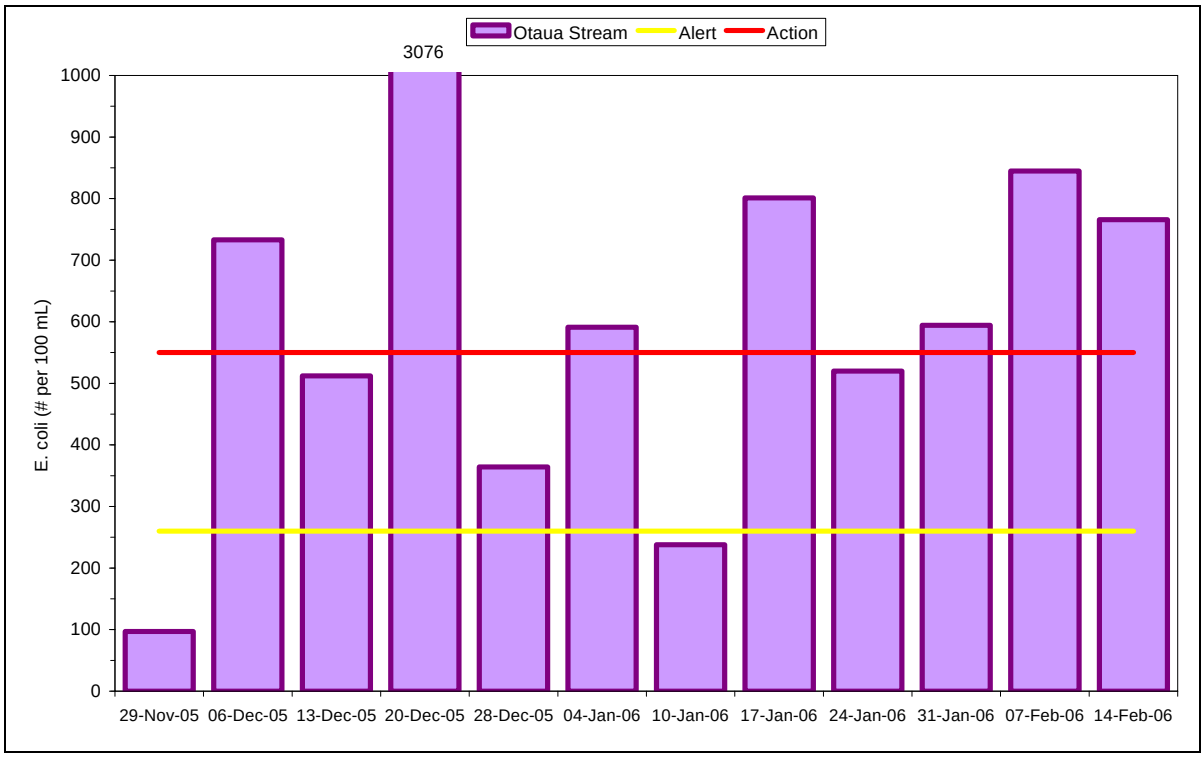

Figure 22: Results from the 2005-06 freshwater recreational contact sampling for Otaua Stream swimming hole

Figure 23 shows that some of the elevated E. coli results are related to rainfall prior to sampling but some are not such as the spike on 17 January. The results from 2005-06 suggest that there is a source of contamination that occurred for the majority of the summer irrelevant of rainfall. It is unlikely to be excrement from water fowl as birds were never seen at or near this site. It therefore could be leaking septic tanks or/and stock access to the stream.

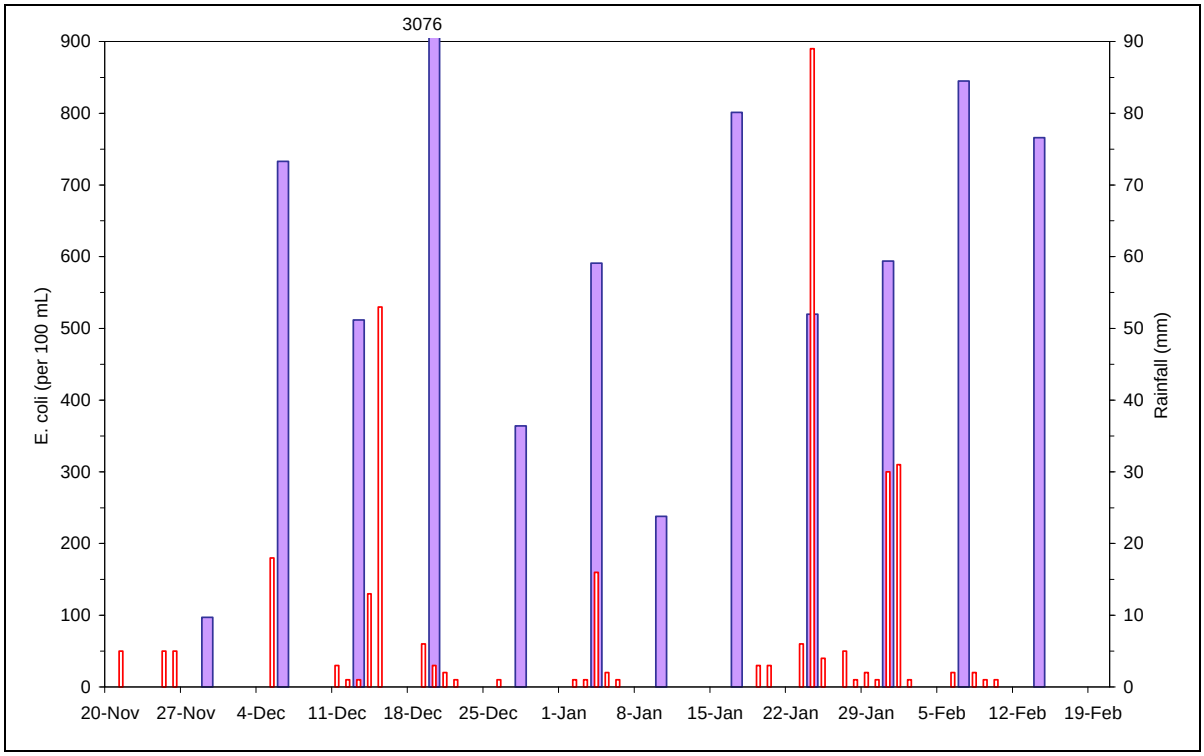

Figure 23: Rainfall and *E. coli* levels for Otaua Stream over the 2005-06 summer

With a SIC assessment category of “moderate” and MAC category of “D”, the interim SFRG grade for Otaua Stream is “Poor”. However very little can be drawn from this interim grading as it is only based on two seasons data, where the two seasons have had quite different bacterial results. Sampling will continue at Otaua Stream to clearly identify what the risks are to recreational users at this site.

5.12 MANGAKAHIA RIVER @ TWIN BRIDGES

SIC: MODERATE **MAC: D** **SFRG: POOR**

The Mangakahia River catchment upstream of Twin Bridges is a mix of native forest, exotic forestry and moderately intensive sheep and beef farming. The Twin Bridges is a popular spot for picnics, camping and swimming, however there are no public toilets available.

Table 17: Collated results for Mangakahia River at Twin Bridges

	2005-06 SURVEY	LAST FIVE SURVEYS
Median	259 *E. coli* per 100 mL	246 *E. coli* per 100 mL
95th Percentile	4048 *E. coli* per 100 mL	4783 *E. coli* per 100 mL
Alert Compliance	50 %	48 %
Action Compliance	67 %	71 %

The Twin Bridges site is one of the more pleasant sites to sample over summer, however water quality was relatively poor over the 2005-06 survey, with an alert compliance rate of only 50% (Table 17). Bacterial water quality this summer was similar to 2004-05, with a 50% alert compliance rate and a similar median (274 in 2004-05). However the 95th percentile was much higher this year due to the extreme peak of E. coli recorded on 24 January of 4352 per 100mL (Figure 24).

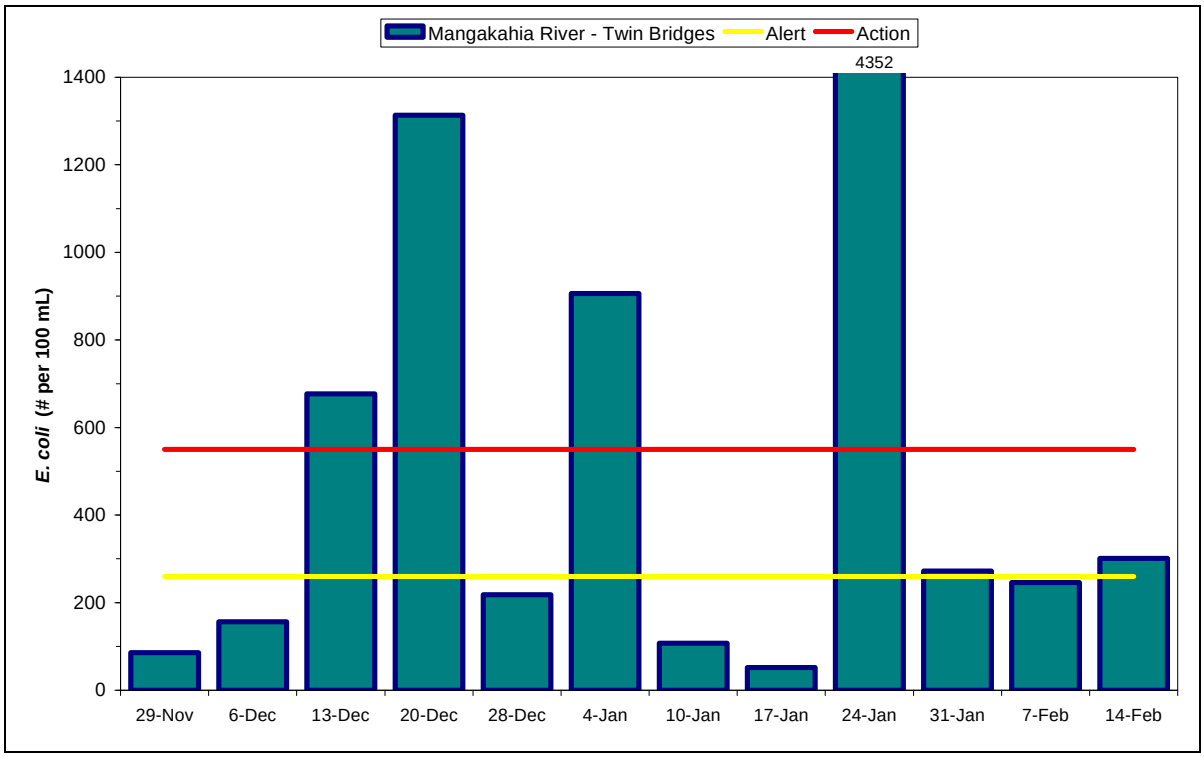

Figure 24: Results from the 2005-06 freshwater recreational contact sampling for Mangakahia River at Twin Bridges

Figure 25 suggests that there is a link between runoff as a result of rainfall and *E. coli* at the Twin Bridges. The more rainfall prior to sampling tended to lead to higher *E. coli* levels and the lowest *E. coli* result was recorded after a week of no rain. The extreme peak of E. coli recorded on 24 January is most likely a result of the 63 mm of rain received on that day. Given the upstream land use of the catchment it is likely that agricultural or forestry run-off is the most likely source of the contamination.

