Report

# Havelock Sewage Treatment Plant Consent Compliance Report (1 June 2016 - 31 May 2017)

**Prepared for Marlborough District Council (Client)**

**By CH2M Beca Limited**

15 September 2017

## Revision History

| Revision Nº | Prepared By | Description | Date |
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| A | Laura Thompson | Draft for client review | 7 August 2017 |
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## Document Acceptance

| Action | Name | Signed | Date |
|---|---|---|---|
| Prepared by | Laura Thompson |  | 15/09/2017 |
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| Approved by | Graeme Jenner |  | 15/09/2017 |
| on behalf of | CH2M Beca Limited | | |

# Table of Contents



# Appendices

# 1 Introduction

The purpose of this report is to summarise the performance of the Havelock Sewage Treatment Plant (STP), for the period 1 June 2016 to 31 May 2017, against the requirements of Consent U070013. This consent will expire on 31 May 2018.

A copy of Consent U070013 is included in **Appendix A.**

The Havelock STP is operated by Marlborough District Council (MDC) and is located on the true left bank of the Kaituna River, just upstream of the road bridge on Mahakipawa/Queen Charlotte Drive, Havelock. The STP was constructed in 1984 and consisted of a single pond (Pond 1) discharging to the Kaituna River. A second pond was constructed in 1999 to allow desludging of Pond 1 in the summer of 1999/2000.

The two ponds operate in series with continuous discharge of treated effluent to a tidal portion of the Kaituna River. An upgrade in 2008 consisted of adding a bund to Pond 2 to create two smaller ponds (Ponds 2 and 3). The objective of this work was to improve the disinfection of the wastewater, (ie increased removal of potential pathogens), as well as further reduce the concentrations of Biochemical Oxygen Demand (BOD) and suspended solids in the effluent.

In June 2010, mechanical aeration was added to Pond 1 to increase the BOD loading capacity (arising from overloading from local industries). An in-bank rock diffuser was also constructed to allow more efficient disposal of treated effluent to the river. Mechanical aeration has been used regularly on Pond 1 over the last year.

While some improvements in on-site treatment were made by industry after the overloading incident trade waste loads are still significant, with 34% of the BOD load to the plant coming from the industrial users in 2016/2017 (based on trade waste monitoring data for the period). This is still a significant proportion of the load, and industrial users have been encouraged to continue to implement practices to reduce high strength discharges.

A map showing the layout and location of the ponds, as well as the treated effluent and river sampling locations, is included in **Appendix B**.

Only those consent conditions that have numerical or qualitative monitoring requirements are assessed. For clarity, consent conditions are quoted in italics.

# 2 Consent Conditions

## 2.1 Consent Purpose

Consent U070013 allows for the discharge of up to 2,400 cubic metres per day of treated effluent from the Havelock STP to the Kaituna River.

## 2.2 Condition 2 – Maximum Daily Discharge Rate

*The maximum daily discharge rate as measured by the inflow to the ponds shall be not more than 2400 cubic metres per day.*

A flow meter has recently been installed at the terminal pump station. Although this was not available for the 2016 -2017 monitoring period, pond inflows will be able to be reported for the 2017 – 2018 period. There is currently no flow meter on the ponds outlet.

The maximum daily discharge volume of 2,400m³ was chosen during the consent application process, as this flow equates to the capacity of the two pumps at the terminal pump station and allows for a significant component of wet weather inflow and infiltration. Therefore, the Havelock STP discharge is considered compliant with this consent condition.

## 2.3 Condition 6 – Pond Effluent and Effluent Monitoring

*The consent holder shall carry out monitoring as follows and make available to the Manager, Regulatory Department, Marlborough District Council, the monitoring results as received.*

### 2.3.1 Condition 6 i) – Effluent Monitoring

*i) Effluent monitoring*

*a) Grab samples of pond effluent shall be taken by the consent holder once yearly in January or February and analysed for the following:*

*a. Chemical oxygen demand*
*b. Dissolved reactive phosphorus*
*c. Nitrate nitrogen*
*d. Nitrite nitrogen*
*e. Ammonia nitrogen*
*f. Total nitrogen*
*g. Total phosphorus*
*h. Total kjeldahl nitrogen*

*Sampling is to be undertaken between two and four hours after high tide.*

A grab sample of pond effluent was taken on 11 January 2017 in compliance with this condition. The results are set out in Table 2.1.

**Table 2.1 - Pond effluent quality (from the sample taken on 11 January 2017)**

| Parameter | Value |
|---|---|
| Chemical oxygen demand (g/m$^3$) | 350 |
| Dissolved reactive phosphorus (g/m$^3$) | 5 |
| Nitrate nitrogen (g/m$^3$) | <0.002 |
| Nitrite nitrogen (g/m$^3$) | 0.011 |
| Ammonia nitrogen (g/m$^3$) | 33 |
| Total nitrogen (g/m$^3$) | 50 |
| Total phosphorus (g/m$^3$) | 7.2 |
| Total kjeldahl nitrogen (g/m$^3$) | 50 |

### 2.3.2 Condition 6 ii) a) – Pond Effluent Monitoring

*ii) Pond Effluent monitoring*

*a) Grab samples of pond effluent shall be taken by the consent holder in June or July and analysed for the following:*

*a. Chemical oxygen demand*
*b. Carbonaceous bio-chemical oxygen demand (5 day)*
*c. Carbonaceous bio-chemical oxygen demand - soluble (5 day)*
*d. Total suspended solids*
*e. Conductivity*
*f. Total nitrogen*
*g. Nitrite nitrogen*
*h. Nitrate nitrogen*
*i. Total kjeldahl nitrogen*
*j. Total phosphorus*
*k. Enterococci*
*l. Faecal coliforms*
*m. pH*
*n. Dissolved oxygen*
*o. Ammonia nitrogen*
*p. Dissolved reactive phosphorus*
*q. Temperature*

*Sampling is to be undertaken between two and four hours after high tide.*

A grab sample of pond effluent was taken on 20 July 2016. The results are set out in Table 2.2. The pH, dissolved oxygen, conductivity and temperature of this sample were not measured. However, effluent pH, dissolved oxygen and temperature are routinely measured by the plant operator, and the average of all June and July measurements for these parameters are shown in Table 2.3. Table

2.2 shows that the $cBOD_5$ and $cBOD_5$ soluble samples had equal values, this is not the normal case as soluble $cBOD_5$ is typically lower.

