APPENDIX K

Monitoring Results

report

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Western Bay of Plenty Comprehensive Stormwater Consents Environmental Assessment

Submitted to:
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1.0 Introduction

1.1 Background

Western Bay of Plenty District Council (WBOPDC) is responsible for the management of stormwater within the Western Bay of Plenty District (the District). WBOPDC submitted an application for comprehensive stormwater consents (CSC) in 2008. This application was put on hold by Environment Bay of Plenty (EBOP) while WBOPDC undertook further investigations into the receiving environment and environmental effects associated with the discharge of stormwater within the District. CPG is currently preparing an updated CSC application for various catchments within the District.

The existing application for CSCs included an ecological assessment of the terrestrial ecological and native fish values in each of the significant freshwater and marine environments that receive stormwater (e.g. Wildlands 2006). The ecological assessment reports prepared by Wildlands did not include water quality, sediment quality or benthic macroinvertebrate data.

The existing CSC application did not include stream or marine sediment quality data and stream and marine water quality data was limited to faecal indicator results associated with areas where contact recreation occurs.

In March 2010 Freshwater Solutions proposed and EBOP agreed that WBOPDC should undertake 'first flush' sampling of key stormwater discharges and receiving environments in order to identify discharges of potential concern and that therefore may require further sampling. In addition to the first flush sampling EBOP recommended a desktop assessment of the likely stormwater contaminant levels from within each of the key stormwater catchments in order to generate contaminant source data to assist with the interpretation of stormwater and receiving water quality data.

This report presents and assesses the results of baseline stream water quality, stream sediment, instream and riparian habitat and benthic macroinvertebrate sampling undertaken in April 2010 and storm event sampling undertaken in July 2010, October 2010 and April 2011 as well as sediment sampling undertaken in September 2010.

1.2 Site Description

There are thirteen urban areas for which the WBOPDC is seeking stormwater discharge consents. The thirteen urban areas include the 4 large communities of Waihi Beach, Katikati, Omokoroa and Te Puke and the nine small settlements of Tanners Point, Tuapiro Point, Ongare Point, Kauri Point, Te Puna West, Minden, Paengaroa, Maketu and Pukehina. The CSC for Omokoroa has already been granted. The original CSC application prepared by Duffil Watts in 2008 included a description of each of the 13 catchments. Relevant details from the original CSC application are included in this report.

The 5 most heavily developed catchments or sub catchments with the greatest potential for adverse effects from stormwater discharges were determined by CPG and investigated as part of this study were:

- Waihi Beach – Two Mile Creek (residential and commercial).
- Katikati – Uretara Stream (residential and commercial).
- Katikati – Unnamed drain (industrial).
- Te Puke – Ohineangaanga Stream – eastern tributary (residential and commercial).
- Te Puke – Ohineangaanga Stream – western tributary (commercial and industrial).

Waihi Beach – Two Mile Creek

Two Mile Creek in Waihi Beach is a highly modified soft bottom stream draining a predominantly rural 525 ha catchment. Most of the stream has been channelised and in the lower reaches the streams course is constrained by flood protection structures. Approximately 21 ha of the lower stream catchment is zoned residential and commercial. The stream discharges directly to the sea over Waihi Beach. The stormwater catchment sampled within Two Mile Creek is 4 ha in size and comprises a mixture of residential and commercial land use (Figure 1).

Katikati – Uretara River

The Uretara River is a hard bottom river draining a 32.9 km^2 catchment with a mean flow at Henry's Crossing of 0.88 m^3/s. The upper third of the catchment (26.5 km of river channel), located on the eastern flanks of the Kaimai Range, is covered in indigenous forest. The river then flows some 53 km from the Kaimai Ranges through pasture and horticultural land uses before entering the urban area (lower 5.5 km of river channel) in the north of Katikati. The river enters the Tauranga Harbour and has a saline estuary section that extends upstream of the state highway bridge in Katikati. The stormwater catchment sampled within the Uretara River is 7.5 ha in size and comprises a mixture of residential and commercial land use and is dominated by the state highway which runs through the middle of the catchment (Figure 2).

Katikati – Unnamed drain

The unnamed drain is a small soft bottom channelised waterway draining a stormwater catchment of 5.3 ha that has almost completely impervious land cover used for commercial and industrial purposes (Figure 2). The drain starts at a culvert from the stormwater catchment that runs beneath sports fields east of the state highway and runs to the Tauranga Harbour through rural land.

Te Puke – Ohineangaanga Stream tributaries.

The Ohineangaanga Stream is a tributary of the Kaituna River and whose catchment is some 24.8 km^2 in size. The mean flow of the Ohineangaanga Stream is 350 L/s (EBOP 2007). The upper 3.5 km^2 is covered in native forest, the middle 17 km^2 is covered in pasture, horticulture or exotic forest while the lower 3.4 km^2 or 13.6% is urbanised (EBOP 2007.

Western tributary

The stormwater catchment sampled is 58 ha in size and comprises residential, commercial and industrial land use as well as a number of busy arterial roads (Figure 3). Land use upstream of the stormwater catchment comprises entirely residential land use. Land use downstream of the stormwater catchment comprises dairying. The receiving environment for the discharges from the stormwater catchment is a highly modified channelised soft bottom tributary of the Ohineangaanga Stream.

Eastern tributary

The stormwater catchment sampled is 7.5 ha in size and comprises commercial and industrial land use and state highway (Figure 3). Land use upstream of the stormwater catchment comprises entirely residential land use. Land use downstream of the stormwater catchment comprises dairying. The receiving environment for the discharges from the stormwater catchment is a highly modified channelised soft bottom tributary of the Ohineangaanga Stream.

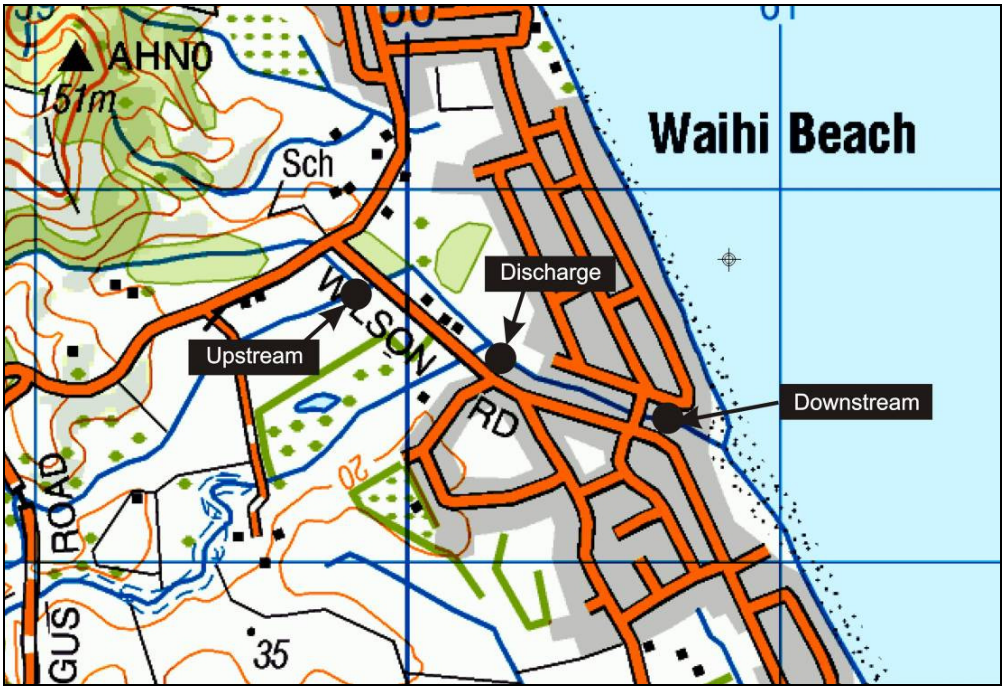

Figure 1: Waihi Beach – Two Mile Creek sampling locations.

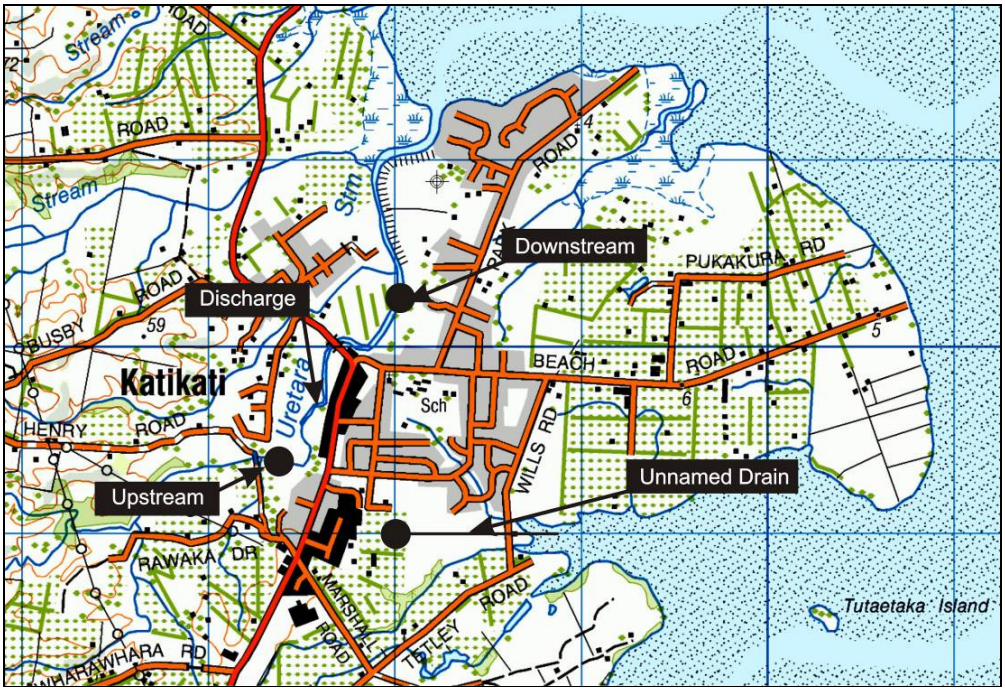

Figure 2: Katikati – Uretara Stream and unnamed drain sampling locations.

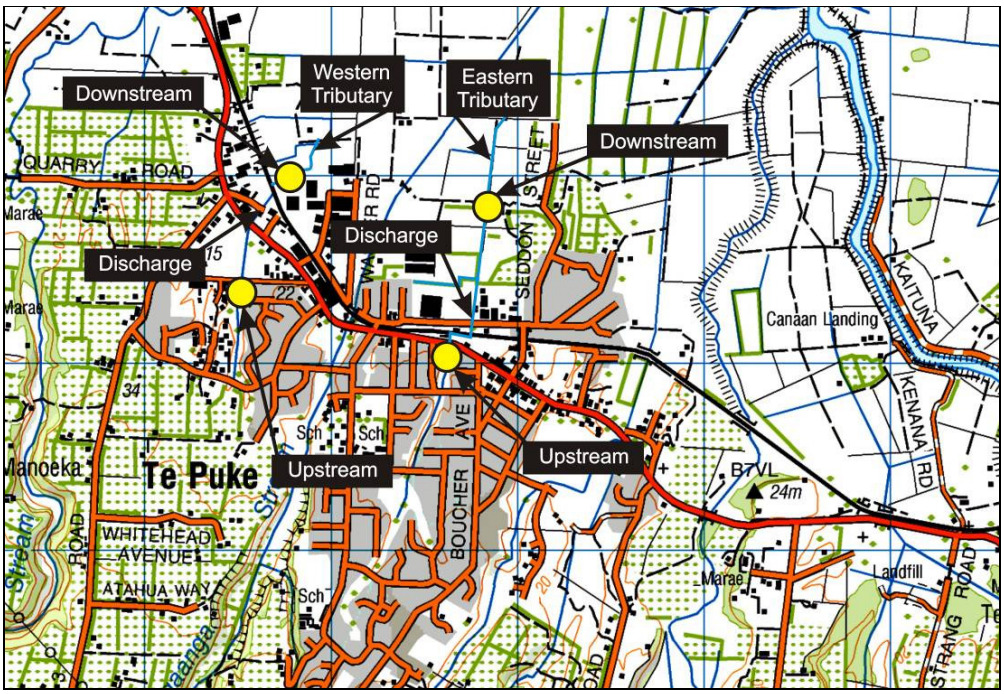

Figure 3: Te Puke - Ohineangaanga Stream eastern and western tributary sampling locations.

2.0 Methodology

2.1 Selection of key stormwater discharges

Key stormwater catchments and discharges for monitoring were selected by CPG using the available stormwater catchment land use data.

In each of the major settlements (Waihi Beach, Katikati and Te Puke) the watercourses that receives most of the stormwater and/or the expected poorest quality of stormwater based on the amount of industrial or commercial use, high traffic volume roads and/or dense residential areas were selected for sampling.

A preliminary assessment of the land use and the density of residential houses in each of the stormwater catchments within the 9 minor settlements indicates that the risk of even minor adverse effects arising from the discharge of stormwater within these catchments are very low. Therefore before any sampling of these areas is undertaken it is proposed to undertake a desktop assessment of the likely stormwater and receiving water contaminant levels. This desktop assessment will be undertaken by CPG.

2.2 Water Quality

Baseline water quality was determined using information published by EBOP and from upstream sample site data collected during storm event sampling. Baseline water quality was compared to regional water quality datasets held by EBOP.

Storm event samples were collected from the selected discharges (immediately before entering the stream) and from immediately upstream and 20 – 50 m downstream of a stormwater catchment at Waihi Beach (see Figure 1) and 2 stormwater catchments in Te Puke although it was not possible to collect a discharge sample from the western tributary (see Figure 3) and 2 stormwater catchments in Katikati although it was only possible to collect an upstream sample from the unnamed drain (see Figure 2).

Samples were collected from each of the selected stormwater discharges and the receiving environments within 1 hour of the start of the storm events (i.e. to capture the first flush). A storm event was defined as a rainfall event that follows a period of at least 72 hours without rainfall and which results in stormwater discharging to the receiving environment for at least 6 hours. Predicted rainfall intensity forecasts were used to select storm events of different sizes in order provide an estimate of first flush stormwater contaminant concentrations over a range of stormwater events of differing sizes.

Storm event sampling was undertaken for all 5 stormwater catchments for storm events on 16th July 2010, 13th October 2010 and 16th April 2011 during moderately intense rainfall. Stormwater and receiving water samples were analysed for the following:

- Total zinc.
- Total copper.
- Total chromium.
- Total lead.
- Total nickel.
- Total arsenic.
- Total hydrocarbons.

- PAH (Katikati and Te Puke samples only and on one occasion only).
- PCB (Katikati and Te Puke samples only and on one occasion only).
- Dissolved oxygen.
- Temperature.
- pH.
- Total suspended solids.
- Turbidity.

2.3 Sediment Quality

A stream sediment sample was collected from immediately upstream and downstream of each of the selected stormwater catchments (see Figures 1 – 3).

Each sample comprised approximately 1 kg of streambed surface (up to 2 cm in depth) sediment collected in up to 10 individual scoops using a plastic container. Each sample was collected from a length of stream of at least 5 m and involved collecting sediment from across the width of the channel.

Samples were collected on 26th April 2010 following an extended period of settled weather and low stream flow. Stream sediment samples were collected on 29th September 2010 following typical winter rainfall and stream flows in order to provide an indication of seasonal variation in sediment quality.

The < 2 mm fraction of sediment samples was analysed for the following parameters:

- Total zinc.
- Total copper.
- Total chromium.
- Total lead.
- Total nickel.
- Total arsenic.
- Total hydrocarbons.
- PAH (Katikati and Te Puke samples).
- PCB (Katikati and Te Puke samples).

The sediment sampling results are compared to the National Oceanic and Atmospheric Administration (NOAA 1999) and ANZECC (2000) guidelines.

2.4 Benthic Macroinvertebrate Community Assessment

Benthic macroinvertebrates (including insects, worms, and molluscs) are a key part of stream ecosystems and are very good indicators of water and habitat quality.

Benthic macroinvertebrate samples were collected from upstream and downstream of each of the selected stormwater catchments on 26th April 2010.

A single sweep net benthic macroinvertebrate sample was collected at each site using Protocol C2 from Stark et al (2001). Samples were preserved in 70% ethanol and sent to the laboratory for identification by an experienced taxonomist using Protocol P3 from Stark et al (2001). The sample collection and processing methodology was similar to that used by

Environment Bay of Plenty for soft bottom streams.

Benthic macroinvertebrate taxa number, abundance, MCI, QMCI and dominant taxa were calculated. Taxa number, abundance and dominant taxa were used to assess macroinvertebrate community health, habitat and water quality.

Taxa Number. This is a measure of the overall health of the benthic macroinvertebrate community and habitat and water quality. Generally the higher the taxa number the healthier the waterway. The number of taxa present at a site can be highly variable and can respond to a large number of factors and can therefore fluctuate widely depending on sampling effort (Stark and Maxted 2007).

Abundance. This is another measure of the overall health of the benthic macroinvertebrate community and habitat and water quality. Generally the higher the abundance of water and habitat sensitive taxa the healthier the waterway.

Macroinvertebrate Community Index (MCI). The MCI is a presence/absence based index for measuring stream health and in particular organic enrichment. Individual taxon scores range from 1 – insensitive to 10 – highly sensitive. Community MCI scores typically range from < 80 – poor or probable severe pollution to >120 – excellent or clean water (Stark and Maxted 2007).

Quantitative Macroinvertebrate Community Index (QMCI). The QMCI is the quantitative equivalent of the MCI and is used for measuring stream health and in particular organic enrichment. Individual taxon scores range from 1 – insensitive to 10 – highly sensitive. Community QMCI scores typically range from < 4 – poor or probable severe pollution to >6 – excellent or clean water (Stark and Maxted 2007).

