South Taranaki District Council
Eltham WWTP
Monitoring Programme
Annual Report
2016-2017

Technical Report 2017-31

ISSN: 1178-1467 (Online)
Document: 1864753 (Word)
Document: 1959300 (Pdf)

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January 2018

Executive summary

The South Taranaki District Council (STDC) operates a municipal wastewater treatment plant (WWTP) located on Castle Street at Eltham, in the Waingongoro catchment. This report for the period July 2016 to June 2017 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess STDC's environmental and consent compliance performance during the period under review. The report also details the results of the monitoring undertaken and assesses the environmental effects of STDC's activities.

STDC holds one resource consent to discharge treated wastewater into an unnamed tributary of the Mangawhero Stream only in the event of high rainfall. This consent includes nine conditions setting out the requirements that they must satisfy.

During the monitoring period, South Taranaki District Council demonstrated an overall high level of environmental performance.

The Council's monitoring programme for the year under review included four inspections and associated odour surveys, four pond effluent and 36 downstream water samples collected for physicochemical analysis, and two biomonitoring surveys of receiving waters.

The monitoring showed that activities at the Eltham WWTP were well managed. There were no issues with operation of the plant or odour associated with plant processes. The level of the primary pond was well managed by the diversion pumping system to Hawera, and the holding pond was not required to be used as short-term storage. As a result of this, no consented overflows to the unnamed tributary of the Mangawhero Stream were recorded.

As in previous years, the monitoring indicated a continual improvement in water quality and the biological health of the downstream environment associated with the diversion of wastes out of the Mangawhero Stream to the Hawera WWTP in the 2010-2011 period. There was one minor unauthorised incident recorded in respect of this consent holder during the period under review. The incident related to an overflow from the sewerage reticulation system, but given the nature of the event and following the timely and satisfactory response by STDC, no further action was required.

During the year, STDC demonstrated a high level of environmental and administrative performance with the resource consent. During the year under review there were no overflows from the system or odour complaints relating to operation of the plant. STDC maintained excellent communication with the Council, regularly informing on the state of the primary pond and what, if any, action was being undertaken to maintain optimal operating conditions.

For reference, in the 2016-2017 year, consent holders were found to achieve a high level of environmental performance and compliance for 74% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 21% of the consents, a good level of environmental performance and compliance was achieved.

In terms of overall environmental and compliance performance by the consent holder over the last several years, this report shows that the consent holder's performance is improving.

This report includes recommendations for the 2017-2018 year.

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1. Introduction

1.1. Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1. Introduction

This report is for the period July 2016 to June 2017 by the Taranaki Regional Council (the Council) and describes the monitoring programme associated with a resource consent held by South Taranaki District Council (STDC), for the operation of a municipal wastewater treatment plant (WWTP) situated on Castle Street at Eltham.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consent held by STDC that relates to the discharge of treated wastewater in the Waingongoro catchment (limited to events associated with high rainfall). This is the 30th annual report to be prepared by the Council to cover STDC's discharge and its effects.

1.1.2. Structure of this report

Section 1 of this report is a background section. It sets out general information about:

- consent compliance monitoring under the Resource Management Act 1991 (RMA) and the Council's obligations;
- the Council's approach to monitoring sites though annual programmes;
- the resource consent held by STDC in the Waingongoro catchment;
- the nature of the monitoring programme in place for the period under review; and
- a description of the activities and operations conducted at STDC's site.

Section 2 presents the results of monitoring during the period under review, including scientific and technical data.

Section 3 discusses the results, their interpretations, and their significance for the environment.

Section 4 presents recommendations to be implemented in the 2017-2018 monitoring year.

A glossary of common abbreviations and scientific terms, and a bibliography, are presented at the end of the report.

1.1.3. The Resource Management Act 1991 and monitoring

The RMA primarily addresses environmental 'effects' which are defined as positive or adverse, temporary or permanent, past, present or future, or cumulative. Effects may arise in relation to:

a. the neighbourhood or the wider community around an activity, and may include cultural and social-economic effects;

b. physical effects on the locality, including landscape, amenity and visual effects;

c. ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;

d. natural and physical resources having special significance (for example recreational, cultural, or aesthetic); and

e. risks to the neighbourhood or environment.

In drafting and reviewing conditions on discharge permits, and in implementing monitoring programmes, the Council is recognising the comprehensive meaning of 'effects' inasmuch as is appropriate for each activity. Monitoring programmes are not only based on existing permit conditions, but also on the obligations of the RMA to assess the effects of the exercise of consents. In accordance with Section 35 of the RMA, the Council undertakes compliance monitoring for consents and rules in regional plans, and maintains an overview of the performance of resource users and consent holders. Compliance monitoring, including both activity and impact monitoring, enables the Council to continually re-evaluate its approach and that of consent holders to resource management and, ultimately, through the refinement of methods and considered responsible resource utilisation, to move closer to achieving sustainable development of the region's resources.

1.1.4. Evaluation of environmental and administrative performance

Besides discussing the various details of the performance and extent of compliance by STDC, this report also assigns them a rating for their environmental and administrative performance during the period under review.

Environmental performance is concerned with actual or likely effects on the receiving environment from the activities during the monitoring year. Administrative performance is concerned with STDC's approach to demonstrating consent compliance in site operations and management including the timely provision of information to Council (such as contingency plans and water take data) in accordance with consent conditions.

Events that were beyond the control of the consent holder and unforeseeable (that is a defence under the provisions of the RMA can be established) may be excluded with regard to the performance rating applied. For example loss of data due to a flood destroying deployed field equipment.

The categories used by the Council for this monitoring period, and their interpretation, are as follows:

Environmental Performance

High: No or inconsequential (short-term duration, less than minor in severity) breaches of consent or regional plan parameters resulting from the activity; no adverse effects of significance noted or likely in the receiving environment. The Council did not record any verified unauthorised incidents involving significant environmental impacts and was not obliged to issue any abatement notices or infringement notices in relation to such impacts.

Good: Likely or actual adverse effects of activities on the receiving environment were negligible or minor at most. There were some such issues noted during monitoring, from self reports, or in response to unauthorised incident reports, but these items were not critical, and follow-up inspections showed they have been dealt with. These minor issues were resolved positively, co-operatively, and quickly. The Council was not obliged to issue any abatement notices or infringement notices in relation to the minor non-compliant effects; however abatement notices may have been issued to mitigate an identified potential for an environmental effect to occur.

For example:

- High suspended solid values recorded in discharge samples, however the discharge was to land or to receiving waters that were in high flow at the time;
- Strong odour beyond boundary but no residential properties or other recipient nearby.

Improvement required: Likely or actual adverse effects of activities on the receiving environment were more than minor, but not substantial. There were some issues noted during monitoring, from self reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent

minor non-compliant activity could elevate a minor issue to this level. Abatement notices and infringement notices may have been issued in respect of effects.

Poor: Likely or actual adverse effects of activities on the receiving environment were significant. There were some items noted during monitoring, from self reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent moderate non-compliant activity could elevate an 'improvement required' issue to this level. Typically there were grounds for either a prosecution or an infringement notice in respect of effects.

Administrative performance

High: The administrative requirements of the resource consents were met, or any failure to do this had trivial consequences and were addressed promptly and co-operatively.

Good: Perhaps some administrative requirements of the resource consents were not met at a particular time, however this was addressed without repeated interventions from the Council staff. Alternatively adequate reason was provided for matters such as the no or late provision of information, interpretation of 'best practical option' for avoiding potential effects, etc.

Improvement required: Repeated interventions to meet the administrative requirements of the resource consents were made by Council staff. These matters took some time to resolve, or remained unresolved at the end of the period under review. The Council may have issued an abatement notice to attain compliance.

Poor: Material failings to meet the administrative requirements of the resource consents. Significant intervention by the Council was required. Typically there were grounds for an infringement notice.

For reference, in the 2016-2017 year, consent holders were found to achieve a high level of environmental performance and compliance for 74% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 21% of the consents, a good level of environmental performance and compliance was achieved.

1.2. WWTP system

1.2.1. Background

Historically, the Eltham township sewage treatment has been provided by a two oxidation pond system. The original design was based on a population of 5,500 persons, prior to the installation of mechanical aeration. Various industrial wastes have also been accepted for treatment by this system. Mechanical aeration of the primary oxidation pond was introduced because of overloading of the two pond system as a consequence of the incorporation of these industrial wastes.

Over time it became evident that the treatment system was not capable of coping with the waste loadings it was receiving. From time to time complaints were received by STDC and the Council concerning objectionable odours emanating from the ponds system as well as various other environmental and maintenance issues.

Poor stream water quality conditions had also been identified from time to time in the past upstream of the oxidation ponds' discharge.

During the 2004-2005 monitoring period, investigation and reviews relating to the proposed pipeline diversion of wastes (out of the Mangawhero Stream) to the Hawera WWTP were completed. The pipeline diversion was completed in June, 2010 following the pipeline and pump station construction.

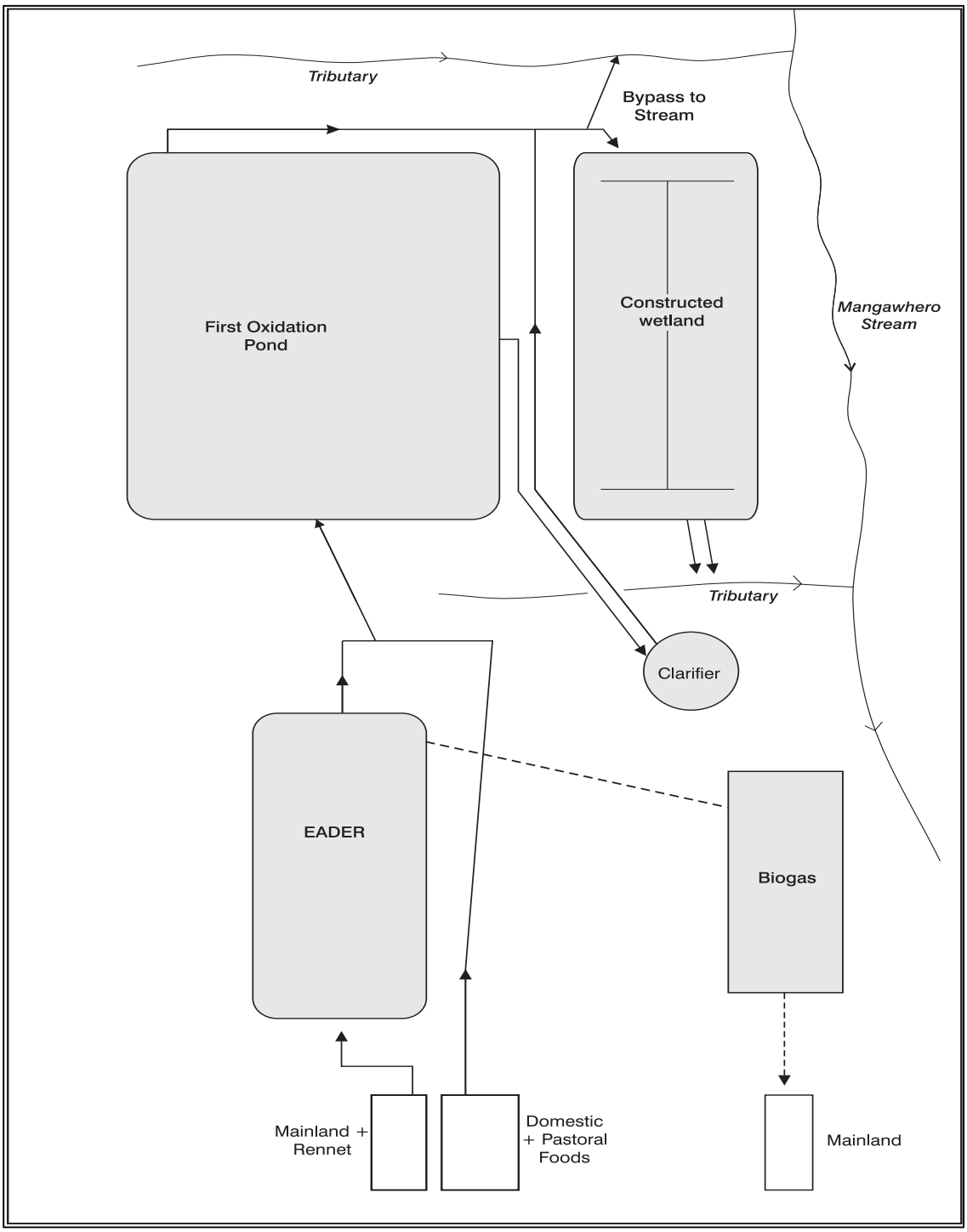

Figure 1 Schematic layout of Eltham WWTP prior to the diversion of wastewater to the Hawera WWTP

The layout of the wastewater plant as it existed prior to the new pipeline diversion is illustrated in Figure 1. Reconfiguration of the wetland to act as a storage pond was undertaken following full diversion of wastes to the Hawera pipeline.