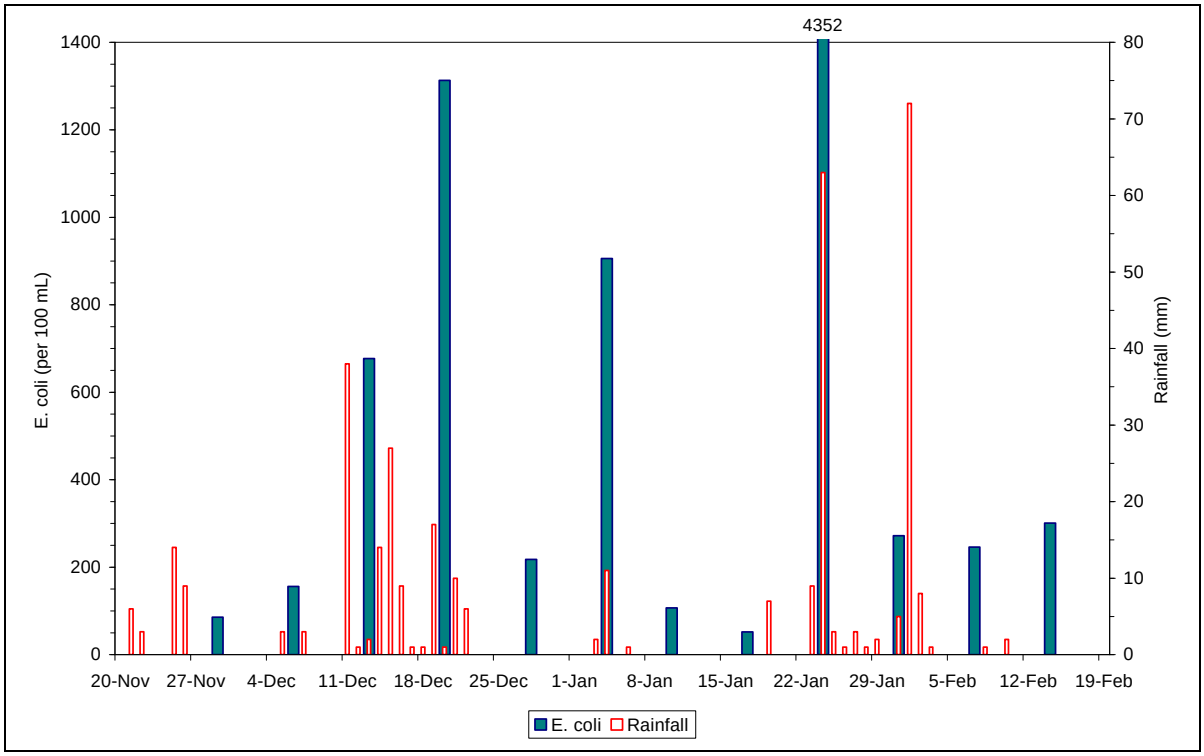

Figure 25 Rainfall and *E. coli* levels at the twin bridges (Mangakahia River) over the 2005-06 summer

The interim SFRG grading of "poor", is perhaps overly harsh, given the strong correlation with rainfall at the site. However, until the causes of the spikes are isolated and remedied, it is unlikely that the 95th percentile for the site (and therefore the MAC) will improve in the near future.

5.13 KAIHU RIVER

SIC: MODERATE **MAC: D** **SFRG: POOR**

The Kaihu River drains from a catchment that is a mix of native bush and agricultural farmland, with a number of dairy farms upstream of the sampling site. The Regional Council takes samples below the camping ground, which is extremely popular over the summer months. By the time the Kaihu River reaches the motor camp, the river includes both the Waima River and Mangatu Stream. In 2005-06 an extra site on the Kaihu River by the Rugby club was sampled (see section 5.19.1).

Table 18: Collated results for the Kaihu River

	2005-06 SURVEY	LAST FIVE SURVEYS
Median	146 *E. coli* per 100 mL	109 *E. coli* per 100 mL
95th Percentile	4783 *E. coli* per 100 mL	5285 *E. coli* per 100 mL
Alert Compliance	75 %	71 %
Action Compliance	75 %	73 %

The bacterial water quality results for Kaihu River for 2005-06 were similar to the last five seasons (Table 18). There were three exceedances of the action threshold, all of which were extreme spikes in E. coli (Figure 26). It was therefore unusual, that there were no further exceedances of the alert threshold, however this is consistent with previous years results (Wilson 2004, Cook 2005). Results tend to be extreme at this site, with samples usually containing less than 200 *E. coli* per 100 mL, other than extreme spikes where counts reached several thousand.

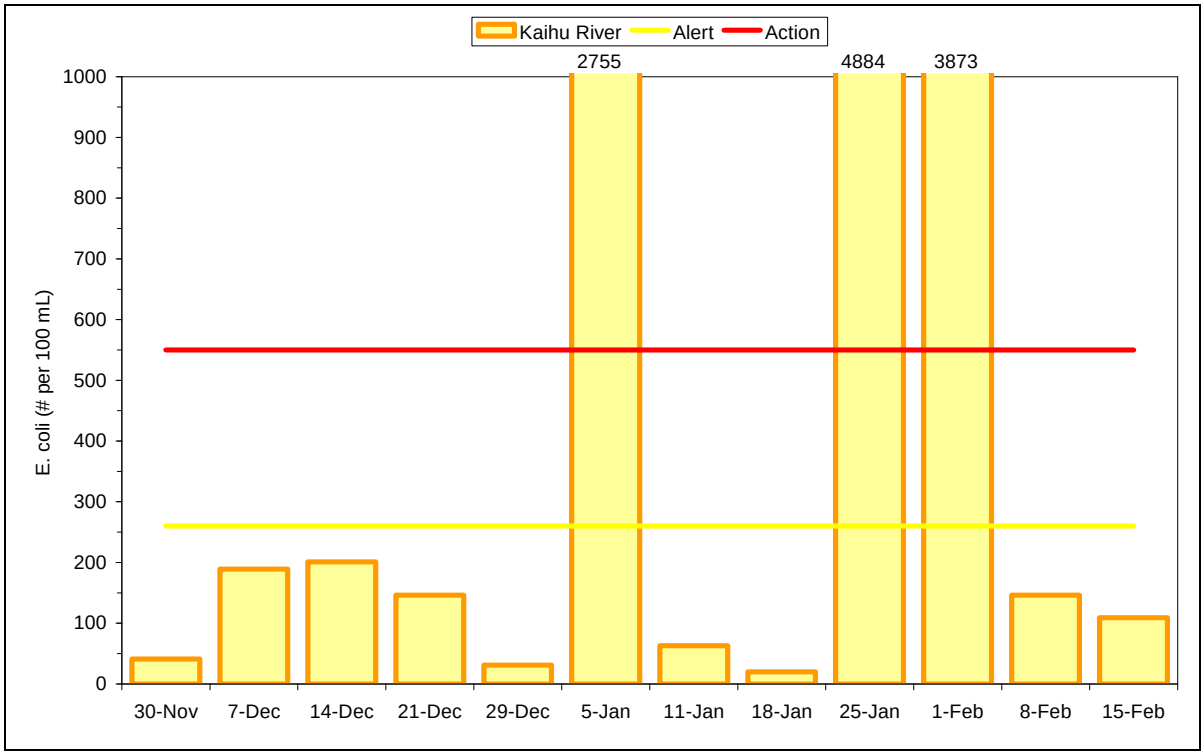

Figure 26: Results from the 2005-06 freshwater recreational contact sampling for Kaihu River

The data collected for the 2005-06 summer (Figure 27) suggests that the Kaihu River site is excellent for swimming in dry periods, but after heavy or prolonged periods of rain it becomes extremely unsuitable. However it is unclear why this site can still have relatively low *E. coli* counts after moderate amounts of rainfall such as on the 14th and 21st of December.

It was thought that it could be that the catchment requires a set amount of rainfall before the bacteriological by-products of agricultural farming are washed into the river or that consistent rainfall over previous months meant that no build up of effluent occurred, and therefore there was nothing to flush in early December (Wilson 2004).

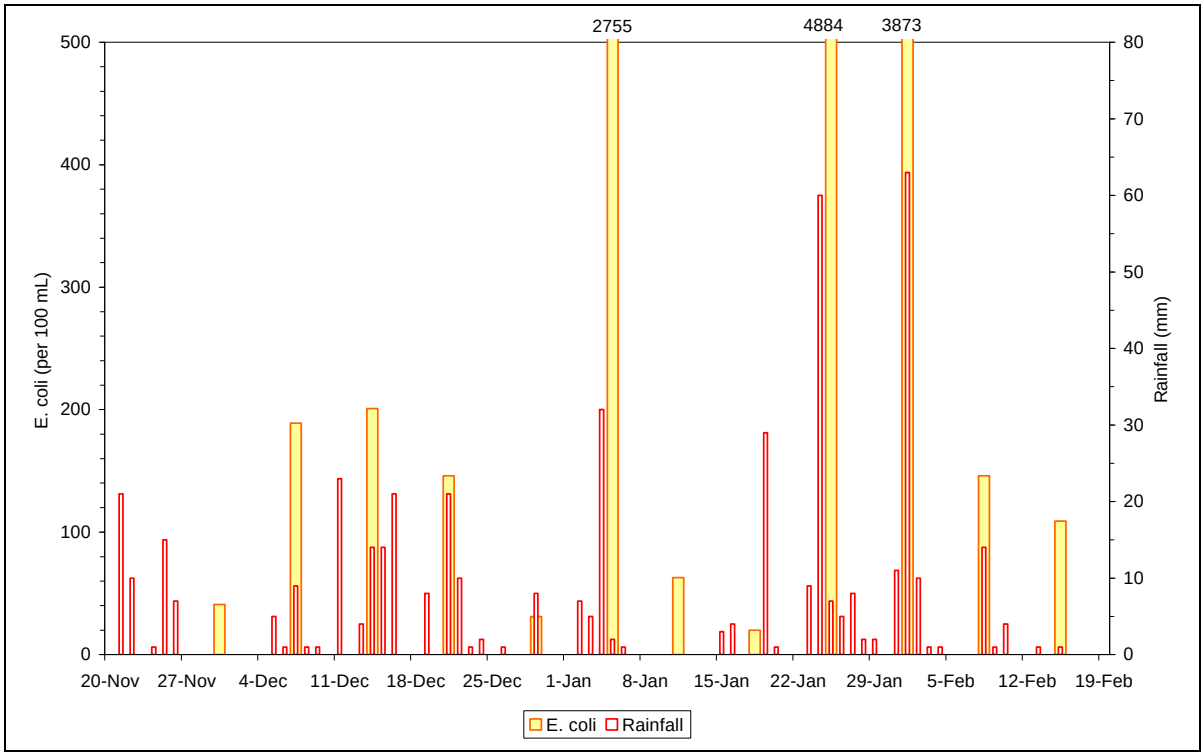

Figure 27: Rainfall and *E. coli* data for the Kaihu River over the 2005-06 summer

The interim SFRG grade, based on a MAC of "D" due to the high 95th percentile and a SIC assessment of "High" due to the intensive agricultural use in the immediate catchment, calculates to be "very poor". However the median and compliance rates suggest that water quality is suitable for swimming the majority of the time and that a grading of either "poor" or "fair" is probably more accurate of the situation at the Kaihu River swimming hole, as long as the basic rules discussed in section 2 of this report are followed.