EPT Taxa Number. This is another measure of the overall health of the benthic macroinvertebrate community and habitat and water quality. A benthic macroinvertebrate community that has a higher number of water and habitat sensitive taxa from the groups – ephemeroptera (mayflies), plecoptera (stoneflies) and trichoptera (caddisflies) (EPT) indicates a healthier waterway.

%EPT. This is another measure of the overall health of the benthic macroinvertebrate community and habitat and water quality. A benthic macroinvertebrate community that has a higher percentage of water and habitat sensitive taxa from the EPT groups indicates a healthier waterway.

Benthic macroinvertebrate results were compared to state of the environment benthic macroinvertebrate monitoring results for the Bay of Plenty Region collected by EBOP.

2.5 Native Fish

The native fish values of the site were assessed using the Bay of Plenty Regional Land and Water Plan - Schedule 1 and the results of site specific surveys carried out as part of the original assessment of receiving environments by Wildlands Consultants Ltd in 2006 and 2007.

3.0 Results

3.1 Physico-chemical Parameters

Waihi - Two Mile Creek.

EBOP do not have a regular monitoring site on Two Mile Creek and water quality monitoring data is therefore very limited. Two Mile Creek upstream of the lower urbanised section of stream is classified in the Bay of Plenty Region Land and Water Plan as 'aquatic ecosystem'. The lower reaches are classified as modified water course with ecological values.

The physico-chemical results from the sampling sites upstream and downstream of the stormwater catchment during dry weather (base flow) conditions on 26th April 2010 and storm event conditions on 16th July 2010, 13th October 2010 and 16th April 2011 are presented in Table 1.

The water quality results from sampling in Two Mile Creek are reflective of the rural and urban catchment of the stream with moderate electrical conductivity and moderate to low dissolved oxygen concentrations particularly at the downstream site on at least one sampling occasion.

The largest recorded decrease in DO concentration between upstream and downstream sites was recorded during the baseline survey on 26th April 2010. The periodic depressed dissolved oxygen levels are likely to be the result of the slow flowing nature of the stream, organic loads and extensive algal growths. High summer stream water temperatures and low dissolved oxygen levels are expected to reduce the ability of the stream to support water quality sensitive benthic macroinvertebrate taxa and native fish species that require low water temperatures and high dissolved oxygen concentrations.

Table 1: Physico-chemical results for Two Mile Creek.

Site	Temperature (°C)	Conductivity (mS/m^3)	pH	Dissolved oxygen (mg/L)	Salinity (%)	Turbidity (NTU)	TSS (g/m^3)
26th April 2010							
Upstream	16.9	82.8	7.6	8.6	0.1	NR	NR
Discharge	NR	NR	NR	NR	NR	NR	NR
Downstream	17.1	105.8	7.6	6.8	0.1	NR	NR
16th July 2010							
Upstream	12.6	97.8	6.7	10.0	0.1	10.7	12
Discharge	12.0	26.3	7.5	10.3	0	41.0	68
Downstream	12.3	82.9	7.2	9.3	0.5	9.4	8
13th October 2010							
Upstream	14.4	95.4	6.9	9.7	0.1	5.2	8
Discharge	15.8	56.7	7.6	9.6	0	71	87
Downstream	13.4	NR	7.4	9.4	14.3*	8.9	24
16th April 2011							
Upstream	16.0	102.3	7.0	9.0	0.1	4.1	5
Discharge	17.3	409.0	7.3	8.8	0.2	42.0	126
Downstream	16.1	391.4	7.6	7.8	0.2	2.5	3

Note: * = high tide and salt water intrusion.

Katikati – Uretara River

EBOP have a SOE monitoring site on the Uretara River at Henry's Crossing ('upstream site in current study). The results of the water quality monitoring at this site between 2001 and 2008 are presented in EBOP (2009). The water quality at Henry's Crossing is characterised by high water clarity (mean 2.7 m), high dissolved oxygen saturation (mean 99%), low conductivity (mean 6.9 mS/m^3), low turbidity (mean 2.6 NTU), moderate to low faecal indicator bacteria (mean faecal coliforms 256 cfu/100mL) and low DRP concentrations (mean 0.006 g/m^3).

The physico-chemical results from the sampling sites upstream and downstream of the stormwater catchment in the Uretara Stream and unnamed drain are presented in Table 2.

The sampling results indicate that the stream had low electrical conductivity, high DO concentrations and was slightly alkaline. High summer stream water temperatures and prolific algal growths are expected to reduce the ability of the middle and lower reaches of the stream to support water quality sensitive benthic macroinvertebrate taxa during summer extended low flow periods. Native fish species that require low water temperatures may also avoid the middle and lower reaches during hot summer low flow periods.

Te Puke – Ohineanganga Stream

EBOP does not have a regular monitoring site on the Ohineangaanga Stream and water quality monitoring data is therefore very limited. The lower reaches of the Ohineangaanga Stream form part of a district drainage scheme and are classified by EBOP has having ecological values associated with its native fish community.

Table 2: Physico-chemical results for Uretara River and unnamed drain - Katikati.

Site	Temperature (°C)	Conductivity (mS/m^3)	pH	Dissolved oxygen (mg/L)	Salinity (%)	Turbidity (NTU)	TSS (g/m^3)
26th April 2010							
Upstream	17.2	63.2	7.6	10.2	0	NR	NR
Discharge	NR	NR	NR	NR	NR	NR	NR
Downstream	19.3	10.8	7.9	9.4	9.8	NR	NR
Unnamed drain	NR	NR	NR	NR	NR	NR	NR
16th July 2010							
Upstream	10.4	49.4	7.5	11.4	0.1	6.2	6
Discharge	12.1	26.6	7.2	10.3	0.1	22	33
Downstream	10.5	4,294	6.8	10.5	3.2*	8.6	10
Unnamed drain	NR	NR	NR	NR	NR	NR	NR
13th October 2010							
Upstream	14.4	47.7	7.3	10.9	0.1	3.8	5
Discharge	15.5	687.0	7.0	11.0	0.4	71	148
Downstream	13.7	137.4	6.7	10.8	10.4*	2.2	5
Unnamed drain	15.9	38.7	6.5	8.3	0	122	123
16th April 2011							
Upstream	15.2	59.6	7.2	10.2	0	0.6	3
Discharge	17.5	58.3	6.9	9.5	0	6.8	40
Downstream	16.4	58.3	6.4	8.5	4.1*	6.6	3
Unnamed drain	17.7	88.6	7.3	8.8	0.1	49	105

Western and eastern tributaries

The physico-chemical results from the sampling sites upstream and downstream of the stormwater catchments in the Ohineangaanga Stream catchment during dry weather (base flow) conditions on 26th April 2010 and storm event sampling on 16th July 2010, 13th October 2010 and 16th April 2011 are presented in Table 3.

The base flow water quality results are reflective of the rural and urban catchment of the tributaries with moderate – high electrical conductivity and low dissolved oxygen concentrations. The dissolved oxygen levels are likely to be the result of the slow flowing nature of the stream and organic loads. High summer stream water temperatures and low dissolved oxygen levels are expected to reduce the ability of the tributaries to support water quality sensitive benthic macroinvertebrate taxa and native fish species that require low water temperatures and high dissolved oxygen concentrations.

Table 3: Baseline physico-chemical results for the western and eastern tributaries of the Ohineangaanga Stream on 26th April 2010.

Site	Temperature (°C)	Conductivity (mS/m^3)	pH	Dissolved oxygen (mg/L)	Salinity (%)
Western tributary					
Upstream	17.7	86.6	6.5	6.4	0.1
Discharge	NR	NR	NR	NR	NR
Downstream	24.4	109.0	6.7	5.4	0.1
Eastern tributary					
Upstream	16.0	83.8	6.2	5.5	0.1
Discharge	NR	NR	NR	NR	NR
Downstream	16.0	87.4	7.0	8.0	0.1

Note: NR = no result.

Table 4: TSS and turbidity results for the western and eastern tributaries of the Ohineangaanga Stream.

Site	Turbidity (NTU	TSS (g/m^3)
16th July 2010		
Western tributary		
Upstream	2.2	5
Discharge	NR	NR
Downstream	620	600
Eastern tributary		
Upstream	7.8	7
Discharge	52	112
Downstream	29	29
13th October 2010		
Western tributary		
Upstream	1.1	3
Discharge	NR	NR
Downstream	95	87
Eastern tributary		
Upstream	2.4	3
Discharge	60	99
Downstream	5.1	5
16th April 2011		
Western tributary		
Upstream	5.8	9
Discharge	NR	NR
Downstream	24	32
Eastern tributary		
Upstream	2.6	3
Discharge	29	33
Downstream	4.9	3

Note: NR = no result.

3.2 Metal Concentrations

Waihi Beach - Two Mile Creek

Metal and metalloid concentrations recorded within the Two Mile Creek catchment during the 3 storm events are presented in Tables 5 - 7. The only exceedance of the ANZECC

(2000) 90% guideline for the metals sampled was for zinc at the downstream site on 16th July 2010 and 13th October 2010. The likely source of zinc at the downstream site is zinc from roofing material within the stormwater catchment. Overall the results indicate that the main stormwater catchment discharge to Two Mike Creek was not having a significant effect on downstream metals concentrations.

Katikati - Uretara Stream

Metal and metalloid concentrations recorded within the Uretara Stream catchment are presented in Tables 5 - 7. The downstream zinc concentration exceeded the ANZECC (2000) 90% guideline on 16th July 2010 and 16th April 2011. No other exceedances of the ANZECC (2000) 90% metals guidelines were recorded during the 3 storm events. The results indicate that the main stormwater catchment discharge was elevating zinc concentrations on some occasions but overall the discharge was not having a significant effect on downstream metals concentrations. The likely source of zinc at the downstream site is zinc from roofing material within the stormwater catchment.

Katikati -Unnamed drain

Metal and metalloid concentrations recorded within the unnamed drain in Katikati are presented in Tables 5 - 7. The ANZECC (2000) 90% guideline for copper, lead and zinc were exceeded on the 2 storm events sampled. The in-stream and riparian habitat is highly modified and the stream is only expected to support water and habitat tolerant taxa. The results indicate that the stormwater catchment discharge to the unnamed drain elevated copper, lead and zinc concentrations. Given the highly modified nature of the drain and the degraded ecological conditions the concentrations of these metals are not expected to be compromising the ecological potential of the drain.

Te Puke – Ohineanganga Stream – western tributary

Metal and metalloid concentrations recorded within the unnamed western tributary of the Ohineanganga Stream in Katikati are presented in Tables 5 - 7. The arsenic, chromium, copper, lead and zinc concentrations at the downstream site on the western tributary exceeded the ANZECC (2000) 90% guideline on 16th July 2010. The arsenic, copper and zinc concentrations at the downstream site exceeded the ANZECC (2000) 90% guideline on 13th October 2010 and 16th April 2011. The results indicate that the stormwater catchment discharge to the western tributary elevated metals concentrations and are likely to have been compromising the ecological potential of the stream. It is probable that the elevated arsenic concentrations were the result of stormwater runoff from the timber processing site immediately upstream of the sampling site.

Te Puke – Ohineanganga Stream – eastern tributary

Metal and metalloid concentrations recorded within the unnamed eastern tributary of the Ohineanganga Stream in Katikati are presented in Tables 5 - 7. The copper and zinc concentrations at the downstream site on the Eastern tributary exceeded the ANZECC (2000) 90% guideline on all 3 storm events. The results indicate that the stormwater catchment discharge to the eastern tributary elevated copper and zinc concentrations that may have been compromising the ecological potential of the stream.

Table 5: Metal and metalloid concentrations 16th July 2010.

Site	Arsenic	Chromium	Copper	Lead	Nickel	Zinc
Waihi Beach						
Two Mile Creek						
Upstream	< 0.0011	<0.00053	<0.00053	0.00033	<0.00053	0.0057
Discharge	0.0017	0.00193	0.0072	0.0048	0.00132	0.071
Downstream	<0.0011	<0.00053	<0.00080	0.00038	<0.00053	0.0175
Katikati						
Uretara River						
Upstream	<0.0011	<0.00053	<0.00053	0.00018	<0.00053	0.0035
Discharge	0.0016	0.00117	0.0050	0.0030	<0.00053	0.113
Downstream	<0.006	< 0.003	<0.003	0.0006	<0.003	0.034
Unnamed drain	NR	NR	NR	NR	NR	NR
Te Puke						
Western Tributary						
Upstream	<0.0011	<0.00053	<0.00053	<0.0011	<0.00053	0.0037
Downstream	0.21	0.199	0.118	0.0110	0.0031	0.50
Eastern Tributary						
Upstream	<0.0011	<0.00053	0.00083	0.00020	<0.00053	0.0072
Discharge	0.0162	0.031	0.075	0.0158	0.00169	0.53
Downstream	<0.0011	0.00104	0.0111	0.0034	0.00144	1.04

Note: NR = no result. Values highlighted in red exceed ANZECC 90% guideline. Values highlighted yellow may have exceeded ANZECC 90% guideline. Chromium VI and Arsenic V guidelines were used to assess compliance with total chromium and total arsenic results. All results in g/m^3.

Table 6: Metal and metalloid concentrations 13th October 2010.

Site	Arsenic	Chromium	Copper	Lead	Nickel	Zinc
Waihi Beach						
Two Mile Creek						
Upstream	<0.011	<0.006	<0.006	<0.0011	<0.006	0.013
Discharge	0.0049	0.0026	0.0145	0.0055	0.0021	0.109
Downstream	<0.0011	<0.00053	<0.00080	0.00038	<0.00053	0.0175
Katikati						
Uretara River						
Upstream	<0.0011	<0.00053	<0.00053	0.00011	<0.00053	0.0015
Discharge	0.0017	0.00153	0.0098	0.0065	0.00076	0.170
Downstream	<0.006	<0.003	<0.003	<0.0006	<0.003	0.009
Unnamed drain	0.0019	0.0029	0.0119	0.0089	0.0029	0.192
Te Puke						
Western Tributary						
Upstream	<0.0011	<0.00053	<0.00053	<0.00011	<0.00053	0.0032
Downstream	0.089	0.149	0.027	0.00143	<0.00053	0.145
Eastern Tributary						
Upstream	<0.0011	0.00064	0.00117	0.00029	<0.00053	0.0110
Discharge	0.0192	0.023	0.077	0.0132	0.0020	0.32
Downstream	<0.0011	0.00065	0.0089	0.0030	0.00055	0.056

Note: NR = no result. Values highlighted in red exceed ANZECC 90% guideline. Values highlighted yellow may have exceeded ANZECC 90% guideline. Chromium VI and Arsenic V guidelines were used to assess compliance with total chromium and total arsenic results. All results in g/m^3.

Table 7: Metal and metalloid concentrations 16th April 2011.

Site	Arsenic	Chromium	Copper	Lead	Nickel	Zinc
Waihi Beach						
Two Mile Creek						
Upstream	<0.0011	<0.00053	<0.00053	0.00021	<0.00053	0.0030
Discharge	0.0022	0.0028	0.046	0.0052	0.0086	0.28
Downstream	<0.0011	<0.00053	<0.00053	0.00014	<0.00053	0.0036
Katikati						
Uretara River						
Upstream	<0.0011	<0.00053	<0.00053	<0.0011	<0.00053	0.0012
Discharge	0.0013	0.00098	0.0092	0.0024	0.00078	0.144
Downstream	<0.0021	<0.0011	<0.0011	<0.00021	<0.0011	0.0173
Unnamed drain	0.002	0.0026	0.0124	0.0111	0.00149	0.33
Te Puke						
Western Tributary						
Upstream	<0.0011	<0.00053	0.00061	0.00015	<0.00053	0.0055
Downstream	0.108	0.128	0.035	0.00127	0.00144	0.107
Eastern Tributary						
Upstream	<0.0011	<0.00053	0.00066	0.00019	<0.00053	0.0109
Discharge	0.0129	0.0122	0.107	0.0081	0.0032	0.47
Downstream	<0.0011	<0.00053	0.0034	0.00039	0.00097	0.169

Note: NR = no result. Values highlighted in red exceed ANZECC 90% guideline. Values highlighted yellow may have exceeded ANZECC 90% guideline. Chromium VI and Arsenic V guidelines were used to assess compliance with total chromium and total arsenic results. All results in g/m^3.

3.3 PAH, PCB and TPH (Katikati & Te Puke)

Katikati - Uretara Stream

The only PAHs, PCBs of TPH identified at Uretara Stream sites was the PAH - phenanthrene (0.000013 g/m^3) at the downstream site (Table 8 and 9).

Te Puke – Ohineanganga Stream – western tributary

Polycyclic aromatic hydrocarbon, polychlorinated biphenyls and total petroleum hydrocarbon concentrations recorded within the western tributary are presented in Tables 8 and 9. No PAH, PCB or TPH were recorded at western tributary sites.

Te Puke – Ohineanganga Stream – eastern tributary

Polycyclic aromatic hydrocarbon, polychlorinated biphenyls and total petroleum hydrocarbon concentrations recorded within the eastern tributary are presented in Tables 8 and 9. No PAH, PCB or TPH were recorded at eastern tributary sites.

Table 8: PAH and PCB Concentrations – 16th July 2010.

Site	PAH	PCB
Waihi Beach		
Two Mile Creek		
Upstream	NR	NR
Discharge	NR	NR
Downstream	NR	NR
Katikati		
Uretara River		
Upstream	ND	ND
Discharge	Detects for Acenaphthylene, Fluroanthene, Phenanthrene, Pyrene*	ND
Downstream	Detect for Phenanthrene	ND
Unnamed drain	NR	NR
Te Puke		
Western Tributary		
Upstream	ND	ND
Downstream	ND	ND
Eastern Tributary		
Upstream	ND	ND
Discharge	Detects for Acenaphthylene, Benzo Phenanthrene, Pyrene	ND
Downstream	ND	ND

Note: NR = No result, ND = non detection.