The primary pond was desludged during the 2006-2007 monitoring year with the dewatered sludge contained in geo-textile bags in an excavated, bunded area adjacent to the Earthen Anaerobic Digester (EADER) (Figure 2). A consent to discharge sludge from the WWTP and STDC water treatment plants to land at the Eltham WWTP site was granted in December 2009 following concerns voiced by neighbours in relation to STDC's disposal of water treatment sludge at the site.

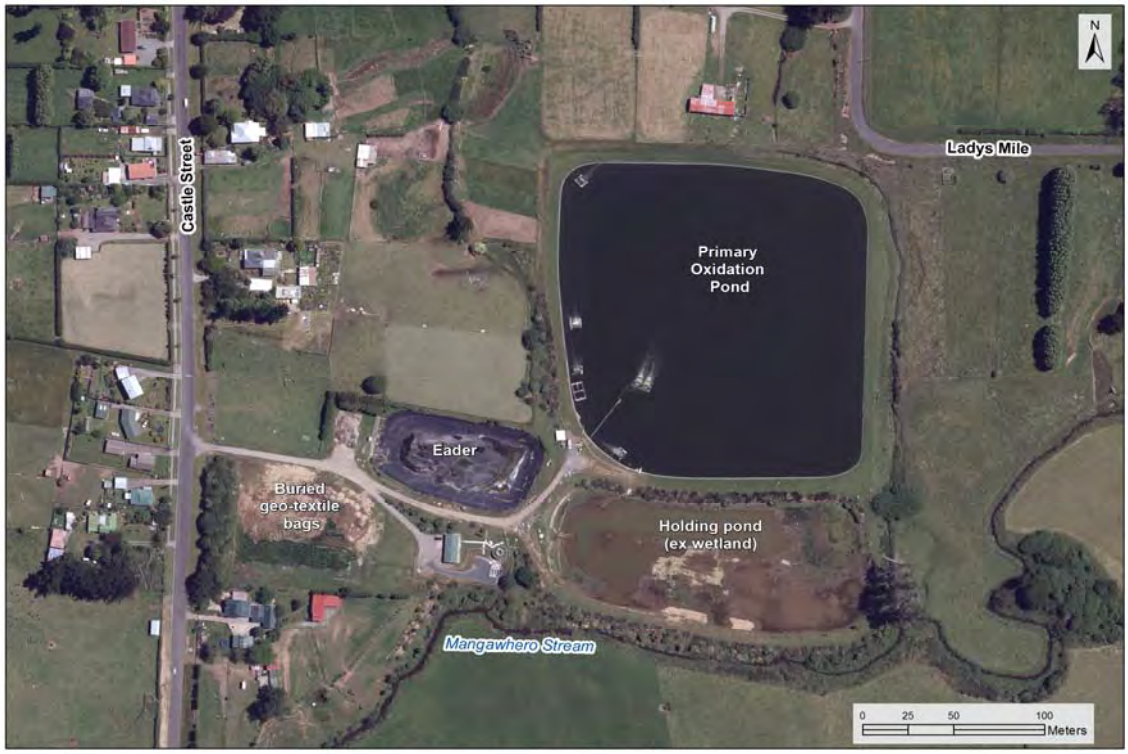

Figure 2 Aerial view of the Eltham WWTP

Work commenced on the pipeline connection to the Hawera WWTP during the latter half of the 2008-2009 monitoring period. A step screen and new inlet to the primary pond were constructed on the raw wastewater reticulation and a new stormwater pipe from this area was directed to the wetland. The wetland was converted to a holding pond in early 2011 to provide high stormwater ingress containment in excess of the pumping capacity of the new pipeline connection. This system is anticipated to have an overflow frequency of one to two occasions in any five year period necessitating a new consent for this discharge which was granted in November, 2009 (consent 7521). Monitoring of overflows from the pond is provided and incorporated within the consent holder's telemetry system.

The new pipeline was operational by June 2010 and the full upgrade (e.g. conversion of the wetland to a storage pond) was completed in early 2011 with the vegetation removed and buried with the sludge. This was covered, levelled, and replanted by the consent holder in the latter part of the 2011-2012 monitoring period. Discharges to the stream ceased completely in late June 2010.

Stormwater infiltration investigative work has been continued by STDC, particularly in relation to illegal connections to the sewerage reticulation. Re-lining of sewerage pipelines has been undertaken by STDC since 2011, with 304 m of pipeline re-lined in the 2015-2016 period.

There was occasional usage of the overflow retention pond in the 2014-2016 period. No authorised overflows as per consent 7521-1 to the Mangawhero Stream were necessary at any time during the 2016-2017 monitoring period.

The EADER was decommissioned during the 2015-2016 period by way of re-lining and burial.

No usage of the Eltham WWTP for disposal of industrial tanker wastes (e.g. septic tank wastes etc.) now occurs as there are purpose-built facilities in place to accept these wastes at the nearby Stratford oxidation ponds and more appropriately, the Hawera system. Monitoring of waste influent in the ponds is performed by STDC (by way of continuous recording of volume and periodic industrial wastewater quality sampling), ensuring that stricter control of such usage now occurs.

1.3. Resource consent

1.3.1. Water discharge permit

Section 15(1)(a) of the RMA stipulates that no person may discharge any contaminant into water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or by national regulations.

STDC holds water discharge permit **7521-1** to discharge, as a consequence of high rainfall, partially treated wastewater from the Eltham Wastewater Treatment Plant into an unnamed tributary of the Mangawhero Stream in the Waingongoro catchment. This permit was issued by the Council on 10 November 2009 under Section 87(e) of the RMA. It is due to expire on 1 June 2027.

Condition 1 sets limits on when the discharge may occur.

Condition 2 details requirements on storage capacity of the system.

Condition 3 limits modifications to the treatment plant that may cause increases in discharge frequency.

Condition 4 sets out requirements of overflow recording and reporting.

Condition 5 requires the consent holder to adopt the best practicable option.

Condition 6 details requirements of notification following overflow events.

Condition 7 details requirements of the contingency plan.

Condition 8 details requirements relating to monitoring.

Condition 9 is a review provision.

The permit is attached to this report in Appendix I.

This summary of consent conditions may not reflect the full requirements of each condition. The consent conditions in full can be found in the resource consent which is appended to this report.

1.4. Monitoring programme

1.4.1. Introduction

Section 35 of the RMA sets obligations upon the Council to gather information, monitor and conduct research on the exercise of resource consents within the Taranaki region. The Council is also required to assess the effects arising from the exercising of these consents and report upon them.

The Council may therefore make and record measurements of physical and chemical parameters, take samples for analysis, carry out surveys and inspections, conduct investigations and seek information from consent holders.

The monitoring programme for the Eltham WWTP consisted of four primary components.

1.4.2. Programme liaison and management

There is generally a significant investment of time and resources by the Council in:

- ongoing liaison with resource consent holders over consent conditions and their interpretation and application;
- in discussion over monitoring requirements;
- preparation for any consent reviews, renewals or new consent applications;
- advice on the Council's environmental management strategies and content of regional plans; and

- consultation on associated matters.

1.4.3. Site inspections

The Eltham WWTP was visited four times during the monitoring period. The main points of interest were plant processes with potential or actual discharges to receiving watercourses, including contaminated stormwater and process wastewaters. Air inspections focused on plant processes with associated actual and potential emission sources and characteristics, including potential odour, dust, noxious or offensive emissions. Sources of data being collected by STDC were identified and accessed, so that performance in respect of operation, internal monitoring, and supervision could be reviewed by the Council. The neighbourhood was surveyed for environmental effects.

1.4.4. Chemical sampling

The Council undertook sampling of the effluent microfloral quality of the primary pond adjacent to the discharge point on four occasions.

1.4.5. Biomonitoring surveys

A biological survey was performed on two occasions in an unnamed tributary of the Mangawhero Stream to continue to monitor the improvement of the stream following diversion of the effluent to the Hawera WWTP.

This information will also be used to determine whether or not the discharge of treated wastewater from the site has had a detrimental effect upon the communities of the stream in the event of any discharges.

2. Results

2.1. Inspections

6 July 2016

A compliance monitoring site inspection was undertaken at the STDC Eltham WWTP in fine weather with light wind conditions.

The step screen was operating and wastes were fully contained. The primary pond level was normal and the surface was mainly flat. It was a turbid green brown colour, with all eight aerators operating. Dissolved oxygen (DO) readings were taken adjacent to the pond outlet and a sample was collected for chlorophyll-a analysis. 'Biobugs' were being continually dosed into the pond. Numerous mallard ducks were observed on the pond's surface.

The holding pond contained minor amounts of stormwater. Any overflow effluent from the primary pond was pumped back into the discharge sump as required.

The remediated EADER area appeared to be stable and unchanged. A clear trickle flow was discharging from the subsurface monitoring manhole to the unnamed tributary of the Mangawhero Stream at the time of inspection. The WWTP was only discharging to the Hawera WWTP at night, with the pumps being turned off during the day.

4 October 2016

A compliance monitoring inspection was undertaken in overcast weather with light wind conditions.

The step screen was operating and wastes were fully contained. The primary pond was mainly flat and at a normal level. It was a turbid dark green colour, with nine aerators operating. DO readings were taken adjacent to the pond outlet, and a sample was collected for chlorophyll-a analysis. 'Biobugs' continued to be dosed to the primary pond, which was occupied by numerous mallard ducks.

The holding pond contained minor amounts of stormwater, with no overflow effluent observed.

The remediated EADER area appeared stable, and a clear trickle flow was discharging from the subsurface manhole to an unnamed tributary of the Mangawhero Stream. The WWTP was discharging to Hawera WWTP at 70 m^3/hr continuous.

10 January 2017

A compliance monitoring inspection was undertaken in mainly fine weather with light wind conditions.

The step screen was operating and wastes were fully contained. The level in the primary pond was normal, and it was a turbid grey green colour with rippling on the surface. Seven bubble and two paddle aerators were operating at the time of inspection. Two additional bubble aerators had been recently installed and were due to be commissioned. DO readings were taken adjacent to the pond outlet.

Discussions with STDC staff onsite found the WWTP online telemetered DO meter had been displaying low DO readings during the past month, mainly during the late evening to early morning hours. The pond DO appeared to recover to normal levels as expected with the onset of daylight. There had been no recent odour issues regarding low pond DO, and the pond had retained a normal green algal colour. Sodium nitrate was on hand to be dosed only when the pond DO remained low and the pond colour changed. 'Biobugs' continued to be dosed into the pond, and an algal sample was collected for chlorophyll-a analysis. Large numbers (300+individuals) of mallard and paradise duck were observed on the primary pond.

The holding pond contained minor amounts of surface water, and the EADER area remained stable and well-managed. The Eltham WWTP discharge to the Hawera WWTP was occurring at 60 m^3/hr with pumping being carried out as required.

10 April 2017

A compliance monitoring inspection was undertaken in fine weather with light wind conditions.

The step screen was operating and wastes were fully contained. The level in the primary pond was normal with a mainly flat surface and a slightly turbid, green brown colour. Seven bubble and two paddle aerators were operating. DO readings were taken adjacent to the pond outlet and a sample was collected for chlorophyll-a analysis. 'Biobugs' were being continually dosed into the primary pond, which was occupied by large numbers (600+ individuals) of mallard and paradise duck, and several black swans.

The holding pond contained some surface water, with no effluent observed.

The remediated EADER area remained stable with no change observed since the previous inspection. The WWTP was discharging to the Hawera WWTP at 120 m^3/hr. Continuous pumping was ongoing after recent high rainfall. The WWTP and surrounds were found to be tidy and well-maintained.

