# RIVER AND STREAMS

The Northland Regional Council carries out State of the Environment Monitoring in several Northland rivers and streams to identify significant environmental issues and trends in water quality. The performance targets relating to SOE monitoring of river water quality are:

- Operate a region-wide water quality network for the measurement, recording and reporting of river water quality trends, and

- Carry out sampling and reporting on summer freshwater bathing water quality.

Both of these performance targets were met in 2004-2005.

The Regional Council carried out sampling at 20 freshwater bathing sites throughout Northland to check whether microbiological water quality was suitable for contact recreation. These sites were sampled weekly for 10 weeks over summer. The results are presented in the **Recreational Bathing Water Quality** section of this report (Refer to page 2).

The **River Water Quality Monitoring Network** (RWQMN) includes 18 sites scattered throughout Northland's major river systems. These sites were monitored monthly for several water quality parameters and annually for stream macroinvertebrates. The majority of these sites now have enough data for long-term trend analysis. The 2004-2005 results and long-term trends in water quality are presented in the RWQMN section of this report (Refer to page 5).

Photo: Waipoua River in Waipoua Forest

# Recreational Bathing Water Quality

The Northland Regional Council, in conjunction with the District Council's and Northland Health, survey the water quality at a number of the region's most popular freshwater bathing sites every summer. Freshwater sites are not always safe for recreational activities, as waterways can sometimes become contaminated with human or animal effluent, which contains large numbers of organisms capable of causing illness. The most common sources of bacterial contamination are human sewage, stormwater and rural run-off, which can include bacteria from both agricultural land use and feral animals.

Twenty swimming sites at eighteen of Northland's rivers, lakes and streams were sampled over a 12-week period, from the start of December 2004 through to the end of February 2005 (excluding the week between Christmas and New years). Samples were collected weekly from each site and analysed for the pollution indicator bacteria, *Escherichia coli* (*E. coli*) following the recommended methods in the '*Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas'* developed jointly by the Ministry for the Environment (MfE) and the Ministry of Health (MoH). The '*Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas'* are available for viewing under publications on the Ministry for the Environment's website.

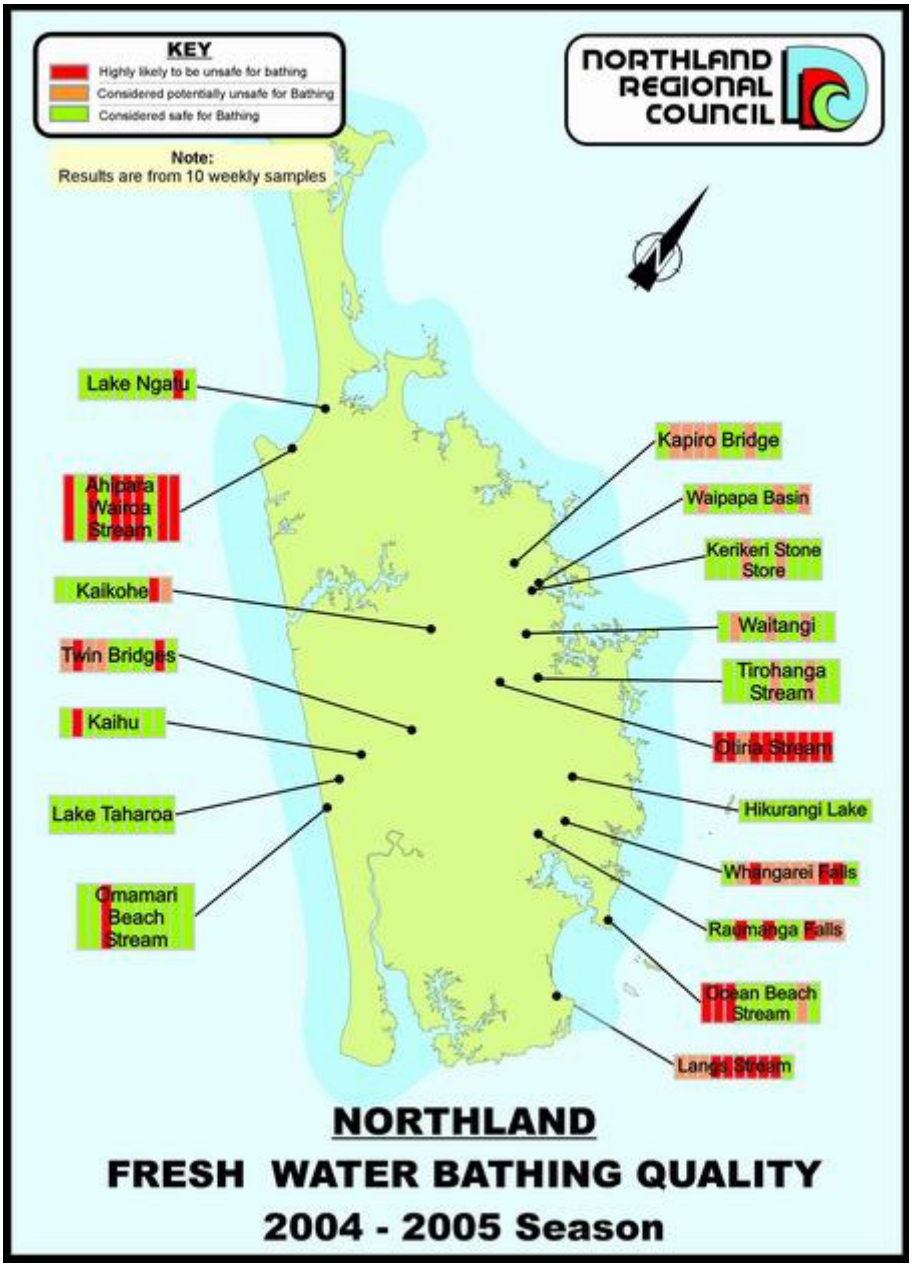
The results were compared to the recommended guidelines and all results were forwarded to the district councils, as well as Northland Health, for follow up action when *E. coli* levels were elevated above the guidelines. The table below shows the guidelines used for microbiological water quality in relation to recreational bathing in Northland and the recommended follow up by District Council's based on the national guidelines above.

| ***E. Coli* count (cells/100mL)** | **Status** | **Suggested follow up** |
|---|---|---|
| Less than or equal to 260 | Acceptable | ▪ No response necessary – continue weekly sampling |
| Greater than 260 but less than or equal to 550 | Alert | ▪ Increase sampling to daily<br>▪ Undertake sanitary survey to isolate source of faecal contamination |
| Greater than 550 | Action | ▪ Increase sampling to daily<br>▪ Undertake sanitary survey<br>▪ Erect warning signs<br>▪ Inform public through the media that a public health risk exists |

## Results

The overall findings from the 2004-05 summer survey were that most of the rivers throughout Northland were generally acceptable for swimming and other freshwater recreational activities during dry weather, but after heavy and/or prolonged rain, the waterways became unsuitable for several days afterwards. Exceptions were Wairoa (Ahipara), Otiria (Moerewa) 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.

On the other hand the water quality of the three lakes sampled, Ngatu on the Aupouri Peninsula, Waro in Hikurangi and Taharoa in the Kai iwi lakes group, were generally excellent over the entire 2004-05 survey, indicating that microbiological water quality was consistently suitable for recreational bathing. 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.




Interim grades, based on the national guidelines developed by MfE and MoH, were calculated for all sites with data stretching back over at least five summers. Grades for other sites have been postponed until a long enough record is collated. The process has tended to overstate the health risks at some sites due to the high rainfall Northland experiences with its semi tropical climate and as Northland's current recreational bathing programme is still short of the 20 weeks that the national guidelines recommend and are based on. All the sites with enough data have been graded as either "poor" or "very poor" with the exception of Lakes Ngatu and Taharoa.

The table below shows the median and 95th percentile for *E. coli* (n/100 mL) based on all surveys (i.e. includes previous year's results) at all sites monitored in the 2004-05 summer with their interim grade where available. Note: Sites are ranked by their median *E. coli* counts

| Location | Median E. coli (No./100mL) | 95th percentile (E. coli/100mL) | Interim grade |
|---|---|---|---|
| Lake Taharoa | 5 | 139 | Very good |
| Lake Ngatu | 10 | 393 | Fair |
| Lake Waro* | 52 | 175 | N/A |
| Kaihu River | 85 | 5686 | Poor |
| Omamari Beach Stream* | 128 | 882 | Follow up |
| Waipapa River | 154 | 1498 | Poor |
| Waitangi River | 172 | 2419 | Very poor |
| Ocean Beach Stream* | 177 | 3076 | N/A |
| Otaua Stream* | 202 | 4352 | N/A |
| Mangakahia River | 230 | 6785 | Poor |
| Kapiro Stream* | 252 | 809 | N/A |
| Tirohanga Stream | 259 | 1484 | Poor |
| Kerikeri River | 275 | 7451 | Very poor |
| Raumanga Stream | 300 | 3655 | Poor |
| Waitaua Stream | 345 | 4526 | Very poor |
| Wairoa Stream | 686 | 1658 | Very Poor |
| Langs Beach Stream* | 828 | N/A | N/A |
| Otiria Stream | 933 | 3448 | Very poor |

* Insufficient data to calculate interim grade

There is a detailed report of the recreational bathing results for 2004-2005 available on the Regional Council website.

