COASTAL WATER QUALITY

Coastal performance targets:

Continue to implement and improve the State of the Environment (SOE) monitoring programme and monitor compliance with, and the effects of, the exercise of resource consents and regional plans by:

- Monitoring water and sediment quality in Northland on a prioritised basis – **ACHIEVED.**
- Annual percentage compliance of priority harbour waters with appropriate guideline values – **ACHIEVED.**
- Undertake a prioritised estuary health monitoring programme – **ACHIEVED.**
- Inspect significant coastal structures and works, marine farms and carry out surveys of the coast where there is sand mining activity – **NOT ACHIEVED (89.8 percent due to staff shortages).**

Key points 2010-2011

Water quality samples were collected from 16 sites in both the Whāngārei Harbour and Bay of Islands and from nine sites in Kaipara Harbour.

Whāngārei Harbour

- Samples collected from sites in the outer harbour were more frequently within the recommended guidelines than sites within the upper harbour.
- None of the samples taken from five sites in the Hātea River were within guideline values for nutrients during 2010-2011.

Bay of Islands

- Levels of bacteria were low and a high percentage of samples were within the guideline values for dissolved oxygen and turbidity.
- A smaller number of samples were within guideline values for nutrients. Samples that exceeded the guideline tended to be collected from sites close to freshwater inputs (rivers and streams).

Kaipara Harbour

- Levels of bacteria were low in the harbour, with only one site recording levels of bacteria above the recommended guidelines.
- Samples taken from sites in the upper harbour exceeded recommended guideline values for nutrients more frequently than samples collected from the outer harbour.

Northland's coastline includes 14 major harbours, many smaller estuaries and extensive stretches of rocky and sandy open coast. The Northland Regional Council carries out monitoring of the region's coastal environment to record the state of this resource, the effects of human activity and detect changes over time.

Maintaining coastal water quality at a good level is important to Northland's residents, economy and the many diverse forms of marine life that live in this environment.

Coastal water quality is influenced by inputs from rivers and streams, urban and rural runoff and direct discharges into the coast. As land use and urban development intensify, coastal water quality comes under increasing pressure. The impact of development on water quality is likely to be worse in semi-enclosed coastal water bodies, such as estuaries and harbours.

Bay of Islands.

Harbour Water Quality Monitoring Programme

In 2010-2011, the council undertook water quality testing at 16 sites in both the Bay of Islands (Figure 1) and Whāngārei Harbour (Figure 3) and at nine sites in the Kaipara Harbour (Figure 5). Sampling was conducted bi-monthly in Whāngārei and the Bay of Islands and monthly in the Kaipara Harbour. One rain-driven sampling event was also done in Whāngārei Harbour and two in the Bay of Islands.

Monitoring sites have been selected to capture the main freshwater inputs into these systems, and to assess water quality across each harbour. Water samples are analysed for physical properties such as temperature, salinity, dissolved oxygen and turbidity – how clear the water looks – and for chemical parameters such as nutrients (phosphorus and nitrogen). The amount of micro bacteria *(Enterococci)* present in the water is also measured.

Results 2010-2011

Results of the monitoring programmes are assessed against water quality standards outlined in the Northland Regional Coastal Plan (RCP), the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC) and the Ministry for the Environment (MfE) *Microbiological Water Quality Guidelines*.

Bay of Islands

In general, low levels of *Enterococci* were recorded at sites in the Bay of Islands Harbour. A high percentage of samples were also within guideline values for both dissolved oxygen and turbidity (Figure 2).

However, a high percentage of samples were above guideline values for nutrients, particularly nitrite-nitrate nitrogen and dissolved reactive phosphorus. Samples collected from sites close to freshwater inputs – such as the Kawakawa River, Kerikeri River, Waitangi River and Waipapa River – were more frequently above guideline values than samples collected from more open water.

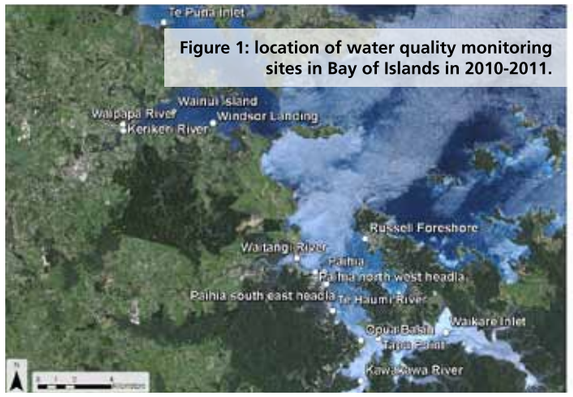


Figure 1: location of water quality monitoring sites in Bay of Islands in 2010-2011.