Table 9: TPH Concentrations.

Site	13th October 2010	16th April 2011
Waihi Beach		
Two Mile Creek		
Upstream	<0.07	<0.07
Discharge	<0.07	<0.07
Downstream	<0.07	<0.07
Katikati		
Uretara River		
Upstream	<0.07	<0.07
Discharge	<0.07	<0.07
Downstream	<0.07	<0.07
Unnamed drain	<0.07	<0.07
Te Puke		
Western Tributary		
Upstream	<0.07	<0.07
Downstream	<0.07	<0.07
Eastern Tributary		
Upstream	<0.07	<0.07
Discharge	2.6	<0.07
Downstream	<0.07	<0.07

3.4 Sediment Quality

April 2010 – low flow results

Metals and Metaliods

Waihi Beach - 2 Mile Creek

All Two Mile Creek sediment metal and metalloid concentrations were below the NOAA and ANZECC (2000) guidelines on 26th April 2010 (Table 10). Metal and metalloid sediment concentrations were lower downstream of the urbanised portion of Two Mike Creek in Waihi compared to the rural portion of the catchment upstream and indicates that stormwater discharges from the residential and commercial areas were not influencing sediment quality in Two Mile Creek at the time of the survey.

Katikati - Uretara River

All Uretara River sediment metal and metalloid concentrations were below the NOAA and ANZECC (2000) guidelines (Table 10).

Some metal and metalloid sediment concentrations were slightly higher downstream of the urbanised portion of the Uretara River in Katikati compared to the rural portion of the catchment upstream and indicates that stormwater discharges from the residential and commercial areas were having a detectable but not ecologically significant effect on sediment quality in the Uretara River at the time of the survey.

Katikati – Unnamed drain

All sediment metal and metalloid concentrations in the unnamed drain were below the NOAA and ANZECC (2000) guidelines (Table 10) and indicate that the stormwater catchment discharges were not having an ecologically significant effect on sediment quality at the time of the sampling.

Te Puke – Ohineangaanga Stream tributaries

Arsenic sediment concentrations at the downstream site on the western tributary exceeded the NOAA Effects Range Median (ERM) and ANZECC ISQG – High guidelines (Table 10).

Zinc sediment concentrations at the downstream site on the western tributary of exceeded the NOAA Effects Range Low (ERL) guideline.

Copper sediment concentrations at the downstream site on the eastern tributary exceeded the NOAA ERL.

The increase in metal and metalloid concentrations at downstream sites compared to upstream and the exceedance of some of the guidelines indicates that discharges within the stormwater catchment were having a detectable effect on sediment quality at the time of the sampling and that there was potential for ecological impairment, particularly in the western tributary where arsenic concentrations exceeded the NOAA ERM guideline.

Organics

The concentration of organics in stream sediments was low and well below the NOAA and ANZECC (2000) guidelines at all sites (Table 11).

Table 10: Stream sediment total recoverable metal and metalloid concentrations.

Site	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc
Waihi Beach							
Two Mile Creek							
Upstream	4.5	0.140	9.4	5.4	13.5	3.5	45
Downstream	4.1	<0.10	4.0	<2	1.7	<2	7.8
Katikati							
Uretara River							
Upstream	<2	<0.10	13.2	4.6	6.0	4.3	32
Downstream	3.6	<0.10	11.4	5.9	11.3	4.1	41
Unnamed drain	<2	<0.10	5.3	7.4	7.2	4.1	60
Te Puke							
Western Tributary							
Upstream	<2	<0.10	<2	2.8	3.1	<2	18.6
Downstream	76	0.21	56	32	8.5	2.2	161
Eastern Tributary							
Upstream	2.6	<0.10	<2	2.8	6.1	<2	24
Downstream	2.2	0.151	3.9	85	10.7	2.3	60

Note: xxx – exceed NOAA Effects Range Median (ERM) and ANZECC ISQG – high guideline. xxx – exceed NOAA Effects Range Low (ERL) guideline. All results mg/Kg dry weight.

Table 11: Stream sediment PAH, PCB and total hydrocarbon concentrations.

Site	Naphthalene	Benzo(b&j) flurothene	Benzo (g,h,i) perylene	Fluoranthene	Pyrene	Total PCBs	Total hydrocarbons
Waihi Beach							
Two Mile Creek							
Upstream	NR	<0.05	<0.05	<0.05	<0.05	NR	<300
Downstream	NR	<0.05	<0.05	<0.05	<0.05	NR	<70
Katikati							
Uretara River							
Upstream	<0.17	<0.04	<0.04	<0.04	<0.04	<0.4	<70
Downstream	<0.3	<0.04	<0.04	<0.04	<0.04	<0.4	<110
Unnamed drain	<0.3	<0.05	<0.04	<0.04	<0.04	<0.4	<100
Te Puke							
Western Tributary							
Upstream	<0.3	<0.06	<0.06	<0.06	<0.06	<0.4	<110
Downstream	<1.7	<0.4	<0.4	<0.4	<0.4	<0.4	<700
Eastern Tributary							
Upstream	<0.3	<0.05	<0.05	<0.05	<0.05	<0.4	<90
Downstream	<0.19	0.051	0.036	0.039	0.068	<0.4	<80

Note: All results mg/Kg dry weight.

September 2010 – post high flow results

Metals and Metaliods

Waihi Beach - Two Mile Creek

All Two Mile Creek sediment metal and metalloid concentrations were below the NOAA and ANZECC (2000) guidelines on 29th Sepember 2010 (Table 12). Metal and metalloid sediment concentrations were similar downstream of the urbanised portion of Two Mile Creek in Waihi compared to the rural portion of the catchment upstream and indicates that stormwater discharges from the residential and commercial areas were not influencing sediment quality in Two Mile Creek at the time of the survey.

Katikati - Uretara River

All Uretara River sediment metal and metalloid concentrations were below the NOAA and ANZECC (2000) guidelines during the 29th September 2010 survey (Table 12).

Lead and zinc sediment concentrations were slightly higher downstream of the urbanised portion of the Uretara River in Katikati compared to the rural portion of the catchment upstream and indicates that stormwater discharges from the residential and commercial areas were having a detectable but not ecologically significant effect on sediment quality in the Uretara River at the time of the survey.

Te Puke – Ohineangaanga Stream eastern and western tributaries

All western and eastern tributary sediment metal and metalloid concentrations were below the NOAA and ANZECC (2000) guidelines during the 29th September 2010 survey (Table 12).

The increase in metal and metalloid concentrations at the downstream site on the western tributary compared to upstream indicates that discharges within the stormwater catchment were having a detectable effect on sediment quality at the time of the sampling although the concentrations were not at a level that would indicate possible effects on ecological values.

Table 12: Stream sediment total recoverable metal and metalloid concentrations.

Site	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc
Waihi Beach							
Two Mile Creek							
Upstream	<2	<0.10	10	<2	5.4	8	19
Downstream	<2	<0.10	5	<2	5.2	<2	19
Katikati							
Uretara River							
Upstream	<2	<0.10	14	6	8.5	5	41
Downstream	<2	<0.10	13	7	11.5	5	53
Unnamed drain	NR	NR	NR	NR	NR	NR	NR
Te Puke							
Western Tributary							
Upstream	4	<0.10	3	6	9.2	<2	35
Downstream	8	<0.10	15	10	5.6	<2	58
Eastern Tributary							
Upstream	<2	<0.10	5	<2	5.2	<2	19
Downstream	<2	<0.10	<2	<2	4.7	<2	18

Note: xxx – exceed NOAA Effects Range Median (ERM) and ANZECC ISQG – high guideline. xxx – exceed NOAA Effects Range Low (ERL) guideline. All results mg/Kg dry weight.

3.5 In-stream and Riparian Habitat

In-stream and riparian habitat are important factors controlling the ecological communities that a stream is capable of supporting.

The receiving environments of the streams potentially most affected by stormwater discharges in Waihi Beach (Two Mile Creek), Katikati (Uretara River and unnamed drain) and Te Puke (western and eastern tributaries of the Ohineangaanga Stream) are generally highly modified water bodies with degraded in-stream and riparian habitat. Figures 4 – 6 show a view of selected sites downstream of the stormwater catchments.

Figure 4: View of downstream site on Two Mile Creek, Waihi Beach.

Figure 5: View of downstream site on the Uretara River, Katikati.

Figure 6 View of unnamed drain in Katkati.

The steam environments upstream of the potentially most affected stream reaches in Katikati (Uretara River) and Te Puke (western and eastern tributaries of the Ohineangaanga Stream) provide significantly better instream and riparian habitat compared to downstream. The stream environment upstream of the urbanised section of Two Mile Creek provides poorer habitat compared to downstream with the downstream section offering greater instream cover and riparian habitat diversity. Figures 7 – 9 show a view of selected sites upstream of the stormwater catchments.

Figure 7: View of upstream site on Two Mile Creek, Waihi Beach.

Figure 8: View of upstream site on the Uretara River, Katikati.

Figure 9: View of upstream site on the western tributary of the Ohineangaanga Stream, Te Puke.

3.6 Benthic Macroinvertebrates

Published Data

EBOP collect benthic macroinvertebrate samples annually from sites throughout the region. The mean indices scores for sampling undertaken at selected sites close to those investigated during the current study are presented in Table 13.

EBOP collect SOE benthic macroinvertebrate data for 2 sites on the Uretara River and 1 site on the Ohineanganga Stream as well as 1 site on Waihi Stream at Waihi Beach.

The results for the Uretara River indicate that the river supports a reasonably diverse benthic invertebrate community with moderate numbers of water and habitat sensitive ephemeroptera (mayfly), plectoptera (stonefly) and trichoptera (caddisfly) (EPT) taxa. MCI and QMCI scores at the Rea Road site are indicative of 'good' quality (Stark and Maxted 2007) while the MCI and QMCI scores downstream at Wharawhara Road are indicative of 'fair' quality (Stark and Maxted 2007).

The results for the Waihi Stream upstream of the urban area indicate that the stream supports a benthic macroinvertebrate community with low diversity (mean 11 taxa), low numbers of water and habitat sensitive EPT taxa and MCI and QMCI scores that are indicative of 'poor' quality (Stark and Maxted 2007).

The results for the Ohineangaanga Stream indicate that the stream supports a benthic macroinvertebrate community with low diversity (mean 18 taxa), moderate numbers of water and habitat sensitive EPT taxa (mean 8 taxa) and MCI and QMCI scores that are indicative of 'fair' quality (Stark and Maxted 2007).

Table 13: Mean macroinvertebrate community indices scores for SOE data collected by EBOP between 2001- 2008.

Stream	Land use	Bed Type	N	Taxa Number	Abundance	EPT taxa number	%EPT	MCI	QMCI
Uretara (Rea Road)	Pasture	cobble	7	18	256	9	0.6	104	5.0
Uretara (Wharawhara Rd)	Hort/Past.	cobble	7	14	192	7	0.6	92	4.2
Waihi (Oceanview Rd)	Past/Urban	cobble	5	11	199	4	0.1	76	3.4
Ohineangaanga	Horticulture	soft	5	18	178	8	0.4	98	4.5
Kaitemako	Past/Urban	soft	5	9	201	3	0.1	97	5.0
Kopurererua	Past/Urban	soft	5	14	185	2	0.1	82	4.0
Otumanga	Past/Urban	soft	5	11	294	2	0.3	88	4.3

The Kaitemako, Kopurererua and Otumanga Streams are all soft bottom streams draining pasture catchments and are located on the boundary between rural and urban land use. The sites on these streams therefore provide a good comparison with the Two Mile Creek at Waihi Beach and the western and eastern tributary sites in Te Puke sampled during the current study.

Benthic macroinvertebrate indices scores for samples collected during the current study are presented in Table 14.

The invertebrate community at the Two Mile Creek Sites were characterised by low diversity (8 taxa downstream and 14 taxa upstream), low EPT taxa number (1 taxa upstream and downstream), low %EPT and low QMCI and MCI scores which placed both sites in the 'poor' quality class (Stark and Maxted 2007). The biological indices scores recorded in the April 2010 survey were similar to the scores reported for another Waihi Beach Stream by EBOP. The benthic invertebrate community was in poorer health at the downstream site compared to upstream. The water quality results indicate that the poorer benthic macroinvertebrate health at the downstream site compared to the upstream site is more likely to be related to low dissolved oxygen concentration and storm surges of marine water into the lower reaches of the stream and less likely to be related to the effects of the stormwater discharge.

The benthic macroinvertebrate community at the Uretara River sites were characterised by low diversity in the soft bottom section of stream and moderate diversity in the hard bottom section of stream. The community was also characterised by moderate EPT taxa number (3 taxa in soft bottom section and 4 taxa in the hard bottom section), moderate %EPT abundance at the hard bottom section and low %EPT at the soft bottom section. QMCI scores placed the soft and hard bottom sites in the 'fair ' and 'poor' quality classes respectively (Stark and Maxted 2007). The MCI scores placed the soft and hard bottom sites in the 'fair' quality class (Stark and Maxted 2007). The biological indices scores recorded in the April 2010 survey were generally lower than the scores reported for 2 sites sampled on the Uretara River by EBOP.

The benthic macroinvertebrate community at the western and eastern tributary sites in Te Puke were characterised by low diversity at downstream sites and moderate diversity at upstream sites. The communities were also characterised by low EPT taxa number and low %EPT abundance. QMCI scores placed all sites in the 'poor' quality class (Stark and Maxted 2007). The MCI scores placed both western tributary and the upstream eastern tributary sites in the 'poor' quality class with the upstream site on the eastern tributary in the 'fair' class' (Stark and Maxted 2007).

The biological indices scores recorded in the April 2010 survey were lower than the scores reported for Ohineangaanga Stream monitored by EBOP this likely to be related to poor water and in-stream and riparian habitat at the sites sampled during the current study. The benthic invertebrate community health was poorer at the downstream sites on the eastern and western tributaries compared to upstream and reflected significantly poorer in-stream and riparian habitat quality and poorer water and sediment quality in the case of the western tributary.

Table 14: Benthic Macroinvertebrate Community Summary.

Site	Taxa Number	Abundance	EPT Taxa Number	%EPT	QMCI	MCI
Waihi Beach						
Two Mile Creek						
Upstream	14	616	1	1.3	4.1	70
Downstream	8	889	1	0.2	4.8	50
Katikati						
Uretara River						
Upstream - hard	20	549	4	24.4	3.0	81
Upstream - soft	10	596	3	0.8	4.6	82
Te Puke						
Western tributary						
Upstream	21	1,333	1	0.6	2.8	69
Downstream	8	2,278	0	0	1.0	58
Eastern tributary						
Upstream	18	947	1	0.3	4.0	83
Downstream	14	181	2	1.1	1.7	79

3.7 Fish Community

Two Mile Creek

Wildlands (2007) reported recording redfinned bully, common bully and shortfinned eel in 2 Mile Creek during a survey in August 2006. The EBOP Regional Land and Water Plan lists the following species for 2 Mile Creek:

- Banded kokopu.
- Redfinned bully.
- Common bully.
- Inanga.
- Common smelt.
- Longfinned eel.
- Short finned eel.

Despite its highly modified nature the stream provides a migratory pathway for native fish and adult and juvenile habitat. There is potential whitebait spawning habitat in the lower reaches of the stream although it is not listed in the EBOP Regional Land and Water Plan as whitebait spawning habitat.

Uretara River

Wildlands (2007) and the EBOP Regional Land and Water Plan lists the following species for the Uretara River catchment:

- Banded kokpu.
- Giant kokopu.
- Redfinned bully.
- Common bully.
- Inanga.
- Common smelt.
- Torrentfish.
- Longfinned eel.
- Short finned eel.

The EBOP Regional Land and Water Plan lists a site in the lower river as a whitebait spawning site.

The Uretara River supports significant native fish values including 2 species (giant kokopu and longfinned eel) that have a threat classification of 'gradual decline' (Hitchmough 2002).

Ohineangaanga Stream

Wildlands (2006) reported recording banded kokopu, giant kokopu and shortfinned eel from what that report referred to as the South-North drainage corridor. Wildlands (2006) reported recording inanga, banded kokopu, giant kokopu and shortfinned eel from what that report referred to as the Centennial Park waterways.

Small shoals of inanga were observed at the downstream site on the eastern tributary during the sediment sampling survey undertaken in April 2010.

The EBOP Regional Land and Water Plan lists the following species for the Ohineangaanga Stream catchment:

- Common bully.
- Inanga.
- Common smelt.

- Longfinned eel.
- Short finned eel.
- Koura.

The Ohineangaanga Stream supports significant native fish values including 2 species (giant kokopu and longfinned eel) that have a threat classification of 'gradual decline' (Hitchmough 2002).

Despite the highly modified nature of the lower reaches of the western and eastern tributaries these stream sections provide a migratory pathway for native fish to sections upstream that provide reasonable habitat quality although this does require fish to pass through various culverts. The lower reaches of the western and eastern tributaries also provide some poor quality adult and juvenile native fish habitat.

4.0 Receiving Environment Values and Sensitivity

4.1 Introduction

The receiving environment values and sensitivity varies considerably between Two Mile Creek, the Uretara River, unnamed drain in Katikati and the eastern and western tributaries of the Ohineangaanga Stream in Te Puke.

4.2 Two Mile Creek

The lower reaches of Two Mile Creek is highly modified and is primarily managed by EBOP as a pathway for native fish and for flood protection purposes. Inanga could potentially use the lower reaches to spawn.

The benthic macroinvertebrate community in the lower reaches of the stream is characterised by the dominance of water and habitat tolerant taxa that are relatively insensitive to poor water quality.