For the summer of 2005-06 monitoring will continue at the same sites but sampling will extended from 10 to 12 weeks and will cover the Christmas to New Year period. Investigative sampling at ongoing problem sites will be carried out where possible. This will include faecal sterol or fluorescent whitening agent sampling to assist with identifying the source of contamination.

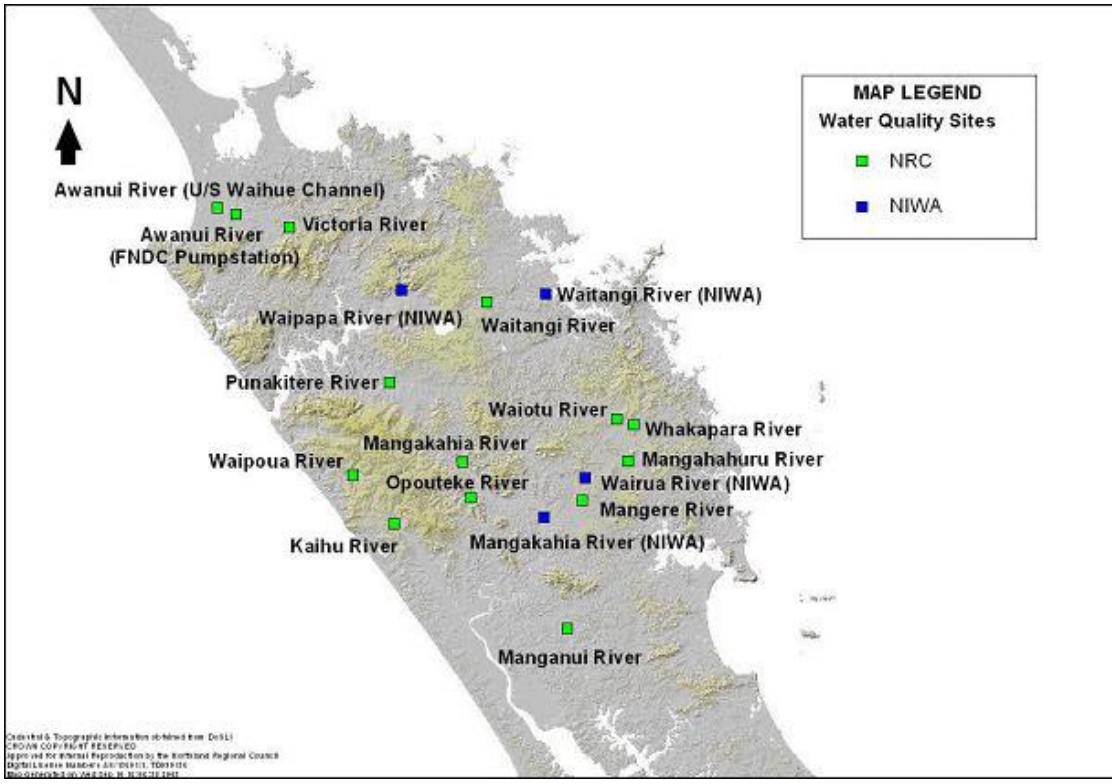
Finally, it must be stressed that any findings presented cannot be taken as absolute conclusions. In all likelihood the Langs Beach, Otiria and Wairoa stream sites are not the only unsafe sites in Northland and just because many of the sites were relatively good over the summer months does not necessarily make them suitable all year round, let alone from year to year. 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.

## River Water Quality Monitoring Network

Our regional River Water Quality Monitoring Network (RWQMN) involves the monitoring of water quality and macroinvertebrate biota in an increasing number of rivers around Northland.

The network currently includes 18 sites on several river systems throughout Northland, of which four sites are part of the National River Water Quality Network and, are monitored by National Institute of Water and Atmospheric Research (NIWA) staff. These four sites are Waipapa River in Puketi Forest, Waitangi River at Watea, Mangakahia River at Titoki and Wairua River at Purua. More information about the national network and results can be viewed on NIWA's website.

However because these four sites are monitored by NIWA it means the Regional Council does not have the data readily available for analysis. A detailed analysis of the data for these four sites will be carried out at the end of next financial year (2005-2006).




Monthly water quality sampling is carried out at each site for a range of chemical and physical parameters, which are shown in the table below. The purpose of the network is to provide information about the general state of Northland's rivers, so that long-term trends can be detected and analysed.

Most results are compared to the New Zealand trigger values for the protection of aquatic ecosystems in the '*Australian and New Zealand Guidelines for Fresh and Marine Water Quality'* (ANZECC 2000), which can be accessed in the publications section of the Ministry for the Environment's website.

It is important to note that the trigger values are used to assess the risk of adverse effects on the ecosystem and when results are outside trigger values further

investigation is required to determine whether there is adverse effects on the environment and to what extent. There are two sets of trigger values; one for upland rivers, which only includes one site in the network (Waipoua River), and for lowland rivers as shown in the table below.

Levels of the indicator bacteria *Escherichia coli* (*E. coli*) are compared to the '*Microbiological Water Quality Guidelines for Marine and Freshwater Recreational areas*' (see the **recreational bathing water quality section** of this report) and the commonly used minimum for dissolved oxygen is 6 mg/L (see section 7 of the '*Regional Water and Soil Plan for Northland*').

| **Parameter** | **Guideline trigger values (NZ lowland rivers)** | **Guideline trigger values (NZ upland rivers)** |
|---|---|---|
| Temperature (Degrees Celsius) | - | - |
| Dissolved oxygen (mg/L) | > 6* | > 6* |
| Dissolved oxygen (% Saturation) | 98 - 105 | 99 – 103 |
| Conductivity (mSm) | - | - |
| Water clarity (m) | > 0.6 | > 0.8 |
| Turbidity (NTU) | < 5.6 | < 4.1 |
| *E. coli* (n/100mL) | < 126^ | < 126^ |
| Dissolved reactive phosphorus(mg/L) | < 0.01 | < 0.009 |
| Total phosphorus (mg/L) | < 0.033 | < 0.026 |
| Ammoniacal nitrogen (mg/L) | < 0.021 | < 0.01 |
| Total nitrogen (mg/L) | < 0.614 | < 0.295 |
| pH | 7.2 – 7.8 | 7.3 – 8.0 |

* accepted level of dissolved oxygen (mg/L)
^ *E. coli* guideline for recreational bathing in freshwater

Refer to the next page (page 7) for the water quality results for 2004-2005. The 2004-2005 results for the four sites monitored by NIWA are not presented in this report but last years results and any long-term trends can be viewed in the 2003-2004 Annual Monitoring Report.

The regional River Water Quality Monitoring Network began in 1996, so the Regional Council now has enough data for some rivers to begin looking for long-term trends in water quality (Refer to page 26).

Stream macroinvertebrate monitoring is carried out at each RWQMN site once a year during summer. A summary of the 2004-2005 results are presented in this report (Refer to page 28).

In the 2005-2006 financial year 3 additional sites will be added to the network. Two on the Waiarohia Stream in Whangarei to incorporate an urban catchment and another site on the headwaters of the Mangahahuru Stream to add another site with a predominately exotic forestry catchment. Also extra sampling will be carried out at selected sites to investigate elevated or unusual results such as the high phosphorus levels in Opouteke River.

## Water Quality Results

Rivers have been ranked for 2004-05 by listing each in order for the range of parameters, from best to worst (i.e. highest to lowest water clarity, or least to most nitrogen).

The order of the sites from overall best water quality to worst is very similar to last financial year with Waipoua River ranked the best and Mangere River the worst. Also similarly to 2003-2004 the ranking of sites is linked to catchment land use, with the best sites having catchments dominated by native forest, moving through to sites with a mix of forestry, native forest and agriculture, to the worst sites being those with their catchment dominated by intensive agriculture land use. Some sites have been shown with equal ranking, as it was difficult to differentiate between them, which one was in better condition.

| Ranking | Site | River system | Land use |
|---|---|---|---|
| 1 | Waipoua River | Waipoua | Native forest |
| 2 | Waipapa River | Waipapa | Native forest |
| 3 | Kaihu River at gorge | Wairua | Agriculture/forestry |
| 4 | Victoria River | Victoria/Awanui | Agriculture/native forest |
| 5 | Opouteke River | Wairua/Mangakahia | Forestry/native forest |
| 6 | Waitangi at Watea | Waitangi | Agriculture/native forest |
| 7 | Mangakahia at Twin Bridges | Wairua/Mangakahia | Agriculture/forestry |
| 7 | Whakapara River | Wairua | Agriculture |
| 7 | Waitangi at Waimate North | Waitangi | Agriculture/native forest |
| 10 | Awanui at FNDC water take | Victoria/Awanui | Agriculture |
| 10 | Mangakahia at Titoki | Wairua/Mangakahia | Agriculture |
| 10 | Punakitere River | Punakitere | Agriculture |
| 13 | Waiotu River at SH 1 | Wairua | Agriculture |
| 13 | Mangahahuru Stream | Wairua | Agriculture |
| 13 | Wairua River at Purua | Wairua | Agriculture |
| 13 | Manganui River | Manganui | Agriculture |
| 17 | Awanui at Waihue Channel | Victoria/Awanui | Agriculture |
| 18 | Mangere River at Knights Rd | Wairua | Agriculture |

Note: the rankings of the following four sites are based on their 2003-2004 results and rankings: Waipapa River, Waitangi at Watea, Mangakahia at Titoki and Wairua River.