Physical properties

There was lower compliance this year of dissolved oxygen levels – 83 percent compared to 100 percent in 2009-2010 (Figure 2) (possibly due to a higher number of storms that contributed organic material to the sea. This material degrades naturally over time but the process uses oxygen from our waters to do so.)

Turbidity levels improved with 90 percent of samples collected during 2010-2011 within the guideline value, compared to 79 percent in 2009-2010. It is unknown why turbidity levels have improved in 2010-2011 compared to the 2009-2010 drought year.

Bacteria

More storms and rainfall in 2010-2011 increased the amount of runoff in catchments so a lower compliance level of *Enterococci* – 90 percent compared to 96 percent in 2009-2010 (Figure 2) – was due to increased inputs. Samples with levels of bacteria above the guideline values were collected after rainfall events.

Nutrients

Samples within guideline values during 2010-2011 were:

- 52 percent of dissolved reactive phosphorus;
- 67 percent of ammonium;
- 85 percent total phosphorus; and
- 33 percent of nitrite-nitrate nitrogen samples.

Sites where water samples were above the guideline values for ammonium and nitrite-nitrate nitrogen included the Kawakawa, Waipapa, Waitangi and Kerikeri Rivers, the Ōpua Basin and Paihia.

Sites where water samples were above the guideline value for total phosphorus included the Kawakawa River, Waikare Inlet, Te Haumi River and Windsor Landing. Poorest water quality was associated with runoff from rural catchments into estuaries.

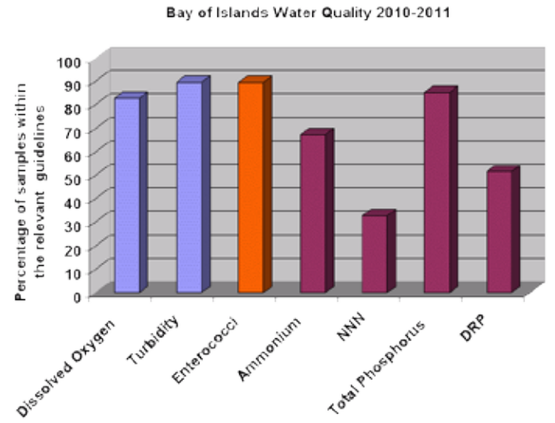


Figure 2: percentage of water samples collected from Bay of Islands within guideline values in 2010-2011.

Whāngārei Harbour

In general, samples collected from sites in the Hātea River – particularly between the Town Basin and Kissing Point – were more frequently above guideline values than those collected from the outer harbour, from One Tree Point to Mair Bank.

Levels of nutrients were high and above the nutrient guideline values on all sampling occasions from five sites in the Hātea River. Water samples collected from these sites were also above the guideline for bacteria more frequently than samples taken from sites in the outer harbour.

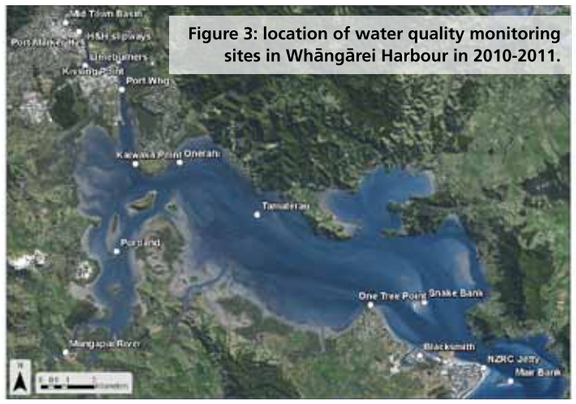


Figure 3: location of water quality monitoring sites in Whāngārei Harbour in 2010-2011.

Physical properties

Overall, 91 percent of samples collected were within the guideline value for dissolved oxygen during 2010-2011 (Figure 4), compared to 88 percent in 2009-2010.

Samples collected from sites in the Hātea River (upper harbour) were less likely to meet the guideline values for dissolved oxygen and turbidity than samples collected from the outer harbour due to inputs from both urban and rural areas. For turbidity, 85 percent of samples collected during 2010-2011 were within the guideline value, compared to 95 percent in 2009-2010.

