# Taranaki Abattoirs Limited Monitoring Programme Report 2010-2014

## Technical Report 2014-57

ISSN: 0144-8184 (Print)
ISSN: 1178-1467 (Online)
Document: 1430841 (Word)
Document: 1423423 (Pdf)

Taranaki Regional Council
Private Bag 713
STRATFORD

November 2014

# Executive summary

Taranaki Abattoirs Ltd operated an abattoir and rendering plant, located on Mountain Road at Stratford, in the Kahouri Stream catchment, a tributary of the Patea River. The Company processed sheep and beef, although pigs were the primary stock processed. Offal, blood and bones were processed on site in the rendering plant, producing meal and tallow. Wastewater was treated in a two pond system, which was discharged to an unnamed tributary of the Kahouri Stream. During the reporting period, this discharge ceased, and wastewater was then either irrigated to land when conditions allowed, or to the Kahouri Stream during high flow conditions. This report for the period July 2010 – June 2014 describes the monitoring programme implemented by the Taranaki Regional Council to assess the Company's environmental performance during the period under review, and the results and environmental effects of the Company's activities.

**During the period, the Company demonstrated a 'improvement required' level for environmental performance and compliance with the resource consents.**

The Company holds 7 resource consents, which include a total of 93 conditions setting out the requirements that the Company must satisfy. The Company holds one consent to allow it to take and use water, three consents to discharge effluent and stormwater into the Kahouri Stream, two consents to discharge wastewater and degenerating product to land, and one consent to discharge emissions into the air at this site.

The Council's monitoring programme for the period under review included 18 inspections, 49 water samples collected for physicochemical analysis, and 6 biomonitoring surveys of receiving waters, totalling 23 macroinvertebrate samples.

The monitoring showed that the day to day running of the site was generally of a good standard, with processes in place to minimise the generation of wastewater, and to minimise the contamination of stormwater. At the start of the reporting period, both water quality and biological monitoring found that the discharge of wastewater to the unnamed tributary was having a significant adverse effect on the tributary, and a notable effect on the Kahouri Stream. Once this activity ceased, monitoring documented a very significant improvement in water quality and in-stream biological communities.

The practice of discharging wastewater to the Kahouri Stream during high flow conditions has not caused any recorded impact on the macroinvertebrate communities of this stream, and the impact on water quality was minimal. The irrigation of wastewater was undertaken with no significant adverse effects on the environment, although due to the consent holder not expanding the available irrigation area, there was over application of nitrogen to some paddocks. Water quality monitoring indicated an increase in ammoniacal nitrogen in the unnamed tributary as it flowed through these paddocks, although not to the extent as to have a lethal impact on the stream biota. This discharge resulted in two unauthorised incidents, which eventuated in two abatement notices being issued, relating to the expansion of irrigation area and over application of nitrogen.

There were five other incidents recorded in respect of this consent holder during the period under review, all relating to air emissions. These were all odour complaints, of which only one was substantiated. However, no enforcement action was taken, as no affected party could be identified.

During the period, the Company demonstrated an 'improvement required' level for environmental performance and compliance with the resource consents. Although administrative compliance was good overall. In addition to the issuance of two abatement notices, a number of other consent conditions were also not complied with, which individually would be considered minor. However, when considered together, it was symptomatic of a company that needs to give a higher priority to consent compliance. As a result, an improvement in the Company's environmental performance is desirable.

For reference, in the 2013-2014 year, 60% 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 29% demonstrated a good level of environmental performance and compliance with their consents.

It should be noted that near the end of this reported period, the site began a process that will eventually see a change of ownership, to Gold International Meat Holdings Limited, with the abattoir being operated by Gold International Meat Processors Limited. Gold International Meat Holdings Limited is owned 100 per cent by the People's Republic of China. This 'improvement required' rating related entirely to Taranaki Abattoirs Limited, and Gold International Meat Holdings Ltd have already displayed a willingness to comply with consent conditions, and are actively liaising with TRC in order to achieve this.

This report includes recommendations for the 2014-2015 year.

# Table of contents

# List of tables

# List of figures



# List of photos

# 1. Introduction

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

### 1.1.1 Introduction

This report is the Monitoring Report for the period July 2010- June 2014 by the Taranaki Regional Council on the monitoring programme associated with resource consents held by Taranaki Abattoirs Limited. The Company operates an abattoir and rendering plant situated on Mountain Road (SH3) at Stratford, in the Kahouri Stream catchment, within the Patea River catchment.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consent held by Taranaki Abattoirs Ltd that relate to abstractions and discharges of water within the Kahouri catchment, and the air discharge permit held by Taranaki Abattoirs to cover emissions to air from the site.

One of the intents of the *Resource Management Act 1991* (RMA) is that environmental management should be integrated across all media, so that a consent holder's use of water, air, and land should be considered from a single comprehensive environmental perspective. Accordingly, the Taranaki Regional Council generally implements integrated environmental monitoring programmes and reports the results of the programmes jointly. This report discusses the environmental effects of the Company's use of water, land and air, and is the first stand alone combined report by the Taranaki Regional Council for the Company. Previously, monitoring of the site was reported in a Kahouri Catchment report, which included a number of industries. All eighteen of these previous reports are included in the references at the end of this report.

### 1.1.2 Structure of this report

Section 1 of this report is a background section. It sets out general information about compliance monitoring under the RMA and the Council's obligations and general approach to monitoring sites though annual programmes, the resource consents held by Taranaki Abattoirs Ltd in the Kahouri 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 Company's site.

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

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

Section 4 presents recommendations to be implemented in the 2014-2015 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 *Resource Management Act 1991* (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 (e.g., recreational, cultural, or aesthetic);
(e) risks to the neighbourhood or environment.

In drafting and reviewing conditions on discharge permits, and in implementing monitoring programmes, the Taranaki Regional 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 consent performance

Besides discussing the various details of the performance and extent of compliance by the consent holder/s during the period under review, this report also assigns a rating as to each Company's environmental and administrative performance.

**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 Company'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 (i.e. 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 compliance**

- **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 2012-2013 year, 35% 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 59% demonstrated a good level of environmental performance and compliance with their consents. In the 2013-2014 year, 60% of consent holders achieved a high level of environmental performance and compliance with their consents, while another 29% demonstrated a good level of environmental performance and compliance.

## 1.2 Process description

Taranaki Abattoir Co (1992) Limited [Taranaki Abattoirs] operate an abattoir and rendering plant situated beside State Highway 3 at the Kahouri Stream bridge, about one kilometre north of Stratford. The facility generally operates Monday-Friday and slaughters cattle, sheep and pigs. Meat meal and tallow are also by-products manufactured on site.

The facility has been upgraded and its capacity expanded significantly since 1995. Figure 1 shows the annual kill of beef, sheep and pigs for the years ending 30 June since 1995.

In the reported period ending 30 June 2014, the total number of stock processed dropped significantly, fuelled primarily by a drop in the numbers of sheep and beef processed, which was the lowest of the twenty year period for which data exists (Figure 1). Sheep kills have gradually decreased since 2000-2001, and over the reported period were a very small component of the total kill. Pigs remained the most commonly processed animal, although there was a reduction in numbers from the highest years of 2005-2007, with slight increase in the 2013-14 period.

Figure 2 shows monthly kills over the reporting period. There was some fluctuation in the number of pigs killed at the beginning of the reporting period, and this was followed by a sharp reduction between December 2011 and February 2013, although pig numbers recovered to be relatively typical in the latter part of the period. Sheep and beef processed during the reporting period dropped off, to be a minor component of the plants throughput by the end of the reporting period. It is possible that this resulted in a reduction in the organic and nutrient loading to the waste pond treatment system from the previous year.

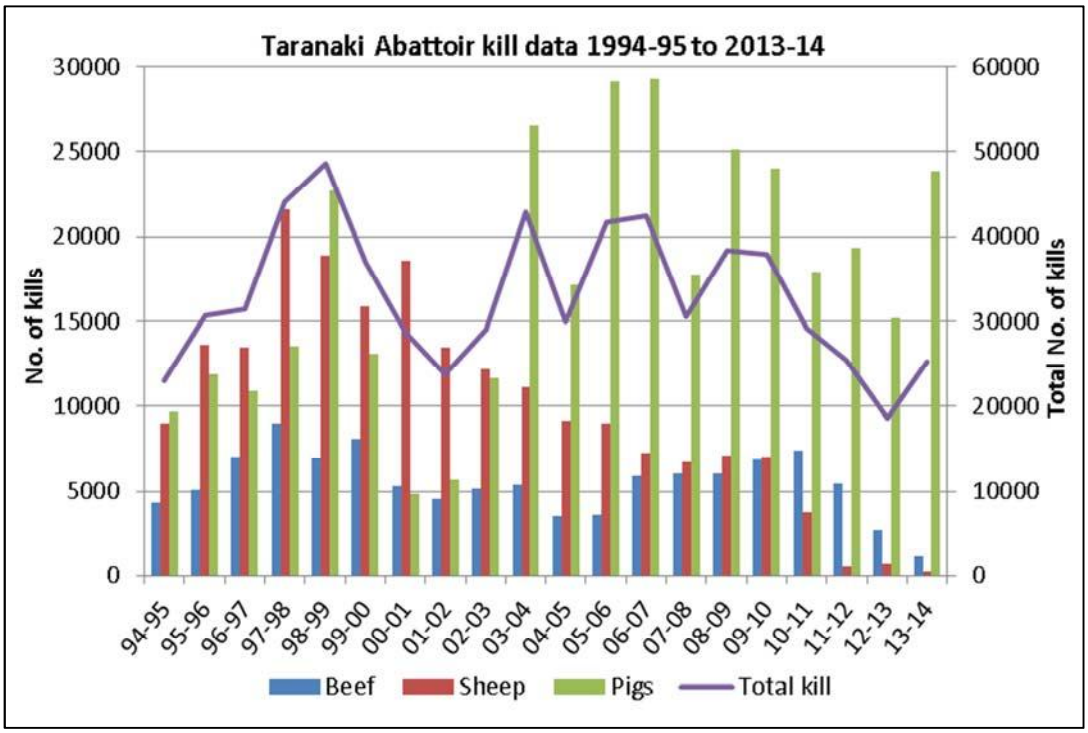


**Figure 1** Annual kill for beef, sheep and pigs at Stratford abattoir from 1994-95 to 2013-2014

The rendering plant processes soft and hard offal from the adjacent abattoir, while some offal is also accepted from other sources. Material is processed in one of two batch cookers. Heating requirements are supplied from two package boilers. Cooked material is discharged into a percolator pan and the product centrifuged to remove surplus tallow. Solid material is milled and bagged. Tallow is refined and stored in bulk. The batch melter used has a capacity of 1500 kg raw material. Cooker gases are routed to a trash cyclone, then to an indirect condenser, with non-condensable gases passed to a compost filter before discharge to atmosphere.

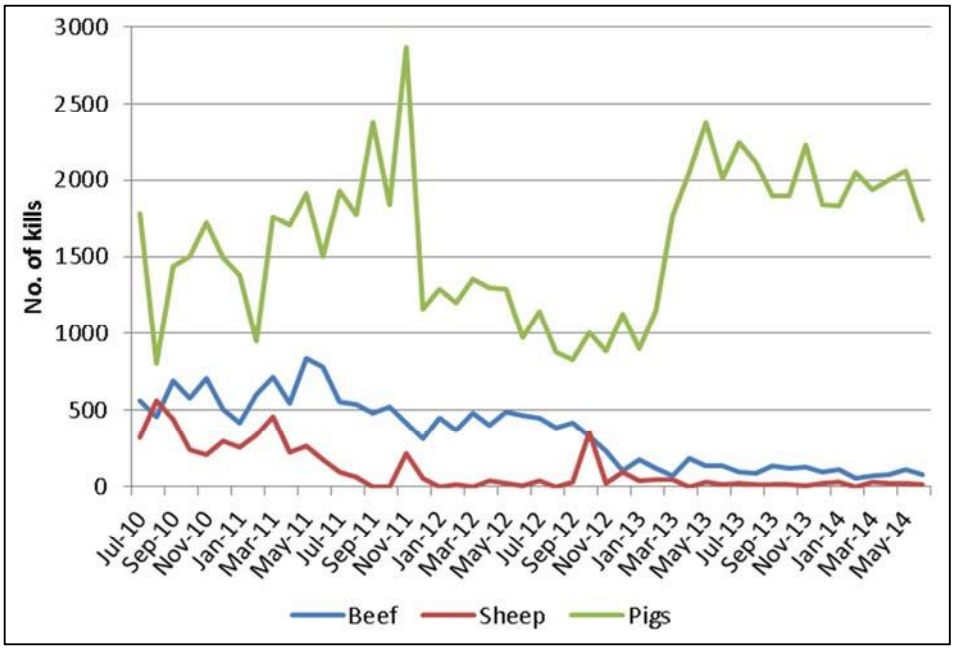


**Figure 2** Monthly kills of cattle, sheep and pigs at Taranaki Abattoirs

Water supply for the site comes from two sources. Water for stock and yard washing used to be drawn at a small weir on an unnamed tributary of the Kahouri Stream, but a variation to the consent in 2008 allowed the point of take to be from the Kahouri Stream proper, approximately 200 metres upstream of the abattoir, whilst water for slaughter and process areas comes from Stratford municipal supply.

The wastewater treatment system is a conventional two-pond system, which is essentially a scaled-up version of those used to treat farm dairy wastes. It consists of an anaerobic pond of approximately 2,000 cubic metres volume followed by an aerobic pond about of 3,200 square metres in area. During the period under review, this system experienced a large upgrade. Initially, the treated wastewater was discharged to an unnamed tributary of the Kahouri Stream. With the renewal of the discharge consents, waste water is no longer discharged to this tributary, and is instead irrigated to land when conditions allow, or discharged to the Kahouri Stream during high flows, when adequate dilution exists.

Wastewater comes from three main sources, namely the slaughterhouse, stockyards and rendering plant. Slaughterhouse wastewater passes through a screening system that removes gross solids and then flows by gravity to the anaerobic pond. Drainage from the partially covered stockyards is also gravity-fed to the treatment system. Waste liquor and floor washings from the rendering process are pumped up to the drainage system. Boiler condensate is disposed of in a soak hole.

