Effluent discharge receiving water impact report 2008

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Executive summary

Major industrial and municipal effluent discharges in the Bay of Plenty have the potential to degrade the receiving environment through a number of mechanisms. Water quality and consent monitoring has helped determine if discharge activities are impacting on the environment.

The objective of this report is to assess the impact of these major discharges on a variety of Bay of Plenty receiving environments.

The following points summarise the findings of analyses undertaken using a variety of compliance and environmental monitoring data:

- *Ballance Agri-Nutrients Limited, Mount Maunganui* - Elevated levels of contaminants near outfalls in the Port area, Tauranga Harbour, although within guideline levels. Shellfish and sediment monitoring shows no appreciable impact attributable to these sources.

- *AFFCO and Te Puke WWTP* - There is some degradation of water quality in the Kaituna River. Nutrient and indicator bacteria levels are increasing, with indicator bacteria levels sometimes above recommended guideline levels.

- *Tasman Industrial Complex* - Colour, BOD and dissolved oxygen concentrations have improved in the past few years in the Tarawera River. However, the limits for colour set in the Regional Plan for the Tarawera River Catchment are not being met.

- *Fonterra, Edgecumbe* - Sewage fungus growth has been increasing in the Rangitaiki River as increased lactose has been discharged to the river. Foam from the discharge is also an issue.

- *CHH Paperboard Whakatane Mill* - Monitoring in the Whakatane River Estuary and comparison of monitoring in the river above the mill discharge reveals no adverse impacts on water quality attributable to the mill discharge.

- *WWTP Marine Effluent Outfalls* - Bacterial monitoring adjacent to marine outfalls shows that at present there is little risk to bathing water quality at nearby beaches. Bacteria concentrations in shellfish near the Ohope outfall have been elevated at times to levels unacceptable for human consumption.

In some cases the monitoring strategies employed for compliance and environmental monitoring purposes fail to provide sufficient information to assess the impacts of industrial and municipal discharges. A range of recommendations are given to help in these situations including increased monitoring frequency and alternative monitoring sites.

Contents

Tables and Figures

Chapter 1: Introduction

Environment Bay of Plenty's compliance and impact monitoring policy was reviewed in 2001 and is set out in Environmental Report 2001/02. As well as compliance monitoring of resource consents the document outlines specific impact monitoring sites. Table 1 describes the sites that are monitored. These sites have been selected to focus on areas of the region where major discharges to water take place.

Major industrial and treated effluent discharges in the Bay of Plenty have the potential to degrade the receiving environment through a number of mechanisms. Water quality and consent monitoring has helped determine if discharge activities are impacting on the environment.

The objective of this report is to assess the impact of resource users on the receiving environments that are monitored.

Table 1 Description of Environment Bay of Plenty's Impact Monitoring Programme

System	Sites	Comment
Tauranga Harbour	Otumoetai foreshore, Tauranga Bridge Marina.	Sites in the vicinity of Port of Tauranga and Ballance Agri-Nutrients Limited.
Kaituna River	AFFCO water intake, Te Matai, Te Tumu.	A sample is taken upstream of the AFFCO effluent outflow, at the State Highway 2 Bridge and at the mouth of the river.
Tarawera River	Kawerau, SCA Footbridge, Onepu, State Highway 30 Bridge, Awakaponga.	These sites monitor the effects of discharges from the Kawerau District Council treated effluent and Pulp and Paper Industry at Kawerau.
Rangitaiki River	Edgecumbe Bridge, Downstream of Fonterra, Edgecumbe.	Monitors the effects of Fonterra, Edgecumbe effluent discharge to the river.
Bay of Plenty coastal waters	Ohope, Tauranga/Mount Maunganui, Matakana Island.	Self monitoring results from District Council marine treated sewage effluent outfalls.
Whakatane River	Water Treatment Plant Quay Street, Whakatane Estuary.	These sites monitor the effects of discharges from the Pulp and Paper Industry at Whakatane.

Data is presented in graphical form or summarised in tabulated form. The whole data sets are not presented but are available from Environment Bay of Plenty on request. Sampling is undertaken at intervals and the use of line graphs is for the sake of presentation. Continuous monitoring is not implied.

Data and data trends are in some cases presented graphically with a seasonal regression, residuals and residuals regression. In these cases data was interpreted using LakeWatch software to deseasonalise the data and test the probability that there is a statistically significant trend. This is related in terms of the p-value. P-values are expressed as proportions (e.g. 0.05) and if the p-value is 0.05 or less then a deseasonalised trend is regarded as statistically significant. The trend calculated for the data set is only representative of the data over the given period analysed. Data analysed in this way is plotted with original data and the residuals, which represent the deseasonalised data and data trend.

Chapter 2: Impact site investigation

2.1 Tauranga Harbour Port area

Two sites are used to monitor any impacts on discharges from industrial sites around the Tauranga Port area. Sites are monitored for a range of physico-chemical parameters, nutrients, suspended solids, and photosynthetic productivity (chlorophyll-a).

Figure 2.1.1 Site location photo, Tauranga Harbour.

Activities around the Port and industrial premises comprise a variety of industries, the two biggest being timber industry related and fertiliser production from Ballance Agri-Nutrients Limited. Discharges from these industries include suspended solids, organics, nutrients, fluoride, and heavy metals.

2.1.1 Results

Figure 2 compares results from two monitoring sites within the Port Tauranga vicinity (Figure 2.1.1). One site is located close to the central channel (BOP150021) and the other site at the Whanaroa Point boat ramp (BOP73024) in a channel that has been shown to contain preferential flow paths for stormwater outlets from around the east side of the Port (Bioresearches 2002). Sampling has occurred predominantly on an incoming tide.

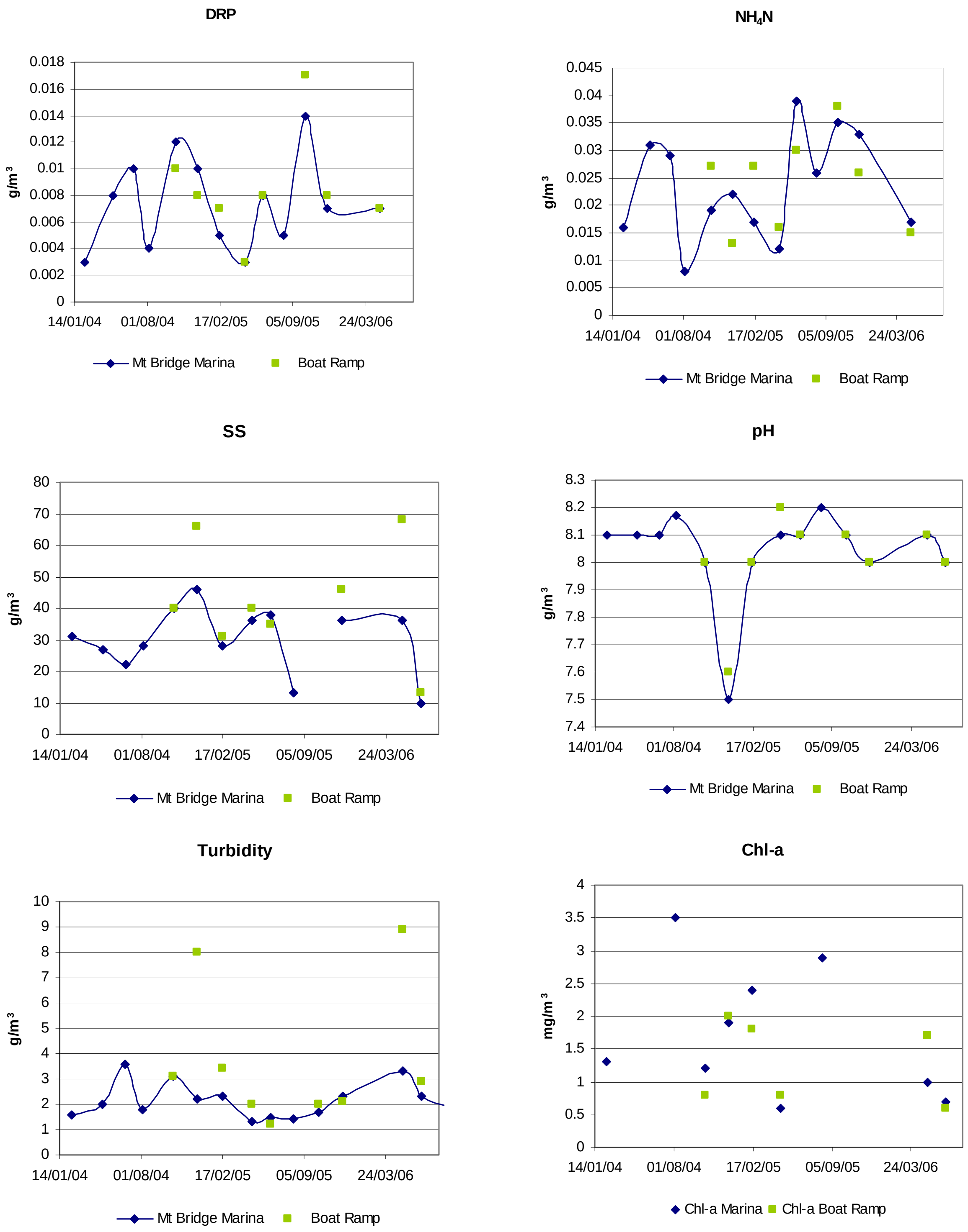
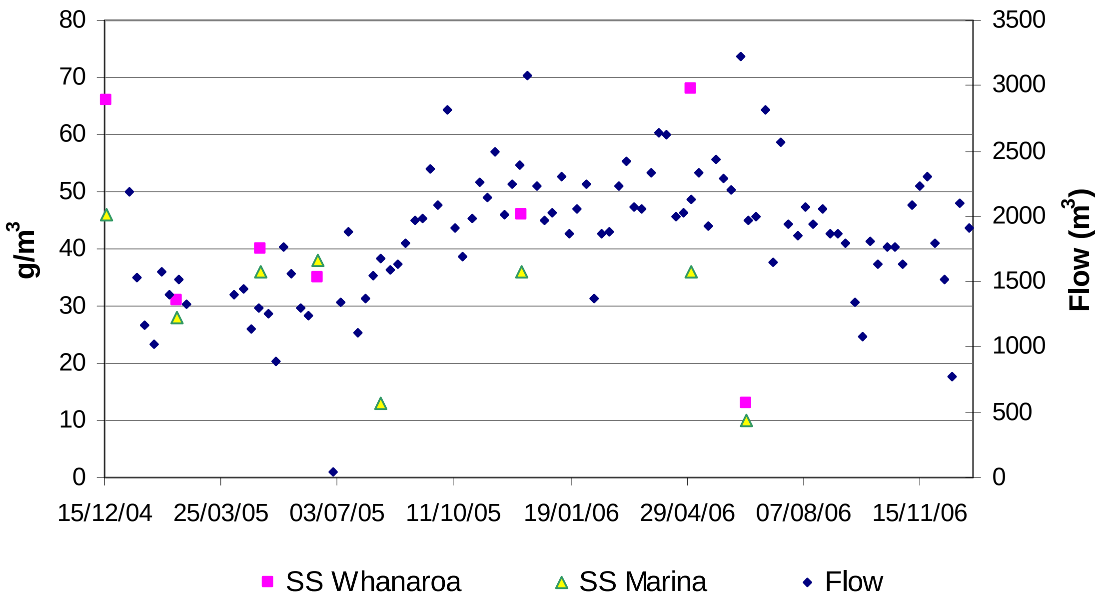


Figure 2.1.2 Water quality parameters at sites Whanaroa boat ramp and Mount Marina, Tauranga Harbour, 2006 to 2006.

Dissolved reactive phosphorus (DRP) results for both sites follow a similar pattern over time. Such a pattern would suggest a uniform distribution of DRP in this area. Trend analysis of DRP data from the marina site shows no significant trend in the data with an average DRP of 0.008 g/m^3. This average is similar to an average DRP concentration for the Town Basin and below the 80th percentile for DRP data is shown in the NERMN Estuarine Water Quality Report 2005.

Comparison of ammonium-nitrogen (NH_4-N) data between the marina and Whanaroa boat ramp sites (Figure 2.1.2) shows concentrations to be more variable than DRP, but concentrations are generally of a similar level. Like DRP, ammonium-nitrogen data at the marina site show no significant trend over time and are relatively stable at an average concentration of 0.027 g/m^3.

Suspended solids and turbidity has only fluctuated between the sites significantly on two occasions (Figure 2.1.2). On these two occasions high wind and/or heavy rain were present or occurred before sampling. The presence of an increase in turbid fresh water in the estuary can be seen on one of these occasions due to fluctuation in the pH level. An input of freshwater at this time is the likely cause of elevated turbidity and suspended solids at the boat ramp site. Elevated suspended solids also increase with higher wind speeds (Scholes, 2004) and this phenomenon may give rise to a recent trend of increasing suspended solids concentrations over time at the marina site (Figure 2.1.3). However, there has been a steady increase in the volume of wastewater and suspended solids discharged from Ballance Agri-Nutrients site. Figure 2.1.4 suggest some correlation between rising suspended solids concentrations at the marina site and the increased wastewater discharge. Although recent data shows SS levels to have decreased at the marina site while SS loading from the discharge has increased. Also, as SS concentrations have been increasing and decreasing at the marina site, turbidity remains relatively stable. This suggests sand size particles are being stirred up in the estuary rather than colloidal or silt particles being added to the



environment.

Figure 2.1.3 Suspended solids concentrations at the Marina and Whanaroa boat ramp sites and wastewater discharge flow from Ballance Agri-Nutrients.

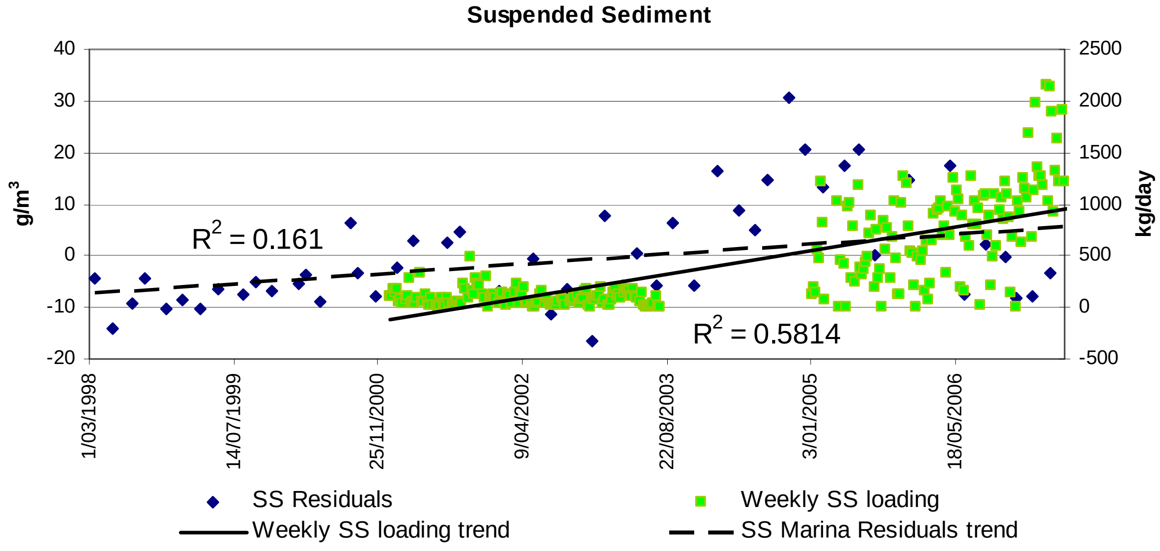


Figure 2.1.4 Deseasonalised residuals for SS data for the Marina site and wastewater suspended solids loading, 1998 to 2007.

Chlorophyll-a concentrations are generally similar between both sites (Figure 2.1.2). The marina site does have a significant increasing trend in chlorophyll-a (0.12 $mgm^{-3} yr^{-1}$, p=0.013) and it is likely that the boat ramp site is experiencing a similar increase. This is contrary to a decreasing trend of chlorophyll-a concentrations in the town basin.

As part of the consents Balance Agri-Nutrients Limited hold there is a requirement to monitor constituents in the discharges and to do sediment and shellfish monitoring of the adjacent estuary. Constituents such as cadmium, chromium, and mercury have only been present in discharges at low levels. Only zinc levels have shown to be discharged at levels above the average, and only on two occasions in the last eight years (Figure 2.1.5).

Potential impacts of these discharge constituents have been assessed by monitoring sediment and shellfish at several sites in the Waipu Estuary and compared with a control site on the inlet of the Waikareao Estuary. Four contaminants are assessed in the sediments: zinc; cadmium; phosphorus; and fluoride. In monitoring of the sediments from 1983 to 2006, on average zinc concentrations in the intertidal zone have been marginally higher than the control site. However, both intertidal and subtidal sites have, on average, zinc concentrations similar to those elsewhere in Tauranga Harbour. The same can be said for cadmium concentrations, and like zinc, the subtidal concentrations around the outfall are markedly higher than the intertidal results. Also like zinc, results on average are below the ANZECC guidelines (ISQG low mg/kg dry weight) for sediments.

Phosphorus concentrations measured by Ballance Agri-Nutrients in sediment between 1983 and 2006 in the intertidal zone show concentrations similar to other areas in the Tauranga Harbour. The subtidal sediment phosphorus concentrations where highly elevated in phosphorus. However, it would appear that these elevated concentrations are localised and do not impact further into the Estuary.