This report presents a summary of the 2004-2005 water quality results for each of these sites (refer to pages 8 – 25). Graphs for each parameter at each site are available in the section on the Regional Council website. A summary of the long term trend analysis is also presented in this report (See page 26).

## Waipoua River

The Waipoua River originates in and flows through Waipoua Forest, the home of the legendary giant Kauri Tree, Tane Mahuta on the West Coast of Northland. The river cuts through volcanic soils, and has a predominantly indigenous forest catchment. The Waipoua River site is the only site in the network that is classified as "hill elevation" by the '*River Environment Classification'* (NIWA & MfE 2004) and therefore the results have been compared to the trigger values for an upland river. Similarly to the Waipapa River, the Waipoua River is one of the nearest to pristine condition of all the rivers in the network.

The 2004-2005 results for the Waipoua River site are summarised in the table below including the median, range and percentage of sampling occasions that comply with relevant guidelines for the 12 sampling occasions.

| Parameter | Median | Range | % comply with guideline |
|---|---|---|---|
| Temperature (deg. cel.) | 14.1 | 8.4 - 16.2 | - |
| Dissolved oxygen (mg/L) | 10.7 | 9.8 - 12.2 | 100 |
| Dissolved oxygen (% Sat.) | 103.4 | 99.1 - 108 | 50 |
| Conductivity (mSm) | 9.5 | 7.3 - 10.9 | - |
| Water clarity (m) | 2.99 | 1.24 - 3.73 | 100 |
| Turbidity (NTU) | 2.0 | 0.8 - 3.8 | 100 |
| E. coli (n/100mL) | 117 | 10 - 776 | 50 |
| Dissolved reactive phosphorus (mg/L) | 0.006 | 0.004 - 0.011 | 92 |
| Total phosphorus (mg/L) | 0.007 | 0.004 - 0.022 | 100 |
| Ammoniacal nitrogen (mg/L) | 0.01 | 0.01 - 0.01 | 100 |
| Total nitrogen (mg/L) | 0.13 | 0.105 - 0.21 | 100 |
| pH | 7.5 | 6.9 - 8 | 75 |

The results from 2004-05 confirm that Waipoua River remains in a relatively pristine condition. The medians of all parameters, except dissolved oxygen percentage saturation, were within relevant guidelines for an upland river, with the majority of parameters meeting the guidelines on all 12 sampling occasions. The median dissolved oxygen of 103.4% is only slightly outside the trigger value range for the protection of aquatic ecosystems for an upland site of 99 to 103%.

Bacterial results (*E. coli*) only met the recreational bathing guideline limit of 126/100mL on half of the sampling occasions, which highlights that run-off from indigenous forestry can still cause small spikes of bacterial contamination. There is no flow data for this site. However the spikes in *E. coli* appear to be related to elevated turbidity levels, which indicates that bacterial contamination is occurring to a small degree during rainfall run-off events.

The Waipoua River site was only added to the network in 2002, meaning there will not be adequate data available for long-term trend analysis until the end of 2006-2007. However it is clear from the 3 years data currently available that water quality in Waipoua River is excellent, with consistently good water clarity and dissolved oxygen, and low nutrient levels.

## Waipapa River

The Waipapa River originates in and flows through Puketi forest in central Northland, meandering through farmland until it reaches the upper Hokianga Harbour. The sampling site is within the forest and therefore the catchment is predominantly indigenous forest with some small areas of exotic forestry in the headwaters. The geology of the Waipapa River is soft sedimentary (siltstones and mudstones). The Waipapa River is one of only two sites in the network that are in a near pristine condition (the other being the Waipoua River site).

The Waipapa site is one of four sites in Northland that are part of the National River Water Quality Network administered by NIWA. Therefore there is no data available as yet for the 2004-2005 financial year. From the 2003-2004 results it is obvious that the Waipapa River remains in a relatively pristine state.

Photo: Waipapa River at Forest Ranger

## Kaihu River

The Kaihu River originates in native forest west of Trounson Kauri Park, and drains into the Wairoa River in Dargaville. The catchment is a mix of both exotic and indigenous forestry, agriculture and horticulture, but dairy farming is the dominant land-use, especially in the middle and lower reaches. Kaihu River is one of six sites in the network that have volcanic acidic catchment geology.

The 2004-2005 results for the Kaihu River site are summarised in the table below including the median, range and percentage of sampling occasions that comply with relevant guidelines for the 12 sampling occasions.

| Parameter | Median | Range | % comply with guideline |
|---|---|---|---|
| Temperature (deg. cel.) | 15.6 | 8.9 - 17.9 | - |
| Dissolved oxygen (mg/L) | 10.8 | 9.4 - 12 | 100 |
| Dissolved oxygen (% Sat.) | 103.4 | 98.5 - 117.5 | 75 |
| Conductivity (mSm) | 11.6 | 9.8 - 17.1 | - |
| Water clarity (m) | 2.10 | 0.85 - 3.8 | 100 |
| Turbidity (NTU) | 3.3 | 0.8 - 12.5 | 83 |
| E. coli (n/100mL) | 120 | 35 - 1413 | 50 |
| Dissolved reactive phosphorus (mg/L) | 0.006 | 0.004 - 0.011 | 92 |
| Total phosphorus (mg/L) | 0.016 | 0.007 - 0.027 | 100 |
| Ammoniacal nitrogen (mg/L) | 0.01 | 0.01 - 0.02 | 100 |
| Total nitrogen (mg/L) | 0.50 | 0.183 - 0.73 | 75 |
| pH | 7.4 | 6.8 - 7.9 | 75 |

The results from 2004-2005 indicate that Kaihu River is only slightly impacted. The medians for all parameters are within the relevant guidelines but only four parameters meet the guidelines on all 12 sampling occasions; dissolved oxygen, water clarity, total phosphorus and ammoniacal nitrogen.

Over the last year there has been several spikes of bacterial contamination and elevated nitrogen (usually associated with increased flow and turbidity). This contamination is most likely as a result of run-off from forestry and/or pastoral land uses within the catchment.

Similarly to Waipoua River, the Kaihu River site was added to the network in 2002 and therefore there is not adequate data yet to carry out long-term trend analysis on water quality in the Kaihu River.

Photo: Kaihu River at Gorge

## Victoria River

The Victoria River begins in the native forest of the Mangamuka Ranges, and runs north through pasture before joining with the Awanui River near Kaitaia. Approximately two kilometres from the native forest, the site is somewhat affected by pastoral land use, however the catchment is still dominated by indigenous forest. The geology of this site is classified as volcanic acidic in the '*River Environment Classification'* (NIWA & MfE 2004).

The 2004-2005 results for the Victoria River site are summarised in the table below including the median, range and percentage of sampling occasions that comply with relevant guidelines for the 12 sampling occasions.

| Parameter | Median | Range | % comply with guideline |
|---|---|---|---|
| Temperature (deg. cel.) | 15.1 | 9.3 - 19 | - |
| Dissolved oxygen (mg/L) | 9.8 | 8 - 12 | 100 |
| Dissolved oxygen (% Sat.) | 94.7 | 84.6 - 106.7 | 25 |
| Conductivity (mSm) | 16.4 | 14.7 - 20.1 | - |
| Water clarity (m) | 2.1 | 1.5 - 2.2 | 100 |
| Turbidity (NTU) | 0.6 | 0.2 - 1.8 | 100 |
| E. coli (n/100mL) | 115 | 74 - 226 | 58 |
| Dissolved reactive phosphorus (mg/L) | 0.018 | 0.01 - 0.025 | 8 |
| Total phosphorus (mg/L) | 0.017 | 0.009 - 0.028 | 100 |
| Ammoniacal nitrogen (mg/L) | 0.010 | 0.01 - 0.01 | 100 |
| Total nitrogen (mg/L) | 0.11 | 0.102 - 0.707 | 92 |
| pH | 7.4 | 7 - 7.9 | 75 |

For the most part, the water quality of the Victoria River is excellent. The median for the majority of parameters are within relevant guidelines and five parameters are within guidelines on all 12 sampling occasions; dissolved oxygen, water clarity, turbidity, total phosphorus and ammoniacal nitrogen.

The parameters of the most concern are dissolved oxygen saturation and dissolved reactive phosphorus. Dissolved oxygen saturation was below the trigger value lower limit on 8 of the 12 sampling occasions, however raw dissolved oxygen levels are consistently above the well accepted guideline of 6 mg/L. As for the elevated dissolved reactive phosphorous, this is most likely as a result of super-phosphate fertiliser usage within the catchment.