5.14 OMAMARI BEACH STREAM

SIC: LOW **MAC: D** **SFRG: POOR**

The Omamari Beach Stream is a small stream created by the meeting of two tributaries, one derived from indigenous wetlands, the other from a mixed sheep and beef farming and exotic forestry catchment. The Omamari Beach Stream is only a small stream but a lot of local children swim in the stream and the Omamari Rate Payers Association have been concerned about the quality of the water for some time. There is a risk of contamination from poorly maintained septic tanks, however the risk would be low as there are not many houses in Omamari.

Table 19: Collated results for the Omamari Beach Stream

	2005-06 SURVEY	LAST THREE SURVEYS
Median	335 *E. coli* per 100 mL	160 *E. coli* per 100 mL
95th Percentile	3010 *E. coli* per 100 mL	1248 *E. coli* per 100 mL
Alert Compliance	42 %	69 %
Action Compliance	67 %	84 %

The results presented in Table 19 show that water quality was worst during the 2005-06 summer at the Omamari Stream site than the previous two summers, with a higher median and 95th percentile and lower compliance rates. Four of the 12 sampling occasions exceeded the action threshold of 550 *E. coli* per 100 mL and a further three exceeded the alert threshold in the 2005- 06 summer (Figure 28).

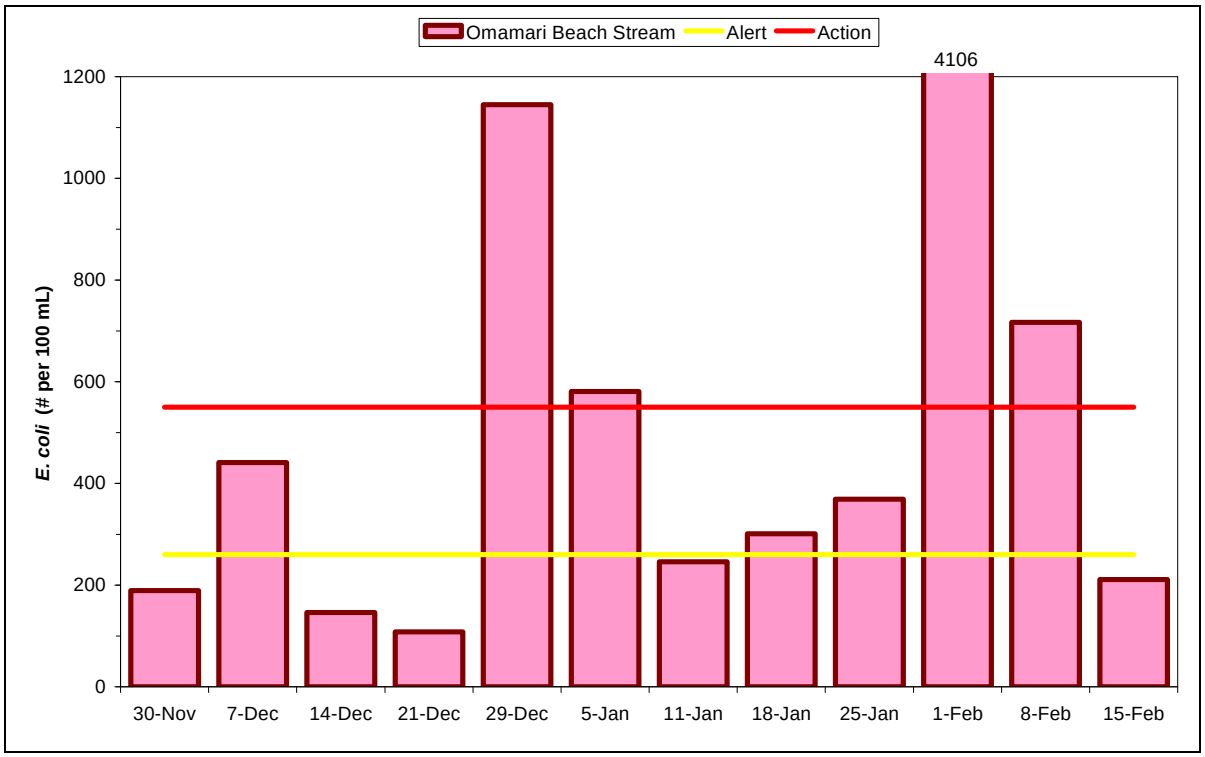

Figure 28: Results from the 2005-06 freshwater recreational contact sampling for Omamari Beach Stream

The comparison between rainfall and *E. coli* in Figure 29 shows no clear relationship between rainfall and elevated *E. coli* counts and in fact there was very little rain prior to the spike that occurred on the 29th of December. This spike could be caused by overloaded septic tanks as a result of the extra people in Omamari for the public holidays, which would be consistent with the spike that occurred last summer as well (Cook 2005). If levels are elevated around the Christmas/New years period again next year,without the influence of rainfall, samples will be sent away for Faecal Sterol analysis.

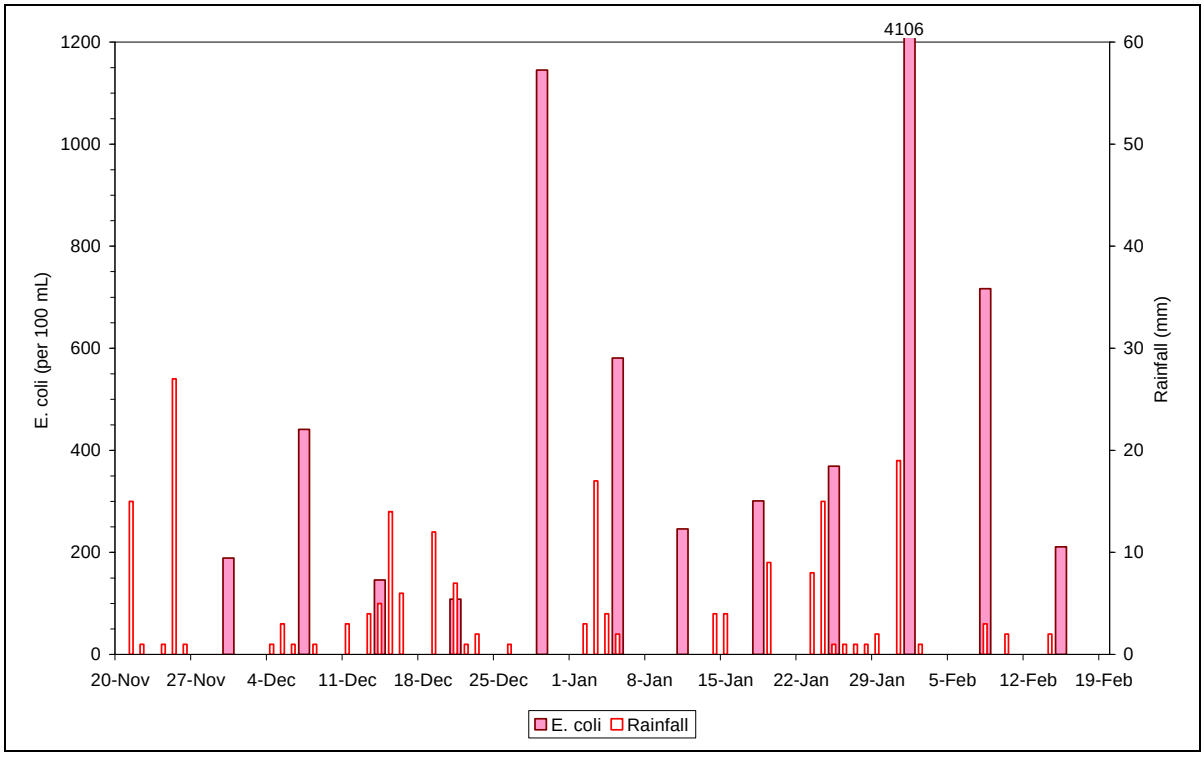

Figure 29 Rainfall and *E. coli* levels in Omamari Beach Stream over the 2005-06 summer

The interim SFRG for Omamari Beach Stream could not be calculated because the SIC assessment of "low" contradicts with the MAC of "D". After two years results it was thought that the 95th percentile was likely to decrease, improving the MAC assessment to "C" and in turn giving an interim grade of "fair". However the results for the 2005-06 indicate that a "low" risk of this site being unsuitable for swimming is likely to be too conservative and it is more likely to be "moderate", which would give an interim grade of "poor". Future surveys and faecal sterols will confirm whether this is the case and therefore it is recommended that sampling continues at this site and that the SIC be re-assessed at the end of next summer.

5.15 LAKE TAHAROA

SIC: VERY LOW **MAC: A** **SFRG: VERY GOOD**

Lake Taharoa is the biggest of the four Kai iwi lakes, an extremely popular area for both locals and tourists alike, situated approximately 25 km northwest of Dargaville. Thousands of people flock to the lake during summer and there are regularly enough tents in the camping grounds to accommodate 500 people. Like Lake Ngatu in the Far North, Lake Taharoa has no significant inputs or outputs with a predominately native and exotic forestry catchment. Without any major inputs, bacteriological contamination should be rare, even given the lake's heavy usage.

Table 20: Collated results for the two Lake Taharoa sites

	2005-06 SURVEY	LAST FIVE SURVEYS
Median	5 *E. coli* per 100 mL	5 *E. coli* per 100 mL
95th Percentile	34 *E. coli* per 100 mL	122 *E. coli* per 100 mL
Alert Compliance	100 %	98 %
Action Compliance	100 %	99 %

Results for the 2005-06 summer for the two sites sampled in Lake Taharoa were excellent with an extremely low median and 95th percentile as in the past (Table 20). The highest result was only 41 *E. coli* per 100 mL at promenade point on the 2nd of February, as shown in Figure 30, and therefore the lake achieved 100 % compliance with the MfE guidelines, which is consistent with the last 3 years.

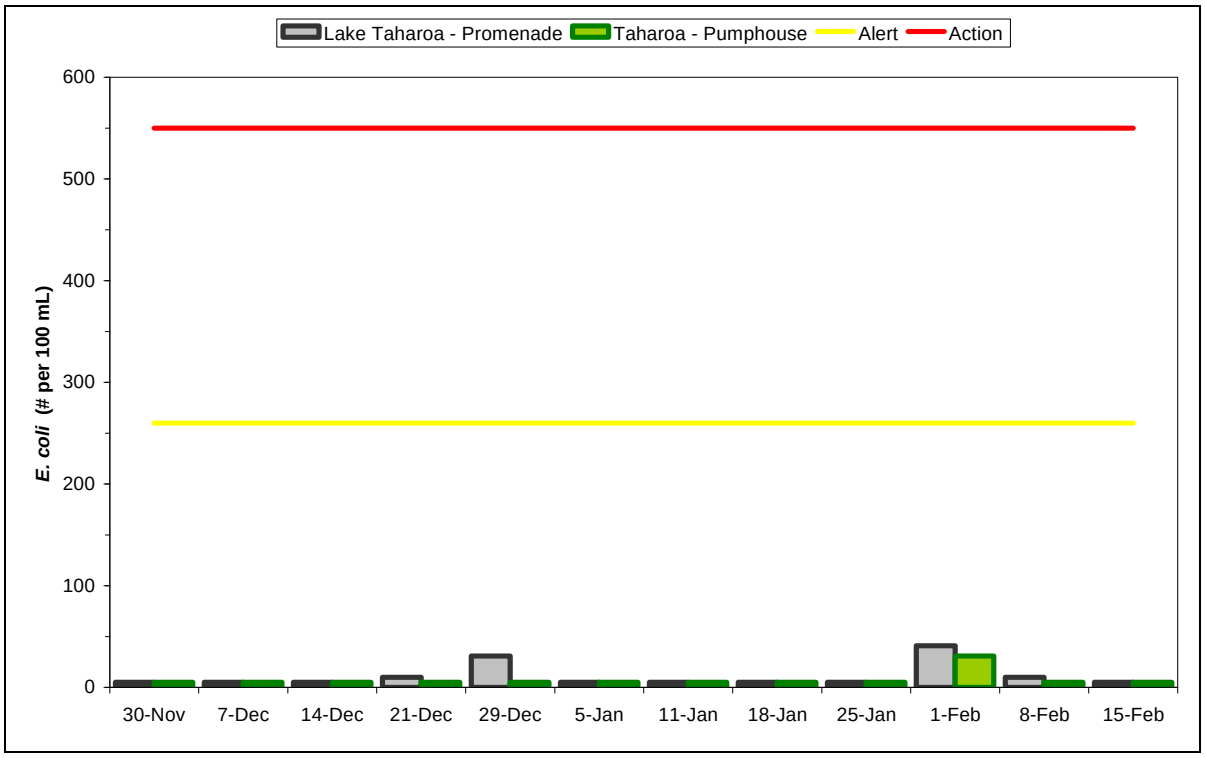

Figure 30: Results from the 2005-06 freshwater recreational contact sampling for the two Lake Taharoa sites

There is no obvious link between rainfall and *E. coli* levels in Lake Taharoa, however the slightly elevated results on 2 February are most likely as a result of the heavy rain received on that day and the source is probably faecal material from the wild animals living in the bush surrounding the lakes (Figure 31). However this is not of concern has the levels are still extremely low.