Shellfish sampling has been undertaken by Bioresearches at several intertidal sites and shellfish analysed for fluoride, cadmium and zinc. Results indicated that concentrations for cadmium were under maximum level of contaminants for food (molluscs) listed by the Australia New Zealand Food Standards Code (2002). There are no current food standards for zinc or fluoride, however zinc levels are comparable to other recent shellfish concentrations in the southern Tauranga Harbour area and the recent fluoride results are below the minimum detection limit.

Environment Bay of Plenty monitoring in 2007 did pick up elevated cadmium concentrations in Pipi collected from the main channel sand bank opposite Salisbury Wharf in Pilot Bay (0.3 mg/kg wet weight). These were almost an order of magnitude higher than detected in the intertidal area of Waipu Bay (mean 0.038 mg/kg, n=4) in 2006.

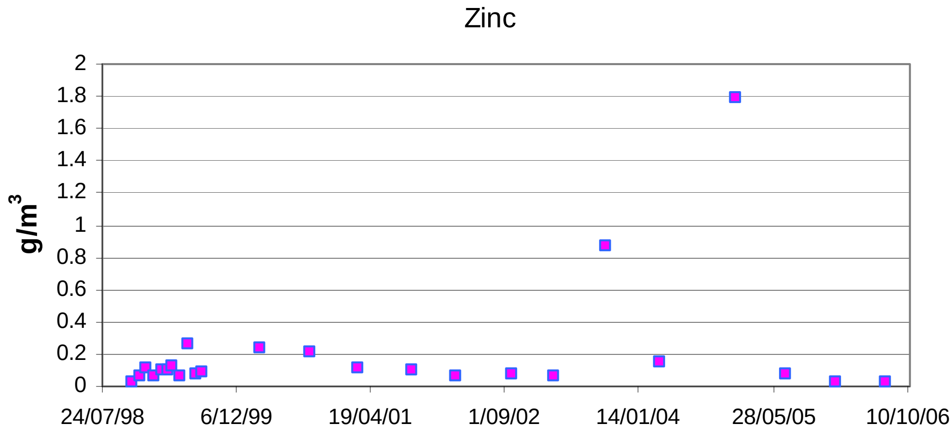


Figure 2.1.5 Zinc concentrations in wastewater discharge.

2.1.2 Discussion

Environmental monitoring has primarily targeted discharges stemming from the Ballance Agri-Nutrients site. The handling and processing of fertilisers at this plant introduce a risk of nutrient and heavy metal contamination to the estuarine environment, but the most prevalent contamination risk is from suspended solids loading to the estuary from Port sources.

Nutrient levels at sites monitored display no obvious impact from any localised contamination in the water column or sediment. Likewise suspended solids levels show little impact from increasing wastewater discharges in recent times. Any increase in suspended solids is attributable to climatic impacts including sediment entering the estuary from stormwater sources. Wood chip, bark and pine needles are commonly seen floating in this area of the estuary and are likely to be sourced from Port activities.

Primary productivity as measured by chlorophyll-a remains at levels consistent with levels measured in the South Basin of Tauranga Harbour, although there is an increasing trend.

Heavy metals cadmium and zinc have shown to be elevated near the Ballance Agri-Nutrient discharge but are at background levels in other areas in sediment and shellfish. The exception to this is one shellfish sample at Pilot Bay which has shown elevated cadmium concentrations. If cadmium was sourced from the Port area due to tidal fluxes, elevated levels of cadmium should also occur in the Waipu estuary as well as near Pilot Bay. Hence, the high cadmium result in shellfish may be an anomaly. Only further monitoring will determine otherwise.

2.2 Kaituna River

The lower Kaituna River is sampled at three sites to monitor the impact of the effluent discharge from the freezing works of AFFCO New Zealand Limited near Te Puke and the discharge of treated sewage effluent from Te Puke township. There is a site just upstream of the AFFCO discharge, one site downstream at State Highway 2 and a site near the river mouth at Te Tumu. The sampling programme changed in 1996, when river mouth sampling was absorbed into Environment Bay of Plenty's estuarine sampling programme. Sampling at Te Tumu has been on a different day to the other two sites and the tidal effects at this site must also be taken into consideration in any data analysis. Site locations are shown in Figure 2.2.1.

Figure 2.2.1 Site location map

2.2.1 Results

The AFFCO New Zealand Limited Rangiuru meat processing facility discharges its treated waste water to the Kaituna River above Te Matai (Figure 2.2.1). There is a daily limit on discharge volume of 6,500 m^3/day, and a median volume of under 3,000 m^3/day has been experienced in the last few years (Figure 2.2.2).

Consent 02 4932 requires the consent holder to monitor for a range of water quality parameters in the wastewater discharge and within the Kaituna River. Nutrients, bacteria, suspended solids, and oxygen demanding organic matter are the main contaminants of concern in the treated wastewater. The results of monitoring are given here and discussed below to assess the impacts of AFFCO and Te Puke sewage discharges on the Kaituna River.

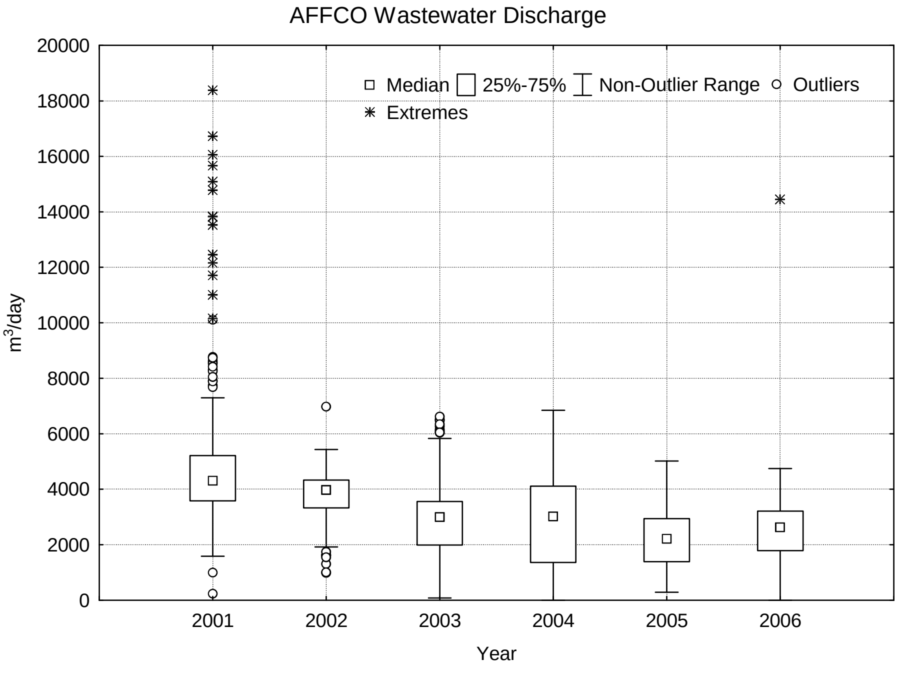


Figure 2.2.2 Box-whisker plot of wastewater discharge volumes from the AFFCO treatment ponds.

Suspended solids (SS) are monitored instream and from the AFFCO discharge. Figure 2.2.3 shows that the suspended solids upstream of the AFFCO discharge and those monitored at Te Matai have a similar relationship (r^2=0.84). The correlation of turbidity at both sites also has a similar relationship (r^2=0.873). Suspended solid levels in the AFFCO discharge have been decreasing since 2001, although data to August 2007 shows an increase (Figure 2.2.4). SS concentrations at Te Matai show no significant trend over the 1991 to 2007 period, however turbidity does display an increasing trend over this period (p<0.05, deseasonalised residuals).

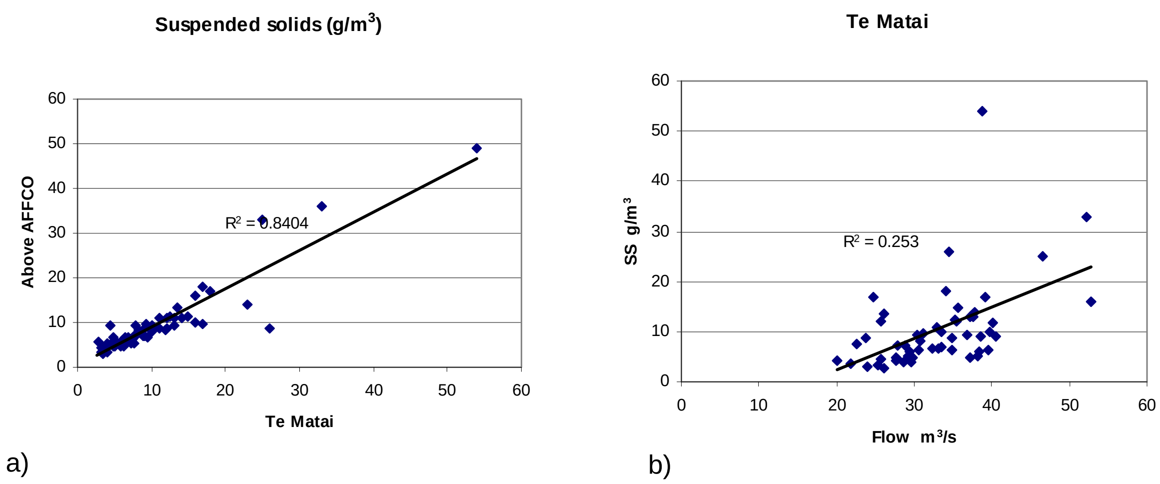


Figure 2.2.3 Correlation of SS data at above AFFCO and Te Matai (a); Flow vs SS at Te Matai (b).

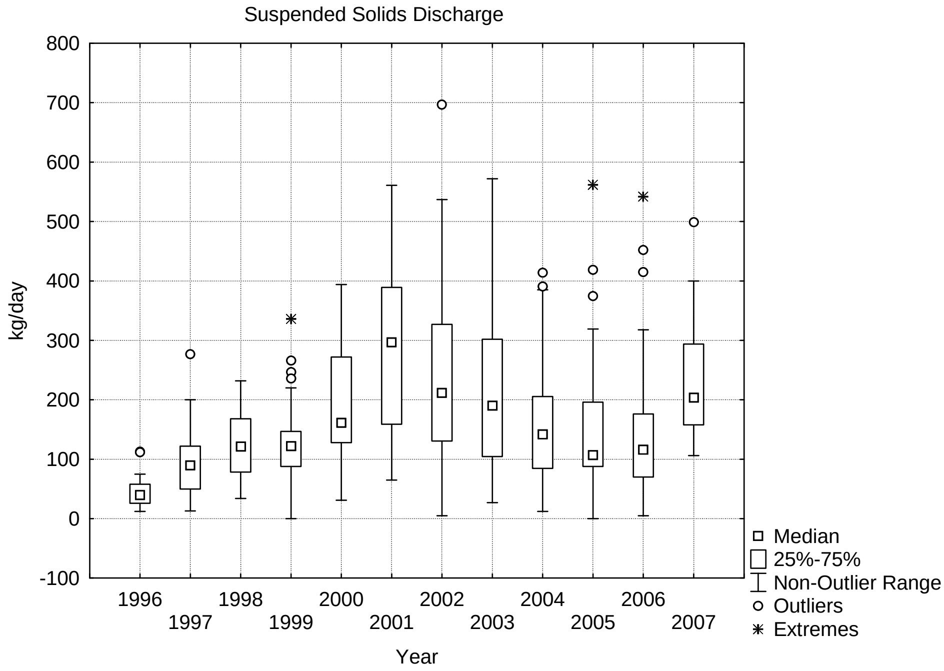


Figure 2.2.4 Box-whisker plot of SS discharge load from AFFCO to the Kaituna River, 1996 to 2007 (2007 data to August).

Figures 2.2.5 and 2.2.6 display nutrient data from the site above the AFFCO discharge and the site at the Te Matai. Total phosphorus (TP) above the AFFCO discharge has been displaying an increasing trend while at Te Matai this trend has been for the most part decreasing, with the exception of some high concentrations at Te Matai towards the end of 2005, beginning of 2006.

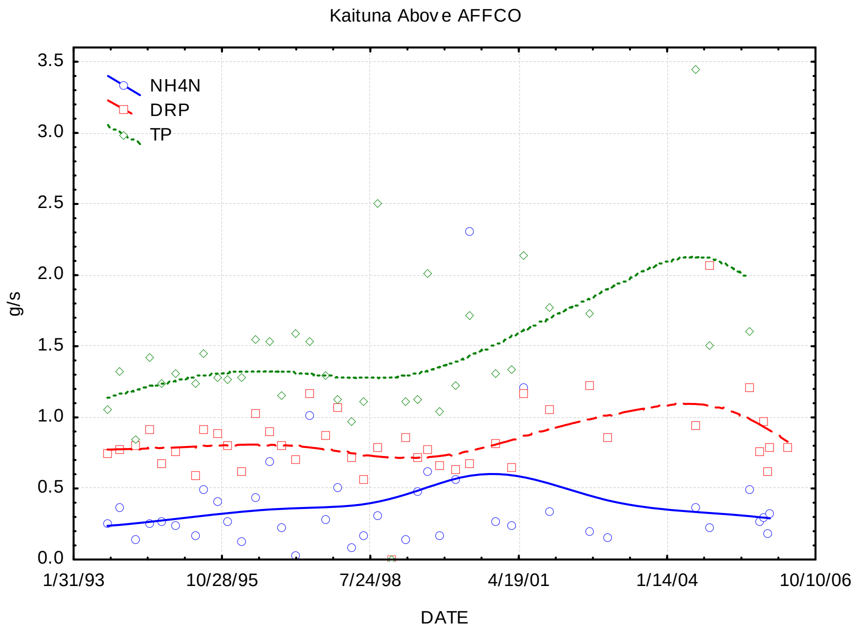


Figure 2.2.5 Nutrient data for the site Above AFFCO with distance weighted least squares fit.

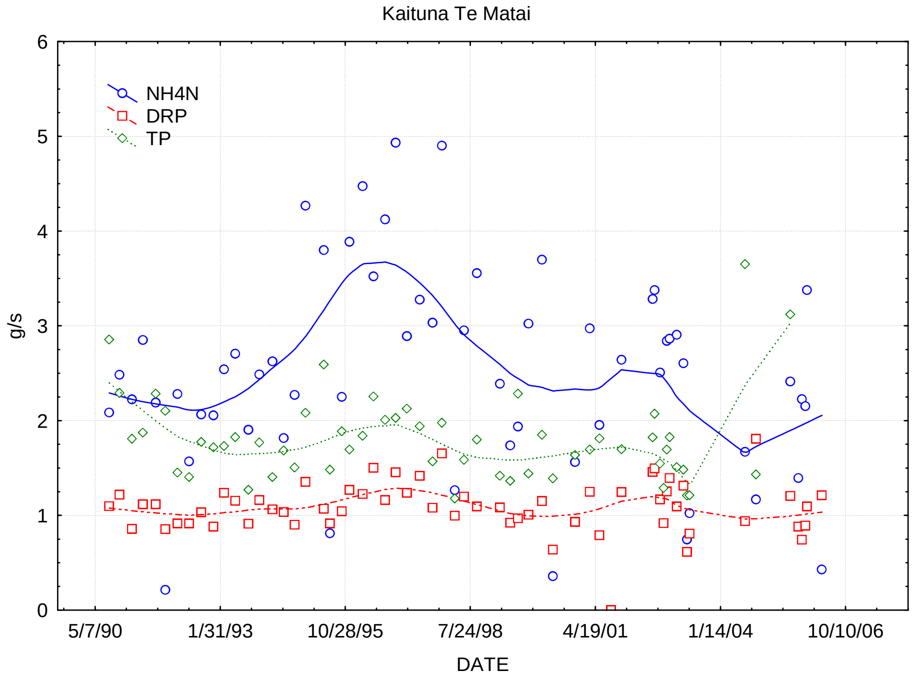


Figure 2.2.6 Nutrient data for the site at Te Matai with distance weighted least squares fit.

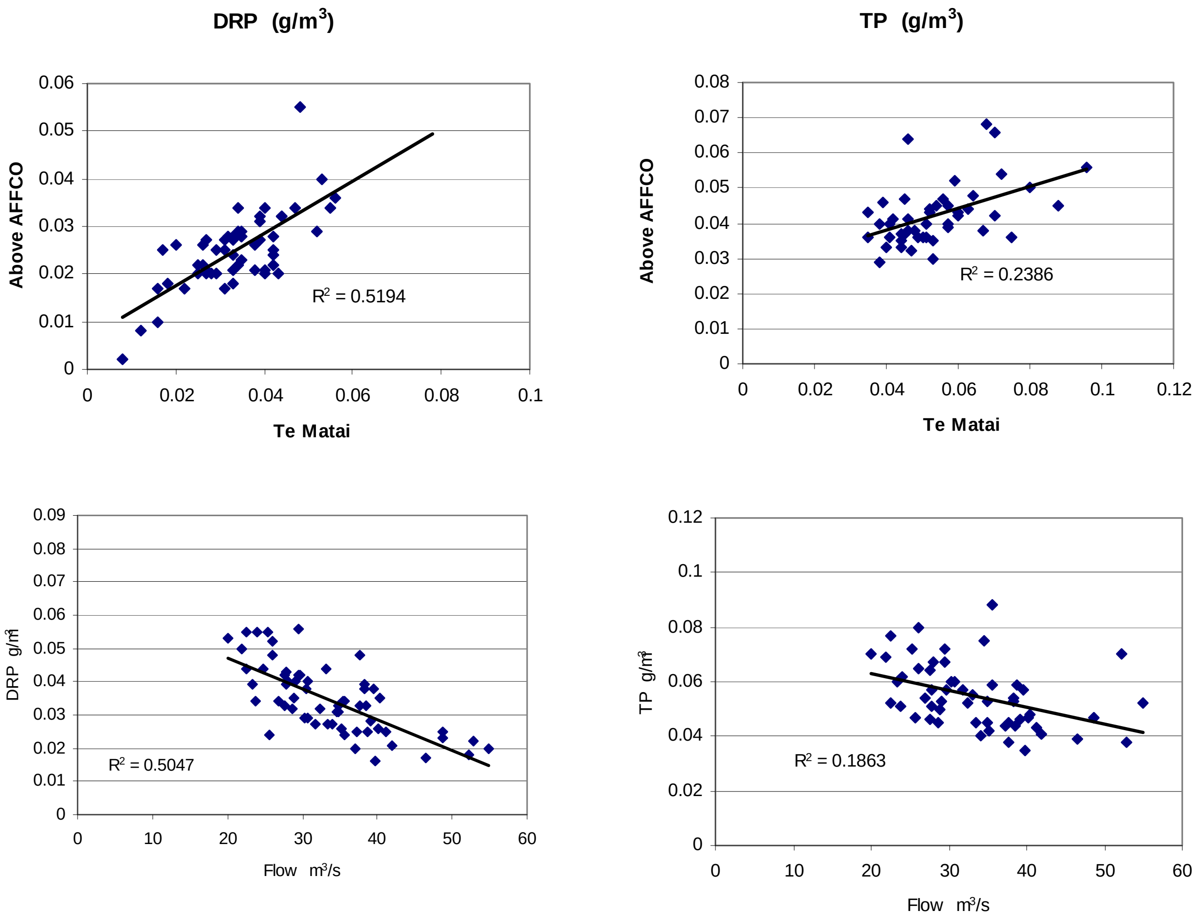


Figure 2.2.7 Correlation of TP and DRP at sites Above AFFCO and Te Matai (two top graphs), and flow vs DRP and TP at Te Matai; 1991 to 2007.