A positive result at the Victoria River site are long-term trends indicate that nitrate/nitrite nitrogen (NNN), total phosphorus and *E. coli* bacteria levels are declining. However there is also a long term trend indicating that pH is increasing (becoming more alkaline). It is unknown whether this is a positive or detrimental trend.

## Opouteke River

The Opouteke River drains from predominantly exotic forestry (pine forest), through a small area of pasture before reaching the Mangakahia River. The only pastoral farming land use upstream of the sampling site is sheep and beef farming, although there are dairy farms further downstream. Acidic volcanic rocks make up the underlying geology.

The 2004-2005 results for the Opouteke River site are summarised in the table below including the median, range and percentage of sampling occasions that comply with relevant guidelines for the 12 sampling occasions.

| Parameter | Median | Range | % comply with guideline |
|---|---|---|---|
| Temperature (deg. cel.) | 17.6 | 9.4 - 23.6 | - |
| Dissolved oxygen (% Sat.) | 109.6 | 104.7 - 114.6 | 8 |
| Conductivity (mSm) | 12.2 | 8.1 - 16.9 | - |
| Water clarity (m) | 2.10 | 0.54 - 2.93 | 92 |
| Turbidity (NTU) | 1.6 | 1 - 7 | 83 |
| E. coli (n/100mL) | 92 | 41 - 408 | 67 |
| Dissolved reactive phosphorus (mg/L) | 0.054 | 0.004 - 0.085 | 17 |
| Total phosphorus (mg/L) | 0.070 | 0.004 - 0.125 | 33 |
| Ammoniacal nitrogen (mg/L) | 0.01 | 0.01 - 0.01 | 100 |
| Total nitrogen (mg/L) | 0.18 | 0.102 - 0.357 | 100 |
| pH | 7.7 | 7.4 - 8.5 | 75 |

Opouteke River had the highest temperature recorded during the 2004-2005 financial year on 15 December 2005 of 23.6°C. It is generally thought freshwater ecosystems, particularly fish and macroinvertebrate communities are likely to be detrimentally effected if water temperatures exceed 25°C. It is likely that temperature exceeds this in Opouteke River at certain times of the day in summer months. The highest range in temperature between the minimum and maximum values recorded was also in Opouteke River with a range of 14.2 degrees.

Similarly to last year elevated phosphorus levels are of the greatest concern for Opouteke River. Not only were the medians for both total and dissolved reactive phosphorous levels well above the guideline values, there is also a long-term trend that suggests that for DRP the problem is getting worse.

Unlike other sites on the network, the source of this phosphorous is probably not agricultural run-off, as nitrogen and E. coli levels are low. More research is required to investigate the problem further, partly because the source of the high phosphorus levels is unclear and also they are exhibiting an unusual oscillating pattern.

## Waitangi River at Watea

The Waitangi River originates in roughly the middle of Northland and flows East where it joins the coast at Waitangi. There are two sites on the Waitangi River that form part of the river network, one at Waimate North and the other at Watea near Waitangi. The catchments of both sites are dominated by pastoral farming. However the geology of the upstream site at Waimate North is predominetly volcanic acidic, while the site at Watea is predominately hard sediments. Unlike many of Northland's rivers, a riparian buffer strip of vegetation exists along the majority of the Waitangi River.

The Watea site on the Waitangi River is one of four sites in Northland that are part of the National River Water Quality Network administered by NIWA. Therefore there is no data available as yet for the 2004-2005 financial year. The 2003-2004 results show that the Watea site is better in terms of its water quality than the Waimate North site further up the Waitangi River. The site at Waimate North is monitored by NRC staff, for which results can be viewed by later in this report.

Photo: Waitangi River at Watea

## Mangakahia River at Twin Bridges

The Mangakahia River originates from Matarua Forest and flows southwest until it reaches the Wairua River. There are two sites on the Mangakahia River in the network; one at Twin Bridges and the other at Titoki Bridge in the lower reaches. The Twin Bridges lie at the confluence of the Awaroa and Mangakahia Rivers. The sampling site is directly upstream of the confluence, on the Mangakahia River. The reserve area at Twin Bridges is a popular swimming spot and picnic area for tourists and locals alike. The upstream catchment is a mix of plantation forestry, and beef and sheep farming, with a volcanic acidic underlying geology.

The 2004-2005 results for the Twin Bridges site on the Mangakahia River are summarised in the table below including the median, range and percentage of sampling occasions that comply with relevant guidelines for the 12 sampling occasions.

| Parameter | Median | Range | % comply with guideline |
|---|---|---|---|
| Temperature (deg. cel.) | 17.5 | 9.3 - 22.8 | - |
| Dissolved oxygen (% Sat.) | 108.5 | 102.1 - 115.4 | 17 |
| Conductivity (mSm) | 11.7 | 8.8 - 15 | - |
| Water clarity (m) | 1.68 | 0.26 - 2.37 | 83 |
| Turbidity (NTU) | 3.7 | 0.5 - 15.2 | 75 |
| E. coli (n/100mL) | 203 | 41 - 2282 | 42 |
| Dissolved reactive phosphorus (mg/L) | 0.062 | 0.004 - 0.278 | 8 |
| Total phosphorus (mg/L) | 0.079 | 0.008 - 0.864 | 8 |
| Ammoniacal nitrogen (mg/L) | 0.01 | 0.0 - 0.01 | 100 |
| Total nitrogen (mg/L) | 0.26 | 0.107 - 1.883 | 92 |
| pH | 7.6 | 7.2 - 8.4 | 67 |

Like Opouteke River, the twin bridges site on the Mangakahia River also had high temperatures recorded in summer months during the 2004-2005 financial year, with 22.8°C recorded on 15 December 2005. It is likely that temperatures exceed 25°C in Mangakahia River at certain times of the day in summer months, which could be a potential risk for the survival of aquatic fauna.

The greatest concern with water quality at the Twin Bridges site is the elevated phosphorus levels that are occurring all year around. Both the median amount of dissolved reactive and total phosphorus for 2004-2005 exceeded guideline trigger values, with only one sampling occasion for both parameters being below their respective trigger values. Also like DRP in Opouteke River there is a long term trend suggesting that dissolved reactive phosphorus levels are increasing at the Twin bridges site.

The median of dissolved oxygen percentage saturation and bacterial levels (*E. coli*) were also above the recommended levels, but the elevated *E. coli* results tend to occur in conjunction with increased flows and the high dissolved oxygen levels occur in summer when photosynthesis rates by plants are greater. Overall, the Twin Bridges site represents a moderately impacted site, which could easily be improved with some riparian planting and fencing.

## Whakapara River

The Whakapara River originates from the ranges east of Hikurangi and Whakapara, to eventually mix with the Waiotu River, forming the headwaters of the greater Wairua River. The river cuts through hard sediments formed from faulted greywacke, along a relatively low gradient. The site is located in a beef cattle farm near State Highway one, with an upstream catchment dominated by forested hills and pastoral farming.

The 2004-2005 results for the Whakapara River site are summarised in the table below including the median, range and percentage of sampling occasions that comply with relevant guidelines for the 12 sampling occasions.

| Parameter | Median | Range | % comply with guideline |
|---|---|---|---|
| Temperature (deg. cel.) | 16.6 | 9.9 - 20.1 | - |
| Dissolved oxygen (mg/L) | 10.9 | 8.6 - 12.6 | 100 |
| Dissolved oxygen (% Sat.) | 109.1 | 87.9 - 129.2 | 25 |
| Conductivity (mSm) | 9.0 | 7.8 - 10.6 | - |
| Water clarity (m) | 1.5 | 0.9 - 2.8 | 100 |
| Turbidity (NTU) | 3.9 | 1.7 - 7.9 | 83 |
| E. coli (n/100mL) | 110 | 14 - 512 | 58 |
| Dissolved reactive phosphorus (mg/L) | 0.020 | 0.008 - 0.896 | 17 |
| Total phosphorus (mg/L) | 0.054 | 0.036 - 1.04 | 0 |
| Ammoniacal nitrogen (mg/L) | 0.01 | 0.01 - 0.02 | 100 |
| Total nitrogen (mg/L) | 0.47 | 0.15 - 0.893 | 83 |
| pH | 7.2 | 6.9 - 7.5 | 67 |

Similarly to Mangakahia at Twin Bridges and Opouteke both total phosphorus and dissolved reactive phosphorus in Whakapara River in 2004 –2005 were elevated on the majority of sampling occasions, with the medians for both exceeding guideline trigger values. These elevated phosphorus results are not related to increased flows. The median for dissolved oxygen saturation is also outside the optimum range for the protection of aquatic ecosystems. There are long term trends suggesting that both dissolved oxygen and DO percentage saturation are increasing in Whakapara River. This could be related to an increase in the biomass of oxygen weed and other macrophytes in the river.

Although the medians for turbidity, *E. coli* and total nitrogen meet their respective guidelines, there are several sampling occasions that they did not. Unlike the elevated phosphorus results these tend to occur in conjunction with elevated flows. The effect of runoff could be minimised with appropriate riparian management such as fencing and planting of a buffer strip of vegetation.

