COASTAL MONITORING

One of Northland's most treasured natural resources is our expansive, diverse and beautiful coastline, over 3000 kilometres in total. The Northland Regional Council produced a Regional Coastal Plan, which became operative in 2004. This plan outlines the rules and regulations regarding what people may and may not do, in terms of activities that can have an impact on coastal areas.

As our coastline is so large and valued it is not surprising that the Northland Regional Council carries out a considerable amount of coastal monitoring in a range of areas such as recreational beach bathing quality, seagrass restoration and coastal hazard monitoring. Refer to the performance targets on page 21 to find out which community outcomes in the Long Term Council Community Plan relate to coastal monitoring.

In 2004-05 75 coastal sites were monitored for 10 weeks over summer for the recreational bathing water quality monitoring programme (refer pages 3 to 5) to assess the suitability of water quality for recreational use. In general, water quality in most of Northland's near-shore coastal waters comply with microbial water quality guidelines for recreational use. However, following heavy rainfall water quality tends to decline in some areas and can remain compromised for several days. At open coast locations water quality tends to be less affected by rainfall than that at estuarine or harbour locations, where contaminants may become concentrated under conditions of limited tidal flushing.

Concurrently to the recreational bathing programme samples from 17 sites were also analysed to assess recreational shellfish gathering water quality (refer to pages 6 and 7). The water quality at most areas sampled did not comply with the water quality guidelines for recreational shellfish gathering, with the exception of Te Haumi River, Kellys Bay and Coopers Beach. These results are indicative only, as samples were only collected for 10 weeks in summer from the water in recreational gathering areas not the shellfish themselves. However it does give us a good idea of the potential risks in Northland for recreational shellfish gatherers.

In May to August 2004 a baseline survey of sediment and water quality in Far North estuaries (refer pages 8 to 14) was carried out. Of the ten Far North estuaries sampled all were found to have some level of contamination from sediment and nutrient inputs. Several estuaries also showed contamination from microbial inputs. This contamination in most cases has arisen from both natural processes and land runoff as a result of land use activities and can have a range of adverse effects on the environment such as smothering estuarine flora and fauna, causing excessive plant growth (i.e. mangroves) and reducing water quality to a point where it is unsafe for recreational use.

In 2004-05 the Northland Regional Council and National Institute of Water and Atmospheric Research (NIWA) undertook a study into the feasibility of restoring Whangarei Harbour's seagrass beds (refer pages 15 and 16). Seagrass beds play an important role in coastal ecosystems by stabilising sediments and providing important habitat for invertebrates, birds and fish. The findings from this work suggest that harbour water and sediment quality has improved in recent years to a level that is suitable for seagrass survival in some areas of the Whangarei Harbour. The Council and NIWA plan to work with the community to carry out initial trial plantings of seagrass in these areas identified within the next 2 years.

The Northland Regional Council completed a coastal inundation hazard assessment (refer pages 17 and 18) for eight Far North settlements in June 2005. This assessment

has provided improved information on the Storm Wave Run-up coastal inundation hazard and revised coastal inundation hazard zones for the selected settlements. A storm Wave Run-up coastal hazard inundation event occurs when extreme low-pressure weather conditions coincide with a mean high water spring tide. Under these conditions the coastal inundation hazard was confirmed to be present for each settlement assessed. The extent of areas subject to inundation was found to be greatest for those settlements that either lacked a sufficient dune system and/or where low-lying river flood plains and river valleys were present.

The beach-profile monitoring programme (refer page 19) was continued in 2004-05 to provide information on the positional stability (i.e. eroding, equilibrium, accreting) of the foreshore and foredune at selected coastal areas. Most beaches monitored were found to be similar to what was recorded in 1998 or returning to their 1998 position following the storms in 2000 with the exception of beaches where the foredune has been extensively modified or had their native vegetation removed in the past.

