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Christchurch Wastewater Treatment Plant

Annual Monitoring Report

July 2010 - June 2011

Summary

This report summarises the results of parameters monitored by the Christchurch Wastewater Treatment Plant (CWTP) over the period July 2010 – June 2011 in accordance with consent CRC051724. Consent CRC051724 allows the discharge of treated wastewater from the CWTP Oxidation Ponds into the Pegasus Bay Coastal Marine Area via an ocean outfall.

Of the comprehensive sampling programme required by the consents, most samples were collected during the monitoring period and most monitored parameters achieved the required standards. Earthquakes occurring 4th Sept 2010, 22nd February 2011 and 13th June 2011 caused significant damage to the treatment plant, oxidation ponds and CCC Laboratory. This resulted in periods where not all samples were taken and/or analysed, and periods where damage to the plant resulted in a deterioration in effluent quality.

The earthquake on 4th September 2010 caused damage to the treatment plant and more particularly the oxidation ponds. The ponds banks suffered extensive damage with most banks slumping and transfer structures between ponds 2 – 3 and 1 – 4 becoming unserviceable. The treatment plant lost the function of some of it's treatment process for a period of two weeks and flows were bypassed untreated to the ponds. The net effect was a loss of treatment efficiency, which was remedied within 2 months of the earthquake. Full repairs were made to the plant and temporary repairs had been made to the oxidation ponds (while a full repair methodology was being developed) by February 2011.

The earthquake on the 22nd February 2011, while smaller in magnitude, caused significantly more damage to both the treatment plant and oxidation ponds – effectively undoing all of the work that was completed in October and November. The treatment plant suffered damage to all systems with the exception of the inlet works. For the first two weeks following the earthquake all flows were bypassed untreated to the oxidation ponds. The ponds themselves suffered further damage with more extensive slumping of pond bunds and further damage to transfer structures. This meant that the operating levels of the ponds had to be reduced to meet the new profile to prevent flows overtopping the pond banks, and transit times through the ponds had to be increased.

The secondary treatment was the hardest hit system with all four clarifiers extensively damaged and completely unserviceable without major repair works. Primary treatment systems were repaired relatively soon after the earthquake but suffered continual damage from liquefaction sediments received at the plant from damaged sewers, resulting in the tanks consistently being fouled with sand and having to be taken service.

By the middle of June all primary tanks were in operation, sand infiltration had effectively stopped, one clarifier had been temporarily repaired and a repair methodology had been formulated for the oxidation ponds. Discharge effluent was finally meeting the discharge consent for the first time since the February earthquake.

The earthquake on June 13th exacerbated the damage to ponds and returned that plant to a state similar to where it was in March 2011. Due to the damage experienced at the plant being similar to the February earthquake, and because contractors were already based on site, work was able to be progressed at a far quicker rate then that following the February earthquake and the plant was back to a similar operational status (as it had been pre June 13) within 4 weeks of the June 13 event.

Following the June earthquake a new recovery plan was completed for the plant and the ponds. The repair programme for the treatment plant is likely to be completed for all items by June/July 2012 and the oxidation ponds are likely to be completed by October 2012.

The work taken to repair the ponds will involve large amounts of earth movement and vibrodensisfication and will necessitate isolating some ponds for extended periods. This will have the effect of reducing transit times through the pond system and will decrease treatment effectiveness until the works are completed. It is highly likely that the effluent discharged from the ocean outfall will not fully meet the discharge standard for all determinants until October 2012.

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1 Outfall Discharge

1.1 Resource Consent Conditions

Table 1.1.1 Pond Discharge Consent Compliance for Monitoring Period July 2010 – June 2011 CRC051724

Consent Condition	Parameter	Compliance Condition	Compliance												
			Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-11	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Overall
2	Discharge Content	Discharge is only wastewater from the CWTP ponds	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
3	Discharge Volume	Recorded	☺	☺	☺	☺	☺	☺	☺	😐	☺	☺	☺	☺	😐
4	Discharge Rate	Recorded	☺	☺	☺	☺	☺	☺	☺	😐	☺	☺	☺	☺	😐
9	Outfall Maintenance	Routine maintenance completed and recorded	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
10	Outfall Condition	Visual inspection of outfall	n/a	n/a	n/a	n/a	n/a	☺	n/a	n/a	n/a	n/a	☺	n/a	☺
12	Pumping Pressure for a given flow	Monitored	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺

Key: ☺ Full Compliance 😐 Minor, Isolated or Risk of Non-Compliance ☹ Major or Consistent Non-Compliance