Dissolved reactive phosphorus (DRP) shows similar concentrations at both sites. There is also a good correlation between both sites indicating the AFFCO discharge has little impact on DRP concentrations in the river (Figure 2.2.7). Correlation of DRP with flow shows that DRP is strongly dependant upon flow at the Te Matai site (Figure 2.2.7) and this is also true to a lesser extent for the site above AFFCO (r^2=0.288). TP displays only a weak relationship with flow at both Te Matai and above AFFCO. This is distinct from the DRP and shows that the AFFCO discharge is likely to have a greater effect on particulate phosphorus (PP) than DRP. Comparison of PP at Te Matai and the site above AFFCO show little difference in overall concentrations.

Ammonium-nitrogen (NH_4-N) load discharged to the Kaituna River does appear to elevate the concentrations of NH_4-N as measured at Te Matai (Figure 2.2.8). There is no obvious correlation of NH_4-N data from the sites at Te Matai and above the AFFCO discharge, and the relationship with flow is different for both sites (Figure 2.2.9). This shows the AFFCO discharge makes a significant contribution to NH_4-N load contained in the Kaituna River. The size of this load to the Kaituna River has been decreasing since 2001, indicating some improvement in treatment has been achieved (Figure 2.2.10).

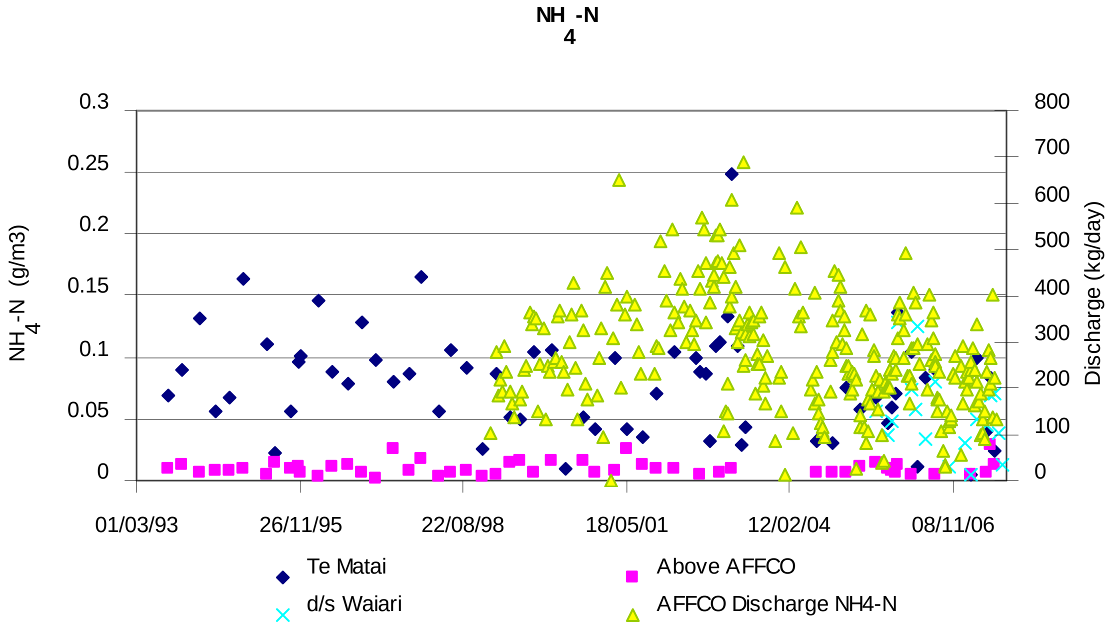


Figure 2.2.8 NH_4-N concentrations at Te Matai and Above AFFCO and the AFFCO discharge load of NH_4-N to the Kaituna River.

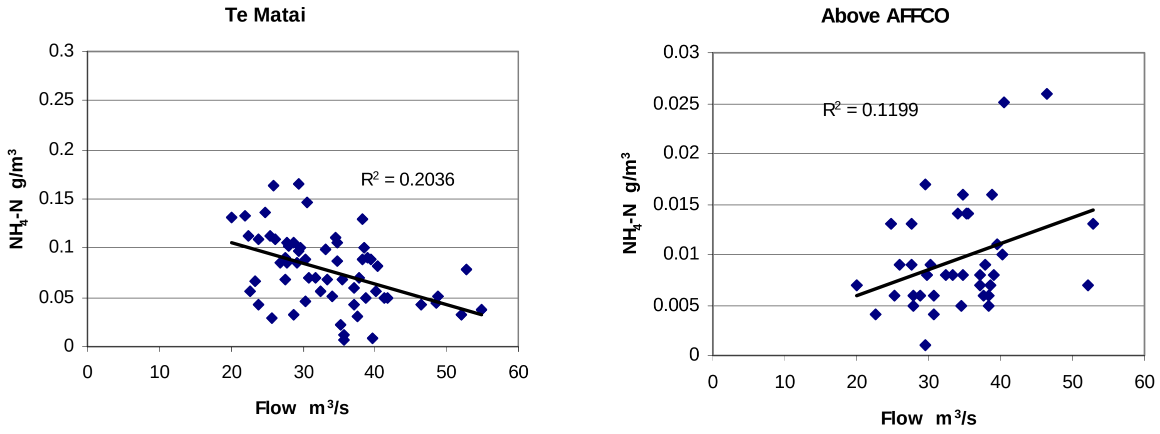


Figure 2.2.9 Flow vs NH_4-N at Te Matai and Above AFFCO, 1991 to 2007.

Indicator bacterial levels at the site above the AFFCO discharge and at Te Matai are, for the most part very similar, with concentrations being slightly higher at Te Matai (Figure 2.2.11). The MfE/MoH microbiological water quality guideline has been exceeded at Te Matai on several occasions; however bacteria are likely to stem from other sources, including the AFFCO discharge.

Since 2003 there has been a decrease in the concentration of indicator bacteria in the treated discharge (Figure 2.2.12). Concentrations of indicator bacteria are now stable with seasonal fluctuations, lows in summer and highs in winter. Monitoring downstream of the Waiari stream shows enterococci concentrations similar to those at Te Matai. This suggests there is minimal influence of the Te Puke WWTP discharge on the Kaituna, and total faecal loading data supports this conclusion.

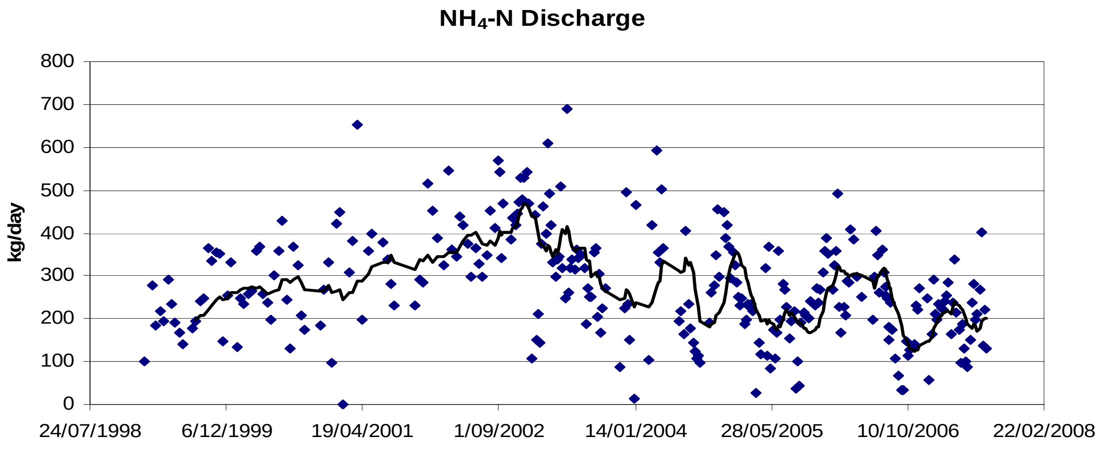


Figure 2.2.10 NH4-N discharge load from AFFCO treatment ponds, data and six month moving mean.

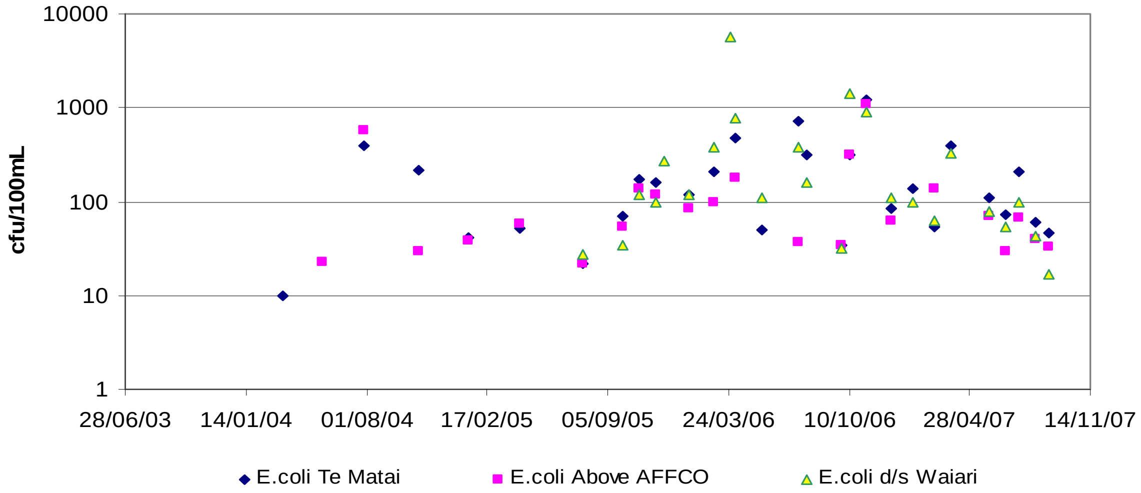


Figure 2.2.11 E.coli concentrations at Te Matai and Above AFFCO and d/s of Waiari Stream.

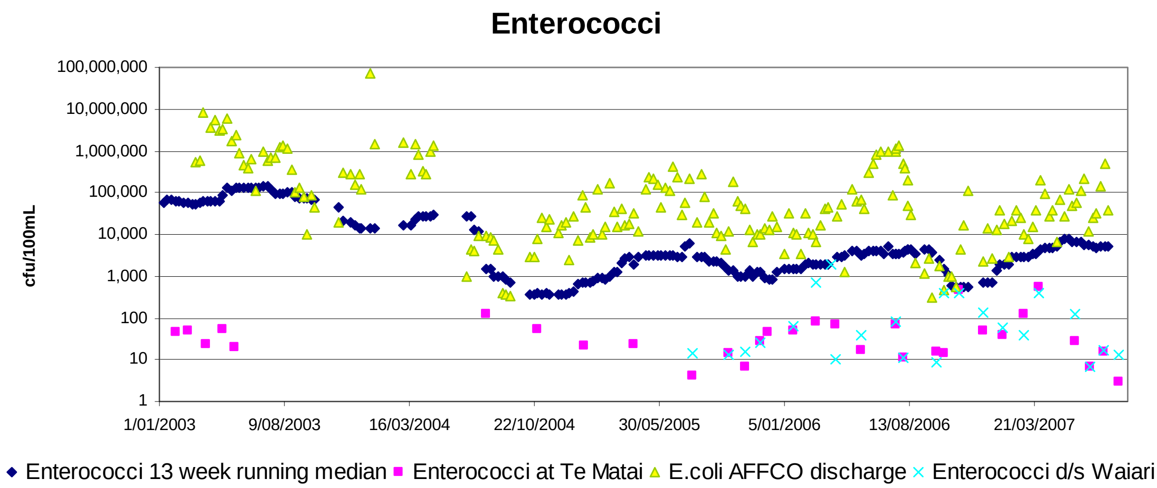


Figure 2.2.12 E.coli and enterococci concentrations in the AFFCO discharge and enterococci concentrations at Te Matai and d/s of Waiari Stream.

Indicator bacterial concentrations entering the Maketu Estuary (measured at Te Tumu) are occasionally at levels above the recommended contact recreational guideline (Figure 2.2.13). *E.coli* data show no obvious trend in the data, while enterococci displays an increasing trend (r=0.508, p=0.004). Both *E.coli* and enterococci data show an increase in concentrations down the river (Figure 2.2.14).

Shellfish have been sampled in various locations within Maketu Estuary over the years, but mostly mid estuary. Enterococci and faecal coliform (FC) concentrations do show an increasing trend over time in shellfish sampled in various locations in the Maketu Estuary (Figure 2.2.16).

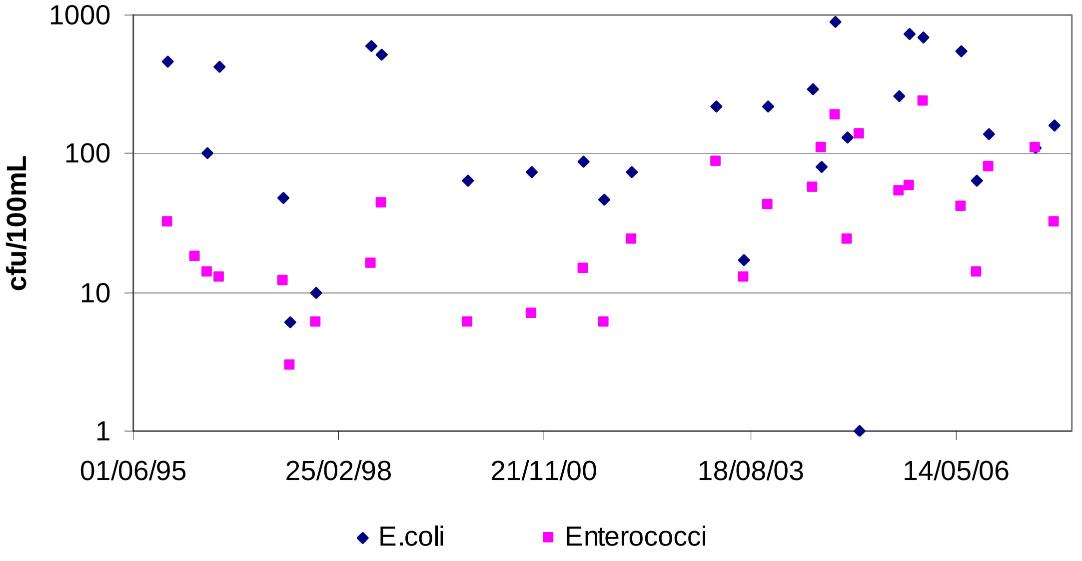


Figure 2.2.13 E.coli and enterococci concentrations, Te Tumu (salinity <5‰).

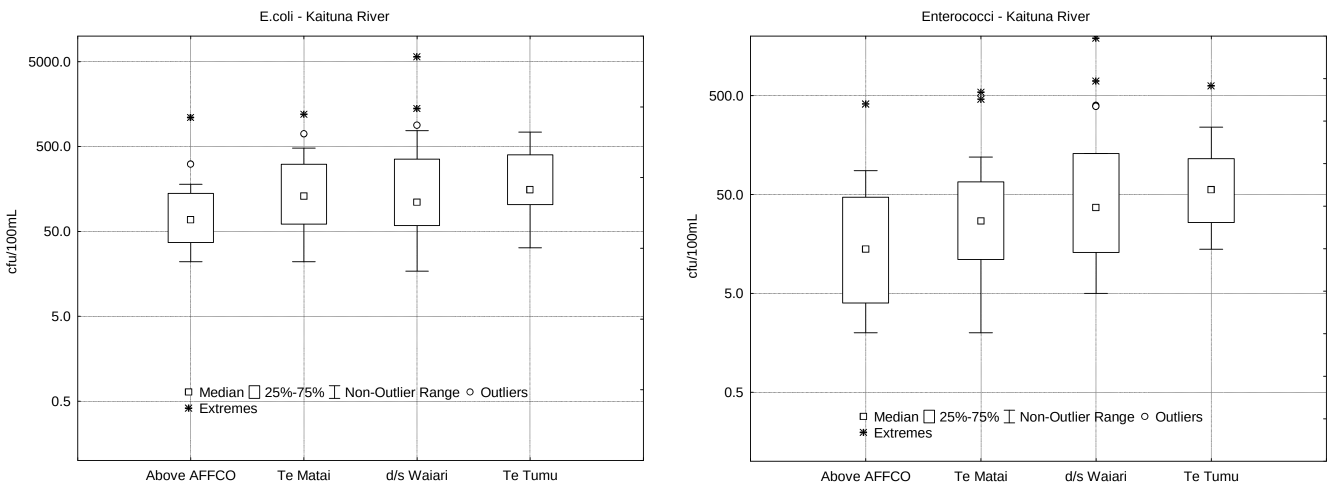


Figure 2.2.14 Box whisker plots of E.coli and enterococci concentrations Kaituna River, 2005 to 2007.