**Table 2.2 - Pond effluent parameters (from the sample taken on 20 July 2016)**

| Parameter | Value |
|---|---|
| Chemical oxygen demand ($g/m^3$) | 159 |
| Carbonaceous biochemical oxygen demand ($cBOD_5$ ) (5 day) ($g/m^3$) | 25 |
| Carbonaceous biochemical oxygen demand ($cBOD_5$ )- soluble (5 day) ($g/m^3$) | 25 |
| Total suspended solids ($g/m^3$) | 77 |
| Conductivity (mS/m) | 160.4 |
| Total nitrogen ($g/m^3$) | 38 |
| Nitrite nitrogen ($g/m^3$) | 0.05 |
| Nitrate nitrogen ($g/m^3$) | 0.133 |
| Total kjeldahl nitrogen ($g/m^3$) | 37 |
| Total phosphorus ($g/m^3$) | 4.4 |
| Enterococci (number/100mL) | 1920 |
| Faecal coliforms (cfu/100mL) | 3850 |
| Ammonia nitrogen ($g/m^3$) | 28 |
| Dissolved reactive phosphorus ($g/m^3$) | 3 |

**Table 2.3 - Pond effluent parameters (averages from June/July 2016 monitoring)**

| Parameter | Value |
|---|---|
| pH | 7.53 |
| Dissolved oxygen (ppm) | 6.14 |
| Temperature (ºC) | 10.1 |

### 2.3.3 Condition 6 ii) b) – Pond Effluent Monitoring

*b) Grab samples of pond effluent shall be taken by the consent holder monthly from November to April inclusive and analysed for the following:*

*a. Carbonaceous bio-chemical oxygen demand (5 day)*
*b. Carbonaceous bio-chemical oxygen demand - soluble (5 day)*
*c. Total suspended solids*
*d. Conductivity*
*e. Enterococci*
*f. Faecal coliforms*
*g. pH*
*h. Dissolved oxygen*
*i. Temperature*

*Sampling is to be undertaken between two and four hours after high tide.*

Grab samples of pond effluent were taken monthly from November 2016 to April 2017. The results for the individual grab samples collected are shown in Table 1 in **Appendix C.**

Table 2.4 shows the median concentrations of the six, monthly samples taken between November 2016 and April 2017 (i.e. summer period). To compare trends over time, the median concentrations of samples for 2012/2013, 2013/2014, 2014/2015 and 2015/2016 are also included in Table 2.4.

**Table 2.4 - Pond effluent monthly monitoring data, median concentrations (November to April) for periods 2012/13 to 2015/17 inclusive**

| Parameter | November 2012 to April 2013 (six samples) | November 2013 to April 2014 (six samples) | November 2014 to April 2015 (six samples) | November 2015 to April 2016 (six samples) | November 2016 to April 2017 (six samples) |
|---|---|---|---|---|---|
| Carbonaceous bio-chemical oxygen demand (5 day) ($g/m^3$) | 31 | 52 | 46 | 57 | 50.5 |
| Carbonaceous bio-chemical oxygen demand - soluble (5 day) ($g/m^3$) | 6.5 | 6 | 11 | 17.5 | 21.5 |
| Total suspended solids ($g/m^3$) | 48 | 116 | 67 | 108.5 | 101 |
| Conductivity (mS/m) | 179.1 | 213 | 271 | 258.5 | 190.7 |
| Enterococci (cfu/100mL) | 575 | 243 | 1,378 | 3,130 | 5,302 |
| Faecal coliforms (cfu/100mL) | >16,000* | 8,950 | 25,500 | 92,000 | 80,000 |
| pH | 8.01 | 8 | 7.85 | 8.21 | 7.8 |
| Dissolved oxygen (ppm) | 7.36 | 10** | 4.84 | 11.62 | 6.8 |
| Temperature (ºC) | 19.1 | 21 | 18.1 | 19.4 | 20.3 |

* Four of the six samples gave faecal coliform concentrations of >16,000 cfu/100mL. This is the maximum measureable concentration for the dilution used by the lab. The lab was asked to provide more accurate results.

**The June 2013 to May 2014 report used only three samples in this average because the other four were considered to be above the maximum dissolved oxygen concentrations possible at the water sample temperature. Reference has since been found to super-saturated water conditions in oxidation ponds and in future results will be included from all samples.

### 2.3.4 Comments on Effluent Quality Monitoring Results

The consent does not include effluent quality limits. However, a comparison of summer effluent quality for the past four years shows that both BOD and TSS concentrations are consistent with that expected from the current pond layout. The median concentration of effluent pH and dissolved oxygen has been variable year-on-year, which is also consistent with expected pond performance. In terms of microbiological quality, median enterococci concentrations have increased each year for the past four years, while the median faecal coliform concentration is similar to the previous year (2015/2016), but significantly higher than the medians in the three preceeding years.

### *2.3.5* Condition 6 iii) a) - Kaituna River Monitoring

*a) Grab samples of Kaituna River water 50 metres upstream and 50 metres downstream of the discharge shall be taken by the consent holder once yearly in January or February and analysed for the following:*

*a. Total nitrogen*
*b. Ammonia nitrogen*
*c. Nitrate nitrogen*
*d. Nitrite nitrogen*
*e. Total kjeldahl nitrogen*
*f. Total phosphorus*
*g. Dissolved reactive phosphorus*

*Sampling is to be undertaken between two and four hours after high tide.*

As grab samples of Kaituna River water, 50m upstream and 50m downstream of the discharge point, were taken on 10 January 2017, compliance with this condition was achieved. The results, which are set out in Table 2.5, show an approximate log order increase in the ammonia nitrogen and dissolved reactive phosphorus concentrations between the upstream and downstream sites. Measured concentrations of all other parameters were generally similar upstream and downstream of the outfall.

**Table 2.5 - Kaituna River water quality parameters for samples taken 50m upstream and downstream of the discharge point on 10 January 2017**

| Parameter | Upstream Value | Downstream Value |
|---|---|---|
| Total nitrogen ($g/m^3$) | 1 | 1.62 |
| Ammonia nitrogen ($g/m^3$) | 0.063 | 0.47 |
| Nitrate nitrogen ($g/m^3$) | 0.74 | 0.72 |
| Nitrite nitrogen ($g/m^3$) | 0.004 | 0.01 |
| Total kjeldahl nitrogen ($g/m^3$) | 0.25 | 0.89 |
| Total phosphorus ($g/m^3$) | 0.024 | 0.11 |
| Dissolved reactive phosphorus ($g/m^3$) | 0.009 | 0.06 |

### 2.3.6 Condition 6 iii) b) - Kaituna River Monitoring

*b) Grab samples of Kaituna River water 50 metres upstream and 50 metres downstream of the discharge shall be taken by the consent holder once yearly in June or July and analysed for the following:*

*a. Conductivity*
*b. Total nitrogen*
*c. Nitrite nitrogen*
*d. Nitrate nitrogen*
*e. Total kjeldahl nitrogen*
*f. Total phosphorus*
*g. Enterococci*
*h. Faecal coliforms*
*i. pH*

*j. Dissolved oxygen*
*k. Ammonia nitrogen*
*l. Dissolved reactive phosphorus*
*m. Temperature*

*Sampling is to be undertaken between two and four hours after high tide.*

Grab samples from the Kaituna River, 50m upstream and 50m downstream of the discharge point, were taken on 20 July 2016. The results are shown in Table 2.6. All samples were analysed for the parameters required by the consent, with the exception of both upstream and downstream pH values.

Most parameters in the July sampling event stayed reasonably consistent between the two sampling points.