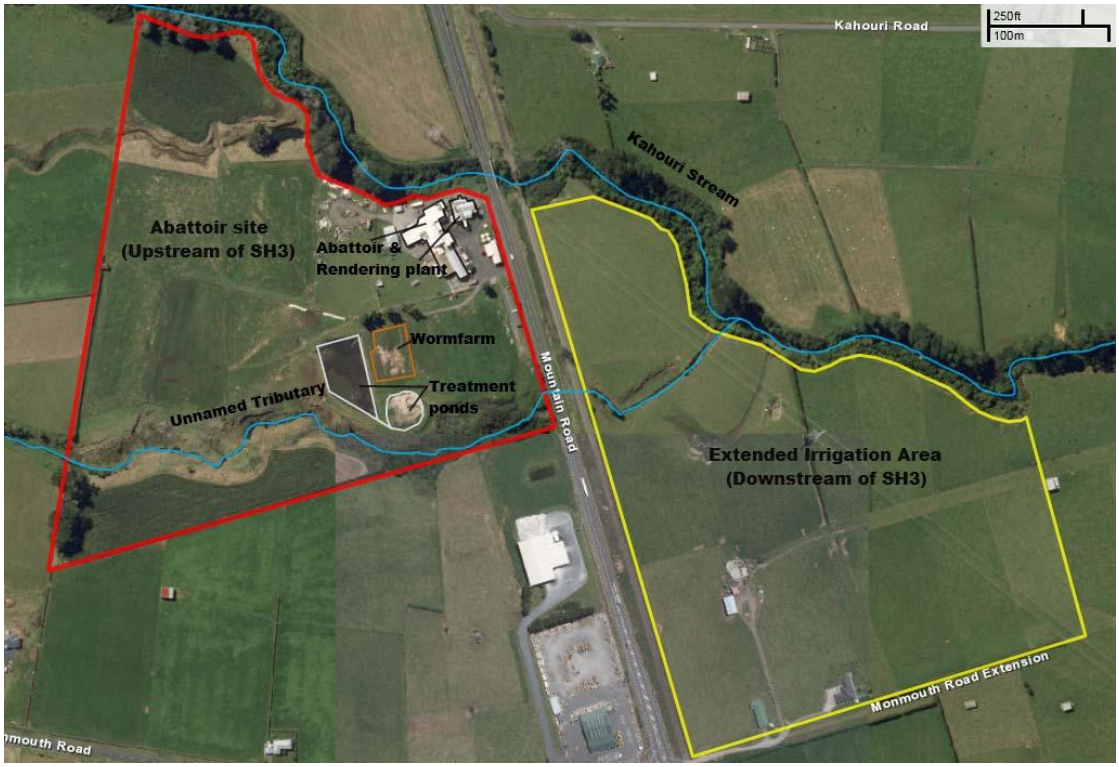


**Photo 1** The Taranaki Abattoir's site, including irrigation area

The Company disposes of material unsuitable for rendering by composting in a paddock next to the effluent treatment system, an area commonly referred to as the worm farm. The composted material is then spread over pasture. Runoff from this area is also directed to the wastewater treatment system. In addition, the Company has a

burial pit which receives product that has spoiled, and is no longer suitable for rendering. This may happen when there is a breakdown with the cooker for example.

Near the end of this reported period, the site began a process that will eventually see a change of ownership, to Gold International Meat Holdings Limited, with the abattoir being operated by Gold International Meat Processors Limited. Gold International Meat Holdings Limited is owned 100 per cent by the People's Republic of China. It is understood that once the Company gains certification to export meat to China, no pigs will be killed on site, and the numbers of sheep and beef killed will increase significantly. Council is currently liaising with the Company to ensure all associated wastes are dealt with, and that adequate provisions are in place for the increase in throughput.

## 1.3 Resource consents

### 1.3.1 Water abstraction permit

Section 14 of the RMA stipulates that no person may take, use, dam or divert any water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or it falls within some particular categories set out in Section 14.

Taranaki Abattoirs holds water permit **5176** to take water from the Kahouri Stream for stock and yard washing purposes. This permit was issued by the Taranaki Regional Council on 19 May 2008 under Section 87(d) of the Resource Management Act. It expires on 1 June 2016.

Special condition 1 requires the consent holder to adopt the best practical option.

Special condition 2 relates to abstraction limits.

Special condition 3 states that a flow meter shall be installed and maintained with the collection and supply of records required by special condition 4.

Special condition 5 specifies the minimum flow in the Kahouri Stream, below which all abstraction must cease.

Special condition 6 states that the consent holder shall ensure the intake is screened to avoid the entrainment of fish.

Special condition 7 relates to the review of the consent.

A copy of the permit is attached in Appendix I.

### 1.3.2 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.

Taranaki Abattoirs Company Limited held water discharge permit **0108** to discharge treated wastewater directly into an unnamed tributary of the Kahouri Stream. This

permit was issued by the Taranaki Regional Council on 7 November 2011 under Section 87(e) of the Resource Management Act. It expired on 1 February 2012.

Special condition 1 required the consent holder to adopt the best practical option.

Special condition 2 set restrictions on the discharge volume and rate, and on what effects the discharge can have on the Kahouri Stream.

Taranaki Abattoirs Company Limited holds water discharge permit **7662** to discharge treated wastewater directly into the Kahouri Stream. This permit was issued by the Taranaki Regional Council on 7 November 2011 under Section 87(e) of the Resource Management Act. It expires on 1 June 2028.

Special conditions 1 and 2 relate to adopting the best practicable option and exercising the consent in accordance with the application, and notification requirements.

Special conditions 3 and 4 relate to pre activity requirements of the exercise of the consent, including how this consent relates to consent 0108, and requiring the installation of a flow meter.

Special condition 5 relates to flow meter requirements, and special conditions 6 and 7 relate to the installation, calibration and maintenance of a staff gauge.

Special conditions 8 and 9 relate to minimising the volume of wastewater created.

Special conditions 10 to 15 relate to managing the discharge in terms of meeting dilution rates, limiting instream impacts, and maintaining site access.

Special conditions 16 and 17 relate to activities intended to minimise the frequency of an after hours discharge from the aerobic pond.

Special condition 18 requires the consent holder to favour the irrigation of wastes to land when conditions allow, even if adequate dilution is available in the stream.

Special conditions 19, 20 and 21 relate to the quality of the treated wastewater, and enabling sampling.

Special condition 22 requires the consent holder to maintain records of the discharge.

Special condition 23 requires the consent holder to implement riparian fencing and planting.

Special condition 24 requires the consent holder to notify Council of any adverse environmental incidents.

Special conditions 25 and 26 relates to the lapse and review of the consent.

Taranaki Abattoirs Company Limited holds water discharge permit **7660** to discharge uncontaminated stormwater to land, in association with meat processing, rendering and associated activities. This permit was issued by the Taranaki Regional Council on 7

November 2011 under Section 87(e) of the Resource Management Act. It expires on 1 June 2028.

Special condition 1 requires the consent holder to adopt the best practical option.

Special conditions 2 and 3 states the constituents the discharge must meet.

Special condition 4 relates to the review of the consent.

A copy of each permit is attached in Appendix I.

### 1.3.3 Air discharge pemit

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

Taranaki Abattoirs Company Limited holds air discharge permit **4055** to discharge emissions to air, in association with meat processing, rendering and associated activities. This permit was issued by the Taranaki Regional Council on 7 November 2011 under Section 87(e) of the Resource Management Act. It expires on 1 June 2028.

Special condition 1 states that the consent holder shall adopt the best practicable option to prevent or minimise adverse effects on the environment.

Special conditions 2 and 3 relate to the Taranaki Abattoirs contingency plan. Operations shall be undertaken in accordance with the contingency plan and the contingency plan must be updated and submitted every two years.

Special conditions 4 requires the consent holder to notify Council of any changes to processes, operations or chemicals used or stored on site that could alter the nature of the discharge.

Special condition 5 states no fish or fish parts shall be received or processed onsite while special condition 6 states that only offal from purpose killed animals shall be received and processed onsite, and no putrescible materials may be stored onsite, as per condition 7.

Special condition 8 states emissions must be extracted to the biofilter for treatment prior to discharge, and special condition 9 the emissions entering the biofilter must not exceed 35°C.

Special conditions 10 and 11 relate to the calibration of the temperature detector and recorder. It must be in working order at all times.

Special condition 12 states the consent holder must minimise emissions by ensuring the effective operation and maintenance of all equipment and processes.

Special conditions 13 and 14 state that there is to be no objectionable or offensive odour or dust beyond the boundary of the site.

Special condition 15 requires the consent holder to notify Council of any adverse environmental incidents and special condition 16 relates to the review of the consent.

A copy of the permit is attached in Appendix I.

### 1.3.4 Discharges of wastes to land

Sections 15(1)(b) and (d) of the RMA stipulate that no person may discharge any contaminant onto land if it may then enter water, or from any industrial or trade premises onto land under any circumstances, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations.

Taranaki Abattoirs holds discharge permit **5221** to discharge treated wastewater from a treatment system onto and into land in the vicinity of an unnamed tributary of the Kahouri Stream. This permit was issued by the Taranaki Regional Council on 7 November 2011 under Section 87(e) of the Resource Management Act. It expires on 1 June 2028.

Special conditions 1 and 2 require the consent holder to adopt the best practical option and to notify Council upon any change in on-site processes.

Special conditions 3 and 4 relate to flow meter requirements.

Special conditions 5 to 8 require the consent holder to develop and adhere to a wastewater irrigation management plan.

Special conditions 9 to 16 relate to application restrictions, such as operating a stirrer in the aerobic pond during discharge, limiting the amount of nitrogen discharged to land, application rate and sodium adsorption ratio, and preventing any discharge to water, discharge across the boundary, or too close to any dwelling house.

Special condition 19 states the consent holder shall maintain records.

Special conditions 20 and 21 require the consent holder to notify Council of any adverse environmental incidents.

Special condition 22 relates to the review of the consent.

Taranaki Abattoirs holds discharge permit **6570** to cover the discharge of degenerating raw product onto and into land in the vicinity of an unnamed tributary of the Kahouri Stream. This permit was issued by the Taranaki Regional Council on 24 March 2005, under Section 87(e) of the Resource Management Act. It is due to expire on 1 June 2022.

Special conditions 1 to 4 relate to adopting the best practicable option, exercising the consent in accordance with the application, and notification requirements.

Special condition 5 defines the information to be included in a Waste Burial Management Plan, and that the disposal shall be in accordance with this plan.

Special conditions 6 and 7 define the type of product and circumstances (emergency) in which this consent should be used.

Special conditions 8 and 9 restrict the discharge of contaminants to surface water, or any adverse effects to groundwater.

Special conditions 10 requires records to be kept, while special conditions 11 to 14 specify how the covering of buried wastes is to be undertaken and also remediation of the land following burial.

Special conditions 15 and 16 are lapse and review provisions.

A copy of each permit is attached in Appendix I.

## 1.4 Monitoring programme

### 1.4.1 Introduction

Section 35 of the RMA sets out obligations upon the Taranaki Regional Council to gather information, monitor, and conduct research on the exercise of resource consents, and the effects arising, within the Taranaki region and report upon these.

The Taranaki Regional 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.

During the reporting period, a number of consents were renewed, and as a result, there were significant changes to the programme over this time.

The monitoring programme for the Taranaki Abattoirs site consisted of four primary components.

### 1.4.2 Programme liaison and management

There is generally a significant investment of time and resources by the Taranaki Regional 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;
- new consents;
- advice on the Council's environmental management strategies and content of regional plans and;
- consultation on associated matters.

### 1.4.3 Site inspections

The site was visited seventeen times during the monitoring period. With regard to consents for the abstraction of or discharge to water, the main points of interest were plant processes with potential or actual discharges to receiving watercourses, including contaminated stormwater and process wastewaters. The irrigation of wastewater was also assessed. Air inspections focused on plant processes with associated actual and potential emission sources and characteristics, including potential odour, dust, noxious

or offensive emissions. Sources of data being collected by the consent holder were identified and accessed, so that performance in respect of operation, internal monitoring, and supervision could be reviewed by the Council. The neighbourhood was surveyed for environmental effects.

### 1.4.4 Chemical sampling

The Taranaki Regional Council undertook sampling of both the discharges from the site and the water quality upstream and downstream of the discharge point and mixing zone.

The wastewater discharge to the unnamed tributary was sampled on six occasions, and the sample analysed for biological oxygen demand (total, carbonaceous & filtered carbonaceous), chloride, conductivity, dissolved oxygen, dissolved reactive phosphorus, *E.coli*, faecal coliforms, unionised ammonia, ammoniacal nitrogen, pH, suspended solids, temperature, total nitrogen, total phosphorus, turbidity, chemical oxygen demand, oil and grease and alkalinity. The unnamed tributary was also sampled at the time (seven occasions, two sites), and the samples analysed for biological oxygen demand (filtered carbonaceous), chloride, conductivity, dissolved oxygen, dissolved reactive phosphorus, *E.coli*, faecal coliforms, unionised ammonia, ammoniacal nitrogen, pH, suspended solids, temperature, total nitrogen, total phosphorus, turbidity, and chemical oxygen demand. On two of these sampling occasions, the Kahouri Stream was also sampled, at two sites. These samples were analysed for biological oxygen demand (filtered carbonaceous), chloride, conductivity, dissolved oxygen, dissolved reactive phosphorus, *E.coli*, faecal coliforms, unionised ammonia, ammoniacal nitrogen, pH, suspended solids, temperature, total phosphorus and turbidity.

The wastewater discharge to the Kahouri Stream was sampled on four occasions, and the sample analysed for biological oxygen demand (total, carbonaceous & filtered carbonaceous), chloride, conductivity, dissolved oxygen, dissolved reactive phosphorus, *E.coli*, faecal coliforms, unionised ammonia, ammoniacal nitrogen, pH, suspended solids, temperature, total nitrogen, total phosphorus and turbidity. The Kahouri Stream was also sampled at the time (four occasions, two sites), and the samples analysed for biological oxygen demand (total & filtered carbonaceous), chloride, conductivity, dissolved oxygen, dissolved reactive phosphorus, *E.coli*, faecal coliforms, unionised ammonia, ammoniacal nitrogen, pH, suspended solids, temperature, total nitrogen, total phosphorus and turbidity.

The irrigated wastewater was also sampled, on seven occasions. These samples were analysed for calcium, conductivity, potassium, potassium adsorption ratio, magnesium, sodium, ammoniacal nitrogen, nitrates, pH, sodium adsorption ratio, temperature, total nitrogen and total phosphorus.

In addition to sampling in relation to the point source discharges, additional sampling was undertaken when no point source discharge was occurring. This sampling was undertaken in an attempt to understand the degree of leaching that may be occurring, in relation to the irrigation of wastewater or burial of poor quality product. This sampling was undertaken on three occasions, at two sites. These sites were located where site boundary crossed the upstream and downstream ends of the Kahouri Stream and unnamed tributary. These sampled were analysed for conductivity,

dissolved reactive phosphorus, faecal coliforms, unionised ammonia, ammoniacal nitrogen, nitrate, pH, suspended solids, temperature, total nitrogen and turbidity.

### 1.4.5 Biomonitoring surveys

Biological surveys were performed on six occasions, either in the unnamed tributary, and/or in the Kahouri Stream to determine whether or not the discharge of treated wastewater from the site had had a detrimental effect upon the communities of the stream.

# 2. Results

## 2.1 Water

### 2.1.1 Inspections

In general, for most if not all 18 compliance monitoring inspections undertaken during the reported period, the site was clean and tidy, with little to no contamination of the stormwater area. In addition, the paunch separator, blood tank, rendering plant, tallow tank and biofilter were generally well maintained. During the reported period, the consent holder undertook some maintenance and upgrades of their own volition, but was also required to undertake some works as a result of observations made during inspections. What follows are excerpts from the inspection history, which describe these upgrades or detail those observations which required follow up from the consent holder. A more complete inspection history is available, and includes other observations regarding primarily the day to day operations at the plant which, in the majority, were undertaken well with no environmental impact.

The first compliance monitoring inspection of the reported period was undertaken on 7 October 2010, and noted that blood was now being added to the rendering process, rather than being discharged to land. In addition, the sheepskins that were previously buried on site are now being transported to Fielding, and the rendering plant had had improvements made to the rainwater drainage, reducing the amount of clean stormwater entering the wastewater system. The water meter had also been modified in accordance with the guidelines. The air treatment system from the rendering plant required attention however, as steam was escaping from a valve, which was a breach of consent 4055-2.