Figure 1.1.1 - Daily Outfall Flow Totals Jul 2010 – Jun 2011

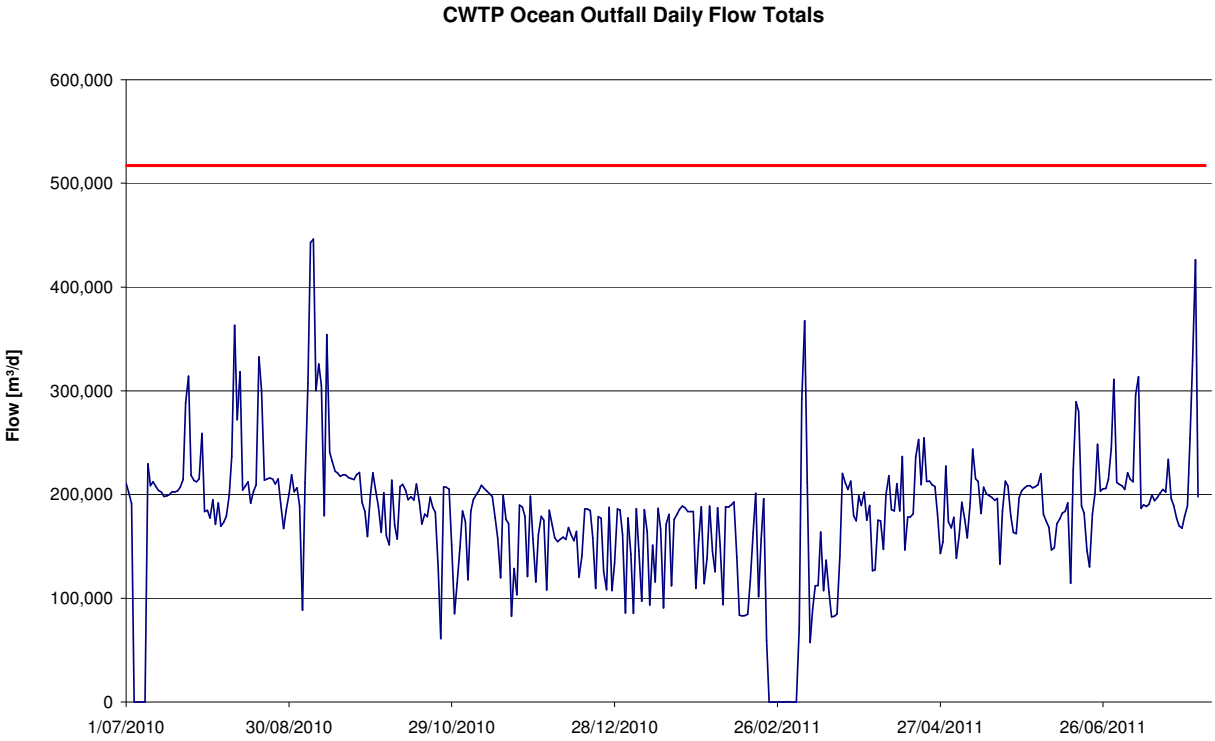
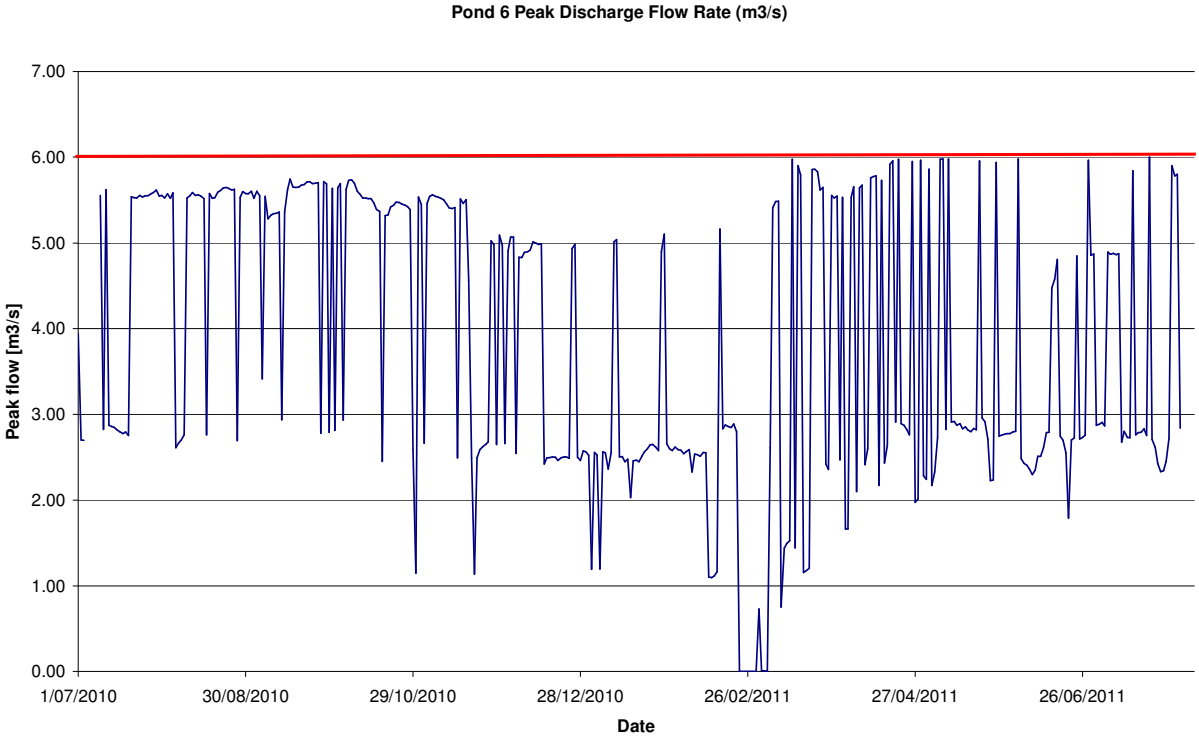


Figure 1.1.2 - Daily Peak Outfall Flows Jul 2010 - Jun 2011



1.2 Comments on Resource Consent Conditions

As this is the first year of operation, there is no previous year of data to use as a comparison and due to the effects of the earthquakes it is difficult to identify any trends. In general the Ocean Outfall pumpstation has performed as per expectations for flow and pressure.

The discharge volume and rate is continuously recorded and reported in the quarterly reports. The February earthquake resulted in a loss of communication with the pump station and as a result volumes, rates and pressures were not recorded for a short period. The pump station lost both power feeds during the February and June earthquakes, though all flows (except for those on June 14 noted below) were able to be discharged via gravity.

The outfall pipeline was inspected via dive surveys in December 2010 and May 2011 which showed that the pipeline had suffered no ill effects from the earthquakes and was performing as designed with all ports flowing evenly and no degradation of structural integrity.

The hydraulic performance of the Ocean Outfall pump station was assessed after the September earthquake on the 6th and 14th of September 2010, after the February earthquake on 14th March 2011 and after the June earthquake on 28th June 2011. The results from all surveys demonstrated that the pipeline is performing as designed and the hydraulic profile is operating within design limits.

The outfall pump station lost both of its electricity feeds during the Feb 22 and June 13 earthquake events and as such was only able to discharge flows via gravity. Flows received at the plant after the June 13 earthquake were in excess of the gravity flow profile of the pipeline and as such effluent was required to be discharged from pond 6 to the estuary via the existing discharge structure to prevent flows overtopping the pond banks causing damage to the pond banks. In total approximately 85,500m^3 were discharged into the estuary over a 24h period, until electricity supply was restored.

1.3 Resource Consent Standard Conditions

Table 1.3.1 Contaminant Limits Consent Compliance Jul 2010 – Jun 2011 CRC051724

Consent Condition	Parameter	Compliance Condition	Compliance												
			Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-11	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Overall
15a	Dissolved BOD_5	Concentration does not exceed 20 g/m^3	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
	Total Suspended Solids	Concentration does not exceed 50 g/m^3	☺	☺	😐	😐	☺	☺	☺	😐	😐	☺	☺	☺	😐
	Ammoniacal Nitrogen	Concentration does not exceed 40 g/m^3	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
16a	Faecal Coliforms	Concentration does not exceed 1,000(standard)/5,000(higher) MPN/100mL	☺	☺	☹	😐	😐	☺	😐	☺	☹	☹	☹	☹	☹
	Enterococci	Concentration does not exceed 1,500 MPN/100mL	☺	☺	😐	☺	☺	☺	☺	☺	😐	☹	☺	☺	☹

Key: ☺ Compliance Achieved with no Exceedance of Standard 😐 Compliance Achieved with Occasional Exceedance of Standard ☹ Exceedance of Standard resulting in Non-Compliance

1.4 Comments on Resource Consent Standard Conditions

Earthquakes in Sept, Feb and June impacted on the ability of the plant to achieve compliance, but emergency repairs have resulted in the treated effluent achieving consent requirements on all determinants except Faecal Coliforms by the end of the reporting period. Secondary processes that were damaged after the February earthquake have been partially re-established with a significantly reduced capacity. Without full clarifier capacity, the quality of effluent entering the ponds is impaired, and requires additional chemical augmentation to meet consent. The process of repairing the clarifiers will require a further 12 months, but once completed the plant should achieve pre-earthquake performance.