2.1.1. Odour surveys

Four routine odour surveys were carried out during the monitoring period in conjunction with all programmed site inspections. Odour strength was rated according to the following scale:

0 = no noticeable odours;

1 = slight occasional wafts;

2 = recognisable and noticeable;

3 = frequently noticeable;

4a = unpleasant odours, frequently strong;

4b = unpleasant odours, continuous and noticeable; and

5 = putrid.

The strength of odour beyond the boundaries of the WWTP site appears to be governed largely by weather conditions. Odour is strongest under calm condition, when aerial emissions from the pond accumulate. This effect is accentuated when it is overcast, as vertical mixing with ambient air is reduced, and under warm temperatures, when odour-generating bacteria in the pond are most active. Effects may be exacerbated by reduction in aeration capacity (mechanical) in the pond and deterioration in the microfloral population of this pond. Aeration capacity was maintained adequately throughout the 2016-2017 period.

Odours from the Eltham WWTP will occur from time to time and will vary in their effect depending upon ambient weather conditions. Therefore, they may only be documented by way of continuing monitoring and recording of incidents, in conjunction with the monitoring of the system now that connection to the Hawera WWTP pipeline has been completed. It is essential that sufficient aeration is provided and capacity is maintained in the primary oxidation pond at all times, particularly coincident with seasonal changes in pond floral communities. It is also essential that the pre-treatment of industrial wastes is maintained to a satisfactory standard at all times prior to discharge into the WWTP.

No odour was detected during any of the four odour surveys, and no odour complaints were received during the period under review.

2.2. Results of effluent monitoring

With the diversion of wastes to the Hawera WWTP in the 2010-2011 period, discharges from the Eltham WWTP now occur only as a result of high rainfall events that exceed the storage capacity of the primary and holding ponds, and the pumping capacity of the reticulated system to Hawera.

Primary pond effluent analyses were not required during the monitoring period, although the condition of the pond and any associated odour continues to be monitored during routine inspections.

Along with a visual survey of the primary pond and surrounds, dissolved oxygen levels (DO) and the microfloral component of the pond are measured during each inspection.

2.2.1. Dissolved oxygen levels

The dissolved oxygen concentrations in WWTPs vary both seasonally and during the day as a result of a combination of factors. The photosynthetic activity of the pond's microflora together with fluctuations in influent waste loadings on the system are major influencing factors. Another significant influence in the Eltham system is the degree of mechanical aeration provided in the primary pond (required by the high industrial wastes loadings on the system). Minimum dissolved oxygen concentrations are generally recorded in the early hours of daylight, and therefore pond performance has been evaluated by standardising sampling times toward mid-morning for all regular inspection visits during the monitoring period.

The results of dissolved oxygen monitoring in the primary pond recorded adjacent to the aerators DO probe are included in Table 1.

Table 1 Dissolved oxygen levels at the surface of the Eltham WWTP primary pond

Date	Time (NZST)	Temperature (°C)	Dissolved Oxygen	
			Concentration (g/m^3)	Saturation (%)
06 July 2016	0930	10.2	6.5	59
04 October 2016	0850	17.1	5.5	59
10 January 2017	0810	19.7	0.6	7
10 April 2017	0940	16.1	3.5	36

Results in Table 1 indicated a relatively narrow range of dissolved oxygen concentrations (between 7 and 59% saturation) in the surface layer of the primary pond near the outlet. These were typical of the levels generally recorded in this heavily loaded oxidation pond (i.e. supersaturation is seldom recorded). Mechanical aeration of the pond (by 8 to 9 aerators) maintained positive dissolved oxygen concentrations on each survey occasion with the lowest concentration measured during the summer period.

2.2.2. Microfloral component

Pond microflora are very important for the stability of the symbiotic relation between aerobic bacteria in the primary pond. These phytoplankton may be used as a bio-indicator of pond conditions, for example cyanobacteria are often present in under-loaded conditions and chlorophyceae are present in overloaded conditions. To maintain facultative conditions in a pond system there must be an algal community present in the surface layer.

The principal function of algae is the production of oxygen which maintains aerobic conditions while the main nutrients are reduced by biomass consumption. Elevated pH (due to algal photosynthetic activity) and solar radiation combine to reduce faecal bacteria numbers significantly.

Samples of the primary pond effluent were collected on all four inspections for chlorophyll-a analyses. Chlorophyll-a concentration can be a useful indicator of the algal population present in the system. Pearson (1996) suggested that a minimum in-pond chlorophyll-a concentration of 300 mg/m^3 was necessary to maintain stable facultative conditions. However, seasonal change in algal populations and also dilution by stormwater infiltration might be expected to occur in any WWTP which, together with fluctuations in waste loadings, would result in chlorophyll-a variability.

The results of primary pond effluent analyses are provided in Table 2 together with field observations of pond appearance.

Table 2 Chlorophyll-a levels and primary pond appearance

Date	Time	Appearance	Chlorophyll-a (mg/m^3)	Chlorophyll-a (mg/m^3) data from July 2015 to June 2016		
				N	Range	Median
06 July 2016	0930	turbid, green brown	770	6	78-2800	446
04 October 2016	0850	turbid, dark green	1070			
10 January 2017	0810	turbid, grey green	487			
10 April 2017	0940	slightly turbid, green brown	108			

Despite the high to very high concentrations of chlorophyll-a in the primary pond, indicative of a significant phytoplanktonic component, low DO levels (0.6 g/m^3 to 6.5 g/m^3) were measured, indicative of the high organic wastes' loadings on this system, particularly considering the additional mechanical aeration provided within this period.

2.2.3. Holding pond conditions

No odours were associated with the holding pond at the time of any inspection visit. The pond contained minimal, if any, wastewater and was generally shallow or empty with occasional increases in stormwater or seepage following wet weather. All water and wastes were pumped back into the primary pond and then directly to into the Hawera WWTP pipeline. No overflows occurred to the unnamed tributary of the Mangawhero Stream.

2.3. Results of receiving environment monitoring

Monthly water quality monitoring was carried out downstream of the WWTP to asses the change in water quality following diversion of the waste from the Mangawhero Stream to the Hawera WWTP.

In addition to this, two biomonitoring surveys, one in spring and one in summer, were carried out to asses the ecological impacts of the diversion, and to provide background data in the event that a discharge from the WWTP should occur.

The lower Mangawhero Stream and Waingongoro River biological and chemical sampling sites are shown in Figure 3.

Figure 3 Aerial map showing location of chemical and biomonitoring sampling sites

2.3.1. Chemical sampling surveys

Monthly water quality monitoring continues to be measured at the lower Mangawhero Stream and two Waingongoro River sites, assessing the impacts of diversion of the WWTP wastes out of the Mangawhero Stream.

A summary of this data is presented in Table 3.

Table 3 2016-2017 water quality results downstream of the Eltham WWTP

Parameter	Units	MWH000498		WGG000620		WGG000640	
		Range	Median	Range	Median	Range	Median
Temperature	°C	8.6 - 18.1	14.2	7.9 - 19.2	12.8	8.2 - 18.9	14.1
Conductivity @ 20°C	mS/m	17.3 - 20.1	18.4	10.0 - 13.3	12.0	12.5 - 14.9	13.6
Chloride	g/m²	15.8 - 20.2	18.4	11.2 - 13.9	12.7	13.2 - 16.7	14.0
pH	pH	7.4 - 7.8	7.5	7.2 - 7.9	7.6	7.4 - 7.9	7.6
DRP	g/m² P	0.01 - 0.05	0.020	0.011 - 0.193	0.032	0.013 - 0.134	0.027
Total phosphorus	g/m² P	0.037 - 0.118	0.068	0.033 - 0.230	0.046	0.035 - 0.171	0.056
Unionised Ammonia	g/m² N	0.00005 - 0.00089	0.00054	0.00018 - 0.00533	0.00065	0.00004 - 0.00101	0.00058
Ammoniacal Nitrogen	g/m² N	0.004 - 0.088	0.058	0.016 - 0.661	0.047	0.003 - 0.450	0.034
Nitrite Nitrogen	g/m² N	0.01 - 0.036	0.017	0.004 - 0.393	0.013	0.007 - 0.195	0.014
Nitrate Nitrogen	g/m² N	1.03 - 2.40	1.72	0.176 - 2.25	1.70	0.363 - 2.31	1.70
TKN	g/m² N	0.23 - 0.60	0.42	0.05 - 0.91	0.14	0.09 - 0.67	0.23
Total nitrogen	g/m² N	1.39 - 2.64	2.17	0.32 - 2.90	1.98	0.61 - 2.66	1.97
Turbidity	NTU	3.3 - 10	5.2	1.2 - 3.2	2.3	1.5 - 4.8	3.1

Median values of selected parameters indicate dilution of the Mangawhero Stream flow by the flow of the Waingongoro River over the sampling period.

Median nutrient concentrations in the Mangawhero Stream post-diversion of WWTP wastes continue to show a reduction in concentration, with ammoniacal nitrogen and dissolved reactive phosphorus medians lower by 99% and 95% respectively than prior to wastes diversion. Most minimum nutrient concentrations have been markedly lower since the diversion.

All of the parameters excluding one showed decreases in the main river below the Mangawhero Stream confluence subsequent to the diversion of the Eltham WWTP discharge out of the Mangawhero Stream. The only exception was turbidity with an increase of 39% compared to pre-diversion results; the reasons for which are unclear.

2.3.2. Biomonitoring surveys

2.3.2.1. Spring 2016

The Councils 'kick-sampling' technique was used at two sites and a combination of 'kick-sampling' and 'sweep netting' to used at one site to collect macroinvertebrates from two sites on the Mangawhero Stream and one site on the Waingongoro River for the spring survey at the Eltham WWTP. This has provided data to assess whether discharges have had an affect on the macroinvertebrate communities present in the Mangawhero Stream and Waingongoro River. Samples were processed to provide number of taxa (richness), MCI, and $SQMCI_S$ scores for each site.

The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of nutrient enrichment in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. The $SQMCI_S$ takes into account taxa abundances as well as sensitivity to pollution. Significant differences in either the taxa richness, MCI or the $SQMCI_S$ between sites may indicate the degree of adverse effects (if any) of the discharge being monitored.

The 'impacted' sites had higher macroinvertebrate indices than the 'control' site. This would be due to both 'impacted' sites having better physical stream habitat conditions for macroinvertebrates. Site 5 showed an improvement for MCI and $SQMCI_S$ scores compared with the historical median and site 8 showed an improvement for the $SQMCI_S$ score compared with the historical median which was probably a reflection of the lack of discharges occurring at the Eltham WWTP.

2.3.2.2. Summer 2017

The Councils 'kick-sampling' technique was used at one site on the Mangawhero Stream and three sites on the Waingongoro River and a combination of 'kick-sampling' and 'sweep netting' used at one site on the Mangawhero Stream to collect macroinvertebrates for this summer survey in relation to the Eltham WWTP and a retired landfill site. This has provided data to assess whether discharges from have had an affect on the macroinvertebrate communities present in the Mangawhero Stream and Waingongoro River. Samples were processed to provide number of taxa (richness), MCI, and $SQMCI_S$ scores for each site.

Taxa richnesses were either similar or higher than historical median taxa richnesses except for a drop in richness at the Waingongoro River 'control' site. The MCI and $SQMCI_S$ scores for the three potentially impacted sites (sites 5, 7 and 8) were all higher than historical medians and there were no significant differences between sites 1 and 5. Site 7 and 8 MCI and $SQMCI_S$ scores were lower than the Waingongoro River 'control' site but this was due to the 'control' site having significantly higher than normal scores, indicating higher than usual macroinvertebrate community health at the 'control' site.

Overall, there was no evidence that the Eltham WWTP or old landfill site was having any impact on the macroinvertebrate communities present in the Mangawhero Stream and Waingongoro River.

A summary of the results for the current year and comparison with previous periods is provided in Table 4.

Table 4 Biomonitoring results for 2016-2017, and comparison with pre- and post-waste diversion results

Site		Taxa Numbers				MCI values				No. of surveys	
No	Code	Oct-16	Feb-17	Pre	Post	Oct-16	Feb-17	Pre	Post	Pre	Post
1	MWH000380	14	21	10-25 [16]	12-24 [16]	74	77	58-85 [73]	72-85 [74]	41	14
5	MWH000490	24	21	13-25 [19]	16-30 [20]	90	80	63-86 [77]	84-102 [79]	36	14
6	WGG000620	-	16	16-35 [27]	16-28 [26]	-	111	77-105 [91]	96-116 [96]	25	8

Site		Taxa Numbers				MCI values				No. of surveys	
No	Code	Oct-16	Feb-17	Pre	Post	Oct-16	Feb-17	Pre	Post	Pre	Post
7	WGG000640	-	22	17-35 [26]	21-31 [26]	-	95	78-100 [91]	89-109 [93]	24	8
8	WGG000665	14	20	14-30 [21]	14-27 [20]	104	101	77-105 [93]	89-111 [94]	32	14

Note: Pre = 1985-2010, Post = 2010-2017, [X] = median.