Recreational Bathing Water Quality

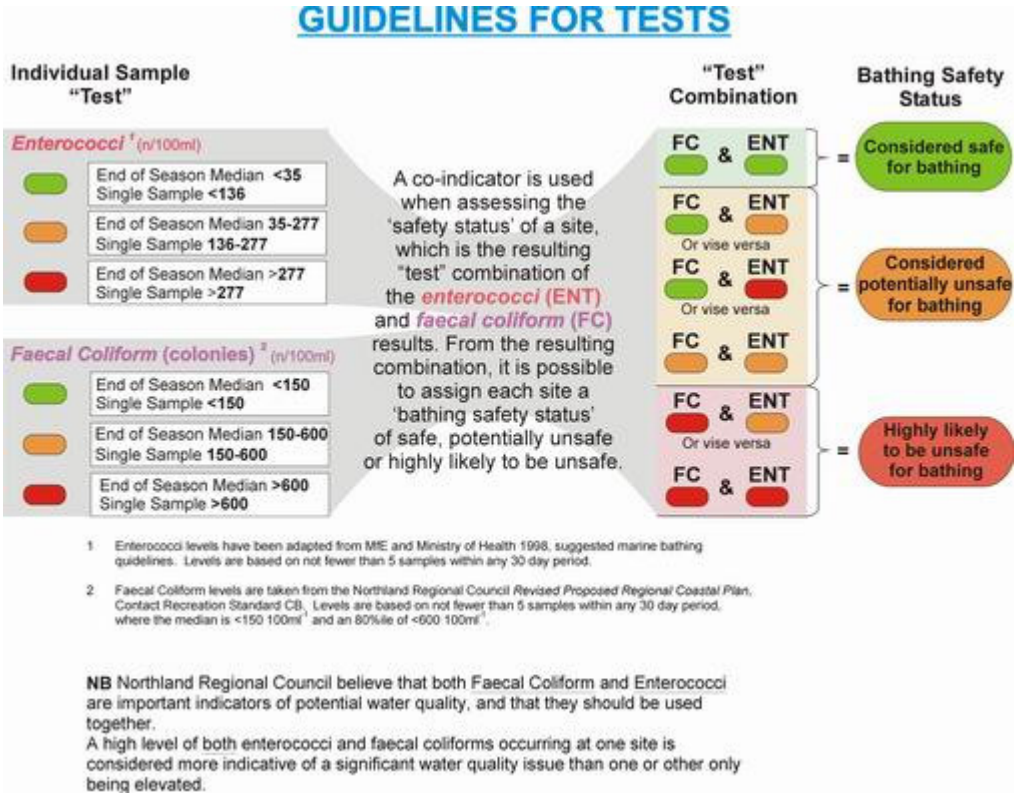
The Northland Regional Council implements the recreational bathing programme every summer during the peak bathing season to assess near-shore coastal water quality, in terms of microbial risk to human health. Contamination of near-shore coastal waters may result from various sources including sewage leaks, septic tank seepage, sewage discharges from boats, contaminated stormwater and diffuse run-off from the land. The Regional Council's responsibility is to carry out routine surveillance monitoring. These results are forwarded to the District Councils and Northland Health, who then carry out follow up sampling as required and warn the public of any bathing sites that may be unsuitable for recreational use.

In 2004-2005 Northland Regional Council carried out surveillance monitoring at 75 marine bathing sites throughout Northland for 10 weeks from early December 2003 to mid February 2004. In general samples were collected on a weekly basis from each site and analysed for concentrations of two indicator bacteria, enterococci and faecal coliform. These are indicative of pathogen levels and therefore the potential risk of illness to recreational users.

The bathing programme including site selection, methods, follow up and guideline values, is based on the '*Microbiological Water Quality Guidelines For Marine and Freshwater Recreational Areas'* developed by the Ministry for the Environment and the Ministry of Health. These guidelines are available under publications on the Ministry for the Environment's website: www.mfe.govt.nz.

Guidelines for Marine Bathing Water Quality in Northland

The guidelines below show how the results of the water quality tests are combined to determine the 'bathing safety status' at each site.



Summary of 2004-05 Results

The microbiological results from the 2004-05 bathing season are summarised below. Refer to Appendix I for the maps for each area with the results for the 10 weeks of sampling:

- **Matapouri**
- **Tutukaka**
- **Ngunguru**
- **Oakura and Ohawini**
- **Teal Bay (Ngawai Bay)**
- **Taipa/Mangonui Harbour**
- **Whangarei Heads**
- **Pataua**
- **Bay of Islands**
- **Hokianga Harbour**
- **Kaipara Harbour**
- **Ruakaka, Waipu and Langs**
- **Mangawhai**
- **Summary**

Matapouri
The water quality complied with the bacteriological guidelines for recreational bathing on most occasions. Most non-compliances were associated with rainfall, although there were several non-compliances not related to rainfall.

Tutukaka
The water quality at Church Bay, Pacific Bay and Kowharewa Bay complied with the bacteriological guidelines for recreational bathing on most occasions. All non-compliances were associated with rainfall during or proceeding sampling.

Ngunguru
The water quality within the lower reach of the Ngunguru Estuary complied with the bacteriological guidelines for recreational bathing on most occasions. All non-compliances were associated with rainfall, with the exception of one non-compliant result on 24 January 2005.

Oakura and Ohawini
The water quality within the Oakura and Ohawini embayments in Whangaruru Harbour complied with the bacteriological guidelines for recreational bathing on all sampling occasions.

Teal Bay (Ngawai Bay)
Several non-compliances with the bacteriological guidelines for recreational bathing were recorded for Teal Bay (refer Appendix I - map Oakura and Ohawini). These were correlated with current or past rainfall events, which suggests influence from the stream discharging into Teal Bay which has limited mixing potential.

Taipa/Mangonui Harbour
The water quality at Taipa, Cable Bay and Coopers Beach complied with the bacteriological guidelines for recreational bathing on all sampling occasions.

Whangarei Heads
The water quality at McLeod Bay, Taurikura and Urquharts Bay complied with the bacteriological guidelines for recreational bathing on most occasions. The one off non-

compliances recorded at Taurikura and Urquharts Bay were associated with rainfall during or proceeding sampling.

Pataua
The water quality within the lower Pataua Estuary and Pataua North beach complied with the bacteriological guidelines for recreational bathing on all sampling occasions.

Bay of Islands
The water quality within and adjacent to Russell, Paihia, Opua, Kerikeri Inlet and Te Puna Inlet complied with the bacteriological guidelines for recreational bathing on most occasions, with 9 of the 15 sampling sites in these areas having 100% compliance with the guidelines over the 2004-05 bathing season. Rainfall events correlated with the occasions when non-compliances with the bacteriological guidelines for recreational bathing were recorded.

Hokianga Harbour
The water quality of the Hokianga Harbour at Omapere, Opononi, Rawene and Horeke complied with the bacteriological guidelines for recreational bathing on most occasions. Rainfall events correlated with the occasions when non-compliances with the bacteriological guidelines for recreational bathing were recorded.

