South Taranaki District Council
Eltham Wastewater Treatment Plant
Monitoring Programme
Annual Report
2015-2016

Technical Report 2016-29

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Executive summary

The South Taranaki District Council (STDC), operates the Eltham municipal wastewater treatment system (WWTP) located to the east of Eltham in the Mangawhero catchment. STDC holds a resource consent to allow it to discharge treated wastewater to the Mangawhero Stream under high rainfall conditions only. Previously STDC also held a consent for the discharge of emissions into the air but this expired in mid 2011 when it was no longer considered necessary as the nature of the biological processes at the plant met a 'permitted' category in the Regional Air Quality Plan.

This report for the period July 2015 to June 2016 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess the environmental performance during the period under review, and the results and effects of the consent holder's activities, particularly the environmental improvements associated with recent major modifications to the disposal system.

This report also records the state of riparian planting and channel improvement initiatives in the lower Mangawhero catchment. Good progress has been made in terms of riparian fencing and vegetation within both the Mangawhero and Mangawharawhara Streams' catchments in recent years.

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

The Council's monitoring programme included inspections, odour surveys, and limited biological surveys of the receiving waters of the Mangawhero Stream and Waingongoro River. These latter surveys were a means of documenting anticipated improvements in receiving water conditions in the absence of continuous wastewater discharges (a result of the diverted pipeline to the Hawera WWTP in mid 2010).

Overall upgraded treatment system was well maintained and operated during the monitoring year in terms of its general performance. A good level of compliance was achieved with the discharge consent in terms of general conditions, with minimal usage of the converted holding basin, and no overflow discharges at any time. Additional industrial loadings at times placed the system under pressure in terms of maintaining positive dissolved oxygen levels. Slight localised pond odours were noted on occasions, and there were eight complaints received during the monitoring year in relation to normal operating conditions in the ponds.

Spring and late summer biological monitoring surveys continued to confirm improvements in the biological 'health' of the Mangawhero Stream and further downstream in the mid-reaches of the Waingongoro River, compared with pre-wastes diversion monitoring periods.

Relatively low dissolved oxygen-levels were recorded in the primary oxidation pond during the monitoring period. This pond has had a high bacterial component of its microflora and average algal taxa richness, although certain of these taxa had been indicative of high wastes loadings on the system.

Remediation of the Earthen Anaerobic Digestion (EADER) site was undertaken during the monitoring period, and no odour complaints relating to the EADER have been received since July 2015.

Overall environmental performance was good and administrational performance was high.

For reference, in the 2015-2016 year, 71% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 24% demonstrated a good level of environmental performance and compliance with their consents.

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 remains at a good or high level.

Components of a suitable monitoring programme for 2016-2017 have been identified and included in recommendations to this report.

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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 2015 to June 2016 by the Taranaki Regional Council (the Council) and describes the monitoring programme associated with the resource consent held by South Taranaki District Council (STDC) for the Eltham wastewater treatment plant (WWTP) system and the associated activity at this site.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consent held by STDC related to the discharge of treated wastes into the Mangawhero Stream (limited to events consistent with high rainfall). While this is the twenty-ninth Annual Report to be prepared by the Council to cover discharges and their effects, it is the sixth to report upon performance since the diversion of the treated wastes discharge out of the Mangawhero Stream, to the Hawera WWTP system.

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 RMA and the Council's obligations;
- the Council's approach to monitoring sites though annual programmes;
- the resource consent held by STDC in the Mangawhero catchment;
- the nature of the monitoring programme in place for the period under review; and
- a description of the activities and operations conducted in the Mangawhero and Waingongoro catchments.

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

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

Section 4 presents recommendations to be implemented in the 2016-2017 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 the consent holder'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 2015-2016 year, 71% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 24% demonstrated a good level of environmental performance and compliance with their consents

1.2 Treatment plant system

1.2.1 Background

Eltham township sewage treatment has been provided historically 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.

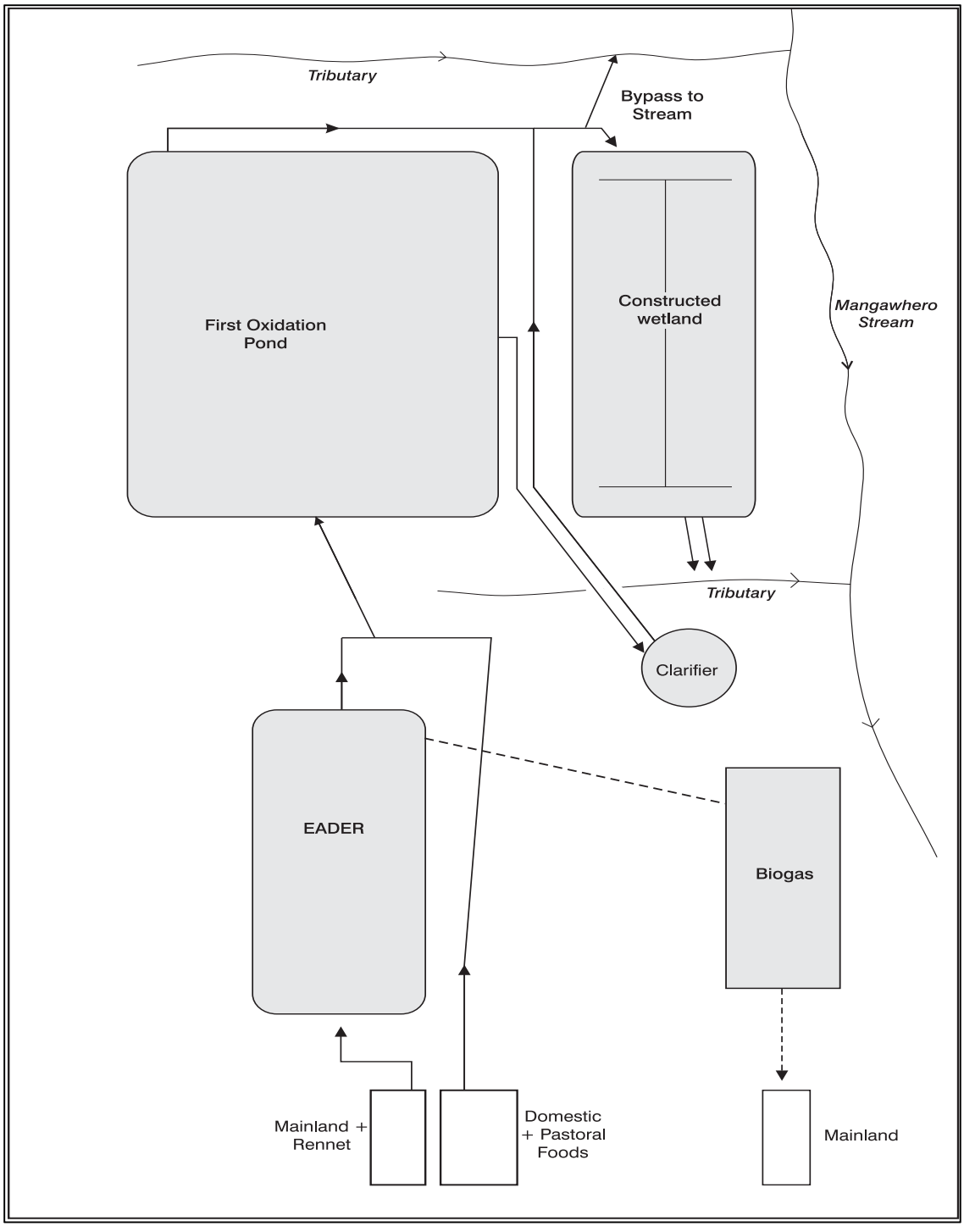
Poor stream water quality conditions had also been identified from time to time in the past upstream of the oxidation ponds' discharge.

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.

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.

Figure 1 Schematic layout of Eltham WWTP as operational prior to the diversion of wastewater to the Hawera WWTP in the 2010-2011 period.



The primary pond was de-sludged during the 2006-2007 monitoring year with the de-watered 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 showing the sludge geo-textile bags disposal area (lower LH corner) near the plant entrance [Note: the wetland (lower, centre) was converted to a holding pond in early 2011]

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 will be 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.

Some use was made of the overflow retention pond in mid July 2011 due to surcharging of the Hawera town reticulation. This pond reached about 33% of its retention capacity (Photo 1) before increased pumping to the Hawera WWTP returned this holding facility to its normal, very low, level.

Photo 1 Overflow retention pond, 21 July 2011

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 2015-2016 monitoring period.

At the time of the diversion to the Hawera WWTP, STDC advised that the EADER would be abandoned by removal of the cover and filling with clean fill. The piped watercourse at the base of the EADER was to be re-lined to provide increased integrity as additional fill would cover this line. Various water treatment plant sludges were to be used to complete the in-filling of the EADER.