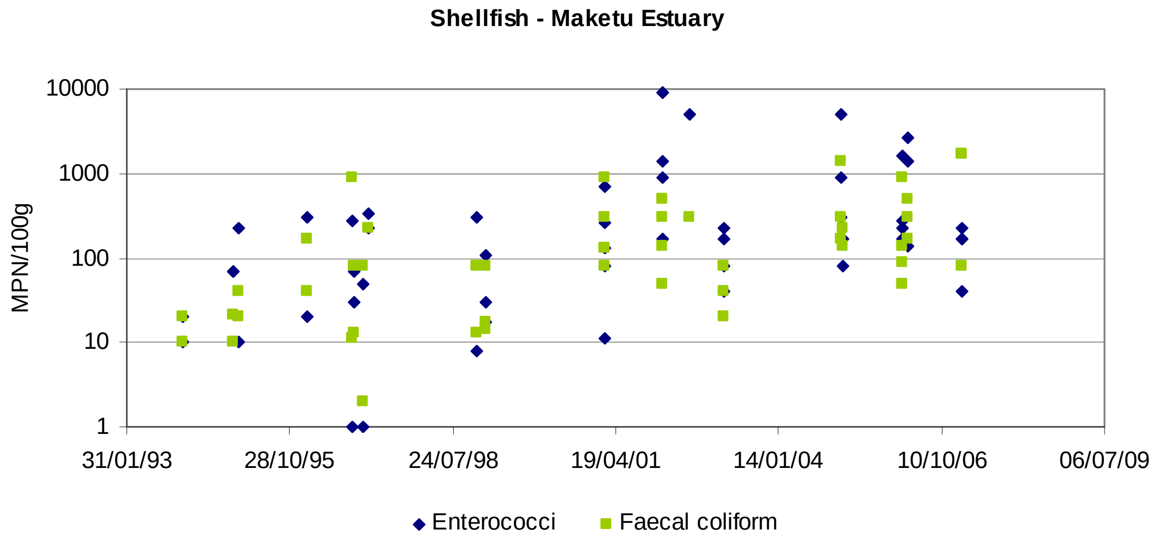


Figure 2.2.15 Enterococci and FC concentrations in Cockles and Pipi, Maketu Estuary.

Other notable trends in data at Te Tumu include an increasing trend in oxides of nitrogen (NOx-N) and TP (Figure 2.2.16). Both these trends are observed further up the river, however the increasing trend in TP is only observed above the AFFCO discharge.

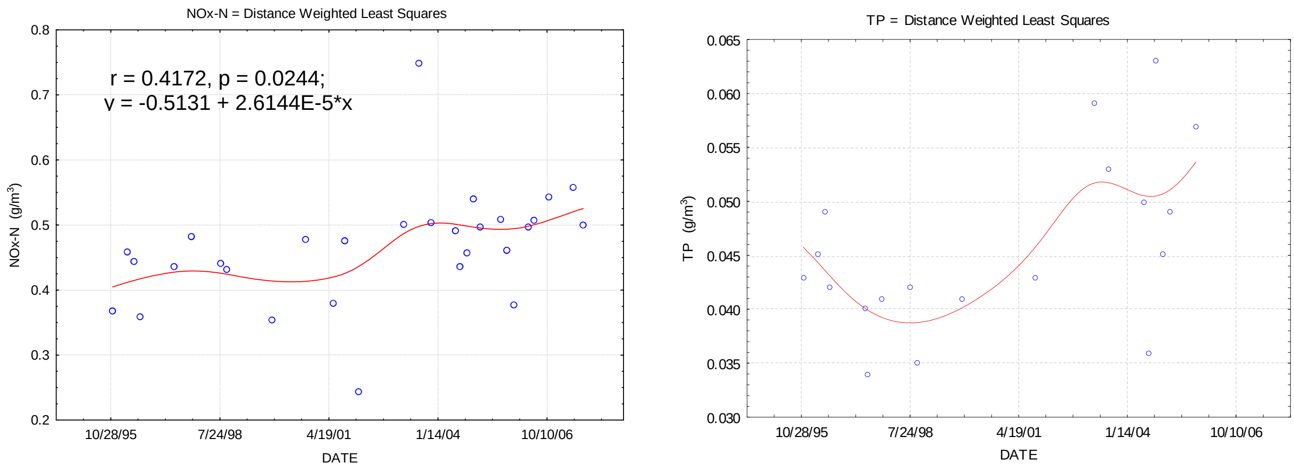


Figure 2.2.16 NOx-N and TP concentrations with least squares fit, Te Tumu (salinity <5‰)

2.2.2 Discussion

A detailed analysis of water quality parameters and discharge data from the AFFCO wastewater treatment ponds indicate some degradation of water quality in the Kaituna River.

The quantity of SS being discharged to the Kaituna from the AFFCO wastewater treatment ponds had been improving up until 2007. SS discharge seems to be having minimal impact on the river when comparing upstream and downstream SS concentrations. A similar relationship exists for turbidity although there is a weak increasing trend of turbidity at Te Matai.

Phosphorus has a similar relationship to SS at the site above and below the AFFCO discharge, and like SS there is some degree of dependency on flow. The concentration of phosphorus has a slight increase from above the AFFCO discharge to below it (at Te Matai). This difference is likely to be the particulate phosphorus contribution from the AFFCO discharge. The phosphorus load in the Kaituna River above the AFFCO discharge has been increasing, whereas at Te Matai the trend, until recently, was decreasing. This difference in trend is likely to be due to the phosphorus loading from the discharge disguising any trend at Te Matai. TP does show an increasing trend at Te Tumu and this may be in part due to other inflows between Te Matai and Te Tumu.

Nitrogen in the form of NH_4-N is the largest addition of nutrient from the AFFCO discharge. The loading of NH_4-N from the discharge significantly increases the concentration of NH_4-N in the river. Potential impacts from excess NH_4-N include decreases on oxygen due to nitrogenous oxygen demand and toxicity due to free ammonia concentrations. Dissolved oxygen concentrations at Te Matai have been stable and are on average above 9 g/m^3 indicating that the discharge is not impacting on oxygen levels in the water column. Due to the neutral pH of the waters and moderate temperature range there is only a small percentage of free ammonia likely to be in solution, and as this is the toxic component of ammonium-nitrogen any toxicity impacts are likely to be minimal. Little pH monitoring has been done directly at the outfall, but monitoring by Argo Environmental Limited in May 2007 found pH levels slightly above a neutral pH of 7, again suggesting there would be little increase in the quantity of free ammonia toxicity at the outfall.

The potential for eutrophication is increased with the addition of nutrients. Phosphorus, ammonium-nitrogen and its conversion to oxides of nitrogen within the river can increase macrophyte, periphyton, and algae. Due to the moderately high water velocities and a mobile river bed macrophyte and periphyton growth within the river system are limited. A report produced as a consent requirement (Argo, 2007) lists a variety of macrophytes along the river downstream of the AFFCO discharge but does not give details on distributions and thus a comparison with other surveys cannot be made.

Monitoring of blue-green algae (cyano-bacteria) has been made at several locations along the river over the past few years. In 2004 a health warning was put in place as levels exceeded recreational guidelines. However, blue-green algae concentrations have been similar above AFFCO to below the discharge and it is likely that these algal bloom events are related to blooms in Lakes Rotoiti and Rotorua.

The Argo Report (2007) also looked at macroinvertebrate communities at several sites along the Kaituna River. It was found that abundances increase and taxa numbers decrease with distance down the river. Taxonomic richness decreases with distance down river also, and this is likely to be expected in a system that slows and to some extent widens with distance down river.

The loading of pathogens to the Kaituna from the AFFCO discharge and Te Puke wastewater treatment plant via the Waiari Stream has been assessed by indicator bacteria monitoring. Both *E.coli* and enterococci concentrations increase with distance down the river. The bacterial loading from the AFFCO discharge is roughly equivalent to the bacterial load already contained in the river. Only minor loading is likely to come from the Te Puke wastewater treatment system through the Waiari Stream as the faecal coliform concentrations have been under 30 cfu/100mL for the last three years. Rural inputs will also contribute to the bacterial loading in the river.

The net effect of the AFFCO discharge is the maintenance of the concentrations of bacteria within the lower Kaituna River. *E.coli* levels have occasionally exceeded recommended safe swimming guidelines downstream of the AFFCO discharge, however under increased flow conditions this has also occurred above the discharge.

Indicator bacteria concentrations in the AFFCO discharge have improved (decreased) over the past few years. However, enterococci levels display an increasing trend at the entrance way to the Maketu Estuary (Te Tumu). This trend is reflected in shellfish sampling in the Maketu Estuary, with bacterial indicator levels occasionally reaching levels considered unsafe for consumption.

2.3 Tarawera River

The lower Tarawera River receives discharges from the township of Kawerau, the pulp and paper mills (including the Tasman industrial complex) and the geothermal bore field. River sampling is carried out at the sites shown in Figure 2.3.1, mainly to monitor the effects of discharges from the pulp and paper mills. Monitoring sites are described in Table 3. The main issues that have been dealt with on the Tarawera River over the past ten years have been: colour; dissolved oxygen; temperature and toxicity.

This section deals predominantly with monitoring of colour and dissolved oxygen and also the bacterial levels and suspended solids in the river. Wastewater discharges below Kawerau must adhere to the standards for Class FPLT (Fish Purposes – Lower Tarawera) as per the Tarawera River Catchment Plan.

Toxic compounds in the mill discharge were predominantly in the form of chlorophenols. These compounds have not been used in the mills since 1988, but there are consent conditions that require annual testing. For an overview of these results see Park, 2007.

The SCA Hygiene Australasia, Kawerau Mill is a bleached sulphonated-chemi-thermo-mechanical (CTMP) pulp mill, producing tissue, light weight paper grades and specialty papers. Until recently, the Kawerau town sewage was processed through the SCA anaerobic treatment system. Discharges were directly to the river and to rapid infiltration basins (RIBs), but river discharges were discontinued in May 2007. Stormwater from the mill is treated through stormwater treatment ponds and wetlands.

The main wastewater discharge to the river is from the Tasman mills; Carter Holt Harvey Tasman produces Kraft pulp and Norske Skog Tasman produces newsprint (from mechanical pulp). Process wastewater from Norske Skog, Carter Holt Harvey and SCA is treated in an aerated pond system with a residence time of 4-5 days. The ponds discharge to the river downstream of the Tasman Pipe Bridge at an average rate of 1.7 m^3/s (July 2006 to June 2007). Stormwater from the Tasman mills is treated in the aerated ponds or in stormwater ponds before discharge to the river. Some stormwater is also discharged to the river untreated via bypass outfalls when the stormwater pond capacity is exceeded.

Table 2.3.1 Description of Tarawera River sampling sites.

Kawerau	Boyce Park, just upstream of the main Kawerau Bridge, above the pulp and paper discharges.	29 km from sea
SCA Foot Bridge	Crosses the Tarawera River just downstream from the SCA Hygiene discharge from the infiltration basins.	27 km from sea
Onepu Springs Road	800 m upstream of the Tasman pipe bridge.	23.5 km from sea
State Highway 30 Bridge	Bridge on main Te Teko/Rotorua highway.	18 km from sea
Awakaponga	Edgecumbe/Matata Road (now State Highway 2).	7 km from sea

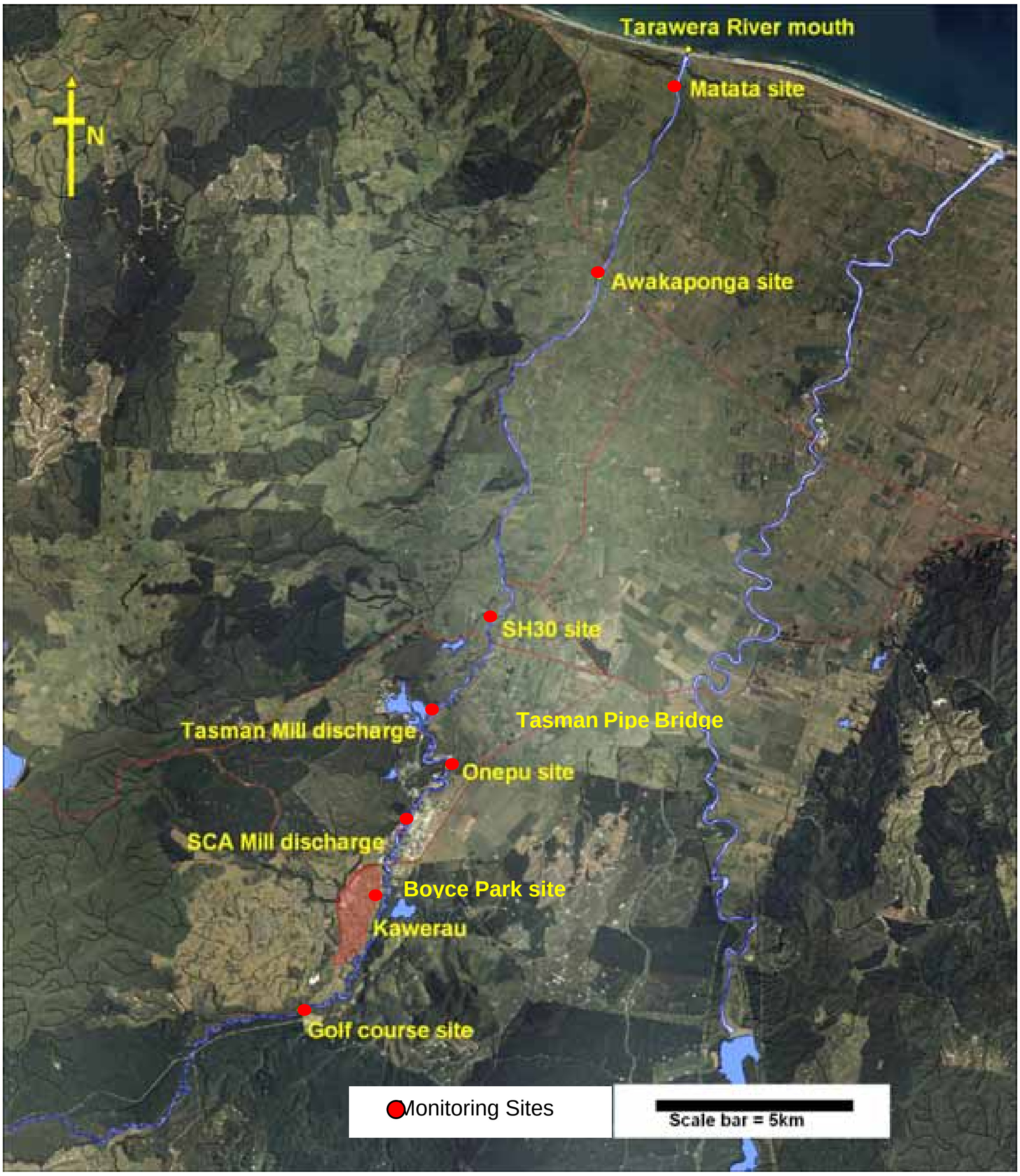


Figure 2.3.1 Monitoring site location on the Tarawera River

2.3.1 Results

Dissolved oxygen

Dissolved oxygen (DO) concentrations for several sites over the past decade are plotted in Figure 2.3.2. DO is measured weekly by technicians on site visits during daylight hours, usually between mid-morning and mid-afternoon. Monitoring shown in Figure 2.3.2 represents a range of daily DO concentrations over the seasons, as DO changes over a 24 hour period with lows in the early morning and highs in the late afternoon.

Dissolved oxygen standards have been set for the lower river in the Tarawera Plan. These are:

From 1 January 2003:

- *6.0 grams per cubic metre for the mean of any consecutive 30 days;*
- *5.0 grams per cubic metre for the mean minimum of any consecutive 7 days;*
- *4.5 grams per cubic metre as an absolute minimum.*

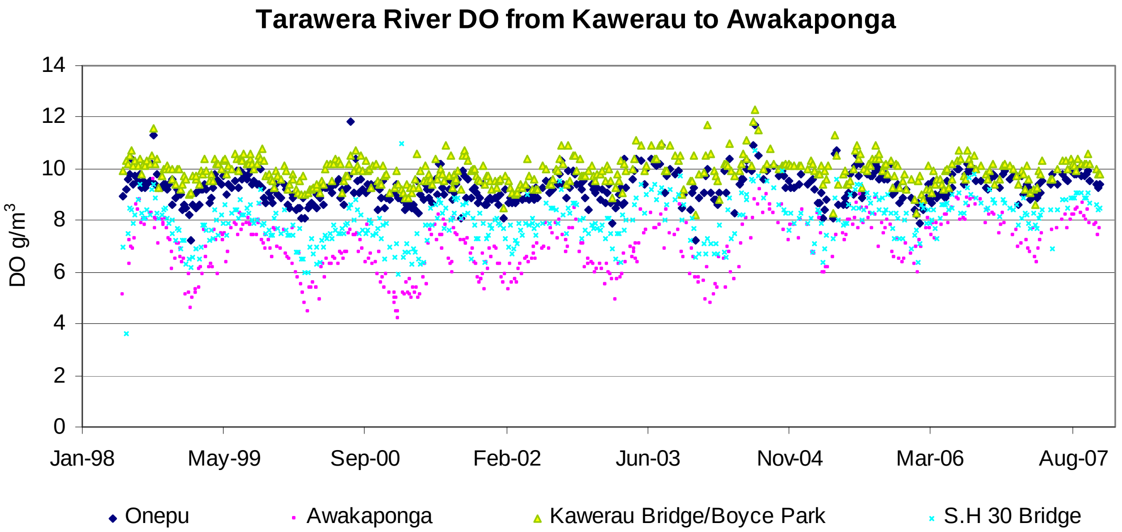


Figure 2.3.2 DO concentrations at 4 sites on the Tarawera River.