Kaipara Harbour
The water quality within the Kaipara Harbour, at Tinopai, Pahi and Kellys Bay complied with the bacteriological guidelines for recreational bathing on all sampling occasions.

Ruakaka, Waipu, and Langs
The water quality at Ruakaka, Waipu Cove and Langs Cove complied with the bacteriological guidelines for recreational bathing on all sampling occasions.

Mangawhai
The overall water quality within the lower Mangawhai Estuary complied with the bacteriological guidelines for recreational bathing on most occasions. There was only one occasion when the Faecal Coliform and Enterococci levels exceeded the threshold limit, which was not strongly correlated with rainfall.

Summary
In general, water quality in most of Northland's nearshore coastal waters comply with microbial water quality guidelines for recreational use. However, following heavy rainfall water quality tends to decline in some areas and can remain compromised for several days. At open coast locations water quality tends to be less affected by rainfall than that at estuarine or harbour locations, where contaminants may become concentrated under conditions of limited tidal flushing.

All sites monitored during the 2004-05 summer will remain for next year's marine bathing programme. A review of all marine sites, which will involve grading sites following the protocols set out in the *'Microbial Water Quality guidelines For Marine and Freshwater Recreational Areas'* will be done in the next two years.

Recreational Shellfish Gathering Water Quality

Water quality monitoring for the purpose of assessing the suitability of microbial water quality for recreational shellfish gathering was undertaken at a number of popular recreational shellfish gathering sites during summer 2004-05. This monitoring was done concurrently with the marine recreational bathing water quality programme.

This programme involved testing concentrations of faecal coliform bacteria in coastal waters at popular shellfish gathering sites. Seventeen individual sites were monitored at weekly intervals on 10 separate occasions from December 2004 to mid February 2005.

Guidelines for Recreational Shellfish Gathering Water Quality

The guideline for recreational shellfish gathering water quality is a median faecal coliform count not exceeding 14 per 100 ml over a shellfish-gathering season and not more than 10% of samples exceeding 43 per 100 ml. Non-compliance with either of these parameters indicates that the waters are not suitable for the purpose of recreational shellfish gathering.

Summary of Results

The results from the 2004-05 monitoring programme indicate that water quality at most areas sampled did not comply with the water quality guidelines for recreational shellfish gathering, shown in red in the table below.

Area	Median Faecal Coliform (# per 100ml (MPN))	Number of samples exceeding 43 Faecal Coliform per 100 ml	Number of Samples Collected
Ngunguru	22	3	10
Oakura - mid	11	2	10
Oakura - north	4	2	10
McLeod Bay	4	2	10
Taurikura	11	4	10
Urquharts	19	4	10
Pataua	53	7	10
Waitangi	10	4	10
Te Haumi River	8	0	10
Tinopai	8	2	9
Kelly's Bay	4	0	9
Ruakaka	7	1	9
Mangawhai	17	2	9
Pahi	65	5	8
Taipa	9	2	9
Coopers Beach	13	0	9
Cable Bay	20	3	8

Of the 17 sites sampled in 2004-05, six exceeded the median faecal coliform limit of 14 per 100 ml and 14 had at least one or more samples that exceeded a faecal coliform count of 43 per 100ml, with 12 of these 14 sites having two or more samples that exceeded a faecal coliform count of 43 per 100ml. Three sites; Te Haumi River, Kellys

Bay and Coopers beach, had 100% compliance with the water quality guidelines for recreational shellfish gathering in the 2004-05 season.

It is acknowledged that these results are indicative only, as they were not collected over an entire shellfish-gathering season (which would be year round in Northland) and more samples are required to have reasonable certainty in testing for compliance with the standard. Nevertheless, these data provide a reasonable snapshot of the suitability of water-quality for recreational shellfish gathering purposes in the areas assessed.

Investigation of Far North Estuaries

Historically a number of investigations have described the characteristics of Northland's coastal waters and estuaries. However, little has been done to assess the baseline water and sediment quality levels of Northland's Far North estuaries. The main contaminant issues affecting these estuaries are considered to be sediment loading, nutrient enrichment and microbial contamination. These contaminant pressures arise from natural processes and land runoff as a result of land use activities. Some examples are given in the table below.

	Sediments	**Nutrients**	**Microbial**
Example of contaminant sources	• Natural weathering • Earthworks • Forest harvesting	• Animal waste discharges • Fertilisers	• Animal waste discharges • Failing sewage treatment/disposal facilities • Sewage discharges from boats
Adverse environmental effects	• Reduced water clarity • Habitat changes • Smothering	• Algal blooms • Habitat changes • Excessive plant growth (i.e. mangroves)	• Health risks associated with: ➢ Aquaculture ➢ Recreational use

Given the above an investigation was undertaken to assess the 'level' of sediment, nutrient and microbial 'contaminants' in selected Far North estuaries. The results from this investigation were compared to results from other estuarine systems to assess the 'health' of estuaries in the Far North.

Estuaries within the Hokianga, Whangape, Herekino, Parengarenga, Houhora, Ranguanu, Taipa/Mangonui and Whangaroa Harbours were assessed. A number of sampling sites were selected in each estuary to provide a representative down-gradient coverage from upper tributary areas through to the estuary mouth. The number of sites per estuary varied, and was largely dependent upon the size and morphological complexity of each estuary. Samples of water and seabed sediments were collected from each site during the period of May to August 2004 and analysed for a suite of parameters as shown in the table below.