**Table 2.6 - Kaituna River water quality parameters for grab samples taken 50m upstream and downstream of the outfall 20 July 2016**

| Parameter | Upstream Value | Downstream Value |
|---|---|---|
| Conductivity (mS/m) | 119.2 | 187.7 |
| Total nitrogen (g/m$^3$) | 1.22 | 1.3 |
| Nitrite nitrogen (g/m$^3$) | <0.002 | <0.002 |
| Nitrate nitrogen (g/m$^3$) | 1.17 | 1.18 |
| Total kjeldahl nitrogen (g/m$^3$) | <0.100 | 0.12 |
| Total phosphorus (g/m$^3$) | 0.024 | 0.021 |
| Enterococci (number/100mL) | 31 | 31 |
| Faecal coliforms (cfu/100mL) | 120 | 90 |
| pH | - | - |
| Dissolved oxygen (ppm) | 10.7 | 10.23 |
| Ammonia nitrogen (g/m$^3$) | 0.01 | 0.033 |
| Dissolved reactive phosphorus (g/m$^3$) | 0.012 | 0.012 |
| Temperature (ºC) | 8.9 | 8.8 |

### 2.3.7 Condition 6 iii) c) Kaituna River Monitoring

*c) Grab samples of Kaituna River water 50 metres upstream and 50 metres downstream of the discharge shall be taken by the consent holder weekly from November to April inclusive and analysed for the following:*

*a. Conductivity*
*b. Enterococci*
*c. Faecal coliforms*
*d. pH*
*e. Dissolved oxygen*
*f. Temperature*
*g. E. coli*

*Sampling is to be undertaken between two and four hours after high tide.*

Grab samples from the Kaituna River, 50m upstream and 50m downstream of the discharge point, were taken with an average interval of 7 days between November 2016 and April 2017. The longest period of time between sampling was 11 days. The results for the grab samples collected are shown in Tables 2 and 3 in **Appendix C**.

Figure 2.1, Figure 2.2 and Figure 2.3 show a summary of the monitoring results. Median, 75$^{th}$ percentile and maximum microbiological concentrations (shown in Figure 2.1) were higher in the downstream sample site compared to the upstream site for all species monitored. The implications of this are discussed further in Section 2.5.1 but it is clear that the discharge is having some impact on the microbial quality of the river.

Figure 2.2 shows that the values for dissolved oxygen, temperature and pH were similar at both the upstream and downstream locations.

The conductivity measurements shown in Figure 2.3 are similar except for the 75$^{th}$ percentile value which is higher downstream compared to upstream.