It can be seen in Figure 2.3.2 that the standard of 4.5 g/m^3 DO as an absolute minimum has been for the most part met since 2003. Continuous monitoring at the Awakaponga site is used to assess DO for consent compliance purposes. Figure 2.2.3 shows that the 30 day and seven day mean standards for DO in the lower Tarawera River are met from April 2004 onwards. Before this the standards were not met over the 2003/2004 summer. A rapid decline in oxygen at Awakaponga during February/March 2005 is due to the trialling of a new automated DO sensor cleaning system.

DO in the lower Tarawera River at several sites over the past decade displays an increasing trend (Figure 2.3.2). This trend is more pronounced in the lower part of the river at Awakaponga and the trend continues to be statistically significant further up the river to Onepu, but there is no statistically significant change in DO at Boyce Park (Table 2.3.2).

Table 2.3.2 Seasonal Kendall test for DO trends Lower Tarawera River, 1998 to 2007.

Site	Z	p	Sen slope median per year
Boyce Park	0.75	0.45	<0.01
Onepu	3.29	<0.01	0.05
SH 30 Bridge	4.30	<0.01	0.10
Awakaponga	6.28	<0.01	0.14

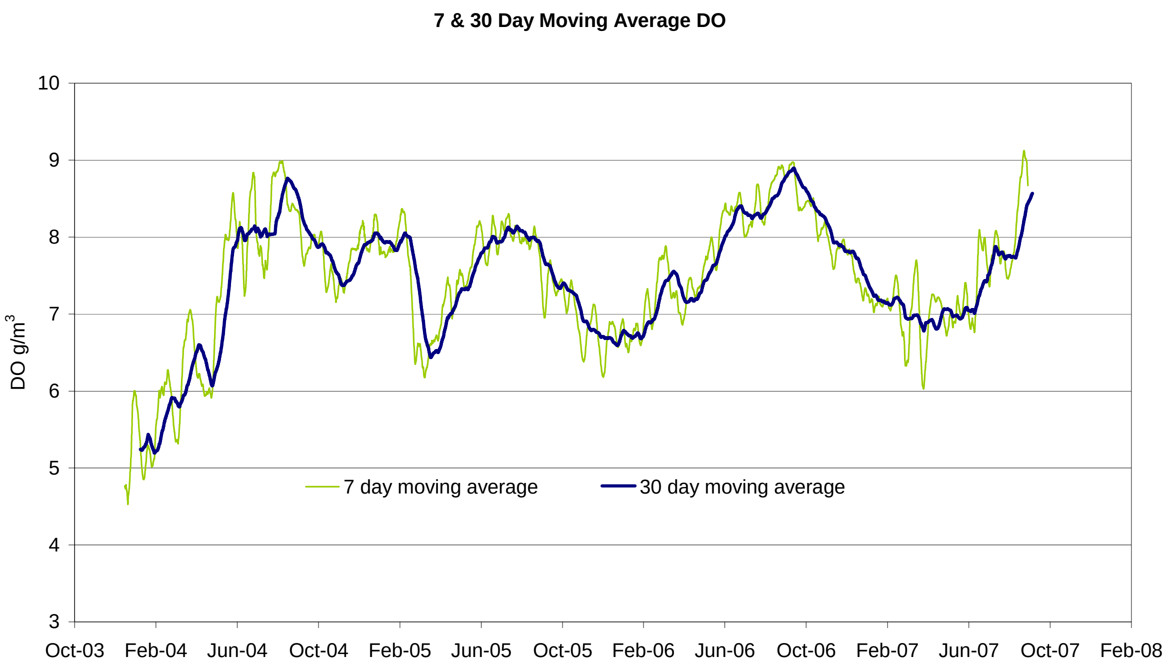


Figure 2.3.3 30 day mean and seven day moving average DO concentrations 2007, Tarawera River @ Awakaponga

Colour

Lignin and carbohydrate degradation products are discharged to the Tarawera River from the pulp and paper mills. Colour in the river is measured by the absorption coefficient of a 0.45 micron filtered sample at 440nm on a spectrophotometer. The standard for colour in the Tarawera River Catchment Plan as of 30 December 2005 is that the colour shall not exceed a six month mean of 0.8 (equivalent to 10 platinum-cobalt units).

Colour has been monitored predominantly at three locations on the river; Boyce Park, Onepu Springs Road and State Highway 30. The six month moving average for the three sites is shown in Figure 2.3.4. The Tarawera Plan colour standard is close to being met for the majority of the time upstream of the Tasman discharge (at Onepu Springs Road). Further downstream at State Highway 30, while it looked like improvements were being made since 2003, colour seems to have increased over the last year.

Trend analysis of the colour data at the three sites from 1998 to 2007 indicates colour to be steady at Boyce Park and Onepu, with a decreasing but statistically non-significant trend at State Highway 30 (z= -1.78, p=0.08).

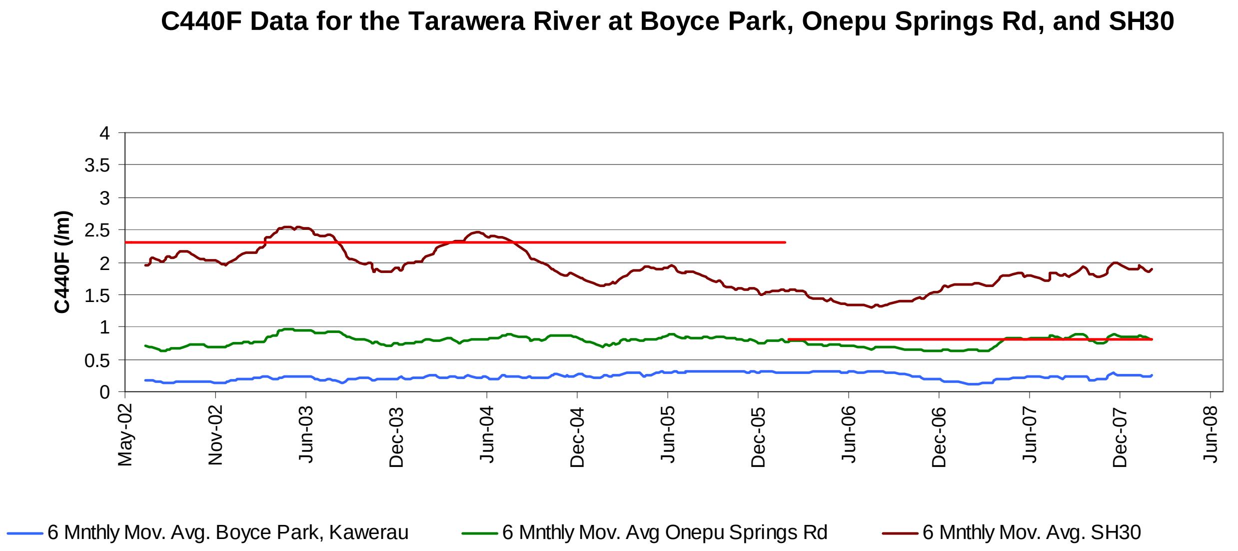


Figure 2.3.4 Colour data at several sites on the Tarawera River (six monthly moving mean), 2002 to 2007.

Temperature and pH

Temperature and pH have been measured at four locations along the lower Tarawera River, one above the Tasman industrial complex and three below it. Figure 2.3.5 shows that temperature has a constant seasonal pattern with the river warming with distance downstream. The temperature standard for the Tarawera River Catchment Plan is:

- *No increase in temperature of more than 3°C, and maximum not to exceed 25°C*.

Comparison of the temperature measured at Boyce Park and Onepu results in temperature differences of less than *3°C*, this increase will be due to natural heating and the discharge of geothermal fluid to the river near the Tasman mill. Comparison of the temperature measured at Boyce Park and Awakaponga over the last nine years results in five temperature differences greater than *3°C*. These differences will be related to the industrial discharges and natural heating. Temperatures in the river have not exceeded 25°C.

The pH range below the Tasman complex discharge has remained within the Tarawera River Catchment Plan range of 6.5 to 8.5. One pH measurement at Boyce Park was recorded as 6.4 pH units and the pH at Boyce Park shows a significant declining trend ($z=-4.78$, $p<0.01$).

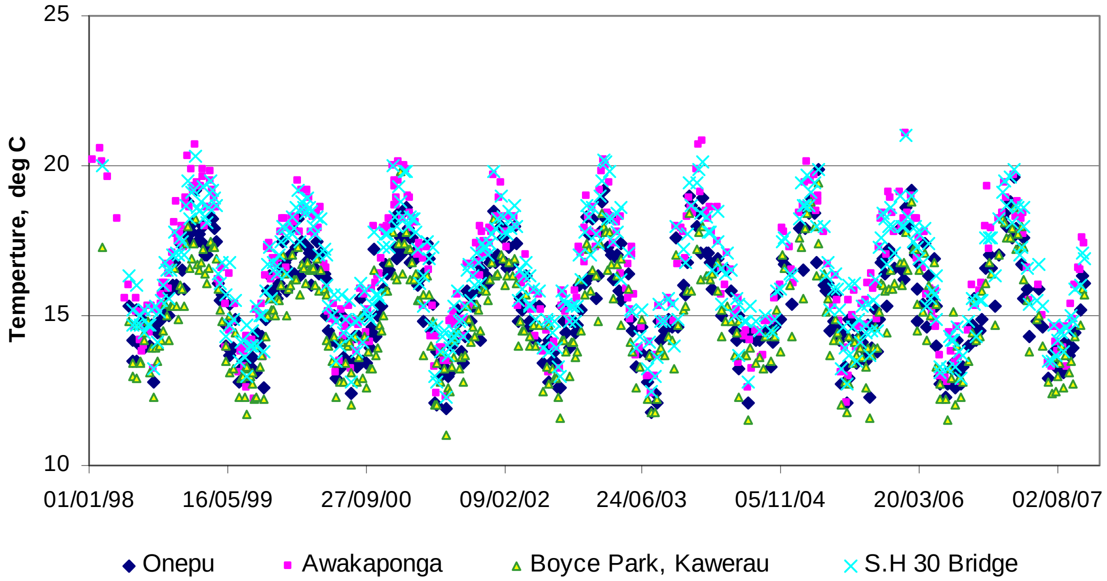


Figure 2.3.5 Temperature data at several sites on the Tarawera River, 1998 to 2007.

Biochemical Oxygen Demand (BOD)

Biochemical oxygen demand, or BOD, measures the amount of oxygen consumed by organic and inorganic matter. BOD directly affects the amount of dissolved oxygen in the river. BOD_5 tests have been carried out on samples taken from three sites along the Tarawera River (Figure 2.3.6).

BOD concentrations in the lower Tarawera River have been declining since 2001 (Figure 2.3.7). This declining trend is strongest at the Awakaponga site (flow adjusted Seasonal Kendall: z=-3.052, p<0.01, 1989 to 2007) and corresponds with the increase in DO concentrations over the same period.

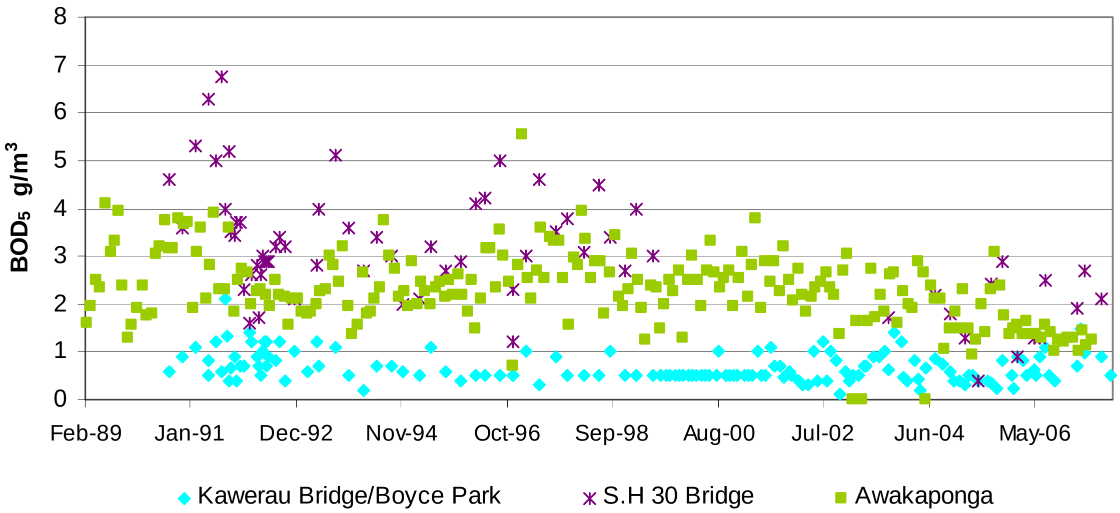


Figure 2.3.6 BOD_5 concentrations, Tarawera River, 1989 to 2007.

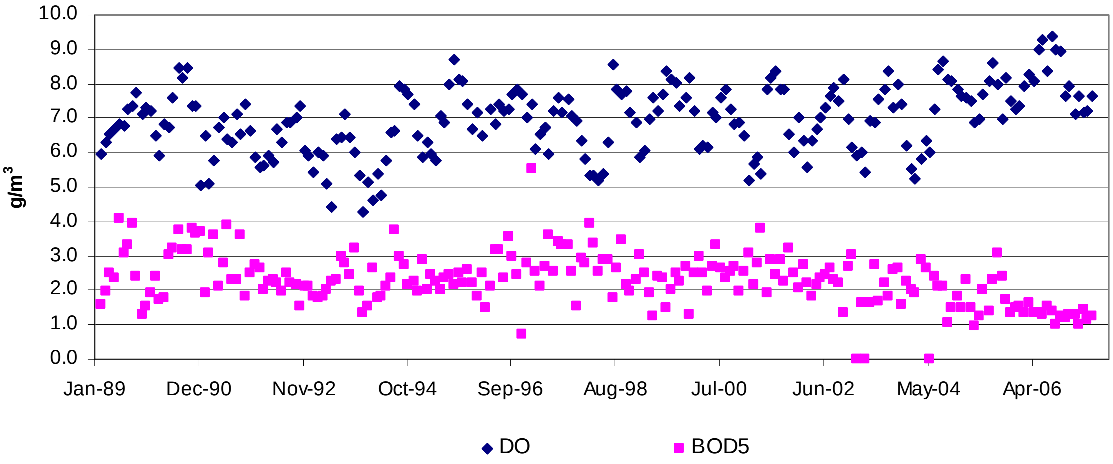


Figure 2.3.7 DO and BOD_5 concentration at Awakaponga, Tarawera River, 1989 to 2007.

Water Clarity and Light Penetration

Surveys of light penetration show that light penetration has increased around 50 percent from 1993 to 2007 (Park, 2008). The euphotic depth measured in 2007 in the lower river is now around 2.0 m, sufficient to allow plants to colonise most of the river bed under suitable habitat conditions.

Water clarity as measured by black disk showed no change between 1998 and 2007.

2.3.2 Discussion

The water quality of the lower Tarawera River has improved in the last few years. In particular, dissolved oxygen has met the river classification most of the time since 2004. These improvements are due to reductions in the levels of BOD discharged from the pulp and paper mills.

Colour measured downstream of the Tasman mill discharge was showing steady improvement until late 2006 but has since increased. The river is not meeting the Tarawera Plan colour standard upstream of the Tasman discharge due to upper river sources, including seepage from the SCA rapid infiltration basins. Discharges of pulp and paper effluent to the basins stopped in May 2007 so colour leaching is expected to reduce over time.

2.4 Rangitaiki River

Impact monitoring is carried out on the lower Rangitaiki River to assess the affect of the discharge from the Fonterra dairy factory at Edgecumbe. River surveys are carried out and a visual description is made at six sites (Figure 2.4.1), one site being above the Fonterra discharge. Observations on the quantity of sewage fungus present at each site are periodically made. The Fonterra resource consent to discharge to the river has limits that are based on the objective of maintaining the river free of sewage fungus.