However, this did not eventuate and liquid sludge was pumped out of the EADER and into the Hawera line in an effort to dewater and remove residual sludge from the EADER. Bacteria and enzymes were added in March 2013 for further breakdown and liquefying of the sludge for pumping purposes. Some sludge remained in the EADER.

There was a major incident during the 2013-2014 period associated with the use of the EADER for the disposal of an oversupply of buttermilk from the Fonterra site at Hawera in September 2013. Further details of this are provided in the 2014-2015 annual monitoring report (TRC, 2015-21). Successful prosecutions of STDC and Fonterra in relation to this incident were undertaken by the Council during the 2014 to July 2015 period. There have been no further incidents following this, and in the 2015-2016 period STDC undertook to re-line and bury the EADER and remaining sludge.

No usage of the Eltham wastewater treatment plant 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 consents

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 permit **7521** to discharge treated wastewater, as a consequence of high rainfall, into an unnamed tributary of the Mangawhero Stream. A copy of this consent is contained in Appendix I. The consent expires on 1 June 2027 and has review dates of June 2015, June 2017, and June 2021. Special conditions attached to the consent require advice to be provided wherever an overflow occurs, set a minimum storage capacity for the system, provide for a contingency plan and require monitoring of effects.

1.4 Monitoring programme

1.4.1 Introduction

Section 35 of the RMA sets out an obligation for the Council to gather information, monitor, and conduct research on the exercise of resource consents, and the effects arising, within the Taranaki region.

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.

An appropriate monitoring programme was established for the system in 1987 and upgraded annual programmes have continued since this date. The programme also required integration with other receiving water monitoring programmes for discharge consents in the vicinity of the municipal wastewater treatment plant system. The 2015-2016 monitoring programme consisted of three 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 reviews, renewals, or new consents, advice on the Council's environmental management strategies and the content of regional plans, and consultation on associated matters. This particularly was the case involving the consideration of options for the disposal of wastewater from the Eltham WWTP over recent years.

1.4.3 Site inspections

The Eltham WWTP was visited as programmed on four occasions (between the hours of 0800 and 0930) during the monitoring period. The main points of interest were plant operation, configuration and performance, air emissions and the diversion of treated wastewater to the Hawera pipeline. These inspections provided for the operation, internal monitoring, and supervision of the plant to be reviewed by the Council, on-site odour surveys to be undertaken, and assessment of the performance of the upgraded pipeline diversion of the wastewater to the Hawera WWTP.

1.4.4 Biomonitoring surveys

Two macroinvertebrate biological receiving water surveys were undertaken at sites in the Mangawhero Stream and Waingongoro River under spring (October 2015) and late summer receiving water flows. The latter was completed during very low flow conditions in March 2016, for the purposes of establishing recovery in stream/river 'health' in the absence of the previous pre-diversion heavy organic overloading of these receiving water systems.

2. Results

2.1 Inspections of treatment system operation

Four routine inspections were performed during the 2015-2016 period. This frequency was in recognition of the environmental performance history of the system and the relatively early phases of pipeline diversion of the wastes to the Hawera WWTP. These were performed as scheduled during the monitoring period. Odour surveys were also performed at various locations around the WWTP on scheduled inspections. Physical features of the system were recorded, and surface dissolved oxygen concentration was measured at the perimeter of the oxidation pond adjacent to the outlet. Dissolved oxygen monitoring was not required within the re-constructed holding pond. A chlorophyll-a sample was also collected from the oxidation pond at the time of each inspection for an assessment of the phytoplankton 'health' of this pond.

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
5	=	putrid.

2.1.1.1 Regular surveys

Eight sites around the wastewater treatment plant were monitored at the time of each mid-morning survey. As odour strength varies naturally according to wind direction and velocity, these variables were also recorded on each survey occasion.

Nil to slight odours were recorded on all inspection visits in the immediate vicinity of the influent entry via the stepscreen to the primary pond. This was in part due to the covering of the stepscreen, which has been effective in reducing odour to the extent that they were no more than noticeable (scale 2) immediately adjacent to this area.

No odours were detected adjacent to the primary pond, nor was any hydrogen sulphide detectable on any occasion near the perimeter of the WWTP. No odours were detectable at the main entrance gate to the WWTP, Castle St, or the Lady's Mile corner of the primary pond (northern boundary of the WWTP). No objectionable odours were recorded off site on any regular inspection occasion.

2.1.1.2 Additional surveys

Three additional odour surveys were conducted in conjunction with site inspections on 1 December and 14 December 2015, and 12 January 2016. These were following prolonged occurrences of very low DO (<0.5 ppm) starting on the 30 November 2015.

Numerous complaints had been received from residents around the ponds in regards to odours associated with the low DO of the primary pond. Odours were encountered on 1 December 2015 (very slight odour in the SE corner of the EADER) and 14 December 2015 (strong odour past the boundary at the Lady's Mile corner). No discharges from the EADER into the main pond occurred during the year, and the completion of the decommissioning project means there will be no future discharges to or from the EADER at all. The pond was dosed with "Biobugs" by the consent holder's contractor at various times throughout the monitoring period.

2.1.1.3 Comments

Generally, the odour that local residents experience depends upon three factors. Firstly, the nature of wastewater treated; secondly, the design, maintenance and operation of the WWTP; and thirdly, ambient weather conditions. Air quality in the vicinity of the WWTP is unlikely to change unless either the composition, strength, or volume of the raw wastewater changes, or the WWTP is upgraded. The aerators on the pond, through their mode of operation, cause the release of odour to the atmosphere.

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 2015-2016 period.

It has been concluded that odours of this nature 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.

2.1.2 Dissolved oxygen levels in the primary pond

The results of dissolved oxygen monitoring in the primary pond recorded during regular inspections are included in Table 1.

Table 1 Dissolved oxygen measurements from the surface of the Eltham primary oxidation pond at the perimeter adjacent to the aerators' DO probe

Date	Time (NZST)	Temperature (°C)	Dissolved Oxygen	
			Concentration (g/m^3)	Saturation (%)
16 July 2015	0910	9.0	0.1	1
12 October 2015	0815	15.0	0.7	7
3 March 2016	0830	21.1	2.9	24
10 May 2016	0935	16.0	4.4	45

The dissolved oxygen concentrations in oxidation pond systems vary both seasonally and during the day as a result of a combination of factors. The photosynthetic activity of the pond's biological flora 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.

Results in Table 1 indicated a narrow range of dissolved oxygen concentrations (between 1 and 45% saturation) in the surface layer of the primary pond near the outlet for the period when the aerators were operating at full capacity. These levels 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 11 aerators) maintained positive dissolved oxygen concentrations on each survey occasion with the lowest concentrations measured during winter and spring periods. Low concentrations (<1 g/m^3) were indicative of these very high waste loadings particularly in winter when the fewest aerators were operating.

STDC maintained manual on-site dissolved oxygen monitoring throughout the period for internal monitoring and operational purposes. This data was made available to the Council via online automated telemetry from December 2015 onwards. Mechanical aeration was maintained at normal operational level throughout the year. Two new diffuser aerators had been installed during the 2012-2013 period (replacing the brush aerators) and a third installed in the 2013-2014 period, and two of these units were serviced in the 2015-2016 period. The brush aerators toward the centre of the pond were retained for emergency purposes; and were required for use following the prolonged period of extremely low DO in the main pond in December 2015.

2.1.3 Primary pond conditions

Slight odours were recorded in the immediate vicinity of the primary oxidation pond (mainly near the influent step-screen) on one of the regular inspection occasions. All other inspections recorded no noticeable odour.

Extensive aeration of the primary pond (8 to 11 mechanical aerators in operation on each occasion) was continued. The pond was turbid in appearance but the colour varied from dark brown to dark green to turbid grey green.

There was no evidence of sludge layers close to the surface of the primary pond on all inspection occasions.

Wave action on the pond surface was generally minimal (flat to rippling) as most of the inspections were coincident with light to moderate wind conditions. However, the aerators generated localised surface movement but not to the same degree as the paddle aerators had in the past. Observations made in conjunction with dissolved oxygen sampling of the primary pond adjacent to the DO probe (i.e. opposite the inlet position), continued to show that there was some anticlockwise current around the pond but more in a central pond direction as a result of the different action of the newer air sparge aerators.

The pond's surrounds were tidy at all times (grazed by sheep), the wavebands were tidy, and the pond surface was free from accumulated debris. Ducks (mainly mallard) were common on the pond almost throughout the year, with large numbers (more than 150) in early autumn. These species are common members of the avifauna associated with treatment ponds systems (Don, 2004).

There were no overflow discharges of primary pond treated wastes to the small tributary stream adjacent to the eastern boundary recorded at the time of any inspection visit, and there were no overflows of treated wastewater into the holding pond (i.e. old wetland area) noted on three occasions. Some overflow into the holding pond occurred late in the 2014-2015 period following heavy rainfall periods. By July 2015, this was being pumped directly to the wetwell for subsequent pumping to the Hawera WWTP.