Immediately after the February earthquake, effluent bypassed both the primary and secondary processes due to damage to a number of process tanks and had to be discharged screened but otherwise untreated into the oxidation ponds. The oxidation ponds were significantly damaged by the earthquake events (as noted in the summary section) and as such the flow path through the ponds had to be changed to accommodate the damage and the levels of the ponds lowered to prevent bank failure. This lead to a loss of the sequential flow pattern through the ponds and a significantly reduced transit time, resulting in an overall deterioration in disinfection performance with discharge Faecal Coliform and Enterococci values of up to 3 log higher than normal values

Repairs at the treatment plant to the damaged processes tanks have lead to a general improvement in disinfection results. Works to repair the oxidation ponds has begun with a completion date expected in October 2012. It is unlikely that effluent discharges will be fully compliant before this date.

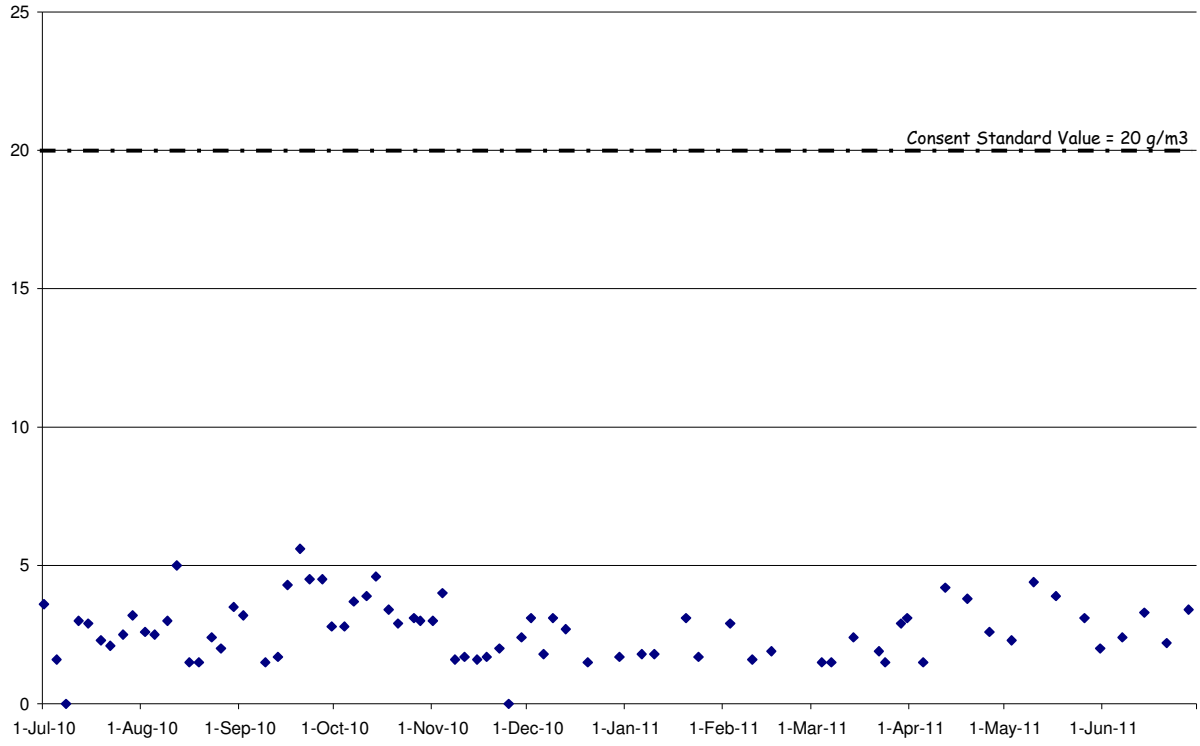
1.5 Dissolved BOD_5 Compliance

Table 1.5.1 Pond Discharge Dissolved BOD_5

Median Value [g/m^3] Current Monitoring Period (July 2010 - June 2011)	2.6	Number of Exceedances Current Monitoring Period (July 2010 - June 2011)	0
Median Value [g/m^3] Previous Monitoring Period (July 2009 - June 2010)	2.3	Number of Exceedances Previous Monitoring Period (July 2009 - June 2010)	N/A[1]

There were no non-compliances recorded for the 2010-2011 year and no values were above the consent standard value (1.5.2). The mean value for the 2010-2011 period was similar to the 2009-2010 reporting period (1.5.1) and neither period experienced exceedances of the consent standard value.

1.5.2 Pond Discharge Dissolved BOD_5



[1] Outfall operational as of March 2010

1.6 Total Suspended Solids Compliance

Table 1.6.1 Pond Discharge Total Suspended Solids

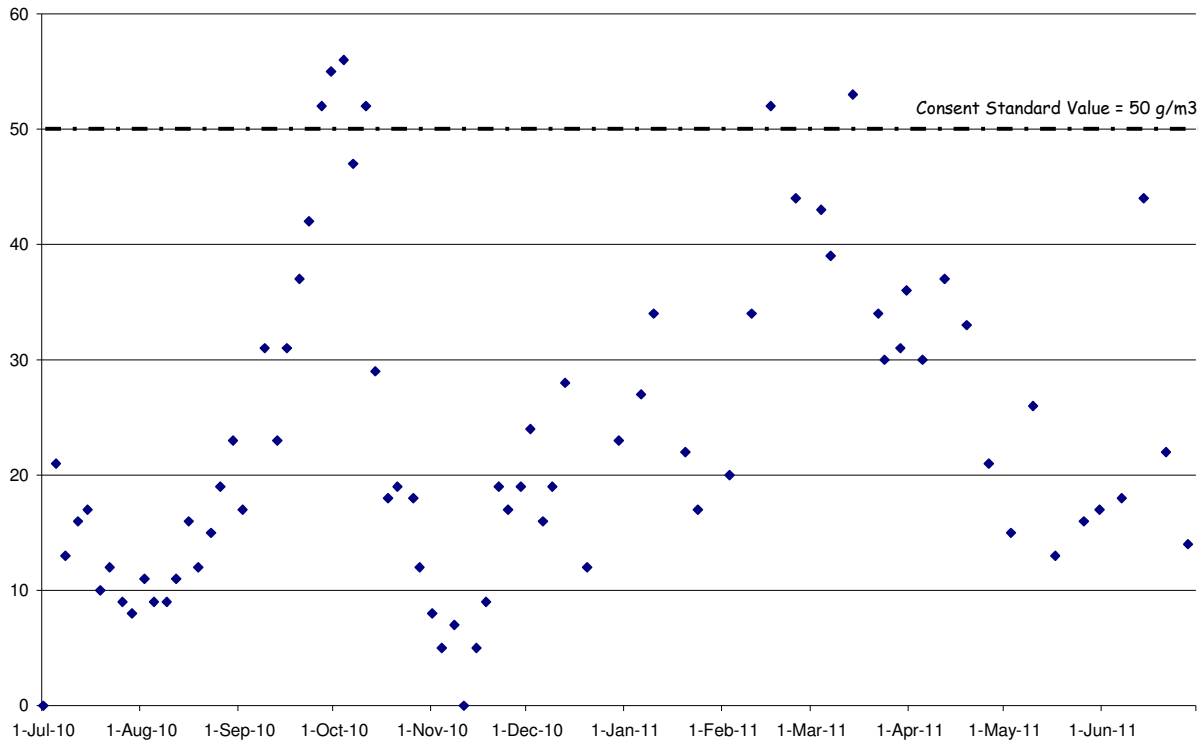
Median Value [g/m^3] Current Monitoring Period (July 2010 - June 2011)	21.5	Number of Exceedances in Current Monitoring Period (July 2010 - June 2011)	6
Median Value [g/m^3] Previous Monitoring Period (July 2009 - June 2010)	29	Number of Exceedances Previous Monitoring Period (July 2009 - June 2010)	NA[1]

There were no non-compliances recorded for the 2010-2011 year and only 6 values were above the consent standard value (1.6.2). The mean value for the 2010-2011 period was slightly lower then the 2009-2010 reporting period (1.6.1).