Bacteria

Eighty-seven percent of samples collected during 2010-2011 were within the guideline value for *Enterococci* bacteria (Figure 4), compared to 96 percent in 2009-2010. Samples with levels of bacteria outside of the guideline values were typically collected after rainfall events.

Nutrients

Levels of nutrients in the Whāngārei harbour were high (Figure 4):

- 44 percent of samples collected were within the guideline values for total phosphorus;
- 25 percent of dissolved reactive phosphorus samples;
- 45 percent of ammonium samples; and
- 31 percent of nitrite-nitrate nitrogen samples were within the guideline values.

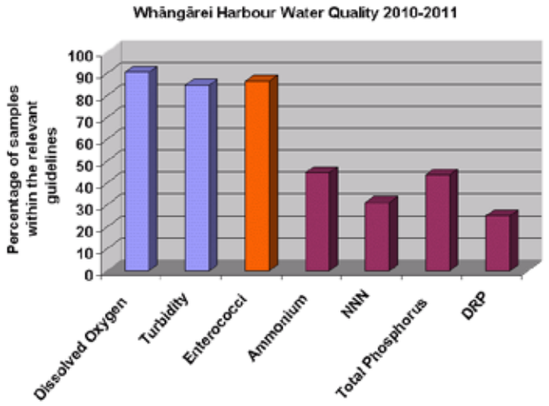


Figure 4: percentage of water samples collected from Whāngārei Harbour within guideline values in 2010-2011.

Kaipara Harbour

In general, samples collected from sites near freshwater inflows – particularly Burgess Island, Kaupau Point and Wahiwaka Creek – more frequently exceeded the guideline values than samples collected from the outer harbour (Tamatea Channel, Ōruawharo River and Five Fathom Channel). This was particularly apparent for nutrients.

Physical properties

Overall 92 percent of samples collected were within the guideline value for dissolved oxygen in 2010-2011 (Figure 6) compared to 100 percent in 2009-2010.

For turbidity, 89 percent of samples collected during 2010-2011 were within the guideline value, compared to 92 percent in 2009-2010.

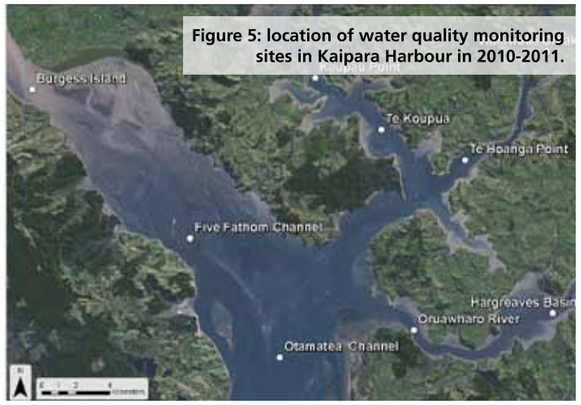


Figure 5: location of water quality monitoring sites in Kaipara Harbour in 2010-2011.

Bacteria

Of samples collected from the harbour during 2010-2011, 98 percent were within the guideline value for *Enterococci* (Figure 6), compared to 97 percent in 2009-2010. Wahiwaka Creek was the only site to record levels of bacteria above the guideline.

Nutrients

In 2010-2011:

- 53 percent of samples collected from the harbour were within the guideline value for total phosphorus – compared to 53 percent in 2009-2010;
- 23 percent were within the guideline for dissolved reactive phosphorus;
- 43 percent for ammonium; and
- 44 percent for nitrite-nitrate nitrogen.
- The highest levels of nutrients were recorded at Wahiwaka Creek, Kapua Point and Burgess Island.