2.1.4 Holding pond conditions

No odours were associated with the holding pond (converted from the wetland) 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/seepage following wet weather (such as at the time of the July 2015 inspection). All water/wastes were pumped back into the primary pond and then directly into the Hawera WWTP pipeline and no overflows occurred into the Mangawhero Stream tributary.

Planting of the eastern and northern perimeters of the WWTP (with native vegetation) and the Castle Street boundary was undertaken by the consent holder during the 2009-2010 period. The levelled sludge disposal area continues to be grassed for grazing purposes (STDC, pers.comm.)

2.2 Results of WWTP monitoring

2.2.1 Primary oxidation pond effluent quality

No assessments of the primary pond wastewater quality were required or undertaken during the monitoring year. Primary pond effluent data recorded since the incorporation of the EADER in the treatment system (to August 2001), are summarised in previous annual reports.

2.2.2 Microflora of the Eltham WWTP

Pond microflora are very important for the stability of the symbiotic relation with aerobic bacteria within the facultative 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.

In the past, samples of the primary pond effluent had been collected at the time of most inspections of the Eltham WWTP system for semi-quantitative microfloral assessment prior to curtailment of this component of the programme during the 2012-2013 period. The microfloral present in the primary oxidation pond have been summarised and discussed in recent annual reports and historical data have been provided in a previous annual report (TRC, 2009).

Samples of the primary pond effluent were collected on all four regular inspection occasions and on two additional occasions 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 measurements from the surface of the Eltham primary oxidation pond at the perimeter adjacent to the outlet

Date	Time	Appearance	Chlorophyll-a (mg/m^3)	Chlorophyll-a (mg/m^3) data for July 2014 to June 2015		
				N	Range	Median
16 July 2015	0940	turbid, yellow-green	232	4	468-3020	1216
12 October 2015	0830	turbid, green-brown	2800			
14 December 2015	1000	turbid, green-yellow	1410			
12 January 2016	0815	turbid, dark brown	78			
3 March 2016	0840	turbid, dark green-brown	544			
10 May 2016	0930	turbid, green-brown	347			

Despite the moderately high to very high concentrations of chlorophyll-a in the primary pond, indicative of a significant phytoplanktonic component, low dissolved oxygen levels (0.1 g/m^3 to 4.4 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.

2.2.2.1 *Daphnia* outbreak

In early February 2016, STDC notified the Council about an outbreak of *Daphnia* (water fleas) in the primary pond (Photo 2). To reduce the effect of the *Daphnia* feeding on and preserve the algal population of the pond, the dissolved oxygen levels in the pond were decreased by reducing the number of aerators operating. This was increased again following the disappearance of the outbreak.

Photo 2 *Daphnia* spp. outbreak on primary pond, February 2016

2.2.2.2 Post-diversion of WWTP wastes discharge

The comparative data have been reassessed in terms of the impacts of diversion of the WWTP wastes out of the Mangawhero Stream, following the connection into the Hawera pipeline in June 2010.

The monthly monitoring at the lower Mangawhero Stream and two Waingongoro River sites has been continued between July 2010 and June 2016. A summary of this data is presented in Table 3 and may be compared with pre-wastes diversion data in Table 4.

Table 3 Summary of selected water quality results from two sites in the Waingongoro River and one site in the lower Mangawhero Stream for the post-wastewater diversion period July 2010 to June 2016 (N=60 samples)

Site		Waingongoro River				Mangawhero Stream (MWH000498)	
		u/s confluence (WGG000620)		d/s confluence (WGG000640)			
Parameter	**Units**	**Range**	**Median**	**Range**	**Median**	**Range**	**Median**
Temperature	^{o}C	6.0-21.0	13.0	6.3-19.2	12.2	7.3-19.9	13.3
Conductivity @ 20^{o}C	mS/m	7.6-15.1	11.6	9.3-15.8	13.2	13.8-27.8	18.5
Chloride	g/m^3	9.2-15.6	12.8	10.8-18.6	14.3	15.0-34.0	19.1
pH		6.9-8.7	7.6	7.1-8.2	7.6	6.8-8.2	7.6
Dissolved reactive phosphorus	g/m^3P	0.004-0.213	0.047	0.010-0.149	0.041	0.007-0.230	0.030
Total phosphorus	g/m^3P	0.022-0.351	0.082	0.027-0.294	0.079	0.030-1.25	0.099
Ammoniacal nitrogen	g/m^3N	0.007-1.16	0.205	0.004-0.791	0.162	0.005-3.01	0.134
Nitrite nitrogen	g/m^3N	0.003-0.40	0.036	0.003-0.260	0.027	0.001-0.082	0.019
Nitrate nitrogen	g/m^3N	0.13-2.23	1.25	0.249-2.33	1.30	0.554-3.34	1.57
Total Kjeldahl nitrogen	g/m^3N	0.02-1.69	0.43	0.01-1.34	0.43	0.10-6.82	0.61
Total nitrogen	g/m^3N	0.25-3.24	1.68	0.32-3.08	1.76	0.80-7.90	2.18
Turbidity	NTU	0.8-41	3.3	1.0-36	4.2	1.7-42	7.2

Selected parameters' median values have indicated dilution of the Mangawhero Stream flow by the flow of the Waingongoro River over this six year sampling period which included periods during which Riverlands Eltham Ltd's meatworks treated wastes were discharged to land irrigation.

Median nutrient concentrations in the Mangawhero Stream post-diversion of WWTP wastes have reduced by 22% to 83%, with total nitrogen and total phosphorus medians lower by 30% and 68% respectively than prior to wastes diversion. Most minimum nutrient concentrations have been markedly lower since the diversion.

All but three of the principal nutrient species showed small 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 exceptions were nitrate nitrogen and total nitrogen with increases of 3.8% and 4.5% respectively; and total Kjeldahl nitrogen which remained unchanged.

Figure 3 Location map of sampling sites in relation to the Eltham WWTP

2.2.3 Macroinvertebrate and microflora biomonitoring surveys

The Council performed spring and summer reduced (three and five sites refer Figure 3) biomonitoring surveys in association with the consented overflow discharge from the Eltham wastewater treatment system and adjacent to the old rubbish tip site. In the absence of consented discharges, both surveys were performed to assess anticipated improvements in the biological 'health' of the receiving waters of both the Mangawhero Stream and Waingongoro River subsequent to the diversion of the Eltham WWTP discharge to the Hawera WWTP in mid-2010. Results of these surveys are summarised in Table 4 together with appropriate historical pre-diversion data (from the freshwater biology database). The full reports are included as Appendix II.

Table 4 Summary of the results of 2015-2016 biomonitoring surveys and past (pre-diversion) biomonitoring data (1985-2010)

Site		Macroinvertebrate Fauna									
		Taxa Numbers				MCI values				No of surveys	
		2015-2016 surveys		Wastes diversion		2015-2016 surveys		Wastes diversion			
				Pre	Post			Pre	Post	Pre	Post
No	Code	Oct 15	Mar 16	1985-2010	2010-2016	Oct 15	Mar 16	1985-2010	2010-2016	1985-2010	2010-2016
Mangawhero Stream											
1	MWH000380	15	18	10-25 [16]	12-24 [16]	83	72	58-85 [73]	72-85 [76]	41	12
5	MWH000490	25	27	13-25 [19]	16-30 [24]	90	83	63-86 [77]	84-102 [90]	36	12
Waingongoro River											
6	WGG000620	-	20	16-35 [27]	19-28 [24]	-	96	77-105 [91]	96-116 [100]	25	6
7	WGG000640	-	28	17-35 [26]	21-31 [27]	-	89	78-100 [91]	89-109 [106]	24	6
8	WGG000665	19	21	14-30 [21]	14-27 [20]	96	89	77-105 [93]	89-111 [104]	32	12

[Note: [ ] = median]

The spring survey was performed under moderately low flow conditions following a number of early spring freshes. It concluded that macroinvertebrate community richnesses were similar to or higher than past median taxa numbers but the MCI scores were much higher than past medians and nearer to historical maxima at downstream sites in the Mangawhero Stream and Waingongoro River. A noticeable improvement was found in MCI score between the two stream sites in a downstream direction. Increased abundances and proportions of certain 'highly' and 'moderately sensitive' taxa within the community, which might be expected to be present at the 'better' physical habitat of site 5, 3 km downstream of the WWTP discharge outfall, were indicative of improved physicochemical water quality conditions at the time of this survey. The MCI and $SQMCI_s$ scores recorded in the Waingongoro River downstream of the Mangawhero Stream confluence were also indicative of improved water quality below the confluence which was dissimilar to trends frequently found by previous surveys during wastewater discharges and more often under lower flow conditions. Improvement in physicochemical water quality and the associated macroinvertebrate faunal communities in the Mangawhero Stream and Waingongoro River were recorded by this survey some four years after wastewater diversion to the Hawera WWTP. No

impacts of leachate from the old landfill to the Mangawhero Stream were indicated from the results of this spring survey.