The second inspection, completed on 15 December 2010 was undertaken following notification from the Company, stating that they had needed to exercise their emergency burial consent, as a bin of product awaiting rendering had spoiled. During this inspection, it was noted that the worm farm had been reduced in size, and improved management of the fat traps had resulted in more fat being returned to the cook cycle, and less fat needing to disposed of. Also noted during this inspection was that a load of pig hair and nails containing quite some blood had been discharged to the worm farm, and that when blood had been applied to land, it had been applied quite thickly in one area. Both areas had the potential to create odour and flies, and the consent holder was advised to cover them with soil.

There was little of note during the following inspection, completed on 10 February 2011, although there was again some steam being emitted from a valve on the air treatment system from the rendering plant. This was resolved following this inspection, and this was confirmed during the fourth visit, on 20 April 2011.

Unfortunately, the next inspection done on 15 June 2011 found that another part of the air treatment system had a fault, with a split in the line allowing steam to escape. The consent holder committed to attending to this immediately. General improvements had been made to the site, with the driveway resealed, and repairs made to a bund that separated the stormwater and wastewater areas.

Upgrades had been made at the wastewater ponds prior to the 11 August 2011 inspection, with new screens fitted to the outlet pipes of both ponds, to reduce the

likelihood of blockage. Unfortunately, the following inspection, completed on 27 October 2011, found that these works may have resulted in the transfer of solid waste from pond one to pond two, reducing its treatment capacity. The consent holder was advised to pump out this pond as soon as possible. Also during this inspection it was noted that blood had been spread to land in a way that maximised coverage and minimised runoff and the potential for odour. In addition, the irrigation system was in the early stages of installation.

This irrigation system was operable at the time of the ninth compliance monitoring inspection, which also noted that the outlet pipe from the second pond had been sealed, preventing discharge to the unnamed tributary. Furthermore a tap was installed on the discharge line to facilitate sampling, and a staff gauge had been installed in the second pond. The rendering plant was in good order, with little odour and all product awaiting rendering stored indoors.

Irrigation was also taking place during the inspection of 18 May 2012, and despite the paddocks being quite wet, there was little ponding, and no runoff. While there was some wind spray noted, it was minimal and not travelling far.

A wet weather inspection was undertaken on 26 June 2012, and noted that the stormwater area was clear of contaminants and the stormwater discharges did not appear to be contaminated.

The twelfth inspection, undertaken on 21 March 2013, found the air treatment system at the rendering plant in good order, with not one steam leak observed. Wastewater was being irrigated to the land around the abattoir, and it was noted that no irrigation system was yet installed on the other side of State Highway 3, as previously committed to by the consent holder. This was of concern as the nitrogen application rate was likely to exceed the consented limits. Furthermore, the wormfarm was not compliant with consent 7662-1, as it either needed to be covered, or the area between the rows needed to be vegetated. In addition, the discharge pipe from the second pond was missing its cap, creating the potential for a discharge of effluent to the unnamed tributary. The consent holder was advised that if effluent was to enter the unnamed tributary, it would constitute significant non-compliance.

A spill of tallow had occurred shortly before the inspection of 21 June 2013, but it had been contained and was being cleaned up at the time. It was apparent that there were good systems in place for the event of a tallow spill. The burial pits however contained pork gut, which was not adequately covered. Council were not notified that the emergency burial consent (6570-1) was to be exercised. This, and the inadequate coverage of the material, meant that this material had been discharged in contravention of this consent. In addition, two paddocks were stocked with sheep and beef, despite the wastewater management plan identifying this land as cut and carry only. The consent holder was instructed to move the stock immediately.

A follow up inspection was undertaken on 27 June 2013, which found that the pork gut had been adequately buried, and the consent holder indicated that no more product would be disposed of in to that burial pit. They also stated that any product that cannot be rendered, would be held on site in the chiller until it can be taken to an alternative disposal site. Also, the sheep had been moved out of the cut and carry paddocks, although during the inspection a small number of escapees were observed in a cut and

carry paddock. These had been rounded up, and all holes in the fence repaired. The beef cattle were being moved at the time of inspection.

Another wet weather inspection was undertaken on 29 August 2013, and again there was no indication of any contamination of the stormwater leaving the site. Also, no stock were observed in the paddocks reserved for cut and carry only. It was apparent during this inspection that irrigation had recently been undertaken in the extended irrigation area across State Highway 3.

The sixteenth inspection of the reported period was completed on 22 November 2013. There was little of note, with the irrigator operating in the extended area, with minimal ponding and no runoff. The cut and carry paddocks had just been harvested for silage, and no stock were present. Some discussion was had around planned upgrades to the site, which will facilitate an increased throughput.

Similarly, there was little of note during the seventeenth inspection, on 21 February 2014. There was a low through put at the abattoir, and as a result there was only a small amount of product awaiting rendering. Works were underway to upgrade the plant, including the construction of a large refrigerated building. Further discussion was held about what increased throughput would mean for the waste management processes, and the consent holder was advised that the capacity of the biofilter on the air treatment system may need review, should the throughput at the rendering plant increase. In addition, the consent holder was reminded that effluent needed to be managed to prioritise irrigation to land.

The final inspection of the reported period, undertaken on 21 May 2014, found that the roof over the paunch separator had been repaired and extended, reducing the volume of clean stormwater diverted to the wastewater ponds. In addition, renovations made to the rendering building should improve the air treatment, by reducing the amount of air flow through the building. Of concern was the location where boiler water was discharged to a soak hole. It was apparent that this boiler water had the potential to reach the river, by discharging through the stream bank immediately below the soak hole. The consent holder was advised this needed investigation, and would either require a change to consent, or cessation of the discharge.

### 2.1.2 Results of abstraction and discharge monitoring

#### 2.1.2.1 Results of discharge monitoring

Various sites are monitored for discharge or receiving environment water quality monitoring. The site locations are shown in Figure 3, and summarised in Table 1.

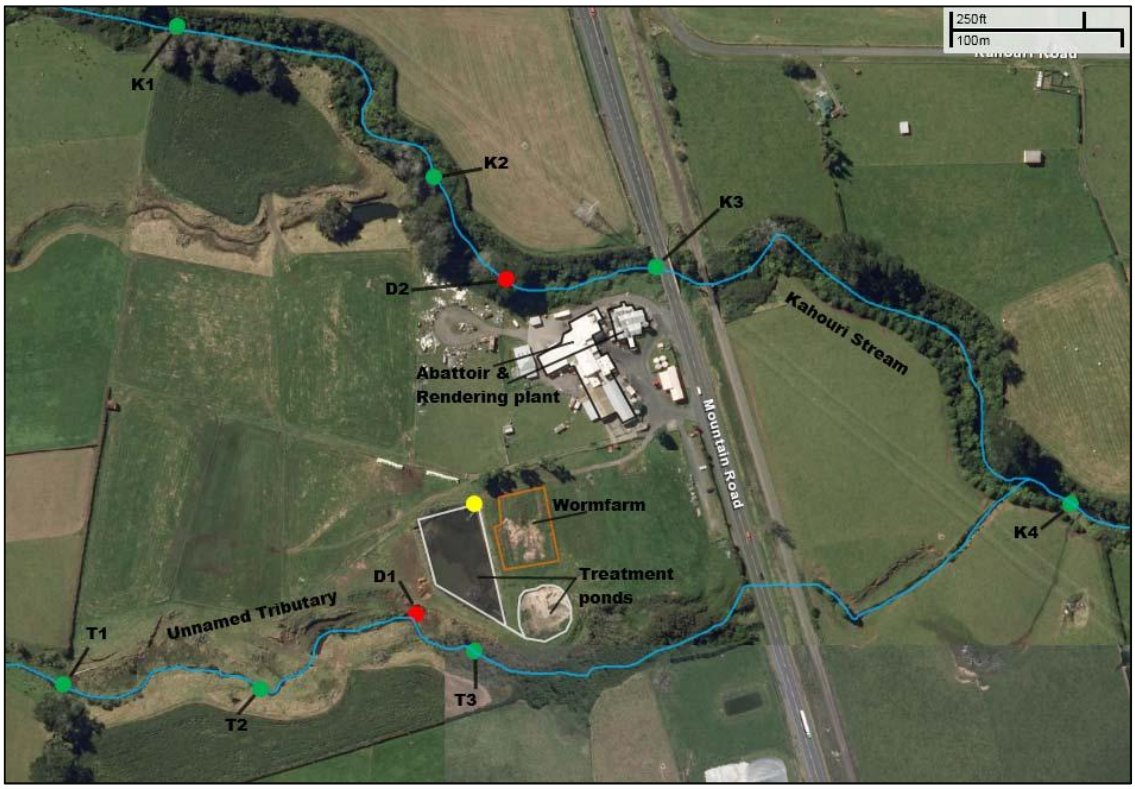


**Figure 3** Sites monitored for discharge or receiving environment water quality

**Table 1** Detail for those sites monitored for discharge or receiving environment water quality

| Sample source | Site | Site Code | Site Description |
|---|---|---|---|
| Discharge to unnamed tributary | D1 | IND003002 | Wastewater discharged to the unnamed tributary via gravity feed (2010-2011) |
| Discharge to Kahouri Stream | D2 | IND003002 | Wastewater discharge pumped to Kahouri Stream (2011-2014) |
| Irrigated effluent | I1 | IND004008 | Effluent irrigated to land |
| Kahouri Stream | K1 | KHI000295 | Upstream property boundary |
| | K2 | KHI000297 | Approx. 150m upstream of SH3 |
| | K3 | KHI000300 | Downstream property boundary and approx. 90m downstream of wastewater discharge(SH3) |
| | K4 | KHI000307 | 50m downstream of confluence with unnamed tributary |
| Unnamed tributary | T1 | KHI000294 | Upstream property boundary |
| | T2 | KHI000301 | Approx. 30m upstream of wastewater discharge |
| | T3 | KHI000302 | Approx. 50m downstream of wastewater discharge |

#### 2.1.2.1.1 Discharge to the unnamed tributary

Seven samples of treated wastewater (site D1) were collected at a time when a discharge to the unnamed tributary was occurring. All samples were analysed for the same parameters, as required by the discharge consent (0108-3). The results for these parameters are given in Table 2 .

The concentrations of most parameters monitored during the period were within the range of values previously recorded. Dissolved oxygen fluctuated somewhat between samples, with two relatively high results, caused by algal blooms, one moderate result, and three very low results, reflecting a lack of algal activity at the time of sampling. One reading was not taken due to a faulty field meter. All results were within the range of values recorded in recent years (Table 2 ), but the significant variation in dissolved

oxygen recorded, indicates that the ability of the ponds to adequately treat the wastes also varies widely, as oxygen is required for the bacteria to breakdown the waste materials. The chemical oxygen demand (COD) also varied somewhat between samples, but all results were within the range of recent values (Table 2).

**Table 2** Chemical monitoring results for the abattoir discharge to the unnamed tributary for 2010-2014, with summary of previous data (1988 – 1 Jul 2008). TRC site code IND003002
Orange figures are new maxima, yellow new minima

| Parameter | Unit | N | Min | Max | Median | 07-Oct-10 | 15-Dec-10 | 10-Feb-11 | 21-Apr-11 | 15-Jun-11 | 11-Aug-11 | 27-Oct-11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | NZST | - | - | - | - | 8:35 | 11:50 | 8:45 | 10:10 | 10:35 | 9:55 | 9:35 |
| Temperature | Deg.C | 81 | 7.3 | 23.9 | 15.9 | 13.4 | 26.5 | 17.1 | 13.5 | 11.3 | 9.4 | - |
| Dissolved oxygen | g/m$^3$ | 77 | 0.1 | 31.9 | 5.0 | 8 | 13.5 | 1.4 | 16 | - | 1.7 | 2.3 |
| Conductivity @ 20°C | mS/m | 83 | 40.6 | 229.0 | 117.0 | 80.5 | 216 | 91.5 | 148 | 84.2 | 120 | 91.1 |
| pH | pH | 69 | 7.0 | 9.4 | 7.8 | 7.3 | 7.0 | 7.7 | 8.0 | 7.4 | 7.6 | 7.6 |
| Turbidity | NTU | 14 | 27.0 | 130.0 | 68 | 59 | 72 | 29 | 72 | 28 | 38 | 25 |
| Suspended solids | g/m$^3$ | 57 | 5 | 470 | 130 | 120 | 100 | 23 | 140 | 26 | 91 | 46 |
| Total Biochemical oxygen demand (BOD) | g/m$^3$ | 48 | 8.2 | 330 | 72 | 49 | 54 | 35 | 57 | 28 | 42 | 40 |
| Filtered Carbonaceous Biochemical oxygen demand (CFBOD) | g/m$^3$ | 11 | 6.2 | 32 | 11 | 5.4 | 12 | 16 | 14 | 5.3 | 8.3 | 13 |
| Carbonaceous Biochemical oxygen demand (CBOD) | g/m$^3$ | 16 | 27 | 94 | 46 | 49 | 53 | 34 | 56 | 28 | 40 | 39 |
| Chemical oxygen demand (COD) | g/m$^3$ | 66 | 58 | 1100 | 215 | 200 | 240 | 120 | 300 | 80 | 140 | 140 |
| Ammoniacal nitrogen | g/m$^3$ | 81 | 3.79 | 263 | 118 | 77 | 261 | 89.3 | 152 | 80.8 | 132 | 85.9 |
| Un-ionised ammonia | g/m$^3$ | 24 | 0.21 | 8.82 | 2.42 | 0.448 | 2.014 | 1.701 | 4.383 | 0.506 | 1.136 | - |
| Total nitrogen | g/m$^3$ | 23 | 54.9 | 301 | 144 | 94.5 | 266 | 96.5 | 174 | 99.4 | 142 | 108 |
| Dissolved reactive phosphorus | g/m$^3$ | 32 | 0.07 | 27.2 | 13.1 | 5.72 | 23.9 | 8.87 | 15.9 | 7.64 | 12.6 | 8.07 |
| Total phosphorus | g/m$^3$ | 39 | 4.9 | 31.4 | 10.8 | 7.61 | 26.2 | 11.2 | 19.8 | 8.57 | 13.1 | 9.54 |
| Faecal coliforms | No./100ml | 31 | 1500 | 3200000 | 100000 | 280000 | 150000 | 140000 | 280000 | 510000 | 620000 | 830000 |
| *E.coli* bacteria | No./100ml | 23 | 21000 | 3200000 | 90000 | 270000 | 140000 | 110000 | 260000 | 480000 | 620000 | 800000 |

The total biochemical oxygen demand (BOD) in the discharge was analysed also, and was less than the historical median of previous values on all occasions. This indicates that there is some reduction from that recorded in the previous monitoring periods, with a slight reducing trend over time becoming apparent (Figure 4). A comparison of

the total BOD, unfiltered carbonaceous BOD and filtered carbonaceous BOD indicates that the majority of the total BOD consists of particulate carbonaceous BOD. The samples collected in the current period all had a carbonaceous BOD similar to the historical median.