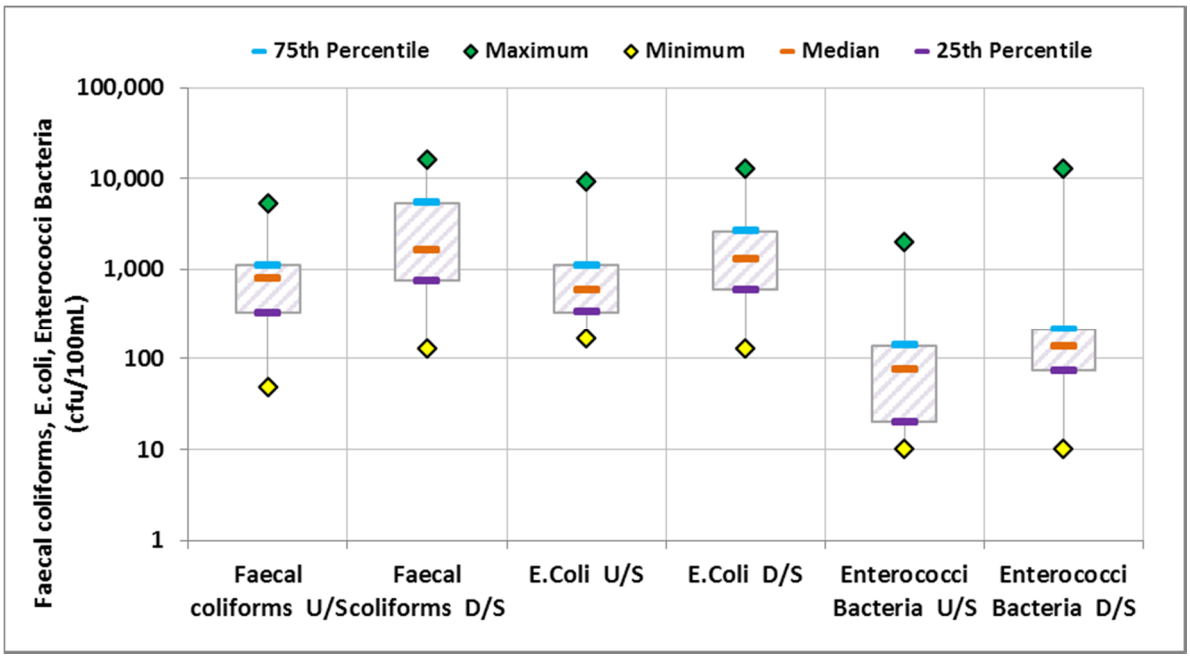


**Figure 2.1 - Microbiological concentrations measured in Kaituna River for period November 2016 to April 2017**

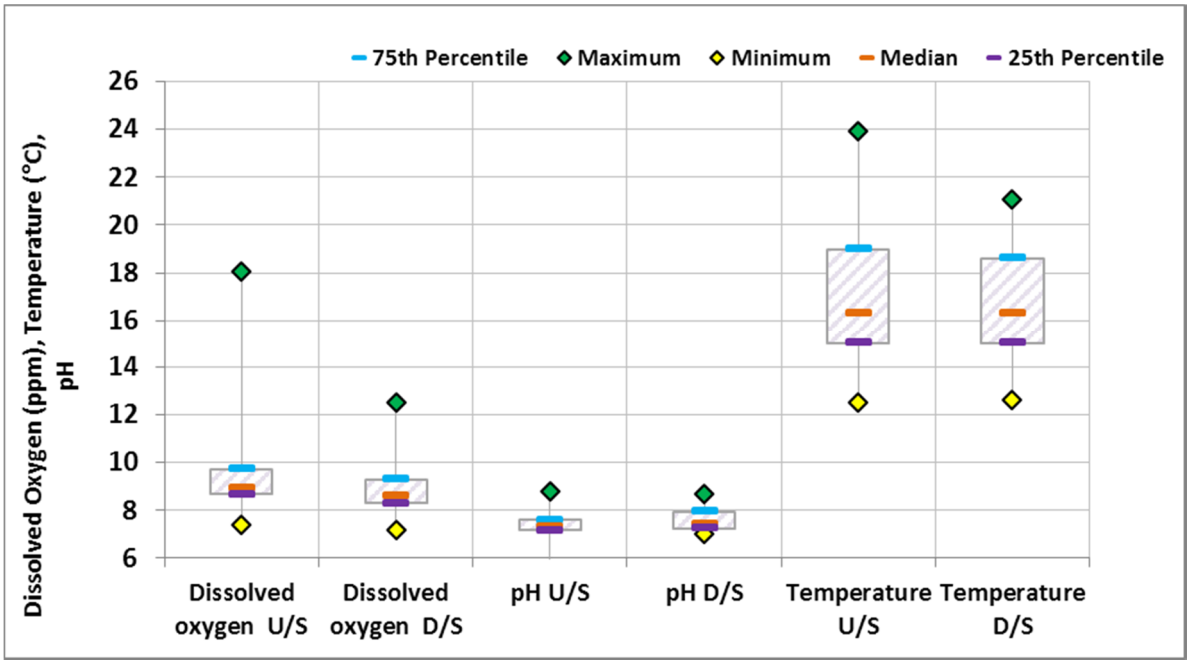


**Figure 2.2 - Dissolved oxygen, temperature and pH measured in Kaituna River for period November 2016 to April 2017**

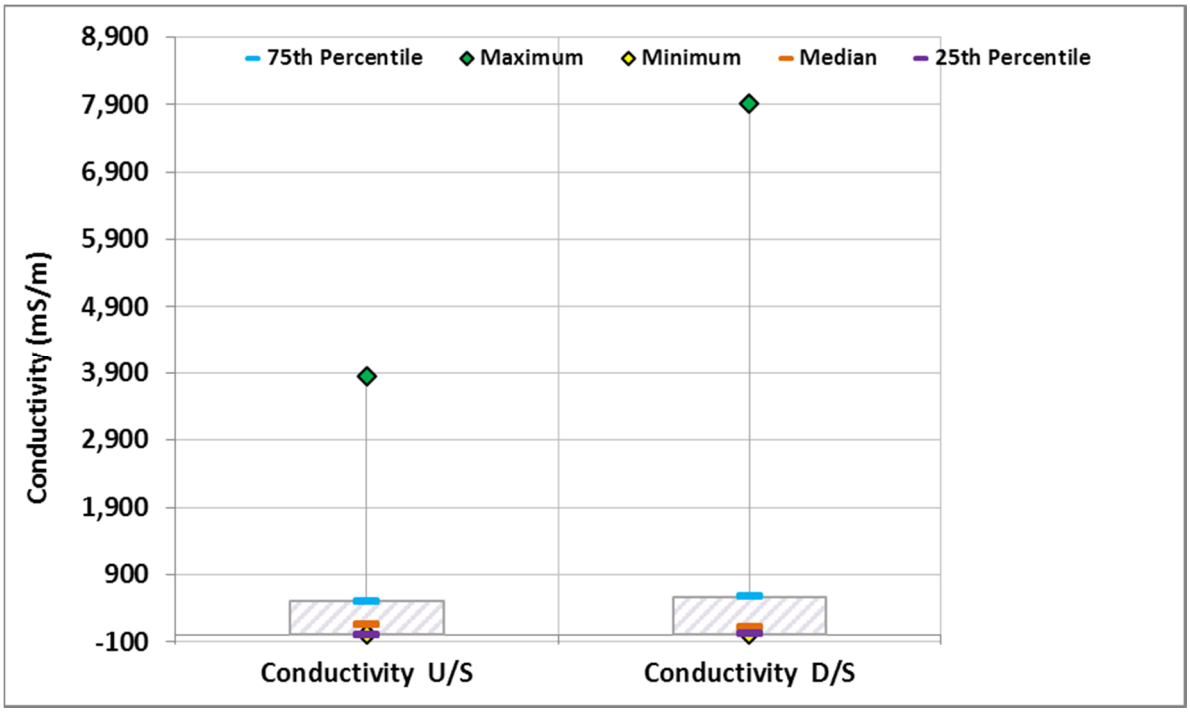


**Figure 2.3 - Conductivity measurements in Kaituna River for period November 2016 to April 2017**

### 2.3.8 Condition 6 iv) Influent Sewage Monitoring

*The consent holder shall carry out monitoring as follows and make available to the Manager, Regulatory Department, Marlborough District Council, the monitoring results as received.*

*iv) Influent Sewage Monitoring*

*a) 24 hour composite samples of Havelock raw sewage influent shall be taken annually by the consent holder in January or February and analysed for the following:*

*a. Chemical oxygen demand*
*b. Biochemical oxygen demand*
*c. Total suspended solids*
*d. Conductivity*
*e. Total nitrogen*
*f. Ammonia nitrogen*
*g. Nitrite nitrogen*
*h. Nitrate nitrogen*
*i. Total kjeldahl nitrogen*
*j. Total phosphorus*
*k. Dissolved reactive phosphorus*
*l. Faecal coliforms*
*m. Enterococci*
*n. pH*

A 24 hour composite sample of sewage influent was taken on 10 January 2017 (see Table 2.6). As noted earlier, contaminant loads to the STP increased prior to 2010 due to industrial expansion in the port area. Industry has been encouraged to implement practices to reduce discharges of high BOD, but the percentage of BOD from industrial sites still accounts for 34% of the total BOD of the loading on the ponds. This is particularly reflected in the BOD and COD concentrations in the composite sample, which are higher than normally expected for municipal sewage. To date, the STP has been coping with the high influent loads as reflected in the effluent monitoring data.

**Table 2.7 – Raw sewage influent 24 hour composite sample 10 January 2017**

| Parameter | Value |
|---|---|
| Chemical oxygen demand (g/m$^3$) | 900 |
| Biochemical oxygen demand (g/m$^3$) | 480 |
| Total suspended solids (g/m$^3$) | 300 |
| Conductivity (mS/m) | 290 |
| Total nitrogen (g/m$^3$) | 79 |
| Ammonia nitrogen (g/m$^3$) | 48 |
| Nitrite nitrogen (g/m$^3$) | <0.02 |
| Nitrate nitrogen (g/m$^3$) | <0.02 |
| Total kjeldahl nitrogen (g/m$^3$) | 79 |
| Total phosphorus (g/m$^3$) | 8 |

| Parameter | Value |
|---|---|
| Dissolved reactive phosphorus (g/m$^3$) | 6.3 |
| Faecal coliforms (cfu/100mL) | >16,000,000 |
| Enterococci (cfu/100mL) | 770,000 |
| pH | 6.7 |

## 2.4 Condition 7 – Annual Monitoring Report

*An annual monitoring report shall be prepared that summarises the performance of the sewage treatment system. Copies of all analyses and comments shall be made available to the Manager, Compliance, Marlborough District Council on request.*

This report has been written to fulfil this consent requirement.

## 2.5 Condition 8 – Recommendations

*The reports required by Condition 7, which are to include recommendations regarding the impact of the treated effluent on the receiving environment, shall be provided to Manager, Regulatory Department, Marlborough District Council, by May 31 each year for the term of the consent.*

### 2.5.1 Comments on Kaituna River Monitoring

The current consent does not include river water quality limits. However, the Marlborough Sounds Resource Management Plan (MSRMP) requires the Kaituna River to be managed for fishery purposes and lists eight water quality standards for the river. Some of these standards are reflected in Condition 4 of the consent (which provides for a mixing zone of 50m upstream and downstream of the discharge point), as well as Condition 5 as follows:

**1. *No Conspicuous oil or grease films or foams or floatable or suspended material***

None of these effects have been observed in the river in the 2016/17 year.

**2. *Any conspicuous change in colour or visual clarity***

Turbidity and black disk monitoring are not required. However, the discharge effluent TSS are unlikely to cause a conspicuous change in visual clarity after reasonable mixing in the often turbid tidal waters.

**3. *Any significant effects on aquatic life***

**Light penetration** – this is not considered relevant because of the tidal fluctuations in the river and its shallow nature at low tide.