2.4. Riparian management

In recognition of the effectiveness of riparian vegetation as a management technique contributing to water quality improvement, Council land management staff prepared a riparian management plan for the Mangawhero catchment (TRC, 1998b). This plan identified the 6.6 km reach of the Mangawhero Stream extending from about 2 km upstream of the WWTP to the stream's confluence with the Waingongoro River, as the reach requiring a combination of riparian planting and fencing, and willow removal. Design and costs were assessed and progress with implementation of the plan was dependent on landowner agreements integrated with funding from various sources, including a consent holder contribution.

For the period ending 30 June 2017, there is a total of 150 km of the 155 km of Mangawhero Stream banks (upstream of the Mangawharawhara Stream confluence) adequately fenced and 26 km with riparian vegetation. A further 5 km (fencing) and 12 km (vegetation) have been recommended within riparian farm plans for completion.

Correspondingly, 67 km (fencing) and 40 km (vegetated) of the 82 km of Mangawharawhara Stream banks (to the Waingongoro River confluence) are adequately riparian protected with an additional 5 km of fencing and 24 km of vegetation recommended by riparian plans (It has been noted that a section of streambanks (approx. 3 km) has recently been piped and therefore not riparian planted).

In summary, 92% of these catchments' stream banks are fenced adequately and 65% of banks requiring riparian vegetation are adequately protected by vegetation.

2.5. Investigations, interventions, and incidents

The monitoring programme for the year was based on what was considered to be an appropriate level of monitoring, review of data, and liaison with STDC. During the year matters may arise which require additional activity by the Council, for example provision of advice and information, or investigation of potential or actual causes of non-compliance or failure to maintain good practices. A pro-active approach that in the first instance avoids issues occurring is favoured.

The Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The incident register includes events where STDC has itself notified the Council. The register contains details of any investigation and corrective action taken.

Complaints may be alleged to be associated with a particular site. If there is potentially an issue of legal liability, the Council must be able to prove by investigation that the identified company is indeed the source of the incident (or that the allegation cannot be proven).

In the 2016-2017 period, the Council was required to record an incident in association with STDC's conditions in their resource consent and provisions in Regional Plans.

On 2 April 2017, an investigation was carried out in response to a complaint that was received concerning an unauthorised discharge from a manhole on Stanners St, Eltham. During a site visit, a contractor found

that fat deposits had built up within the sewage reticulation system, resulting in a overflow. Once the issue had been identified, the contractors unblocked the system immediately and the overflow ceased.

Untreated effluent had discharged onto and into land where it had potentially reached surface water. Water quality samples and pictures were taken, as it had been reported by the property occupier that the discharge had been occurring for some time. No adverse environmental effects were observed as a result of the discharge, and the sampling results supported this.

The overflow to water was due to unforeseen circumstances, and as a result no further action was undertaken. However, it was recommended that STDC continue to ensure operating procedures were followed as outlined in the STDC Wastewater Contingency Plan.

3. Discussion

3.1. Discussion of site performance

All aspects of plant performance and normal maintenance were compliant during the 2016-2017 year, with good liaison maintained between STDC and the Council. Ongoing management of the pond operation and trade wastes inflow led to no odour complaints being received from neighbouring properties or any breaches of the Taranaki Regional Air Quality Plan.

No significant overflows from the holding pond (previously the wetland) have occurred since the installation of the diversion pipeline, and it has seldom been necessary to utilise the storage pond at all. The most recent brief duration overflow occurred during the 2011-2012 monitoring year.

As no significant overflows occurred from the primary pond to the holding pond, there were no consented discharges to the stream. Relatively low dissolved oxygen concentrations were recorded in the primary pond through the period. These were lower than normal on occasions due to additional dairy industrial wastes loadings placed upon the system. No odours were detected at locations about the WWTP during the period under review. Previous works to decommission and remediate the EADER area appear to have been successful, with no issues or odour complaints associated with this area.

One minor overflow from the sewerage reticulation system occurred in April 2017; however this did not result in any further action and was the result of unforeseeable events. STDC's response to this event was carried out in a timely and satisfactory manner.

3.2. Environmental effects of exercise of consents

Past significant impacts on the receiving water quality of the Mangawhero Stream, and to a lesser effect on the Waingongoro River downstream of the confluence with the Mangawhero Stream, have been alleviated with the pipeline diversion of the wastewater to the Hawera WWTP. This is evidenced by the monthly sampling of the lower reach of the Mangawhero Stream and mid-reaches of the Waingongoro River, which have confirmed marked improvements in water quality (such as nutrient reduction).

Improvements in the macroinvertebrate fauna and the flora of the Mangawhero Stream below the original discharge outfall were also recorded during spring and summer biomonitoring surveys. No significant impacts were recorded on the Waingongoro River below the Mangawhero Stream confluence with improvements in the macroinvertebrate fauna noted at these sites in comparison with historical (pre-wastes diversion) data. State of the environment trend monitoring over a twenty year period has shown significant statistical and ecological improvements in stream and river biological health at both sites downstream of the wastewater outfall.

Future riparian planting and the movement towards dairy shed treated waste irrigation to land should further contribute to marked improvements in the water quality of the receiving waters of the Mangawhero Stream and the Waingongoro River.

3.3. Evaluation of performance

A tabular summary of the consent holder's compliance record for the year under review is set out in Table 5.

Table 5 Summary of performance for consent 7521-1

Purpose: ***To discharge, as a consequence of high rainfall, partially treated wastewater from the Eltham Wastewater Treatment Plant into an unnamed tributary of the Mangawhero Stream in the Waingongoro catchment.***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Limits on the timing of discharges	Inspection, liaison with consent holder	Yes
2. Requirements of plant storage capacity	Inspection	Yes
3. Limits on plant modifications	Inspection, liaison with consent holder	Yes
4. Requirements of overflow reporting	No overflows – not applicable	N/A
5. Consent holder to adopt best practicable option	Inspection	Yes
6. Requirements of overflow notification	No overflows – not applicable	N/A
7. Requirements of contingency plan	Inspection, report received	Yes
8. Provisions for monitoring	Chemical and biological sampling	Yes
9. Review condition	No review sought by Council	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 6 Evaluation of environmental performance for consent 7521-1 over time

Year	High	Good	Improvement req	Poor
2009				1
2010				1
2011	1			
2012	1			
2013	1			
2014	1			
2015		1		
2016		1		
Totals	4	2	0	2

During the year, STDC demonstrated a high level of environmental and high level of administrative performance with the resource consent as defined in Section 1.1.4. During the year under review there were no significant issues associated with the performance or operation of the treatment plant. There were no overflows from the system, and the holding pond was not required to be used for temporary storage during the monitoring period.

Downstream monitoring of receiving waters continues to document the improvement of the Mangawhero Stream health following the diversions of the treated wastes from the stream to the Hawera WWTP.

3.4. Recommendations from the 2015-2016 Annual Report

In the 2015-2016 Annual Report, it was recommended:

1. THAT monitoring be continued for the 2016-2017 period by formulation of a suitable monitoring programme, similar in format to that of the 2015-2016 programme designed in conjunction with the requirements of the recently granted consent.
2. THAT regular liaison continues between the consent holder and the Council with respect to monitoring records of primary pond dissolved oxygen levels in relation to aerator effectiveness, and monitoring storage pond levels in general.
3. THAT the consent holder continues to immediately advise the Council of any operational problems with the primary pond aerators, and the steps taken to ensure that aerobic conditions are maintained within the pond's system.
4. THAT the consent holder immediately reports any overflow events to the Council as required by Special Conditions 4 and 6 of consent 7521.
5. THAT the Council maintains a suitable inspection programme and recording system and reports upon wastes disposal management in the Mangawhero Stream catchment, particularly in respect of agricultural wastes disposal upstream of the WWTP system outfall.
6. THAT the consent holder liaises with the Council in advance of any proposals for significant additional industrial wastes disposal into the Eltham WWTP system.
7. THAT the consent holder monitors authorised trade wastes connections to the sewerage reticulation in terms of ensuring that waste loadings placed upon the WWTP do not compromise the operation of that system thereby resulting in possible non-compliance with its resource consent and/or the Regional Air Quality Plan.

All recommendations were carried out and the consent holder maintained liaison and reporting to the Council in relation to the diversion of the wastewater out of the Mangawhero Stream. The consent holder maintained manual on-site dissolved oxygen monitoring throughout the period and this data was made available to the Council via online automated telemetry throughout the monitoring period.

The requisite consent granted for occasional overflow of treated wastes from the upgraded system to the Mangawhero Stream was operative but was not utilised during the period. The Council continued inspections of waste disposal practices in the upstream catchment of the Mangawhero Stream (by way of the regular annual round of dairy shed inspections), as required by Recommendation 5, with follow-up inspections where necessary and internal reporting within the existing consents' database. The (reduced) monitoring programme was performed as scheduled by the Council in recognition of the significant upgrade to the waste disposal system. No additional wastes disposal occurred into the WWTP system during the 2016-2017 period.

3.5. Alterations to monitoring programmes for 2017-2018

In designing and implementing the monitoring programmes for air/water discharges in the region, the Council has taken into account:

- the extent of information already made available through monitoring or other means to date;
- its relevance under the RMA;
- the Council's obligations to monitor consented activities and their effects under the RMA;
- the record of administrative and environmental performances of the consent holder; and
- reporting to the regional community.

The Council also takes into account the scope of assessments required at the time of renewal of permits, and the need to maintain a sound understanding of industrial processes within Taranaki exercising resource consents.

It is proposed that for 2017-2018 monitoring of consented activities at the Eltham WWTP continue at the same level as in 2016-2017. A recommendation to this effect is attached to this report.

It should be noted that the proposed programme represents a reasonable and risk-based level of monitoring for the site(s) in question. The Council reserves the right to subsequently adjust the programme from that initially prepared, should the need arise if potential or actual non-compliance is determined at any time during 2017-2018.

4. Recommendations

1. THAT in the first instance, monitoring of consented activities at Eltham WWTP in the 2017-2018 year continue at the same level as in 2016-2017.
2. THAT should there be issues with environmental or administrative performance in 2017-2018, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.

Glossary of common terms and abbreviations

The following abbreviations and terms may be used within this report:

Biomonitoring	Assessing the health of the environment using aquatic organisms.
BOD	Biochemical oxygen demand. A measure of the presence of degradable organic matter, taking into account the biological conversion of ammonia to nitrate.
BODF	Biochemical oxygen demand of a filtered sample.
cfu	Colony forming units. A measure of the concentration of bacteria usually expressed as per 100 millilitre sample.
Conductivity	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m.
DO	Dissolved oxygen.
DRP	Dissolved reactive phosphorus.
Fresh	Elevated flow in a stream, such as after heavy rainfall.
g/m^3	Grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred.
Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring.
Investigation	Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident.
Incident Register	The Incident Register contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
L/s	Litres per second.
m^2	Square Metres.
MCI	Macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats.
mS/m	Millisiemens per metre.
NH_4^+	Ammonium, normally expressed in terms of the mass of nitrogen (N).
NH_3	Unionised ammonia, normally expressed in terms of the mass of nitrogen (N).
NO_3^-	Nitrate, normally expressed in terms of the mass of nitrogen (N).
NO_2^-	Nitrite, normally expressed in terms of the mass of nitrogen (N).
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water.
pH	A numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.

Physicochemical	Measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment.
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
RMA	*Resource Management Act 1991* and including all subsequent amendments.
SQMCI	Semi quantitative macroinvertebrate community index.
Temp	Temperature, measured in °C (degrees Celsius).
TKN	Total Kjeldahl nitrogen. Combination of organic nitrogen, NH_3, and NH_4^+.
Turb	Turbidity, expressed in NTU.
WWTP	Wastewater treatment plant.