Also of interest in relation to discharge water quality, is the ammoniacal nitrogen concentration ($NH_4$). Since 1998, this concentration has frequently exceeded 100 $g/m^3$ (Figure 4). Three of the seven samples taken during the current period significantly exceeded 100 $g/m^3$ (Table 2), and one came very close to the maximum concentration recorded to date. It is unclear what has caused this variation in ammoniacal nitrogen concentration, but some of the samples that recorded less than 100 $g/m^3$ of $NH_4$ appeared to have been diluted through recent rain (Table 2). Changes to the amount of throughput at the plant may have also influenced the quality of the wastewater. Similar to the ammoniacal nitrogen results, the total nitrogen results for the 2010-2014 period exceeded the historical median on two of the seven sampling occasions (Table 2). This close relationship between the two parameters is a reflection of the fact that the majority of the nitrogen in the discharge is in the form of ammoniacal nitrogen (Table 2).

Another nutrient of interest is dissolved reactive phosphorus (DRP). The DRP was also measured seven times in the discussed monitoring period, and showed the same pattern as that seen for total nitrogen (Table 2), being higher than the historical median on two sampling occasions. One of these results is amongst the highest concentrations recorded to date, and is within 87% of the maximum result, recorded in the 2007-2008 monitoring period (Figure 4). However, five of the seven samples recorded below average DRP concentrations, which is against the general trend seen since monitoring began, of a general increase over time of DRP in the discharge (Figure 4).

This overall increase in DRP and total nitrogen has been of concern in the past, as should this increase in nutrient output continue, it is possible a concurrent increase in nuisance algal growths may be experienced further downstream. Unfortunately, the Patea River, of which the Kahouri Stream is a tributary, already suffers from algal proliferation (TRC, 2006b), and Lake Rotorangi already experiences heightened nitrogen levels (TRC, 2009c). Lake Rotorangi has not experienced algal blooms because the algal population is limited by the DRP concentrations. However, the DRP concentration in the lake is slowly trending up.

These concerns were addressed during the consent renewal process that was completed during the reported period, and as a result the discharge to the unnamed tributary ceased in late 2011. Since that time, the wastewater has either been discharged to the Kahouri Stream during high flow conditions, or irrigated to land when conditions allowed.

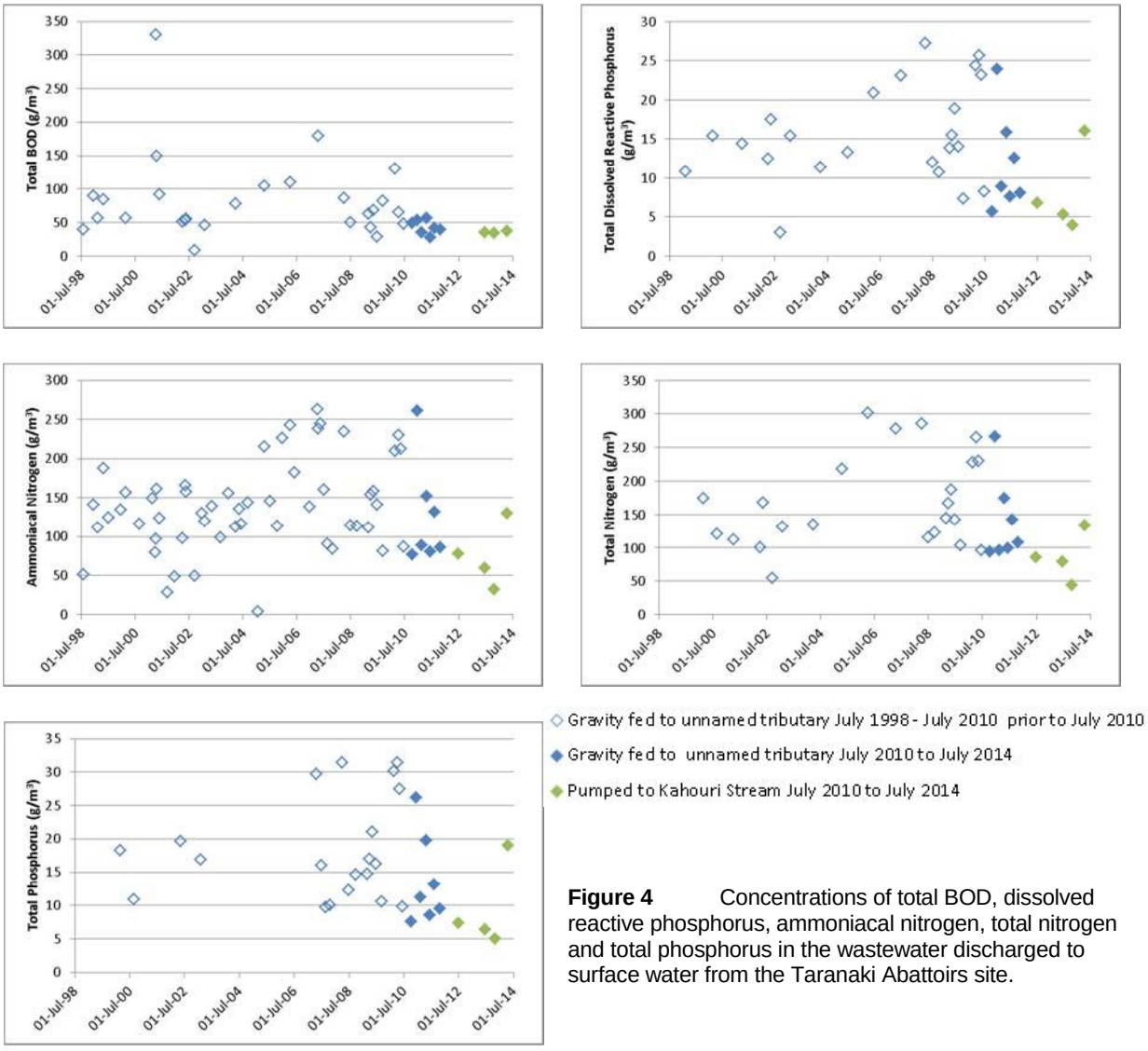


**Figure 4** Concentrations of total BOD, dissolved reactive phosphorus, ammoniacal nitrogen, total nitrogen and total phosphorus in the wastewater discharged to surface water from the Taranaki Abattoirs site.

#### 2.1.2.1.2 Irrigated effluent & wastewater discharge to Kahouri Stream

The irrigated effluent was sampled on 7 occasions by Council (site I1). This sampling was undertaken for two reasons, to estimate the nutrients (total nitrogen and phosphorus) being discharged to land (and consequently not water), and to determine compliance with consent conditions, specifically the restriction on the sodium adsorption ratio (SAR) of the discharge, which is intended to prevent soil losing its structure. If irrigation water with a high SAR is applied to a soil for years, the sodium in the water can displace the calcium and magnesium in the soil. This will cause a decrease in the ability of the soil to form stable aggregates and a loss of soil structure. This will also lead to a decrease in infiltration and permeability of the soil to water leading to problems with crop production.

Table 3 shows that the SAR consent limit of 15 was complied with, with all seven samples recording a ratio of less than 3. This will continue to be monitored in subsequent monitoring periods.

**Table 3** Chemical monitoring results for the abattoir discharge for 2010-14 with a summary of previous data. Note that historical data is for the gravity fed discharge to the unnamed tributary.

| Site | Carbonaceous BOD ($g/m^3$) | | Total Nitrogen ($g/m^3$) | | Total phosphorus ($g/m^3$) | | Ammoniacal nitrogen ($g/m^3$) | | Dissolved reactive phosphorus ($g/m^3$) | | Sodium absorption ratio | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Median (N) | Range | Median (N) | Range | Median (N) | Range | Median (N) | Range | Median (N) | Range | Median (N) | Range |
| Historical data (prior to 1 July 2010) | 46 (16) | 27-94 | 144 (23) | 54.9-301 | 10.8 (39) | 4.6-31.4 | 118 (81) | 3.79-263 | 13.1 (32) | 0.068-27.2 | - | - |
| I1 | - | - | 104 (7) | 82.6-461 | 15.7 (7) | 8.6-85.2 | 90.3 (7) | 54.2-123 | - | - | 1.87 (7) | 1.29-2.59 |
| D1 | 40 (7) | 28-56 | 108 (7) | 94.5-266 | 11.2 (7) | 7.6-26.2 | 89.3 (7) | 77-261 | 8.87 (7) | 5.7-23.9 | - | - |
| D2 | 34 (4) | 31-35 | 82.5 (4) | 44.2-134 | 6.9 (4) | 5.06-19 | 68.65 (4) | 32.3-130 | 6.06 (4) | 3.9-16 | - | - |

Table 3 also shows that in comparison to the historical discharge of treated wastewater to the unnamed tributary (site D1), the effluent discharged to the Kahouri Stream (site D2) was lower in nutrients, with the median concentration of total phosphorus being 63% of the historical median, and 57% for total nitrogen. Similar reductions were evident for the ammoniacal nitrogen and dissolved reactive phosphorus concentrations.

This reduction can likely be attributed to two main mechanisms. Firstly, when effluent is irrigated to land, a stirrer is used, in an effort to entrain solids as well as liquids from the pond. This is indicated by the higher concentrations of nutrients in the irrigated wastewater (Table 3). This stirrer is not active when the discharge is pumped to the river, but the removal of solids may result in a reduced concentration of nutrients in the liquid wastewater. However, the primary contributor to this reduced concentration is likely to be the ingress of stormwater to the ponds, diluting the wastewater. As effluent is primarily pumped to the river during wet weather, the proportion of effluent sourced as stormwater will be higher.

The nutrient concentrations in the irrigated effluent are presented in Figure 5. The first sample, collected in May 2012, was collected when pumping had just started that for the day, and the stirrer had only just started, resulting in the entrainment of a significant amount of solids. As a result, the concentration of nutrients was very high, being significantly higher than any concentration recorded in any previously collected discharge samples (Table 3), and almost four times higher than the concentrations recorded in any subsequently collected samples.

In terms of compliance with consent conditions, the wastewater discharge to the Kahouri Stream, which was sampled on four occasions (site D2), had a total $BOD_5$ of less than $110 g/m^3$ on all sampling occasions (Table 3). In addition, the dilution ratio, estimated using dissolved reactive phosphorus concentrations, was above 100 to 1 on all sampling occasions (Table 9). This indicates that the discharge was well managed.

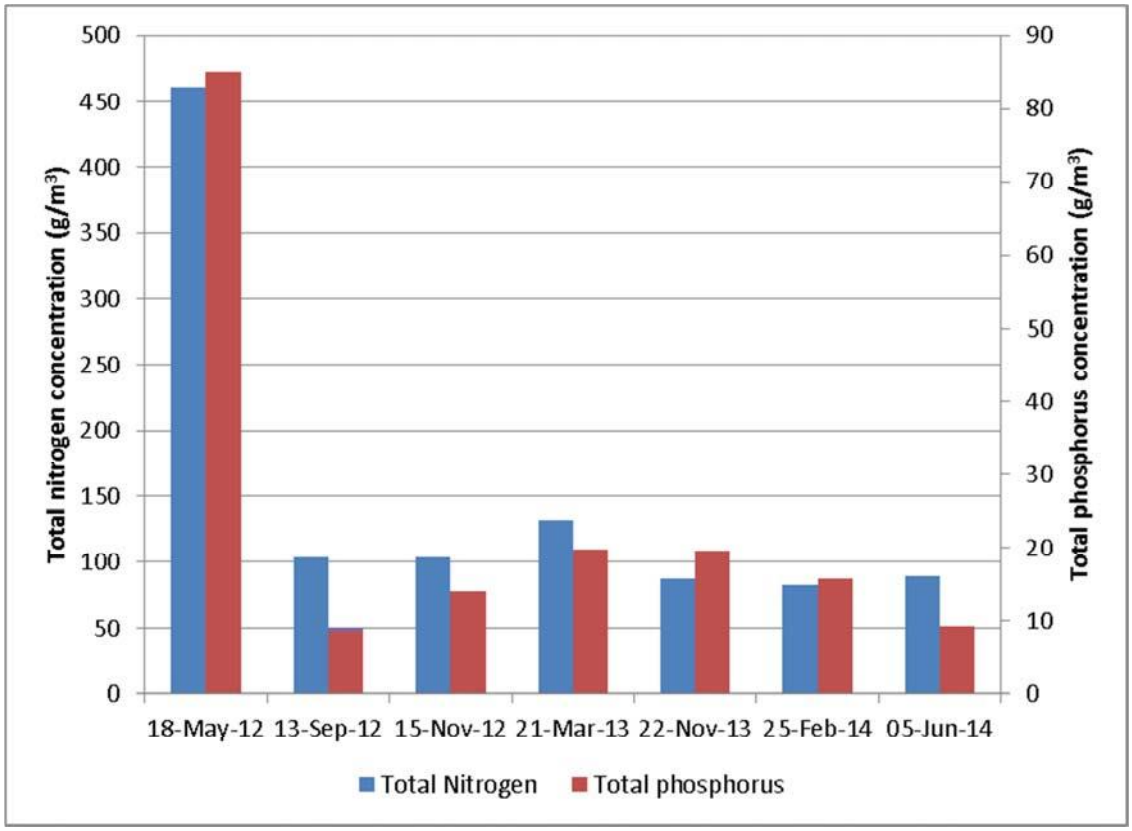


**Figure 5** Concentrations of total nitrogen and total phosphorus in the irrigated wastewater.

The wastewater discharge was sampled on four occasions, primarily to assess compliance.

### 2.1.3 Provision of Company data

The Company has provided data on abstraction rates, the discharge of effluent to water, irrigation of effluent to land, and the discharge of any other nitrogenous wastes to land. This data is presented in the summaries.

#### 2.1.3.1 Abstraction data

Taranaki Abattoirs Ltd abstracts water from the Kahouri Stream, under consent 5176-1. Under this consent, the consent holder is required to maintain records of abstraction. These records have been provided to Council, and are summarised in Figure 6.