**Ammonia Toxicity** – the ammonia-N concentrations measured at the downstream sampling site in July 2016 and January 2017 were 0.033 and 0.47 g/m³, respectively. These values are within the ANZECC (2000) marine waters guideline of 0.91g/m³ for "slightly to moderately disturbed" ecosystems (95% level of protection for aquatic species at pH of 8). The values also meet the ANZECC 2000 trigger value of 0.90 g/m³ for "slightly to moderately disturbed" freshwater at the same level of ecosystems protection. On the basis of these trigger values, ammonia within the STP discharge is unlikely to be having a toxic effect on aquatic life outside the mixing zone.

**Particulate Organic Matter –** Cawthron (2006) noted some localised enrichment in sediments for 10m downstream of the discharge. The downstream water nutrient concentrations are relatively low and coupled with the relatively turbid tidal environment, are unlikely to support significant enrichment of the waterbody

**Aquatic Invertebrate Communities –** Cawthron (2006) concluded that the STP discharge does not appear to have a significant adverse effect on aquatic invertebrate communities in the river.

Other standards required by the MSRMP for fishery purposes are:

***The temperature shall not be changed by more than 3˚C and shall not exceed 20˚C.***

Over the monitoring period of November 2016 to April 2017, the difference in temperature between the upstream and downstream sampling point was only greater than 0.6 °C on one instance. On 14 February 2017 the measured upstream temperature of 23.9°C was 5.3 °C higher than the downstream temperature of 18.6°C. In addition, on four separate dates (4 February, 10 February and 28 February 2017), the temperature exceeded 20 °C but this was true in both the upstream and downstream sampling points. Therefore, the discharge is not likely to be having a significant effect on the temperature of Kaituna River.

***The dissolved oxygen shall exceed 80% of saturation –*** On 26 December 2016, the upstream and downstream DO measurements were 77 and 73% of saturation, respectively (see Table 3 in **Appendix C**). Additionally on 4 January 2017, the upstream and downstream DO was 77 and 78% of saturation, respectively. These were the only occurrences of measured DO percentage of saturation being less than 80%. As it occurred in both the upstream and downstream locations, it is likely to be typical of the estuarine environment.

The lower reaches of the river may be considered part of the coastal marine area which is required by the MSRMP to be managed for shellfish gathering (according to Appendix H of MSRMP). Along with the above conditions for temperature and dissolved oxygen, the MSRMP requires that water in such areas shall not be rendered unsuitable by the presence of contaminants as follows:

***Median faecal coliforms concentration of not less than five samples, taken within any consecutive 30 day period, shall not exceed a Most Probable Number (MPN) of 14 per 100ml (or Colony Forming Units per 100ml), and not more than ten percent of samples taken within any consecutive 30 day period shall exceed an MPN of 43 per 100ml (or 43 Colony Forming Units per 100ml) as a result of any discharge of a contaminant or water. Samples shall not be taken on the same or consecutive days.***

During the sampling period, July 2016 to April 2017, the lowest faecal coliforms concentration measured 50m upstream and downstream of the discharge point was 90 cfu/100 mL and 120 cfu/100ml, respectively. As a result, the limit for median faecal coliforms was exceeded. The downstream median faecal coliform concentration of the samples, taken between November 2016

and January 2017, was 1600 cfu/100mL. In addition, all upstream faecal coliform concentrations also exceeded these requirements with a median faecal coliforms concentration of 790cfu/100mL over the monitoring period.

A report by Cawthron (2007) on the effects of the discharge on shellfish gathering concluded that if a STP upgrading can reduce the median faecal coliforms concentration of the discharge to 10,000cfu/100mL or better, this is likely to bring the median faecal coliform concentration at the river mouth very close to the median faecal coliforms standard in the MSRMP for shellfish gathering. The median faecal coliforms concentration of the effluent as measured between November 2016 and April 2017 was 80,000 cfu/100mL (see Table 2.4). It should be noted that the lower estuary (ie below the bridge) receives other discharges including rural runoff and stormwater from Havelock Township. Regardless, shellfish gathering in such environments is not encouraged by the Nelson/Marlborough Public Health Unit. This point was made clear by Geoff Cameron, Senior Public Health Protection Officer during consultation for the consenting of the Blenheim STP discharge to the Wairau Estuary.

Although the MSRMP does not require the river to be managed for contact recreation purposes, people have been observed bathing at the Queen Charlotte Bridge about 300m downstream of the discharge. There are three standards in the plan for contact recreation:

**Visual Clarity –** see above discussion for fishery purposes

**Microbiological Contaminants** – The MSRMP states that:

***The median concentration of enterococci of at least 20 samples taken throughout the bathing season shall not exceed 33 per 100 mL, nor shall any sample exceed 107 enterococci per 100 mL. The bathing season is defined as the period of 1 November to 1 April inclusive.***

The upstream and downstream median enterococci concentration of samples taken between November 2016 and April 2017, (75 number/100mL and 134 number/100ml respectively), were both above the MSRMP median concentration of 33 number/100mL. The maximum MSRMP enterococci limit of 107/100mL was also exceeded in the river at both the upstream and downstream locations (see Figure 2.1). Enterococci concentrations were higher in the downstream sample but concentrations will decrease with dilution and some expected die-off between the downstream sampling point and the Mahakipawa Bridge, a further 250m downstream. The state of the tide will influence available dilution and time available for die-off of enteric bacteria.

MDC commissioned NIWA to carry out an investigation in 2015 into the health risk for swimmers in the river, at the Mahakipawa Bridge as it is occasionally used as a swimming spot. The NIWA report used the highly infectious Norovirus as a "model" pathogen to quantify the risk to swimmers at the bridge. It was concluded that health risks to swimmers can occasionally be high at the bridge due to the following factors:

- A high Norovirus concentration in the ponds influent
- Low rates of removal of Norovirus through the ponds
- Low dilutions of the wastewater plume occur at the bridge during the ebb tide

NIWA recommended improving the STP treatment system's virus removal efficacy to consistently achieve two log orders of magnitude removal of Norovirus. Options for increasing virus reduction through the treatment plant to attain this virus reduction have been investigated and are being developed in consultation with the community.

**Biological Growths –** biological growths can reduce the aesthetic quality of a river. Although the BOD concentration at the edge of the mixing zone may exceed the MSRMP limit of 2g/m³, Cawthron (2006) notes that oxygen-depleting microorganisms will be flushed to the sea before there is any significant additional effect on the river. Plant nutrients such as nitrogen and phosphorus can cause

excessive plant growths. However, Cawthron (2006) consider this is unlikely in the river as strong tidal flows will prevent biological growths forming.

### 2.5.2 Summary

From the above discussion, it can be concluded that the STP discharge generally meets the eight water quality standards for the river requirements of the MSRMP. However, water quality within the lower reaches of the estuary exceeds the requirements for shellfish gathering due to multiple factors, including runoff from farmland and stormwater discharges from the township, as well as the STP discharge. Shellfish gathering is not encouraged by MDC or public health authorities in estuaries which flow through farmland and urban areas.