*an abbreviation for a metal or other analyte may be followed by the letters 'As', to denote the amount of metal recoverable in acidic conditions. This is taken as indicating the total amount of metal that might be solubilised under extreme environmental conditions. The abbreviation may alternatively be followed by the letter 'D', denoting the amount of the metal present in dissolved form rather than in particulate or solid form.

For further information on analytical methods, contact the Council's laboratory.

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Appendix I

Resource consent held by South Taranaki District Council

(For a copy of the signed resource consent
please contact the TRC Consents department)

Discharge Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	South Taranaki District Council Private Bag 902 HAWERA 4640
Consent Granted Date:	10 November 2009

Conditions of Consent

Consent Granted:	To discharge, as a consequence of high rainfall, partially treated wastewater from the Eltham Wastewater Treatment Plant into an unnamed tributary of the Mangawhero Stream in the Waingongoro catchment at or about (NZTM) 1712439E-5633480N
Expiry Date:	1 June 2027
Review Date(s):	June 2015, June 2017, June 2021
Site Location:	Castle Street, Eltham
Legal Description:	Pt Lot 3 DP 1564 Lot 9 DP 2321
Catchment:	Waingongoro
Tributary:	Mangawharawhara Mangawhero

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

   i) the administration, monitoring and supervision of this consent; and
   ii) charges authorised by regulations.

Special conditions

1. The discharge shall only occur as a consequence of high rainfall events when the inflows to the wastewater treatment plant are such that the holding capacity of the treatment plant is exceeded.

2. The total storage capacity of the treatment plant shall be no less than 25,000 cubic metres.

3. The consent holder shall not undertake any modifications to the treatment plant that may result in an increase in the frequency of the discharge.

4. The consent holder shall record the timing and duration of the overflow to the unnamed stream, and report these records to the Chief Executive, Taranaki Regional Council, on request.

5. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects on the environment from the exercise of this consent.

6. The consent holder shall phone the Taranaki Regional Council immediately after becoming aware of each discharge authorised by this permit, in order to enable the undertaking monitoring of the discharge in accordance with special condition 8.

7. Within three months of the granting of this consent, the consent holder shall prepare and maintain a contingency plan. The contingency plan shall be adhered to in the event of a discharge and shall, to the satisfaction of the Chief Executive, Taranaki Regional Council, detail measures and procedures to be undertaken to avoid, remedy or mitigate the environmental effects of the discharge.

8. Subject to Section 36 of the Resource Management Act [1991], monitoring, including physicochemical, bacteriological and ecological monitoring of the wastewater treatment system and receiving waters shall be undertaken, as deemed reasonably necessary by the Chief Executive, Taranaki Regional Council, to understand the effects of the discharge.

9. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2015 and/or June 2017 and/or June 2021, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 10 November 2009

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

Appendix II

Biomonitoring reports

To	Rae West, Job manager
From	Darin Sutherland, Scientific Officer
Document	1802098
Report	DS056
Date	11 January 2017

Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to the South Taranaki District Council's Eltham Wastewater Treatment Plant System and Rubbish Tip leachate discharge, October 2016

Introduction

This spring survey was the first of two surveys programmed for the 2016-2017 monitoring period. Since summer 2011, biomonitoring surveys in the Mangawhero Stream have been reduced from four sites to two sites in recognition of the minimal usage of the WWTP consented overflow facility to the Mangawhero Stream in recent years. No overflows to the stream have occurred since this time.

Method

This survey was the 21st spring biomonitoring programme coincident with riparian planting of the Mangawhero Stream banks and stream willow clearance work over the past several years. It was performed some six years after commissioning of the pipeline for conveyance of the Eltham WWTP wastewater to the Hawera WWTP and the cessation of the discharge of partially treated wastewater into the Waingongoro catchment. No (consented) overflows from the WWTP to the Mangawhero Stream had occurred during this period. Current biomonitoring sites are presented in Table 1.

The standard 400 ml 'kick sampling' and 'sweep netting' techniques were used to collect streambed (benthic) macroinvertebrates from site 1 in the Mangawhero Stream. The 'kick sampling' technique only was used for site 5 in the Mangawhero Stream and site 8 in the Waingongoro River (illustrated in Figure 1) on 18 October 2016.

Table 1 Biomonitoring sites in the Mangawhero Stream and Waingongoro River in relation to the South Taranaki District Council's Eltham Wastewater Treatment Plant System and Rubbish Tip leachate discharge

Site No	Site code	Grid reference	Location
1	MWH000380	E1712475 N5633431	Mangawhero Stream: upstream of wastewater treatment plant's discharge
5	MWH000490	E1710795 N5632738	Mangawhero Stream: approximately 200 m downstream of rail bridge
8	WGG000665	E1709784 N5632049	Waingongoro River: approx 2 km downstream of Mangawhero S. confluence (off Stuart Road)

The 'kick-sampling' and 'vegetation sweep' techniques are very similar to Protocol C1 (hard-bottomed, semi-quantitative) and C2 (soft-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark et al, 2001).

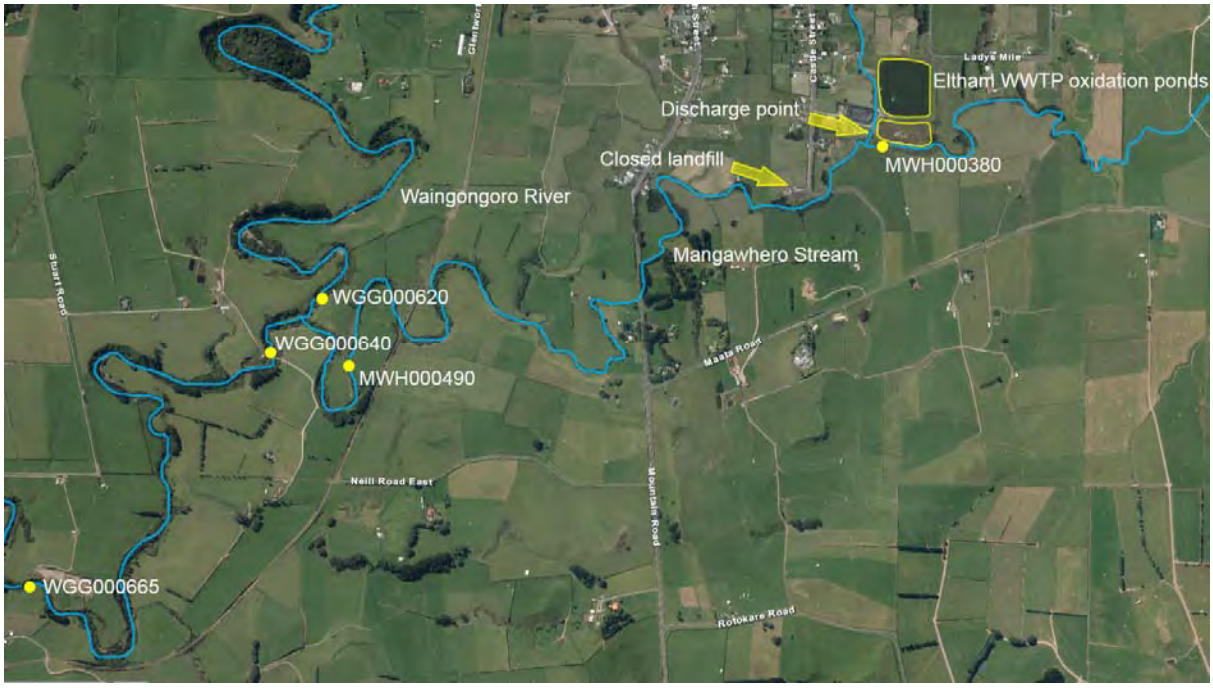

Figure 1 Aerial location map of biomonitoring site locations in the Mangawhero Stream and Waingongoro River in relation to Eltham WWTP and landfill

The 'kick-sampling' and 'vegetation sweep' techniques are very similar to Protocol C1 (hard-bottomed, semi-quantitative) and C2 (soft-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark et al, 2001).

Samples were preserved with Kahle's Fluid for later stereomicroscopic sorting and identification according to documented Taranaki Regional Council methodology and macroinvertebrate taxa abundances scored based on the categories in Table 2.

Table 2 Macroinvertebrate abundance categories

Abundance category	Number of individuals
R (rare)	1-4
C (common)	5-19
A (abundant)	20-99
VA (very abundant)	100-499
XA (extremely abundant)	500+

Macroinvertebrate Community Index (MCI) values were calculated for taxa present at each site (Stark 1985) with certain taxa scores modified in accordance with Taranaki experience.

A semi-quantitative MCI value, SQMCIs (Stark, 1999) has also been calculated for the taxa present at each site by multiplying each taxon score by a loading factor (related to its abundance), totalling these scores, and dividing by the sum of the loading factors. The loading factors were 1 for rare (R), 5 for common (C), 20 for abundant (A), 100 for very abundant (VA) and 500 for extremely abundant (XA).

Where necessary sub-samples of algal and detrital material were also taken from the macroinvertebrate samples at all sites and were scanned under 40-400x magnification to determine the presence or absence of any mats, plumes or dense growths of bacteria, fungi or protozoa ('undesirable biological growths') at a microscopic level. The presence of masses of the organisms is an indicator of organic enrichment within a stream.

Results

Site habitat characteristics and hydrology

This spring survey was performed under moderate flow conditions, nine days after a fresh in excess of 3 times median flow and 16 days after a fresh in excess of 7 times median flow in the Waingongoro River.

The water temperatures during the survey were in the range 13.8-14.7 °C. Water levels were moderate and water speed was swift. The water was cloudy for sites 1 and 5 and uncoloured for site 8. Site 1 had brown coloured water, site 5 had grey coloured water and site 8 had uncoloured water. The substrate at the three sites comprised either entirely of hard clay (site 1), a mixture of cobble/boulder (site 5), and gravel/cobble (site 8).

Site 1 had slippery algal mats and filamentous algae were patchy. There was patchy moss and macrophytes growing on the edge of the stream. Site 5 had widespread algal mats and filamentous algae and there was patchy moss and macrophytes on the edge of the river. Site 8 had slippery algal mats and no filamentous algae.

Macroinvertebrate communities

The results of past biomonitoring surveys performed at the various established stream sites are summarised in Table 1 and illustrated in Figure 2.

Table 3 Summary of macroinvertebrate taxa numbers and MCI values for previous surveys performed between January 1985 and October 2016

Site No.	N	No of taxa			MCI value			$SQMCI_s$ value		
		Median	Range	Current survey	Median	Range	Current survey	Median	Range	Current survey
1	53	16	10-25	14	74	58-85	74	4.1	1.5-6.3	2.3
5	48	20	13-30	24	79	63-102	90	3.0	1.5-6.4	4.1
8	44	20	14-30	14	94	77-111	104	4.3	2.4-7.6	7.2

The macroinvertebrate fauna recorded by the current survey at each of the three sites are presented in Table 2.