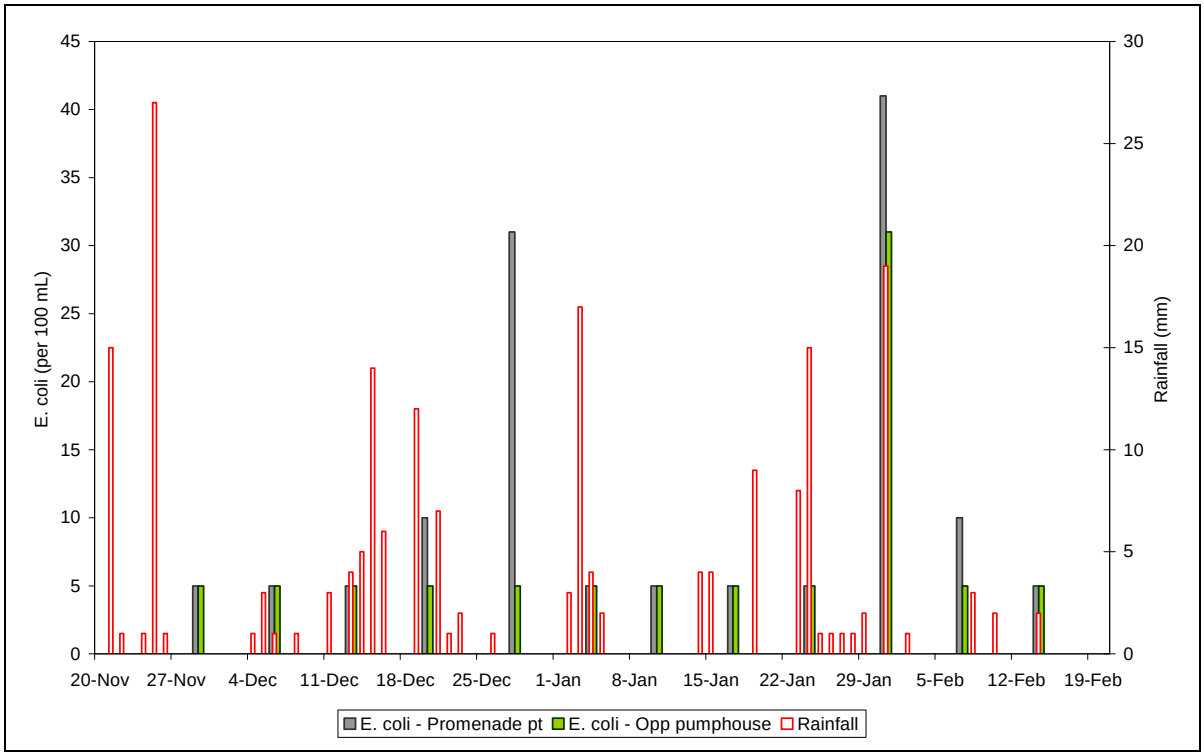

Figure 31 Rainfall and *E. coli* data for the two Lake Taharoa sites over the 2005-06 summer

The MAC category based on five summers data for the two Lake Taharoa sites shifted from "B" to "A" with the inclusion of this summers results. However the interim SFRG grade, with a SIC assessment of "Very Low", does not change from "Very Good" (the best it can be). It is envisaged that Lake Taharoa, along with Lake Ngatu, will have enough data to be properly graded within the next few years if sampling remains weekly. Such a feat is unlikely for any other site unless the sampling frequency is increased, and therefore it is recommended that sampling continues at Lake Taharoa until a dataset of 100 points collected over 5 years is achieved. At which point it can be decided whether sampling can be stopped as long as there are no significant changes in the surrounding catchment.

5.16 LAKE WARO @ HIKURANGI

SIC: HIGH **MAC: D** **SFRG: VERY POOR**

Lake Waro is a small manmade lake with a small catchment area, located north of Hikurangi, it is a popular swimming spot for local children in summer months. It has no contributing permanent flowing streams or drains. The catchment is predominately low intensity beef farming, with a few houses that have septic tanks. Waterfowl are commonly seen on the lake, so there is a risk of bacteriological contamination from birds excreting into the water. Lake Waro was sampled for the first time in the 2004-05 summer and was added to the freshwater bathing monitoring programme due to concerns over water quality for recreational users.

Table 21: Collated results for the Lake Waro site

	2005-06 SURVEY	LAST TWO SURVEYS
Median	772 *E. coli* per 100 mL	259 *E. coli* per 100 mL
95th Percentile	3059 *E. coli* per 100 mL	2951 *E. coli* per 100 mL
Alert Compliance	17 %	52 %
Action Compliance	42 %	64 %

Bacterial levels were much higher in Lake Waro this summer compared to 2004-05 (Cook 2005), with a much higher median and 95th percentile and lower compliance rates (Table 21). The E. coli counts only meet the alert threshold on two sampling occasions and the action threshold on a further three occasions (Figure 32).

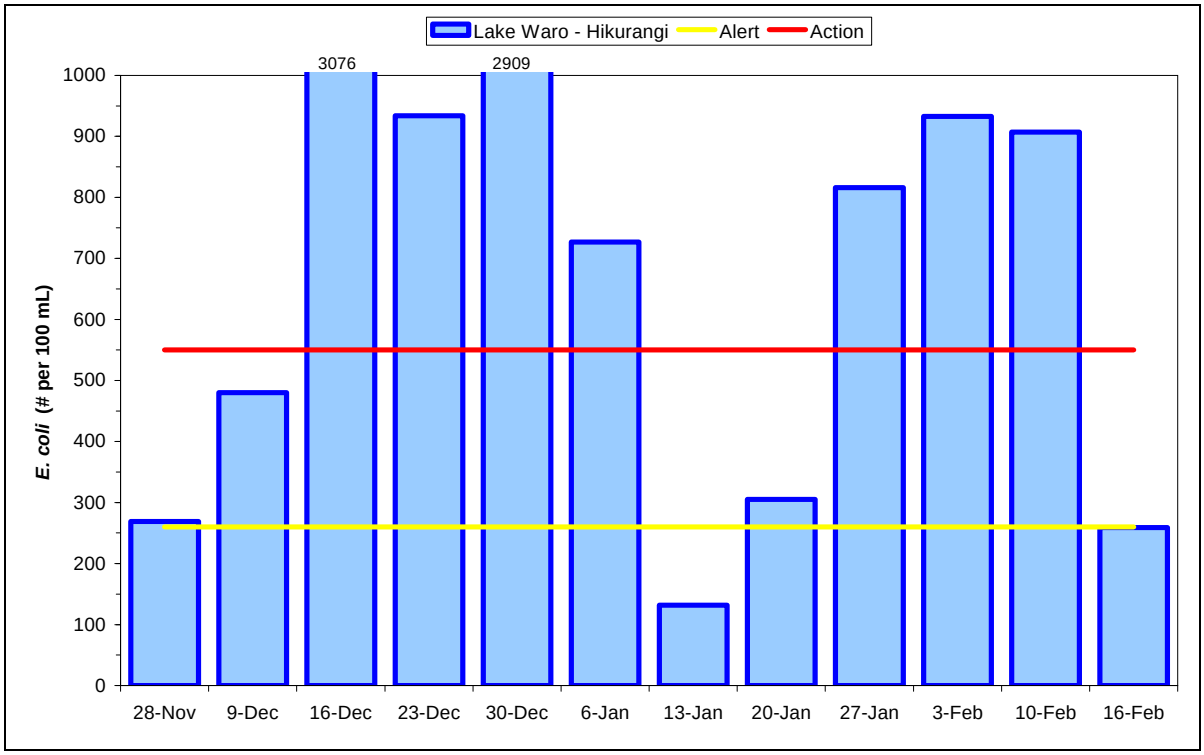

Figure 32: Results from the 2005-06 freshwater recreational contact sampling for Lake Waro, Hikurangi

Unlike last summer the water quality in Lake Waro was not appropriate for swimming for the majority of the 2005-06 summer and therefore a warning sign was erected. This significant change in water quality is attributed to a member of the public releasing a large number of waterfowl into the lake and then continuing to feed them. . To some people it may seem pleasant to see a lot of birds on a lake and to feed ducks, however it is not appropriate to have a significant number of water fowl in a popular swimming area. The majority of the birds have been relocated, so it will be interesting to see what next years results are like.

A comparison of rainfall and *E. coli* showed no clear relationship between rainfall and bacteriological water quality in Lake Waro (Figure 33), which is consistent with Lakes Taharoa and Ngatu.