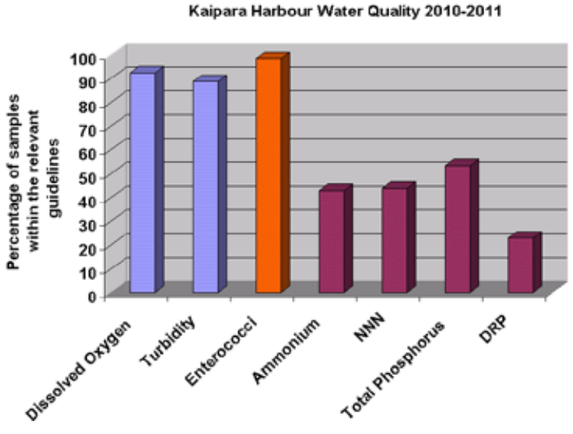


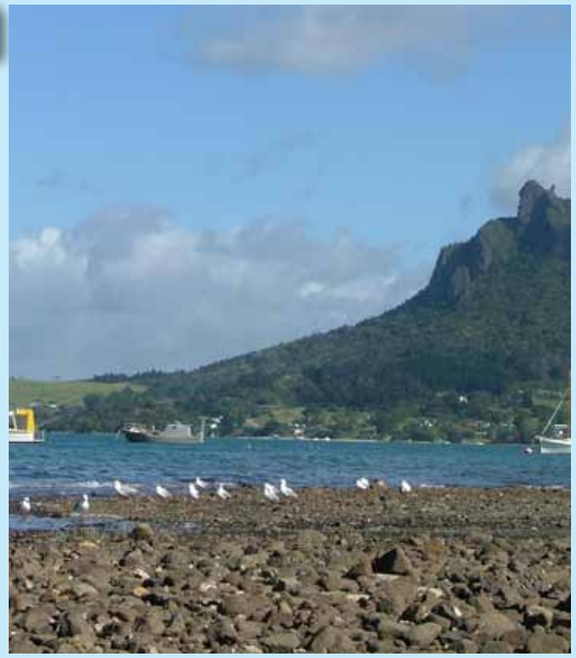
Figure 6: percentage of water samples collected from Kaipara Harbour within guideline values in 2010-2011.

CASE STUDY: Whāngārei Harbour

The council has conducted water quality monitoring in the Whāngārei Harbour since 1990. A recent review of this data and other historical data recorded in the Whāngārei Harbour showed:

- A decreasing trend in faecal coliform levels at eight sites in the Hātea River, with the biggest decrease recorded at three sites near Limeburners Creek between 1986 and 1991. This is most likely due to the major upgrade of the main wastewater treatment plant.
- *Enterococci* peak levels show a decrease over time, which is likely to be as a result of further improvements in the wastewater treatment plant; and
- The recent recovery of seagrass also suggests that water clarity and turbidity levels have significantly improved in the mid to outer harbour.

Levels of nutrients have only been measured since 2008 and so there is currently insufficient data to investigate any changes in these parameters over time.



Coastal Sediment Monitoring Programme

Northland Regional Council monitors sediment metal concentrations and the physical characteristics of sediments every two years, at 16 sub-tidal sites in Whāngārei Harbour and the Bay of Islands. The sites have been selected in order to capture the main freshwater inputs and to ensure a good geographical spread.

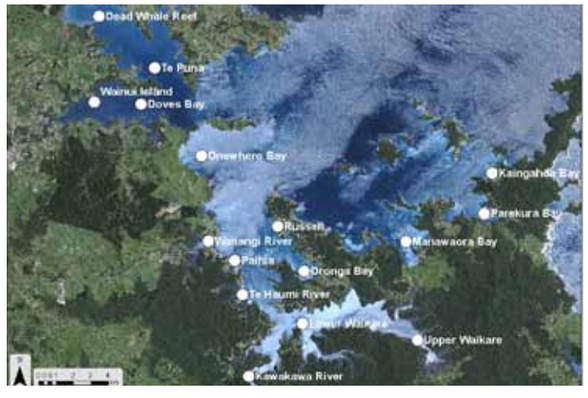
Sediment samples are analysed for sediment grain size – the proportion of mud – and concentrations of total cadmium, total chromium, total copper and total zinc. Concentrations of metal contaminants are assessed against the *Australian and New Zealand Guidelines for Fresh and Marine Water quality* (ANZECC guidelines).

Whāngārei Harbour

In 2010-2011, metal concentrations in sediments in the Whāngārei Harbour were within guideline levels at all sites, except for zinc concentration measured in the Waiarohia Canal.

Sediments collected from tidal creeks in the upper Whāngārei Harbour, Hātea River and Otaika Creek, generally had higher proportions of mud and metal concentrations. These patterns are as expected because tidal creek environments usually act as sediment traps and metal contaminants are attracted to mud.

Bay of Islands



Metal concentrations recorded in sediments collected from the Bay of Islands were all within guideline levels. Sediments collected from tidal creeks, such as Kerikeri Inlet, Kawakawa River and the Waikare Inlet generally had higher proportions of mud and metal concentrations, with lower proportions of mud and metal concentrations recorded in more exposed locations, such as Onewhero Bay.