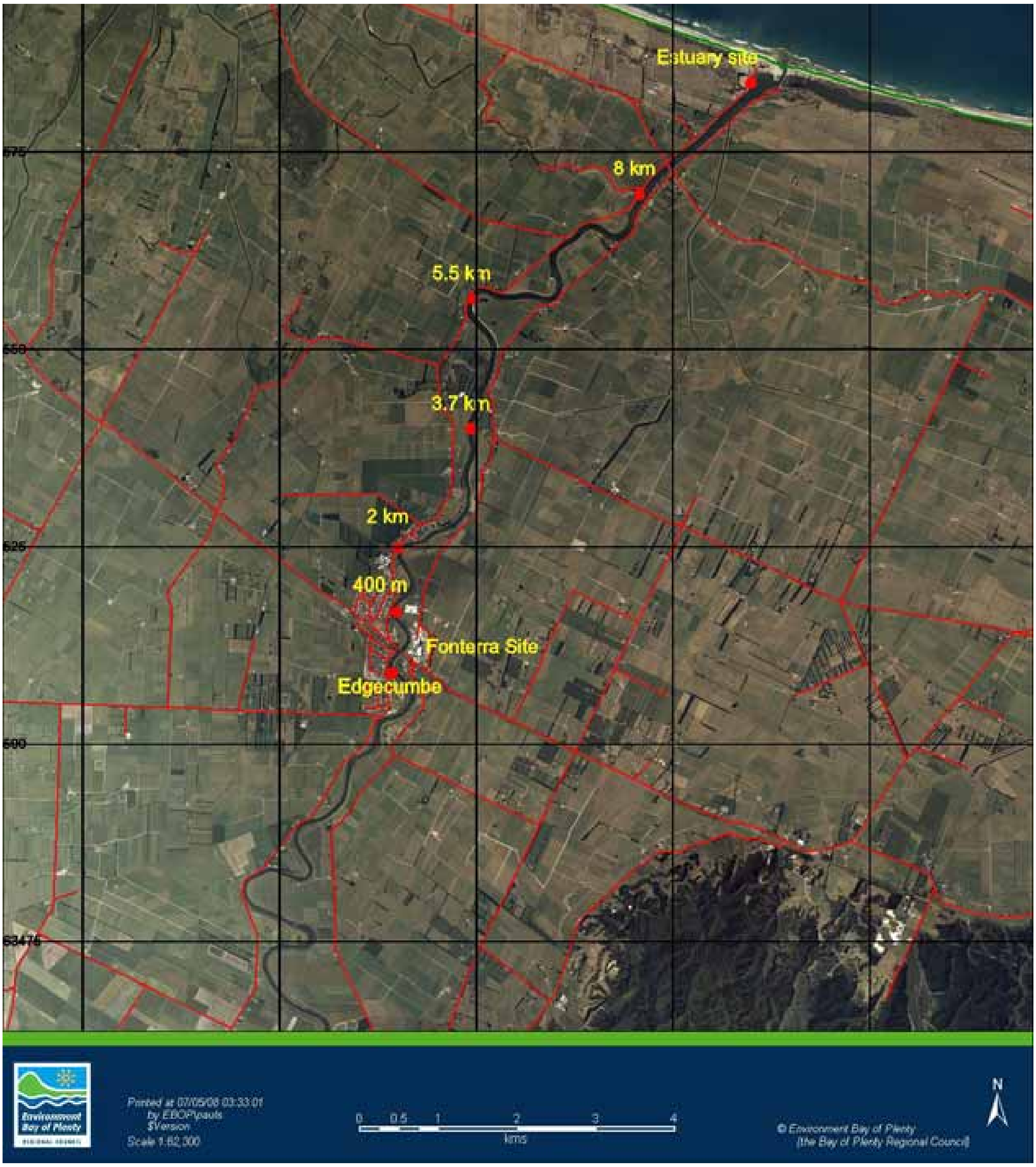


Figure 2.4.1 Sewage fungus observation sites, Rangitaiki River.

2.4.1 Results

Observations of the lower Rangitaiki River since April 2004 have shown periods when the effluent has promoted sewage fungus growth.

River surveys are undertaken by Environment Bay of Plenty and Fonterra staff, who record a visual assessment of the amount of sewage fungus present at fixed sites on the river. The comments have been interpreted and scored in Table 2.4.1 for presence of sewage fungus. No entry means that there was no sewage fungus; 'p' means that there was some sewage fungus present; 'ppp' means that there was a large quantity below the outfall and 'pp' indicates an intermediate situation.

Table 2.4.1 List of Rangitaiki River sampling dates with the presence of sewage fungus recorded (p = present below NZMP; pp = intermediate; ppp = large quantity at sites to below Fonterra; blank = absent).

Date	**Sewage Fungus Present**						**Monitored by**
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	
26/04/04							EnvBOP
04/05/04							Fonterra
26/05/04							Fonterra
14/07/04							Fonterra
18/08/04							Fonterra
3/09/04							Fonterra
16/09/04							Fonterra
26/09/04							Fonterra
12/10/04							Fonterra
25/10/04		p					Fonterra
3/11/04		ppp		p	p		EnvBOP
8/11/04		ppp	p	p	p		Fonterra
22/11/04		pp	pp		p		EnvBOP
28/11/04		ppp	pp				Fonterra
10/12/04		p	pp				EnvBOP
10/12/04		pp					Fonterra
24/12/04		ppp			pp		Fonterra
7/01/05							Fonterra
21/01/05		p					Fonterra
30/03/05		p	p				EnvBOP
8/09/06		ppp		pp			Fonterra
22/09/06		ppp	p	pp			Fonterra
6/11/06		pp	ppp	pp	p		EnvBOP
3/08/07							Fonterra
21/08/07		pp	pp				Fonterra
24/08/07		pp	pp				EnvBOP
31/08/07		ppp	pp	p			Fonterra
14/09/07		ppp	ppp	ppp	pp	pp	Fonterra
21/09/07		ppp	ppp	ppp	pp		EnvBOP
28/09/07		ppp	ppp	ppp	pp		Fonterra
5/11/07		ppp	pp	pp	pp		EnvBOP
3/12/07		ppp	p	p			EnvBOP
17/12/07		pp	p	p			EnvBOP
10/01/08			p	p	p		EnvBOP

2.4.2 Discussion

The conditions of the resource consent are designed to limit lactose discharges to levels that will not promote sewage fungus growth under normal river flow conditions. However, it is recognised that under low-flow conditions sewage fungus would be present in the river in the region of the outfall.

Lactose concentrations in the river are dictated by seasonal production at the Fonterra factory and river flow. Figures 2.4.2 and 2.4.3 show lactose concentrations in the river. Although variable, the more intense growths of sewage fungus occur in times of sustained lactose concentrations in the river.

Sewage fungus growth has at times been identified at the 5.5 kilometre site with the more intense growths occurring at the site immediately downstream of the discharge. Sewage fungus growths have steadily increased since 2004. This is due to the increase in lactose and contingency discharges.

The lactose discharge has exceeded the consent limits for concentration of lactose in the river on a number of days in the past three years (Figure 2.4.2). This has impacted on the lactose five day moving average resulting in potential non-compliance with condition 7.2.3 for a greater number of days, particularly in 2007. The peak five day average lactose concentrations in the river occurred in September 2007 (Figure 2.4.3) and resulted in some large sewage fungus growths. Greater low flow conditions occurred towards the end of 2007 compared to previous years contributing to increased lactose concentrations in the river on discharge.

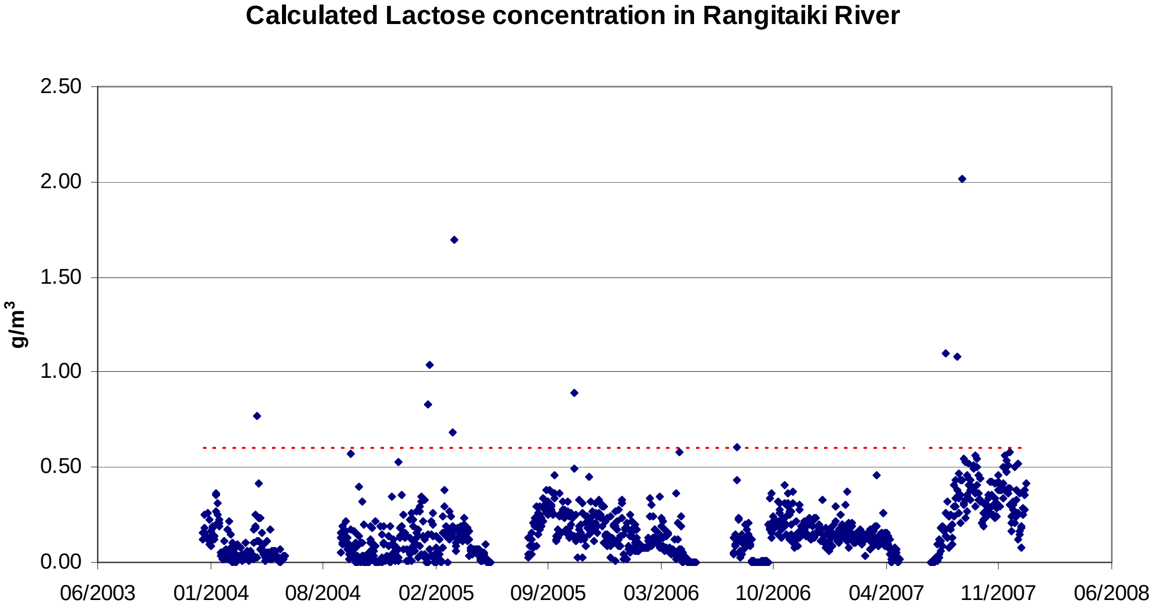


Figure 2.4.2 Lactose concentrations in the Rangitaiki River downstream of the Fonterra discharge.

The current data support the Bioresearches Report (2005) that under stable river flow conditions, when lactose concentrations increase to above 0.2 g/m^3, the potential exists for sewage fungus to develop.

Foam on the surface of the river near the discharge has also been an issue. Fonterra are currently exploring ways to minimise this impact.

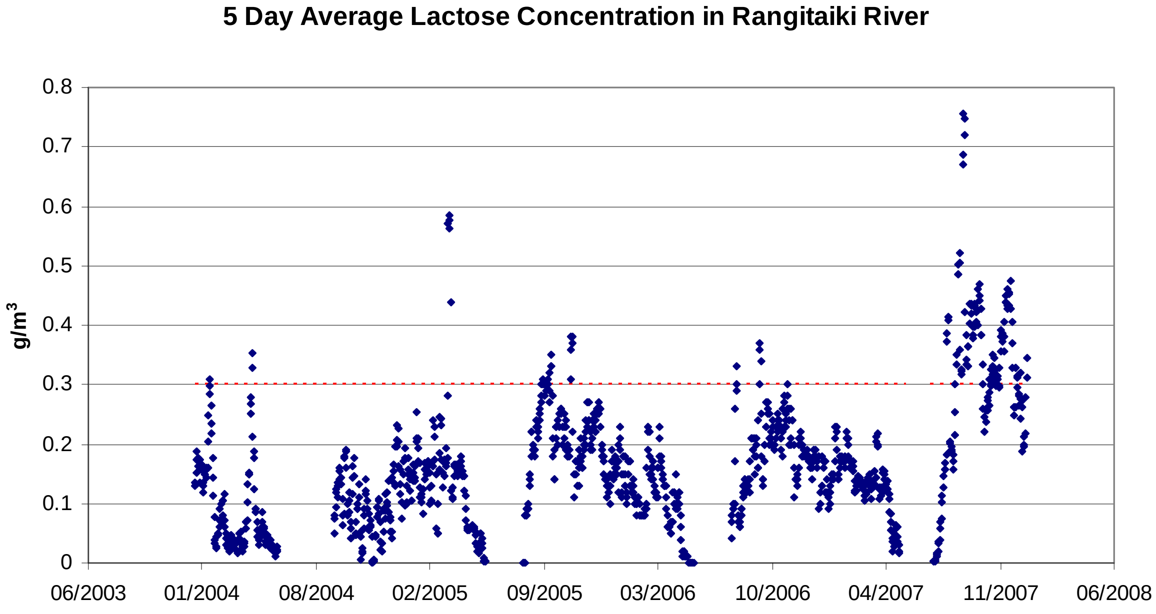


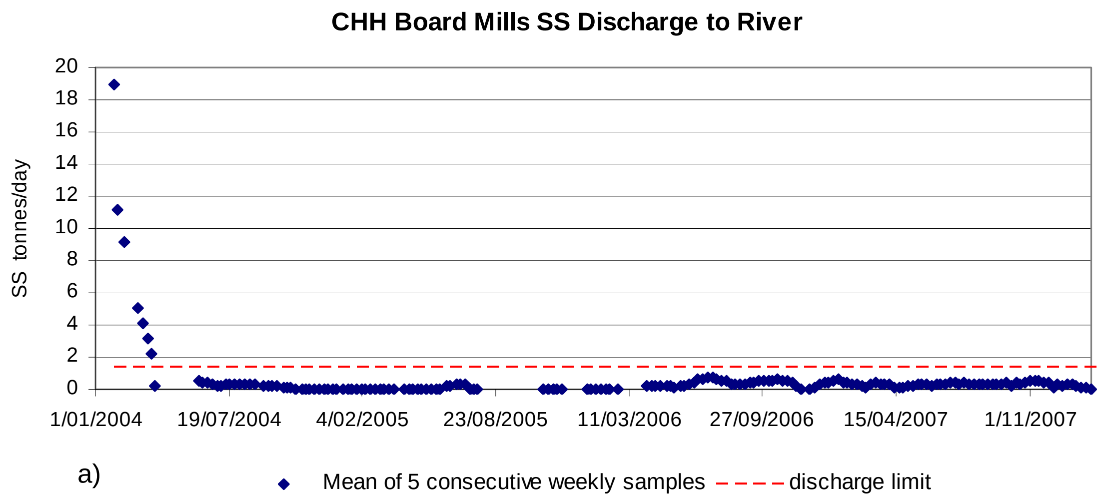
Figure 2.4.3 Five day average lactose concentrations in the Rangitaiki River downstream of the Fonterra discharge.

2.5 Whakatane River

The Carter Holt Harvey Paperboard Whakatane Mill discharges around 18,000 m^3/day of effluent to the Whakatane River. The discharge consent (61438) has limits for pH, suspended solids (SS), conductivity, BOD, and sulphide.

Two sites on the Whakatane River are monitored to help assess any effects from the discharge. One site is located above the mill near the Whakatane water treatment plant intake and the other site is located at Quay Street within the Whakatane Estuary. There is also an estuarine sampling site located at the Whakatane boat ramp which provides additional data.

2.5.1 Results



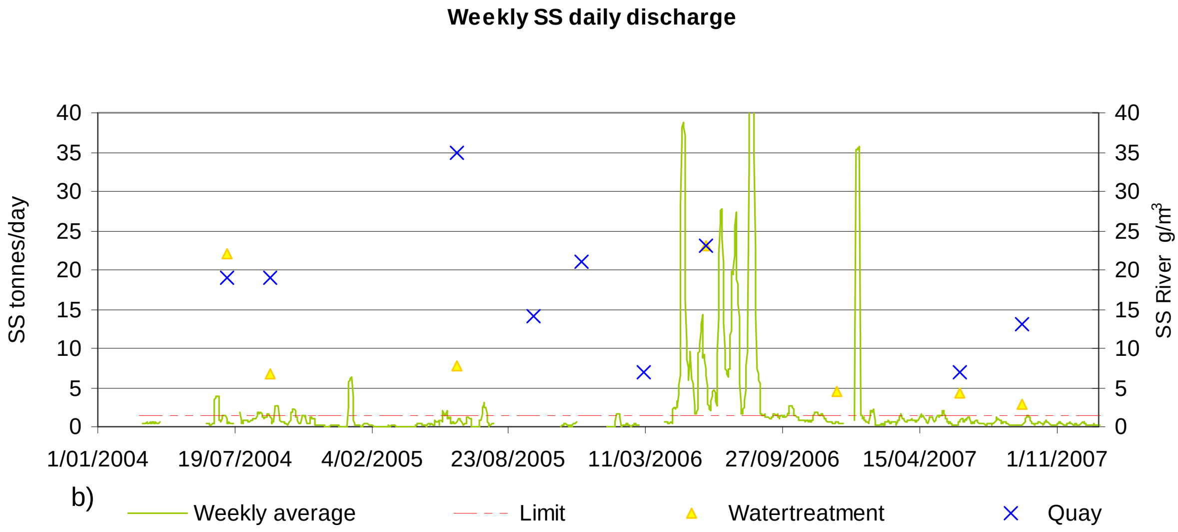


Figure 2.5.1 *a) five week moving average of SS discharge from CHH Board Mill to the Whakatane River; b) weekly moving average of daily SS discharge load to river, and SS concentrations at two river sites.*

Discharge concentration and loading data for SS, BOD and pH are displayed in Figures 2.5.1 to 2.5.3 with the respective consent limits. Figure 2.5.1 also displays the SS concentration data for monitoring carried out at the Water Treatment Plant (above the CHH discharge) and at Quay Street (below the discharge).

Data on pH, dissolved oxygen (DO) and biochemical oxygen demand (BOD5) are given in Figures 2.5.2 to 2.5.5.