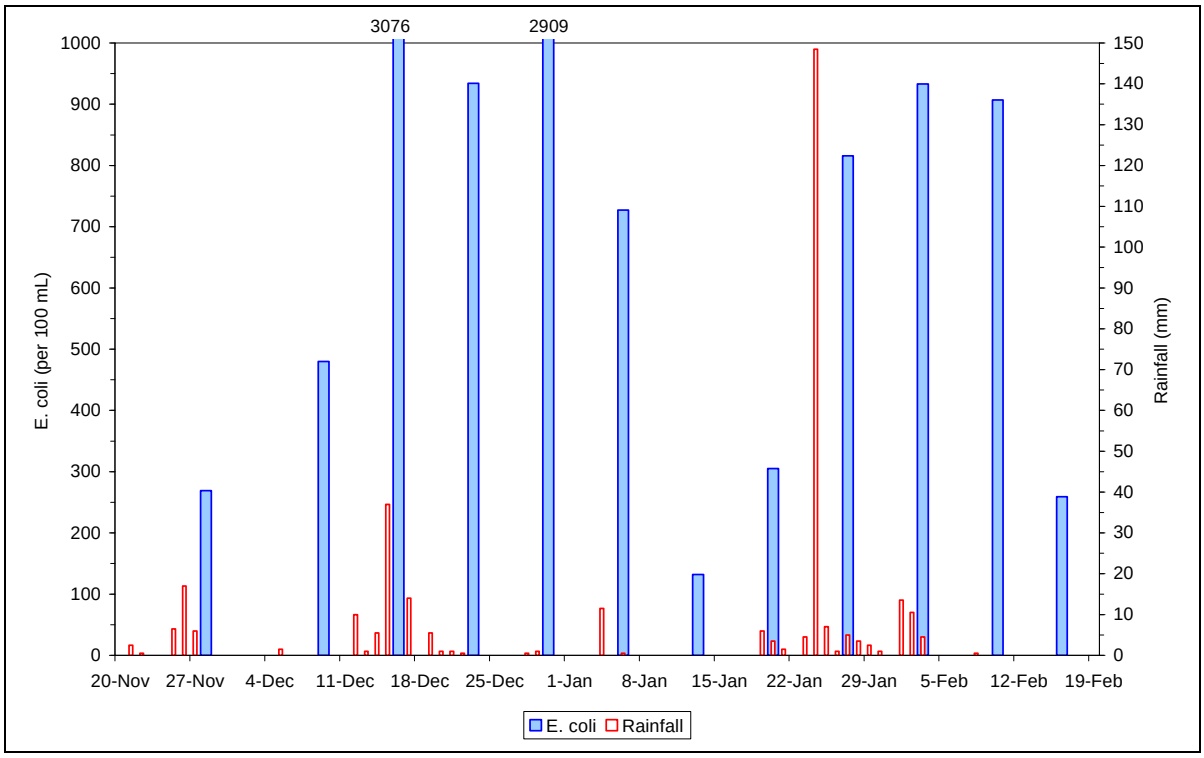

Figure 32: Rainfall and *E. coli* data for Lake Waro over the 2005-06 summer

There is now sufficient data to calculate a MAC and therefore an interim SFRG grade for Lake Waro. Following on from this years poor results, the SIC has been re-assessed to "high" to represent the high risk of contamination from water fowl and with a 95th percentile of 2951 E. coli per 100mL giving a MAC category of "D", the SFRG grade for Lake Waro is "Very Poor: It will be interesting to see whether results improve in the future, if the waterfowl population is kept to a minimum. If results are still elevated next summer faecal sterol analysis is an option for this site, to try to confirm the source of contamination.

5.17 OCEAN BEACH STREAM

SIC: VERY HIGH **MAC: D** **SFRG: VERY POOR**

Ocean beach stream is only small, flowing out onto Ocean Beach on the coastal side of Whangarei Heads, with a predominately sheep and beef farming catchment and some native forest in the headwaters. It is a popular stream for children to paddle in and therefore was added to the recreational monitoring programme for the 2004-05 summer. The most likely sources of bacteriological contamination include agricultural runoff and poorly maintained septic tanks.

Table 22: Collated results for the Ocean Beach Stream

	2005-06 SURVEY	LAST TWO SURVEYS
Median	947 *E. coli* per 100 mL	711 *E. coli* per 100 mL
95th Percentile	6867 *E. coli* per 100 mL	6867 *E. coli* per 100 mL
Alert Compliance	8 %	32 %
Action Compliance	17 %	41 %

Similarly to Lake Waro, bacterial water quality was much worse this summer in Ocean Beach Stream compared to 2004-05 (Cook 2005), with a much high median and Hazen 95th percentile and much lower compliance rates (Table 22). There was only one sampling occasion that met the alert threshold of 260 E. coli/100mL and one further occasion that met the action threshold (Figure 34). Of the 10 exceedences of the action threshold, three were extremely high spikes of *E. coli*. The District Council erected a sign near the stream warning people not to swim.

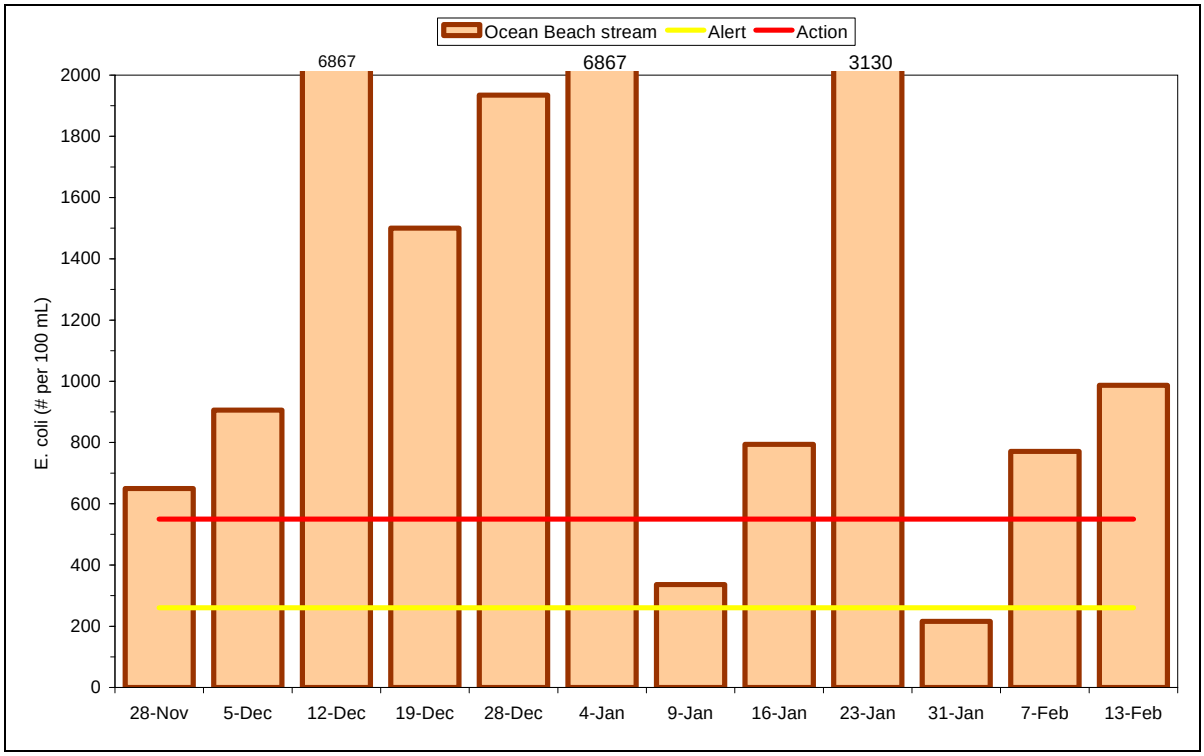

Figure 34: Results from the 2005-06 freshwater recreational contact sampling for Ocean beach stream

The E. coli results for Ocean Beach Stream for the 2005-06 summer do not show qa clear relationship with rainfall (Figure 35), with the two highest spikes in E. coli occurring with basically no rain prior to sampling.

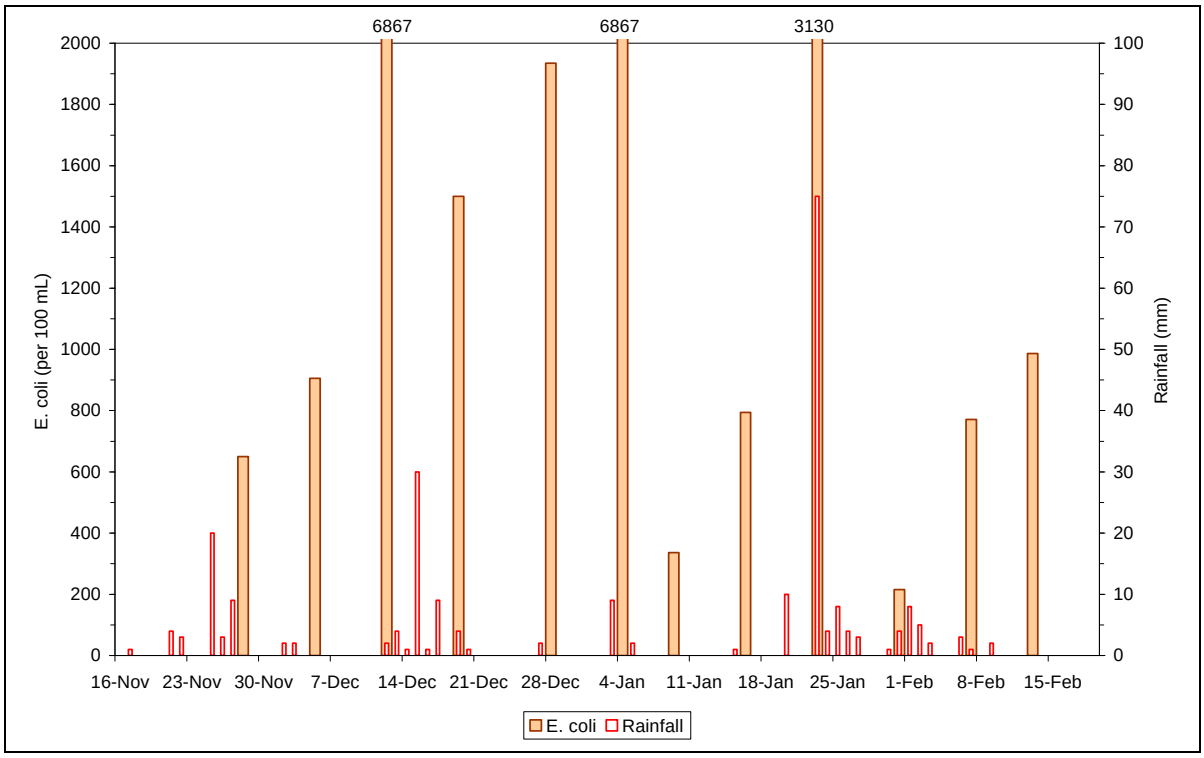

Figure 35: Rainfall and *E. coli* data at Ocean Beach Stream site over the 2005-06 summer

As the bacterial levels were constantly elevated in Ocean Beach Stream irrelevant of rainfall the possible sources of contamination are stock access further upstream, waterfowl or leaking septic tanks. Like Otiria Stream, faecal sterol analysis was carried out on extra sample collected on 5 December to assist with identifying the source of contamination in Ocean Beach Stream. Unfortunately the results of the faecal sterol analysis were inconclusive, however they do eliminate the source of contamination as being either from humans or ruminants such as cows and sheep. Although the results do not directly identify what the source of contamination is, through elimination it suggests that the source in Ocean Beach Stream on this day at least is most likely waterfowl.

As Ocean beach Stream has now been sampled for two years, there is sufficient data to calculate a MAC and therefore an interim SFRG grade. With the high 95th percentile of 6867 E. coli per 100mL giving a MAC category of “D” and a SIC risk of being contaminated of “very high”, it is not surprising that the interim SFRG grade for Ocean Beach Stream is “Very Poor”.

5.18 LANGS BEACH STREAM

SIC: VERY HIGH **MAC: D** **SFRG: VERY POOR**

This small stream flows on to Langs Beach and has a predominately native forest and shrub catchment with small areas of beef farming. Similarly to Ocean Beach Stream, Langs Beach stream is a popular spot for children to paddle in and therefore was added to the recreational monitoring programme in the 2004-05 summer. The most likely sources of bacteriological contamination include agricultural runoff, feral animals, poorly maintained septic tanks or a leak from the public toilets upstream of the site.