	Sediments	**Nutrients**	**Microbial**
Water samples	• Turbidity • Suspended solids	• Dissolved Reactive Phosphorous (DRP) • Total Phosphorus (TP) • Ammoniacal Nitrogen (NH_4) • Nitrate/Nitrite Nitrogen (NNN) • Total Kjeldahl Nitrogen (TKN)	• Faecal coliform bacteria • Enterococci bacteria
Sediment samples	• Particle size (silt/clay, sand, gravel fractions) • Organic content (ash free dry weight)	• Ammoniacal Nitrogen (NH_4) • Total nitrogen (TN) • Nitrate (NO_3) • Total Phosphorous (TP)	

All results were compared to relevant guideline values. Microbial water quality results were compared to the recreational marine bathing guidelines for Northland, which are used as an indicator for water quality suitable recreational use (for more information see the section on '*Recreational Bathing Water Quality*'. The nutrient and turbidity results are compared to the trigger values for south-east Australia in ***'The Australian and New Zealand Guidelines for Fresh and Marine Water Quality'*** *(refer to website http://www.mfe.govt.nz/publications/water/anzecc-water-quality-guide-02/)* (ANZECC

2000), which is considered the most suitable standard in the absence of a set of specific New Zealand trigger values. Concentrations of nutrients above the trigger level values indicate the potential for adverse environmental effects as a result of nutrient enrichment.

As only single samples were obtained from each sample site, caution must be taken when interpreting the results and discussing their implication. It is acknowledged that more samples, collected at a higher frequency over a longer time period, are required to have more confidence and certainty in the data. The concentrations of bacteria, suspended solids and nutrients in water are dependent on many factors and subject to seasonal fluctuations. The samples that were collected are likely to be indicative of levels typical for late autumn/winter, given the accumulated rainfall volumes in the period preceding sampling.

Rainfall

Accumulated rainfall totals indicated high volume rainfall in the 30-day period preceding sampling in the estuaries surveyed. The table below shows the accumulated rainfall totals (in millimetres) prior to sampling, with the 30-day rainfall ranging from 90 to 153 mm for the eight areas sampled.

Sample Date	20-Jul	21-Jul	19-Jul	22-Jul	24-May	25-May	19-Aug	19-Aug
Days Before Sampling	Parengarenga North	Parengarenga South	Houhora	Rangaunu	Whangape & Herekino	Hokianga	Taipa & Mangonui	Whangaroa
1	12	0.8	0	4	0.5	4	0.5	0
2	12	13	0	6	0.5	10	3	4
5	14	13	4	25	11	22	28	13
10	23	24	14	34	35	26	37	42
20	43	44	50	58	75	72	85	96
30	90	91	103	104	152	153	130	123

These accumulated total volumes are considered to be within the typical range for these areas for late autumn and winter. Reasonable variability was encountered in the accumulated rainfall totals. The effect of this on the water quality results is taken into account in the analysis.

To view the results refer to the following pages:

- **Water Quality Results** (refer pages 10-11)
- **Sediment Quality Results** (refer pages 12-13)
- **Summary** (refer page 14)

Water Quality Results

Microbial Indicators

The concentrations of faecal coliform and enterococci bacteria were generally low and at, or near, minimum detection limits. However, elevated bacterial results, greater than the recreational bathing guidelines, were recorded for a number of sites in the Herekino and Whangape Harbours. Bacterial results tended to be highest in the upper estuarine areas, indicative of the lower mixing/dilution potential in these areas and potentially higher inputs of faecal contaminants.

The results indicate that water quality is largely unaffected by microbial contamination, particularly so when considering that all estuaries have varying degrees of contaminant sources (feral and domesticated animals) and were subject to rainfall and associated runoff in the days preceding sampling. The elevated faecal coliform concentrations recorded in the Whangape and Herekino would appear to be of concern, however salinity results from these sites indicate significant freshwater inputs at the time of sampling. Contamination at these sites is most likely as a result of diffuse runoff from pastoral agriculture and feral animals in the catchments, particularly given the low human populations in these areas.

Nutrients

Ammoniacal Nitrogen (NH_4) and Nitrate/Nitrite Nitrogen (NNN) concentrations were elevated above the ANZECC trigger values for the majority of sites sampled and the median result for each estuary exceeded the ANZECC trigger value (highlighted in red in the table below). The elevated nitrogen concentrations are of concern, as nitrogen is typically the 'limiting' nutrient in marine ecosystems.

	TP (g/m^3)	DRP (g/m^3)	NH4 (g/m^3)	NNN (g/m^3)	SS (g/m^3)	Turbidity (NTU)
Hokianga	**0.064**	0.013	**0.042**	**0.092**	15.8	**10.8**
Whangape	**0.052**	0.011	**0.033**	**0.036**	31.7	**15.8**
Herekino	-	0.007	**0.018**	**0.033**	20.7	**10.6**
Parengarenga - North	0.018	0.009	**0.038**	**0.026**	6.7	1.5
Parengarenga - South	0.058	0.009	**0.103**	**0.031**	5.2	1.2
Houhora	0.029	0.013	**0.043**	**0.039**	6.1	1.6
Ranguanu	0.030	0.011	**0.037**	**0.036**	6.9	2.8
Taipa	-	0.013	**0.025**	**0.029**	8.5	5.4
Mangonui	-	0.010	**0.018**	**0.047**	6.8	3.2
Whangaroa	-	0.010	**0.024**	**0.035**	7.6	3.4
Overall Mean	***0.039***	***0.011***	***0.044***	***0.043***	***10.8***	***5.1***
ANZECC Trigger Values	***0.03***	***0.05***	***0.015***	***0.015***	***-***	***0.5 - 10***
Coastal Plan Maximums	***-***	***0.01***	***0.005***	***0.06***	***-***	***-***