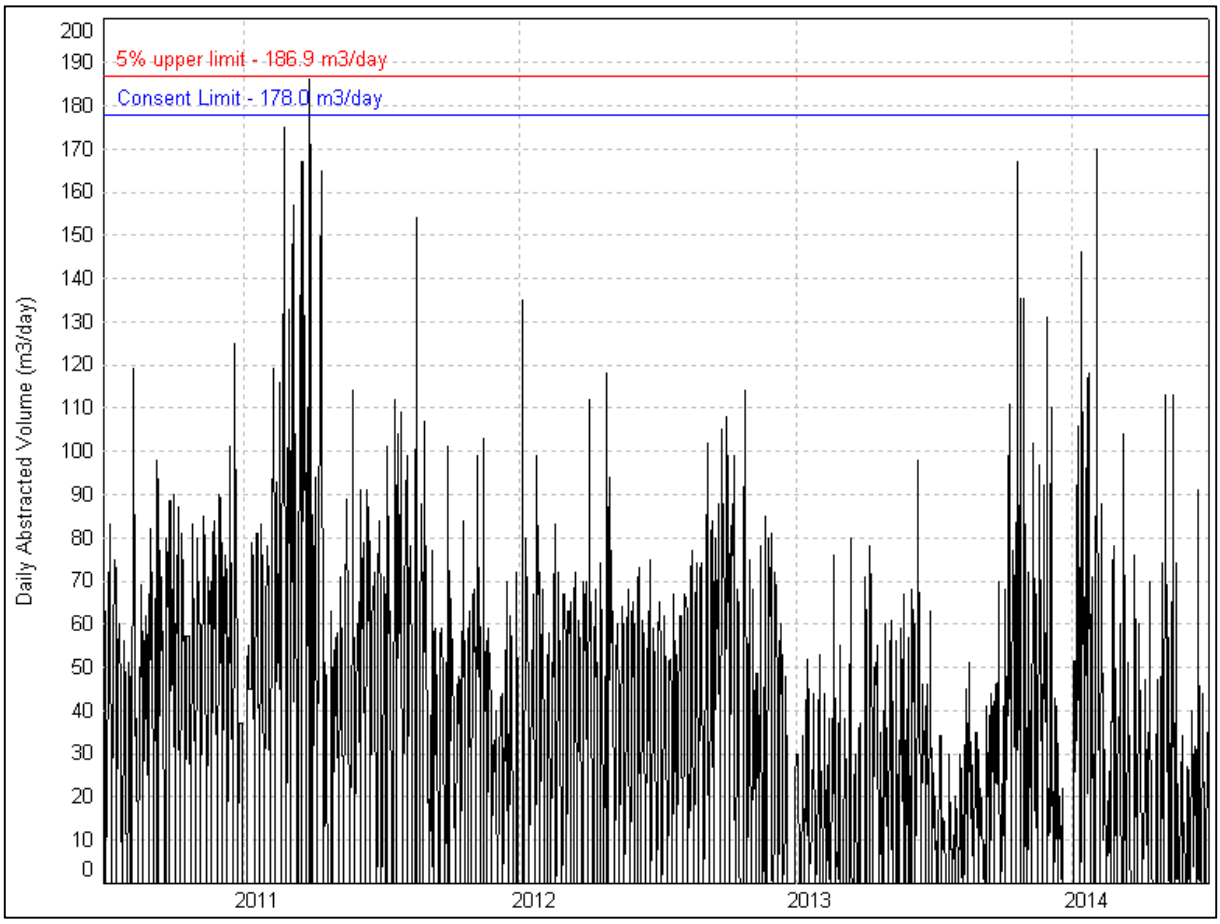


**Figure 6** Abstraction rate, detailing the abstraction of water from the Kahouri Stream.

The daily rate is restricted to 178 $m^3$/day. Figure 6 shows that the consent holder has complied with this restriction. The highest daily volume abstracted occurred on 30 March 2011, when 186 $m^3$ was taken. This occurred during the period of greatest demand, following which demand generally reduced, although it has increased again in the 2013-14 period. Of note is the absence of a strong seasonal change in demand, with little difference between the winter and summer months.

#### 2.1.3.2 Irrigation of wastewater

The irrigation of wastewater has occurred over two areas. The land surrounding the abattoir, west of State Highway 3, and the land east of State Highway 3 (Figure 7). Irrigation began on the land surrounding the abattoir, and this area was eventually confirmed as cut and carry. This means that the land was not to be stocked, and the feed grown on this land was to be harvested and removed, to be fed to stock off site. This had the intention of removing the nitrogen applied, and consequently this land may have a higher nitrogen application rate. The consent allows for the application of up to 600kg of nitrogen to be applied per hectare per year to cut and carry paddocks, while a limit of 200kg applies to the land east of SH3. The land east of SH3 is also used by the landowner to run stock.

Table 4 presents both the volume of wastewater and estimated total nitrogen applied to each paddock in the cut and carry paddocks, while Table 5 presents this data for the land across SH3. This data indicates that two cut and carry paddocks experienced over application of nitrogen, which occurred in the 2011-12 monitoring year. It should be

noted that the quality of this wastewater can vary both between occasions, and through out the day. This is well demonstrated in Figure 5. The average total nitrogen concentration of the sampled wastewater is 151g/m$^3$, which is 150% of the median (104g/m$^3$). This suggests that the figures provided in Table 4 and Table 5 are indicative only, and probably conservative.


**Figure 7** The irrigation areas, showing the cut and carry paddocks (green) and regular paddocks (blue). Please note that the boundary lines are indicative only.

In addition, the application depth within any area of irrigation, which is not to exceed 24mm over any 15 day period, has also not been managed well. Table 6 presents a summary of the application depth for the reported period. It is clear that the consent holder has not complied with this restriction for all cut and carry paddocks, and most other paddocks. The highest 15 day application depth was recorded in paddock 8 in the 2012-13 period, when 289mm of wastewater was applied over 15 days.

**Table 4** Total volume of wastewater (m3) and total nitrogen (kg/ha) applied to each cut and carry paddock in each year of the reported period. Total nitrogen has been estimated using the median nitrogen concentration of irrigated wastewater samples collected by TRC only.

| Year | | Paddock Number | | | | | | | | | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
| 2011-2012 | Total volume | 780 | 0 | 450 | 5411 | 3660 | 1930 | 4680 | 5640 | 1530 | - |
| | Total N | 98.9 | 0 | 19.3 | 639.5 | 594.8 | 304.1 | 616.1 | 586.6 | 81.6 | 326.8 |
| 2012-2013 | Total volume | 880 | 550 | 3140 | 2540 | 1515 | 570 | 2880 | 3460 | 3220 | - |
| | Total N | 111.6 | 65.7 | 134.4 | 300.2 | 246.2 | 89.8 | 379.1 | 359.8 | 171.7 | 206.5 |
| 2013-2014 | Total volume | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | Total N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 5** Total volume of wastewater (m3) and total nitrogen (kg/ha) applied to paddocks east of SH3 in each year of the reported period. Total nitrogen has been estimated using the median nitrogen concentration of all irrigated wastewater samples collected by TRC only.

| Year | | Paddock Number | | | | | | | Average |
|---|---|---|---|---|---|---|---|---|---|
| | | j1 | j2 | j3 | J5 | j6 | J7 | j8 | |
| 2011-2012 | Total volume | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | Total N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2012-2013 | Total volume | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | Total N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2013-2014 | Total volume | 300 | 490 | 550 | 450 | 470 | 0 | 780 | - |
| | Total N | 15.8 | 16.9 | 44.0 | 69.9 | 50.9 | 0 | 52.3 | 35.7 |

Essentially, every 240m$^3$ of wastewater needs to be irrigated over one hectare of land, in order to comply with this condition. The intention of this condition, which is consistent with appendix VIIA of the Regional Freshwater Plan, is to avoid surface ponding, runoff into waterways, leaching and groundwater contamination. Exceeding this limit may also lead to damaged pasture. Although inspections of the irrigation area did not note any runoff, nor was there any excessive ponding, the consent holder does need to manage the irrigation system with this condition in mind. In essence, it appears that the irrigator needs to be run on a faster speed, and there needs to be a rotation system that ensures that the land is not irrigated too frequently.

**Table 6** Application depth statistics for the paddocks that received irrigated wastewater during the reported period.

| | | Paddock Number | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | J1 | J2 | J3 | J5 | J6 | J7 | J8 |
| 2011-2012 | Max 15 day application depth | 85 | 0 | 30 | 188 | 125 | 144 | 165 | 167 | 63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Average 15 day application depth | 11 | 0 | 0 | 65 | 58 | 33 | 58 | 61 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2012-2013 | Max 15 day application depth | 74 | 47 | 67 | 149 | 122 | 86 | 167 | 289 | 73 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Average 15 day application depth | 16 | 9 | 18 | 41 | 39 | 13 | 63 | 51 | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2013-2014 | Max 15 day application depth | 0 | 0 | 40 | 57 | 17 | 0 | 39 | 0 | 23 | 21 | 16 | 42 | 67 | 49 | 27 | 50 |
| | Average 15 day application depth | 0 | 0 | 7 | 26 | 9 | 0 | 15 | 0 | 5 | 9 | 5 | 23 | 36 | 26 | 3 | 15 |

Other nitrogenous wastes

From time to time the consent holder discharges vermicast from the wormfarm to land, and also blood from the abattoir. A record of each discharge is required to kept, and these have been provided to Council. These records indicate that the discharge is small,

with no vermicast spread during the reported period, and the occasional discharge of blood being of relatively small quantities (averaging 190 litres)

#### 2.1.3.3 Discharge to the Kahouri Stream

When the discharge consent was originally applied for, the applicant committed to restricting the discharge rate to 3.3l/s. Although this was not included as a consent condition, the consent did require that no discharge was to occur when flows in the Kahouri Stream were less than 330l/s, to enable compliance with the 1:100 dilution ratio also required by consent. The discharge records, which include a record of the stage height in the stream at the time of discharge, indicate that this minimum flow was complied with on all but one occasion, which equates to a 99% compliance rate. On the occasion where flows were not sufficient (4 April 2013), Stratford had received 13.5mm of rain. This amount of rain could have saturated the land, and it would certainly have added to the wastewater ponds, potentially necessitating a discharge, but it was not enough to produce much more than a slight rise in the flow of the nearby Patea River. It is likely at this time that the discharge was non-compliant with both the minimum required flow in the Kahouri Stream, and also the minimum dilution rate for this discharge.

In addition, when the daily discharge figures are assessed, it was possible to calculate statistics for the discharge rates. These statistics are as follows:

| | |
|---|---|
| Minimum daily discharge rate | 4.6 l/s |
| Maximum daily discharge rate | 19.8 l/s |
| Average daily discharge rate | 10.7 l/s |
| Median daily discharge rate | 9.3 l/s |

It is clear that the discharge is rarely (if ever) at the proposed rate of 3.3l/s. Although this is not strictly non-compliant with the consent, as the consent does not specify a maximum discharge rate, it creates the potential for the consent holder to not comply with the minimum dilution rate of 100:1. Although sampling indicates that dilution was being complied with at the time of sampling, these are spot measurements, and compliance is required throughout the entire discharge. Therefore, it is recommended that this is very carefully managed by the consent holder, and that the discharge rate to the stream be reduced to the rate as originally intended.

Another very important consent condition requires that as far as practicable, discharge to the Kahouri Stream be minimised and discharges to land be maximised. This means that even at times when adequate dilution is present in the Kahouri Stream, wastewater shall be irrigated to land, unless the land is saturated, and consequently is incapable of accepting the discharge.

Figure 8 shows that for the first half of the reporting period, the consent holder was very proactive, and favouring the application of effluent to land. It is apparent that at least half of the wastewater generated on site between November 2011 and March 2013 was irrigated to land. Unfortunately, after March 2013, this practice changed to be heavily in favour of a discharge to the Kahouri Stream. It is highly unlikely that the soil conditions since that time were such that the irrigation of effluent would be so heavily restricted, although this was not assessed through inspections. It is apparent that the consent holder's compliance with this consent condition is in need of significant

improvement, and subsequent inspections will focus more closely on this aspect of the site's management.

Figure 8 shows a clear relationship with monthly rainfall and the volume of wastewater generated, and very little relationship between the volume of wastewater generated and the throughput at the plant. This is confirmed by Figure 9. This indicates that there is a significant ingress of stormwater to the wastewater system, which is most likely sourced through runoff from unroofed areas of the yard, and also runoff from the wormfarm. It is also likely that shallow groundwater is entering the treatment ponds, as has been observed from time to time in the second pond. It is suggested that the consent holder examine this stormwater ingress, with a view to undertaking further steps to minimise this ingress.

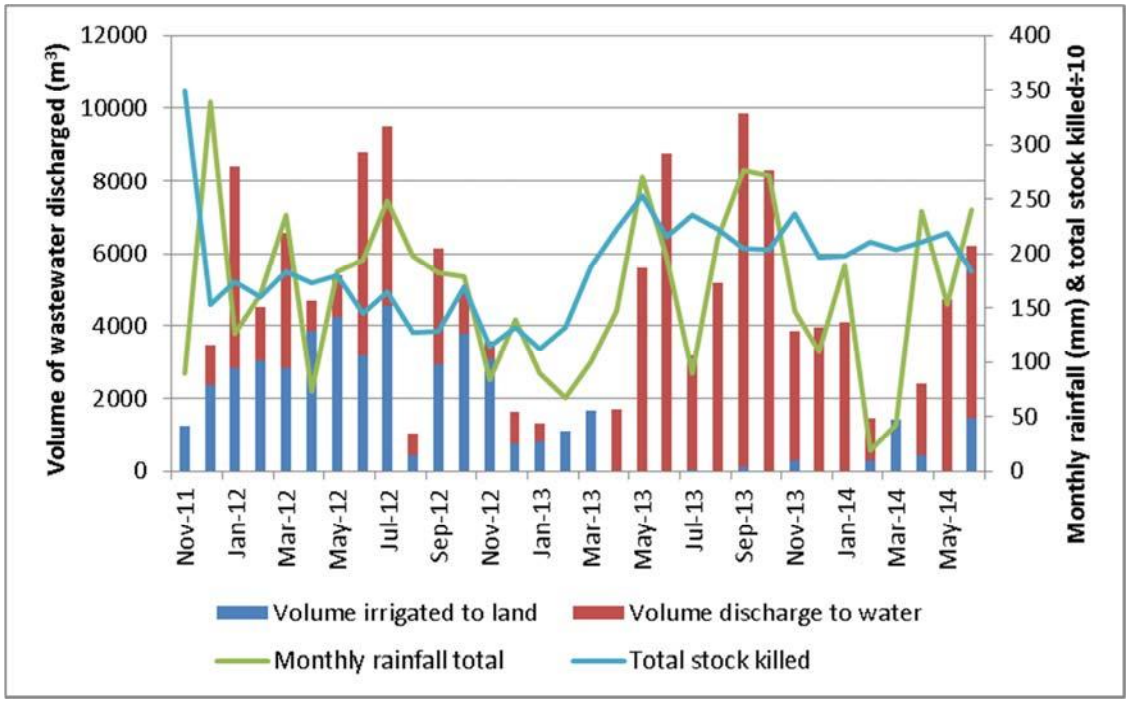


**Figure 8** The volume of wastewater irrigated to land and discharged to water, compared with the monthly rainfall totals. Rainfall figures are from the rainfall recorder located at TRC, Stratford.

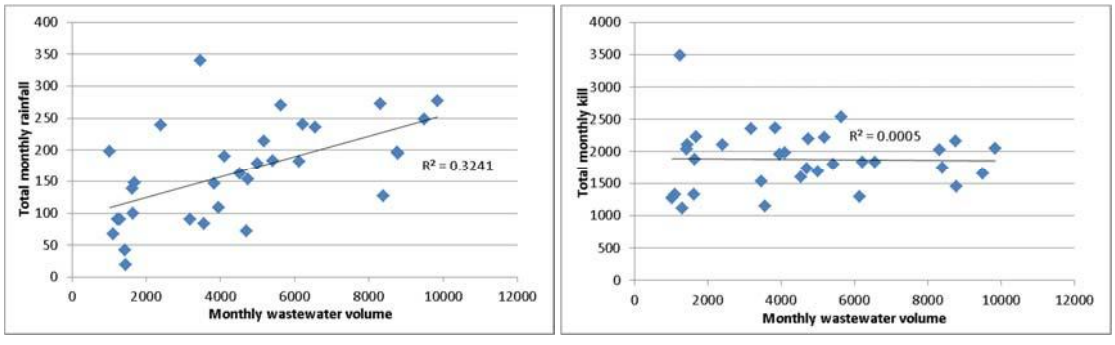


**Figure 9** Monthly wastewater volume compared with monthly total kill and total monthly rainfall, including the $R^2$ value. The closer the $R^2$ value is to 1, the stronger the relationship.

## 2.2 Results of receiving environment monitoring

#### 2.2.1.1 Water chemistry – unnamed tributary

The abattoir tributary was sampled on seven occasions, all in conjunction with discharge sampling. The results for these samples are presented in Table 7, Table 8 and Figure 10. Six samples were collected during dry weather, during this monitoring period, although some surveys were preceded by rain, while the sample collected on 11 August 2011 was done so following recent rain.