In-stream and riparian habitat and sediment quality results indicate that Two Mile Creek upstream of the urbanised portion of the catchment is in poor condition. Two Mile Creek upstream of the urban portion of the catchment offers water and habitat that is suitable for water and habitat tolerant benthic macroinvertebrate taxa such as chironomids and worms and water and habitat tolerant fish species such as eels.

The ultimate receiving environment for stormwater that enters Two Mile Creek is the sea at Waihi Beach. This is an open water receiving environment and the large assimilative capacity means that its existing water and ecological values below the high tide mark are unlikely to be sensitive to stormwater discharges.

4.3 Uretara River

The lower reaches of the Uretara River have been modified by urban development and flood protection activities.

The lower reaches within and downstream of the urban portion of the catchment provide good quality habitat for a range of native fish species. The lower reaches also provide whitebait spawning habitat and an important pathway for native fish that migrate to the middle and upper reaches and which offer high quality native fish habitat.

The benthic macroinvertebrate community in the lower reaches of the stream and that receive stormwater discharges was not able to be characterised due to the brackish nature of the stream. The benthic macroinvertebrate community upstream of the stormwater discharge was characterised by moderate EPT taxa number, moderate %EPT abundance and QMCI scores placed the water quality in the 'fair 'quality class (Stark and Maxted 2007).

The current sediment quality is unlikely to be adversely affecting the ecological values that exist in the Uretara River.

Overall the Uretara River is assessed as having moderate to high native fish values and sensitivity to stormwater discharges and low benthic macroinvertebrate community values and sensitivity to stormwater discharges.

The ultimate receiving environment for stormwater that enters the lower Uretara River is a depositional area within the upper harbour that is likely to support significant ecological values and be sensitive to stormwater discharges.

4.4 Katikati – Unnamed drain

The unnamed drain in Katikati is a highly modified channelised drain that offers poor in-stream and riparian habitat and very limited in-stream habitat for benthic macroinvertebrates and native fish.

There is no open stream habitat upstream of the study site and therefore the drain is not a migratory pathway for native fish.

The sediment quality results indicate that the current sediment quality is unlikely to be adversely affecting the ecological values that exist in the drain.

Overall the unnamed drain is assessed as having low benthic macroinvertebrate community and native fish values and low sensitivity to stormwater discharges.

The ultimate receiving environment for stormwater that enters the unnamed drain is a depositional area within the upper harbour that is likely to support significant ecological values and be sensitive to stormwater discharges.

4.5 Ohineangaanga Stream – western tributary

The lower reaches of the western tributary of the Ohineangaanga Stream are a highly modified channelised drain that offers poor instream and riparian habitat and very limited in-stream habitat for benthic macroinvertebrates and native fish.

There is much better quality stream habitat upstream of the lower reaches and therefore the lower reaches of the tributary (downstream of the urban area) is primarily a migratory pathway for native fish.

The benthic macroinvertebrate community in the lower reaches was characterised by the dominance of water and habitat tolerant taxa that are insensitive to poor water quality. The

benthic macroinvertebrate community upstream of the stormwater catchment had greater diversity and supported some taxa that are moderately sensitive to water and habitat quality.

The water and sediment quality results indicate that the current water and sediment quality could be adversely affecting the ecological values that exist in the lower reaches of the western tributary.

Overall the lower reaches of the western tributary is assessed as having low benthic macroinvertebrate community values and sensitivity to stormwater discharges. The lower reaches of the western tributary are assessed as having moderate native fish values that result from the presence of good native fish habitat upstream and downstream in the Ohineanganga Stream.

4.6 Ohineangaanga Stream – eastern tributary

The lower reaches of the eastern tributary of the Ohineangaanga Stream are a highly modified channelised drain that offers poor instream and riparian habitat for benthic macroinvertebrates and native fish.

There is much better quality stream habitat upstream of the lower reaches and therefore the lower reaches of the tributary (downstream of the urban area) is primarily a migratory pathway for native fish.

The benthic macroinvertebrate community in the lower reaches was characterised by the dominance of water and habitat tolerant taxa that are insensitive to poor water quality. The benthic macroinvertebrate community upstream of the stormwater catchment had greater diversity and supported some taxa that are moderately sensitive to water and habitat quality.

The water quality results indicate that the current water quality could be adversely affecting the ecological values that exist in the lower reaches of the eastern tributary.

Overall the lower reaches of the eastern tributary is assessed as having low benthic invertebrate community values and sensitivity to stormwater discharges. The lower reaches of the eastern tributary are assessed as having moderate native fish values that result from the presence of good native fish habitat upstream and downstream in the Ohineangaanga Stream.

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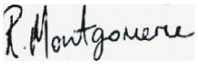

Richard Montgomerie

Director

APPENDIX 1

Raw benthic macroinvertebrate data

Raw benthic macroinvertebrate data

		Eastern	Eastern	Uretara	Uretara	Western	Western	Two Mile	Two Mile
		U/S	D/S	riffle	Pool	U/S	D/S	U/S	D/S
Taxa	**MCI**								
INSECTA									
Trichoptera									
Aoteapsyche	4			6					
Beraeoptera	8			2					
Hudsonema	6		1		2				
Olinga	9			10					
Paraoxyethira	2								2
Polyplectropus	8	3	1			8			
Pycnocentrodes	5			116	2				
Triplectides	5				1			8	
Oxyethira	2		8	46	8	17	1	2	
Archichauliodes	7			4					
Austrolestes	6	3							
Xanthocnemis	5	2				3		2	
Hemiptera									
Sigara	5					33			
Coleoptera									
Elmidae	6			49	2				
Hydrophilidae	5	2							
Diptera									
Austrosimulium	3		1	5					
Ceratopogonidae	3	1				6			
Chironomus	1	2				3	816		2
Corynoneura	2			1		1		5	1
Culicidae	3	4	1				3		
Maoridiamesa	3			2	1				
Orthocladiinae	2	4	2	76	3	4		3	40
Paradixa	4	44						5	
Paralimnophila	6	3							
Polypedilum	3	4							1
Tanypodinae	5	5	1			5			
Tanytarsini	3			28					
Zelandotipula	6	1							
Collembola	6		1						
ACARINA	5		12	1		3		1	
CRUSTACEA									
Amphipoda	5							2	
Copepoda	5	1	2			8	4		
Cladocera	5						6		
Ostracoda	3	1	4			30	2	9	
Paratya	5	21		2	384			72	804
MOLLUSCA									
Latia	3			1	1				
Physa (= Physella)	3					6			
Potamopyrgus	4	840		12	192	480		504	37
Sphaeriidae	3					220		1	
OLIGOCHAETA	1	6	136	180		440	1440	1	2
HIRUDINEA	3					3	6	1	
PLATYHELMINTHES	3		6	2		38			
NEMATODA	3			2		2			
NEMERTEA	3		5	4		4			
Hydra	3					19			

Contaminant Load Model
(based on ARC guidelines - CLM May 2006)

Catchment: Te Puna
Outfall: SWCO1135

	Catchment Area (m^2)		15570.5	Total Suspended Solids (TSS)		Zinc		Cooper		Total Petroleum Hydrocarbons (TPH)	
Source	Source Type		Source Area (m^2)	Yield ($g*m^{-2}a^{-1}$)	Load ($g*a^{-1}$)	Yield ($g*m^{-2}a^{-1}$)	Load ($g*a^{-1}$)	Yield ($g*m^{-2}a^{-1}$)	Load ($g*a^{-1}$)	Yield ($g*m^{-2}a^{-1}$)	Load ($g*a^{-1}$)
Roofs (average)			1113.8	*5.00*	5569.10	*0.04*	44.55	*0.00*	0.89		
Roads	Vehicles per day	Length (m)									
	<1000		4390.4	*4.00*	17561.58	*0.02*	92.20	*0.01*	30.73	*0.11*	482.94
	1000-5000			*30.00*	0.00	*0.11*	0.00	*0.03*	0.00	*0.54*	0.00
	5000-20000			*150.00*	0.00	*0.54*	0.00	*0.17*	0.00	*2.68*	0.00
	20000-50000			*299.00*	0.00	*1.07*	0.00	*0.35*	0.00	*5.34*	0.00
	50000-100000			*300.00*	0.00	*2.28*	0.00	*0.74*	0.00	*11.41*	0.00
	>100000			*300.00*	0.00	*3.53*	0.00	*1.15*	0.00	*17.66*	0.00
Roads (sum)			4390.4		17561.58		92.20		30.73		482.94
Paved Surfaces other than roads	Residential		1151.0	*20.00*	23020.15	*0.07*	80.57	*0.01*	11.51		
	Industrial			*50.00*	0.00	*0.10*	0.00	*0.13*	0.00		
	Commercial			*100.00*	0.000	*0.05*	0.00	*0.05*	0.00		
Urban Grass lands	Slope	<10	8915.3	*35.00*	312035.18		0.00		0.00		
		10 to 20	0.0	*80.00*	0.00		0.00		0.00		
		>20	0.0	*160.00*	0.00		0.00		0.00		
Urban Stream Channel	length x width		0.0	*6000.00*	0.00		0.00		0.00		
Urban area without construction sides			**15570.5**		**358186.0**		**217.3**		**43.1**		**482.9**

Catchment Totals				**Total Suspended Solids (TSS)**		**Zinc**		**Cooper**		**Total Petroleum Hydrocarbons (TPH)**	
Outfall Loads ($g*a^{-1}$)					358186.02		217.32		43.13		482.94
Outfall Loads ($kg*a^{-1}$)					358.19		0.22		0.04		0.48
Average Yield ($g*ha*a^{-1}$)				*23004.12*		*139.57*		*27.70*		*310.17*	
Average Yield ($kg*ha*a^{-1}$)				*230.04*		*1.40*		*0.28*		*3.10*	
Event Volume [m3]	166.212	Event Volume (L)	166211.8								
Average Mass - Load (mg)											
Average Mass - Load (g)											
Average Mass - Load (kg)											
Density ($g*cm^{-3}$)							7.14		8.96		0.83
Density ($kg*m^{-3}$)							7140.00		8960.00		830.00
Note: Concentrations do not include any pretreatment.											
Average concentrations (mg*kg-1)							606.73		120.42		1348.30
Average concentrations ($mg*m^{-3}$)							4332041.21		1078991.81		1119092.19
Average concentrations ($\mu g*L^{-1}$)							4.33204		1.07899		1.11909
Average concentrations ($g*m^{-3}$)							0.61		0.12		1.35
Guideline concentrations ($\mu g*L^{-1}$)							<8		<1.3		
Guideline concentrations ($g*m^{-3}$)					<150		0.008		0,0014		<15

NATIONAL WATER QUALITY MANAGEMENT STRATEGY
Australian and New Zealand Guidelines for Fresh and Marine Water Quality - trigger values

Arsenic
A high reliability freshwater trigger value of 24 µg/L was derived for arsenic (III) using the statistical distribution method with 95% protection.
An Environmental Concern Level (ECL, see Section 8.3.4.5) of 2.3 µg/L was derived for As (III) in marine waters, using an AF of 100. This figure could be adopted as a marine low reliability trigger value, to be used only as an indicative interim working level. Further review at a later revision may produce a more reliable trigger value.

Chromium
A low reliability freshwater trigger value for chromium (III) of 3.3 µg/L was derived using the AF method (a factor of 20 was applied to the lowest, O. mykiss figure, from a limited set of chronic data). This applies to low hardness water at 30 mg/L as CaCO3. This figure should only be used as an indicative interim working level.
A marine moderate reliability trigger value for chromium (III) of 10 µg/L was derived, using the statistical distribution method with 95% protection and an ACR of 77.6.
A freshwater high reliability trigger value for chromium (VI) of 1.0 µg/L was derived using the statistical distribution method at 95% protection.
A marine high reliability trigger value for chromium (VI) of 4.4 µg/L was derived using the statistical distribution method at 95% protection.

Copper
A freshwater high reliability trigger value for copper of 1.4 µg/L was derived using the statistical distribution method with 95% protection. This applies to waters of hardness of 30 mg/L as CaCO3.
A marine high reliability trigger value for copper of 1.3 µg/L was derived using the statistical distribution method with 95% protection. This figure is above the converted NOEC for Mytilus edulis but below the experimental EC50 (2 µg/L) and is considered appropriate for slightly-moderately disturbed systems.

Lead
A high reliability freshwater trigger value for lead of 3.4 µg/L was calculated using the statistical distribution method at 95% protection. This applies to waters of low hardness, 30 mg/L as CaCO3.
A marine high reliability trigger value for lead of 4.4 µg/L was calculated using the statistical distribution method with 95% protection.

Nickel
A freshwater high reliability trigger value of 11 µg/L was calculated for nickel using the statistical distribution method at 95% protection. This applies to low hardness waters, 30 mg/L as CaCO3.

Zinc
A freshwater high reliability trigger value of 8 µg/L was calculated for zinc using the statistical distribution method with 95% protection. This applies at hardness of 30 mg/L of CaCO3.
A marine high reliability trigger value of 15 µg/L was calculated for zinc using the statistical distribution method with 95% protection.

Metal	Marine water (µg/L)	Estuarine water (µg/L)	Fresh water (µg/L)	Country
Arsenic	1.0–1.6[a]	1.0–3.3[m]	NI	Australia
Cadmium	0.01–0.2[b]	NI	0.002–0.08[b]	USA
	0.001–1.1[c]	NI	0.01[d]; 0.002–0.1[e]; 0.08[k]	World
	0.002–0.7[a,f]	0.002–0.026[g,m]	0.001[g]	Australia
		0.51–1.2[h]		
	NI	NI	0.008[l]	New Zealand
Copper	0.1–3[b]	NI	0.4–4[b]	USA
	0.003–0.37[i]	NI	1.5[d]	World
	0.025–0.38[a]	0.06–1.3[g,m]	0.11[g]	Australia
	0.1–0.2[j]	NI	0.15[l]	New Zealand
Chromium	0.062–0.1[a]	0.01–0.1[m]	NI	Australia
Iron	0.006–0.14[c]	<0.04–13.7[m]	40 [d]	World
	NI	0.76–67[g,m]	NI	Australia
Lead	0.01– 1[b]	NI	0.01–0.19[b]	USA
	<0.006–0.03[a]	0.02–0.13[m]	NI	Australia
	NI	NI	0.02–0.03[l]	New Zealand
Manganese	0.003–0.38[c]	NI	1.5[d]	World
	NI	0.55–3.1[g]	NI	Australia
Mercury	NI	0.0007–0.003[m]	0.01[k]	World
	NI	0.0017[m]	NI	Australia
Nickel	0.3–5[b]	NI	1–2[b]	USA
	0.12–0.7[c]	NI	0.5[d]; 3.3[k]	World
	0.13–0.5[a]	0.14–1.10[g,m]	0.10[g]	Australia
	0.33[j]	NI	0.1–0.15[l]	New Zealand
Silver	0.006–0.2[b]	NI	NI	USA
	<0.0005[a]	NI	NI	Australia
Zinc	0.1–15[b]		0.03–5[b]	USA
	0.003–0.59[c]		0.6[d]; 2.8[k]	World
	<0.022–0.1[a]	0.39–3.8[g,m]	0.9 [g]	Australia
		0.4–1.8[h]		
	0.005–0.02[j]		0.15–0.2[l]	New Zealand

Footnotes: NI = No information found. References: a = Apte et al. 1998; b = Prothro 1993; c = Bruland 1983; d = 'World average' Martin & Windom 1991; e = Canada: Stephenson & Mackie 1988; f = NW Shelf, Australia: Mackey 1984; g = Bathurst Harbour & Old River, Tasmania: Mackey et al. 1996; h = Higgins & Mackey 1987; i = Ahlers et al. 1991; j = Dickson & Hunter 1981; k = Geometric mean in The Netherlands: RIVM 1999; m = Port Phillip Bay: CSIRO 1996.