Other significant long term trends in Whakapara River include an increasing pH, decreasing turbidity, increase in organic nitrogen (TKN) levels and decrease in nitrite/nitrate nitrogen (NNN) levels.

## Waitangi River at Waimate North

The Waitangi River originates just east of Lake Omapere, and flows into the Bay of Islands. There are two sites on Waitangi River in the Regional Council's river network; one in the upper to mid reaches at Waimate North and the other in the lower reaches at Watea. At the Waimate North site, the catchment is a mix of beef, sheep and dairy farming, with significant areas of indigenous forest in the headwaters. The underlying geology is predominantly acidic volcanics.

The 2004-2005 results for the Waitangi River site at Waimate North are summarised in the table below including the median, range and percentage of sampling occasions that comply with relevant guidelines for the 12 sampling occasions.

| Parameter | Median | Range | % comply with guideline |
|---|---|---|---|
| Temperature (deg. cel.) | 15.8 | 9.2 - 19.8 | - |
| Dissolved oxygen (mg/L) | 10.8 | 8.7 - 16.2 | 100 |
| Dissolved oxygen (% Sat.) | 103.9 | 89.7 - 142 | 17 |
| Conductivity (mSm) | 9.4 | 8.4 - 11.4 | - |
| Water clarity (m) | 1.53 | 0.91 - 3.35 | 100 |
| Turbidity (NTU) | 3.6 | 1.4 - 10 | 83 |
| E. coli (n/100mL) | 594 | 158 - 2489 | 0 |
| Dissolved reactive phosphorus (mg/L) | 0.006 | 0.004 - 0.197 | 75 |
| Total phosphorus (mg/L) | 0.023 | 0.013 - 0.253 | 75 |
| Ammoniacal nitrogen (mg/L) | 0.01 | 0.01 - 0.02 | 100 |
| Total nitrogen (mg/L) | 0.53 | 0.254 - 0.855 | 75 |
| pH | 7.1 | 6.5 - 7.4 | 42 |

In general water quality in the Waitangi River at the Waimate North site is quite good with nutrient levels elevated above the guidelines on only a few occasions in 2004-2005. Only the median for *E. coli* and pH were not within accepted guidelines. In fact, the bacteria *E. coli* exceeded the bathing guideline of 126 per 100mL on all sampling occasions.

A median as high as 594 *E. coli* per 100 mL and consistently elevated results indicate that intermittent sources of *E. coli* such as leaking septic tanks, or stock with access to the river may be more of a problem at this site than surface run-off. Restricting stock access and encouraging the maintenance of septic tanks can reasonably easily mitigate these sources.

Although only significant at a 90% confidence level (not shown on the table in the trends section of this report) there was a long term trend suggesting that E. coli counts are increasing at the Waimate North site at a rate of 50 per 100mL/year.

There was also a long term trend suggesting that pH is increasing at this site. Although in general it is not known whether an increase in pH is beneficial or detrimental. It is likely at this site that an increase in pH is beneficial, as pH levels were only ever below the optimum pH range for the protection of aquatic ecosystem in 2004-2005, never above.

## Awanui River at FNDC water take

The Awanui River originates from Raetea Forest (Mangamuka's) and meanders north for a significant distance through pasture and the Kaitaia township, eventually flowing into the Rangunu Harbour. There are 3 sites on the Awanui River system in the network; one in the upper reaches on Victoria River, one in the mid reaches at the FNDC water take and the last one in the lower reaches directly above Waihue channel. The FNDC water take from the Awanui River is beside State Highway 1, just south of Kaitaia. The upstream catchment is predominantly pastoral land use, with some semi-forested tributaries such as the Victoria River. Most of the river's bottom is made up of soft sediments, and riparian planting varies from non-existent to quite dense.

The 2004-2005 results for the Awanui River at the location of the FNDC water take are summarised in the table below including the median, range and percentage of sampling occasions that comply with relevant guidelines for the 12 sampling occasions.

| Parameter | Median | Range | % comply with guideline |
|---|---|---|---|
| Temperature (deg. cel.) | 17.2 | 9.1 - 19.7 | - |
| Dissolved oxygen (mg/L) | 8.5 | 7.3 - 10.8 | 100 |
| Dissolved oxygen (% Sat.) | 84.8 | 79.6 - 96.9 | 0 |
| Conductivity (mSm) | 19.9 | 17 - 24.8 | - |
| Water clarity (m) | 0.8 | 0.4 - 1.5 | 50 |
| Turbidity (NTU) | 6.3 | 1.7 - 10.1 | 50 |
| E. coli (n/100mL) | 258 | 134 - 1120 | 0 |
| Dissolved reactive phosphorus (mg/L) | 0.019 | 0.01 - 0.042 | 8 |
| Total phosphorus (mg/L) | 0.036 | 0.02 - 0.05 | 33 |
| Ammoniacal nitrogen (mg/L) | 0.01 | 0.01 - 0.02 | 100 |
| Total nitrogen (mg/L) | 0.30 | 0.104 - 0.47 | 100 |
| pH | 7.4 | 7 - 7.8 | 67 |

Similarly to last year the nitrogen concentrations were satisfactory, however dissolved oxygen saturation, phosphorus, turbidity and *E. coli* failed to meet the guidelines. Also water clarity only met the guideline trigger values on half of the 12 sampling occasions. Some of these elevated results coincide with elevated flows and therefore are most likely as a result of surface run-off during rainfall events. However some of the spikes in *E. coli* and phosphorus cannot be as easily linked to rainfall events. This contamination could be as a result of leaking septic tanks or stock with access to the river.

Improved riparian management will assist with mitigating some of these elevated results, by restricting stock access, and reducing excess run-off. Better maintenance of septic tanks within the catchment is also likely to reduce the number and size of contamination events. Another potential source of phosphorus is inefficiently applied fertiliser. Accurate nutrient budgeting and appropriate application can reduce the amount of fertiliser wasted by being washed into streams.

## Mangakahia River at Titoki

The Mangakahia River originates from native bush near Waipoua Forest flowing southwest until it reaches the Wairua River. There are two sites on the Mangakahia River; one mid catchment at Twin Bridges and the other at Titoki Bridge in the lower reaches. By the time the Mangakahia River reaches the settlement of Titoki, land use is predominantly beef and dairy farming, still with an underlying geology of acidic volcanics. Riparian management along the lower Mangakahia varies in quality, from quite dense to non-existent.

The Titoki bridge site on the Mangakahia River is one of four sites in Northland that is part of the National River Water Quality Network administered by NIWA. Therefore there is no data available as yet for the 2004-2005 financial year. The 2003-2004 results indicate that the Mangakahia River has moderate water quality by the time it reaches Titoki.

Photo: Mangakahia River at Titoki Bridge

## Punakitere River

The Punakitere River, originating from a wetland area southwest of Kaikohe, is a major tributary into the Waima River (which flows into the Hokianga Harbour). The catchment is predominantly agricultural land use with an underlying geology of soft sediments.

The 2004-2005 results for Punakitere River are summarised in the table below including the median, range and percentage of sampling occasions that comply with relevant guidelines for the 12 sampling occasions.

| Parameter | Median | Range | % comply with guideline |
|---|---|---|---|
| Temperature (deg. cel.) | 15.6 | 8 - 19.7 | - |
| Dissolved oxygen (mg/L) | 10.3 | 8.4 - 16.2 | 100 |
| Dissolved oxygen (% Sat.) | 101.3 | 87 - 138.3 | 42 |
| Conductivity (mSm) | 12.9 | 11 - 16.1 | - |
| Water clarity (m) | 1.50 | 0.55 - 3.07 | 90 |
| Turbidity (NTU) | 4.6 | 1.2 - 15.7 | 58 |
| E. coli (n/100mL) | 379 | 111 - 1014 | 8 |
| Dissolved reactive phosphorus (mg/L) | 0.031 | 0.013 - 0.058 | 0 |
| Total phosphorus (mg/L) | 0.061 | 0.037 - 0.104 | 0 |
| Ammoniacal nitrogen (mg/L) | 0.02 | 0.01 - 0.03 | 83 |
| Total nitrogen (mg/L) | 0.73 | 0.406 - 0.952 | 33 |
| pH | 7.4 | 6.6 - 8.1 | 75 |

Similarly to last year's results, the 2004-2005 results indicate that the Punakitere River suffers from significant nutrient overloading and bacterial contamination. The Punakitere River is one of the few in Northland in which median total nitrogen exceeds the guidelines, and total phosphorous levels are almost twice the limit. Only one *E. coli* result meets the bathing guideline of 126 per 100mL.

Run-off is the likely source of most of the nutrients (and *E. coli*) in Punakitere River. Aerial photography is not yet available for this area, so it is not known what the extent or density of riparian management is in the area. The good dissolved oxygen levels, reasonably high water clarity and low ammoniacal nitrogen results suggest that, the Punakitere River could potentially be restored to a much healthier condition over time with improved farm practices within the catchment.

There is not yet enough data for long term trend analysis on water quality in Punakitere River.

## Waiotu River at SH1

The Waiotu River is a hard sediment bottomed river derived from a predominantly agricultural catchment. The river originates from hills to the northeast of State Highway one between Kawakawa and Whangarei, to eventually combine with the Whakapara River and form the greater Wairua River.