Table 4 Macroinvertebrate fauna of the Mangawhero Stream (sites 1 and 5) and the Waingongoro River at Stuart Road (site 8) in relation to the Eltham WWTP, sampled on 18 October 2016

Taxa List	Site Number	MCI score	1	5	8
	Site Code		MWH000380	MWH000490	WGG000665
	Sample Number		FWB16235	FWB16236	FWB16237
NEMERTEA	Nemertea	3	R	-	-
NEMATODA	Nematoda	3	-	R	-
ANNELIDA (WORMS)	Oligochaeta	1	VA	A	R
	Lumbricidae	5	-	R	-
MOLLUSCA	*Ferrissia*	3	-	R	-
	Potamopyrgus	4	A	C	-
CRUSTACEA	*Paracalliope*	5	C	C	-
	Paranephrops	5	-	R	-
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	C	R	-
	Deleatidium	8	-	A	VA
	Zephlebia group	7	-	-	R
PLECOPTERA (STONEFLIES)	*Zelandobius*	5	C	C	R
	Zelandoperla	8	-	-	R
COLEOPTERA (BEETLES)	Elmidae	6	-	C	R
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	-	R	R
TRICHOPTERA (CADDISFLIES)	*Hydropsyche (Aoteapsyche)*	4	C	A	C
	Hydrobiosis	5	C	C	C
	Neurochorema	6	-	R	-
	Oxyethira	2	R	-	-
	Pycnocentria	7	-	C	R
	Pycnocentrodes	5	-	A	C
DIPTERA (TRUE FLIES)	*Aphrophila*	5	C	A	R
	Maoridiamesa	3	-	C	R
	Orthocladiinae	2	C	A	C
	Polypedilum	3	R	A	-
	Tanytarsini	3	-	A	-
	Empididae	3	R	R	-
	Austrosimulium	3	C	R	-
	No of taxa		14	24	14
	MCI		74	90	104
	SQMCIs		2.3	4.1	7.2
	EPT (taxa)		4	8	8
	%EPT (taxa)		29	33	57

'Tolerant' taxa | 'Moderately sensitive' taxa | 'Highly sensitive' taxa

R = Rare C = Common A = Abundant VA = Very Abundant XA = Extremely Abundant

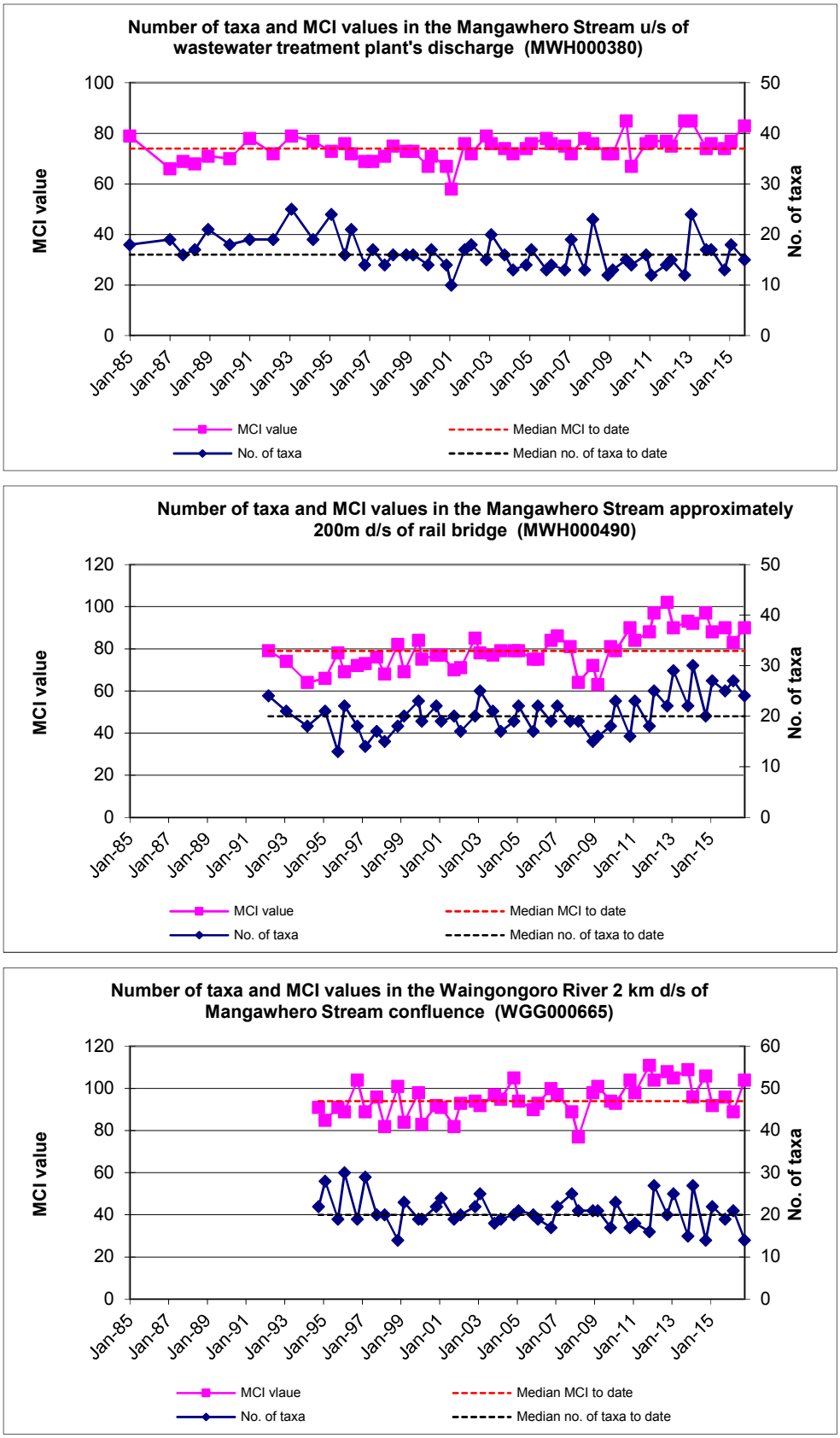

Figure 2 Taxa richness and MCI scores recorded at each site to date for Mangawhero Stream sites

Site 1 (upstream of the WWTP outfall)

A moderately low macroinvertebrate community richness of 14 taxa was found at site 1 ('control' site) at the time of the spring survey (Table 3).

The MCI score of 74 units indicated a community of 'poor' biological health which was the same score as the median MCI score of 74 units. The $SQMCI_S$ score of 2.3 units was significantly lower (Stark, 1998) than the median $SQMCI_S$ score of 4.1 units (Table 3).

The community was characterised by two 'tolerant' taxa [oligochaete worms and snails (*Potamopygus*)] (Table 3).

Site 5 (downstream of Mangawharawhara Stream confluence; approx 3 km below the WWTP outfall and old landfill)

A moderate macroinvertebrate community richness of 24 taxa was found at site 5 ('primary impacted' site) at the time of the spring survey (Table 3).

The MCI score of 90 units indicated a community of 'fair' biological health but this was significantly higher (Stark, 1998) than the median MCI score of 79 units. The $SQMCI_S$ score of 4.1 units was also significantly higher than the median $SQMCI_S$ score of 3.0 units (Table 3).

The community was characterised by five 'tolerant' taxa [oligochaete worms, caddisfly *Hydropsyche/ Aoteapsyche* and midges (Orthocadiinae, *Polypedilum*, and Tanytarsini)], two 'moderately sensitive' taxa [caddisfly (*Pycnocentria*) and cranefly (*Aphrophila*) one 'highly sensitive' taxon [mayflies (*Deleatidium*] (Table 3).

Waingongoro River site (downstream of the Mangawhero Stream confluence (site 8))

A moderately low macroinvertebrate community richness of 14 taxa was found at site 8 ('secondary impacted' site) at the time of the spring survey (Table 3)

The MCI score of 104 units indicated a community of 'good' biological health which was not significantly different (Stark, 1998) to the median MCI score of 94 units. The $SQMCI_S$ score of 7.2 units was significantly higher than the median $SQMCI_S$ score of 4.3 units (Table 3).

The community was characterised by one extremely abundant 'highly sensitive' taxon [mayflies (*Deleatidium*] (Table 3).

Microscopic streambed heterotrophic assessment

The microscopic heterotrophic assessments of substrate growths performed for all sites indicated an absence of any mats, plumes or dense growths of heterotrophic organisms at each of the three sites.

Discussion and conclusions

The 'impacted' sites had higher macroinvertebrate indices than the 'control' site. This would largely be due to both 'impacted' sites having better physical stream habitat conditions for macroinvertebrates. For example, the cobble/boulder and gravel/boulder substrates of sites 5 and 8 respectively provide superior macroinvertebrate habitat compared with the hard clay of site 1. The median values for both taxa number, MCI and $SQMCI_S$ support this observation.

The removal of WWTP wastes from the Mangawhero Stream has probably contributed to the higher than normal MCI and $SQMCI_S$ score at site 5 and the higher than normal $SQMCI_S$ score at site 8. This contrasts with

the 'control' site which had a typical MCI score of 74 units and significantly worse $SQMCI_S$ score as it was dominated by 'tolerant' taxa.

There has been a noticeable improvement in MCI scores at site 5 and to a slightly lesser extent site 8 since waste water discharges were stopped in mid 2011 (Figure 2). The lack of any significant difference at site 8 between the current survey MCI score and the historical median was presumably due to the site being further away from the discharge point and diluted by the Waingongoro River. Therefore, historic waste discharges presumably had less of an affect on the macroinvertebrate community present at the site making a significant improvement less likely.

No impacts of leachate from the old landfill on the macroinvertebrate community of the lower Mangawhero Stream site were indicated by the results of this spring survey.

The results of the current survey support the current situation where no WWTP discharges are currently entering the Mangawhero Stream and therefore the two downstream sites are not being impacted by the Eltham WWTP. Differences among sites largely reflect habitat differences.

Summary

The Councils 'kick-sampling' technique was used at two sites and a combination of 'kick-sampling' and 'sweep netting' used at one site to collect macroinvertebrates from two sites on the Mangawhero Stream and one site on the Waingongoro River for the spring survey at the Eltham waste water treatment plant. This has provided data to assess whether discharges have had an affect on the macroinvertebrate communities present in the Mangawhero Stream and Waingongoro River. Samples were processed to provide number of taxa (richness), MCI, and $SQMCI_S$ scores for each site.

The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of nutrient enrichment in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. The $SQMCI_S$ takes into account taxa abundances as well as sensitivity to pollution. Significant differences in either the taxa richness, MCI or the $SQMCI_S$ between sites may indicate the degree of adverse effects (if any) of the discharge being monitored.

The 'impacted' sites had higher macroinvertebrate indices than the 'control' site. This would be due to both 'impacted' sites having better physical stream habitat conditions for macroinvertebrates. Site 5 showed an improvement for MCI and $SQMCI_S$ scores compared with the historical median and site 8 showed an improvement for the $SQMCI_S$ score compared with the historical median which was probably a reflection of the lack of discharges from the Eltham WWTP.

Overall, there was no evidence that leachate from the Eltham WWTP or from the closed landfill site for the current monitoring period was having any impact on the macroinvertebrate communities of the Mangawhero Stream and Waingongoro River.

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To	Job manager, Rae West
From	Scientific Officer, Darin Sutherland
Document	1837755
Report	DS061
Date	3 April 2017

Biomonitoring of the Mangawhero Stream and Waingongoro River in relation to the South Taranaki District Council's Eltham Wastewater Treatment Plant System and rubbish tip leachate discharge, February 2017

Introduction

This summer survey was the second of two surveys programmed for the 2016-2017 monitoring period. Since summer 2011, biomonitoring surveys in the Mangawhero Stream have been reduced from four sites to two sites in recognition of the minimal usage of the WWTP consented overflow facility to the Mangawhero Stream in recent years. No overflows to the stream have occurred since this time.

Method

This survey was performed some six and a half years after commissioning of the pipeline for conveyance of the Eltham WWTP wastewater to the Hawera WWTP and the cessation of the discharge of partially treated wastewater into the Waingongoro catchment. No (consented) overflows from the WWTP to the Mangawhero Stream had occurred during this period, nor were occurring at the time of the survey. In recognition of the successful diversion of the wastewater, recent surveys have been reduced (by two sites in the Mangawhero Stream) from the previous intensity (see CF528 and other references) and will continue at this level in order to address temporal stream and river 'health' recovery. Current biomonitoring sites are presented in Table 1.

The standard '400 ml kick sampling' technique was used to collect streambed (benthic) macroinvertebrates from site 5 in the Mangawhero Stream and a combination of 'kick sampling' and 'sweep netting' at site 1 in the Mangawhero Stream on 14 February 2017. Two sites in the Waingongoro River (illustrated in Figure 1) and an additional site, established in the river (site 8) approximately 2 km further downstream for monitoring use in conjunction with the Riverlands Eltham Ltd discharges, and the state of the environment monitoring programme, were also sampled on 1 March 2016.

Table 1 Biomonitoring sites in the Mangawhero Stream and Waingongoro River in relation to the South Taranaki District Council's Eltham Wastewater Treatment Plant System and Rubbish Tip leachate discharge

Site No	Site code	Grid reference	Location
1	MWH000380	E1712475 N5633431	Mangawhero Stream: upstream of wastewater treatment plant's discharge
5	MWH000490	E1710795 N5632738	Mangawhero Stream: approximately 200 m downstream of rail bridge
6	WGG000620	E1710708 N5632961	Waingongoro River: approx 150 m upstream of Mangawhero S. confluence
7	WGG000640	E1710554 N5632790	Waingongoro River: approx 200 m downstream of Mangawhero S. confluence
8	WGG000665	E1709784 N5632049	Waingongoro River: approx 2 km downstream of Mangawhero S. confluence (off Stuart Road)

Figure 1 Aerial location map of biomonitoring site locations in the Mangawhero Stream and Waingongoro River in relation to Eltham WWTP and landfill

This 'kick-sampling' technique is very similar to Protocol C1 (hard-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark et al, 2001).