Runoff	Rain Event	Time [s]	Time [a]		Intensity I [mm/h]	Stormwater Runoff Flow		Event	Event Volume [m3]
	5yr - 10min	600	0.00002		**122.2**				
Area AC			Run-off coefficient C			Run-off Qci [m3/s]		Qci [l/s]	
No.	[m2]	[ha]	Coef.	slope [%]	Slope cor.	per Area	total		
Roofs									
Roofs (average)	1114	0.11	0.90	10.0	0	0.034	0.034	34.027	20.416
Roads - Vehicles per day									
<1000	4390	0.44	0.90	10.0	0	0.134	0.134	134.127	80.476
1000-5000	0	0.00	0.90	10.0	0	0.000	0.000	0.000	0.000
5000-20000	0	0.00	0.90	10.0	0	0.000	0.000	0.000	0.000
20000-50000	0	0.00	0.90	10.0	0	0.000	0.000	0.000	0.000
50000-100000	0	0.00	0.90	10.0	0	0.000	0.000	0.000	0.000
>100000	0	0.00	0.90	10.0	0	0.000	0.000	0.000	0.000
Roads (sum)	4390	0.44	0.90	10.0	0	0.134	0.134	134.127	80.476
Paved Surfaces other than roads									0.000
Residential	1151	0.12	0.85	10.0	0	0.033	0.033	33.210	19.926
Industrial	0	0.00	0.85	10.0	0	0.000	0.000	0.000	0.000
Commercial	0	0.00	0.85	10.0	0	0.000	0.000	0.000	0.000
Urban Grass lands									0.000
<10	8915	0.89	0.25	10.0	0	0.076	0.076	75.656	45.394
10 to 20	0	0.00	0.25	12.5	0.05	0.000	0.000	0.000	0.000
>20	0	0.00	0.25	25.0	0.1	0.000	0.000	0.000	0.000
Urban Stream Channel	0	0.00	0.70	10.0	0	0.000	0.000	0.000	0.000
Urban area without construction sides							**0.277**	**277.020**	**166.212**

First flush volume
1hour storm

997

Rainfall Intensity Charts 5yr - 10min	
Urban	
Te Puna/Minden	122.2

Contaminant Load Model
(based on ARC guidelines - CLM May 2006)

Catchment: Minden
Outfall: SWCO1147

	Catchment Area (m^2)		221966.0	Total Suspended Solids (TSS)		Zinc		Cooper		Total Petroleum Hydrocarbons (TPH)	
Source	Source Type		Source Area (m^2)	Yield ($g*m^{-2}a^{-1}$)	Load ($g*a^{-1}$)	Yield ($g*m^{-2}a^{-1}$)	Load ($g*a^{-1}$)	Yield ($g*m^{-2}a^{-1}$)	Load ($g*a^{-1}$)	Yield ($g*m^{-2}a^{-1}$)	Load ($g*a^{-1}$)
Roofs (average)			5462.3	*5.00*	27311.37	*0.04*	218.49	*0.00*	4.37		
Roads	Vehicles per day	Length (m)									
	<1000		671.0	*4.00*	2683.88	*0.02*	14.09	*0.01*	4.70	*0.11*	73.81
	1000-5000		11103.9	*30.00*	333115.82	*0.11*	1188.11	*0.03*	387.52	*0.54*	5996.08
	5000-20000			*150.00*	0.00	*0.54*	0.00	*0.17*	0.00	*2.68*	0.00
	20000-50000			*299.00*	0.00	*1.07*	0.00	*0.35*	0.00	*5.34*	0.00
	50000-100000			*300.00*	0.00	*2.28*	0.00	*0.74*	0.00	*11.41*	0.00
	>100000			*300.00*	0.00	*3.53*	0.00	*1.15*	0.00	*17.66*	0.00
Roads (sum)			11774.8		335799.70		1202.20		392.22		6069.89
Paved Surfaces other than roads	Residential		8254.7	*20.00*	165093.25	*0.07*	577.83	*0.01*	82.55		
	Industrial			*50.00*	0.00	*0.10*	0.00	*0.13*	0.00		
	Commercial			*100.00*	0.000	*0.05*	0.00	*0.05*	0.00		
Urban Grass lands	Slope	<10	196474.3	*35.00*	6876599.31		0.00		0.00		
		10 to 20	0.0	*80.00*	0.00		0.00		0.00		
		>20	0.0	*160.00*	0.00		0.00		0.00		
Urban Stream Channel	length x width		0.0	*6000.00*	0.00		0.00		0.00		
Urban area without construction sides			**221966.0**		**7404803.6**		**1998.5**		**479.1**		**6069.9**

Catchment Totals	**Total Suspended Solids (TSS)**		**Zinc**		**Cooper**		**Total Petroleum Hydrocarbons (TPH)**	
Outfall Loads ($g*a^{-1}$)		7404803.63		1998.52		479.14		6069.89
Outfall Loads ($kg*a^{-1}$)		7404.80		2.00		0.48		6.07
Average Yield ($g*ha*a^{-1}$)	*33360.08*		*90.04*		*21.59*		*273.46*	
Average Yield ($kg*ha*a^{-1}$)	*333.60*		*0.90*		*0.22*		*2.73*	
Event Volume [m3] 1459.240	Event Volume (L) 1459239.5							
Average Mass - Load (mg)								
Average Mass - Load (g)								
Average Mass - Load (kg)								
Density ($g*cm^{-3}$)				7.14		8.96		0.83
Density ($kg*m^{-3}$)				7140.00		8960.00		830.00
Note: Concentrations do not include any pretreatment.								
Average concentrations (mg*kg-1)				269.90		64.71		819.72
Average concentrations ($mg*m^{-3}$)				1927051.53		579769.08		680370.49
Average concentrations ($\mu g*L^{-1}$)				1.92705		0.57977		0.68037
Average concentrations ($g*m^{-3}$)				0.27		0.06		0.82
Guideline concentrations ($\mu g*L^{-1}$)				<8		<1.3		
Guideline concentrations ($g*m^{-3}$)		<150		0.008		0,0014		<15

NATIONAL WATER QUALITY MANAGEMENT STRATEGY
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Metal	Marine water (µg/L)	Estuarine water (µg/L)	Fresh water (µg/L)	Country
Arsenic	1.0–1.6[a]	1.0–3.3[m]	NI	Australia
Cadmium	0.01–0.2[b]	NI	0.002–0.08[b]	USA
	0.001–1.1[c]	NI	0.01[d]; 0.002–0.1[e]; 0.08[k]	World
	0.002–0.7[a,f]	0.002–0.026[g,m]	0.001[g]	Australia
		0.51–1.2[h]		
	NI	NI	0.008[l]	New Zealand
Copper	0.1–3[b]	NI	0.4–4[b]	USA
	0.003–0.37[i]	NI	1.5[d]	World
	0.025–0.38[a]	0.06–1.3[g,m]	0.11[g]	Australia
	0.1–0.2[j]	NI	0.15[l]	New Zealand
Chromium	0.062–0.1[a]	0.01–0.1[m]	NI	Australia
Iron	0.006–0.14[c]	<0.04–13.7[m]	40 [d]	World
	NI	0.76–67[g,m]	NI	Australia
Lead	0.01– 1[b]	NI	0.01–0.19[b]	USA
	<0.006–0.03[a]	0.02–0.13[m]	NI	Australia
	NI	NI	0.02–0.03[l]	New Zealand
Manganese	0.003–0.38[c]	NI	1.5[d]	World
	NI	0.55–3.1[g]	NI	Australia
Mercury	NI	0.0007–0.003[m]	0.01[k]	World
	NI	0.0017[m]	NI	Australia
Nickel	0.3–5[b]	NI	1–2[b]	USA
	0.12–0.7[c]	NI	0.5[d]; 3.3[k]	World
	0.13–0.5[a]	0.14–1.10[g,m]	0.10[g]	Australia
	0.33[j]	NI	0.1–0.15[l]	New Zealand
Silver	0.006–0.2[b]	NI	NI	USA
	<0.0005[a]	NI	NI	Australia
Zinc	0.1–15[b]		0.03–5[b]	USA
	0.003–0.59[c]		0.6[d]; 2.8[k]	World
	<0.022–0.1[a]	0.39–3.8[g,m]	0.9 [g]	Australia
		0.4–1.8[h]		
	0.005–0.02[j]		0.15–0.2[l]	New Zealand

Footnotes: NI = No information found. References: a = Apte et al. 1998; b = Prothro 1993; c = Bruland 1983; d = 'World average' Martin & Windom 1991; e = Canada: Stephenson & Mackie 1988; f = NW Shelf, Australia: Mackey 1984; g = Bathurst Harbour & Old River, Tasmania: Mackey et al. 1996; h = Higgins & Mackey 1987; i = Ahlers et al. 1991; j = Dickson & Hunter 1981; k = Geometric mean in The Netherlands: RIVM 1999; m = Port Phillip Bay: CSIRO 1996.

Runoff	Rain Event	Time [s]	Time [a]		Intensity I [mm/h]	Stormwater Runoff		Event	Event Volume [m3]
	5yr - 10min	600	0.00002		**122.2**	Flow			
Area AC					Run-off coefficient C	Run-off Qci [m3/s]		Qci [l/s]	
No.	[m2]	[ha]	Coef.	slope [%]	Slope cor.	per Area	total		
Roofs									
Roofs (average)	5462	0.55	0.90	10.0	0	0.167	0.167	166.872	100.123
Roads - Vehicles per day									
<1000	671	0.07	0.90	10.0	0	0.020	0.020	20.498	12.299
1000-5000	11104	1.11	0.90	10.0	0	0.339	0.339	339.223	203.534
5000-20000	0	0.00	0.90	10.0	0	0.000	0.000	0.000	0.000
20000-50000	0	0.00	0.90	10.0	0	0.000	0.000	0.000	0.000
50000-100000	0	0.00	0.90	10.0	0	0.000	0.000	0.000	0.000
>100000	0	0.00	0.90	10.0	0	0.000	0.000	0.000	0.000
Roads (sum)	11775	1.18	0.90	10.0	0	0.360	0.360	359.721	215.833
Paved Surfaces other than roads									0.000
Residential	8255	0.83	0.85	10.0	0	0.238	0.238	238.170	142.902
Industrial	0	0.00	0.85	10.0	0	0.000	0.000	0.000	0.000
Commercial	0	0.00	0.85	10.0	0	0.000	0.000	0.000	0.000
Urban Grass lands									0.000
<10	196474	19.65	0.25	10.0	0	1.667	1.667	1667.302	1000.381
10 to 20	0	0.00	0.25	12.5	0.05	0.000	0.000	0.000	0.000
>20	0	0.00	0.25	25.0	0.1	0.000	0.000	0.000	0.000
Urban Stream Channel	0	0.00	0.70	10.0	0	0.000	0.000	0.000	0.000
Urban area without construction sides							**2.432**	**2432.066**	**1459.240**

First flush volume
1hour storm

8755

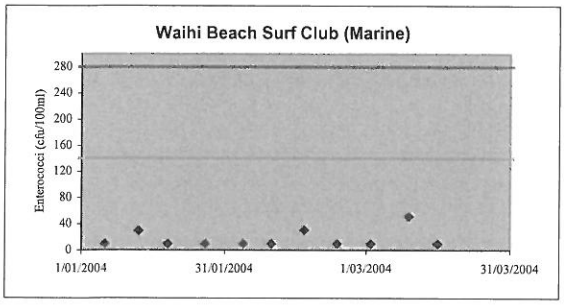
Rainfall Intensity Charts 5yr - 10min	
Urban	
Te Puna/Minden	122.2

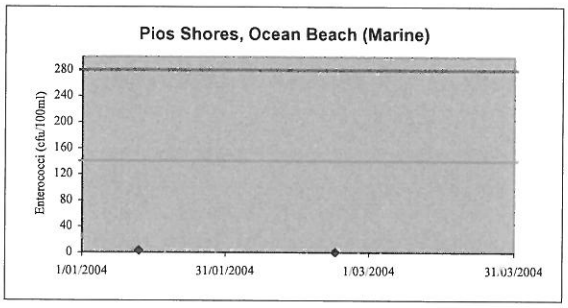
Western Bay of Plenty Non-Routine Analysis

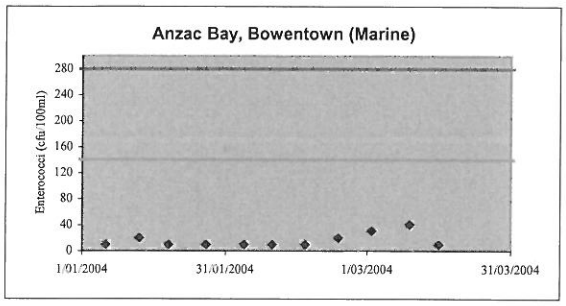
LabNumber	SampleDate	Sample	Catchment	Notes	Alkalinity - Total g CaCO3 /m³	Arsenic - Total g/m³	Arsenic - Total mg/Kg	Bicarbonate Alkalinity g CaCO3 /m³	Boron - Total g/m³	Cadmium - Total g/m³	Cadmium - Total mg/Kg	Calcium - Acid Soluble g/m³	Calcium - Total g/m³	Calcium Hardness g CaCO3 /m³	Chloride g/m³	Chromium - Total g/m³	Chromium - Total mg/Kg	Conductivity at 25°C mS/m	Copper - Acid Soluble g/m³	Copper - Total g/m³	Copper - Total mg/Kg	E. coli /100mL	E. coli cfu/100mL	Faecal Coliforms cfu/100ml	Fluoride g/m³	Iron - Acid Soluble g/m³	Iron - Total g/m³	Lead - Acid Soluble g/m³	Lead - Total g/m³	Lead - Total mg/Kg	Magnesium - Acid Soluble g/m³	Magnesium - Total g/m³	Manganese - Acid Soluble g/m³	Manganese - Total g/m³	Mercury - Total g/m³	Mercury - Total mg/Kg	Microscopic Examination	Moisture %	Nickel - Total g/m³	Nickel - Total mg/Kg	Nitrate - Nitrogen g/m³	Nitrite - Nitrogen g/m³	pH	Phosphorus - Total mg/Kg	Potassium - Total g/m³	Saturation Index	SemiVolatile Organic Compounds	Silica g/m³	Sodium - Total g/m³	Sulphate Total g/m³	Suspended Solids - Total g/m³	Temperature on arrival Deg C	Total (NP) Organic Carbon g/m³	Total Coliforms /100mL	Total Hardness g CaCO3 /m³	Total Petroleum Hydrocarbons	Total Solids %	Turbidity NTU	Zinc - Acid Soluble g/m³	Zinc - Total g/m³	Zinc - Total mg/Kg	Comments
Guideline Tricker Values						<0.042											<0.006		<0.0018									<0.0056									<0.013				7.2-7.8							<150				<15		<5.6	<0.015		
08/25238-01	12/9/2008	SW Discharge	TPN	Matahiwi Road, Te Puna Stormwater Outlet																																					6.6							<6					Attached						pre construction monitoring

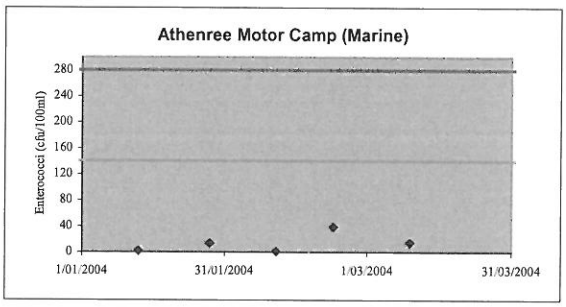
Recreational Water Qualty Monitoring 2003/2004 Bathing Season
Results from Sampling undertaken by Environment Bay of Plenty for the WBOPDC Area

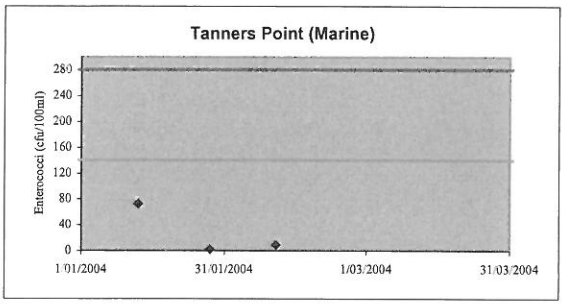
SURVEILLANCE, ALERT AND ACTION LEVELS FOR MARINE	
Safe Mode	Enterococci single sample <140 /100ml
Amber/Alert Mode	Enterococci single sample > 140 /100ml
Action/Red Mode	Enterococci 2 consecutive samples > 280 /100ml

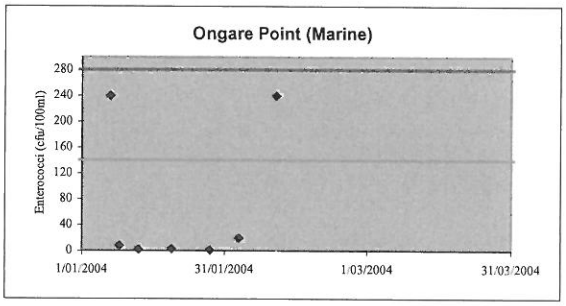


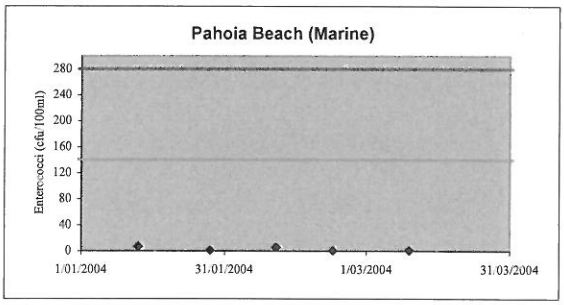


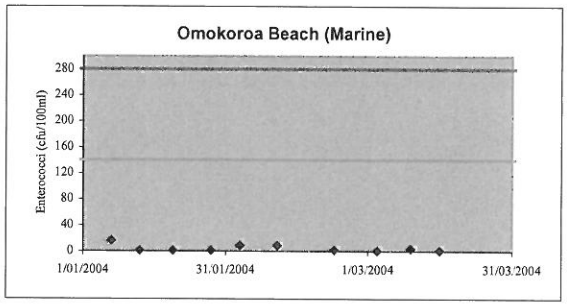


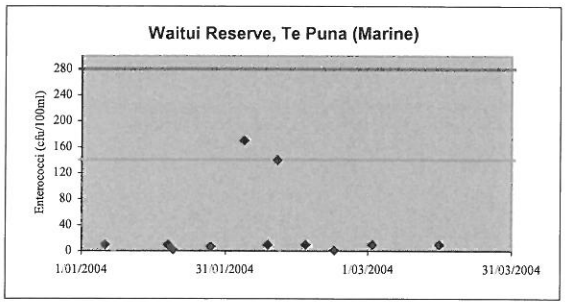


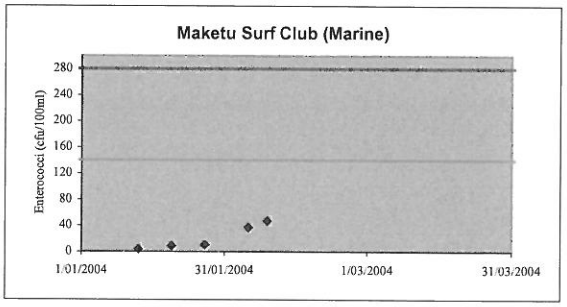




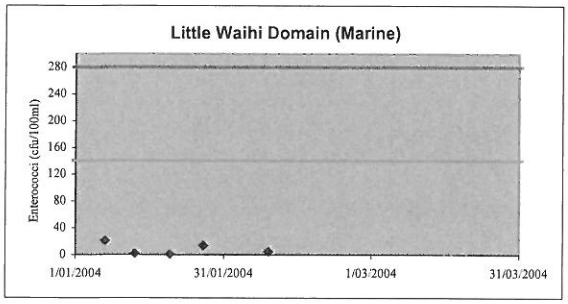


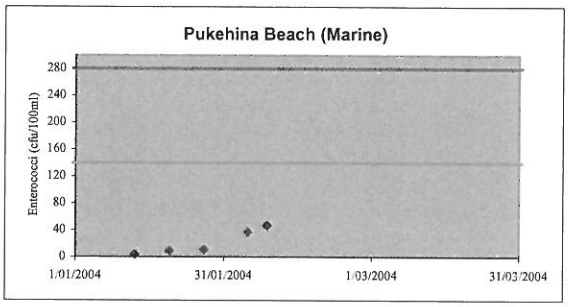




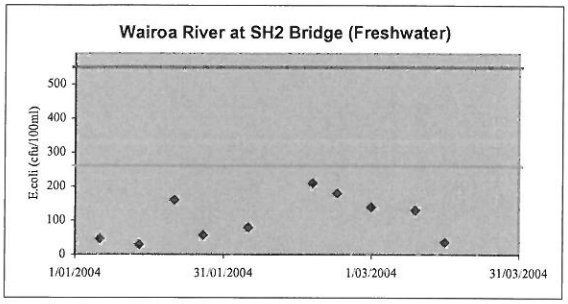


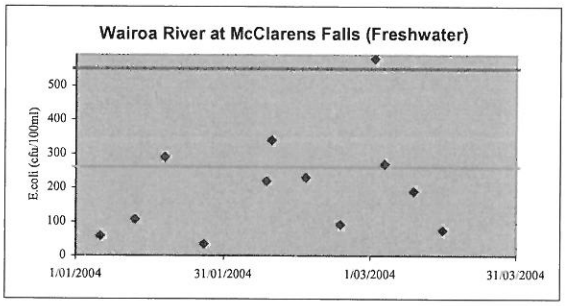
Recreational Water Qualty Monitoring 2003/2004 Bathing Season
Results from Sampling undertaken by Environment Bay of Plenty for the WBOPDC Area