The 2004-2005 results for the Waiotu River site are summarised in the table below including the median, range and percentage of sampling occasions that comply with relevant guidelines for the 12 sampling occasions.

| Parameter | Median | Range | % comply with guideline |
|---|---|---|---|
| Temperature (deg. cel.) | 16.8 | 9.3 - 19.5 | - |
| Dissolved oxygen (mg/L) | 9.0 | 6.1 - 12.2 | 100 |
| Dissolved oxygen (% Sat.) | 96.6 | 62.6 - 116.8 | 17 |
| Conductivity (mSm) | 9.8 | 7 - 77.7 | - |
| Water clarity (m) | 1.01 | 0.48 - 2.52 | 100 |
| Turbidity (NTU) | 6.5 | 3.4 - 27 | 33 |
| E. coli (n/100mL) | 263 | 95 - 3873 | 25 |
| Dissolved reactive phosphorus (mg/L) | 0.020 | 0.009 - 0.042 | 18 |
| Total phosphorus (mg/L) | 0.063 | 0.03 - 0.112 | 9 |
| Ammoniacal nitrogen (mg/L) | 0.02 | 0.01 - 0.1 | 82 |
| Total nitrogen (mg/L) | 0.56 | 0.256 - 1.367 | 64 |
| pH | 7.2 | 6.6 - 7.9 | 42 |

Similarly to many other sites sampled in 2004-2005, the medians of the dissolved oxygen saturation, phosphorus and *E. coli* results did not met the relevant guidelines. Although the medians of all other parameters met relevant guidelines, there was extremely high conductivity, turbidity and nitrogen levels recorded in Waiotu River in 2004-05.

This year was the first year were there is enough data for a long term trend analysis to be carried out. There is a long term trend suggesting that dissolved oxygen percentage saturation is increasing, most likely as a result of increased aquatic macrophyte biomass. Similarly to all other sites in the network, except the four NIWA sites, there is a long term trend suggesting that pH is increasing in Waiotu River. There are also trends suggesting that turbidity, total nitrogen and nitrite/nitrate nitrogen (NNN) are decreasing.

Photo: Waiotu River at SH1

## Mangahahuru Stream at Apotu Road

The Mangahahuru Stream, which begins in *Pinus radiata* forestry southeast of Hikurangi, is a small tributary of the Wairua River. Other than the exotic forestry in the headwaters the catchment is predominantly agricultural land use, with an increasing number of lifestyle blocks. Riparian management in the catchment is variable. The underlying geology is hard sedimentary.

The 2004-2005 results for the Mangahahuru Stream at Apotu Road are summarised in the table below including the median, range and percentage of sampling occasions that comply with relevant guidelines for the 12 sampling occasions.

| Parameter | Median | Range | % comply with guideline |
|---|---|---|---|
| Temperature (deg. cel.) | 17.0 | 9.7 - 21.1 | - |
| Dissolved oxygen (mg/L) | 9.4 | 7.2 - 12.2 | 100 |
| Dissolved oxygen (% Sat.) | 98.4 | 75.2 - 121.6 | 17 |
| Conductivity (mSm) | 14.6 | 11.9 - 21.7 | - |
| Water clarity (m) | 1.44 | 0.4 - 2.95 | 89 |
| Turbidity (NTU) | 3.8 | 2 - 58 | 75 |
| E. coli (n/100mL) | 314 | 98 - 2909 | 8 |
| Dissolved reactive phosphorus (mg/L) | 0.045 | 0.021 - 0.225 | 0 |
| Total phosphorus (mg/L) | 0.123 | 0.054 - 0.279 | 0 |
| Ammoniacal nitrogen (mg/L) | 0.02 | 0.01 - 0.08 | 55 |
| Total nitrogen (mg/L) | 0.76 | 0.413 - 1.75 | 36 |
| pH | 7.1 | 6.8 - 7.4 | 17 |

The Mangahahuru River is significantly impacted on, with the phosphorus results for 2004-2005 exceeding the guideline trigger values on all sampling occasions and the median for total nitrogen and *E. coli* also exceeding guidelines.

There is cause for reserved optimism though, as the long-term trends for nitrate/nitrite nitrogen, turbidity, clarity and pH all suggest that the situation is improving in the long term. There are however also negative long term trends such as increasing conductivity, which is likely to be as a result of an increased nutrient loading, and increasing organic nitrogen (TKN).

Non-point diffuse surface run off is the likely source of most of the contamination, as spikes in contamination are associated with elevated river flows. However some may also be contributed to poorly maintained septic tanks, stock access to the stream or point source discharges.

## Wairua River at Purua

The Wairua River flowing west above Whangarei all the way into the Kaipara Harbour, is one of the major tributaries of the greater Wairoa River. Upstream of the sampling site the catchment is predominantly pastoral, with the river cutting through hard sediments along a low gradient.

The Wairua River site at Purua is one of four sites in Northland that are part of the National River Water Quality Network administered by NIWA. Therefore there is no data available as yet for the 2004-2005 financial year. The 2003-2004 results suggest that the Wairua River is a moderately impacted waterway, which one would expect with the intensive agricultural land use in its catchment.

Photo: Wairua River at Purua

## Manganui River

The Manganui is a major tributary into the Wairoa River, flowing from the western fringes of the Marertu forest to join the Wairoa just east of Dargaville. The river runs through extremely low gradient predominantly agricultural pastures, with some forestry blocks scattered through the catchment. The underlying geology at the site is soft sediments.

The 2004-2005 results for the Manganui River are summarised in the table below including the median, range and percentage of sampling occasions that comply with relevant guidelines for the 12 sampling occasions.

| Parameter | Median | Range | % comply with guideline |
|---|---|---|---|
| Temperature (deg. cel.) | 16.7 | 8.3 - 21.8 | - |
| Dissolved oxygen (mg/L) | 8.0 | 5.3 - 10.9 | 83 |
| Dissolved oxygen (% Sat.) | 84.1 | 55.3 - 105.1 | 0 |
| Conductivity (mSm) | 22.1 | 17.4 - 27.7 | - |
| Water clarity (m) | 1.05 | 0.49 - 1.78 | 88 |
| Turbidity (NTU) | 5.4 | 2.5 - 18.5 | 50 |
| E. coli (n/100mL) | 177 | 31 - 1439 | 50 |
| Dissolved reactive phosphorus (mg/L) | 0.027 | 0.018 - 0.047 | 0 |
| Total phosphorus (mg/L) | 0.070 | 0.045 - 0.131 | 0 |
| Ammoniacal nitrogen (mg/L) | 0.01 | 0.01 - 0.06 | 83 |
| Total nitrogen (mg/L) | 0.69 | 0.302 - 1.171 | 33 |
| pH | 7.2 | 6.5 - 7.7 | 50 |

The Manganui River has been heavily impacted on and in turn has relatively poor water quality. The medians of five parameters did not meet their respective guideline values. None of the dissolved oxygen saturation results for 2004-2005 were within the optimum range for the protection of aquatic ecosystems. This is the only site in the network to have a dissolved oxygen reading below the accepted guideline of 6 mg/L in 2004-2005 and in fact it had two. These low dissolved oxygen results are not surprising with the sluggish nature of the extremely low gradient Manganui River.

High levels of all nutrients but particularly dissolved reactive and total phosphorus suggest that agricultural run-off is a problem in the Manganui catchment. All DRP and TP results were above the their respective guideline trigger values. Elevated phosphorous in particular is a sign that a significant amount of the fertilisers applied to paddocks are not being absorbed, but washing into streams and rivers instead. Better riparian management and fertiliser application practices would help prevent such run-off.

There is not enough data yet for Mangonui River to carry out long term trend analysis.

## Awanui River at Waihue Channel

The lowest of three sites on the Awanui River system it is located directly downstream of the discharge from Kaitaia oxidation ponds and upstream of the Waihue Channel. By the time it reaches this point the Awanui River has flowed through more than 30 km of agricultural land and Kaitaia township. The '*River Environment Classification'* identifies this site as a low elevation river with soft sediment geology and pastoral land use.

The 2004-2005 results for the Awanui River site at Waihue Channel are summarised in the table below including the median, range and percentage of sampling occasions that comply with relevant guidelines for the 12 sampling occasions.

| Parameter | Median | Range | % comply with guideline |
|---|---|---|---|
| Temperature (deg. cel.) | 17.8 | 9.7 - 20.4 | - |
| Dissolved oxygen (mg/L) | 9.1 | 7.4 - 11.4 | 100 |
| Dissolved oxygen (% Sat.) | 90.3 | 80 - 103.5 | 25 |
| Conductivity (mSm) | 20.5 | 15.6 - 28.2 | - |
| Water clarity (m) | 0.5 | 0.4 - 0.8 | 42 |
| Turbidity (NTU) | 9.3 | 3.5 - 26 | 25 |
| E. coli (n/100mL) | 438 | 157 - 1300 | 0 |
| Dissolved reactive phosphorus (mg/L) | 0.051 | 0.03 - 0.259 | 0 |
| Total phosphorus (mg/L) | 0.109 | 0.068 - 0.434 | 0 |
| Ammoniacal nitrogen (mg/L) | 0.01 | 0.01 - 0.17 | 67 |
| Total nitrogen (mg/L) | 0.66 | 0.418 - 1.53 | 42 |
| pH | 7.5 | 6.7 - 7.8 | 92 |

This site on the Awanui River is severely impacted. Like last year, the medians of seven of the 10 parameters above did not meet their respective guideline values. Of particular concern are greatly elevated phosphorous concentrations and high bacterial levels, with E. coli counts, DRP and TP exceeding their respective guidelines on all 12 sampling occasions.