The late summer survey was performed during very low flow conditions in the Mangawhero Stream and in the Waingongoro River some five and a half years after the diversion of the Wastewater Treatment Plant's wastes out of the Mangawhero Stream by way of the constructed pipeline to the Hawera WWTP. It was undertaken 12 days following a fresh in excess of both 3 x and 7 x median flow in the Waingongoro River.

This survey was the sixteenth summer survey since willow removal work had been undertaken in the stream through the reach below the SH3 culvert. That work had resulted in some physical stream habitat improvements to the mid-reaches of the stream below the historical discharge outfall.

Macroinvertebrate richness and MCI values found in the lower reaches of the Mangawhero Stream were influenced by the improved physicochemical water quality conditions. Aspects of community composition (particularly moderate $SQMCI_s$ value and higher MCI score) emphasised these improvements in physicochemical water quality conditions downstream of the Eltham WWTP discharge. At the furthest downstream site, recovery in community composition was also coincident with the improvement in physical habitat and dilution provided by the Mangawharawhara Stream tributary.

Relatively similar biological communities were recorded in the Waingongoro River between the upstream site and the two sites downstream of the Mangawhero Stream confluence under low summer flow conditions. Minimal significant differences in individual taxon abundances occurred in this reach of the main river, and $SQMCI_s$ scores showed typical downstream decreases. Improvements in MCI scores at the two sites downstream of the Mangawhero Stream confluence were coincident with physicochemical water quality improvement. These were also generally were also consistent with scores recorded since diversion of the Eltham WWTP discharge, and post ANZCO Riverlands meatworks summer diversion of treated wastewater discharges to land irrigation.

Both surveys confirmed that improvements in physicochemical water quality and the macroinvertebrate faunal communities of the Mangawhero Stream continued to be apparent. The improvements extended into the mid-Waingongoro River downstream of the Mangawhero Stream confluence. It is considered that these are likely attributed to the removal of the wastewater discharge out of the Mangawhero Stream catchment (to the Hawera WWTP).

More recently, statistical temporal trend analyses of macroinvertebrate data collected over the 19-year period from 1995 to 2014 (Stark and Fowles, 2006 and TRC, 2015a) have identified significant temporal trends of improvement (increasing MCI scores) at the downstream Mangawhero Stream (Figure 5) and Waingongoro River at Stuart Road (Figure 6) sites which were also both ecologically significant.

The biological 'health' at both of these sites has improved by one band in MCI grading over this period. These trends have become apparent particularly since the diversion of the wastewater from the catchment (i.e. post July 2010).

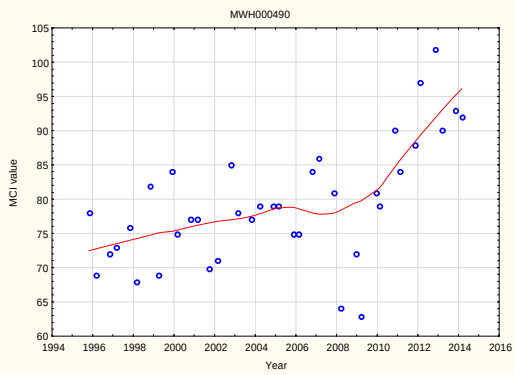


Figure 5 Trend in MCI at the Mangawhero Stream site downstream of the Mangawharawhara Stream confluence (MWH000490)

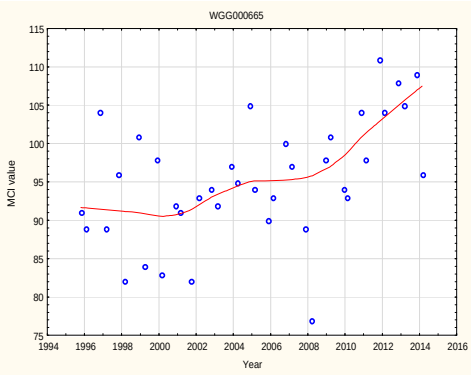


Figure 6 Trend in MCI at the Stuart Road site in the Waingongoro River (WGG00065)

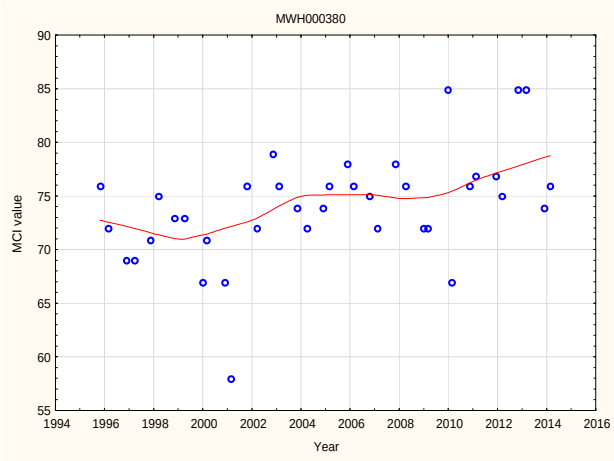


Figure 7 Trend in MCI at the Mangawhero Stream site upstream of the WWTP outfall (MWH000380)

A more steady significant improving trend has been detected at the upstream Mangawhero Stream site (Figure 7). This, however, has not been of ecological significance. The MCI gradation of 'health' has trended in the 'poor' category throughout the period (TRC, 2015a), despite an occasional MCI score in the 'fair' category more recently.

2.3 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 the consent holder. 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 cases 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 the consent holder concerned 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).

During the monitoring period, there were no problems at the Hawera WWTP (reticulation or other issues in Hawera) causing any cessation of pipeline pumping. As a result it was not necessary to use the Eltham holding pond facility, and therefore no overflows to the Mangawhero Stream eventuated.

During the 2015-2016 period, a total of 14 odour complaints were received by the Council from residential neighbours, all of which were in the first six months. None of these odour complaints were found to breach the Regional Air Quality Plan, and inspections recorded only slight to intermittent odour. Two of these incidents were potentially related to work that was being undertaken to decommission the EADER.

On or around 30th November 2015, the dissolved oxygen concentration of the primary pond dropped to low levels, and by 14 December 2015 it was near zero (<0.5 ppm). Eight odour complaints were received between 30 November and 18 December 2015. Meetings were held between STDC, the Council, and representatives from the dairy industry sites in Eltham. Remedial measures taken to increase the dissolved oxygen concentration of the pond and mitigate odours included:

- Increasing aeration on the pond with 3 additional aerators (including a 55kW aerator loaned from Fonterra),
- Dosing of the pond with "Biobugs" to encourage anaerobic biological processes,
- Monitoring of industrial waste streams using composite samplers at the Fonterra and Renco sites,
- Improved industry onsite pre-treatment of wastes,
- Improved communication with affected parties and increased frequency of air monitoring by STDC, and
- Establishment of a working group of industry and STDC representatives to address sort term odour issues and implement an adequate trade waste system.

By 22 December 2015, the dissolved oxygen content of the pond had improved and no further odour complaints were received for the remainder of the monitoring period. No enforcement action was taken by the Council in relation to these incidents.

2.3.1 Additional EADER remediation survey

From May to July 2015, STDC undertook to decommission and remediate the EADER area by re-lining and burying the liner and remaining sludge onsite. A six-month investigation was carried out by TRC following the completion of this work, with regular inspections and odour surveys conducted, and analysis of surface water samples for impacts from the EADER project.

The results of the inspections and surface water sampling indicated that there were no measurable adverse environmental effects to water or air quality as a result of the

remedial works on the STDC Eltham EADER. No further odour complaints relating to the EADER have been received since the completion of this work. This was reported on in a separate report (TRC, 2016).

2.4 Receiving water riparian management

In recognition of the effectiveness of riparian vegetation as a management technique contributing to water quality improvement, and Special Condition 10 of consent 0160, 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 2016, there is a total of 137 km of the 140 km of Mangawhero Stream banks (upstream of the Mangawharawhara Stream confluence) adequately fenced and 24 km with riparian vegetation. A further 3 km (fencing) and 11 km (vegetation) have been recommended within riparian farm plans for completion.

Correspondingly, 62 km (fencing) and 38 km (vegetated) of the 79 km of Mangawharawhara Stream banks (to the Waingongoro River confluence) are adequately riparian protected with an additional 16 km of fencing and 22 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, 91% of these catchments' stream banks are fenced adequately and 65% of banks requiring riparian vegetation are adequately protected by vegetation.

3. Discussion

3.1 Discussion of plant performance

Most aspects of plant performance and normal maintenance were compliant during the 2015-2016 year, with good liaison maintained between the consent holder and the Council. However, issues related to the operation of the pond and management of the trade wastes inflow led to odour complaints from neighbouring properties. This did not result in 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. Odours were occasionally noticeable but generally slight or undetectable at some locations about the WWTP, under normal pond operational conditions during the period. Work was carried out in the early stages of the monitoring year to decommission the existing EADER and remediate the site. This work has been completed to a standard such that no further odour complaints relating to the EADER have been received since July 2015.