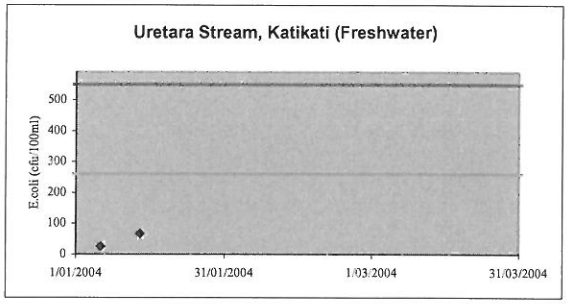


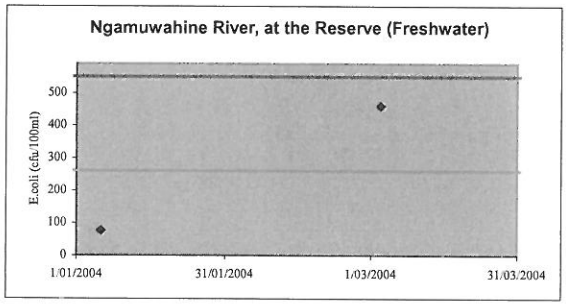


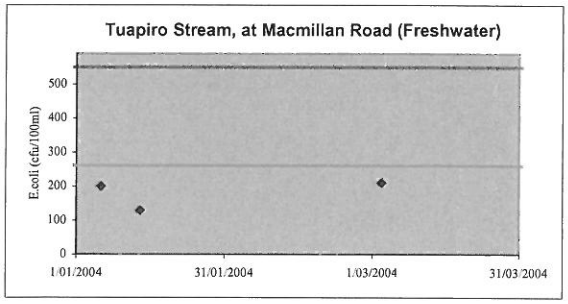
SURVEILLANCE, ALERT AND ACTION LEVELS FOR FRESHWATER	
Safe Mode	E.coli single sample <260 /100ml
Amber/Alert Mode	E.coli single sample > 260 /100ml
Action/Red Mode	E.coli 2 consecutive samples > 550 /100ml

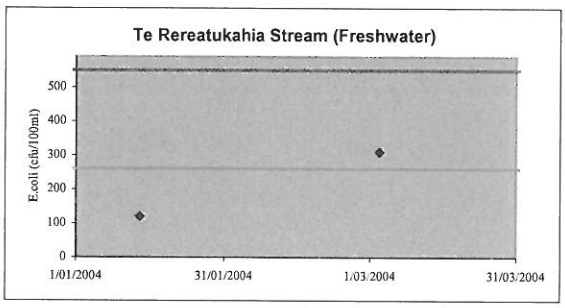






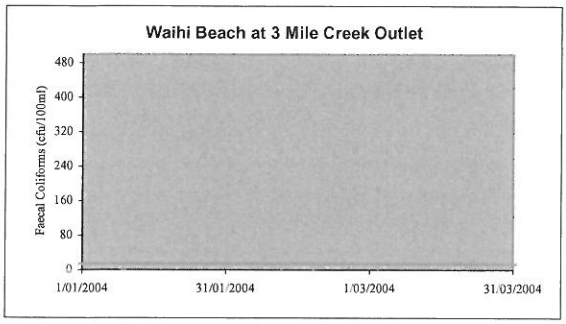


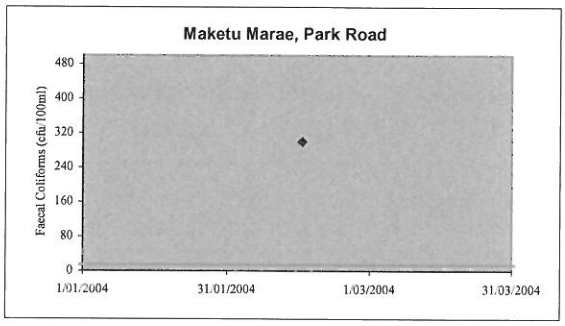


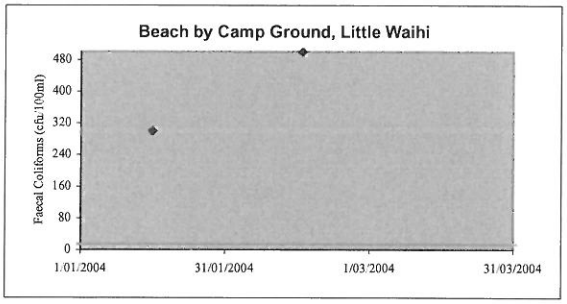


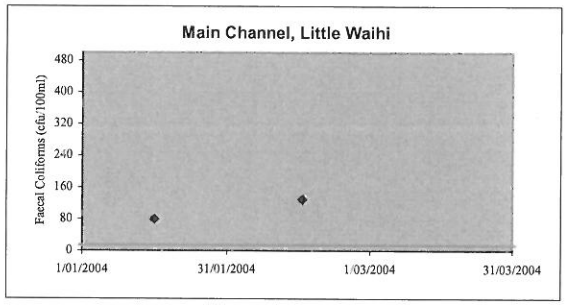
Shellfish Monitoring 2003/2004 Bathing Season
Results from Sampling undertaken by Environment Bay of Plenty for the WBOPDC Area

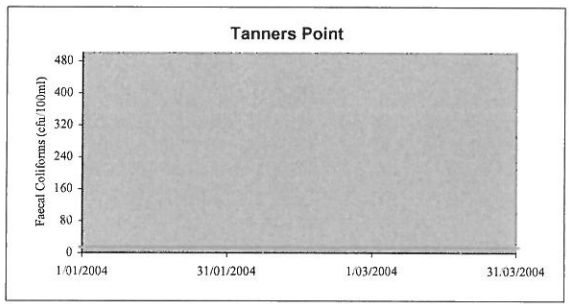
ALERT AND ACTION LEVELS FOR SHELLFISH	
Median over Bathing Season	Faecal Coliforms < 14MPN/100ml
Upper Limit	Faecal Coliforms < 10% samples > 43MPN/100ml











Recreational Water Qualty Monitoring 2004/2005 Bathing Season
Results from Sampling undertaken by Environment Bay of Plenty for the WBOPDC Area

SURVEILLANCE, ALERT AND ACTION LEVELS FOR MARINE	
Safe Mode	Enterococci single sample <140 /100ml
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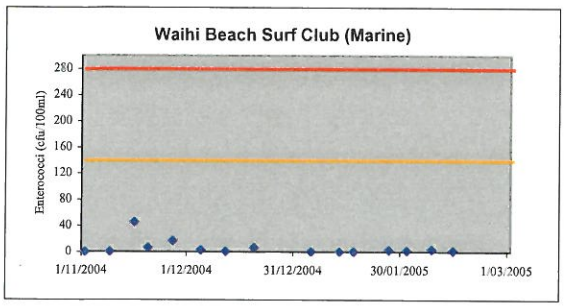
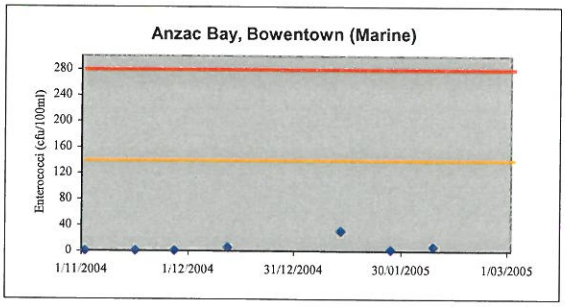
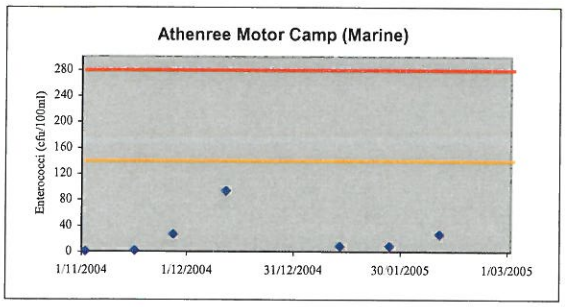
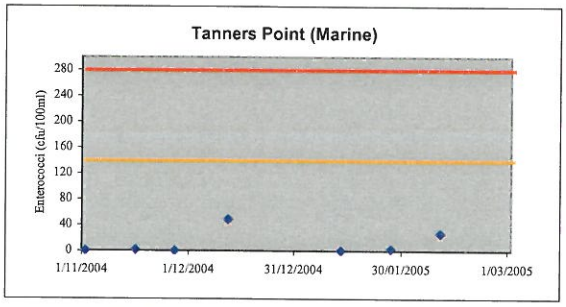
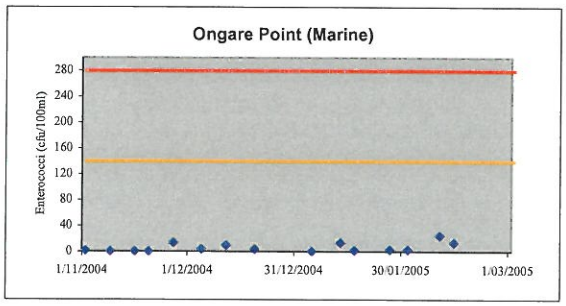
Action/Red Mode	Enterococci 2 consecutive samples > 280 /100ml

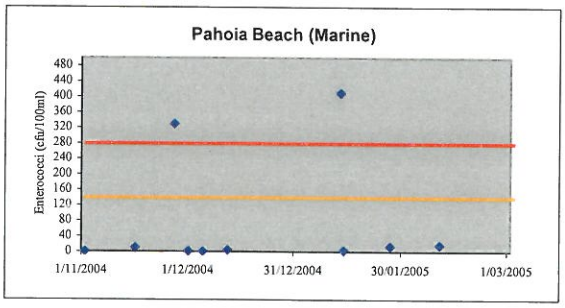


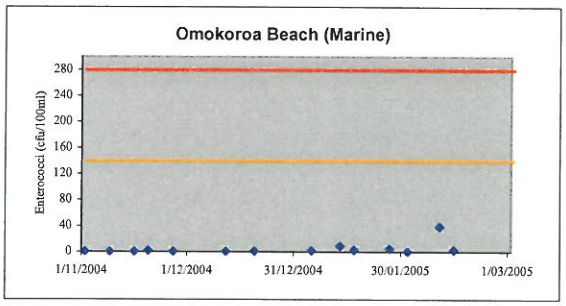


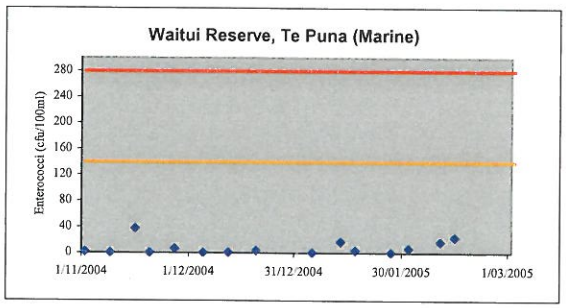


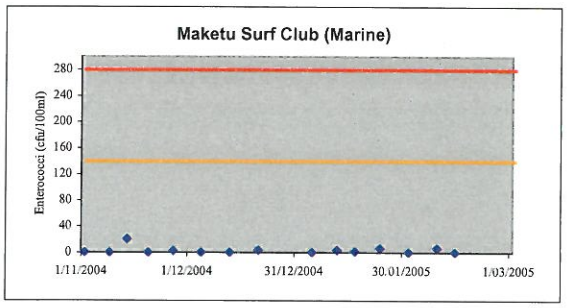


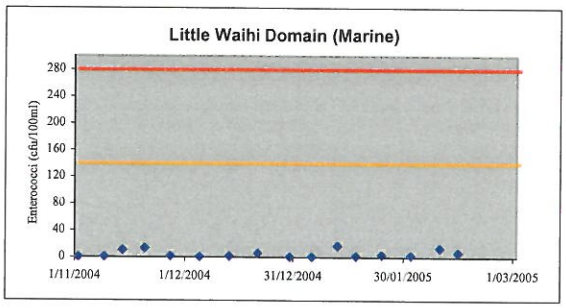




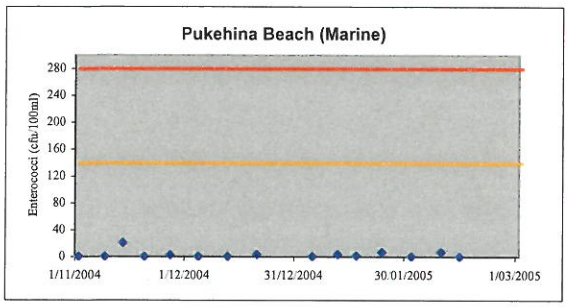








Recreational Water Qualty Monitoring 2004/2005 Bathing Season
Results from Sampling undertaken by Environment Bay of Plenty for the WBOPDC Area



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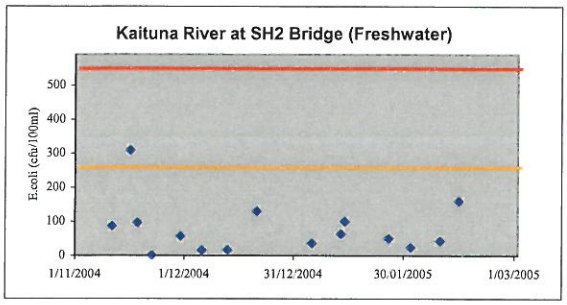

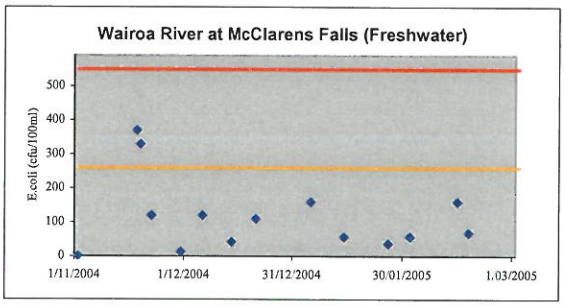

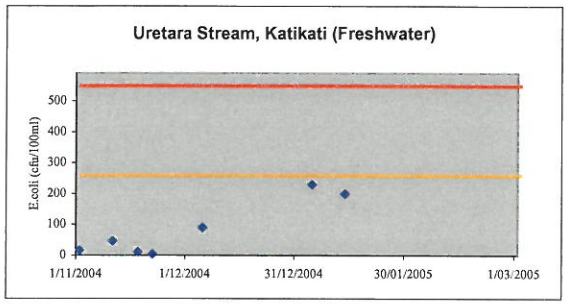

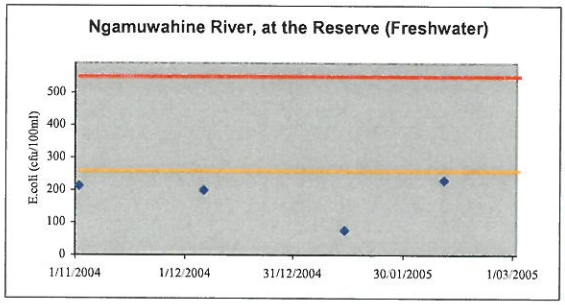

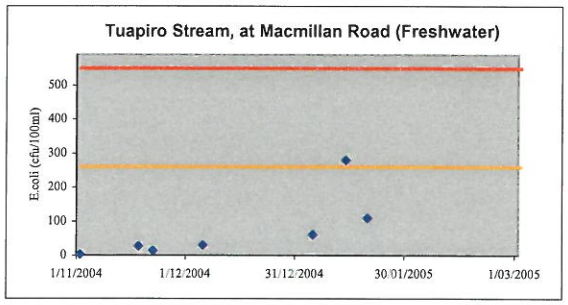

Recreational Water Qualty Monitoring 2005/2006 Bathing Season
Results from Sampling undertaken by Environment Bay of Plenty for the WBOPDC Area