The highest concentrations of Ammoniacal Nitrogen were generally associated with Parengarenga South, the upper Houhora and upper Hokianga, while the highest NNN concentrations were recorded throughout the length of the Hokianga estuary. Nitrate/Nitrite Nitrogen results tended to be below trigger values for the northwest

estuarine areas in the Parengarenga Harbour. Concentrations of Total Kjeldahl Nitrogen (TKN) were, in most cases, less than the analytical detection limit.

Total Phosphorus (TP) exceeded trigger values for a number of sites in Parengarenga South, upper Houhora, upper Ranguanu, Herekino, most sites in the Whangape and all sites in the Hokianga. The mean concentration of total phosphorus was above the trigger value for Hokianga, Whangape and Parengarenga South as shown in the table above. The overall mean concentration for all estuaries also exceeded the trigger value. The results showed very little spatial trend in TP concentrations within each estuary, although elevated concentrations in Houhora, Ranguanu and Herekino were confined to the upper estuarine areas.

Dissolved Reactive Phosphorus (DRP) concentrations were less than the trigger value for all sites sampled, as were the means for each estuaries (shown in table above). Highest concentrations were associated with Houhora, Ranguanu, Taipa and Hokianga estuaries. Intra-harbour spatial trends for DRP concentrations showed higher concentrations were typically recorded in upper estuarine areas.

The concentrations of nutrients in the present study were generally higher than the recommended ANZECC trigger values for the avoidance of adverse environmental effects, which indicates that nutrients may be impacting on the health of estuarine ecosystems in Northland. Potential impacts that may occur include changes in community composition (i.e. increased growth rate and distribution of mangroves), particularly when combined with sedimentation, and increased risk of algal blooms.

Suspended Solids and Turbidity

Suspended solid (SS) levels tended to be low in the Parengarenga, Houhora, Ranguanu, Taipa, Mangonui and Whangaroa Harbours. Turbidity readings, which are directly related to the amount of suspended solids in the water, were so low that they were near analytical detection limits at most sites.

High suspended solid and turbidity levels were recorded for the Herekino, Whangape and mid to upper Hokianga. The mean turbidity levels in these three harbours exceeded the trigger values, as shown in the table above.

The estuaries with the highest concentrations of suspended solids and turbidity were all West Coast estuaries. This is considered to be largely a function of the catchments of these particular estuaries. These catchments all have substantial areas of deforested pastoral highlands with steep topographies i.e. areas prone to erosion during high intensity rainfall events, which means high sediment-load transport from upper catchment to estuarine areas.

Sediment Quality Results

Particle size

Parengarenga, Houhora, Ranguanu, Taipa and Herekino estuaries were predominantly comprised of sandy sediments, which include sediment ranging from 63 microns to 2 millimetres in size. Fine fractions, which includes sediments smaller than 63 microns (commonly known as silt, mud and clay) were in small proportions in these five estuaries, shown as a mean percentage of fine sediment in the table below. Whangape, Hokianga, Whangaroa and Mangonui generally had high proportions of the fine fractions at most sampling sites, although the lower reaches of these estuaries were predominantly sandy.

	Mean % of fines[1]	Mean AFDW (g/100g)[2]	Mean TP (mg/kg)	Mean TP Normalised (mg/kg)[3]	Mean TN (mg/kg)	Mean TN Normalised (mg/kg)[4]
Hokianga	53.6	13.6	492.6	1870	1300	3160
Whangape	50.2	13.2	375.6	868	1500	3398
Herekino	9.7	4	216.0	2478	900	10048
Parengarenga - North	16.2	2.4	108.5	887	5792	40620
Parengarenga - South	5.7	1.1	66.2	895	650	1368
Houhora	5.5	1.5	84.3	1497	3533	57531
Ranguanu	11.6	4.0	204.9	2769	960	3478
Taipa	19.4	4.3	561.2	3325	600	3793
Mangonui	32.5	6.8	689.7	2483	1200	3648
Whangaroa	45.1	6.0	702.7	2005	1067	2659
Overall Mean	**23.5**	**5.3**	**300.3**	**1790**	**2451**	**15018**

1 Percentage of sediment less than the 63 um fraction, as an overall proportion of total sample dry weight.
2 Ash Free Dry Weight per 100 grams of sediment dry weight.
3 Total Phosphorous normalised to % of sediment < 63 um (mg/kg).
4 Total Nitrogen normalised to % of sediment < 63 um (mg/kg).

Organic Content

Sampling sites with a higher percentage of fine sediments typically had higher Ash Free Dry Weight (AFDW), which is a reflection of the higher organic content in finer sediments compared to sandy sediments. For example, samples on average from both Hokianga and Whangape estuaries had over 50% fine sediments and over 13 grams of AFDW (organic material) as shown in the table above.