Table 23: Collated results for the Langs Beach Stream

	2005-06 SURVEY	LAST TWO SURVEYS
Median	1569 *E. coli* per 100 mL	1254 *E. coli* per 100 mL
95th Percentile	4962 *E. coli* per 100 mL	3914 *E. coli* per 100 mL
Alert Compliance	0 %	0 %
Action Compliance	8 %	18 %

Bacteriological water quality was very poor in the Langs Beach Stream over the 2005-06 summer, consistently not suitable for recreational use with zero compliance with the alert threshold of 260 *E. coli* per 100mL (Table 23). Eleven of the 12 samples exceeded the action threshold, in fact all were greater than 1000 E. coli per 100mL (Figure 36). The District Council erected a permanent sign to warn people against swimming in the stream.

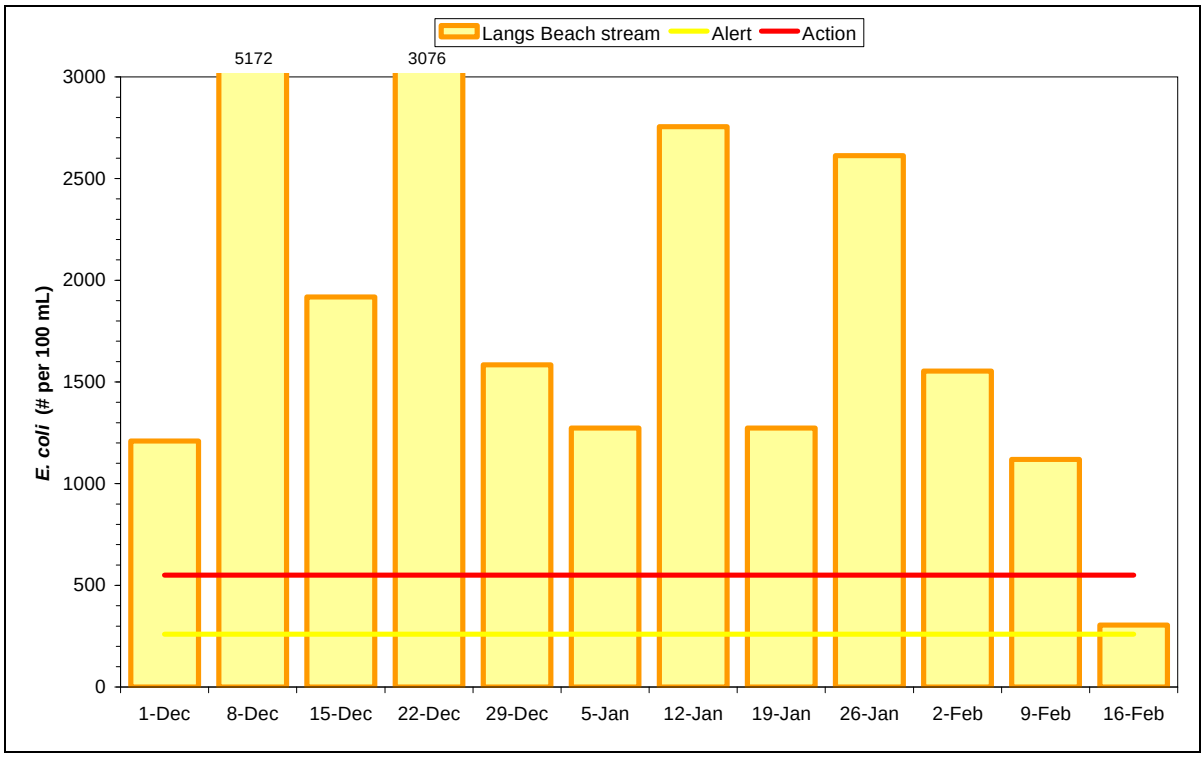

Figure 36: Results from the 2005-06 freshwater recreational contact sampling for Langs beach stream

E. coli results appear to be extremely high in Langs Beach stream irrelevant of rainfall (Figure 37).

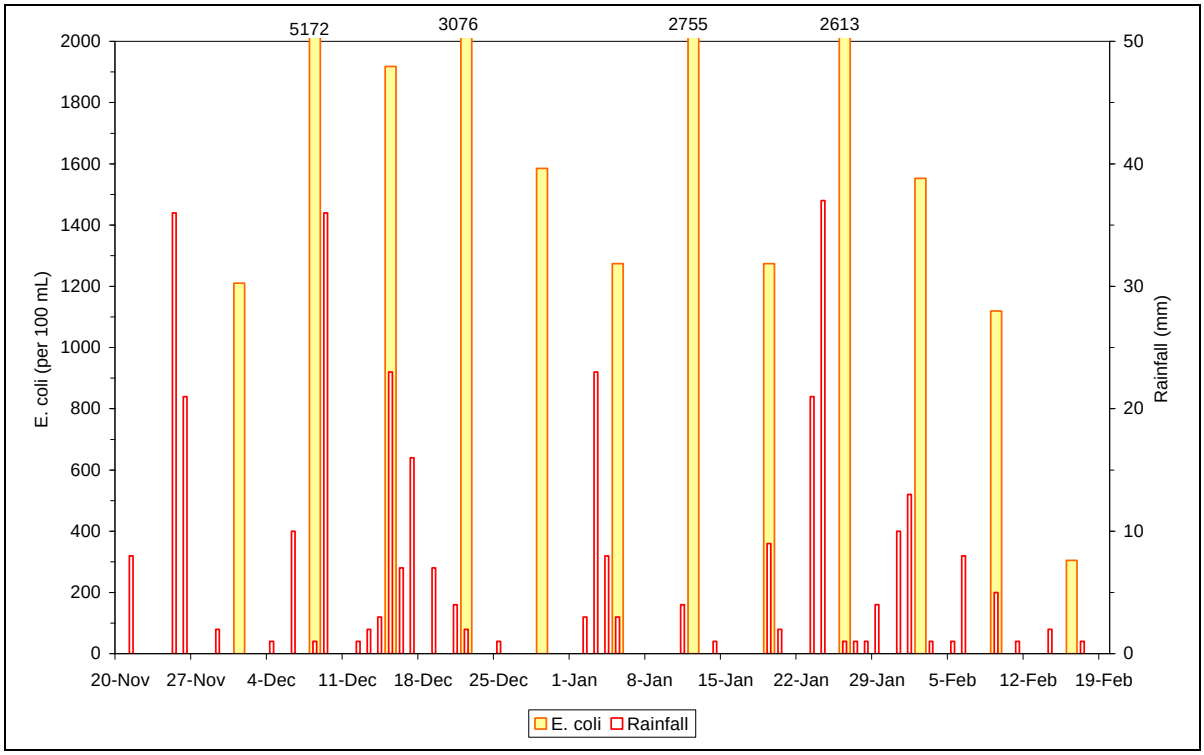

Figure 37: Rainfall and *E. coli* data for the Langs Beach Stream site over the 2005-06 summer

As this site has had consistently high results for the last two seasons, faecal sterol analysis was carried out. Similarly to Ocean Beach Stream, this ruled out the source of contamination as being human or ruminants such as sheep and cows. This leaves the likely source of contamination to be water fowl such as ducks and seagulls.

It is not surprising with this consistently and extremely high Bacterial results that the interim SFRG grade for Langs Beach Stream was calculated as “Very Poor”. This is an accurate indication of the unsuitability of this site for recreational use. Therefore a permanent sign has been erected and will remain until results fall below guidelines.

5.19 ADDITIONAL SITES

The following three sites were sampled for the majority of the 2005-06 survey because they are popular swimming spots, where the public and Northland Health had concerns over water quality; Kaihu River at Rugby Club, Waipoua River at the Department of Conservation camping ground and Waiharakeke Stream in Moerewa.

5.19.1 Kaihu River at Rugby Club

This site on the Kaihu River, approximately 30 km north of Dargaville, is only about 3 kilometres downstream of the existing Kaihu River bathing site by the motor camp. There is minimal contributing streams between the two sites and low risk potential sources of bacterial contamination with the majority of the catchment being forestry and native forest with some small areas of farming and the small Kaihu township.

As the sites are very close and similar, it is not surprising that the bacterial levels at the two sites were similar, as shown in Figure 38 below. Both sites exceeded the action threshold on the same three occasions and otherwise were under the alert level of 260 E. coli/100mL. As shown in section 5.13 the three peaks in bacterial contamination were associated with rainfall events.

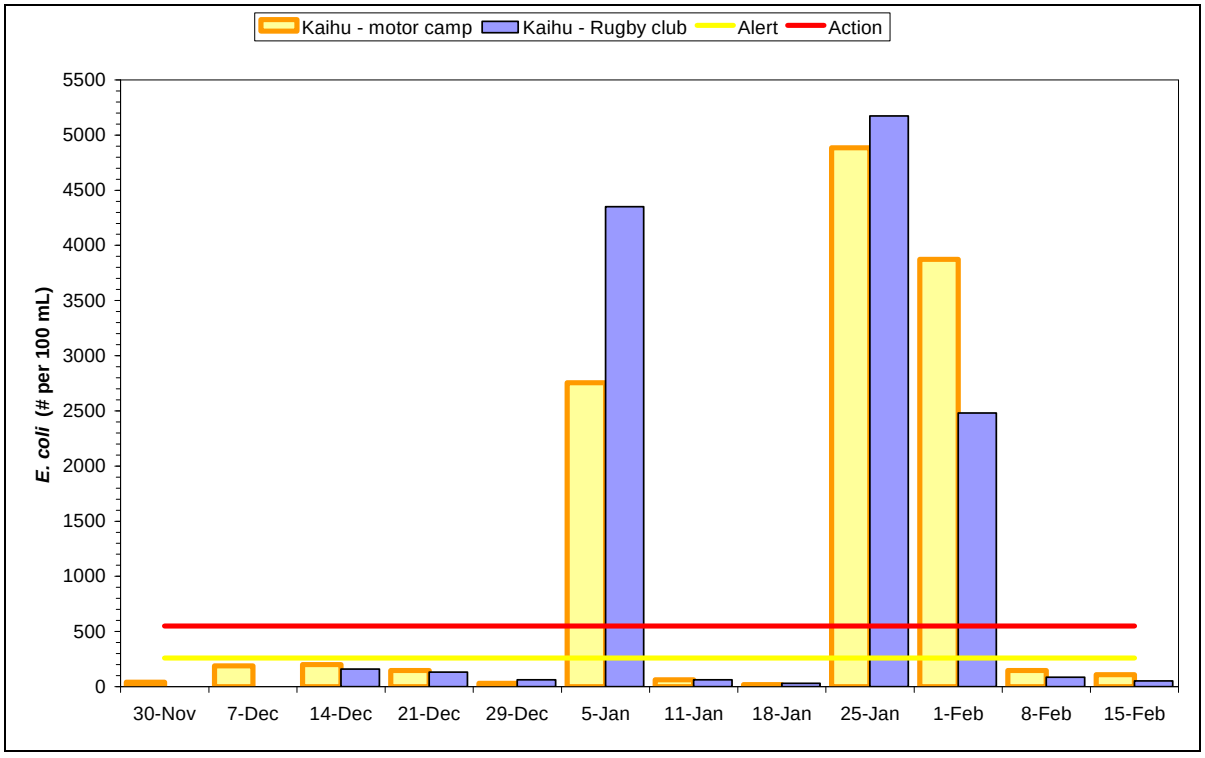

Figure 38: Rainfall and *E. coli* data for the two Kaihu River sites over the 2005-06 summer

As this site is only a few kilometres away and has similar bacterial levels to the existing Kaihu River site and has rainfall induced contamination events, with the approval from Northland Health this site will not be sampled next year. The usual precautions should be taken at this site such as no swimming after heavy rain or if the water is murky. If bacterial levels become elevated at the site by the motor camp without the effect of rain and a warning sign is erected, we recommend people do not swim in the river by the rugby club as it is could also be affected.