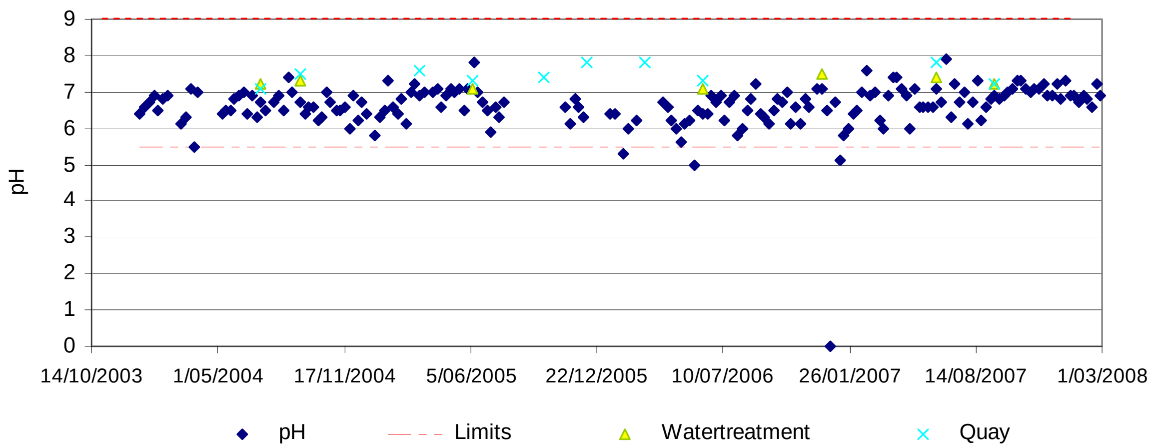


Figure 2.5.2 *Weekly pH results of CHH Board Mill discharge to the river and river pH results above and below discharge.*

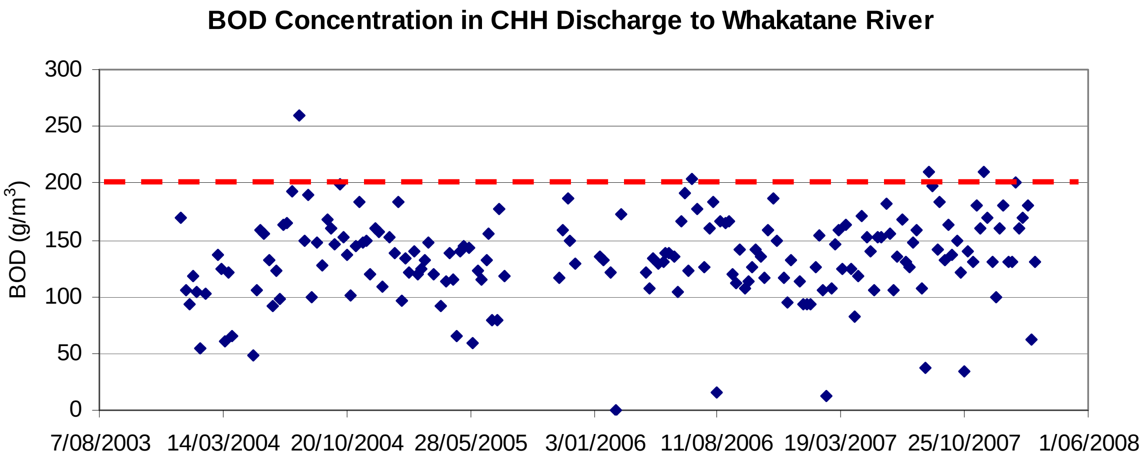


Figure 2.5.3 Weekly BOD concentrations results of CHH Board Mill discharge to the river.

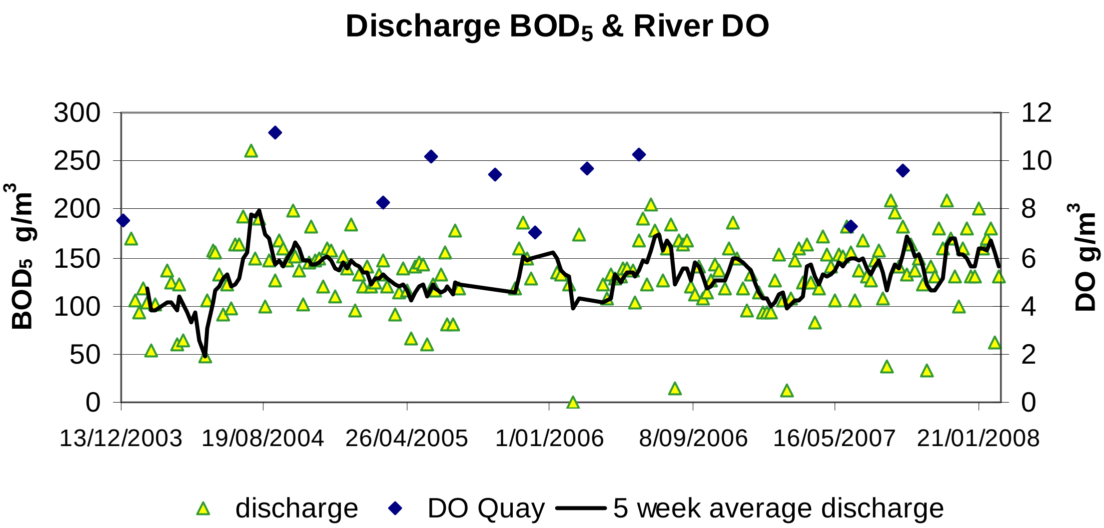


Figure 2.5.4 DO concentrations at Quay Street, Whakatane River, and BOD concentrations in the CHH discharge, 2003 to 2007.

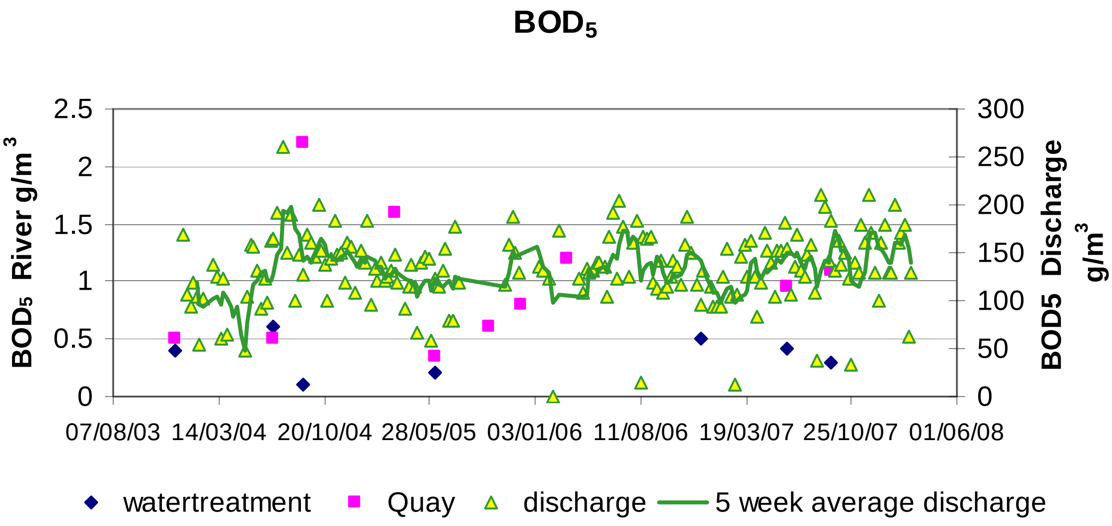


Figure 2.5.5 BOD concentrations at two sites on the Whakatane River, and BOD concentrations in the CHH discharge 2003 to 2007.

2.5.2 Discussion

Apart from some exceedances in early 2004 the suspended solids loading to the river has been meeting consent requirements. A more accurate picture of the SS loading to the river from the effluent stream is shown by Figure 2.5.1 using daily SS load data. Using daily data to produce a five week moving average indicates there are multiple events where the loading to the river exceeded 1.4 tonnes per day. While most events were small and short lived, over several months in mid 2006 events occurred which are likely to have added a significant SS load to the river. The river carries a average SS load of over 20 tonnes per day so sustained discharges over 1.4 tonnes per limit may impact the river, particularly visually.

Only one SS concentration sample was taken in the river over the mid 2006 elevated discharge period. SS concentrations at this time were elevated in the river but were similar above and below the discharge (Figure 2.5.1). As SS concentrations in the river above the discharge are proportional to flow (Figure 2.5.6) the SS load in the river at this time may have masked any impact from the CHH discharge.

There is a reasonable correlation between turbidity measured at the two sites on the Whakatane River, above and below the discharge (r^2=0.60, n=8; Figure 2.5.7). Apart from two events, a similar correlation exists for SS also. The two events occur when high SS are recorded downstream from the discharge, but not upstream. However, on both occasions the salinity was increased showing high tide conditions which may have influenced SS concentrations from other sources (e.g. Kopeopeo canal).

The CHH discharge pH has been under its lower pH consent limit three times between 2004 and 2007 (Figure 2.5.2). River monitoring suggests this has had little impact on the river pH levels, with pH levels above the discharge generally being lower than those monitored below the discharge.

BOD concentrations in the river have potentially been impacted by the CHH discharge. Figure 2.5.5 shows BOD concentrations in the river below the discharge (Quay Street) having a similar distribution to the five week average BOD discharge. It is possible that the BOD concentrations in the effluent and river are influenced by rainfall. This might explain the elevated BOD levels from the start of 2007 in the effluent and the corresponding exceedances of the SS discharge limit for stormwater from the site (six in the last year).

Monitoring of DO at the Quay Street site on the Whakatane River show no obvious influence of the BOD load in the CHH discharge, with DO concentrations remaining above 7g/m^3 (Figure 2.5.4).

To conclude, river data indicates little in way of environmental impact from the CHH discharge, but given the frequency and location of data collection and the influence of other environmental factors a change in the environmental sampling may need to occur if any impacts are to be detected.

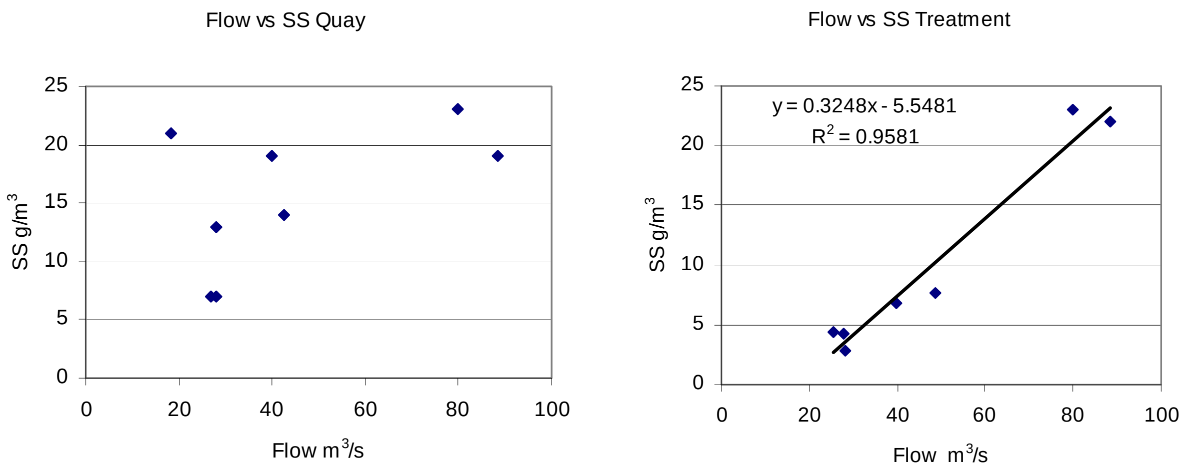


Figure 2.5.6 Flow versus SS at two sites in the Whakatane River, 2004 to 2007.

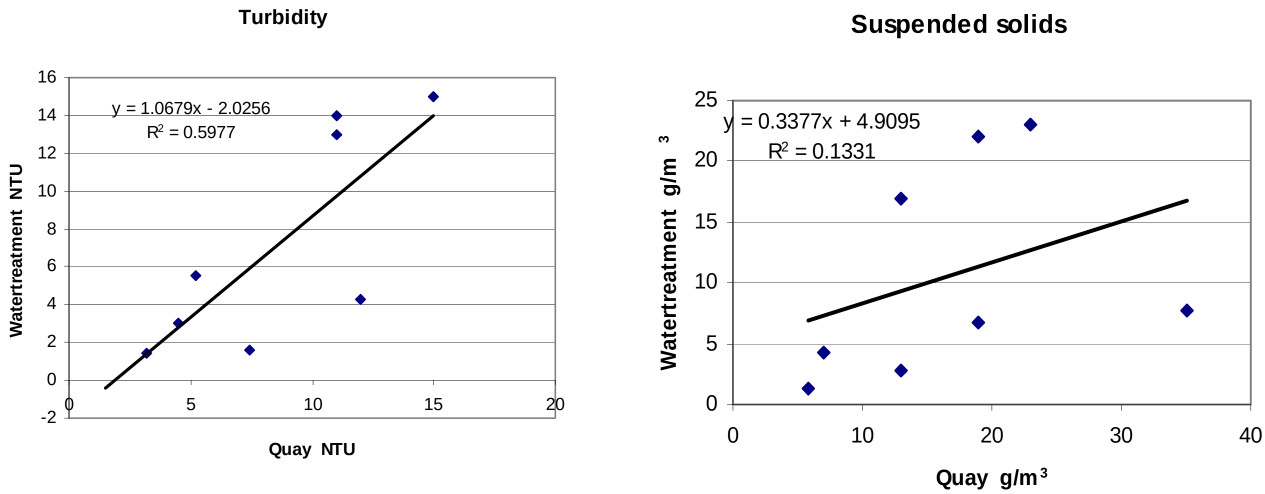


Figure 2.5.7 Correlation of turbidity and SS between the Quay Street and Water Treatment sites, 2002 to 2007 (one outlier removed).

2.6 Marine outfalls

Three marine outfalls for treated sewage effluent have conditions that require the environmental quality of the receiving environment to be monitored. These are Ohope, Tauranga/Mount Maunganui and Katikati. The self-monitoring by the consent holder is reported here.

Ohope outfall

Treated effluent is discharged offshore from Ohope Beach from a diffuser. The consent for discharge requires indicator bacteria monitoring of the near shore environment around the diffuser. Samples are taken at shallow water depth (0 to 2 m) and at moderate water depth (5 to 10 m) to the east, west and south of the outfall. Results are shown in Table 2.6.1 and 2.6.2.

Indicator bacteria around the diffuser have been within compliance for the past few years with only one sample in February 2004 nearing the compliance limit (136 faecal coliforms cfu/100 ml). Mussels sampled from around the diffuser at the time were elevated above levels safe for human consumption indicating a possible contamination event had occurred. Shellfish samples taken to the south-east of the diffuser in February 2006 also had elevated faecal coliform levels (500 MPN/100 g). This coincides with elevated faecal coliform concentrations in the water at the 0-2 m depth range.

Table 2.6.1 Monitoring results for enterococci and faecal coliform at the 0.2 m depth range 100 m from the Ohope outfall diffuser.

0- 2 m Depth	Enterococci cfu/100 ml			Faecal cfu/100 ml		
Date	South	East	West	South	East	West
26/02/2004	11	<1	<1	<1	<1	<1
26/02/2004	7	1	<1	<1	<1	80
7/07/2004	<1	<1	<1	<1	1	1
7/07/2004	<1	<1	<1	<1	1	<1
25/01/2005	2	1	<1	1	<1	3
25/01/2005	1	<1	<1	1	<1	2
25/01/2005	<1	<1	<1	<1	<1	<1
25/01/2005	<1	<1	<1	<1	<1	<1
4/08/2005	<1	<1	1	<1	<1	<1
4/08/2005	<1	<1	<1	<1	<1	<1
23/02/2006	<1	2	<1	14	1	14
23/02/2006	<1	<1	1	15	17	3
27/07/2006	<1	1	<1	<1	<1	<1
27/07/2006	<1	<1	<1	<1	1	<1
14/02/2007	<1	<1	<1	<1	<1	<1
14/02/2007	<1	<1	<1	<1	<1	<1
29/10/2007	<1	<1	<1	<1	<1	<1
29/10/2007	<1	<1	<1	<1	<1	<1
4/02/2008	<1	<1	<1	1	<1	<1
4/02/2008	<1	<1	<1	<1	1	<1

Table 2.6.2 Monitoring results for enterococci and faecal coliform at the 5-10 m depth range 100 m from the Ohope outfall diffuser

5-10m depth	Enterococci cfu/100ml			Faecal cfu/100ml		
Date	South	East	West	South	East	West
26/02/2004	2	<1	<1	<1	1	<1
26/02/2004	1	<1	<1	<1	<1	<1
7/07/2004	2	<1	<1	<1	<1	<1
7/07/2004	1	1	<1	<1	<1	2
25/01/2005	<1	2	<1	<1	2	1
25/01/2005	<1	2	<1	<1	3	2
25/01/2005	<1	<1	<1	<1	<1	<1
25/01/2005	<1	<1	<1	<1	<1	<1
4/08/2005	<1	<1	<1	<1	<1	<1
4/08/2005	<1	<1	<1	<1	3	<1
23/02/2006	<1	<1	<1	<1	<1	<1
23/02/2006	<1	<1	<1	<1	<1	<1
27/07/2006	1	<1	<1	<1	<1	<1
27/07/2006	<1	<1	<1	<1	<1	<1
14/02/2007	<1	<1	<1	<1	1	<1
14/02/2007	1	<1	<1	<1	<1	<1
29/10/2007	<1	<1	<1	<1	<1	<1
29/10/2007	<1	<1	<1	<1	<1	<1
4/02/2008	<1	<1	<1	<1	1	1
4/02/2008	<1	<1	<1	1	1	1

Elevated indicator bacteria levels in the water column around the diffuser were previously found in March 2003. At that time indicator bacteria concentrations were shown to be within compliance limits (Figure 2.6.1). Since this time there have been several episodes of enterococci concentrations being above the compliance limit for the post maturation ponds and two non-compliances for faecal coliforms. There is also a significant trend of increasing faecal coliform concentrations in these ponds (Kendal z=2.683, p=0.007) since 2002.

These factors suggest there is a potential problem with the current maturation ponds in pathogen removal and that current environmental monitoring is not adequately monitoring any elevated episodic discharges at the diffuser.