COASTAL CASE STUDY

Key points 2010 - 2011

- Sites in Whāngārei harbour, Kerikeri Inlet, Ruakaka estuary, Whangaroa Harbour and Kaipara Harbour were monitored.
- Tidal creeks generally had higher proportions of mud, nutrients and metals compared to sites in more exposed environments.
- Metal sediment concentrations were generally within the ANZECC guideline values.
- Some metal concentrations in sediments at sites in Whāngārei Harbour and Kerikeri Inlet were higher than similar monitoring programmes elsewhere in New Zealand.
- Overall sediment nutrient levels were higher than similar programmes run by other regional councils in New Zealand and were at levels which indicate that some sites are 'enriched'.
- Although the elevated nitrogen concentrations in sediments are still of concern, the levels at some sites were significantly lower than concentrations recorded in 2008 and 2009.
- Biological communities at different sites within each estuary were distinctly different from each other. The physical and chemical properties of the sediment explained a relatively large amount of the variation in the community structure.

Estuary Monitoring Programme

Northland's estuaries are important economic, social and cultural assets, with harbour and estuarine systems such as the Whāngārei Harbour and the Bay of Islands contributing significantly to Northland's economy and the environment.

Estuaries are particularly valued because they are very productive ecosystems that play important roles in the functioning of coastal environments. However, because estuaries and harbours are located at the end of the freshwater drainage system, they are vulnerable to land-based activities and processes that occur within their catchments. Sediments and chemicals often deposit in estuaries. As freshwater mixes with saltwater, fine silts and clays – often with chemicals attached or absorbed – and settle out of the water column.

Despite their importance to people and the environment, many of Northland's estuaries have been modified and impacted by human activity. Extensive vegetation clearance for agriculture and urban development has increased the amount of sediment, nutrient and metal contaminants that reach estuarine environments. Significant areas of saltmarsh and mangrove forest, which can act as natural filters, have also been drained for agriculture, urban development and infrastructure projects.

The Northland Regional Council has implemented an estuarine monitoring programme in order to:

- Assess the health of our estuaries and monitor change over time;
- Identify impacts from diffuse inputs and cumulative impacts of contaminants from human activity and development;
- Assess the effectiveness of Northland's regional plans and rules and enable informed decision-making by politicians and resources managers; and
- Inform the public and promote awareness of environmental issues impacting estuarine health.

What we monitor and where

In 2010, the regional council monitored four sites in Whāngārei Harbour, three sites in Kerikeri Inlet and two sites in Ruakaka Estuary, Kaipara and Whangaroa Harbours. The council's estuary monitoring programme uses methods described in the Estuary Monitoring Protocol, which was developed by Cawthron Institute for use by regional councils.

A key element of the programme involves sampling the biological communities of representative intertidal habitats together with the physical (sediment particle size) and chemical properties (nutrient and metal contaminants) of the sediment. This helps us understand the environmental factors that are influencing the biological communities at different sites.

Concentrations of metal contaminants are assessed against the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC guidelines).

Metals

In 2010, sediment metal concentrations were within ANZECC guidelines at all of the monitoring sites (Table 1), except for the concentration of nickel recorded at Kerikeri Inlet. Although the concentrations were generally within guideline levels, concentrations of copper and zinc in the Hātea River in Whāngārei were relatively high compared to levels reported in similar monitoring programmes elsewhere in New Zealand.

Concentration of chromium, copper, nickel and zinc in Kerikeri Inlet were also higher than similar monitoring programmes monitored by other regional councils elsewhere in New Zealand. Runoff from roading, urban areas, agricultural and horticultural land, and stormwater discharges are all likely sources of metal contamination in these systems.

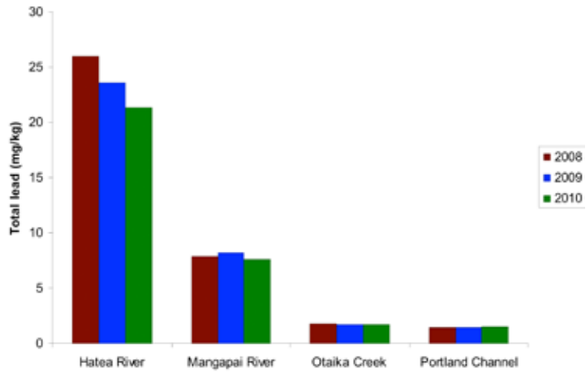


Figure 1: mean lead concentration in sediments collected from three sites in Whāngārei Harbour during 2008-2010.

Changes in metal contaminant concentrations over time have been seen at some sites (Figure 1).