5.19.2 Waipoua River at DOC camping Ground

This site is a very popular picnic, camping and swimming spot. It has a predominately native forest catchment, so therefore you would expect consistently good water quality.

This site was sampled on 10 occasions in 2005-2006. The results from this summer were relatively good, with one sampling event exceeding the alert threshold and another exceeding the action threshold.

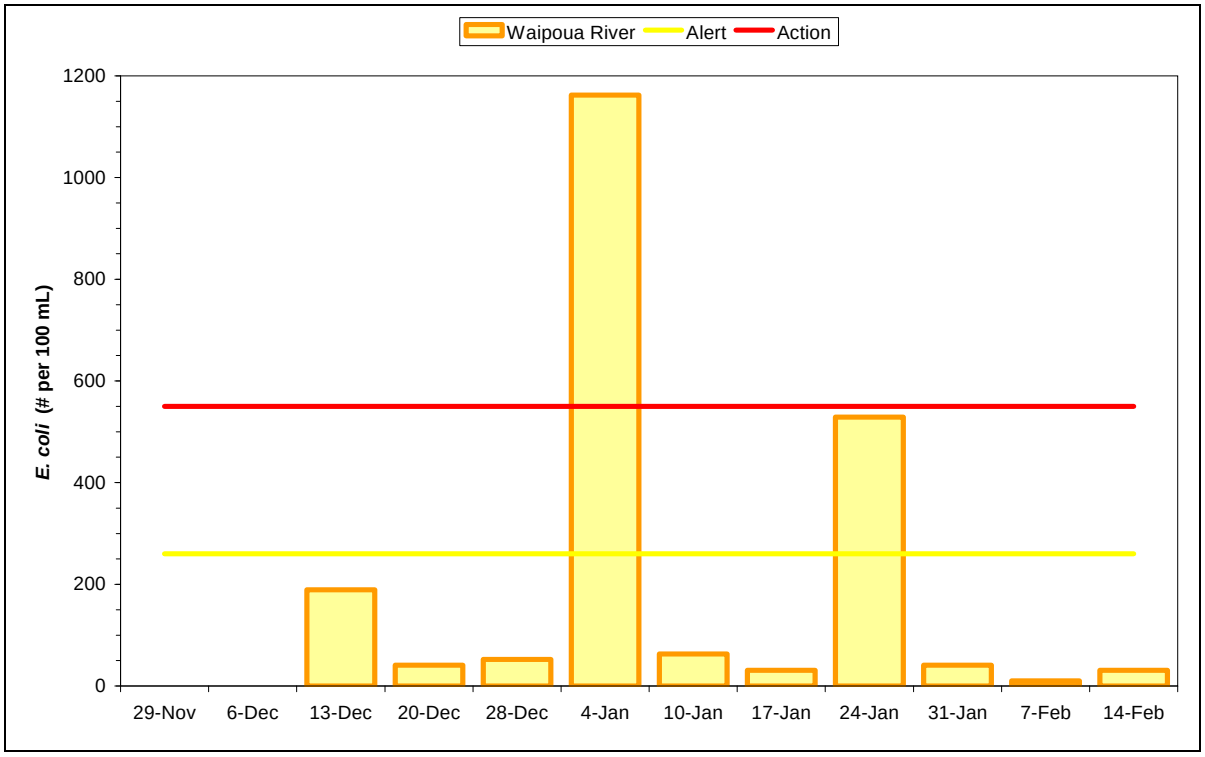

Figure 39: *E. coli* data for the Waipoua River site over the 2005-06 summer

The two spikes in E. coli were linked to rainfall events (Figure 40). The likely source of the bacterial contamination is excrement from wild animals such as possums, goats and pigs.

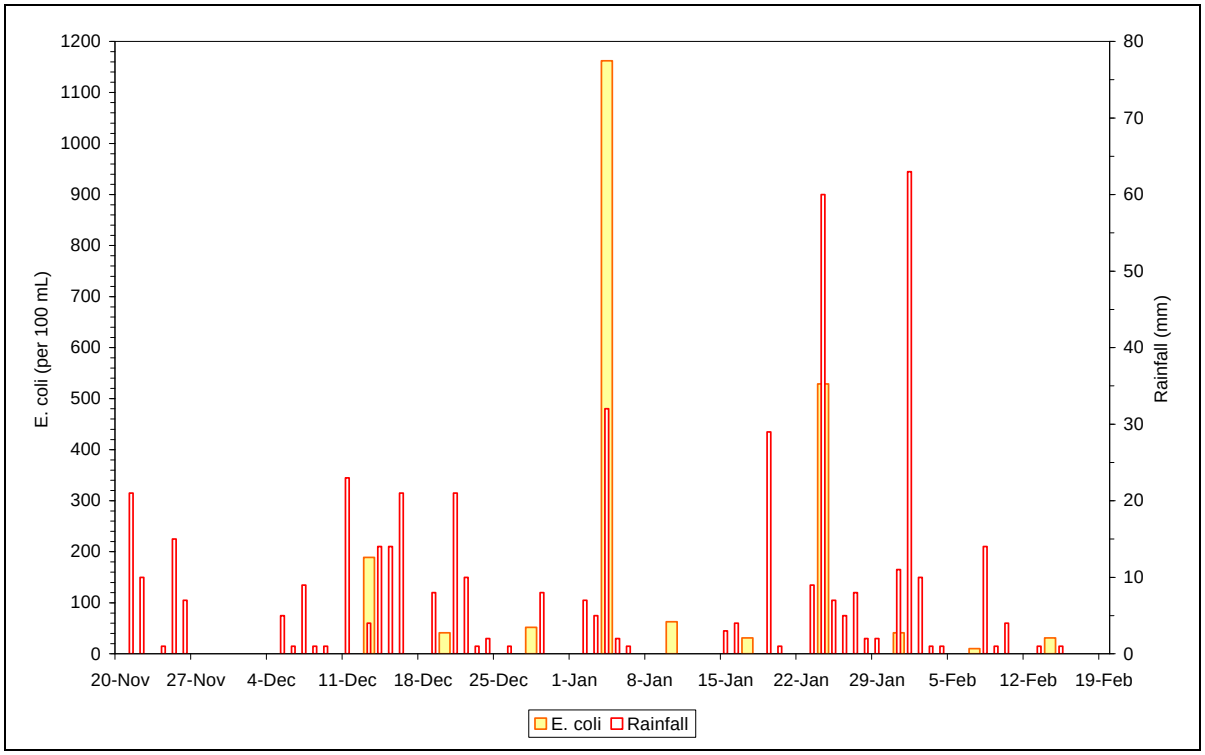

Figure 40: Rainfall and *E. coli* data for the Waipoua River site over the 2005-06 summer

There is insufficient data to calculate a MAC category and inturn SFRG grading for this site. Therefore sampling will continue at this site at least until enough data is collected to calculate an interim SFRG grade.

5.19.3 Waiharakeke Stream in Moerewa

This is a popular swimming spot for local children, especially as the nearby Otiria Stream swimming hole is consistently unsuitable for swimming. Summarily to Otiria Stream this site has a mix of forestry and farming in the upstream catchment.

Waiharakeke Stream was sampled on nine occasions during the 2005-06 summer. This site had relatively moderate bacterial water quality, with two breaches of the alert threshold and a further two breaches of the action threshold (Figure 41).

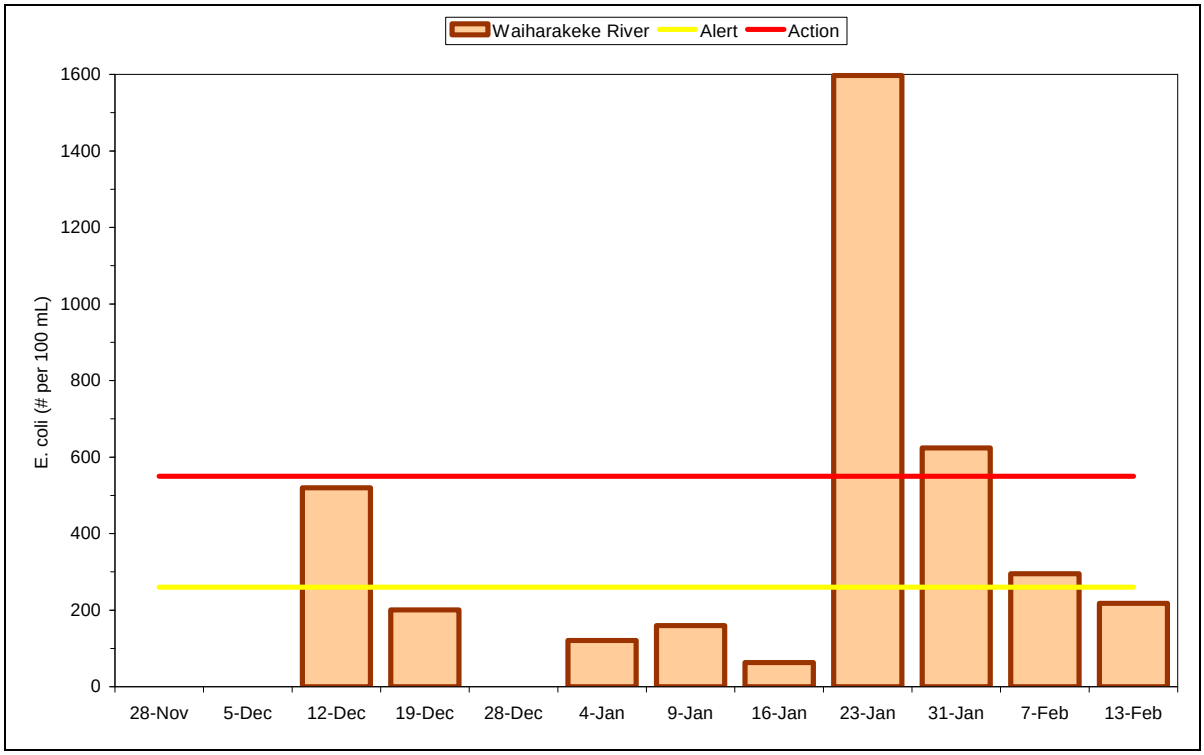

Figure 41: *E. coli* data for the Waiharakeke Stream site over the 2005-06 summer

It seems there is a relationship between rainfall and E. coli in Waiharakeke Stream, with most spikes in E. coli occurring after heavy or prolonged rainfall (Figure 42).