SURVEILLANCE, ALERT AND ACTION LEVELS FOR MARINE	
Safe Mode	Enterococci single sample <140 /100ml
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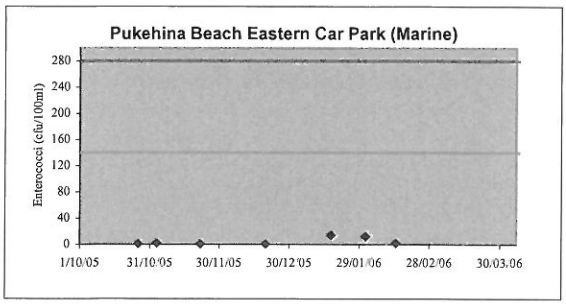
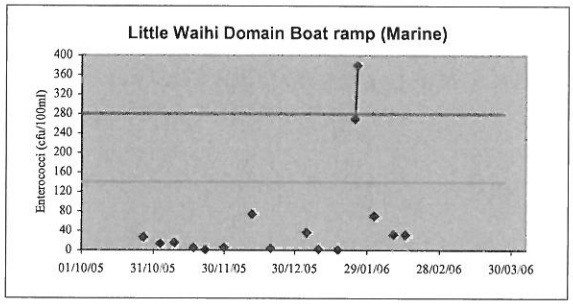
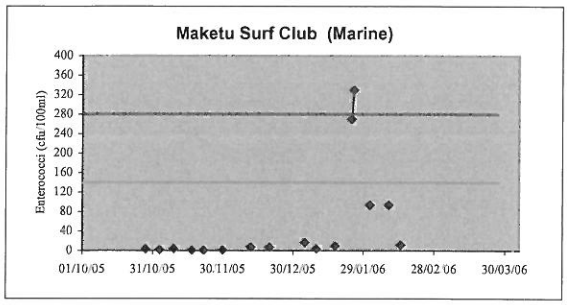
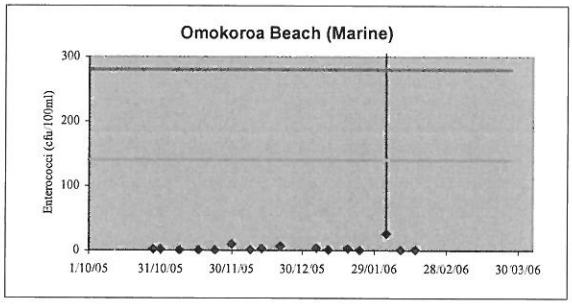
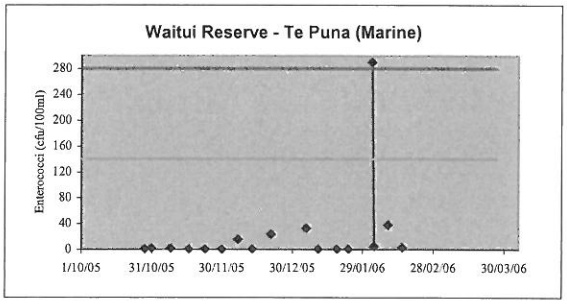
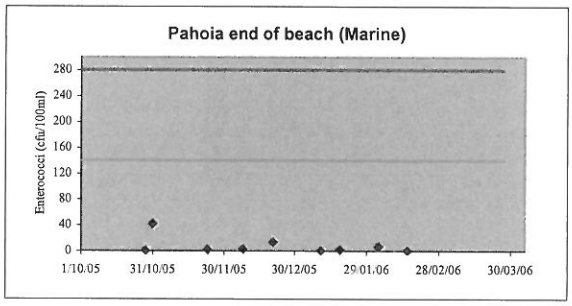


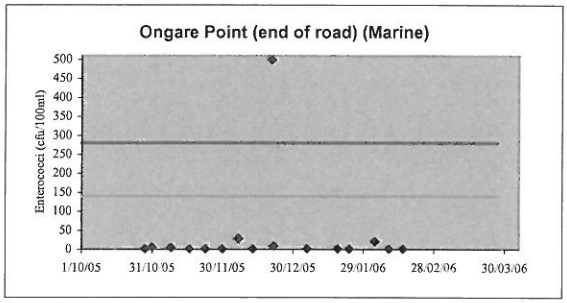


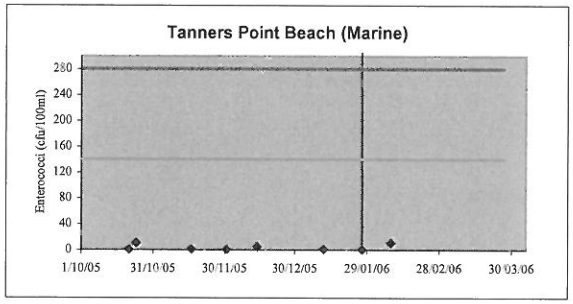


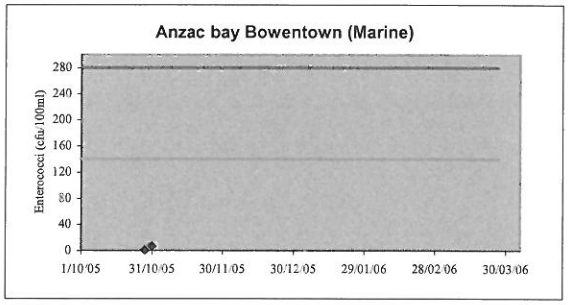


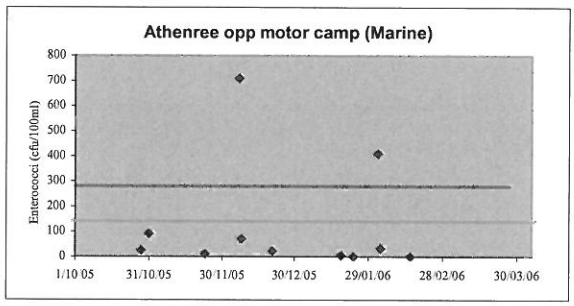




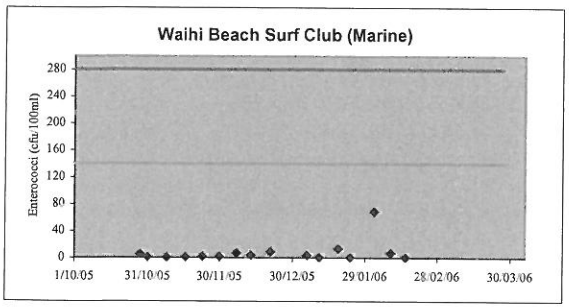


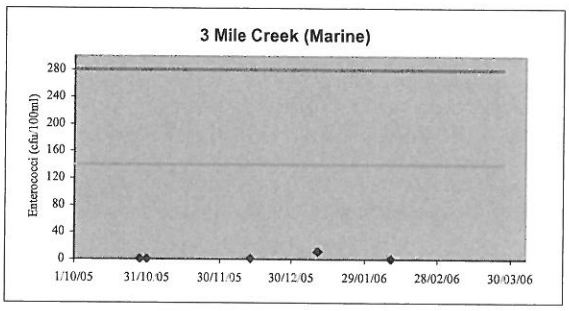






Recreational Water Qualty Monitoring 2005/2006 Bathing Season
Results from Sampling undertaken by Environment Bay of Plenty for the WBOPDC Area





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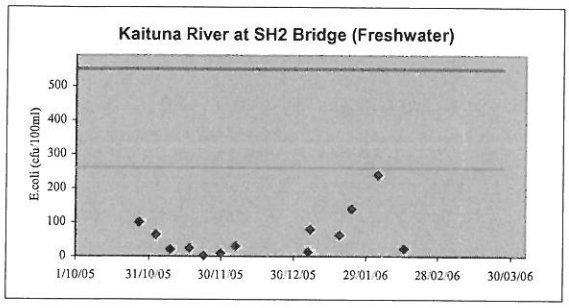
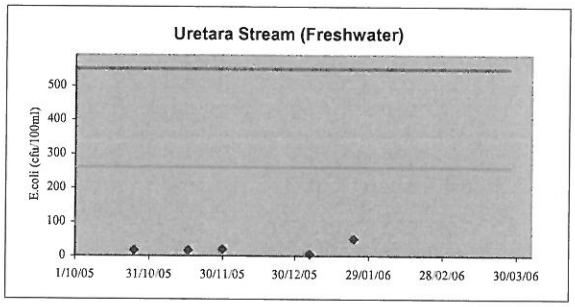
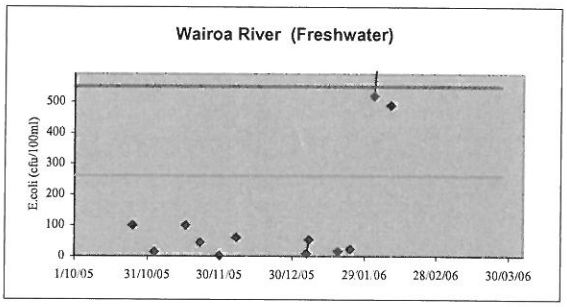
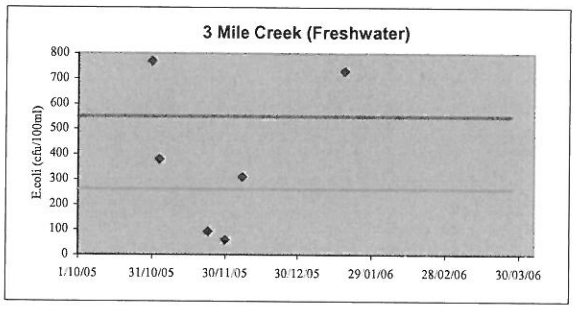
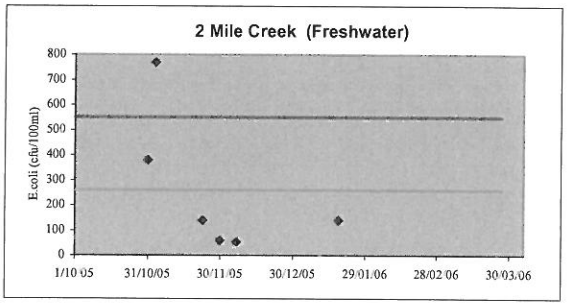
Action/Red Mode	E.coli 2 consecutive samples > 550 /100ml







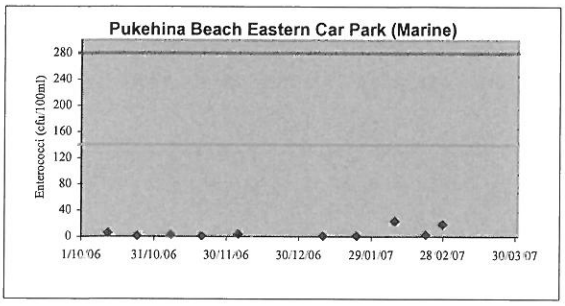


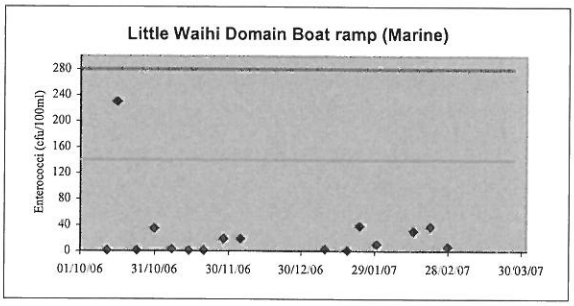


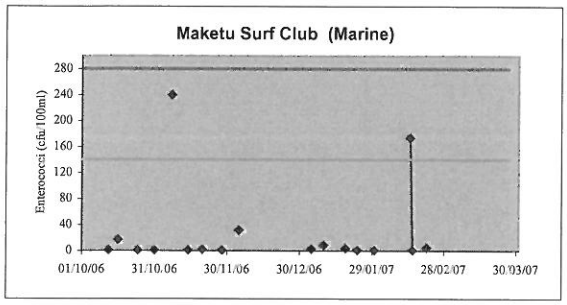
Note: EBOP does not intend any follow-up sampling for 3 Mile & 2 Mile Creeks this new bathing season as the sites are known problem areas. Warning signs erected permanently at these sites.

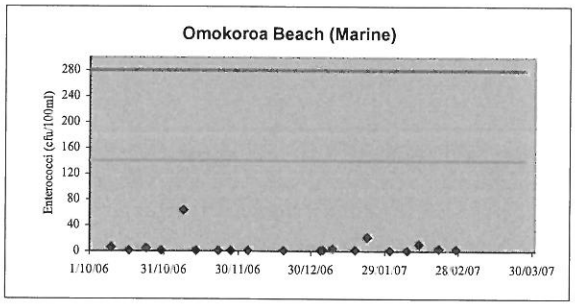
Recreational Water Qualty Monitoring 2006/2007 Bathing Season
Results from Sampling undertaken by Environment Bay of Plenty for the WBOPDC Area

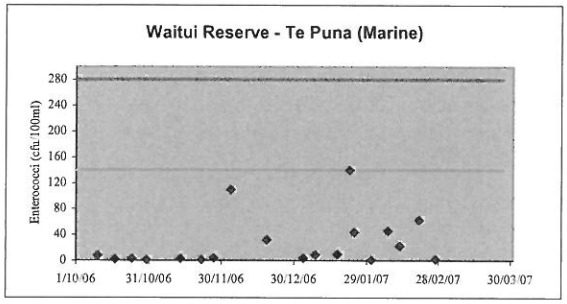
SURVEILLANCE, ALERT AND ACTION LEVELS FOR MARINE	
Safe Mode	Enterococci single sample <140 /100ml
Amber/Alert Mode	Enterococci single sample > 140 /100ml
Action/Red Mode	Enterococci 2 consecutive samples > 280 /100ml

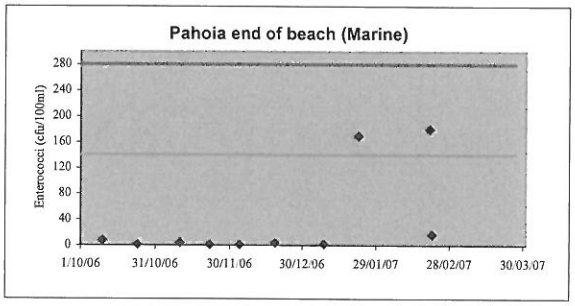


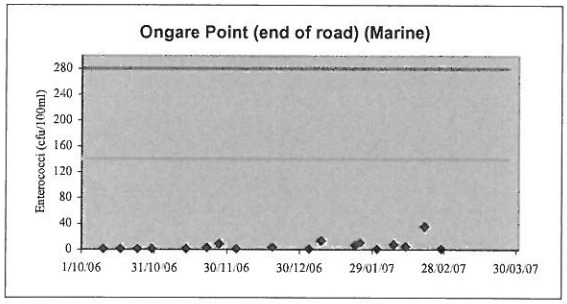


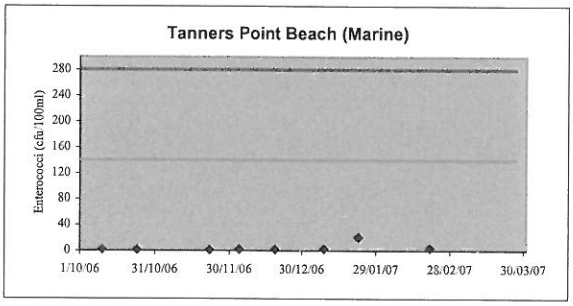


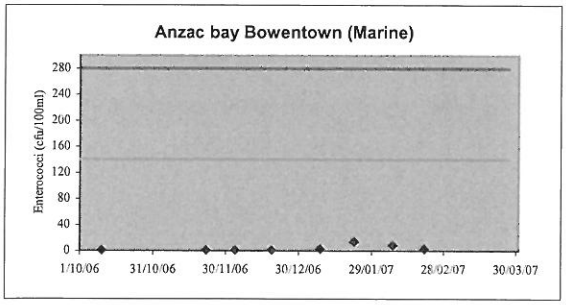


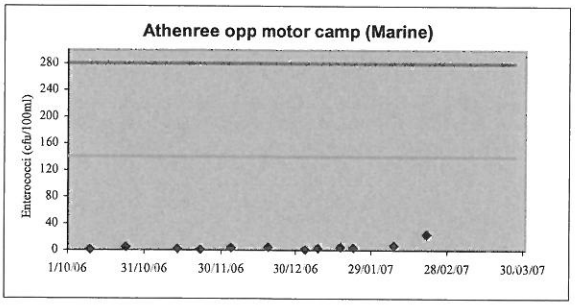




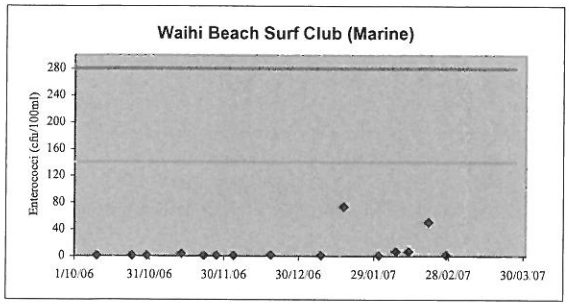


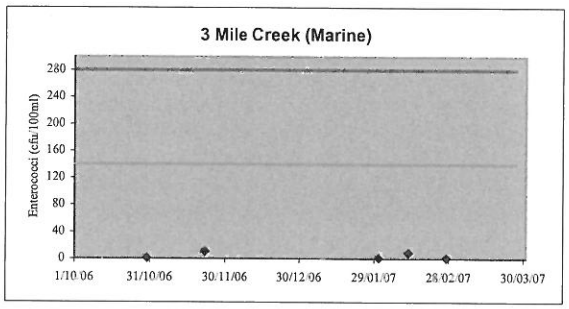




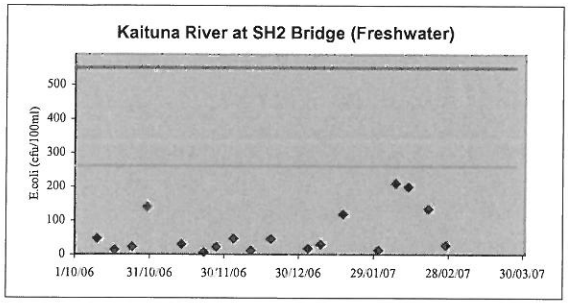


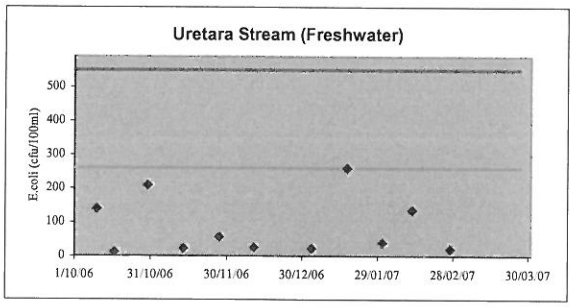
Recreational Water Qualty Monitoring 2006/2007 Bathing Season
Results from Sampling undertaken by Environment Bay of Plenty for the WBOPDC Area