The river water quality does not currently meet bathing water requirements. NIWA has determined that there can be a higher risk to swimmers at the Mahakipawa Bridge under certain conditions. The key improvement would be to reduce the pathogen concentrations in the effluent. MDC is currently assessing the disinfection options at the STP to further reduce health risks to swimmers at the bridge.

## 2.6 Condition 14 – Discharge to Air

*There shall be no odour detectable beyond the boundary of the property on more than ten (10) days per calendar year commencing January 1 and concluding December 31, that in the opinion of a Council officer, responsible for air quality functions, is offensive and objectionable.*

As no complaints of odour were received by Council, during the period 1 June 2016 to 31 May 2017, it can be concluded that compliance with this condition was achieved.

# 3 Conclusions

The Havelock STP appears to be performing well with effluent quality within the range expected for the existing pond layout. The pond aerators were used regularly during the reporting period to maintain pond DO concentrations and no odour complaints were received.

Monitoring was carried out in the June 2016 to May 2017 period, generally as required by Consent U070013. However, it is recommended that MDC ensure that all parameters are tested for when sampling effluent.

The current consent does not include river water quality limits. However, monitoring shows that the STP discharge generally meets the Marlborough Sounds Resource Management Plan (MSRMP) standards for the Kaituna River. The Plan requires that the river be managed for fishery purposes and lists eight water quality standards to be met. It is noted that while the concentration of microbial contaminants in the river, immediately downstream of the discharge, exceeds the MSRMP quality standards, these are exceeded upstream as well. The water quality within the lower reaches of the estuary is impacted by the presence of runoff from farmland, stormwater discharges from the township, as well as the STP discharge.

A higher risk to swimmers at the bridge 300m downstream of the STP may be present when high influent Norovirus concentrations, low treatment pond removal rates and lower river dilutions occur (eg during the ebb tide). This risk can be reduced by improving disinfection performance of the STP and MDC is currently working with the community to identify a preferred upgrade option.

## References

ANZECC (2000). *Australian and New Zealand Guidelines for Marine and Freshwater Quality Volume 2 – Aquatic Ecosystems.*

Cawthron (2006). *Resource Consent Application for Discharge from Havelock Oxidation Pond into the Kaituna River*, received by Marlborough District Council.

Cawthron (2007). *Resource Consent Application for Discharge from Havelock Oxidation Pond into the Kaituna River – Shellfish Monitoring Requirements*, received by Marlborough District Council.

Marlborough District Council (2003). *Marlborough Sounds Resource Management Plan.*

NIWA (2015). *Kaituna River (Havelock) Swimmers' Health Risk Assessment.*

Appendix A

# Consent U070013

# Schedule of Consent Conditions

**Discharge Permit (to Water)**

**Expiry Date**

1. This consent shall expire May 31 2018.

**Maximum Daily Discharge Rate**

2. The maximum daily discharge rate as measured by the inflow to the ponds shall be not more than 2400 cubic metres per day.

3. The discharge to the Kaituna River shall be in general accordance with resource consent application U070013, received by the Marlborough District Council, January 9 2007, and the further information provided on September 26 2007.

**Mixing Zone**

4. The mixing zone in the Kaituna River shall be defined as 50 metres from the discharge point (both upstream and downstream).

5. The treated effluent from the Havelock Sewage Treatment Plant, after reasonable mixing (i.e. beyond the mixing zone), shall not give rise to all or any of the following effects in the receiving waters:

   (i) The production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;

   (ii) Any conspicuous change in colour or visual clarity;

   (iii) Any significant adverse effects on aquatic life.

**Pond Effluent and Effluent Monitoring**

6. The consent holder shall carry out monitoring as follows and make available to the Manager, Regulatory Department, Marlborough District Council, the monitoring results as received.

(i) Effluent Monitoring.

a) Grab samples of pond effluent shall be taken by the consent holder once yearly in January or February and analysed for the following:

a. Chemical oxygen demand
b. Dissolved reactive phosphorous
c. Nitrate nitrogen
d. Nitrite nitrogen
e. Ammonia nitrogen
f. Total nitrogen
g. Total phosphorus
h. Total Kjeldahl nitrogen

Sampling is to be undertaken between two and four hours after high tide.

(ii) Pond Effluent Monitoring.

a) Grab samples of pond effluent shall be taken by the consent holder in June or July and analysed for the following:

a. Chemical oxygen demand
b. Carbonaceous bio-chemical oxygen demand (5 day)
c. Carbonaceous bio-chemical oxygen demand – soluble (5 day)
d. Total suspended solids
e. Conductivity
f. Total nitrogen
g. Nitrite nitrogen
h. Nitrate nitrogen
i. Total Kjeldahl nitrogen
j. Total phosphorus
k. Enterococci
l. Faecal coliforms
m. PH
n. Dissolved oxygen
o. Ammonia nitrogen

p. Dissolved reactive phosphorus
q. Temperature

Sampling is to be uncertaken between two and four hours after high tide.

b) Grab samples of pond effluent shall be taken by the consent holder monthly from November to April inclusive and analysed for the following;

a. Carbonaceous Bio-chemical oxygen demand (5 day)
b. Carbonaceous Bio-chemical oxygen demanc – soluble (5 day)
c. Total suspended solids
d. Conductivity
e. Enterococci
f. Faecal coliforms
g. PH
h. Dissolved oxygen
i. Temperature

Sampling is to be undertaken between two and four hours after high tide.

(iii) Kaituna River Monitoring.

a) Grab samples of Kaituna River water 50 metres upstream and 50 metres downstream of the discharge shall be taken by the consent holder once yearly in January or February and analysed for the following:

a. Total nitrogen
b. Ammonia nitrogen
c. Nitrate nitrogen
d. Nitrite nitrogen
e. Total Kjeldahl nitrogen
f. Total phosphorus
g. Dissolved reactive phosphorus

Sampling is to be undertaken between two and four hours after high tide.

b) Grab samples of Kaituna River water 50 metres upstream and 50 metres downstream of the discharge shall be taken by the consent holder once yearly in June or July and analysed for the following:

a. Conductivity
b. Total nitrogen
c. Nitrite nitrogen
d. Nitrate nitrogen
e. Total Kjeldahl nitrogen
f. Total phosphorus
g. Enterococci
h. Faecal coliforms
i. PH
j. Dissolved oxygen
k. Ammonia nitrogen
l. Dissolved reactive phosphorus
m. Temperature

Sampling is to be undertaken between two and four hours after high tide.

c) Grab samples of Kaituna River water 50 metres upstream and 50 metres downstream of the discharge shall be taken by the consent holder weekly from November to April inclusive and analysed for the following:

a. Conductivity
b. Enterococci
c. Faecal coliforms
d. PH
e. Dissolved oxygen
f. Temperature
g. E.coli ← NEEDS TO BE ADDED

Sampling is to be undertaken between two and four hours after high tide.