All exceedances were associated with earthquake events and it is likely that these exceedances could be the result of turbulence created by the earthquake event or the release of liquefiable material into the ponds, which took a couple of weeks to settle out. The effects of the earthquakes on discharge suspended solids was fairly short in duration and the ponds recovered quickly.

Major earthworks are planned to be carried out in the ponds over the next 12 month period and it is likely that this will have an impact on the discharge suspended solids levels until works completion in October 2012.

1.6.2 Pond Discharge Total Suspended Solids



[1] Outfall operational from March 2010

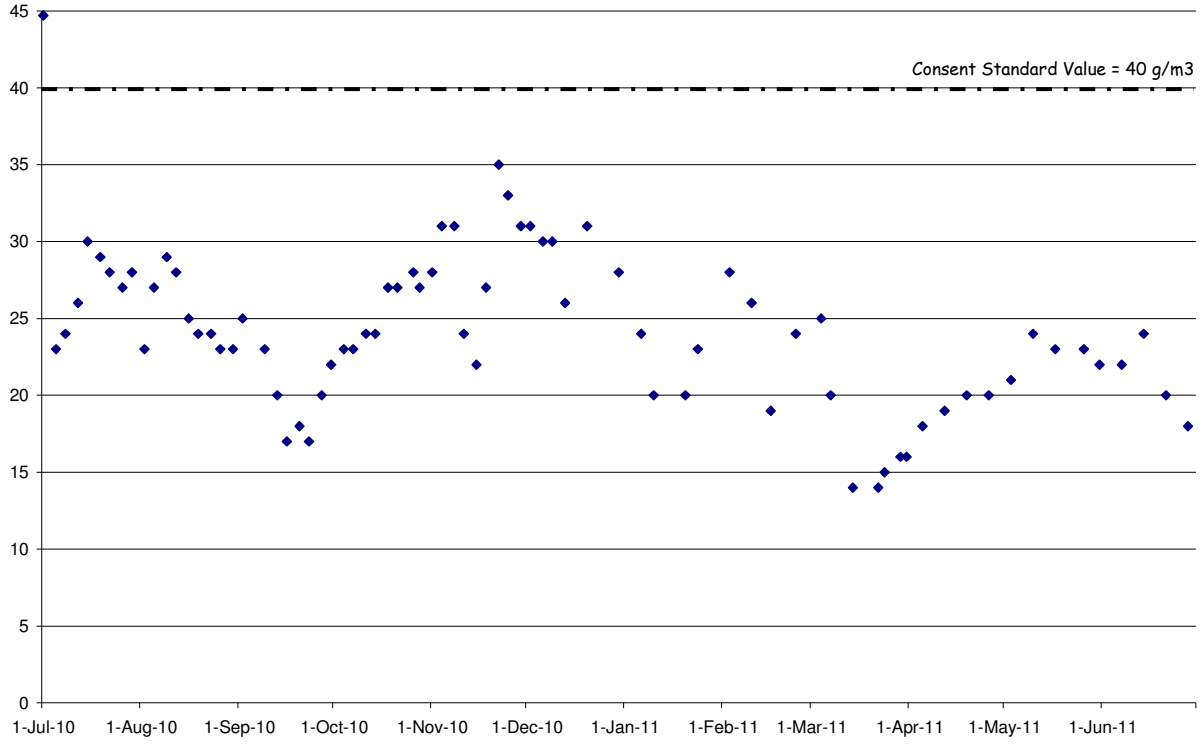
1.7 Ammonia Nitrogen Compliance

Table 1.7.1 Pond Discharge Ammoniacal Nitrogen

Median Value [g/m^3] Current Monitoring Quarter (July 2010 - June 2011)	24	Number of Exceedances Current Monitoring Quarter (July 2010 - June 2011))	0
Median Value [g/m^3] Previous Monitoring Period (July 2009 - June 2010)	22	Number of Exceedances Previous Monitoring Period (July 2009 - June 2010)	NA[1]

There were no non-compliances recorded for the 2010-2011 year and no values were above the consent standard value (1.7.2). The mean value for the 2010-2011 period was similar to the 2009-2010 reporting period (1.7.1).

1.7.1 Pond Discharge Ammoniacal Nitrogen



[1] Outfall operational from March 2010

1.8 *Enterococci Monitoring*

Table 1.8.1 Pond Discharge Enterococci

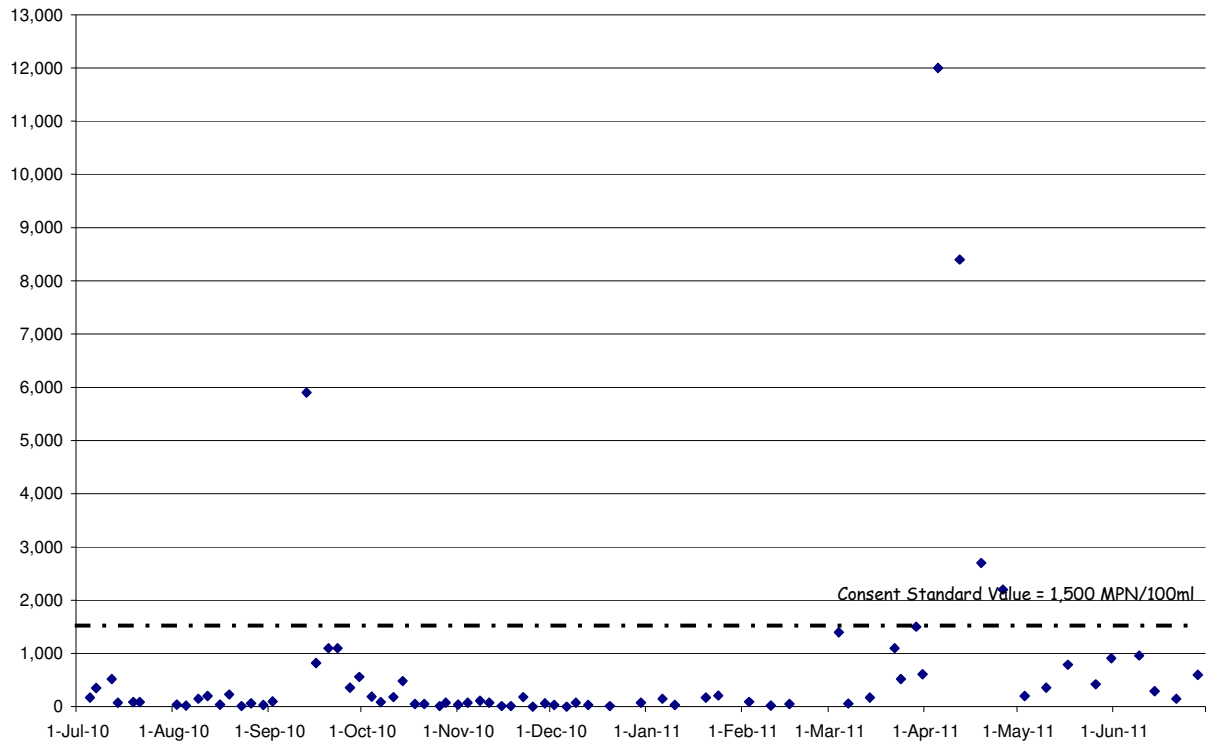
Median Value [MPN/100ml] Current Monitoring Quarter (July 2010 - June 2011)	160	Number of Exceedances Current Monitoring Quarter ((July 2010 - June 2011)	5
Median Value [MPN/100ml] Previous Monitoring Period (July 2009 - June 2010)	36	Number of Exceedances Previous Monitoring Period (July 2009 - June 2010)	NA[1]