3.2 Environmental effects of exercise of water permits

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 low flow conditions. 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 nineteen 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 STDC'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 sewage treatment plant wastes to surface water***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved**
1. Timing of discharges	Inspections; liaison with consent-holder	Yes (no overflows)
2. Storage capacity provision	Inspections	Yes
3. Limit on plant modifications	Inspections; liaison with consent holder	N/A
4. Reporting overflows	Consent holder records	N/A (no overflows)
5. Avoidance of adverse effects	Inspections; sampling	Yes–although issues with DO in primary pond
6. Immediate advice of discharge	Consent holder reporting	N/A (no overflows)
7. Provision of contingency plan	Liaison with consent holder	Yes
8. Provisions for monitoring	Sampling programme	Yes
9. Review provisions	Due June 2015	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**Good**
Overall assessment of administrative performance in respect of this consent		**High**

The STDC demonstrated a good level of environmental and high level of administrative performance with operational aspects of the resource consent conditions.

Potential issues with some parts of the operational performance of the plant, in particular the dissolved oxygen levels in the primary pond, were addressed in an appropriate manner by STDC as required, and this led to no enforcement action being required during the period under review.

3.4 Recommendations from the 2014-2015 Annual Report

The previous Annual Report (TRC 2015-21) contained the following recommendations in relation to monitoring of the operation of the Eltham WWTP:

1. THAT monitoring be continued for the 2015-2016 period by formulation of a suitable monitoring programme, similar in format to that of the 2014-2015 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 immediately advises the Council of any operational problems with the primary pond aerators, and the steps taken to ensure that aerobic conditions are maintained within the ponds' 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 complied with 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 from December 2015 onwards as per Recommendation 2. 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 2015-2016 period.

3.5 Alterations to the monitoring programme for 2015-2016

In designing and implementing the monitoring programmes for water discharges in the region, the Council has taken into account the extent of information made available by previous authorities, its relevance under the RMA, the obligations of the RMA in terms of monitoring discharges and effects, and subsequently reporting to the regional community, the scope of assessments required at the time of renewal of permits, and the need to maintain a sound understanding of municipal treatment processes within Taranaki discharging to the environment.

It is intended that the current monitoring programme be retained for future compliance monitoring purposes including the minor change to the microfloral monitoring of the pond system (where chlorophyll-a analyses replaced the requirement for detailed phytoplankton evaluation).

3.6 Exercise of optional review of consent

Resource consent **7521** provided for an optional review in June 2015. Based upon the high standard of performance of the pipeline diversion to the Hawera WWTP and the almost total non-usage of the holding pond, together with no consented overflows to the Mangawhero Stream, it was considered that there were no grounds requiring this review to be pursued at that time. The next operational review provided by Special Condition 9 of consent **7521** is in June 2017.

4. Recommendations

As a result of the 2015-2016 monitoring programme for consent **7521** the following recommendations are made:

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 advises the Council of any operational problems with the primary pond aerators, and the steps taken to ensure that aerobic conditions are maintained within the ponds' 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.

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.
Bund	A wall around a tank to contain its contents in the case of a leak.
CBOD	Carbonaceous biochemical oxygen demand. A measure of the presence of degradable organic matter, excluding the biological conversion of ammonia to nitrate.
cfu	Colony forming units. A measure of the concentration of bacteria usually expressed as per 100 millilitre sample.
COD	Chemical oxygen demand. A measure of the oxygen required to oxidise all matter in a sample by chemical reaction.
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.
EADER	Earthen Anaerobic Digestor
FC	Faecal coliforms, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
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.
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.

Mixing zone	The zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point.
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).
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).
Turb	Turbidity, expressed in NTU.

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

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Appendix I

Resource consents 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 1648516
Report DS039
Date 30 March 2016

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 2015

Introduction

This spring survey was the first of two surveys programmed for the 2015-2016 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

The standard '400 ml kick sampling' technique was used to collect streambed (benthic) macroinvertebrates and algae from two established sampling sites (sites 1 and 5) in the Mangawhero Stream and one site (site 8) in the Waingongoro River (illustrated in Figure 1) on 7 October 2015.

This survey was the twentieth 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 five 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.

These sites were:

Site No	Site code	Map reference	Location
1	MWH000380	Q20: 227 952	Mangawhero Stream: upstream of WWTP discharge outfall
5	MWH000490	Q20: 210 946	Mangawhero Stream: approximately 200 m downstream of rail bridge and downstream of the Mangawharawhara Stream confluence
8	WGG000665	Q20: 199 937	Waingongoro River: approximately 2 km downstream of Mangawhero Stream confluence

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).

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

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using protocol P1 of NZMWG protocols for sampling macroinvertebrates in wadeable streams (Stark et al, 2001). Macroinvertebrate taxa found in each sample were recorded as:

R (rare)	= less than 5 individuals;
C (common)	= 5-19 individuals;
A (abundant)	= 20-99 individuals;
VA (very abundant)	= 100-499 individuals;
XA (extremely abundant)	= 500 or more individuals.

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 25 days after a fresh in excess of 7 times median flow in the Mangawhero Stream and 15 days after a fresh in excess of 3 times and 7 times median flow in the Waingongoro River. The survey followed a wet early spring period with seven significant river freshes recorded over the preceding month.

The water temperatures during the survey were in the range 13.4-14.2 °C. Water levels were moderate and water speed was swift. The water was uncoloured and clear. The substrate at the three sites comprised either entirely of hard clay (site 1), a mixture of cobble/boulder (site 2), and gravel/cobble (site 3).

Site 1 had no algal mats but filamentous algae were patchy. There was patchy moss and macrophytes growing on the edge of the stream. Site 5 had patchy algal mats and widespread filamentous algae and there were patchy leaves on the streambed. Site 8 had widespread algal mats and patchy 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 1 Summary of macroinvertebrate taxa numbers and MCI values for previous surveys performed between January 1985 and October 2015

Site No.	N	No of taxa			MCI value			$SQMCI_s$ value		
		Median	Range	Oct 2015	Median	Range	Oct 2015	Median	Range	Oct 2015
1	51	16	10-25	15	67	56-85	83	4.1	1.4-6.3	3.5
5	3	20	13-30	25	79	63-102	90	2.9	1.5-6.4	4.2
8	3	20	14-30	19	94	77-111	96	4.3	2.4-7.6	6.4

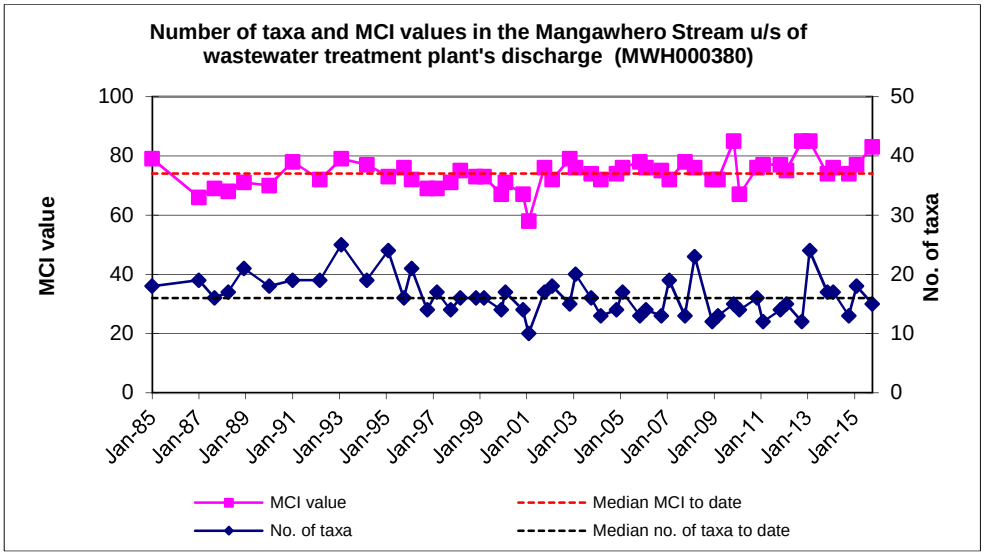
The macroinvertebrate fauna recorded by the current survey at each of the three sites are presented in Table 2.