The good news is that the long-term trends for this site suggest that both total phosphorous and nitrite/nitrate nitrogen (NNN) concentrations are declining.

Photo: Awanui River upstream of Waihue channel

## Mangere River at Knights Road

The Mangere River is a low-lying sluggish tributary to the Wairua River, flowing through a mostly intensive agricultural catchment. The river begins as the Mangere Stream, which flows east out of the Pukenui forest near Whangarei, becoming a river on the flats before joining the Wairoa River just west of Kokopu. For the most part, soft sedimentary rocks make up the underlying geology with small pockets of riparian vegetation remaining along the river.

The 2004-2005 results for the Mangere River are summarised in the table below including the median, range and percentage of sampling occasions that comply with relevant guidelines for the 12 sampling occasions.

| Parameter | Median | Range | % comply with guideline |
|---|---|---|---|
| Temperature (deg. cel.) | 15.4 | 8.8 - 18.7 | - |
| Dissolved oxygen (mg/L) | 8.5 | 6.4 - 11 | 100 |
| Dissolved oxygen (% Sat.) | 84.7 | 66.9 - 94.3 | 0 |
| Conductivity (mSm) | 18.1 | 16.9 - 22.9 | - |
| Water clarity (m) | 1.03 | 0.87 - 1.82 | 100 |
| Turbidity (NTU) | 6.0 | 0.2 - 7.5 | 50 |
| E. coli (n/100mL) | 407 | 74 - 5475 | 25 |
| Dissolved reactive phosphorus (mg/L) | 0.111 | 0.024 - 0.186 | 0 |
| Total phosphorus (mg/L) | 0.181 | 0.058 - 0.296 | 0 |
| Ammoniacal nitrogen (mg/L) | 0.15 | 0.02 - 0.28 | 8 |
| Total nitrogen (mg/L) | 1.13 | 0.353 - 1.836 | 17 |
| pH | 7.1 | 6.8 - 7.4 | 42 |

The Mangere River is the most impacted river in the regional network with the worst water quality of the 18 sites monitored. Nutrient and bacterial levels are elevated throughout the year. An already high *E. coli* median of 407 per 100mL, may only get worse as a long term trend as been detected that suggests that *E. coli* counts are increasing at a rate of 66/100mL/year.

In March and April 2005, in stark contrast to other months, nutrient levels were noticeably lower than usual, as were *E. coli* and turbidity. At the same time, dissolved oxygen and clarity reached their maximum values for the year. The cause(s) of this event have not been identified, but the results show that not even heavily impacted waterways such as the Mangere are beyond restoration. In the future, it is hoped that such results become more common, rather than a rarity.

Photo: Mangere River at Knight Road Bridge

## Trends in water quality

Long-term trend analysis was carried out all sites (other than the four NIWA sites) using a Seasonal Kendall test, which eliminates any seasonal influences on the results. To view any long-term trends for the four NIWA sites that are part of the National River Water Quality network check out the 2003-2004 annual monitoring report.

The table below shows water quality trends at 10 of Northland's river network sites, which are the rivers that have been sampled for five or more years. There is not yet five years data for Punakitere, Manganui, Kaihu and Waipoua Rivers and therefore the results are not presented below. Only significant trends are shown which are those with at least a 95% confidence level i.e. 95% likelihood that the trend is "real". It must be highlighted that 5 years data is a minimum for carrying out long term trend analysis and that this analysis should be carried out again in two years to confirm the significant trends are still occurring.

In the table an up arrow indicates an increasing trend, a down arrow a decreasing trend and a green arrow a desirable trend, while a red arrow indicates an undesirable trend. The increasing trend in pH at all sites has been shown in blue as it is not yet known whether this is an improvement or deterioration.

There were no trends in water temperature at any of the sites. Any significant trends in ammoniacal nitrogen ($NH_4$) have not been shown, as they are most likely influenced by the change of detection limits that resulted from a change in testing methods two years ago.

| Site | COND | DO% | DO | pH | Clarity | TURB | *E. coli* | TKN | NNN | TN | DRP | TP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Awanui FNDC watertake | ↑ | | | ↑ | | | | | ↓ | | | ↓ |
| Awanui Waihue channel | ↑ | | | ↑ | | | | | | | | ↓ |
| Victoria | | | | ↑ | | | ↓ | | ↓ | | | ↓ |
| Opouteke | | | | ↑ | | | | | | | ↑ | |
| Mangakahia Twin Bridges | ↑ | | | ↑ | | | | | | | ↑ | |
| Mangahahuru | ↑ | ↑ | | ↑ | ↑ | ↓ | | ↑ | ↓ | | | |
| Waiotu | | ↑ | | ↑ | | ↓ | | | ↓ | ↓ | | |
| Whakapara | | ↑ | ↑ | ↑ | | ↓ | | ↑ | ↓ | | | |
| Waitangi Waimate North | | ↑ | ↑ | ↑ | | | | | ↓ | | | |
| Mangere | ↑ | | | ↑ | | | ↑ | | ↓ | | | |

### Conductivity

Conductivity (COND) is a measure of the amount of ions in the water column and can be used as in indicator of nutrient enrichment. The increasing trend in conductivity at two sites on the Awanui River (FNDC watertake and Waihue channel), Mangakahia

at Twin Bridges, Mangahahuru and Mangere Rivers is most likely an indication of increasing enrichment and therefore has been shown as an undesirable trend.

### Dissolved oxygen

The increasing trend in dissolved oxygen (DO) at Mangahahuru at Apotu Road, Whakapara River, Waiotu at SH1 and Waitangi at Waimate North sites is perceived as a beneficial trend, because oxygen is required for freshwater fauna to survive. However dissolved oxygen does not have a maximum or minimum guideline but an optimum range, which it should be within. This is because extremely high DO during the day indicates that there could be low DO events during the night and early morning.

Although the trend analysis shows that dissolved oxygen has increased at these sites over the last five to six years, DO at these sites is often outside the optimum range. This is most likely because all of these four sites are dominated by aquatic macrophytes such as *Egeria densa* (oxygen weed), which produce copious amounts of oxygen during the day while they are able to photosynthesis but not at night when lags in DO occur.

### Water clarity

The trend analysis shows that water clarity has increased (improved) by 7.5 cm per year in Mangahahuru Stream since 1999 with a corresponding decrease in turbidity (TURB) readings. It is not obvious why water clarity has improved at this site; it could be as a result of reduced land run off in conjunction with improved farming and forestry practices or better quality discharges from point source discharges such as farm dairy effluent or the Kauri Dairy factory. Trend analysis in the future will confirm whether this trend still exists and whether it is occurring at any other sites.

### Bacterial contamination

There were only two sites that had significant trends in bacterial quality (*E. coli*); Victoria River in which *E. coli* has decreased by 18 per 100 mL per year since 1999, which is seen as an improvement and Mangere stream in which *E. coli* has increased by 66 per 100 mL per year, which is seen as a deterioration. Similarly to water clarity, these trends cannot be attributed to anything in particular at this stage. Further data is required to confirm the trend and understand why it is occurring.

### Nutrients

In general nutrient levels are showing decreasing trends at the majority of sites with the exception of Mangakahia at twin bridges and Opouteke River. These two sites only showed an increase in dissolved reactive phosphorus (DRP), which is seen as a deterioration. Mangahahuru Stream and Whakapara River showed an increasing trend in organic nitrogen (TKN), however they also showed a decrease in nitrite/nitrate nitrogen levels (NNN).

Five other sites showed a significant improvement in NNN levels ranging from a decrease of 0.003 to 0.071 mg/L per year. Three sites, all on the Awanui-Victoria River system, showed an improvement in total phosphorus levels and only one site, Waiotu River, showed an improvement in total nitrogen levels since 1999.

# Macroinvertebrate Monitoring

Different stream macroinvertebrates show different responses to changes in their environment such as water quality or low flows and different species show different tolerances to pollution. Macroinvertebrates are good indicators of local conditions because they tend to stay in one place and are affected by the environmental conditions over an extended period of time, unlike water quality results, which tend to be spot measurements, i.e. that exact point in time. Also stream macroinvertebrates are the best indicator of the life supporting capacity of a stream or river, as they are usually near the middle of the food web and an important component of stream ecosystems.

This report summarises the results from the February/March 2005 round of macroinvertebrate monitoring carried out at four Waiarohia Stream sites, the 18 River Water Quality Monitoring Network sites, four Otarao catchment sites and seven rivers both upstream and downstream of different resource consent activities throughout Northland.