There was one non-compliance recorded for the 2010-2011 year during the month of April and 5 values were above the consent standard value (1.8.2). Enterococci values exceeded the consent standard value once in September 2010 and four times in April 2011. The mean value for the 2010-2011 period was significantly higher then the 2009-2010 reporting period (1.8.1).

As mentioned in the chapter summary, these excedeenaces were directly attributable to the effects on the treatment plant and oxidation ponds of the September 2010 and February 2011 earthquakes. The values returned towards normal as repairs to the treatment plant were effected.

Major earthworks are planned to be carried out in the ponds over the next 12 month period and it is likely that this will have an impact on the discharge Enterococci levels until works completion in October 2012.

1.8.1 Pond Discharge Enterococci



[1] Outfall operational from March 2010

1.9 *Faecal Coliform Compliance*

Table 1.9.1 Pond Discharge Faecal Coliforms

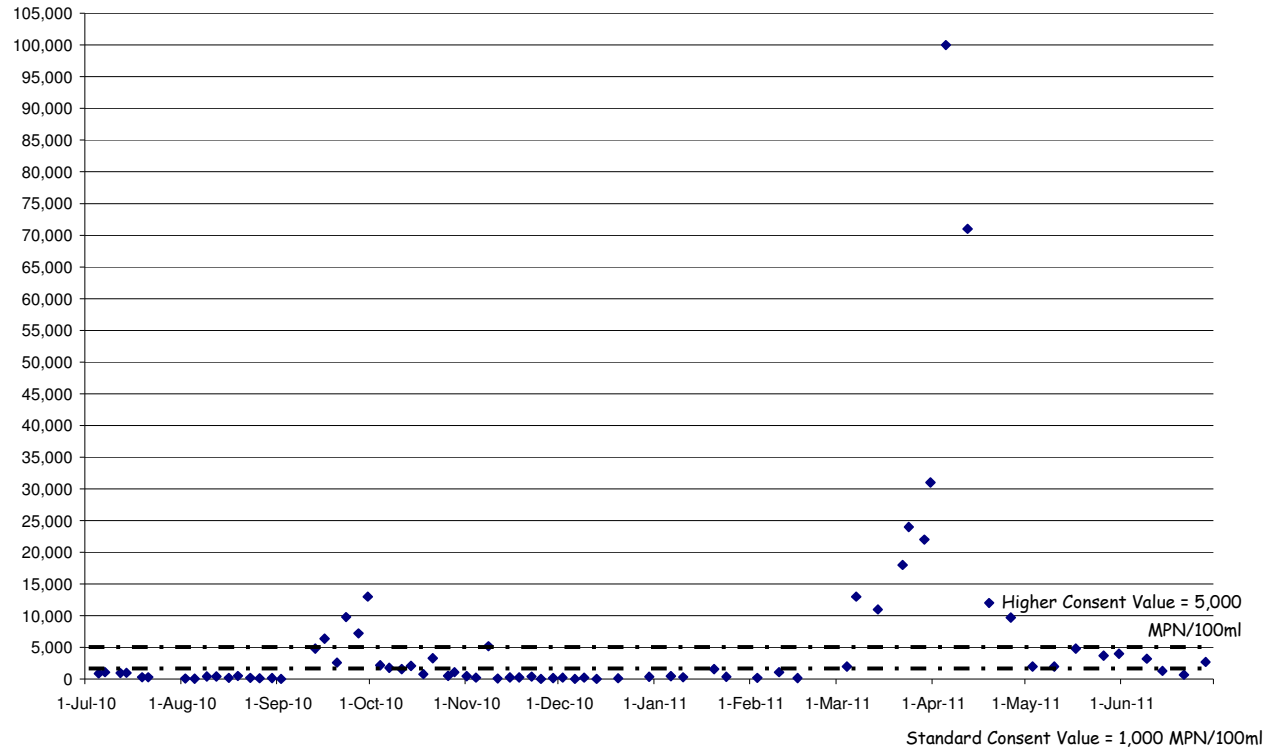
Median Value [MPN/100ml] Current Monitoring Quarter (July 2010 - June 2011)	1100	Number of Exceedances of Lower Limit for Current Monitoring Period (July 2010 - June 2011)	35
Median Value [MPN/100ml] Previous Monitoring Period (July 2009 - June 2010)	165	Number of Exceedances Previous Monitoring Period (July 2009 - June 2010)	NA[1]

There were three non-compliance periods recorded for the 2010-2011 year during the September-October 2010, March-April 2011 and May-June 2011 periods and 35 values were above the lower consent standard value of which 14 were also above the higher consent value (1.9.2). Faecal Coliform values exceeded the lower consent standard value in September, October , November, January, March, April, May and June, and the higher consent standard value in September, March and April. The mean value for the 2010-2011 period was significantly higher then the 2009-2010 reporting period (1.9.1).

As mentioned in the chapter summary, these excedeenaces were directly attributable to the effects on the treatment plant and oxidation ponds of the September 2010 and February 2011 earthquakes. The values returned towards normal as repairs to the treatment plant were effected.

Major earthworks are planned to be carried out in the ponds over the next 12 month period and it is highly likely that this will have an impact on the discharge Faecal Coliform levels until works completion in October 2012.

1.9.1 Pond Discharge Faecal Coliforms



[1] Outfall operational from March 2010

1.10 Other Pathogenic, and Other Contaminants

Condition 13e

Giardia cysts, cryptosporidium, salmonella, and campylobacter levels have been measured in July, October, January, March and June; and were found to be either of insignificant concentration, or have negligible affect due to poor survivability in sea water.

Condition 13f

Heavy metals (copper, chromium, nickel, zinc, cadmium, lead, arsenic, and mercury) were measured and reported each quarter and found to be below the ANZECC, USEPA, and Canadian CCME quality standards listed in Table 7.4 of the AEE.