Samples were preserved with Kahle's Fluid for later stereomicroscopic sorting and identification according to documented Taranaki Regional Council methodology and macroinvertebrate taxa abundances scored based on the categories in Table 2.

Table 2 Macroinvertebrate abundance categories

Abundance category	Number of individuals
R (rare)	1-4
C (common)	5-19
A (abundant)	20-99
VA (very abundant)	100-499
XA (extremely abundant)	500+

Stark (1985) developed a scoring system for macroinvertebrate taxa according to their sensitivity to organic pollution in stony New Zealand streams. Highly 'sensitive' taxa were assigned the highest scores of 9 or 10, while the most 'tolerant' forms scored 1. Sensitivity scores for certain taxa have been modified in accordance with Taranaki experience.

By averaging the scores obtained from a list of taxa taken from one site and multiplying by a scaling factor of 20, a Macroinvertebrate Community Index (MCI) value was obtained (Table 3). The MCI is a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. More 'sensitive' communities inhabit less polluted waterways. A difference of 11 units or more in MCI values is considered significantly different (Stark 1998).

A semi-quantitative MCI value ($SQMCI_s$) has also been calculated for the taxa present at each site by multiplying each taxon score by a loading factor (related to its abundance), totalling these products, and dividing by the sum of the loading factors (Stark, 1998 and 1999). The loading factors were 1 for rare (R), 5 for common (C), 20 for abundant (A), 100 for very abundant (VA) and 500 for extremely abundant (XA). Unlike the MCI, the $SQMCI_s$ is not multiplied by a scaling factor of 20, so that its corresponding range of values is 20x lower. A difference of 0.9 units or more in $SQMCI_s$ values is considered significantly different (Stark 1998).

Table 3 Macroinvertebrate health based on MCI ranges which has been adapted for Taranaki streams and rivers (TRC, 2015) from Stark's classification (Stark, 1985, Boothroyd and Stark, 2000, and Stark and Maxted, 2007)

Grading	MCI
Excellent	>140
Very Good	120-140
Good	100-119
Fair	80-99
Poor	60-79
Very Poor	<60

Where necessary sub-samples of algal and detrital material were also taken from the macroinvertebrate samples at all sites and were scanned under 40-400x magnification to determine the presence or absence of any mats, plumes or dense growths of bacteria, fungi or protozoa ('undesirable biological growths') at a microscopic level. The presence of masses of the organisms is an indicator of organic enrichment within a stream.

Results

Site habitat characteristics and hydrology

This summer survey was performed under low flow conditions (approximate 550 l/s) approaching MALF (443 l/s), 22 days after a fresh in excess of 3 times median flow and 23 days after a fresh in excess of 7 times median flow in the Waingongoro River (flow gauging site: Waingongoro River at Eltham). The survey followed a typical summer period with only one significant fresh and three minor freshes recorded over the preceding month.

For the Mangawhero Stream sites the water temperatures during the survey were in the range 17.5-17.6 °C. Water speed was steady and the water was uncoloured and cloudy at site 1 and grey and cloudy at site 5. The substrate at site 1 was mostly hard clay while at site 5 it was a mixture of fine and coarse gravels, cobble and boulder. Site 1 had no algal mats or filamentous algae. There were moss and patchy leaves on the streambed. Site 5 had patchy algal mats and widespread filamentous algae. There were macrophytes growing on the edge of the stream. Site 1 had partial shading from overhanging vegetation and site 5 had no shading.

For the Waingongoro River sites the water temperatures during the survey were in the range 17.7-19.1 °C. Water speed was swift and the water was uncoloured and cloudy. The substrate at all three sites comprised predominately cobble/ coarse gravel. Site 6 had patchy algal mats and filamentous algae. There was moss and patchy leaves on the streambed. Site 7 also had had patchy algal mats and filamentous algae. There were also patchy leaves on the streambed. Site 8 had widespread algal mats and patchy filamentous algae. There was patchy moss on the streambed. Site 6 and 7 had partial shading from overhanging vegetation while site 8 had no shading.

Macroinvertebrate communities

The results of past biomonitoring surveys performed at the various established stream sites are summarised in Table 4 and illustrated in Figure 2.

Table 4 Summary of macroinvertebrate taxa numbers and MCI values for previous surveys performed between January 1985 and February 2017

Site No.	N	No of taxa			MCI value			$SQMCI_s$ value		
		Median	Range	Current survey	Median	Range	Current survey	Median	Range	Current survey
1	54	16	10-25	21	74	58-85	77	4.1	1.5-6.3	4.5
5	49	20	13-30	21	79	63-102	80	3.0	1.5-6.4	4.2
6	30	27	16-35	16	95	77-116	111	5.6	3.7-6.5	6.8
7	30	26	17-35	22	92	78-109	95	4.5	2.2-7.0	5.5
8	45	20	14-30	20	94	77-111	101	4.3	2.4-7.6	4.8

The macroinvertebrate fauna recorded by the current survey at each of the five sites are presented in Table 5.

Table 5 Macroinvertebrate fauna of the Mangawhero Stream (sites 1 and 5) and the Waingongoro River (sites 6, 7 and 8) in relation to the Eltham WWTP, sampled on 14 February 2017

Taxa List	Site Number	MCI score	1	5	6	7	8
	Site Code		MWH000380	MWH000490	WGG000620	WGG000640	WGG000665
	Sample Number		FWB17060	FWB17061	FWB17055	FWB17056	FWB17057
NEMERTEA	Nemertea	3	-	C	-	R	-
ANNELIDA (WORMS)	Oligochaeta	1	R	C	-	R	R
	Lumbricidae	5	R	-	-	-	-
MOLLUSCA	*Physa*	3	-	R	R	-	-
	Potamopyrgus	4	VA	VA	VA	R	C
CRUSTACEA	Ostracoda	1	C	R	-	-	-
	Paracalliope	5	XA	VA	-	-	-
	Talitridae	5	-	C	-	R	-
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	A	-	R	A	R
	Coloburiscus	7	R	-	C	C	R
	Deleatidium	8	R	-	XA	VA	VA
	Nesameletus	9	-	-	C	-	R
	Zephlebia group	7	C	-	-	R	-
PLECOPTERA (STONEFLIES)	*Zelandobius*	5	-	-	-	R	-
COLEOPTERA (BEETLES)	Elmidae	6	-	A	C	C	R
	Hydraenidae	8	-	-	R	-	R
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	-	C	C	C	C
TRICHOPTERA (CADDISFLIES)	*Hydropsyche (Aoteapsyche)*	4	C	VA	VA	VA	VA
	Costachorema	7	-	R	C	-	C
	Hydrobiosis	5	C	C	A	A	C
	Beraeoptera	8	-	-	-	R	-
	Oxyethira	2	R	R	-	-	-
	Paroxyethira	2	R	-	-	-	-
	Pycnocentria	7	-	C	-	-	-
	Pycnocentrodes	5	-	C	C	C	R
DIPTERA (TRUE FLIES)	*Aphrophila*	5	R	R	-	A	A
	Chironomus	1	R	-	-	-	-
	Maoridiamesa	3	R	C	R	C	VA
	Orthocladiinae	2	A	A	-	C	A
	Polypedilum	3	R	-	-	C	-
	Tanytarsini	3	R	A	R	A	A
	Empididae	3	-	C	R	C	C
	Muscidae	3	R	C	-	-	R
	Austrosimulium	3	VA	-	-	C	-
	Tanyderidae	4	-	-	-	-	R
	No of taxa		21	21	16	22	20
	MCI		77	80	111	95	101
	SQMCIs		4.5	4.2	6.8	5.5	4.8
	EPT (taxa)		6	5	8	9	8
	%EPT (taxa)		29	24	50	41	40
'Tolerant' taxa	'Moderately sensitive' taxa	'Highly sensitive' taxa					

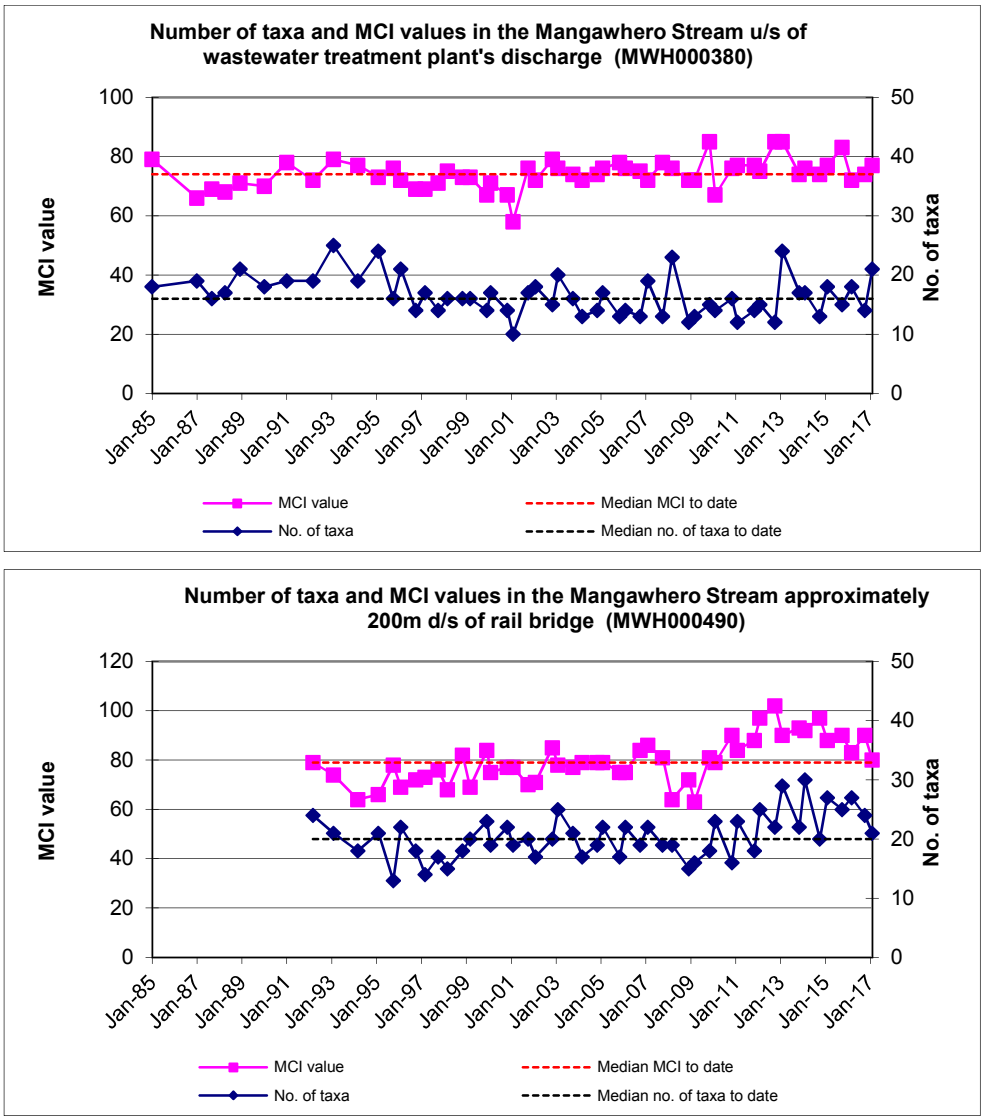

Figure 2 Taxa richness and MCI scores recorded at each site to date for Mangawhero Stream sites

Site 1 (upstream of the WWTP outfall)

A moderate macroinvertebrate community richness of 21 taxa was found at site 1 (Mangawhero Stream 'control' site) at the time of the summer survey (Table 4) which was slightly higher than the historic median of 16 taxa.

The MCI score of 77 units indicated a community of 'poor' biological health but this was not significantly different (Stark, 1998) to the median MCI score of 74 units. The $SQMCI_S$ score of 4.5 units was also not significantly different to the median $SQMCI_S$ score of 4.1 units (Table 4).

The community was dominated by three 'tolerant' taxa [snail (*Potamopygus*), midge (Orthocladiinae) and sandfly (*Austrosimulium*], and two 'moderately sensitive' taxa [amphipod (*Paracalliope*) and mayfly (*Austroclima*)] (Table 5).