Environment Bay of Plenty runs a bathing surveillance programme each summer sampling at two locations along Ohope beach; one at the Ohope surf club and the second near the Surf and Sand motor camp. There have been five exceedances over the red alert level for recommended bathing guidelines over the past five years at the Ohope Surf Club and no exceedances at the Ohope Surf and Sand site. While not conclusive, it is likely that exceedances at the Ohope Surf Club are a result of large flocks of seagulls that congregate in that area and/or the impact of high flows from the Whakatane River. Given predominant currents it is more likely that the discharge from the diffuser would potentially impact the Surf and Sand site. However, there is no relationship between Ohope outfall data and bathing surveillance data at this site.

There is a relationship between enterococci and faecal coliform data from the post maturation ponds (Figure 2.6.2) that indicates a near one to one relationship. There is research to support that enterococci are less reliable as an indicator of waste stabilisation pond effluent treatment and that *E.coli* are the better indicator. Given these relationships, any review of current consent conditions or consent renewal should look at alternative consent limits and indicator bacteria.

Shellfish monitoring over the past few years indicates that shellfish have become contaminated to levels unacceptable for human consumption (Figure 2.6.3). However, due to the frequency and timing of monitoring it is difficult to tell whether this is directly attributable to the outfall discharge.

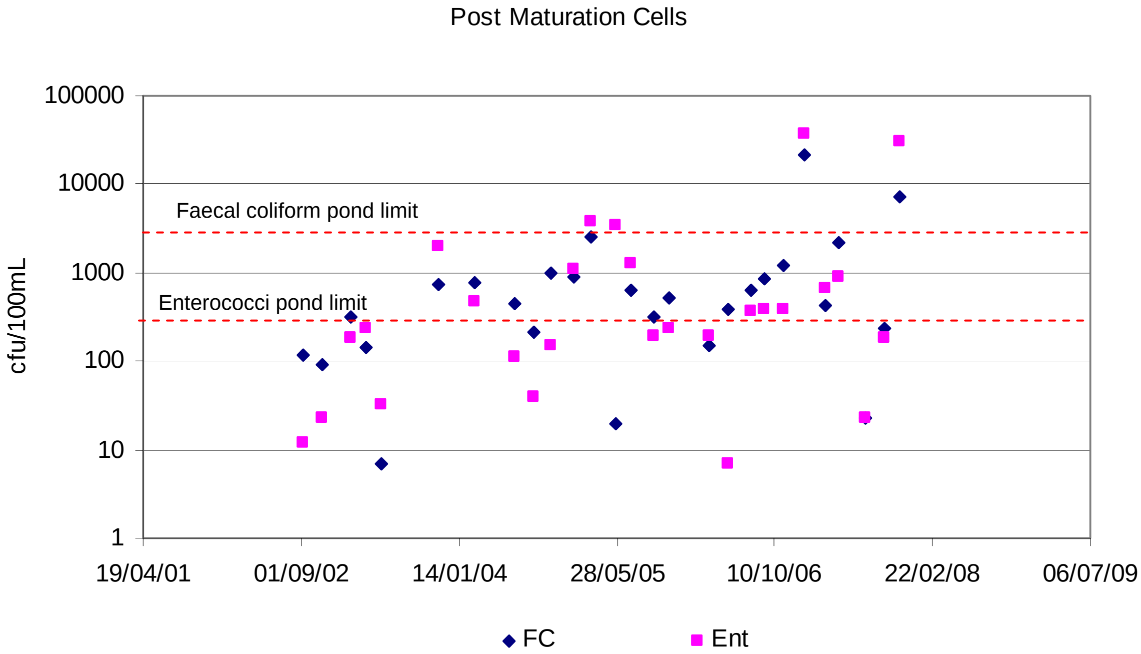


Figure 2.6.1 Indicator bacteria data from the post maturation ponds, Ohope WWTP.

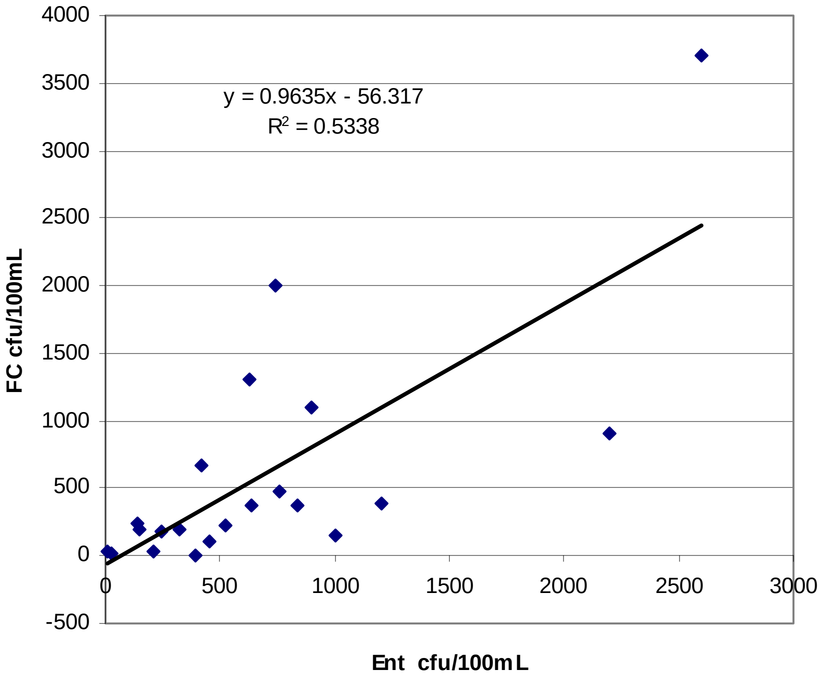


Figure 2.6.2 Correlation between enterococci and faecal coliforms from the Ohope WWTP post maturation pond, 2003-2008 (data over 5000 cfu/100 mL omitted, one outlier omitted).

In late 2007 it was discovered during routine sampling that the outfall pipe had become dislodged from the diffuser. Whakatane District Council undertook intensive monitoring to see if any impacts of the discharge were occurring at the near shore environment of Ohope Beach. One result in the orange alert level for contact recreation was recorded during high swells with easterly winds, but otherwise impacts were minimal.

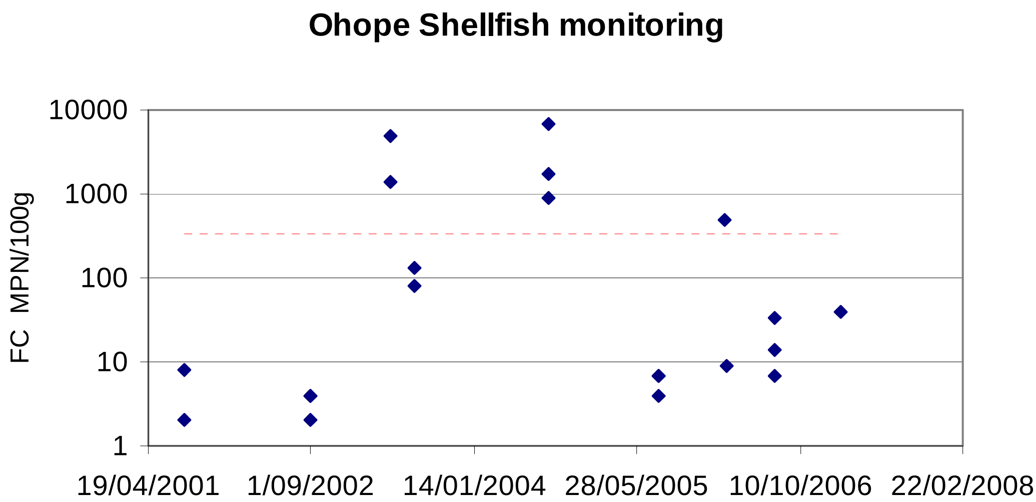


Figure 2.6.3 Compliance shellfish monitoring from within 300 m of diffuser.

Tauranga/Mount Maunganui Outfall

Ocean monitoring is performed at intervals along the coast either side of the Tauranga/Mount Maunganui treated sewage outfall. There are nine sampling points approximately 400 m off-shore and located at intervals two kilometres either side of the outfall as indicated in Table 4. These are analysed for enterococci. The objective of the monitoring programme is to sample along a line, 4 km long, between the outfall and the beach to detect any contamination that may impact beach users. Consent 62878 states that "*based on 20 coastal water samples collected each year in accordance with condition 11.1, the treated wastewater discharge shall not cause more than 13 enterococci values to exceed 35 enterococci per 100 mL, or cause any single sample to exceed 104 enterococci per 100 mL*".

Monitoring has shown the discharge has remained well within consent limits over the past few years. The highest recorded enterococci results occurred in March 2007 with three sites registering around 40 cfu/100 mL. Although slightly elevated, monitoring of indicator bacteria at the outfall pumping station shows no increase. The results show that there is low risk of contamination reaching the beach as enterococci levels are well below consent limits and recommended guidelines for bathing.

Shellfish monitoring is carried out at a range of sites long the coast at similar locations to the water sampling. Shellfish are analysed for a range of heavy metals and *E.coli*. Four samples out of 41 over the 2006/2007 period detected *E.coli* levels close to concentrations unsuitable for human consumption, but these were just within consent limits. Heavy metal analysis has shown shellfish samples to be well within consent limits with the exception of sampling undertaken in February and March 2008. These results showed high concentrations of nickel and chromium. Results ranged from 2.4-10 mg/kg total chromium and 2.5-6.6 mg/kg nickel (wet weight). As the results did not reflect any change in the concentrations of these metals in the effluent outfall and mussels collected from the diffuser it is likely that these elevated concentrations stem from stormwater discharges.

Chromium concentrations obtained from shellfish at Omanu/Papamoa are elevated in comparison to monitoring undertaken in 1999 in Tauranga Harbour at six locations. The range of chromium concentrations in this study was 2.1-4.8 mg/kg (dry weight); the highest result being from cockles at Hunters Creek. A recent analysis (April 2007) of chromium in pipi from Tilby Point and Pilot Bay showed concentrations of 0.22 and 0.076 mg/kg (wet weight) respectively, nickel was found to be 0.17 and 0.12 mg/kg (wet weight).

Katikati Outfall

The Katikati marine outfall offshore from Matakana Island delivers treated effluent to the Pacific Ocean. Near the outfall biological monitoring is undertaken at four sites and analysed for enterococci and faecal coliforms. One site is up current and three at intervals down current of the marine outfall. Ten samples are taken at each site on each sampling occasion.

To meet the requirements of the consent condition for shellfish growing waters, the faecal coliform levels should have a median of 14 n/100 ml or less and no more than 10% should exceed 43 n/100 ml. From Table 2.6.3 it can be seen that there has been compliance with the consent limits with some elevated results occurring in February 2005. However, no unusual elevated results were recorded in the effluent discharge and flow was normal.

The contact recreation standard referred to in the condition requires that the median of the samples be less than 35 enterococci/100ml and all results shall be less than 101 enterococci/100 ml. This was also achieved over the 2004 to 2008 period.

Heavy metal concentrations are measured in the effluent stream. Concentrations are usually below detection limits.

Table 2.6.3 Offshore monitoring results for the Katikati outfall.

	200m up current of the outfall structure		**100m down current of the outfall structure**		**50m down current of the outfall structure**		**200m down current of the outfall structure**	
Date	Faecal Coliforms per/100ml	Enterococci per/100ml	Faecal Coliforms per/100ml	Enterococci per/100ml	Faecal Coliforms per/100ml	Enterococci per/100ml	Faecal Coliforms per/100ml	Enterococci per/100ml
1/05/2004	<4	<4	<4	<4	<4	<4	<4	4
	<4	<4	<4	<4	4	<4	<4	<4
	<4	<4	4	<4	<4	<4	<4	<4
	<4	<4	4	<4	<4	4	<4	<4
	4	<4	<4	<4	4	<4	<4	<4
	<4	<4	4	<4	4	<4	<4	<4
	<4	<4	<4	<4	4	<4	8	<4
	<4	<4	4	<4	<4	<4	<4	<4
	4	<4	<4	<4	<4	<4	<4	<4
	4	<4	<4	<4	<4	<4	<4	<4
1/08/2004	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	4	<4	<4
	<4	<4	<4	<4	<4	4	<4	<4
	<4	<4	<4	<4	<4	4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
1/11/2004	<4	<4	<4	<4	<4	<4	<4	<4

	200m up current of the outfall structure		100m down current of the outfall structure		50m down current of the outfall structure		200m down current of the outfall structure	
Date	Faecal Coliforms per/100ml	Enterococci per/100ml	Faecal Coliforms per/100ml	Enterococci per/100ml	Faecal Coliforms per/100ml	Enterococci per/100ml	Faecal Coliforms per/100ml	Enterococci per/100ml
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
1/02/2005	4	<4	<4	<4	8	<4	12	<4
	4	<4	12	<4	8	<4	8	<4
	12	<4	8	<4	8	<4	4	<4
	12	<4	**16**	<4	<4	<4	4	<4
	<4	<4	4	<4	16	<4	4	<4
	4	<4	**56**	<4	12	<4	4	<4
	28	<4	**28**	<4	12	<4	<4	<4
	12	<4	8	<4	20	<4	8	<4
	8	<4	4	<4	4	<4	<4	<4
	20	<4	4	<4	16	<4	<4	4
1/05/2005	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
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	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
1/02/2006	<4	<4	<4	<4	4	<4	<4	<4
	<4	<4	<4	<4	<4	4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	80	<4	<4
	<4	<4	<4	<4	<4	8	<4	<4
	<4	<4	<4	<4	<4	8	<4	<4
	<4	8	<4	<4	<4	8	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
1/11/2006	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
24/08/07	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	12	<4	12	<4	4	<4	<4

	200m up current of the outfall structure		**100m down current of the outfall structure**		**50m down current of the outfall structure**		**200m down current of the outfall structure**	
Date	Faecal Coliforms per/100ml	Enterococci per/100ml	Faecal Coliforms per/100ml	Enterococci per/100ml	Faecal Coliforms per/100ml	Enterococci per/100ml	Faecal Coliforms per/100ml	Enterococci per/100ml
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	<4	<4	<4	<4	<4
	<4	<4	<4	8	<4	16	<4	<4
	<4	8	<4	<4	<4	8	<4	<4

Chapter 3: Conclusions

Impacts of a number of the larger industrial and municipal discharges on the aquatic environment have been assessed through a variety of environmental and compliance monitoring programmes. The table below summarises the conclusions of monitoring for river and marine sites around the region.

System	Impact	Comment
Tauranga Harbour	Ballance Agri-Nutrients Limited, Port of Tauranga.	Some increase in discharges, but no real change in the water column except in storm events. Elevated levels of contaminants near outfalls although within guideline levels. Shellfish and sediment monitoring show no appreciable impact attributable to these sources.
Kaituna River	AFFCO, Te Puke treated sewage.	There is some degradation of water quality in the Kaituna River. Nutrient and indicator bacteria levels are increasing, with indicator bacteria levels sometimes above recommended guideline levels. There is significant nutrient loading from the AFFCO discharge particularly of NH_4-N but it is unclear what impact this may be having. Bacterial contamination from the AFFCO site has improved in recent years, but levels continue to increase in the lower river and Maketu Estuary.
Tarawera River	SCA Hygiene, Kawerau District Council, CHH Tasman, Norske Skog Tasman, and Geothermal discharges.	Industrial, geothermal and stormwater discharges from the Tasman industrial complex continue to affect the Tarawera River. Colour, BOD and dissolved oxygen concentrations have improved in the past few years. BOD in the river has steadily decreased resulting in full compliance with DO standards set for the river. However, the colour standard set in the Regional Plan for the Tarawera River Catchment is not being met.
Rangitaiki River	Fonterra Edgecumbe.	Monitoring of the Rangitaiki River has concentrated on biological growths in the form of sewage fungus. Lactose in the effluent tends to promote the growth of sewage fungus once it exceeds a threshold. Sewage fungus growth has been increasing as increased lactose has been discharged to the river. Foam from the discharge is also an issue.
Whakatane River	Carter Holt Harvey Paperboard Whakatane Mill.	Monitoring in the Whakatane Estuary and comparison with the river above the mill discharge shows no detectable adverse impacts on water quality, as a result of the mill discharge. Several exceedances of consent condition have occurred in the past few years, but no impact has been detected in the lower river environment. A change in monitoring may be required to remove the influence of the tide and other inputs.

WWTP Marine Effluent Outfalls	Whakatane District Council, Tauranga City Council, Western Bay of Plenty District Council.	Bacterial monitoring adjacent to marine outfalls shows that at present there is little risk to bathing water quality at nearby beaches. Bacteria in shellfish near the Ohope outfall have at times been elevated to levels unacceptable for human consumption. Heavy metal concentrations in shellfish adjacent to the Tauranga/Mount Maunganui outfall have been elevated with respect to nickel and chromium. This seems to be unrelated to the outfall.

Recommendations

In some cases the monitoring strategies employed for compliance and environmental monitoring purposes fail to provide sufficient information to assess the impacts of industrial and municipal discharges. A range of recommendations are listed below which will help in these situations:

- Increased frequency of sediment and shellfish monitoring in estuarine environments; e.g. Tauranga Harbour adjacent to the Port.

- Increased shellfish bacterial surveys of the Maketu Estuary. This could take the form of less frequent but more intensive surveys.

- Due to tidal influences and potential influence of other waterways entering the Whakatane River Estuary an alternative impact site is recommended. A site immediately downstream of the Landing Road Bridge on the true left of the river would give a better idea of the influence of the CHH Board Mills discharge. Sampling should be restricted to low or outgoing tides.

- The current shellfish monitoring around the Ohope outfall requires collection of shellfish within 300 m of the diffuser. Sampling of tuatua from the surf zone would help better determine any on-beach impacts and protect public health.

Chapter 4: References

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