Condition 13g

Organochlorine pesticides, organophosphate pesticides, PCBs, and polycyclic aromatic hydrocarbons were measured in August 2010, and found to be near or below lower detectable limits.

Condition 17

No scums, foams or other floatable material was observed at the edge of the diffuser mixing zone.

2 Receiving Environment Monitoring in Pegasus Bay

2.1 *Water Quality Resource Consent Conditions*

Table 2.1.1 Receiving Environment Water Quality Consent Compliance Aug 2010 – Jul 2011

Consent Condition	Parameter	Compliance Condition	Compliance				
			Aug - Oct 10	Nov –Jan 11	Feb – Apr 11	May - Jul 11	Overall
18	Faecal Coliforms	Sampled and Analysed	😐	😐	☹	☹	☹
	Enterococci	Sampled and Analysed	☺	☺	☺	😐	😐
22a	Temperature	Two yearly[1]	☺	☺	☺	n/a	☺
	DO	Two yearly	☺	☺	☺	n/a	☺
	Salinity	Two yearly	☺	☺	☺	n/a	☺
	Total Suspended Solids	Two yearly	☺	☺	☺	n/a	☺
	Nitrogen Oxides	Two yearly	☺	☺	☺	n/a	☺
	Ammoniacal Nitrogen	Two yearly	☺	☺	☺	n/a	☺
	Dissolved Reactive Phosphorus	Two yearly	☺	☺	☺	n/a	☺
	Chlorophyll-a	Two yearly	☺	☺	☺	n/a	☺
	Trace Metals (arsenic, cadmium, copper, chromium, lead, nickel and zinc)	Two yearly	☺	☺	☺	n/a	☺
	Faecal Coliforms	Two yearly	☺	☺	☺	n/a	☺
	Enterococci	Two yearly	☺	☺	☺	n/a	☺
	Phytoplankton Species	Two yearly	☺	☺	☺	n/a	☺

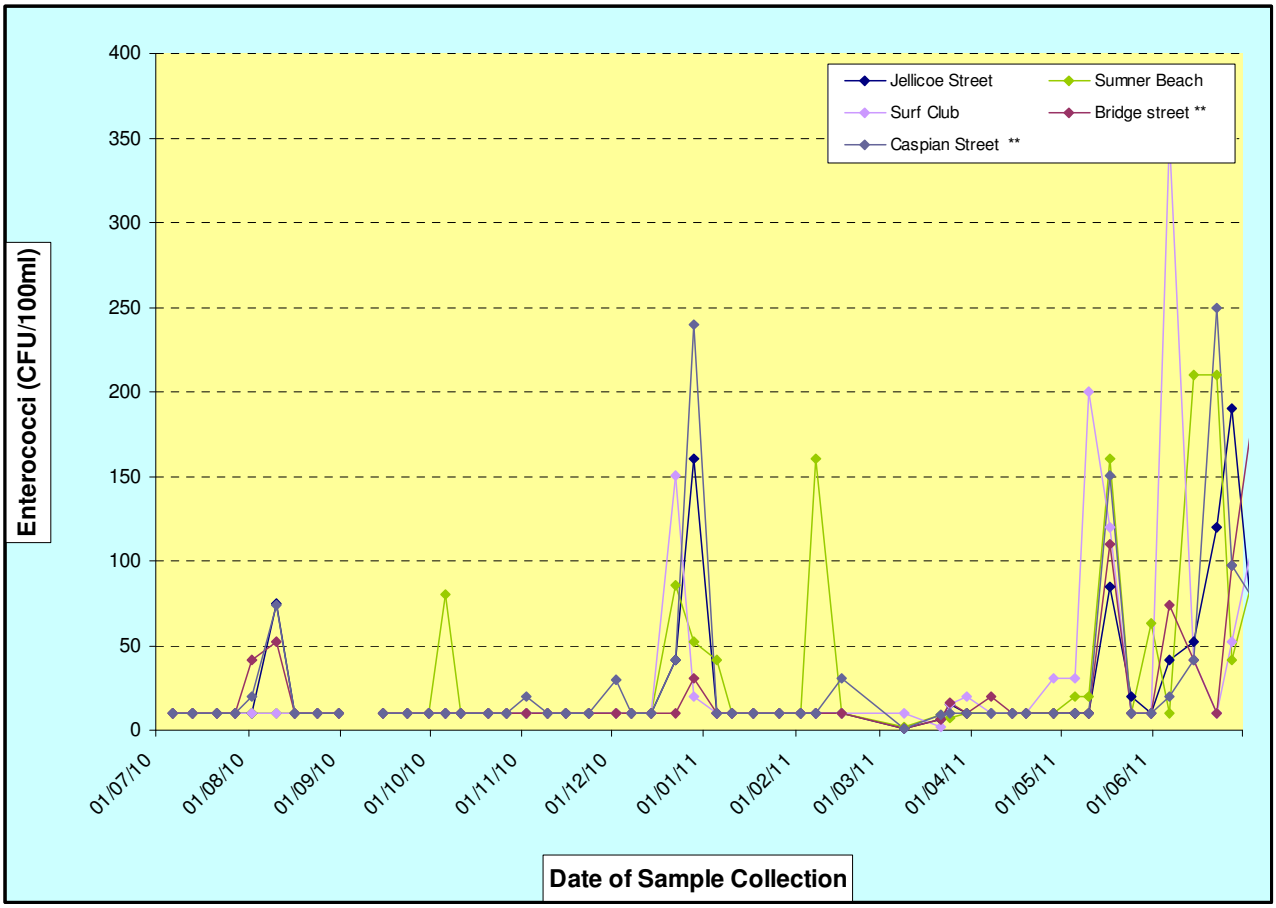
Key: ☺ Full Compliance 😐 Minor, Isolated or Risk of Non-Compliance ☹ Major or Consistent Non-Compliance

[1] Reporting requirements are every two months for one year after commissioning, and two yearly thereafter.