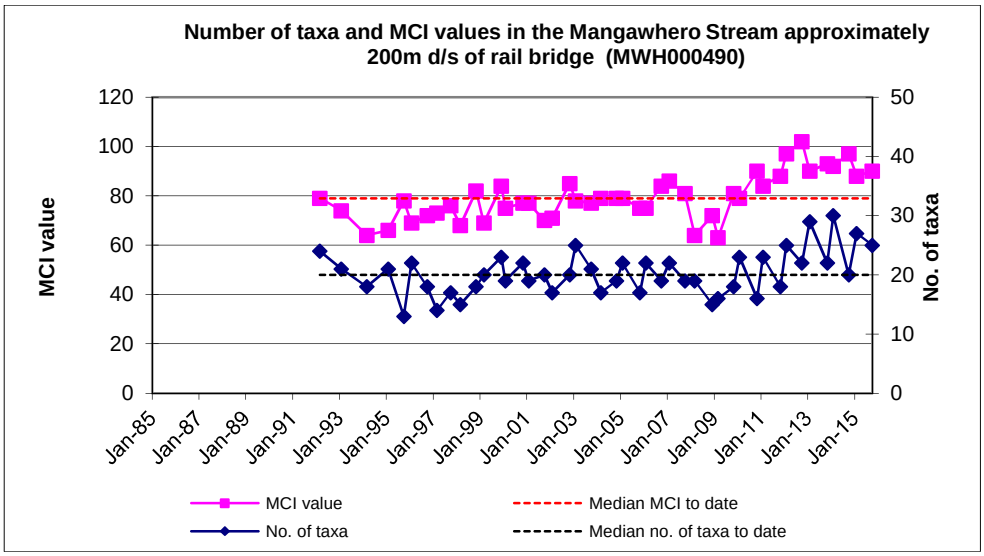
Table 2 Macroinvertebrate fauna of the Mangawhero Stream (sites 1 and 5) and the Waingongoro River at Stuart Road (site 8) in relation to the Eltham WWTP, sampled on 7 October 2015

Taxa List	Site Number	MCI score	1	5	8
	Site Code		MWH000380	MWH000490	WGG000665
	Sample Number		FWB15253	FWB15254	FWB15250
NEMERTEA	Nemertea	3	R	R	-
NEMATODA	Nematoda	3	-	R	R
ANNELIDA (WORMS)	Oligochaeta	1	A	A	R
MOLLUSCA	*Potamopyrgus*	4	A	C	-
CRUSTACEA	*Paracalliope*	5	C	C	R
	Paraleptamphopidae	5	R	-	-
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	C	R	-
	Coloburiscus	7	-	-	R
	Deleatidium	8	-	A	VA
	Zephlebia group	7	-	R	-
PLECOPTERA (STONEFLIES)	*Zelandobius*	5	R	C	C
COLEOPTERA (BEETLES)	Elmidae	6	-	C	-
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	-	R	C
TRICHOPTERA (CADDISFLIES)	*Hydropsyche (Aoteapsyche)*	4	-	C	R
	Costachorema	7	-	R	R
	Hydrobiosis	5	C	C	R
	Beraeoptera	8	-	-	R
	Oxyethira	2	R	R	-
	Pycnocentria	7	R	C	R
	Pycnocentrodes	5	-	A	A
	Triplectides	5	R	R	-
DIPTERA (TRUE FLIES)	*Aphrophila*	5	C	C	R
	Maoridiamesa	3	-	C	R
	Orthocladiinae	2	C	A	A
	Polypedilum	3	R	C	-
	Tanytarsini	3	-	C	R
	Empididae	3	-	C	C
	Austrosimulium	3	R	C	R
		No of taxa	15	25	19
		MCI	83	90	96
		SQMCIs	3.5	4.2	6.4
		EPT (taxa)	5	10	9
		%EPT (taxa)	33	40	47

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

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





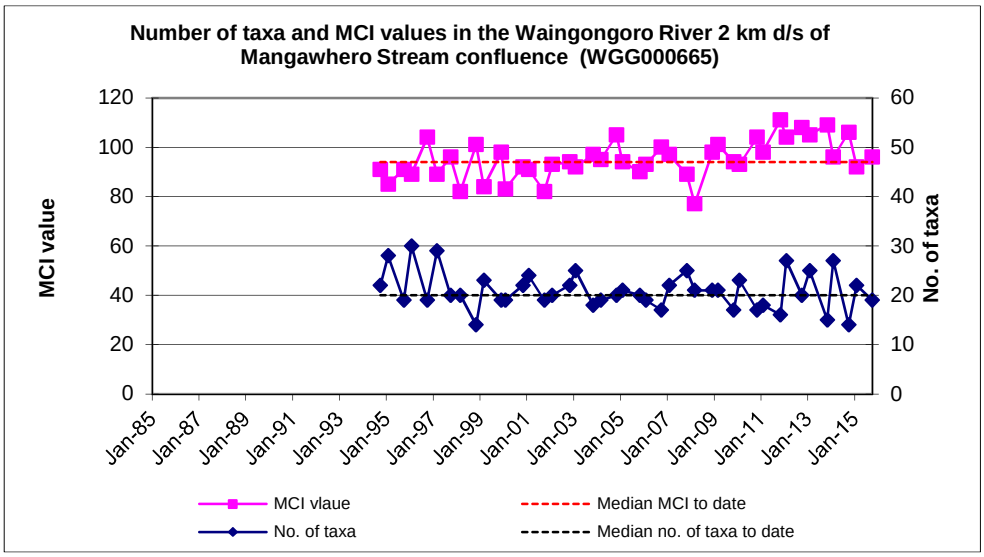


Figure 2 Taxa richness and MCI scores recorded at each site to date

Site 1 (upstream of the WWTP outfall)

A moderately low macroinvertebrate community richness of 15 taxa was found at site 1 ('control' site) at the time of the spring survey (Table 1).

The MCI score of 83 units indicated a community of 'fair' biological health but this was significantly higher (Stark, 1998) than the median MCI score of 67 units. The $SQMCI_S$ score of 3.5 units was lower than the median $SQMCI_S$ score of 4.1 units (Table 1).

The community was characterised by two 'tolerant' taxa [oligochaete worms and snails (*Potamopygus*)] (Table 2).

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

A moderate macroinvertebrate community richness of 25 taxa was found at site 5 ('primary impacted' site) at the time of the spring survey (Table 1).

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 4.2 units was higher than the median $SQMCI_S$ score of 2.9 units (Table 1).

The community was characterised by two 'tolerant' taxa [snails (*Potamopygus*) and orthoclad midges], and one 'highly sensitive' taxon [mayflies (*Deleatidium*] (Table 2).

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

A moderately low macroinvertebrate community richness of 19 taxa was found at site 8 ('secondary impacted' site) at the time of the spring survey (Table 1).

The MCI score of 96 units indicated a community of 'fair' biological health which was not significantly different (Stark, 1998) to the median MCI score of 94 units. The $SQMCI_S$ score of 6.4 units was higher than the median $SQMCI_S$ score of 4.3 units (Table 1).

The community was characterised by one extremely abundant 'highly sensitive' taxon [mayflies (*Deleatidium*] (Table 2).

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

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. 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 may have contributed to the higher than normal MCI and $SQMCI_S$ score at site 5 though the 'control' site also showed an improvement in MCI scores which would not be related to the Eltham WWTP. However, there has been a noticeable improvement in MCI scores at site 5 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 unlikely.

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 reflect habitat differences.

Summary and conclusions

The Councils 'kick-sampling' technique was used at three sites 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 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.

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 which was possibly a reflection of the lack of discharges occurring at the Eltham WWTP.

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

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To Job manager, Rae West
From Scientific Officer, Darin Sutherland
Document 1668831
Report DS044
Date May 2016

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, March 2016

Introduction

This summer survey was the second of two surveys programmed for the 2015-2016 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

The standard '400 ml kick sampling' technique was used to collect streambed (benthic) macroinvertebrates from two established sampling sites in the Mangawhero Stream on 1 March 2016. 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.

This survey was performed some five 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**.

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	GPS 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

Site No	Site code	GPS reference	Location
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 510 l/s) approaching MALF (443 l/s), 12 days after a fresh in excess of both 3 times and 7 times median flow in the Waingongoro River (flow gauging site: Waingongoro River at Eltham). The survey followed a dry summer period with only one significant river fresh recorded over the preceding month but this was extremely large (>50 times median flow).

For the Mangawhero Stream sites the water temperatures during the survey were in the range 18.0-18.9 °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 slippery algal mats and no filamentous algae. There were moss and patchy leaves on the streambed. Site 5 had slippery patchy algal mats and filamentous algae. There was also patchy moss and leaves on the streambed. 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 19.5-19.7 °C. Water speed was swift and the water was uncoloured and clear. The substrate at all three sites comprised predominately cobble/ coarse gravel. Site 6 had slippery algal mats and no filamentous algae. There were patchy leaves on the streambed. Site 7 had slippery algal mats and patchy filamentous algae. There was also patchy moss, leaves and wood on the streambed. Site 8 had slippery algal mats and no filamentous algae. There were patchy moss and leaves on the streambed. Site 6 had no shading while sites 7 and 8 had partial shading from overhanging vegetation.