The monitoring was carried out following the standard protocols developed by the NZ Macroinvertebrate working group in 2001; *'Protocols for sampling macroinvertebrates in Wadeable streams' (Stark et al. 2001[1])*. Four standard biotic indices were calculated to assess water quality and biological health at the sites;

- Species richness
- Macroinvertebrate Community Index (MCI)
- Semi Quantitative Macroinvertebrate Community Index (SQMCI)
- The percentage of Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) taxa (%EPT taxa)

For more information on sampling methods and biotic indices check out the detailed **macroinvertebrate monitoring report for 2004** on the Regional Council website.

[1] Stark, J.D.; Boothroyd, I.K.G.; Harding, J.S.; Maxted, J.R. and Scarsbrook, M.R. (2001). **Protocols for sampling macroinvertebrates in wadeable streams.** New Zealand Macroinvertebrate Working group Report No. 1. Prepared for the Ministry for the Environment. Sustainable Management Fund Project No. 5103, 57p.

## Biotic indices results

The table below shows the four biotic index scores for all sites monitored in 2005. MCI, SQMCI and %EPT taxa have been colour coded to show the range in water quality or degradation at each site. For example, red indicates poor water quality and a severely degraded site, through orange and yellow which indicate moderate water quality, to green which indicates good water quality or a stream still in a relatively 'pristine' state (very little impact from humans).

**Waiarohia sites**

| Site description | Species richness | MCI | SQMCI | %EPT taxa |
|---|---|---|---|---|
| Rust Ave Bridge | 17 | 88 | 4.21 | 23.5 |
| Russell Road Bridge North | 23 | 82 | 4.04 | 21.7 |
| Kamo tributary | 11 | 76 | 2.90 | 9.1 |
| Whau Valley Road | 16 | 95 | 4.79 | 37.5 |

**RWQMN sites**

| Site description | Species richness | MCI | SQMCI | %EPT taxa |
|---|---|---|---|---|
| Awanui @ Waihue channel | 14 | 86 | 5.25 | 42.9 |
| Awanui @ FNDC water take | 12 | 87 | 4.45 | 25.0 |
| Victoria @ Thompsons Bridge | 22 | 116 | 4.54 | 50.0 |
| Waipapa @ Forest Ranger | 24 | 115 | 5.55 | 41.7 |
| Waitangi @ Waimate North | 24 | 103 | 5.65 | 45.8 |
| Waitangi @ Watea | 9 | 73 | 3.68 | 0.0 |
| Whakapara @ Cableway | 15 | 83 | 4.25 | 40.0 |
| Mangahahuru @ Apotu Road | 17 | 84 | 4.10 | 23.5 |
| Wairua @ Purua | 9 | 73 | 3.95 | 0.0 |
| Mangere @ Knights Road | 17 | 84 | 4.01 | 11.8 |
| Mangakahia @ Titoki | 12 | 104 | 4.10 | 50.0 |
| Opouteke @ Suspension Bridge | 19 | 82 | 2.74 | 26.3 |
| Mangakahia @ Twin bridges | 13 | 74 | 2.46 | 15.4 |
| Punakitere @ Taheke Recorder | 19 | 94 | 4.94 | 47.4 |
| Waiotu @ SH1 | 12 | 96 | 4.03 | 50.0 |
| Kaihu @ gorge | 17 | 93 | 2.34 | 35.3 |
| Waipoua @ SH12 Rest area | 20 | 135 | 7.39 | 55.0 |
| Manganui @ Permanent station | 9 | 93 | 4.20 | 22.2 |

**Otarao catchment sites**

| Site description | Species richness | MCI | SQMCI | %EPT taxa |
|---|---|---|---|---|
| Otarao near Mangakahia River | 10 | 73 | 3.75 | 10.0 |
| Ruahuia at Viaduct | 24 | 128 | 6.68 | 58.3 |
| Otarao at Norvil Road | 15 | 92 | 4.30 | 26.7 |
| Otarao above Mangakahia Road | 9 | 103 | 4.31 | 44.4 |

**Resource consent sites**

| Site description | Species richness | MCI | SQMCI | %EPT taxa |
|---|---|---|---|---|
| Dam A downstream | 12 | 67 | 3.14 | 8.3 |
| Dam A upstream | 15 | 109 | 3.06 | 33.3 |
| Dam B downstream | 17 | 109 | 4.79 | 41.2 |
| Dam B upstream | 22 | 143 | 6.84 | 59.1 |
| Dam C downstream | 11 | 102 | 4.14 | 36.4 |
| Dam C upstream | 22 | 117 | 6.14 | 50.0 |
| Oxidation pond A downstream | 12 | 73 | 3.00 | 16.7 |
| Oxidation pond A upstream | 8 | 89 | 4.17 | 25.0 |
| Meat works downstream | 11 | 89 | 4.52 | 27.3 |
| Meat works upstream | 21 | 94 | 4.49 | 42.9 |
| Oxidation pond B downstream | 21 | 94 | 3.73 | 38.1 |
| Oxidation pond B upstream | 16 | 106 | 3.11 | 50.0 |
| Quarry downstream | 14 | 119 | 5.41 | 50.0 |
| Quarry upstream | 16 | 114 | 5.65 | 43.8 |

**Interpretation of MCI & SQMCI (Boothroyd & Stark 2000[2])**

| Interpretation | MCI score | QMCI score |
|---|---|---|
| Clean water | >120 | >6.0 |
| Doubtful quality or possible mild pollution | 100-119 | 5.0-5.99 |
| Probable moderate pollution | 80-99 | 4.0-4.99 |
| Probable severe pollution | <80 | <4.0 |

**Colour codes for %EPT taxa**

| |
|---|
| >60% EPT taxa |
| 40 - 60% EPT taxa |
| 20 - 40 % EPT taxa |
| Less than 20% EPT taxa |

[2] Boothroyd, I and Stark, J. (2000). **Use of invertebrates in monitoring.** *In*: Collier, K.J.; Winterbourn, M.J. *eds*. New Zealand stream invertebrates: ecology and implications for management. New Zealand Limnological Society, Chirstchurch. Pp. 344 373.

## Macroinvertebrate results summary

**Waiarohia Stream sites**
Three of the Waiarohia Stream sites; at Rust Ave Bridge, at the Northern Russell Road Bridge and Whau Valley Road all had macroinvertebrate communities associated with moderate water quality and impacted stream ecosystem. While the small tributary that flows from Kamo into Waiarohia Stream had macroinvertebrate index scores indicative of a severely degraded stream with poor water quality.

**River Water Quality Monitoring Network Sites**
Of the 18 RWQMN sites monitored in 2005 only the Waipoua River site in Waipoua Forest had biotic indices results that showed the stream ecosystem is still in a relatively pristine state (i.e. no or very little impact from humans).

The following sites had macroinvertebrate index scores that indicate a slightly impacted stream ecosystem and/or mild water pollution:

- Victoria River at Thompsons Bridge
- Waipapa River at Forest ranger
- Waitangi River at Waimate North
- Mangakahia River at Titoki bridge

The macroinvertebrate index scores for 2005 show that the following sites are moderately impacted:

- Awanui River at the FNDC water take by SH1
- Awanui River upstream of Waihue Channel
- Whakapara River
- Mangahahuru Stream
- Mangere River
- Opouteke River
- Punakitere River
- Waiotu River
- Kaihu River
- Manganui River

The macroinvertebrate results indicate that the following sites are severely impacted and/or have poor water quality:

- Waitangi River at Watea
- Wairua River at Purua
- Mangakahia at Twin bridges

**Otarao catchment sites**
The Otarao stream is a relatively small catchment which flows into the Mangakahia River near Titoki which is the subject of an integrated catchment management project. The Regional Council, New Zealand Landcare Trust, Mangakahia Landcare Group and landowners within the catchment have been working together for four years with the overall aim of improving water quality in the Otarao stream. This includes work such as farm workshops, fencing and planting days, farm mapping and water quality and macroinvertebrate monitoring.

Of the four sites monitored for macroinvertebrates in 2005 the native forest site (Ruahuia Stream) in the headwaters is still in a relatively pristine state, while the lowest site in the catchment near Mangakahia River is the most degraded, with macroinvertebrate communities indicative of poor water quality. The

macroinvertebrate communities for the other two sites on the Otarao Stream, which are mid catchment, indicate slightly impacted and moderately impacted water quality and stream health.

**Resource Consent sites**

The macroinvertebrate communities are sampled upstream and downstream of three dams in Northland. The results for 2005 show a difference in macroinvertebrate communities at all three dams upstream and downstream, with the macroinvertebrate index scores for downstream showing poorer water quality or more degradation when compared to the upstream sample. However some of this difference is most likely as a result of differences in surrounding land use.

Likewise macroinvertebrates are monitored upstream and downstream of two oxidation pond discharges and similarly to the dams both downstream sites had macroinvertebrate index scores indicating worse water quality or more impacted stream health than the upstream sites.

Macroinvertebrates are also sampled every year upstream and downstream of the discharges from an operating quarry and meatworks. The 2005 macroinvertebrate results show that neither of these operations appear to be having a detrimental effect on water quality or stream health.