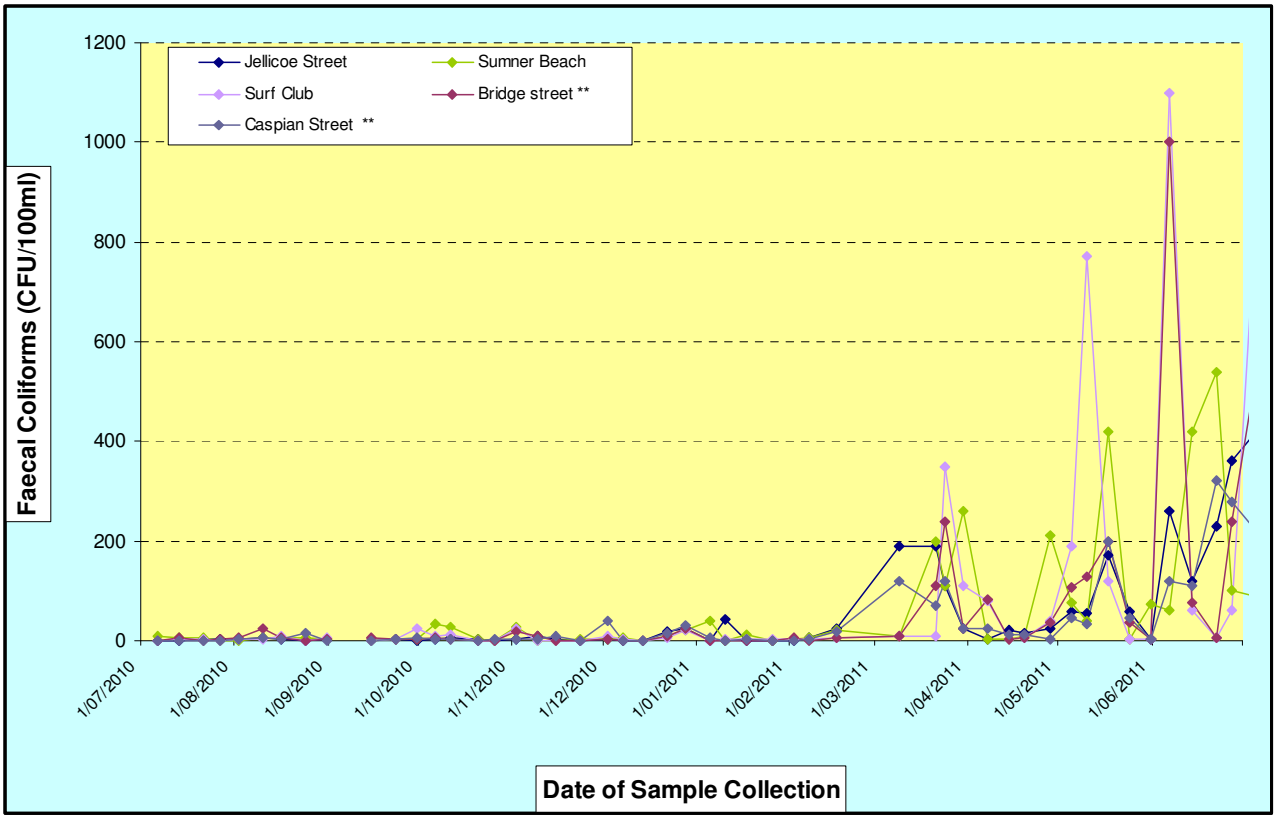
2.2 *Beach Water Quality Analysis Results*

Samples for condition 18 are taken at weekly intervals from locations around the vicinity of the outfall. Enterococci was identified in the AEE as a pathogenic organism, while faecal colliforms are an indicator organism used to monitor the likelihood of other pathogenic organisms. The results are presented in Figures 2.2.1and 2.2.2; missing samples are due to the September and February earthquakes. Retest results are contained in the Quarterly Reports.