(iv) Influent sewage monitoring.

a) 24 hour composite samples of Havelock raw sewage influent shall be taken annually by the consent holder in January or February and analysed for the following;

a. Chemical oxygen demand
b. Biochemical oxygen demand
c. Total suspended solids
d. Conductivity
e. Total nitrogen
f. Ammonia nitrogen
g. Nitrite nitrogen
h. Nitrate nitrogen
i. Total Kjeldahl nitrogen
j. Total phosphorus
k. Dissolved reactive phosphorus
l. Faecal coliform
m. Enterococci
n. PH

7. An annual monitoring report shall be prepared that summarises the performance of the sewage treatment system. Copies of all analyses and comments shall be made available to the Manager, Compliance, Marlborough District Council on request.

8. The reports required by Condition 7, which are to include recommendations regarding the impact of the treated effluent on the receiving environment, shall be provided to Manager, Regulatory Department, Marlborough District Council, by May 31 each year for the term of the consent.

9. In accordance with section 128 of the Resource Management Act 1991, the Marlborough District Council may review the conditions of this resource consent. This review may be conducted annually in either February or August for the duration of the consent, for the following purposes:

a) To review the effectiveness of the existing resource consent conditions in avoiding or mitigating any adverse effects on the environment from the

exercise of this resource consent and, if necessary, to avoid, remedy or mitigate such effects by way of further or amended conditions; or

b) To review the adequacy of and necessity for monitoring the effect of the discharge on the environment; or

c) To require the consent holder to adopt the best practicable option to remove or reduce adverse effects on the surrounding environment; or

d) To enable Council's Regulatory Department to impose any further conditions or take any further action requiring the consent holder to adopt the best practicable option to remove or reduce any effect on the environment arising from the discharge of treated sewage effluent.

**Public Warning**

10. In all circumstances where the results of any analysis, required under this consent, exceeds any applicable public health standards or are such as to give rise to any risk to the public the applicant shall forthwith upon the receipt of the results notify on the Marlborough District Council website the circumstances of the high readings, the implications of the same in terms of risk to health and safety and the estimated duration of such risks. The form of the public notice shall be submitted to the Manager, Resource Consents, Marlborough District Council, and approved and repeated at each juncture that such a reading is received.

11. Appropriate signage to be approved by the Manager, Resource Consents, Marlborough District Council, shall be placed in plain public view identifying the location of the point of any discharge and the potential hazards of high readings with the mixing zone. The signage shall also include details of the Marlborough District Council website and advice to the effect that any readings of the kind referred to in condition 10 shall be notified on the Marlborough District Council website.

**Lapse Condition**
**Discharge Permit (to Air)**

**Expiry Date**

12. This consent shall expire May 31 2018.

13. The discharge to the Kaituna River shall be in general accordance with resource consent application U070013, received by the Marlborough District Council, January 9 2007, and the further information provided on September 26 2007.

14. There shall be no odour detectable beyond the boundary of the property on more than ten (10) days per calendar year commencing January 1 and concluding December 31, that in the opinion of a Council officer, responsible for air quality functions, is offensive and objectionable.

15. The applicant shall ensure that checks are made not less than once in each fourteen (14) day period, to determine if any offensive or objectionable discharge to air is occurring and shall maintain a record of each check and the results. The record shall be available for inspection at any time, by any authorised officer of the Marlborough District Council.

**Lapse Condition**
**Land Use (River Surface or Bed Activity)**

16. This consent shall expire May 31 2043.

17. This consent shall lapse November 30 2009, unless given effect to within that timeframe.

18. The discharge to the Kaituna River shall be in general accordance with resource consent application U070013, received by the Marlborough District Council, January 9 2007, and the further information provided on September 26 2007.

**IMPORTANT NOTE:**

1. Without predetermining the question of any application for extension of the lapse period in relation to Condition 17, it is recorded that the applicant would be expected to justify why the construction has not commenced in the periods provided.

2. The consent holder may be charged for actual and reasonable costs associated with any review and any monitoring required in accordance with this consent.

Signed M J Hunt
Commissioner

Appendix B

# Havelock Sewage Treatment Ponds and Sampling Locations


Queen Charlotte Drive
WAT-041
Mahakipawa Pump Station
Mahakipawa Road
KTR-009
50m d/s Havelock Oxidation Ponds
OXP-017
Effluent Discharge
KTR-008
50m u/s Havelock Oxidation Ponds

Appendix C

# Monitoring Data

**Table 8 - Havelock STP Monthly Pond Effluent Data**

| Parameter | 1 Nov '16 | 1 Dec '16 | 1 Jan '17 | 1 Feb '17 | 1 Mar '17 | 1 Apr '17 |
|---|---|---|---|---|---|---|
| Carbonaceous $BOD_5$ ($g/m^3$) | 30 | 27 | 68 | 69 | 53 | 48 |
| Carbonaceous $BOD_5$ - soluble ($g/m^3$) | - | 9 | 17 | 37 | 26 | - |
| Total suspended solids ($g/m^3$) | 64 | 43.5 | 98 | 104 | 122 | 147 |
| Conductivity (mS/m) | 132 | 170.4 | 211 | 291 | 303 | 103.1 |
| Enterococci (cfu/100mL) | 410 | 5505 | 5098.5 | 8145 | 3260 | 13000 |
| Faecal coliforms (cfu/100mL) | - | 69000 | 14000 | 91000 | 580000 | 1000000 |
| pH | 7.6975 | 7.735 | 7.956 | 7.836 | 8.158 | 7.466 |
| Dissolved oxygen (ppm) | 11.13 | 5.82 | 7.978 | 7.706 | 3.74 | 3.84 |
| Temperature (°C) | 20.1 | 20.475 | 23.48 | 21.1 | 18.86 | 15.1 |