The results for the upstream site were relatively stable across most parameters. Only bacterial results showed slight variation, with a minimum of 50 and maximum count of 1500/100ml, this compared with the median concentration of 320/100ml. The occasion that recorded the high bacteriological result also recorded a new maximum turbidity, filtered carbonaceous biological oxygen demand, ammoniacal nitrogen, unionised ammonia and total nitrogen. Although this in part reflects the wet weather that preceded this survey, it could also suggest the presence of a poorly assimilated dairy shed discharge upstream. On the remaining sampling occasions, the majority of results were within that previously recorded for this site, and generally what you would expect for a small stream draining a farmed catchment.

**Table 7** Chemical monitoring results for the abattoir tributary, upstream of the abattoir wastewater discharge for 2010-2014, including summary data for this site up to 1 July 2010

| Parameter | Units | N | Min | Max | Median | 07-Oct-10 | 15-Dec-10 | 10-Feb-11 | 21-Apr-11 | 15-Jun-11 | 11-Aug-11 | 27-Oct-11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | NZST | - | - | - | - | 8:25 | 11:30 | 8:30 | 9:55 | 10:25 | 9:50 | 9:20 |
| Temperature | °C | 27 | 8 | 16.7 | 11.3 | 11.1 | 17.4 | 13 | 11.5 | 11.7 | 9.2 | 11.1 |
| Dissolved oxygen | g/m$^3$ | 12 | 9.5 | 11.1 | 10.4 | 10.5 | 9.7 | 9.8 | 10.8 | - | 10.8 | 10.5 |
| Conductivity @ 20°C | mS/m | 25 | 9.1 | 11.4 | 9.8 | 9.5 | 11.1 | 10.2 | 9.8 | 9.4 | 10 | 9.6 |
| pH | | 27 | 6.8 | 7.8 | 7.5 | 7.3 | 7.6 | 7.5 | 7.5 | 7.3 | 7.5 | 7.4 |
| Turbidity | NTU | 14 | 1.7 | 7.2 | 2.6 | 3.2 | 2.8 | 1.8 | 4.2 | 5.5 | 25 | 3 |
| Suspended solids | g/m$^3$ | 21 | 2 | 47 | 2 | 3 | <2 | <2 | 5 | 8 | 24 | 6 |
| Filtered Carbonaceous Biochemical oxygen demand (CFBOD) | g/m$^3$ | 11 | 0.5 | 0.5 | 0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 2.9 | <0.5 |
| Ammoniacal nitrogen | g/m$^3$ | 27 | 0.003 | 0.217 | 0.01 | 0.016 | 0.024 | 0.01 | 0.016 | 0.018 | 0.245 | 0.016 |
| Un-ionised ammonia | g/m$^3$ | 23 | 0.00002 | 0.00022 | 0.00009 | 0.00008 | 0.00037 | 0.00009 | 0.00013 | 0.00009 | 0.00165 | 0.0001 |
| Total nitrogen | g/m$^3$ | 12 | 0.43 | 1.3 | 0.92 | 1.22 | 0.58 | 0.77 | 0.89 | 1.5 | 2.25 | 1.06 |
| Dissolved reactive phosphorus | g/m$^3$ | 22 | 0.004 | 0.024 | 0.01 | 0.008 | 0.019 | 0.004 | 0.007 | 0.008 | 0.005 | 0.007 |
| Total Phosphorus | g/m$^3$ | 1 | 0.022 | 0.022 | 0.022 | - | 0.035 | 0.018 | 0.025 | 0.033 | 0.171 | 0.023 |
| Faecal coliforms | nos/100ml | 18 | 28 | 2400 | 320 | 140 | 900 | 700 | 220 | 50 | 1500 | 710 |
| *E.coli* bacteria | nos/100ml | 22 | 28 | 2400 | 360 | 140 | 900 | 700 | 220 | 50 | 1600 | 780 |

**Table 8** Chemical monitoring results for the abattoir tributary, downstream of the abattoir wastewater discharge for 2010-2014, including summary data for this site up to 1 July 2010

| Parameter | Units | N | Min | Max | Median | 07-Oct-10 | 15-Dec-10 | 10-Feb-11 | 21-Apr-11 | 15-Jun-11 | 11-Aug-11 | 27-Oct-11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | NZST | - | - | - | - | 8:15 | 11:15 | 8:14 | 9:45 | 10:10 | 9:31 | 9:05 |
| Temperature | °C | 12 | 7.6 | 14.6 | 11 | 10.9 | 17.3 | 12.9 | 11.4 | 11.6 | 9.1 | 11.2 |
| Dissolved oxygen | g/m$^3$ | 11 | 7.3 | 11.3 | 10.1 | 10.2 | 7 | 9.2 | 10.1 | - | 10.3 | 10.1 |
| Conductivity @ 20°C | mS/m | 12 | 10.2 | 23.2 | 12.7 | 10.6 | 37.7 | 12 | 11.1 | 10.4 | 11.6 | 12.1 |
| pH | | 13 | 7 | 7.5 | 7.3 | 7.3 | 7.7 | 7.4 | 7.5 | 7.2 | 7.5 | 7.4 |
| Turbidity | NTU | 12 | 3.1 | 10 | 4 | 4.2 | 8.6 | 2.3 | 5.4 | 5.8 | 17 | 3.7 |
| Suspended solids | g/m$^3$ | 12 | 3 | 15 | 4 | 7 | 12 | <2 | 4 | 7 | 16 | 4 |
| Filtered Carbonaceous Biochemical oxygen demand (CFBOD) | g/m$^3$ | 11 | 0.5 | 1.4 | 0.6 | <0.5 | 2.6 | <0.5 | <0.5 | 0.5 | 1 | 0.6 |
| Ammoniacal nitrogen | g/m$^3$ | 13 | 0.958 | 12.6 | 2.85 | 1.14 | 26.7 | 1.82 | 1.35 | 0.947 | 2.71 | 2.5 |
| Un-ionised ammonia | g/m$^3$ | 12 | 0.00198 | 0.11941 | 0.01554 | 0.00552 | 0.51601 | 0.01284 | 0.01072 | 0.00384 | 0.01815 | 0.01555 |
| Total nitrogen | g/m$^3$ | 12 | 2.12 | 13.4 | 4.2 | 2.58 | 34.2 | 2.93 | 2.52 | 2.52 | 3.98 | 3.6 |
| Dissolved reactive phosphorus | g/m$^3$ | 13 | 0.079 | 1.36 | 0.285 | 0.083 | 2.61 | 0.19 | 0.144 | 0.092 | 0.22 | 0.232 |
| Total Phosphorus | g/m$^3$ | - | - | - | - | - | - | - | 0.172 | 0.125 | 0.319 | 0.286 |
| Faecal coliforms | nos/100ml | 10 | 450 | 44000 | 2300 | 4700 | 23000 | 4100 | 2400 | 5300 | 10000 | 32000 |
| *E.coli* bacteria | nos/100ml | 12 | 500 | 44000 | 2400 | 4800 | 23000 | 4100 | 2400 | 5600 | 10000 | 34000 |
| Approx. dilution (calculated using chloride concentrations) | | | | | | 160 | 6.1 | 25.8 | 53.5 | 34.4 | N/A | 22.3 |

Downstream of the discharge however, significant increases were recorded in the majority of parameters tested. The small historical data set does not allow for a robust comparison, however, a comparison with the upstream data indicates that the abattoir wastewater discharge was causing significant nutrient enrichment, significant bacterial contamination, and even a slight reduction in dissolved oxygen. This reduction in dissolved oxygen is most likely caused by bacteria growing on the bed, feeding on the wastewater. This bacteria, otherwise known as undesirable heterotrophic growths or 'sewage fungus', was observed growing on the bed on two of the seven sampling occasions, and is an indication that the stream is overloaded by the wastewater discharge. For such growth to establish, the 24 hour average filtered carbonaceous biological oxygen (CFBOD) demand needs to exceed 2 g/m$^3$ (MFE, 1992). However, the CFBOD results for this monitoring period only exceeded this limit once, and this suggests that the discharge fluctuates either in rate and/or quality throughout the day.

A factor contributing to these impacts on the receiving environment is the amount of dilution in the stream. Discharge rates were only estimated at the time of sampling, and it is unclear how much flow was present in the tributary. However, dilution can be estimated by comparing changes in chloride concentrations between the upstream and downstream sites. During the five sampling occasions, the amount of dilution available ranged from approximately 6 parts receiving water to 1 part discharge, to approximately 160 parts receiving water to 1 part discharge (Table 8). The day which recorded the lowest dilution occurred following an extended dry period, but was immediately preceded by a small amount of rain. It is apparent that the rain was not sufficient to recharge the flow in the stream, but caused an increased discharge rate, resulting in the very poor dilution ratio. The impact on water quality of this poorly assimilated discharge is very evident in Figure 10.

Some of the most significant changes in this stream are well illustrated in Figure 10. For example, on 15 December 2014 the unionised ammonia downstream of the discharge was 1394 times that recorded upstream, and the 0.025g/$m^3$ frequently applied to wastewater discharge consents was exceeded on this occasion. The dissolved reactive phosphorus (DRP) concentrations downstream of the discharge were between 10 and 137 times that recorded upstream, and similarly above the concentration considered likely to lead to periphyton proliferation. Total nitrogen also recorded significant increases, but not to the same extent (1.6-58.9 times). All downstream samples recorded numbers of E. coli in excess of the 'action' level (550) set by the Ministry of Health for contact recreation, and no sample recorded less than the median of 12 previous samples taken at this site.

These results were taken into account during the consent renewal process, and as a result, this discharge no longer occurs.

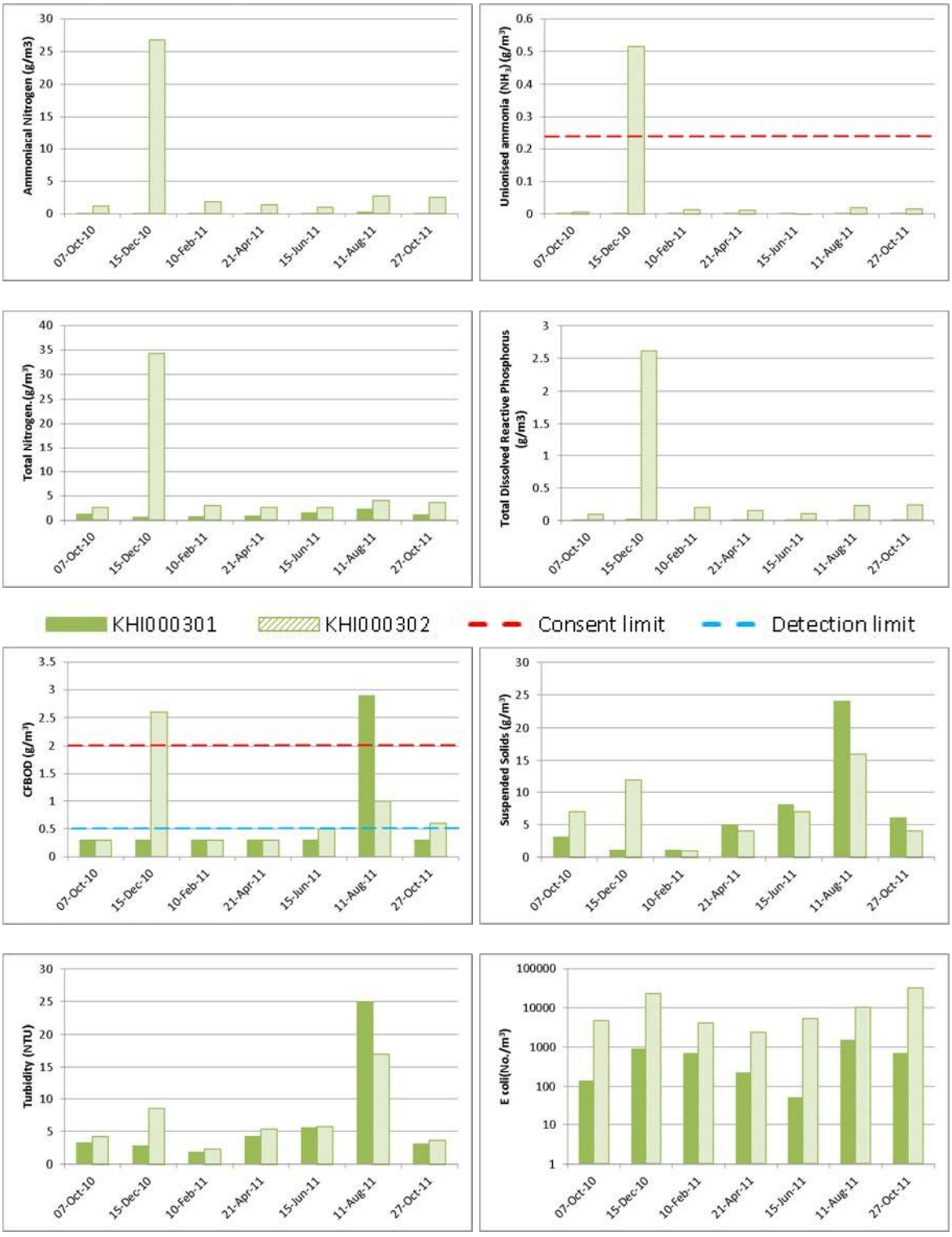


**Figure 10** Sample results from the unnamed tributary upstream and downstream of the Taranaki Abattoir wastewater discharge. Note that axes may differ in scale from that in Figure 11.