Nutrients

Total Phosphorus (TP) concentrations were highest in the upper reaches of the Hokianga, Whangaroa, upper Mangonui, Taipa and upper Rangaunu and Whangape. The mean Total Phosphorus results were highest in Hokianga, Taipa, Mangonui and Whangaroa estuaries as shown in the table above. When normalised to only include the fine sediment fraction the data showed higher concentrations of TP in Herekino, Ranguanu, Taipa and Mangonui estuaries.

Total Nitrogen (TN) was recorded in the highest concentrations in north Parengarenga, Houhora and upper Hokianga estuaries. When normalised to only include the fine sediment fraction the data showed higher concentrations of TN in the north Parengarenga, Houhora and Herekino Harbours. The normalisation reduced the relative concentration of TN in the Hokianga Harbour.

Ammoniacal Nitrogen (NH_4) concentrations were generally below detection limits for the analytical method used. However, five Hokianga, one Mangonui, three Ranguanu and three Whangape Harbour sites had concentrations of NH_4 greater than the minimum detection limit.

The photo below shows the upper reaches of the Waiheuheu Channel of the Parengarenga Harbour. Results for the sediment samples from this site had high proportions of mud/silt, nitrogen and organic matter, indicative of recent high sedimentation, most likely related to forestry harvesting operations.

Photo: Waiheuheu Channel

Higher proportions of fine sediment and organic content and elevated nutrient levels in the Hokianga and Whangape estuaries, and to a lesser extent the Mangonui and Whangaroa estuaries, indicate a high level of sedimentation in these estuaries. High sedimentation is likely to be a result of the modified catchment landuse, such as pastoral agriculture and forestry, high water residence times and the morphology of the estuaries favouring sedimentation. The sedimentation of these estuaries, coupled with elevated nutrient concentrations, is likely to be having a significant effect on the composition of the estuarine flora and fauna. An example of this is the anecdotal evidence that indicates an increase in the proportion of mangrove-colonised intertidal flats and a reduction in filter feeding infaunal invertebrates (such as pipi and cockle) as a result of changing sediment composition (moving from sandy to a higher proportion of fine sediment) and habitat structure.

Summary

The Far North estuaries that were sampled all showed, to greater or lesser extents, contamination from sediment and nutrient inputs. Several estuaries also showed contamination from microbial inputs.

Nutrient concentrations in water samples were elevated in all estuaries assessed, particularly for ammoniacal nitrogen and nitrate-nitrite nitrogen. The range of concentrations found in the water samples are similar to other northern New Zealand estuarine examples shown in the table below, and are indicative of the developed catchments and land use activities.

Parameter (g/m^3)	Current Study Range (Mean)	Waitemata[1] Range (Mean)	Tauranga/Ohiwa[2] Range (Mean)
TP	0.018 – 0.064 (0.039)	N/A	(0.022)
DRP	0.09 – 0.013 (0.011)	0 – 0.022 (0.01)	0.005 – 0.015 (0.005)
NNN	0.026 – 0.092 (0.043)	0.002 – 0.3 (0.1)	0.032 – 0.216 (0.115)
NH_4	0.018 – 0.103 (0.044)	0.01 – 0.02	0.005 – 0.036 (0.021)

1 Lam, C.W.Y. 1979. The Assessment of Eutrophication in Estuaries A review of New Zealand and Overseas Studies. Auckland Regional Water Board. 44p.

2 Park, S. 1994. Environment B.O.P Natural Environment Regional Monitoring Network Coastal and Estuarine Ecology Programme. Environment B.O.P. 137p.

The effects of contamination are likely to be greatest, in terms of chronic impacts, on habitat and floral and faunal communities. Habitat will change in response to sediment and nutrient inputs, with increased sedimentation causing the accumulation of finer sediments enriched with nutrients. These effects are presently being witnessed, anecdotally, in many of these estuaries with increased areas of intertidal flat colonised by mangrove, less areas colonised by seagrass (due to higher turbidity) and less filter feeding infaunal invertebrates. Microbial contamination may also affect the recreational and commercial use of estuarine areas by restricting areas where people can bath or gather or grow shellfish without risking exposure to microbial contaminants.

Reducing sediment, nutrient and microbial contamination will require significant changes in current land use practices and management, and is likely to require considerable time before positive changes can be realised.

Whangarei Harbour Seagrass Restoration

Seagrass beds play an important role in coastal ecosystems by stabilising sediments, providing important habitat for invertebrates (including shellfish), grazing areas for wading and migrating birds and nursery areas for juvenile fish. In New Zealand there is only one genus of seagrass, *Zostera*, which is found throughout the country typically in soft sediments in estuarine environments. Seagrass has declined significantly in Whangarei Harbour over the last 40 years, just as it has throughout New Zealand and the rest of the world.

Photo: Seagrass

The Northland Regional Council and National Institute of Water and Atmospheric Research (NIWA) jointly undertook a study into the feasibility of restoring degraded seagrass beds in the Whangarei Harbour in 2004-05. This feasibility study was funded via the Whangarei Harbour Health Improvement Fund, as part of Northport Limited's commitment to improving the health of the harbour, and a Sustainable Management Fund grant awarded to the Regional Council from the Ministry for the Environment.

The seagrass restoration feasibility study was undertaken in several phases. Firstly, an assessment was undertaken to determine the historical distributions of seagrass beds and environmental factors influencing their health in the Whangarei Harbour. An assessment was then carried out to determine the current health of the Harbour, in terms of suitability for seagrass habitation and restoration. Finally a methodology and decision-making document to be used when attempting seagrass restoration was produced.