- Whāngārei Harbour – chromium sediment concentrations measured in the Hātea River were significantly lower in 2010 than in 2008.
- Kerikeri Inlet – nickel concentrations in the Waipapa River were significantly lower in 2010 than in 2008 while lead concentrations at all sites in Kerikeri inlet were significantly higher in 2010 than 2008.
- Ruakaka Estuary – zinc and lead sediment concentrations were lower at both sites in 2010 than in 2008 while nickel sediment concentrations at both sites were higher in 2010 than in both 2009 and 2008.
- Whangaroa Harbour – zinc sediment concentrations at both sites were lower in 2010 than in 2009.
- Kaipara Harbour – copper, zinc and lead concentrations at both sites were lower in 2010 than in 2009.

Nutrients

There are currently no national guideline values for nutrient sediment concentrations in New Zealand. However, nutrient concentrations in sediments measured at some sites were higher than similar monitoring programmes elsewhere in the North Island of New Zealand.

Both phosphorus and nitrogen sediment concentrations were highest at sites in the Hātea River and Mangapai River in Whāngārei Harbour, Waipapa River and Kerikeri River in the Bay of Islands and the Kahoe River in Whangaroa Harbour. These nutrient concentrations are typically higher where wastewater treatment plants, industries, horticulture and stormwater discharge and close to where rural catchments drain into upper estuaries of enclosed harbours. Such high concentrations are considered to indicate that these environments are 'enriched'. This can lead to excessive plant growth, which can in turn cause a rapid reduction in water quality, harmful algal blooms, shellfish contamination, fish kills and a reduction in biodiversity.

Although nutrient sediment concentrations were relatively high in 2010, there was a significant decrease in nitrogen concentrations at most sites compared to concentrations measured in 2009 and 2008 (Figure 2).

- In Kerikeri inlet, Whangaroa Harbour and Ruakaka Estuary, nitrogen concentrations in 2010 were significantly lower than concentrations measured in 2009 and 2008.
- Phosphorus sediment concentrations in Whangaroa and Kaipara Harbours were also lower in 2010 than 2009 while phosphorus sediment concentrations in Kerikeri Inlet in 2010 were significantly higher than levels recorded in 2008.

It is possible that the decrease was due to the drought that hit Northland during 2009-2010. Further monitoring is needed to determine whether the decrease in nitrogen concentrations is a persistent trend or a short-term fluctuation.

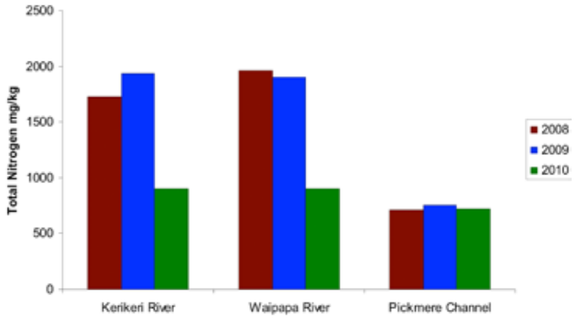


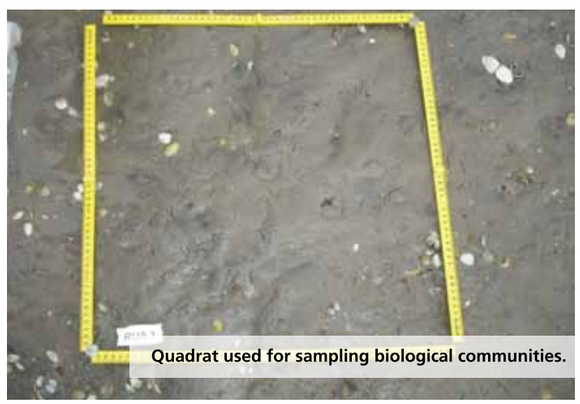
Figure 2: mean nitrogen concentration in sediments collected from three sites in Kerikeri Inlet from 2008-2010.

Biological communities

The make up of the biological communities at each monitoring site were found to be distinctly different from each other and differences were also found between the community structures at each site over time.

Analysis of the biological community and the sediment data indicated that a relatively large amount of the variation in the biological community was explained by the physical and chemical properties of the sediment.

In Kerikeri, for example, the sediment chromium and zinc concentrations explained approximately 64 percent of the variation in the community structure. This has important implications as it shows that the quality of the sediment influences the biological communities found in the sediment. Such impacts can be reduced by better controlling those metal concentrations entering our waterways.



Quadrat used for sampling biological communities.