Site 5 (downstream of Mangawharawhara Stream confluence; approx 3 km below the WWTP outfall and old landfill)

A moderate macroinvertebrate community richness of 21 taxa was found at site 5 ('primary impact' site) at the time of the survey (Table 4) which was very similar to the historic median score of 20 taxa.

The MCI score of 80 units indicated a community of 'fair' biological health which was not significantly different (Stark, 1998) to the median MCI score of 79 units. However, this was the lowest MCI score recorded at the site since the removal of discharges from the Eltham WWTP and scores appear to be deteriorating over the last four years. The $SQMCI_S$ score of 3.4 units was also not significantly higher (Stark, 1998) than the median $SQMCI_S$ score of 3.0 units (Table 4).

The community was dominated by three 'tolerant' taxa [snail (*Potamopygus*), caddisfly (*Hydropsyche/Aoteapsyche*), and midges (Orthocladiinae and Tanytarsini)] and two 'moderately sensitive' taxa [amphipod (*Paracalliope*) and elmid beetles] (Table 5).

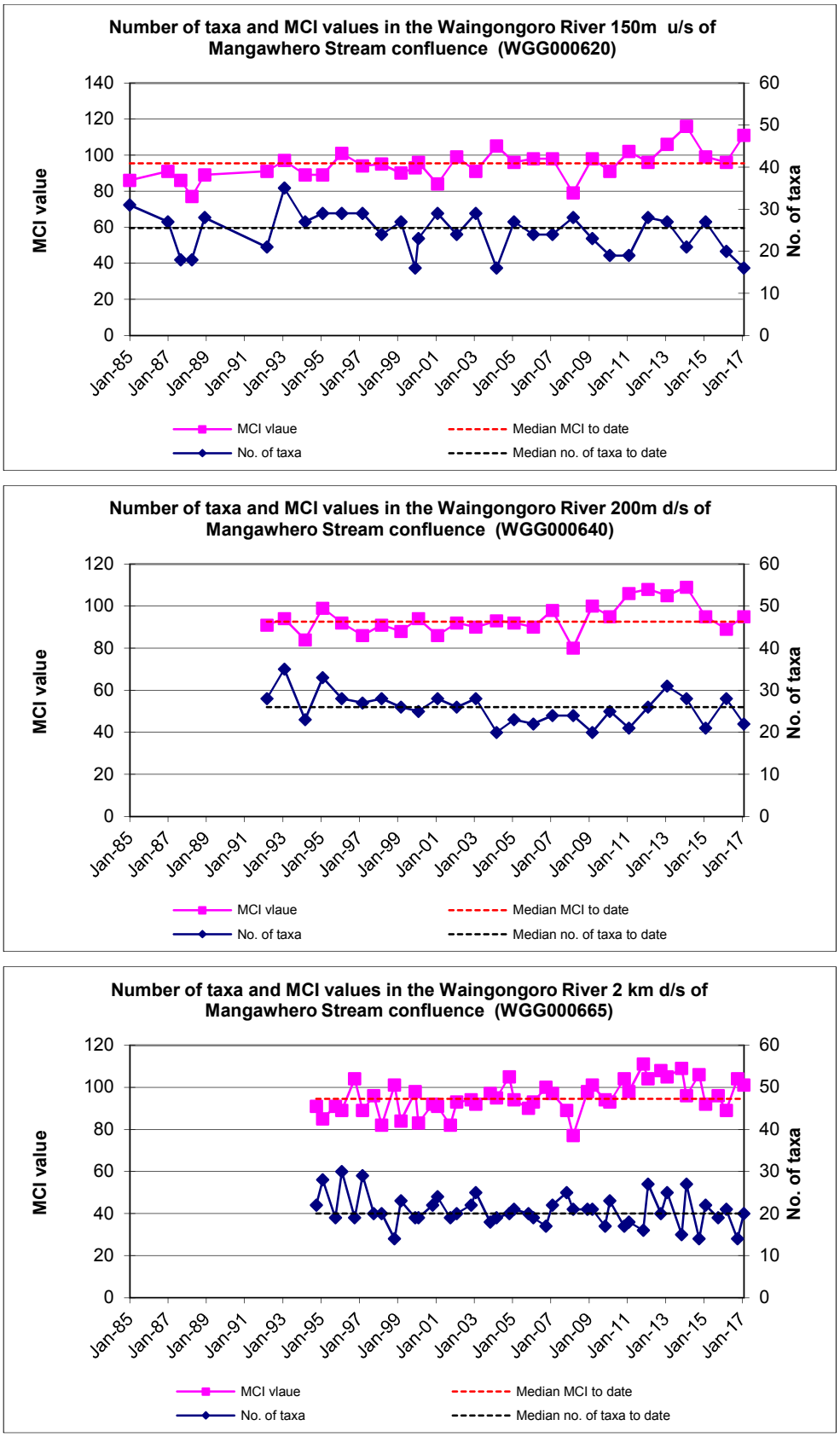

Figure 3 Taxa richness and MCI scores recorded at each site to date for Waingongoro River sites

Waingongoro River site (Upstream of Mangawhero River confluence (site 6))

A moderate macroinvertebrate community richness of 16 taxa was found at site 6 (Waingongoro River 'control' site) at the time of the survey (Table 4) which was substantially lower than the median taxa richness of 27 taxa.

The MCI score of 111 units indicated a community of 'good' biological health which was significantly higher (Stark, 1998) than the median MCI score of 95 units. The $SQMCI_S$ score of 6.8 units was also significantly higher than the median $SQMCI_S$ score of 5.6 units (Table 4).

The community was dominated by two 'tolerant' taxa [snail (*Potamopygus*) and caddisfly (*Hydropsyche/Aoteapsyche*)], one moderately sensitive 'taxon [caddisfly (*Hydrobiosis*)], and a 'highly sensitive' taxon [mayfly (*Deleatidium*)] (Table 5).

Waingongoro River site (Downstream of Mangawhero River confluence (site 7))

A moderate macroinvertebrate community richness of 22 taxa was found at site 7 ('secondary impact' site) at the time of the survey (Table 4) which was slightly lower than the median taxa richness of 26 taxa.

The MCI score of 95 units indicated a community of 'fair' biological health which was not significantly different (Stark, 1998) to the median MCI score of 92 units. The $SQMCI_S$ score of 5.5 units was however significantly higher (Stark, 1998) than the median $SQMCI_S$ score of 4.5 units (Table 4).

The community was dominated by two 'tolerant' taxa [caddisfly (*Hydropsyche/Aoteapsyche*) and midge (Tanytarsini)], three 'moderately sensitive' taxa [mayfly (*Austroclima*), caddisfly (*Hydrobiosis*) and cranefly (*Aphrophila*)] and one 'highly sensitive' taxon [mayfly (*Deleatidium*)] (Table 5).

Waingongoro River site (downstream of the Mangawhero Stream confluence (site 8))

A moderate macroinvertebrate community richness of 20 taxa was found at site 8 ('tertiary impact site) at the time of the survey (Table 4) which was equal to the median taxa richness.

The MCI score of 101 units indicated a community of 'good' biological health which was not significantly different (Stark, 1998) to the median MCI score of 94 units. The $SQMCI_S$ score of 4.8 units was also not significantly different (Stark, 1998) to the median $SQMCI_S$ score of 4.3 units (Table 4).

The community was dominated by four 'tolerant' taxa [caddisfly (*Hydropsyche/Aoteapsyche*) and midges (*Maoridiamesa*, Orthocladiinae and Tanytarsini)], one 'moderately sensitive' taxon [cranefly (*Aphrophila*)] and one 'highly sensitive' taxon mayfly (*Deleatidium*) (Table 5).

Microscopic streambed heterotrophic assessment

The microscopic heterotrophic assessments of substrate growths performed for all sites indicated an absence of any mats, plumes or dense growths of heterotrophic organisms at each of the five sites.

Discussion and conclusions

Taxa richnesses at the Mangawhero Stream sites were within five taxa of historic median levels. The Mangawhero Stream 'control' site had 'poor' health which was typical for the site while the downstream 'impact' site had 'fair' health. The low MCI score at the 'control' site was due to the low quality habitat as the sites' substrate was largely comprised of hard clay which makes poor quality habitat for macroinvertebrates compared with the gravel/cobble substrate at the other four sites. The Mangawhero Stream 'impact' site had an identical taxa richness (21 taxa) to the 'control' site while the MCI score was a non-significant three units higher and $SQMCI_S$ score 0.3 units lower than the 'control' site scores indicating that there was no difference in the health of the macroinvertebrate community between the two sites at the time of the survey.

The Waingongoro River 'control' site (site 6) had a significantly lower taxa richness (by 11 taxa) compared with the historic median of 27 taxa but the two downstream 'impact' sites taxa richnesses were within four taxa of historical medians indicating relatively normal levels of richness at both sites. MCI scores for the two potentially impacted sites (sites 7 and 8) on the Waingongoro River indicated 'fair' (site 7) or 'good' (site 8) macroinvertebrate community health and were both non-significantly higher than their historical medians, while the 'control' site score was significantly higher than the historical median (by 16 MCI units) and indicated 'good' health. The high 'control' site score resulted in site 7 but not site 8 having a significantly lower MCI score than the 'control' site but this was unlikely to be caused by any impacts at site 7 but rather an atypically high result for the 'control' site.

All five surveyed sites recorded MCI scores either higher than (sites 1, 6, 7 and 8) or not significantly different (site 5 by three units) to the previous summer survey.

There had been a noticeable improvement in MCI scores at site 5 since wastewater discharges were stopped in mid 2011 but unfortunately the current score, though higher than the historical median by one unit, was the lowest recorded MCI score since wastewater discharges stopped (Figure 2). This decrease in condition was unlikely due to the WWTP as no discharges have been recorded but instead could be due to agricultural inputs negating the benefit of the removal of nutrients from the WWTP. Should subsequent surveys see further deterioration, further investigation may be warranted.

Taxa composition was noticeable different between the Mangawhero Stream sites and Waingongoro River sites. The Waingongoro River had more 'highly sensitive' taxa (e.g. *Deleatidium* mayfly) at higher abundances which caused significant differences in $SQMCI_S$ scores between the two waterbodies. However, there were no significant decreases in score between site 1 and site 5 but there were between sites 6 and 7 and 8 which were largely congruent with the MCI scores. $SQMCI_S$ scores at all three Waingongoro River sites were all higher than historic medians, with sites 6 and 7 having significantly higher scores.

The results of the current survey largely support the current situation where no WWTP discharges are currently entering the Mangawhero Stream and therefore the three downstream sites are not being impacted by the Eltham WWTP. No significant impacts could be attributed to the closed landfill site but if further deterioration at site 5 occurs in following surveys further investigation may be warranted.

Summary

The Councils 'kick-sampling' technique was used at one site on the Mangawhero Stream and three sites on the Waingongoro River and a combination of 'kick-sampling' and 'sweep netting' used at one site on the Mangawhero Stream to collect macroinvertebrates for this summer survey in relation to the Eltham waste water treatment plant and a retired landfill site. This has provided data to assess whether discharges from the Eltham WWTP and closed landfill have had an affect on the macroinvertebrate communities present in the Mangawhero Stream and Waingongoro River. Samples were processed to provide number of taxa (richness),

MCI, and $SQMCI_S$ scores for each site.

The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. The $SQMCI_S$ takes into account taxa abundances as well as sensitivity to pollution. Significant differences in either the taxa richness, MCI or the $SQMCI_S$ between sites may indicate the degree of adverse effects (if any) of the discharge being monitored.

Taxa richnesses were either similar to or higher than historical median taxa richnesses except for a drop in richness at the Waingongoro River 'control' site. The MCI and $SQMCI_S$ scores for the three potentially impacted sites (sites 5, 7 and 8) were all higher than historical medians and there were no significant differences between sites 1 and 5. Site 7 and 8 MCI and $SQMCI_S$ scores were lower than the Waingongoro River 'control' site but this was due to the 'control' site having significantly higher than normal scores indicating higher than usual macroinvertebrate community health at the 'control' site.

Overall, there was little evidence that leachate from the Eltham WWTP or closed landfill site for the current monitoring period was having any impact on the macroinvertebrate communities present in the Mangawhero Stream and Waingongoro River. However, site 5 was appears to be gradually deteriorating in condition. If further deterioration occurs further investigation may be warranted.

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