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 March 2016

Site No.	N	No of taxa			MCI value			$SQMCI_s$ value		
		Median	Range	Mar 2016	Median	Range	Mar 2016	Median	Range	Mar 2016
1	52	16	10-25	18	74	58-85	72	4.1	1.5-6.3	4.1
5	47	20	13-30	27	79	63-102	83	2.9	1.5-6.4	3.4
6	30	27	16-35	20	95	77-116	96	5.7	3.7-6.5	5.6
7	29	26	17-35	28	92	78-109	89	4.5	2.2-7.0	4.8
8	43	20	14-30	21	94	77-111	89	4.3	2.4-7.6	5.4

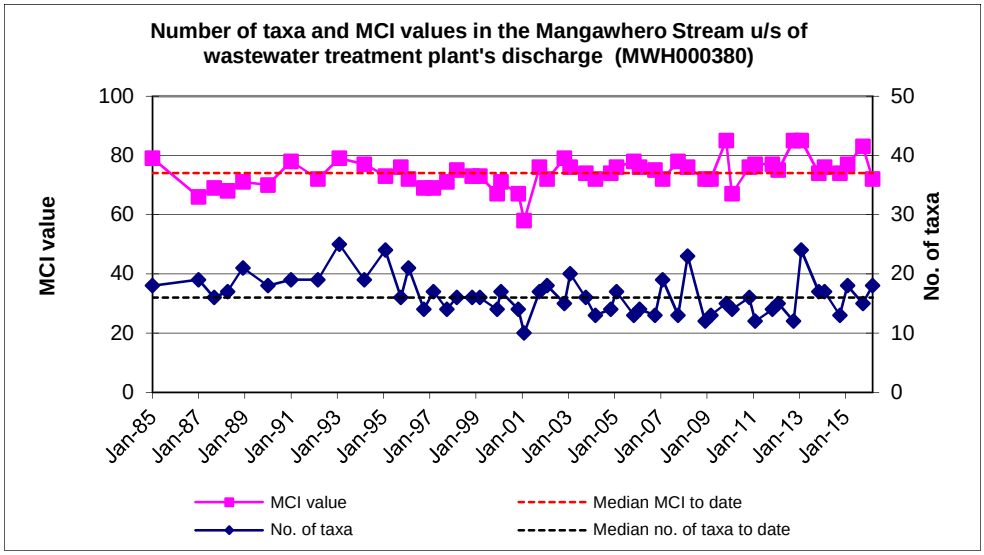
The macroinvertebrate fauna recorded by the current survey at each of the five sites are presented in Table 5.

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 1 March 2016

Taxa List	Site Number	MCI score	1	5	6	7	8
	Site Code		MWH000380	MWH000490	WGG000620	WGG000640	WGG000665
	Sample Number		FWB16122	FWB16123	FWB16117	FWB16118	FWB16119
NEMERTEA	Nemertea	3	C	A	-	R	-
NEMATODA	Nematoda	3	-	-	-	R	-
ANNELIDA (WORMS)	Oligochaeta	1	C	VA	C	A	R
	Lumbricidae	5	-	-	R	R	-
MOLLUSCA	*Ferrissia*	3	-	R	-	-	-
	Physa	3	-	-	-	R	-
	Potamopyrgus	4	A	VA	R	A	C
CRUSTACEA	Ostracoda	1	VA	R	-	R	-
	Paracalliope	5	XA	VA	-	C	R
	Paraleptamphopidae	5	-	-	-	R	-
	Talitridae	5	-	C	-	-	-
	Paranephrops	5	R	R	-	-	-
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	-	-	C	C	R
	Coloburiscus	7	-	-	C	C	R
	Deleatidium	8	R	C	VA	VA	VA
	Zephlebia group	7	-	-	R	R	-
HEMIPTERA (BUGS)	*Microvelia*	3	R	-	-	-	-
COLEOPTERA (BEETLES)	Elmidae	6	-	A	R	C	R
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	-	C	R	C	C
TRICHOPTERA (CADDISFLIES)	*Hydropsyche (Aoteapsyche)*	4	R	VA	A	VA	VA
	Hydrobiosis	5	-	A	C	A	C
	Neurochorema	6	-	R	-	-	-
	Polyplectropus	6	R	-	-	-	-
	Beraeoptera	8	-	-	-	R	-
	Oxyethira	2	R	A	R	A	R
	Pycnocentria	7	-	C	R	R	R
	Pycnocentrodes	5	-	A	C	A	R
	Triplectides	5	R	-	-	-	-
DIPTERA (TRUE FLIES)	*Aphrophila*	5	-	R	R	R	R
	Limonia	6	-	R	-	-	-
	Corynoneura	3	R	-	-	-	-
	Maoridiamesa	3	-	R	-	R	C
	Orthocladiinae	2	C	VA	A	A	A
	Polypedilum	3	R	C	C	C	C
	Tanypodinae	5	-	-	R	-	-
	Tanytarsini	3	R	VA	A	A	C
	Empididae	3	-	A	-	C	R
	Ephydridae	4	R	C	-	-	-
	Muscidae	3	-	C	-	-	R
	Austrosimulium	3	VA	C	A	C	R
No of taxa			18	27	20	28	21
MCI			72	83	96	89	89
SQMCIs			4.1	3.4	5.6	4.8	5.4
EPT (taxa)			4	6	8	9	7
%EPT (taxa)			22	22	40	32	33

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

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



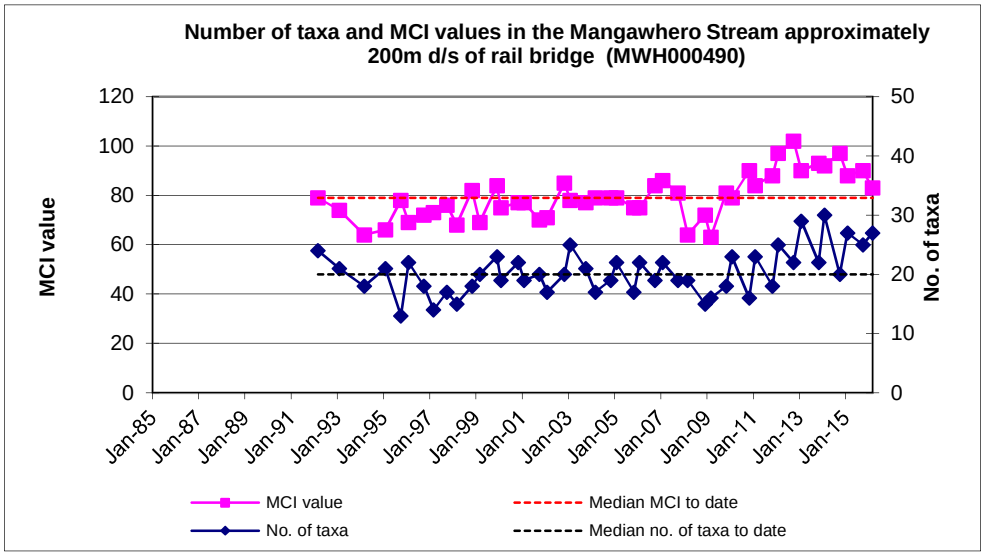


Figure 2 Taxa richness and MCI scores recorded at each site to date for Mangawhero Stream sites

Site 1 (upstream of the WWTP outfall)

A moderately low macroinvertebrate community richness of 18 taxa was found at site 1 (Mangawhero Stream 'control' site) at the time of the summer survey (Table 4).

The MCI score of 72 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 4.1 units was the same as the median $SQMCI_S$ score of 4.1 units (Table 4).

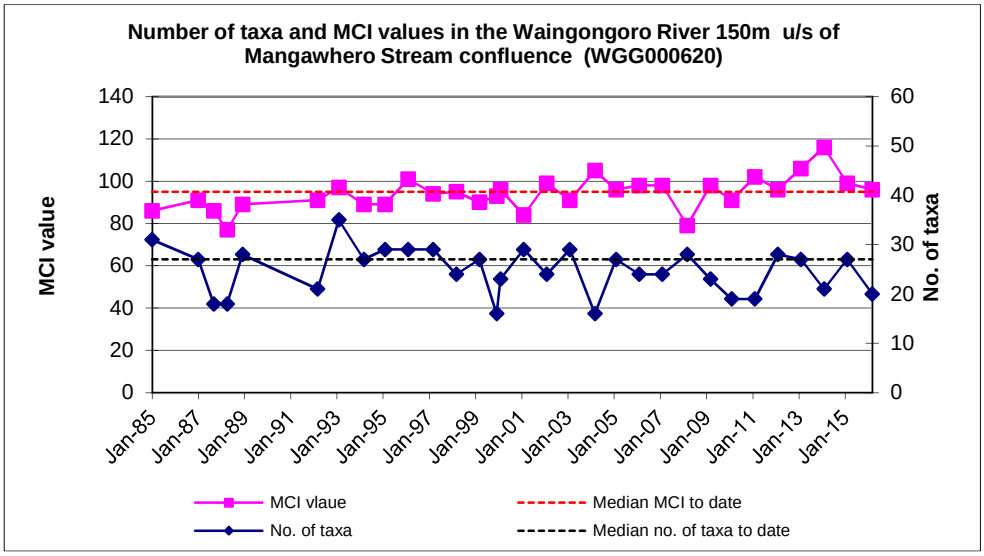
The community was dominated by an 'extremely abundant' 'moderately sensitive' amphipod (*Paracalliope*) and two 'very abundant' 'tolerant' taxa [ostracod shrimp and sandfly (*Austrosimulium*)] (Table 5).