The historical distributions of seagrass show that as recently as the 1940's, many parts of the Whangarei Harbour were thriving with healthy seagrass meadows, including areas around Takahiwai, One Tree Point, Snake Bank, Parua Bay and McDonald Bank. In fact, in 1942 there was approximately 1400 ha of seagrass beds in the Whangarei Harbour. By the 1960's this had dwindled to smaller pockets, and by the 1970's only small patches of seagrass remained. Factors that contributed to the loss were an increased rate and degree of sedimentation, erosion/accretion or mechanical excavation of sediment, increased suspended sediment loads, changes in sediment texture and seabed shape. An example of this was the major dredging programme undertaken in 1966-69 to deepen the shipping channel. In this programme alone over a million cubic metres of sediments were excavated and deposited in other areas of the harbour such as Snake Bank, Takahiwai, and the entrance to Parua Bay. Another example was the discharges from Portland cement works, which is estimated to have contributed close to 3 million cubic metres of sediment into the harbour between 1958 and 1971.

The second phase of the study involved a comparison of historical and recent water and sediment quality results for the length of the Whangarei Harbour and assessing the current 'health' of Whangarei Harbour's water and sediment quality in three areas; Takahiwai, western One Tree Point and eastern One Tree Point (Marsden Point). This

determined that water clarity, nutrient and contaminant status in the western One Tree Point and Takahiwai areas were within the published ranges for seagrass habitation. These factors are critical for seagrass habitation as high water clarity provides sufficient light penetration for photosynthesis to occur, whilst nutrient concentrations must fall within a range that enables sufficient plant growth to occur without being too high as to encourage the growth of parasitic epiphytes and toxicity effects. The evidence from this study suggests that adverse environmental conditions, such as low water clarity caused by excessive sediment inputs, have improved over historic levels. These findings are promising as they indicate that environmental conditions at areas previously inhabited by seagrass are improving and are still suitable for seagrass habitation.

The final deliverable of the study was the development of a decision making document. This document includes methodologies for identifying restoration sites and requirements for environmental enhancement, methodologies for restoration trials and a procedure for monitoring the success of a trial.

Given the well documented ecological benefits provided by seagrass beds, such as providing important habitat for juvenile fish species and increasing community biodiversity, the restoration of even small areas of seagrass habitat would have a positive impact on the health of Whangarei Harbour and adjacent coastal communities. The implementation of restoration trials by the local community with assistance from a science provider, funded through initiatives such as the Whangarei Harbour Health Improvement Fund, would be the next step in restoring seagrass in the Whangarei Harbour.

The full reports from this work are available for viewing online at: *http://www.nrc.govt.nz/reports.and.news/media.releases/2005/august/mr_040805_seagrass.shtml)*.

Coastal Hazard Assessment

A storm wave run-up (SWRU) coastal inundation hazard occurs when high astronomical tides coincide with intense low-pressure weather systems causing storm surge and the associated run-up from large waves to temporarily inundate low lying coastal hinterlands.

Coastal Hazard Zone (CHZ) assessments were first carried out for selected settlements in the Far North District in 1991. These assessments identified the coastal erosion, coastal inundation and coastal landslide hazards applicable to each settlement from which Coastal Hazard Zone's were derived.

In 2002 and 2003 most of these CHZ assessments were reviewed in response to improved understandings of coastal processes, the availability of additional shoreline movement data and improved methodologies for coastal hazard zone assessments. However, the reviews focused on the erosion hazard with little detailed assessment or delineation of the coastal inundation hazard undertaken. Based on this, it became necessary to revise the inundation component of the hazard zones.

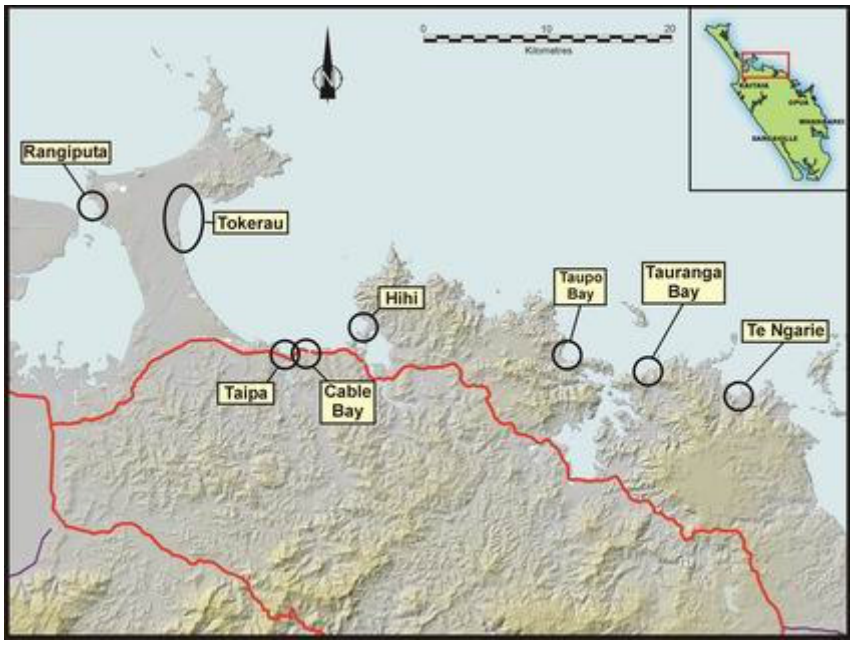
The Northland Regional Council completed a SWRU coastal inundation hazard assessment for eight selected Far North settlements in June 2005. This assessment has provided improved information on the SWRU coastal inundation hazard and revised coastal inundation hazard zones for the selected settlements.