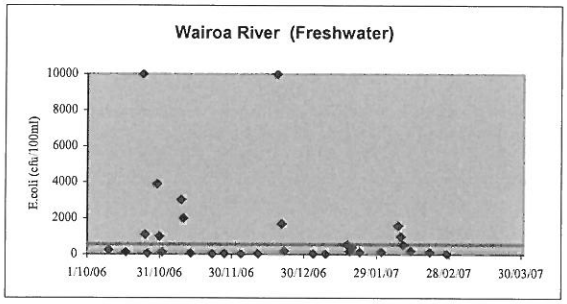


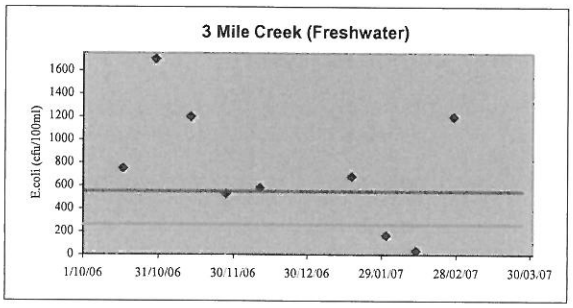


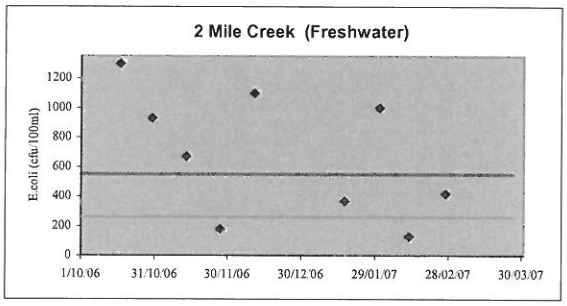
SURVEILLANCE, ALERT AND ACTION LEVELS FOR FRESHWATER	
Safe Mode	E.coli single sample <260 /100ml
Amber/Alert Mode	E.coli single sample > 260 /100ml
Action/Red Mode	E.coli 2 consecutive samples > 550 /100ml







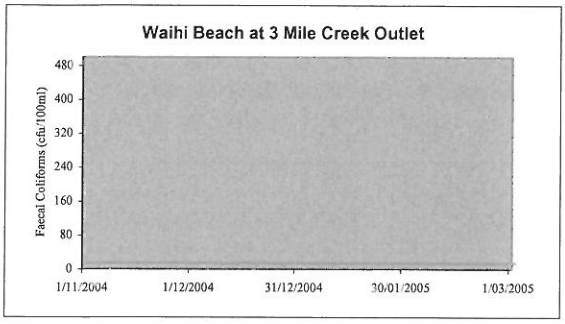


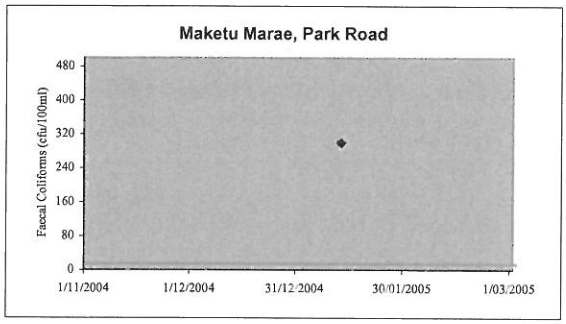


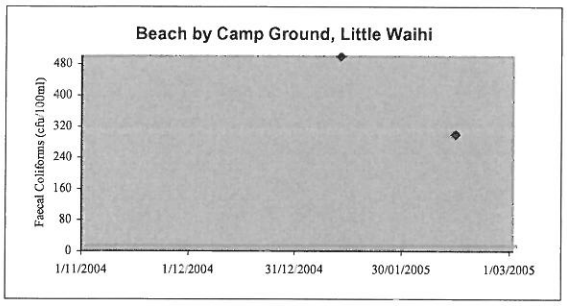
Note: EBOP is investigating the source of the contamination of 2 & 3 Mile Creeks. Four permanent health warning signs were erected to warn the public not to swim in the creeks. Toi te ora Public Health instructed WBOPDC to erect Temporary Health Warning signs at McLaren falls, Ngamuwahine and Pahoia estuary off Pahoia Beach Road during the month of November. No further Temporary Health Warning signs erected as exceedances were traced to heavy rainfall prior to sampling. During February, five 'Water Quality Advice' signs were erected in different locations along the Wairoa river and at McLarens falls.

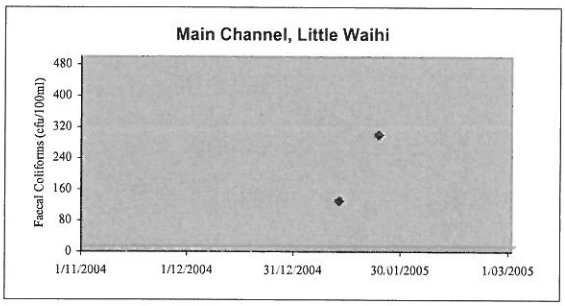
Shellfish Monitoring 2006/2007 Bathing Season
Results from Sampling undertaken by Environment Bay of Plenty for the WBOPDC Area

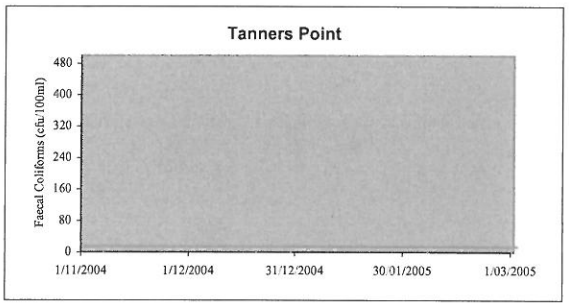
ALERT AND ACTION LEVELS FOR SHELLFISH	
Median over Bathing Season	Faecal Coliforms < 14MPN/100ml
Upper Limit	Faecal Coliforms < 10% samples > 43MPN/100ml











RESULTS - WESTERN BAY OF PLENTY Marine Sites

Site	Description	BOP Site Number	Week 16/10/2007	23/10/2007	30/10/2007	7/11/2007	14/11/2007	15/11/2007	21/11/2007	22/11/2007	27/11/2007	28/11/2007	29/11/2007	4/12/2007	11/12/2007	12/12/2007	18/12/2007	3/01/2008	8/01/2008
Pukehina Beach	Pukehina	160015	21		0.5			<1			19				4				<1
Little Waihi Domain Boat Ramp	Little Waihi	160016	2	46	0.5	100		2	1		210	160	3		2		290		9
Maketu Surf Club	Maketu	160017	20	1	1	<1		<1	1		11				237	6	33		<1
Omokoroa Beach	Omokoroa	160022	0.5	1	0.5	<1	4			2		6		1		9	<1		
Waitui Reserve	Te Puna	800087	3	1	67	<1	6			<1		800	<1	2		15	2		
Pahoia End of Beach	Pahoia	160023	2		37		19					34				3			
Ongare Point End of Ongare Point Road	Ongare Pt	160032	1	0.5	120	2	1					290	140	<1		7	<1		
Tanners Point Beach	Tanners Pt	160031	2		1		1					56				13			
Anzac Bay Bowentown Domain	Anzac Bay	160028	2		1		6					64				7		4	
Athenree Opposite Motor Camp	Athenree	160030	14		2		3					400	47			17			
Waihi Beach Surf Club	Waihi Beach	160027	22	1	2	<1	<1			<1		<1		<1		<1	<1	2	
Waihi Beach	3 Mile Creek	900077		2		61				2		4					1		

Safe mode:		Enterococci single sample <140 /100ml
Alert/amber mode :		Enterococci single sample > 140 /100ml
Action/red mode:		Enterococci 2 consecutive samples > 280 /100ml

RESULTS - WESTERN BAY OF PLENTY Marine Sites

Site	Description	BOP Site Number	Week 16/10/2007	23/10/2007	30/10/2007	7/11/2007	14/11/2007	9/01/2008	14/01/2008	15/01/2008	16/01/2008	29/01/2008	30/01/2008	16/01/2008	23/01/2008	29/01/2008	30/01/2008	7/02/2008	11/02/2008	########
Pukehina Beach	Pukehina	160015	21		0.5										8					
Little Waihi Domain Boat Ramp	Little Waihi	160016	2	46	0.5	100					64	8		64	400	8				14
Maketu Surf Club	Maketu	160017	20	1	1	<1					16	2		16	9	2				2
Omokoroa Beach	Omokoroa	160022	0.5	1	0.5	<1	4	16					<1				<1	2	11	
Waitui Reserve	Te Puna	800087	3	1	67	<1	6	69	<1				<1				<1	210	2	
Pahoia End of Beach	Pahoia	160023	2		37		19	230										7		
Ongare Point End of Ongare Point Road	Ongare Pt	160032	1	0.5	120	2	1	130	200	310			<1	<1			<1	4	2	
Tanners Point Beach	Tanners Pt	160031	2		1		1	19										17		
Anzac Bay Bowentown Domain	Anzac Bay	160028	2		1		6	3										1		
Athenree Opposite Motor Camp	Athenree	160030	14		2		3	3	1									21		
Waihi Beach Surf Club	Waihi Beach	160027	22	1	2	<1	<1	0	6				<1				<1	1	17	
Waihi Beach	3 Mile Creek	900077		2		61							6				6		9	

Safe mode:		Enterococci single sample <140 /100ml
Alert/amber mode :		Enterococci single sample > 140 /100ml
Action/red mode:		Enterococci 2 consecutive samples > 280 /100ml

RESULTS - WESTERN BAY OF PLENTY Marine Sites

Site	Description	BOP Site Number	Week 16/10/2007	23/10/2007	30/10/2007	7/11/2007	14/11/2007	19/02/2008	20/02/2008	21/02/2008	27/02/2008	28/02/2008	4/03/2008	5/03/2008	6/03/2008	12/03/2008	13/03/2008
Pukehina Beach	Pukehina	160015	21		0.5				11						2		
Little Waihi Domain Boat Ramp	Little Waihi	160016	2	46	0.5	100			61		7				24		3
Maketu Surf Club	Maketu	160017	20	1	1	<1			<1		<1				<1		18
Omokoroa Beach	Omokoroa	160022	0.5	1	0.5	<1	4	2				1	94			<1	
Waitui Reserve	Te Puna	800087	3	1	67	<1	6	1				2	6			6	
Pahoia End of Beach	Pahoia	160023	2		37		19	3					34				
Ongare Point End of Ongare Point Road	Ongare Pt	160032	1	0.5	120	2	1		16			7	66			4	
Tanners Point Beach	Tanners Pt	160031	2		1		1		7				61				
Anzac Bay Bowentown Domain	Anzac Bay	160028	2		1		6		180	3			53				
Athenree Opposite Motor Camp	Athenree	160030	14		2		3		200	<1			480	14			
Waihi Beach Surf Club	Waihi Beach	160027	22	1	2	<1	<1		153	7		19	120			4	
Waihi Beach	3 Mile Creek	900077		2		61						27				1	

Safe mode:		Enterococci single sample <140 /100ml
Alert/amber mode :		Enterococci single sample > 140 /100ml
Action/red mode:		Enterococci 2 consecutive samples > 280 /100ml

RESULTS - WESTERN BAY OF PLENTY River Sites

Site	Description	BOP Site Number	Date 16/10/2007	18/10/2007	23/10/2007	24/10/2007	30/10/2007	7/11/2007	14/11/2007	22/11/2007	23/11/2007	28/11/2007	4/12/2007	7/12/2007	11/12/2007	12/12/2007	13/12/2007	14/12/2007	########	3/01/2008
Kaituna River	Te Matai Rail Bridge	160129	27		16		24	53	17	17		4	21			70		38	153	
Uretara Stream	Katikati	160123	650	37	290	63		150		70			<1					93		
Wairoa River	below McLaren Falls Dam	160124	230		87		61	210	200	57		46	33			210	42	28		63
Ngamuwahine River	at Reserve	160125			40			57					50							
Tuapiro Stream	McMillan Road	160126			83			120		37			67						137	
3 Mile Creek	Waihi Beach	110042			1100			580		830	370		210							
2 Mile Creek	Waihi Beach	110043			2600			840		280	970		220							
Kaiate Stream	Kaiate Falls	160130											840	5100	600	770	1200			210

Safe mode:	E. coli single sample < 260 /100ml
Alert/amber mode I:	E. coli: single sample > 260 /100ml
Action/red mode:	E. coli single sample > 550 /100ml

RESULTS - WESTERN BAY OF PLENTY River Sites

Site	Description	BOP Site Number	Date 16/10/2007	18/10/2007	23/10/2007	8/01/2008	9/01/2008	14/01/2008	16/01/2008	17/01/2008	18/01/2008	23/01/2008	25/01/2008	29/01/2008	30/01/2008	7/02/2008	11/02/2008	13/02/2008	14/02/2008	19/02/2008
Kaituna River	Te Matai Rail Bridge	160129	27		16	41		38				260			74	63			41	13
Uretara Stream	Katikati	160123	650	37	290		280	93												
Wairoa River	below McLaren Falls Dam	160124	230		87		27	28					100		71	17	203			56
Ngamuwahine River	at Reserve	160125			40		19						290	87			220			
Tuapiro Stream	McMillan Road	160126			83		23										220	193		
3 Mile Creek	Waihi Beach	110042			1100		540										123			
2 Mile Creek	Waihi Beach	110043			2600		870										71			
Kaiate Stream	Kaiate Falls	160130				186			460	370	700	2000			140				370	

Safe mode:	E. coli single sample < 260 /100ml
Alert/amber mode I:	E. coli: single sample > 260 /100ml
Action/red mode:	E. coli single sample > 550 /100ml

RESULTS - WESTERN BAY OF PLENTY River Sites

Site	Description	BOP Site Number	Date 16/10/2007	18/10/2007	23/10/2007	20/02/2008	27/02/2008	28/02/2008	4/03/2008	5/03/2008	12/03/2008	13/03/2008
Kaituna River	Te Matai Rail Bridge	160129	27		16		19			47		42
Uretara Stream	Katikati	160123	650	37	290			19			260	220
Wairoa River	below McLaren Falls Dam	160124	230		87			180	930	21	40	
Ngamuwahine River	at Reserve	160125			40			14			130	
Tuapiro Stream	McMillan Road	160126			83			186			100	
3 Mile Creek	Waihi Beach	110042			1100							
2 Mile Creek	Waihi Beach	110043			2600							
Kaiate Stream	Kaiate Falls	160130				940	260		520			530

Safe mode:	E. coli single sample < 260 /100ml
Alert/amber mode 1:	E. coli: single sample > 260 /100ml
Action/red mode:	E. coli single sample > 550 /100ml

Results - Shellfish

Site	Description	Date	9/10/2007	8/11/2007	6/12/2007	7/01/2008	7/02/2008				
Wiaotahi Beach	Estuary	160008									
Ohiwa Harbour	Uretara Channel	900028									
Ohiwa Harbour	Eastern Ohiwa	600005									
Little Waihi	Beach by campground*	900302	300	130	20	130	140				
Little Waihi	Boat Ramp	160016									
Maketu	Marae end of Park Road	900301									
Tauranga Harbour	Tilby Pt*	900032	8	23	4	2	50				
Tauranga Harbour	Pilot Bay*	900304	1	23	<2	2	3000				
Tauranga Harbour	Tanners Point	900091									
Tauranga Harbour	Pio's Beach^	900048	13	80	240	30	500				
Tauranga Harbour	Pio's Beach Yellow Pt	900020									
Tauranga Harbour	Hunter Creek	900029									
Tauranga Harbour	Te Puna @	900035	140	240	9000	170	5000				
Tauranga Harbour	Te Puna2 #	900075	170	240	170	2					
Waihi Beach	2 & 3 Mile Creeks	900077									

Faecal Coliform Content /100g flesh
as per the ' Bay of Plenty Regional Coastal Environment Plan', 2003
& based on the Ministry for Food & Health guideline.

m = 230 — m = (FC) acceptable levels and levels above it are marginally acceptable or unacceptable.
M = 330 — M = (FC) values above M are unacceptable

Species Code

* *Pipi*
^ *Cockle*
\# *Horse muscles*
@ *Oysters*