**Table 9 - Kaituna River Weekly Monitoring Data Upstream Results**

| Upstream Sample Date | Conductivity (mS/m) | Enterococci (cfu/100mL) | Faecal coliforms (cfu/100mL) | pH | Dissolved oxygen (ppm) | Temperature (°C) | E.Coli (cfu/100mL) | % DO Saturation |
|---|---|---|---|---|---|---|---|---|
| 2-Nov-16 | 57.6 | 2010 | 49 | 8.82 | 9.92 | 14.8 | 490 | 96% |
| 11-Nov-16 | 7 | 10 | >1600 | 7.6 | 8.3 | 16.5 | 1600 | 84% |
| 14-Nov-16 | 9.9 | 20 | 1100 | 7.72 | 8.97 | 13.3 | 1100 | 85% |
| 23-Nov-16 | 11.8 | 10 | 350 | 7.03 | 9.94 | 15.5 | 350 | 99% |
| 30-Nov-16 | | 10 | 1100 | | | | 1100 | |
| 9-Dec-16 | 13.9 | 20 | 490 | 7.28 | 9.47 | 15.2 | 490 | 94% |
| 12-Dec-16 | 6.9 | 41 | 330 | 7.42 | 8.93 | 15.4 | 330 | 89% |
| 23-Dec-16 | 12.9 | 373 | 1600 | 7.22 | 11.65 | 15 | 920 | 116% |
| 26-Dec-16 | 7.6 | 20 | 220 | 7.29 | 7.42 | 17.2 | 220 | 77% |
| 4-Jan-17 | 194 | 62 | 1600 | 7.4 | 8.76 | 17.9 | 350 | 91% |
| 10-Jan-17 | 683 | 110 | 170 | 7.18 | 10.7 | 20.1 | 170 | 111% |
| 16-Jan-17 | 880 | 96 | 330 | 7.36 | 8.5 | 20.8 | 330 | 88% |
| 24-Jan-17 | 9 | 63 | 700 | 7.61 | 9.96 | 16.4 | 700 | 101% |
| 31-Jan-17 | 684 | 218 | 1300 | 7.74 | 8.9 | 19.9 | 1300 | 92% |
| 8-Feb-17 | 418 | 86 | 3500 | 7.47 | 8.98 | 16.3 | 1300 | 91% |
| 14-Feb-17 | 538 | 20 | 790 | 5.46 | 8.31 | 23.9 | 330 | 86% |
| 22-Feb-17 | 15.3 | 10 | 330 | 7.29 | 8.92 | 19.6 | 330 | 92% |
| 28-Feb-17 | 164 | 226 | 1100 | 7.63 | 8.25 | 20.8 | 1100 | 85% |
| 8-Mar-1 | 506 | 96 | 330 | 8.12 | 8.78 | 15.4 | 170 | 87% |
| 13-Mar-17 | 193.7 | 121 | 460 | 7.73 | 9.73 | 16.3 | 460 | 99% |
| 24-Mar-17 | 158.4 | 145 | 460 | 7.3 | 8.86 | 16.6 | 460 | 90% |
| 28-Mar-17 | 826 | 1668 | 5400 | 7.12 | 8.68 | 19 | 5400 | 90% |
| 7-Apr-17 | 7.3 | 155 | 920 | 7.02 | 9.33 | 12.5 | 9250 | 87% |
| 11-Apr-17 | 193.1 | 86 | 1400 | 7.13 | 8.2 | 14.3 | 940 | 80% |
| 18-Apr-17 | 7 | 41 | 920 | 6.93 | 9.24 | 14.3 | 920 | 90% |

| Upstream Sample Date | Conductivity (mS/m) | Enterococci (cfu/100mL) | Faecal coliforms (cfu/100mL) | pH | Dissolved oxygen (ppm) | Temperature (°C) | E.Coli (cfu/100mL) | % DO Saturation |
|---|---|---|---|---|---|---|---|---|
| 27-Apr-17 | 3850 | 63 | 1100 | 7.16 | 18.04 | 14 | 1100 | 175% |
| | | | | | | | | |

**Table 10 - Kaituna River Weekly Monitoring Data Downstream Results**

| Downstream Sample Date | Conductivity (mS/m) | Enterococci (cfu/100mL) | Faecal coliforms (cfu/100mL) | pH | Dissolved oxygen (ppm) | Temperature (°C) | E.Coli (cfu/100mL) | DO Sat U/S | % DO |
|---|---|---|---|---|---|---|---|---|---|
| 2-Nov-16 | 19.50 | 216.00 | 790.00 | 7.94 | 9.70 | 15.00 | 490.00 | 10.07 | 96% |
| 11-Nov-16 | 12.60 | 185.00 | >1600 | 8.55 | 8.62 | 16.30 | >1600 | 9.86 | 87% |
| 14-Nov-16 | 10.20 | 41.00 | 1100.00 | 8.69 | 9.30 | 13.10 | 700.00 | 10.53 | 88% |
| 23-Nov-16 | 10.50 | <10 | 350.00 | 7.04 | 9.73 | 15.40 | 350.00 | 10.07 | 97% |
| 30-Nov-16 | - | 52.00 | 230.00 | - | - | - | 230.00 | | |
| 9-Dec-16 | 15.10 | 134.00 | 2200.00 | 8.28 | 9.60 | 15.40 | 1300.00 | 10.07 | 95% |
| 12-Dec-16 | 12.50 | 10.00 | 230.00 | 8.12 | 7.95 | 15.80 | 230.00 | 10.07 | 79% |
| 23-Dec-16 | 12.70 | 631.00 | >1600 | 7.40 | 12.53 | 15.00 | 920.00 | 10.07 | 124% |
| 26-Dec-16 | 25.10 | 121.00 | 220.00 | 7.54 | 7.20 | 16.80 | 220.00 | 9.86 | 73% |
| 4-Jan-17 | 476.00 | 63.00 | 1600.00 | 7.43 | 7.50 | 18.20 | 920.00 | 9.65 | 78% |
| 10-Jan-17 | 863.00 | 85.00 | 950.00 | 7.24 | 8.60 | 20.20 | <1 | 9.65 | 89% |
| 16-Jan-17 | 1864.00 | 148.00 | 3500.00 | 7.62 | 7.81 | 21.10 | 3500.00 | 9.65 | 81% |
| 24-Jan-17 | 24.00 | 74.00 | 3500.00 | 7.70 | 8.20 | 16.10 | 1700.00 | 9.86 | 83% |
| 31-Jan-17 | 508.00 | 816.00 | 1400.00 | 7.96 | 8.70 | 20.10 | 700.00 | 9.65 | 90% |
| 8-Feb-17 | 776.00 | 2490.00 | 5400.00 | 7.47 | 8.80 | 16.70 | 2400.00 | 9.86 | 89% |
| 14-Feb-17 | 770.00 | 185.00 | 16000.00 | 7.38 | 8.31 | 18.60 | 3500.00 | 9.65 | 86% |
| 22-Feb-17 | 21.50 | 31.00 | 5400.00 | 7.45 | 8.49 | 19.50 | 5400.00 | 9.65 | 88% |
| 28-Feb-17 | 209.00 | 145.00 | 9200.00 | 7.30 | 7.94 | 20.90 | 2800.00 | 9.65 | 82% |
| 8-Mar-01 | 111.60 | 13000.00 | 9200.00 | 8.01 | 8.50 | 15.20 | 5400.00 | 10.07 | 84% |
| 13-Mar-17 | 573.00 | 213.00 | 5400.00 | 7.86 | 9.29 | 16.90 | 2200.00 | 9.86 | 94% |
| 24-Mar-17 | 249.00 | 122.00 | >16000 | 7.26 | 8.42 | 16.90 | >16000 | 9.86 | 85% |

| Downstream Sample Date | Conductivity (mS/m) | Enterococci (cfu/100mL) | Faecal coliforms (cfu/100mL) | pH | Dissolved oxygen (ppm) | Temperature (°C) | E.Coli (cfu/100mL) | DO Sat U/S | % DO |
|---|---|---|---|---|---|---|---|---|---|
| 28-Mar-17 | 980.00 | 226.00 | 13000.00 | 7.16 | 8.56 | 19.50 | 13000.00 | 9.65 | 89% |
| 7-Apr-17 | 11.70 | 134.00 | 1600.00 | 7.18 | 9.07 | 12.60 | 1600.00 | 10.76 | 84% |
| 11-Apr-17 | 536.00 | 185.00 | 1700.00 | 7.17 | 8.54 | 14.50 | 1700.00 | 10.29 | 83% |
| 18-Apr-17 | 8.70 | 72.00 | 130.00 | 7.17 | 9.12 | 14.10 | 130.00 | 10.29 | 89% |
| 27-Apr-17 | 7910.00 | 84.00 | 700.00 | 7.26 | 11.80 | 13.80 | 700.00 | 10.53 | 112% |