### 2.2.1.2 Water chemistry – Kahouri Stream

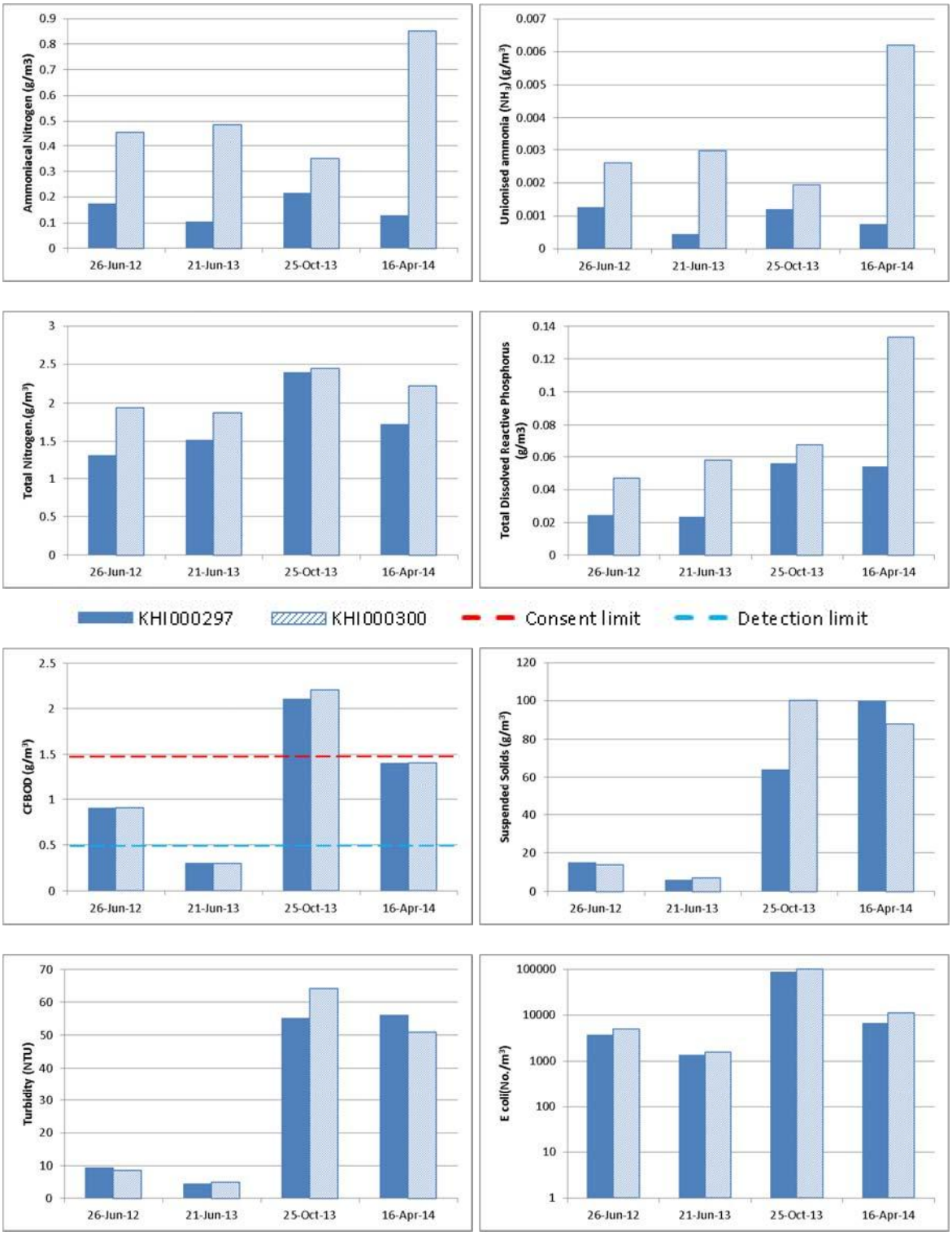


**Figure 11** Sample results from the Kahouri Stream upstream and downstream of the Taranaki Abattoir wastewater discharge. Note that axes may differ in scale from that in Figure 10.

The activity of discharging treated wastewater directly to the Kahouri Stream was only initiated in December 2011, under a new consent issued in the same year. This consent places restrictions on how this discharge affects water quality of the Kahouri Stream.

Specifically, this discharge is not to give rise to the following effects in the Kahouri Stream, beyond a mixing zone of 50 m:

a) a level of filtered carbonaceous BOD5 of more than 2.00 $gm^{-3}$;
b) a level of unionised ammonia of greater than 0.025 $gm^{-3}$;
c) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
d) any conspicuous change in the colour or visual clarity;
e) any emission of objectionable odour;
f) the rendering of fresh water unsuitable for consumption by farm animals;
g) any significant adverse effects on aquatic life; and
h) the generation of undesirable heterotrophic growths [sewage fungus].

Furthermore, after allowing for reasonable mixing, within a mixing zone extending 50 m downstream of the discharge point, the discharge is not to give rise to either of the following effects in the receiving waters of the Kahouri Stream:

a) an increase in suspended solids concentration in excess of 5 $gm^{-3}$, when the stream turbidity as measured upstream of the discharge point is equal or less than 5 NTU [nephelometric turbidity units]; or
b) an increase in turbidity of more than 50% when the stream turbidity as measured upstream of the discharge point is greater than 5 NTU [nephelometric turbidity units].

Table 9 presents the results of the sampling undertaken in relation to the discharge of wastewater to the Kahouri Stream, and some results are also displayed graphically (Figure 11). Table 9 shows that the discharge complied with both the unionised ammonia restriction, and also the turbidity/suspended solids restriction. The samples collected on 25 October 2013 were collected when the stream was in significant flood. As a result background concentrations of filtered carbonaceous biological oxygen demand (CFBOD) already exceeded the consent limit of 2.0 $g/m^3$. Downstream of the discharge, there was a slight increase in CFBOD, but this was not considered a breach of this consent condition due to the high background concentrations at this time.

**Table 9** Sample results for some parameters from the Kahouri Stream upstream and downstream of the Taranaki Abattoir wastewater discharge.

| | Date: | 26-Jun-12 | | 21-Jun-13 | | 25-Oct-13 | | 16-Apr-14 | |
|---|---|---|---|---|---|---|---|---|---|
| | Time: | 12:05 | 12:25 | 11:45 | 12:05 | 10:20 | 10:35 | 13:45 | 14:00 |
| Parameter | Site: | U/S | D/S | U/S | D/S | U/S | D/S | U/S | D/S |
| Filtered Carbonaceous BOD ($g/m^3$) | | 0.9 | 0.9 | <0.5 | <0.5 | 2.1 | 2.2 | 1.4 | 1.4 |
| Un-ionised ammonia($g/m^3$) | | 0.00124 | 0.0026 | 0.00045 | 0.00295 | 0.00119 | 0.00193 | 0.00074 | 0.00619 |
| Suspended solids($g/m^3$) | | 15 | 14 | 6 | 7 | 64 | 100 | 100 | 88 |
| Turbidity(NTU) | | 9.5 | 8.6 | 4.4 | 4.9 | 55 | 64 | 56 | 51 |
| Approximate dilution (estimated using DRP concentrations) | | 293:1 | | 150:1 | | 319:1 | | 200:1 | |

In terms of impacts on water quality, Figure 11 shows that there is some influence. However, comparing Figure 11 with Figure 10 provides some perspective, and shows that although there is an increase in most parameters on most sampling occasions, the size of this increase is relatively small. For example, the dissolved reactive phosphorus (DRP) concentrations downstream of the discharge were between 1.2 and 2.5 times that recorded upstream, while the ammoniacal nitrogen concentrations were between 1.6-2.7 times that recorded upstream. It should be noted that these nutrients are important in terms of periphyton growth, but that this discharge occurred during high or flood conditions. Periphyton growth is usually most affected by a constant or at least frequent discharge of nutrients, and it is expected that the relatively sporadic discharge of wastewater from the abattoirs' site to the Kahouri Stream would have had little effect on periphyton growth.

#### 2.2.1.3 Water chemistry – Synoptic survey

Three additional surveys were undertaken in an attempt to quantify the impacts of any potential diffuse discharge(s) from the site, sourced from (for example) the irrigation of effluent to land or by burial of poor quality product that was not suitable for rendering. Sites K1, K3, T1 and T3 were sampled (Figure 3).

The results indicate that there is very little influence on the Kahouri Stream, with very little change in the parameters tested from the upstream site (K1) to the downstream site (K3), over the three surveys completed (Figure 12).

The unnamed tributary on the other hand tells a slightly different story. There is little change in dissolved reactive phosphorus from upstream to downstream, but there appears to be a slight increase in total nitrogen (Figure 12). This is confirmed by the ammoniacal nitrogen concentrations, which show a notable increase in concentration from upstream to downstream, and consequently a similar increase in the concentration of unionised ammonia. There is no indication that these increases are due to a point source discharge, as there is no concurrent increase in faecal coliform or suspended solids concentration, which would be expected of a point source discharge. Therefore it indicates the presence of a diffuse discharge(s), which is most likely related to the excessive irrigation of wastewater, resulting in too much nitrogen being applied to land, and/or the burial of poor quality product too close to the stream. These activities could contaminate the shallow groundwater, which could flow to the unnamed tributary. Monitoring has confirmed that both excessive irrigation and the burying of material too close to the stream have occurred in the reported period.

It is comforting to note however, that the unionised ammonia concentrations are well below 0.025 $g/m^3$, indicating that there are little to no toxic impacts on the stream, but also that the concentrations of unionised ammonia and ammoniacal nitrogen are within the range of concentrations recorded at site T2 over time (Figure 4).

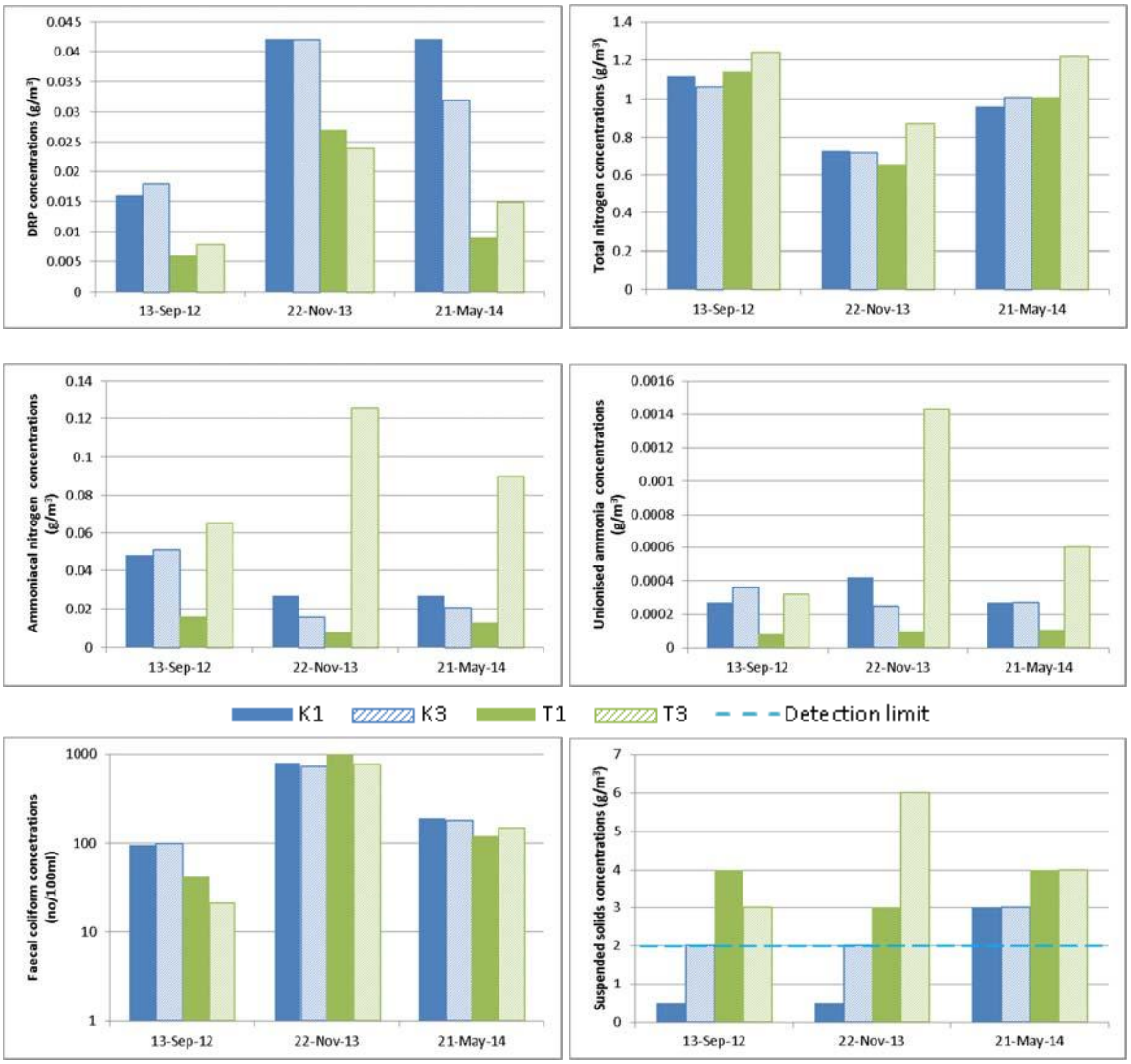


**Figure 12** Water quality sampling results for the three synoptic surveys completed

Special condition 4 of resource consent 0108-3 required that in the Kahouri Stream downstream of the unnamed tributary confluence, the discharge of treated wastewater to the unnamed tributary was not to cause the concentration of unionised ammonia to exceed 0.025g/m$^3$ or the concentration of filtered carbonaceous BOD to exceed 2.0 g/m$^3$.

Figure 13 presents the results for these two parameters from three samples collected in the reported period. No samples were collected from 2012 onwards, as consent 0108-3 was no longer active at that time.

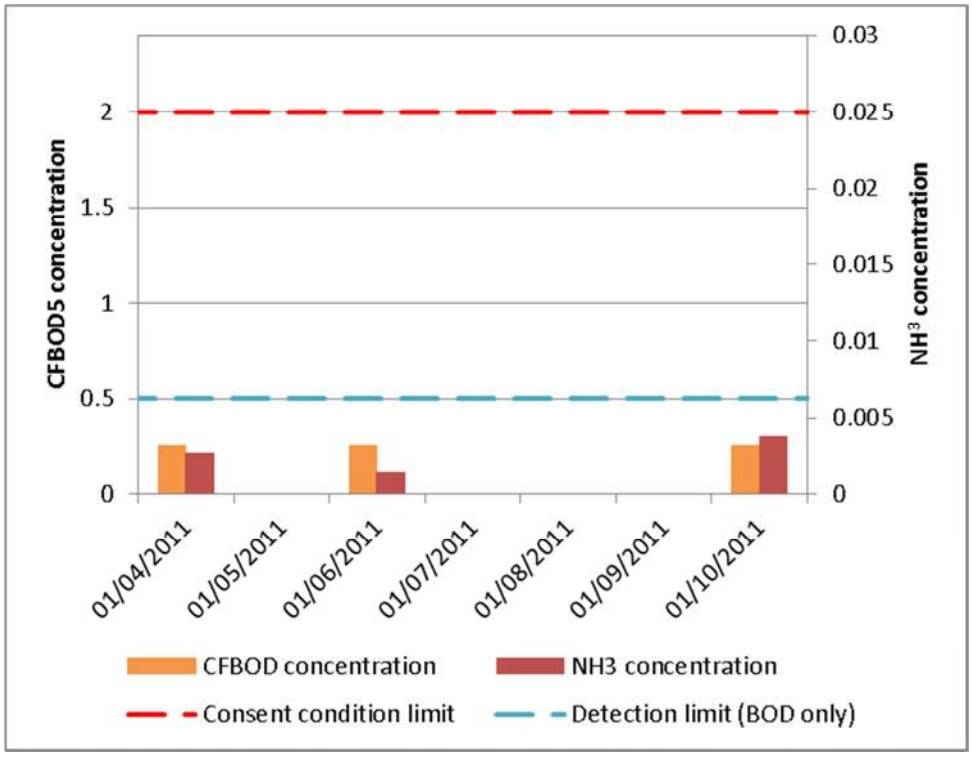


**Figure 13** Water quality sampling results for site K4, located in the Kahouri stream downstream of the confluence with the unnamed tributary.

The CFBOD concentration 50 m downstream of the tributary that receives the Taranaki Abattoir wastewater discharge was below the detection limit for all samples. This is compliant with the relevant consent condition.

The un-ionised ammonia concentration 50 m downstream of the tributary ranged from 0.00135 to 0.00368 g/m$^3$, compared to the consent limit of 0.025 g/m$^3$. Compliance in respect of special condition 2 of consent 0108 was therefore achieved at these times. Un-ionised ammonia is the most toxic form of ammonia, and at these concentrations, is unlikely to cause significant adverse effects on the biological communities of the Kahouri Stream.

While this concentration of unionised ammonia may not have been expected to cause significant adverse effects it still reflected a significant increase when compared to upstream concentrations. Since this discharge has ceased in late 2011, the concentrations in the unnamed tributary have dropped significantly, and it can be expected that the concentrations in the Kahouri Stream experienced a similar reduction.