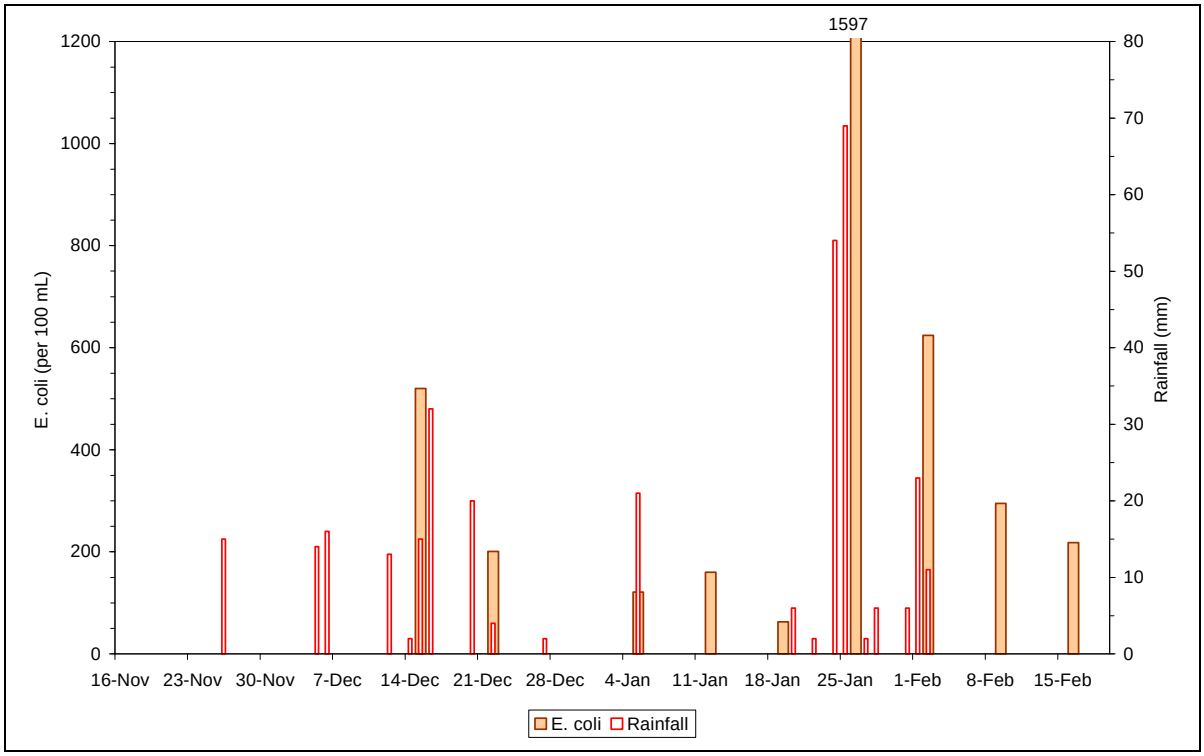

Figure 42: Rainfall and *E. coli* data for the Waiharakeke Stream site over the 2005-06 summer

There is insufficient data to calculate a MAC category and inturn SFRG grading for this site. Therefore sampling will continue at this site at least until enough data is collected to calculate an interim SFRG grade.

6 SUMMARY TABLE

When looking at a summary of the freshwater bathing sites ranked by their median *E. coli* results over the last five surveys, a few things become clear (Table 24):

- It becomes apparent which sites are probably unrealistically graded using the MfE guidelines to be worse than what they actually are such as Waitangi River, which has bacteriological water quality more similar to sites graded as "poor" rather than "very poor".

- Finally, it highlights how restrictive the MfE guidelines can be and possibly how they are not realistic for Northland with our semi-tropical weather conditions and therefore unpredictable rainfall in summer months. As the MAC assessment is based on the hazen 95th percentile, it typically only takes one elevated *E. coli* result caused by rainfall to give a 95th percentile above 550 *E. coli* per 100 mL and therefore a MAC assessment of "D". As shown in Table 24 all the sites, except the three lakes, have percentiles exceeding the 550 *E. coli* per 100 mL threshold, which immediately means they can only be graded as "poor" or "very poor" (Refer to Table 1 and 3).

Table 24: Table showing median and 95th percentile for *E. coli* per 100 mL based on the last five surveys at all ongoing sites with their interim SFRG grade. Note: Sites are ranked by their median *E. coli* counts.

Location	Median	95th percentile	Interim SFRG
Lake Taharoa	5	122	Very Good
Lake Ngatu	10	134	Good
Kaihu River	109	5285	Poor
Waipapa Stream	140	1218	Poor
Omamari Beach Stream	160	1248	Poor
Kapiro Stream	180	739	Poor
Waitangi River	189	2525	Very Poor
Twin Bridges	246	4783	Poor
Lake Waro	259	2951	Very Poor
Raumanga Stream	265	5342	Poor
Kerikeri River	275	6593	Very Poor
Tirohanga Stream	277	1214	Poor
Otaua Stream	317	3586	Poor
Waitaua River	399	4788	Very poor
Wairoa Stream	660	6723	Very Poor
Ocean beach stream	711	6867	Very poor
Otiria Stream	1122	3716	Very Poor
Langs beach stream	1254	3914	Very poor

7 CONCLUSIONS FROM THE SURVEY

The 2005-06 freshwater recreational contact survey was the most comprehensive the NRC has conducted since the programme began in 1999. The regime still falls short of the prescribed MfE guidelines (that recommend 20 samples per site per summer), but with weekly sampling at least enough data is being collected where results can be compared with rainfall data and problem sites identified.

The overall findings from the 2005-06 summer survey were that most of the rivers throughout Northland were generally acceptable for swimming and other freshwater recreational activities during the dry periods, but after heavy and/or prolonged rain, the waterways became unsuitable for days afterwards. In a region such as Northland with a semi-tropical climate and a high annual rainfall, using 95th percentiles for grading sites results in grades that do not necessarily reflect the "true" state of Northland's freshwaters.

Exceptions were Wairoa, Otiria, Oceans Beach and Langs Beach streams, which were all generally unsuitable for freshwater contact in all conditions. Otiria and Langs Beach streams are of the most concern as *E. coli* levels were consistently above the alert threshold over the entire summer. Faecal sterol analysis on one sample collected from Otiria, Langs Beach and Ocean beach streams, eliminated the source of contamination in Ocean Beach and Langs Beach streams as being from humans or stock, suggesting it is likely to be waterfowl. However in Otiria River it is likely that some of the source of contamination is sheep and cattle in the catchment.

On the other hand the lakes sampled have consistently good water quality, other than Lake Waro, in which bacterial contamination was most likely as a result of an extensive community of water fowl. Lakes are not as susceptible to rainfall as rivers and streams are, particularly the dune lakes of Northland which do not have any significant surface inflows. However, as results collected at Lake Ngatu in the Aupouri peninsula showed, even these lakes can be subject to occasional faecal contamination, and therefore sampling of Lakes Waro, Ngatu and Taharoa should continue.

Finally, it must be stressed that any findings presented in this document cannot be taken as absolute conclusions. In all likelihood the Langs Beach, Otiria and Wairoa sites are not the only unsafe sites in Northland and just because many of the sites were relatively good over the summer months does not necessarily make them suitable all year round, let alone from year to year. The impact that human activities have had on the health of our waterways should not be underestimated and it is probably best that, if you are unsure of the quality of a given swimming site, then that site should be considered potentially unsafe until you know otherwise.

8 RECOMMENDATIONS

Before each summer survey begins, it is customary for the NRC to meet with Northland's District Councils and Northland Health to discuss any amendments or changes from previous years. Reports such as this one typically provide the foundation for these discussions and it is therefore important to present several recommendations here, many of them following on from previous years:

8.1 FURTHER SAMPLING

The NRC has not collected enough data to make formal SFRGs for any of the 20 swimming spots currently monitored. Therefore, it is recommended that none of the sites be dropped from future surveys and, in fact that the sampling period is extended for at least another two weeks at the end of the season to the end of February.

Further investigation into the source of contamination at ongoing problem sites be carried out using faecal sterol analysis as was done at three sites in 2005-2006. These sites could be resurveyed especially if they are still consistently contaminated, and particularly Lake Waro.

Key Recommendation: All sites monitored in the 2005-06 survey remain for next summer's programme and sampling is extended to 14 weeks.

Key Recommendation: Faecal sterol analysis be carried out on samples from problem sites including but not limited to Lake Waro and possibly again for Langs Beach, Ocean Beach and Otiria streams.

8.2 EDUCATION

The main purpose of these summer surveys is to determine what the potential risk is to those who indulge in freshwater recreation. This programme is now six years old and it may now be worthwhile to investigate setting some additional goals. In essence it is recommended that the NRC, in partnership with Northland Health and Northland's District Councils, begin to become more proactive.

People's health is inextricably linked to the health of their environment. In other words, and in very broad terms, if our waters are healthy then we as a people will be as well. The Regional and District Councils have developed, or are in the process of developing plans which, among other things, address water quality issues. However, this does not mean that the authorities involved need not take further action. By developing and promoting a region-wide health campaign, there is a real possibility that local authorities can make a massive, positive impact on the health and wellbeing of Northland's people and its environment.

Northland Health has distributed brochures detailing the simple ways in which people can determine how safe a body of water is for swimming or gathering shellfish but whether their message is getting across remains to be seen. Northland Health's campaign would be greatly aided if the Regional and District Councils became more involved by also making the pamphlets available and discussing the principles of safe bathing as part of their own educational programmes. Individually, each organisation can only do so much and an integrated approach could make a real difference. It is

therefore recommended that all of Northland's TLAs should become involved in disseminating the pamphlets by having them available with their other pamphlets and handing them out to schools when representatives make visits.

Schools need to be the primary target in any education campaign because children are both the most numerous users of inland swimming holes, plus one of the more at-risk groups. It may also be necessary to begin to erect more signs at Northland's most popular sites, not necessarily warning of the dangers of contact recreation, but instead providing advice on when it is best to swim and when the swimming holes should be avoided.

As well as warning people of the potential dangers, an education campaign should make people more aware of their own actions; "Am I or my family part of the problem?" is a question that, when linked to something as dear to people's hearts as water quality, can have a major impact. It is common knowledge that children are impressionable, that it is important for adults to set the "right" examples, but what is often forgotten is that children can also be extremely influential and that teaching our children is often the best way to get the message through to adults as well. Therefore an education programme, particularly targeted at schools, should aid in the dual goals of improving people's health and reducing the impact we, as a species, have on the environment (by improving stream health). The NRC, for example, is currently involved in making school children (and their teachers) aware of water quality issues and therefore it should not be too difficult to include some discussion of the causes and effects of bacteriological contamination as well.

In this regard it may be beneficial for policy-makers and those involved in the monitoring of Northland's bathing sites alike to perhaps set some long-term goals, especially in terms of awareness. Local bodies can lead the way on issues such as health and the environment, but it is up to the community as a whole if any substantial change is to occur.

Key Recommendation: That TLAs become involved with the distribution of the pamphlets developed by Northland Health.

Key Recommendation: That the issues relating to freshwater contact recreation be integrated into all relevant agencies' education programmes.

8.3 IMPROVING SIGNAGE

At present, it is not always clear which territorial authority should be responsible for the maintenance of warning signs at any given site. In conjunction with an expanding educational programme, another key step towards safer recreational-contact behaviour would be if all the authorities involved (NRC, Northland Health, and the three District Councils), developed a formal protocol for signage. This could be as simple as designing one sign for the entire region with the only variation being which District Council the site was in, or more complicated in which the signs become quite varied.

Details aside, a clear protocol would allow signage to be put up promptly without the need for any inter-agency discussions and thus better enable all involved in getting the risks associated with recreation contact out to the public. The development of such a protocol should be a top priority and, as such, should be drawn up before the start of the next bathing survey (the summer of 2005-06). This protocol may have to be specific to freshwater sites only, although the option of expanding the protocol to include marine sites as well must be considered.

It was also raised and discussed at a previous meeting between Northland Health, the district councils and Northland Regional Council, the need for standardisation of warning signs throughout Northland and the ideal presentation of these signs. Northland Health have designed several different signs depending on the warning to be portrayed and the template will be made available to district councils.

Key Recommendation: That a protocol for signage be drawn up and agreed to between the NRC, Northland Health and the three District Councils before the beginning of the next freshwater bathing survey.

Key Recommendation: As signs need replacing in Northland, all TLA's and Northland Health should work towards having all signs the same throughout the region, using the template designed by Northland Health.

9 REFERENCES

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