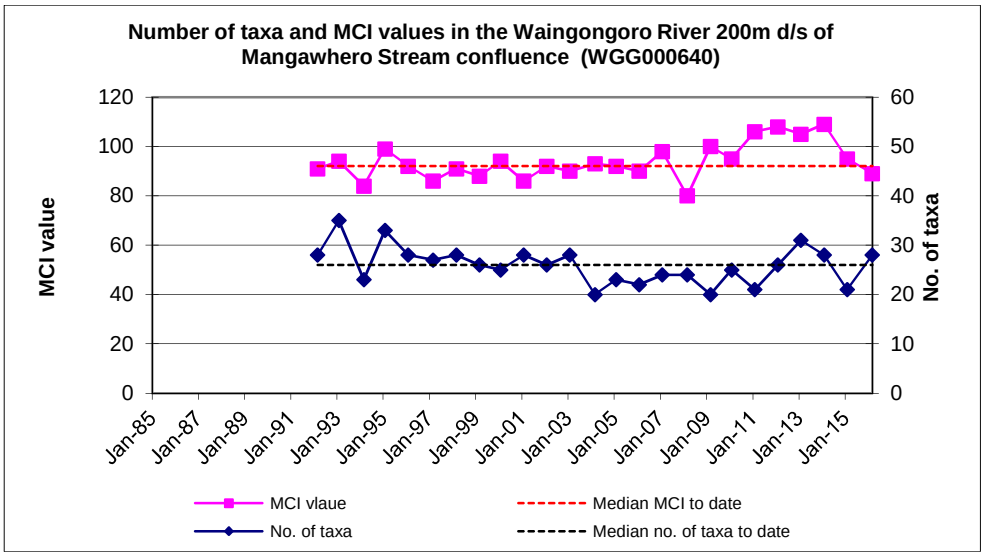
Site 5 (downstream of Mangawharawhara Stream confluence; approx 3 km below the WWTP outfall and old landfill)

A moderate macroinvertebrate community richness of 27 taxa was found at site 5 ('primary impacted' site) at the time of the survey (Table 4).

The MCI score of 83 units indicated a community of 'fair' biological health which was not significantly different (Stark, 1998) to the median MCI score of 79 units. The $SQMCI_S$ score of 3.4 units was not significantly higher (Stark, 1998) than the median $SQMCI_S$ score of 2.9 units (Table 4).

The community was dominated by several 'very abundant' 'tolerant' taxa [oligochaete worms, snails (*Potamopygus*), caddisfly (*Hydropsyche/Aoteapsyche*) and midges (Orthocladiinae and Tanytarsini)] taxa and a 'moderately sensitive' amphipod (*Paracalliope*) (Table 5).





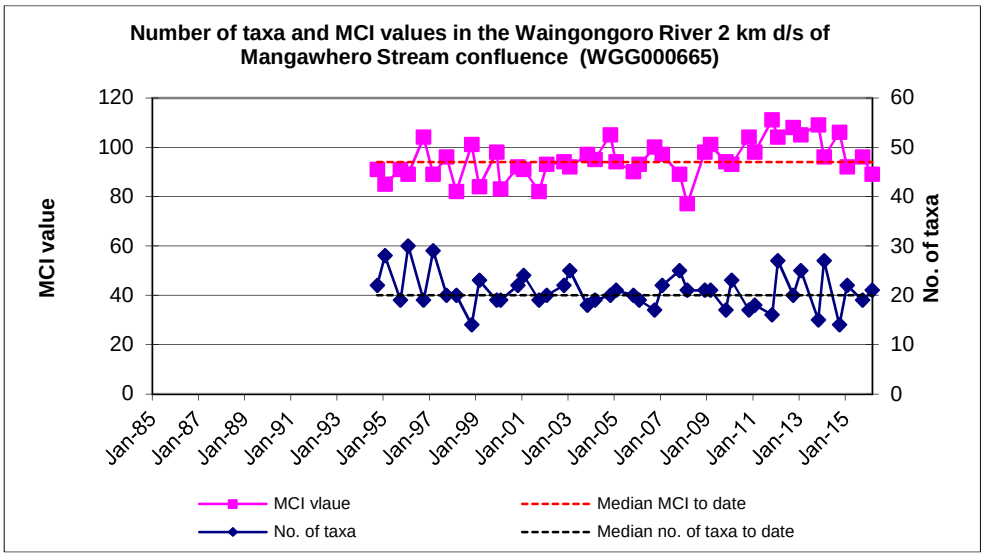


Figure 3 Taxa richness and MCI scores recorded at each site to date for Waingongoro River sites

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

A moderately low macroinvertebrate community richness of 18 taxa was found at site 6 (Waingongoro River 'control' site) at the time of the survey (Table 4).

The MCI score of 96 units indicated a community of 'fair' biological health which was not significantly different (Stark, 1998) to the median MCI score of 95 units. The $SQMCI_S$ score of 5.6 units was not significantly different to the median $SQMCI_S$ score of 5.7 units (Table 4).

The community was dominated by a 'very abundant' 'moderately sensitive' mayfly (*Deleatidium*) and several 'abundant' 'tolerant' taxa [caddisfly (*Hydropsyche/Aoteapsyche*), midges (Orthocladiinae and Tanytarsini) and sandfly (*Austrosimulium*)] (Table 5).

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

A moderate macroinvertebrate community richness of 28 taxa was found at site 7 ('secondary impact' site) at the time of the survey (Table 4).

The MCI score of 89 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 4.8 units was not significantly (Stark, 1998) different to the median $SQMCI_S$ score of 4.5 units (Table 4).

The community was dominated by a 'very abundant' 'moderately sensitive' mayfly (*Deleatidium*) and 'tolerant' caddisfly (*Hydropsyche/Aoteapsyche*), and six 'abundant' 'tolerant' taxa [snail (*Potamopyrgus*), caddisfly (*Oxyethira*), midges (Orthocladiinae and Tanytarsini) and one 'abundant' 'moderately sensitive' caddisfly (*Pycnocentrodes*) (Table 5).

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

A moderate macroinvertebrate community richness of 21 taxa was found at site 8 ('tertiary impact site) at the time of the survey (Table 4).

The MCI score of 89 units indicated a community of 'fair' biological health which was not significantly different (Stark, 1998) to the median MCI score of 94 units. The $SQMCI_S$ score of 5.4 units was significantly higher (Stark, 1998) than the median $SQMCI_S$ score of 4.3 units (Table 4).

The community was dominated by a 'very abundant' 'moderately sensitive' mayfly (*Deleatidium*) and 'tolerant' caddisfly (*Hydropsyche/Aoteapsyche*), and one 'abundant' 'tolerant' midge (Orthocladiinae) (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

Taxa richnesses at all five sites were either similar or higher than historical median taxa richnesses though there was a large decrease in taxa richness from the Mangawhero Stream 'control' site to the 'primary impact' site. The Mangawhero Stream 'control' site also had 'poor health' which was typical for the site. Both low indices were due to the poor habitat at the 'control' site 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.

MCI scores for the three potentially impacted sites (sites 5, 7 and 8) were all significantly higher than the Mangawhero Stream 'control' site. In addition, sites 7 and 8 MCI scores were not significantly lower than the Waingongoro River 'control' site (site 6) which is a more appropriate 'control' site for sites on the Waingongoro River. All five sites recorded MCI scores lower than the previous spring survey which was probably due to normal seasonal variation as summer scores are generally lower than spring scores in the Taranaki Region because of higher sunlight hours and warmer temperatures promoting periphyton growth.

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 four units, 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.

Taxa composition was noticeable different between the Mangawhero Stream sites and Waingongoro River sites. The Mangawhero Stream had more 'tolerant' taxa at higher abundances which caused significant differences in $SQMCI_S$ scores between the two waterbodies. However, there were no significant decreases in score from site 1 to site 5 and site 6 to sites 7 and 8 indicating that differences were related to differences within waterbodies rather than the WWTP.

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 summer survey.

The results of the current survey 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. Differences among sites reflect habitat differences and differences between waterbodies.

Summary and conclusions

The Councils 'kick-sampling' technique was used at five sites to collect macroinvertebrates from two sites on the Mangawhero Stream and three sites on the Waingongoro River for the summer 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 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 at all five sites were either similar or higher than historical median taxa richnesses. The MCI scores for the three potentially impacted sites (sites 5, 7 and 8) were all significantly higher than the Mangawhero Stream 'control' site. This would be due to 'impacted' sites having better physical stream habitat conditions for macroinvertebrates. Sites 7 and 8 scores were also not significantly lower than the Waingongoro River 'control' site. There were no significant decreases in $SQMCI_S$ scores from site 1 to site 5 and site 6 to sites 7 and 8 indicating that differences between the Mangawhero Stream and Waingongoro River were related to differences within waterbodies rather than the WWTP discharge.

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

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