What the Hazard Assessment Covered

The purpose of the coastal inundation hazard assessment was to provide revised predictions, based on accurate topographic data, of the extent of coastal hinterland that is likely to be subject to inundation from the combined effects of storm surge and wave-assisted coastal flooding. Communities and regulatory authorities can use this information to plan better to avoid or minimise the risk of the coastal inundation hazard.

In the assessment, maximum storm wave run-up elevations were estimated from a combination of contributing factors, such as astronomical tide, storm surge, wave run up and sea level rise. In determining the extent of contributing factors to the overall storm wave run-up elevation, other site-specific factors such as past storm wave run-up inundation events, degree of exposure and geomorphology, were also assessed to differentiate the estimated extent of storm surge and wave run-up for each settlement. This data were then compared to accurate topographic data of the coastal hinterlands to determine areas likely to be subject to coastal inundation.

Eight settlements were assessed: Rangiputa, Tokerau Beach (North), Taipa, Cable Bay, Hihi, Taupo Bay, Tauranga Bay, Taupo Bay and Te Ngaire, shown in the map below. Coastal inundation hazard zones were delineated for each of the eight settlements based on the scenarios for 2005 and 2100.



The coastal inundation hazard zones reflect the estimated extent of land likely to be subject to inundation from SWRU for the 2005 and 2100 planning scenarios based on an event forced by an extreme low pressure weather event coinciding with a mean high water spring tide event. Under these conditions the coastal inundation hazard was confirmed to be present for each settlement assessed. As expected, the extent of areas subject to inundation was greatest for those settlements that either lacked a well-developed and sufficiently elevated dune system and/or those areas where low-lying river flood plains and river valleys were present.

Sea-level rise by 2100 was found to substantially increase the estimated extent of areas subject to inundation over the 2005 planning horizon, particularly in the settlements of Te Ngaire, Taupo Bay, Taipa, Tokerau and Rangiputa. This reflects the high proportion of low-lying coastal hinterlands associated with these settlements, and the fact that even a 0.49 metre rise in sea level will substantially increase the potential impact of the coastal inundation hazard.

How Will The Information Be Used?

Regulatory authorities and local communities should use the information contained within the coastal inundation hazard assessments to better plan for avoidance and/or minimise the potential effects of the coastal inundation hazard. This can be achieved through a number of mechanisms including coast care initiatives to enhance natural barrier features, such as foredunes and barrier spits, and minimising the allowance of poorly sited or planned developments that enhance the inundation hazard.

The Northland Regional Council intends to collaborate with the Far North District Council to determine the best method for adoption of the coastal inundation hazard zones, which could include both regulatory methods (i.e. a District Plan hazard register) or as a stand-alone report that the Council refers to when considering applications for activities within the hazard zones.

Beach Profile Monitoring

A beach-profile monitoring programme, which was commenced during 2003-04, was continued in 2004-05. This programme was established to provide information on the positional stability (i.e. eroding, equilibrium, accreting) of the foreshore and foredune or cliff at selected coastal areas. Data gathered from this programme is necessary to better understand the dynamics of Northland's coastline assisting the Council and community in assessing the suitability and effect of developments in and adjacent to coastal areas. It is also used for the delineation of coastal hazard zones.

The programme involves surveying the position of the toe of the foredune with a differential global positioning system and surveying one or more cross sectional profiles of the foreshore and foredune complex at each beach. The programme was designed to provide coverage of a number of key 'monitor' beaches in the region. The monitoring is done six-monthly in summer and winter, with other beaches done once every two years or after events that cause substantial changes to the position of the shoreline such as storms and landslides.

The photographs below of Bream Bay on the East Coast of Northland highlight how the foredune can change. The left photo was taken in July 2000 following a period of sustained onshore winds that caused substantial erosion to a number of east coast beaches, while the photo on the right is from August 2003 following a period of calmer conditions enabling formation of incipient foredune and accumulation of sand on the beach.

July 2000 – onshore winds caused substantial erosion.

August 2003 – formation of incipient foredune.

Results from the 2004 winter survey indicate that the overall position of the toe of the foredune has changed little for most east coast beaches from that recorded in 1998. Those east coast beaches that suffered erosion during the easterly storms in July 2000 appear to be recovering in most cases, with incipient foredune growth and beach levels and positions trending back towards the 1998 pre-storm event levels.

The exception is those areas where historically the foredune complex has been extensively modified and native foredune vegetation, such as pingao and spinifiex, removed. These areas appear to have lost the ability to rebuild during calmer periods. This causes the cut part of the cut and fill cycle (the erosion and accretion cycle) to dominate, resulting in net negative retreat of the foredune. Examples of these areas include Tauranga Bay beach, parts of the Omapere foreshore, although this case is further affected by inappropriate coastal structures interfering with sand transport, Waipu Cove and the estuarine end of Matapouri Beach.

Performance Targets

To continue to develop and implement a prioritised state of the environment monitoring programme based on the Regional Policy Statement and regional plans by:

- Carrying out sampling and reporting on summer coastal and freshwater bathing water quality.
- Supporting and contributing to the development and implementation of coastal hazard management strategies, by the collection and provision of coastal hazard and processes information and advice to the communities of affected areas.