2.2.1 Enterococci Levels at beaches adjacent to the Outfall



2.2.2 Faecal Coliform Levels at beaches adjacent to the Outfall

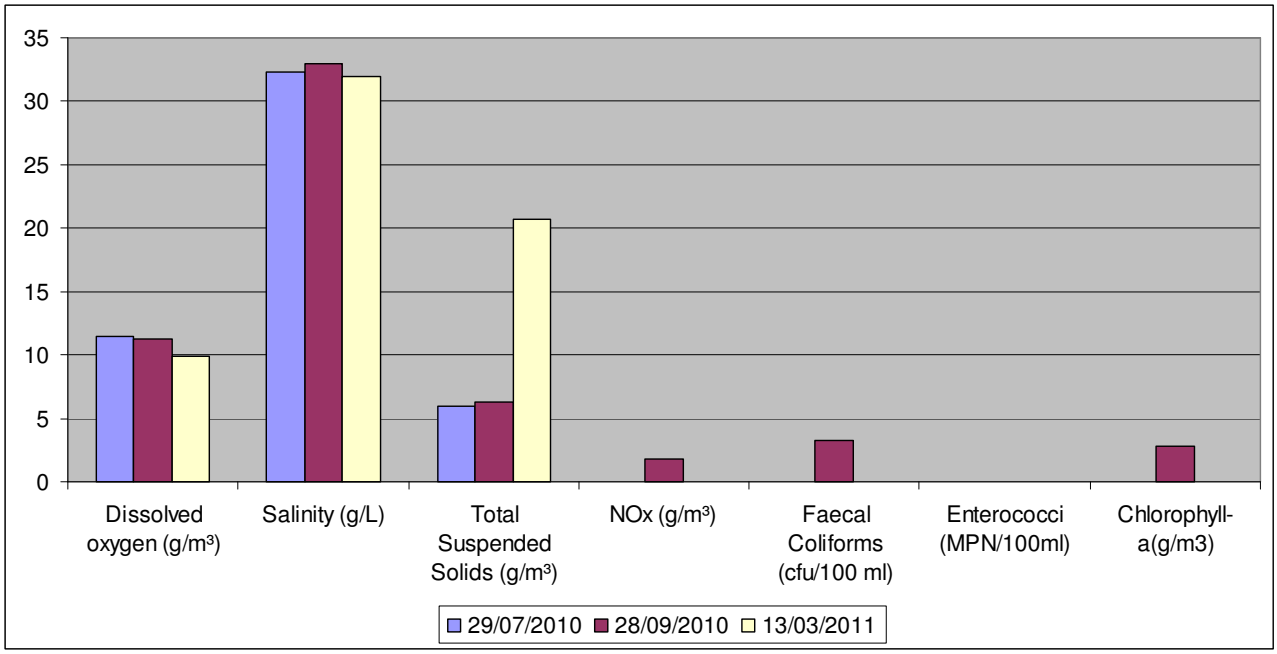


2.3 Ocean Water Sampling

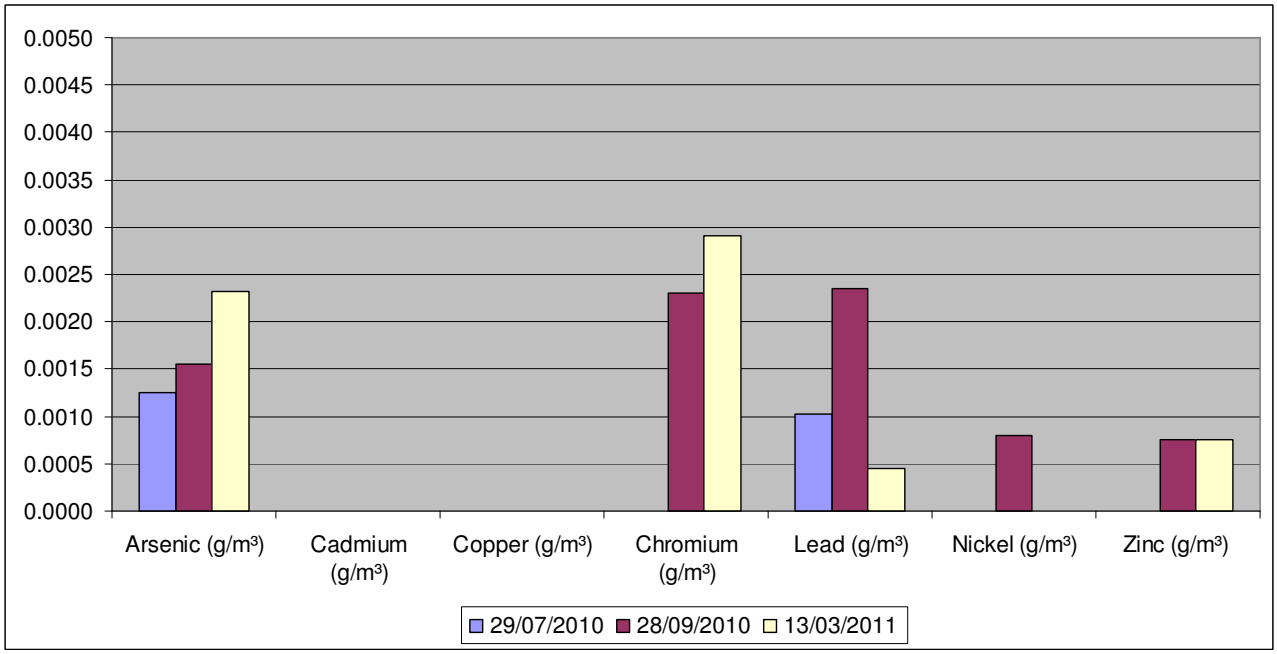
Samples are taken of the receiving waters for condition 21 200m north, south, east and west of the centre of the outfall diffusers, every 2 months from the commissioning of the outfall for one year and then at two yearly intervals. Samples were taken in May, July, September and November 2010 and January and March 2011. The results of the sampling is reported quarterly as per condition 22.

Average results are summarised below across all four sample points before and after the September and February earthquakes.

2.3.1 Averages of Samples taken 200m from Outfall Diffuser



2.3.2 Averages of Samples taken 200m from Outfall Diffuser



2.4 *Comments on Water Quality Resource Consent Conditions*

Results from the beaches monitoring have shown high levels of Faecal Coliforms and Enterococci following the February earthquake. Feacal Coliforms levels at most beach monitoring sites were above consent levels of 43MPN/100ml for the whole of March, April, May and June; only starting to return to normal during July. Although Enterococci levels were elevated, there was only one occasion where the enterococci levels were above the consent limit of 280MPN/100ml, which was not confirmed by retest.

It can be seen from the above graphs that the higher levels coincided with the Febrauary earthquake and increased after the June earthquake.

There are a couple for possible reasons for the high bacterial counts seen:

1) Earthquake damage to the wastewater network – large sections of the wastewater network were damaged after the February earthquake and then again after the June earthquake. This resulted in direct discharges of untreated wastewater directly into surface waterways or storm drains from either broken pipes or overflowing pumping stations. Within two weeks of the February earthquake over 60ML/d of untreated sewage was estimated to have been discharged to the environment. While this volume decreased gradually throughout March – May, it increased dramatically immediately following the June earthquake. By the end of August this total had decreased to less then 10ML/d. River monitoring results also show extremely high faecal coliform levels for the same period.
2) Damage to secondary processes and oxidation ponds, - this reduced the disinfection capacity during the months of March, April and May, though by the latter part of June the effluent discharge was within the lower compliance level.

Ocean water monitoring in the area surrounding the outfall diffusers has shown little difference in concentrations of all determinants, except suspended solids (which could be related to climatic conditions), prior to and following the September and February earthquakes. Faecal Coliform and Enterococci samples taken in March 200m from the diffuser site showed levels below the limit of detection (<2MPN/100ml and <10MPN/100ml respectively). Unfortunately no samples from the area surrounding diffusers were taken in May.

Given the results mentioned above and given the 3km distance of the diffusers from the coast, it is more likely that the higher bacterial counts observed at the beaches were specifically the result of untreated sewer discharges to surface and marine environments as the result of earthquake damage to sewer infrastructure.

2.5 Other Receiving Environment Analysis

Consent conditions 23, 25, 26 and 27 call for monitoring of the marine environment around the outfall at various frequencies and were identified in the AEE. These requirements are summarised in Table 2.5.1. The results are attached to the quarterly reports covering the same period.

Table 2.5.1 Receiving Environment Monitoring Consent Compliance Aug 2010 - July 2011

Consent Condition	Parameter	Frequency	Compliance Condition	Compliance				
				Aug –Oct 10	Nov – Jan11	Feb – Apr 11	May – Jul 11	Overall
23	Marine Sediments	5-yearly	Not Monitored This Period	n/a	n/a	n/a	n/a	n/a
25	Benthic Invertebrates	5-yearly	Not Monitored This Period	n/a	n/a	n/a	n/a	n/a
26	Epibenthic Fauna	5-yearly	Not Monitored This Period	n/a	n/a	n/a	n/a	n/a
27	Shellfish/Tuatua	Quarterly	Sampled and Analysed	☺	☺	☹	☹	☹
29	Complaints	As required	Recorded and Reported	☺	☺	☺	☺	☺
31	Report	Annually	Report and information lodged with ECan	☺	n/a	n/a	n/a	☺
32	Report	Quarterly	Report and information lodged with ECan	☺	☺	☺	☺	☺
33	Diffuser Testing	6 Months of commissioning	Report and information lodged with ECan	n/a	☺	n/a	n/a	☺
35	Management Plan	6 Months of commissioning	Report and information lodged with ECan	n/a	☹	n/a	n/a	☹
36	Community Liaison	Annually	Reported	n/a	n/a	☺	n/a	☺

Key: ☺ Full Compliance ☹ Minor, Isolated or Risk of Non-Compliance ☹ Major or Consistent Non-Compliance

2.6 Comments on Other Receiving Environment

Conditions 23 - 26

The February earthquake disrupted plans for the first annual sediment, benthic and epibenthic inspections (conditions 23,25 & 26). The post-commissioning test is now scheduled for the Feb/Mar 2012 period to keep it in line with the five yearly sampling period thereafter, and hopefully mitigate some of the environmental effects of untreated sewage discharges which could skew the results. ..

Condition 27

The shellfish samples following the February earthquakes are above the consent limits for E.coli and enterovirus. While it is mentioned in the AEE that the ocean outfall could have an effect on surf clams, there are a number of additional sources of contamination caused by the earthquakes. The probable reasons for the consent breech are the same as the reasons for the high bacterial beach samples mentioned in Section 2.4.

ECan and CCC entered into an agreement in April 2011 that repeat testing of shellfish was not required, due to the continued discharging of untreated sewage into the marine environment directly from sewers, and this has been in effect until the end of the reporting period.

Condition 29

There were no complaints from the public regarding the ocean outfall during the reporting period.

Condition 32

Quarterly reports have been submitted to ECan.

Condition 33

A report on the field testing of the diffuser was completed and supplied to ECan.

Condition 35

The management plan had not been completed within the reporting period. It is currently undergoing final review.

Condition 36

The CLG meet in January 2011. The next meeting is planned for November 2011.