#### 2.2.1.4 Biological monitoring

Macroinvertebrate surveys were undertaken in relation to the Taranaki Abattoirs site for two purposes. The first was to document the impact of the wastewater discharge on the communities of the unnamed tributary, and subsequently the recovery of these communities once this discharge was removed. The second was to monitor the invertebrate communities of the Kahouri Stream, in relation to the discharge of wastewater during high flow conditions, which began in late 2011. These separate surveys will be discussed separately.

All surveys employed the Council's standard 'kick-sampling' technique, and the samples were processed to provide number of taxa (richness), MCI and $SQMCI_S$ scores, and also EPT taxa 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 abundance as well as sensitivity to pollution, and may reveal more subtle changes in communities. It may be the more appropriate index if non-organic impacts are occurring. EPT taxa quantifies the number of mayflies, stoneflies and caddisflies present in the sample, and this can also be expressed as a proportion of the total number of taxa (%EPT).

Significant differences in either the MCI or the $SQMCI_S$ between sites indicate the degree of adverse effects (if any) of the discharges being monitored.

Unnamed tributary

The unnamed tributary was sampled on three occasions over the reported period, on 13 April 2011, 24 May 2012 and 12 June 2013. Two sites are sampled during each survey, upstream of the discharge (KHI000301), and downstream of the discharge (KHI000302). The 2011 survey was undertaken when wastewater was being discharged to the tributary, while the latter two surveys were undertaken after the discharge ceased.

The upstream site has consistently recorded good taxa richness, MCI scores and $SQMCI_S$ scores. This pattern was continued in the reported period, with this site recording the MCI and $SQMCI_S$ scores similar to or higher than those recorded in the nearby Kahouri Stream in all three surveys, indicating good preceding water quality.

Previous surveys have consistently recorded a significant impact downstream of the wastewater discharge. This was repeated in the April 2011 survey, when changes in the community composition resulted in a statistically significant drop in MCI score. Although this was still a moderate result considering the nature of the stream, it is an indication that this community was significantly different to that present upstream, the primary cause of which was the wastewater discharge from the abattoir.

In addition to this significant reduction in MCI score, there was a very large drop of four units in $SQMCI_S$ score. This was due to a significant increase in 'tolerant' oligochaete and lumbricid worms, coupled with reductions in abundance of most 'highly sensitive' taxa. In addition, *Chironomus* bloodworms were present at site B2. *Chironomus* bloodworms and oligochaete worms often significantly increase in abundance where a stream's assimilative capacity is overloaded by an organic discharge, and such situations are often accompanied by the presence of sewage fungus. Sewage fungus was not observed at the time of sampling, but was confirmed as present under magnification, and the fact that *Chironomus* blood worms were present and oligochaete worms were extra abundant at site B2 during this survey indicates that the discharge from the Taranaki Abattoir wastewater ponds was having a strong adverse impact on the receiving tributary at this time. However, there was reduced abundance of *Chironomus* bloodworms from the last survey, and this indicates that the adverse impact was less severe than previously recorded.

The first survey undertaken following cessation of the wastewater discharge again recorded an MCI score downstream which was significantly less than that recorded upstream, but this MCI score recorded at the downstream site was the highest recorded at this site to date. The $SQMCI_S$ on the other hand indicated significant improvement, owing primarily to reduced abundances of 'tolerant' taxa, coupled with improved abundances of 'sensitive' taxa. In addition, sewage fungus was neither observed at the time, nor detected through microscopic examination.

The last survey undertaken in this tributary, performed on 12 June 2013, recorded an MCI score at the downstream site only one unit less than that recorded upstream and the $SQMCI_S$ score was equivalent. The MCI score no longer indicated any reduction in invertebrate community health at the downstream site, and indicates significant improvement on previous surveys. The $SQMCI_S$ again indicated significant improvement, and sewage fungus was again absent.

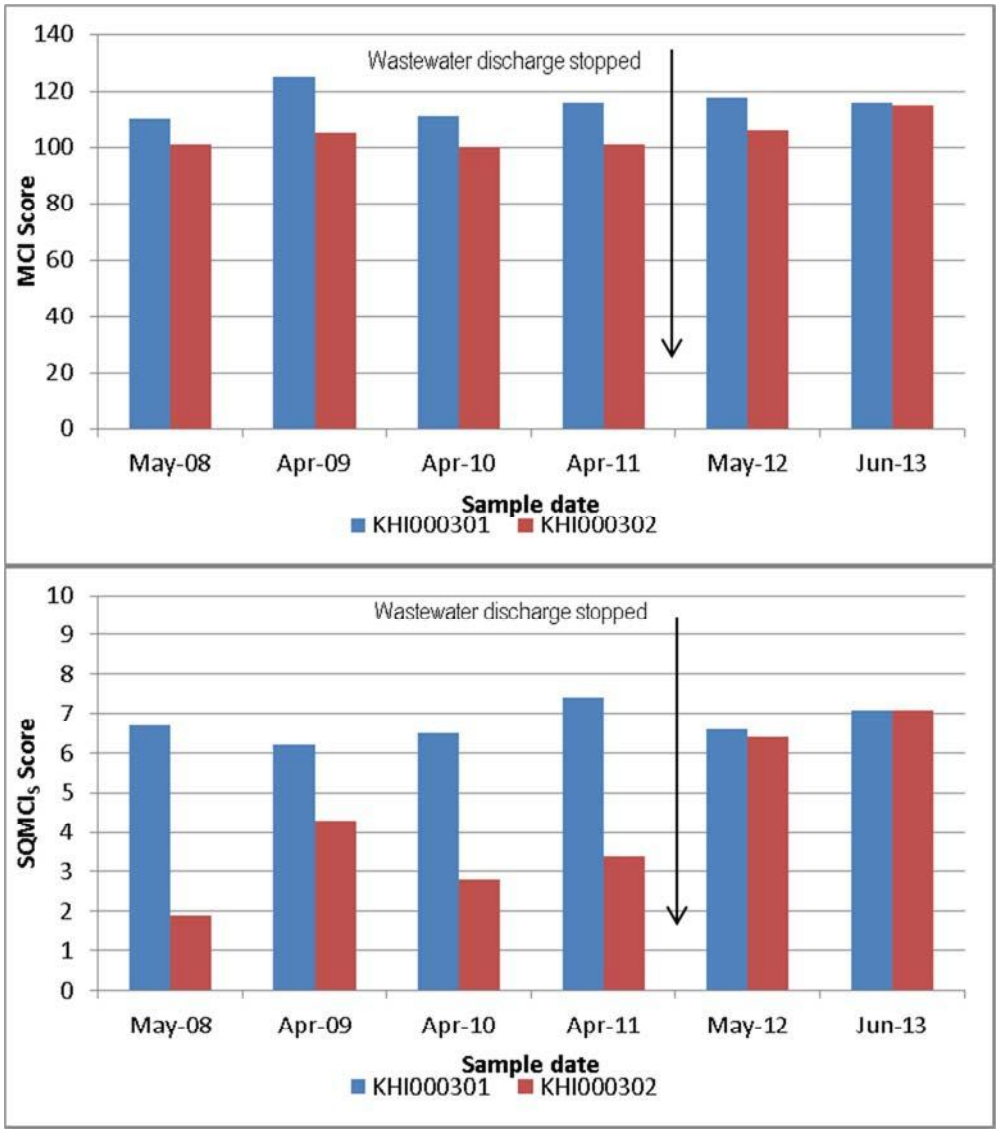


**Figure 14** MCI and $SQMCI_S$ scores recorded upstream and downstream of the discharge in the unnamed tributary since May 2008.

This improvement in MCI and $SQMCI_S$ scores, illustrated in Figure 14, can be directly attributed to the fact that wastewater is no longer discharged to this tributary, resulting

in a significant improvement in macroinvertebrate community health. It is reasonable to conclude that the stream has fully recovered, and therefore it is recommended that monitoring of the unnamed tributary be discontinued.

Kahouri Stream

The Kahouri Stream was sampled on five occasions in the reported period. The sampling dates were 8 September 2011, 24 May 2012, 12 June 2013, 14 November 2013 and 25 February 2014, and involved sampling three sites, one upstream of the discharge(KHI000297), a second site 95m downstream of the discharge (KHI000300) and a third site 85m further downstream (KHI000305). The sampling related to a discharge of wastewater to the Kahouri Stream, governed by consent 7662-1, which is generally only undertaken during high flows, but also when the land conditions pre-empt irrigation due to the soils being too saturated.

It should be noted that special condition13 of the relevant consent (7662-1) includes the following statement:

*"The difference in macroinvertebrate community between the upstream control site and the potential impact site immediately below the mixing zone will be examined in order to determine if the discharge has resulted in a 'significant adverse effect on aquatic life'. This will include examining any change in the Semi-Quantitative Macroinvertebrate Community Index [SQMCI], overall composition of the community [including %EPT] and Macroinvertebrate Community Index [MCI]. Should this examination identify a significant adverse effect caused by the discharge, this will constitute a breach of this condition."*

The sampling was undertaken to assess whether this condition had been breached when exercising this consent.

The first survey undertaken in September 2011 was a baseline survey, intended to establish the baseline health of the macroinvertebrate community of the Kahouri Stream prior to any discharge of wastewater from the Taranaki Abattoir site. This early spring survey found that the three sites sampled in the Kahouri Stream recorded taxa richnesses, MCI scores and $SQMCI_S$ scores that were very similar, both to each other and to the respective medians recorded at site 1 upstream. This indicated that although there may be some slight deterioration in community health in a downstream direction, these sites are similar enough to ensure any impacts of the wastewater discharge would be detected, should such impacts occur with sufficient intensity.

Figure 15 shows how MCI score, taxa richness, $SQMCI_S$ score and %EPT has changed both in time (survey to survey) and space (site to site). During all surveys, the three sites sampled in the Kahouri Stream recorded little variation in taxa richness, and the MCI scores and $SQMCI_S$ scores recorded at each site were very similar between sites and also with regard to median MCI and $SQMCI_S$ scores recorded at site 1 upstream. In addition, these sites were largely dominated by the same taxa, with very few significant differences in individual taxon abundance between sites. The results of these surveys also did not differ markedly from that recorded in the baseline survey, suggesting little change in communities since the discharge of wastewater commenced. The $SQMCI_S$ scores were all well above the median score recorded at site 1, indicating a lack of organic enrichment at these sites. Overall, these surveys indicate that although there may be a slight deterioration in community health in a downstream direction, this is natural, and not related to any discharge from the Taranaki Abattoirs site. This was

supported by the absence of sewage fungus, as determined by microscopic inspection of the samples.

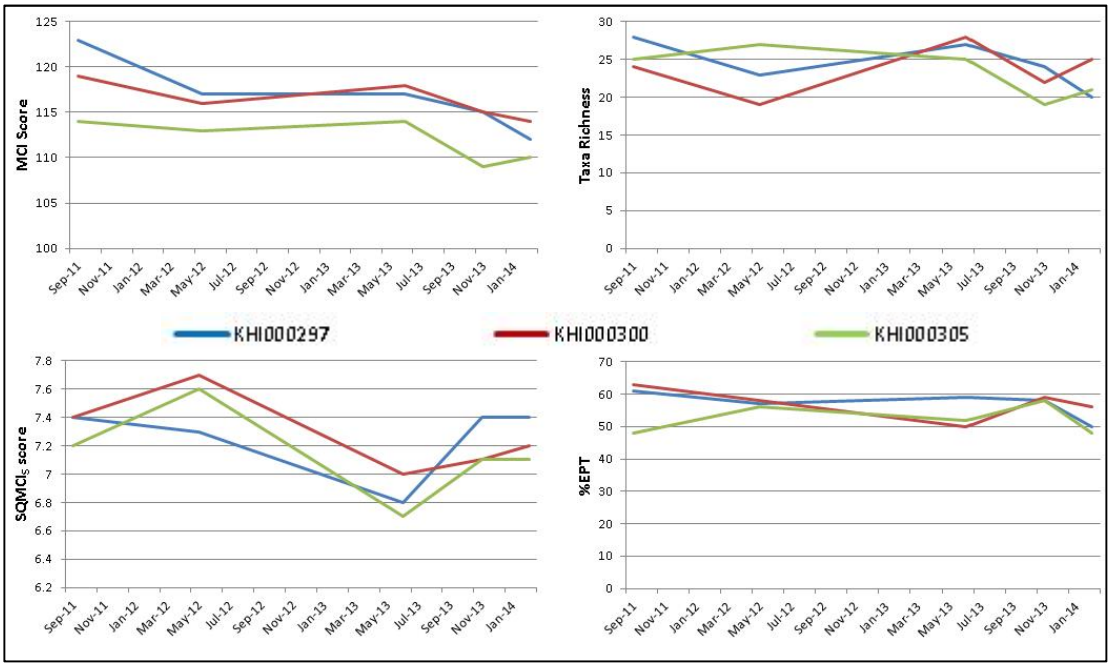


**Figure 15** MCI score, taxa richness, $SQMCI_S$ score and %EPT at the three sites sampled, over the reported period. Note: the first sampling occasion (Sept 2011) was a baseline survey.

Overall, the Kahouri Stream was in good condition, and with regards to the statement in the consent, an examination of the MCI, $SQMCI_S$ scores and the %EPT found no indication of a significant adverse effect caused by the discharge, and as such, there was no breach of condition 13 of consent 7662-1.

Copies of the reports which discuss each survey are included in Appendix II.

## 2.3 Investigations, interventions, and incidents

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

The Taranaki Regional 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 Unauthorised Incident Register (UIR) includes events where the company 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).

In the 2010-2014 period, the Council was required to undertake significant additional investigations and interventions, or record incidents, in association with Taranaki Abattoirs conditions in resource consents or provisions in Regional Plans. In total, seven incidents were recorded and investigated by the Council that were associated with Taranaki Abattoirs.

On 5 January 2012 a complaint was received regarding odour emanating from the abattoir site. An odour survey was undertaken in the area and only a noticeable odour was noted.

On 11 October 2012 a similar complaint was received concerning odour emanating from the site. Investigation found only slight cooking odours near the main road bridge.

Another odour complaint was received on 20 February 2013.This complaint was regarding odours on Monmouth Road. Investigations found a slight odour on Monmouth Road, and an inspection was undertaken of the site and normal plant odours were found onsite.

A compliance monitoring inspection undertaken on 21 March 2013 noted non-compliance, in that the irrigation area had not been extended, and therefore the application of nitrogen was likely to have exceeded the limit specified in the consent. In addition, no updated wastewater irrigation management plan had yet been received by this Council, which was also a requirement of consent. An abatement notice was issued requiring the Wastewater Irrigation Management Plan be amended and submitted, while another was issued requiring works to be undertaken to ensure there was adequate irrigation area, so as to comply with the nitrogen application rate requirement. An updated wastewater management plan has since been received by Council, and a subsequent inspection confirmed that the irrigation area had been extended as required.

Unfortunately, during the next routine compliance monitoring inspection, undertaken on 21 June 2013, it was found that resource consent conditions were again being contravened. It was found that the cut and carry paddocks contained stock (sheep & beef cattle), and that the burial pit had been used for the emergency disposal of pork gut, but that this material was not adequately covered by soil. An inspection notice was issued, instructing that the pork gut be buried as per consent conditions, and that the sheep and beef cattle in the cut and carry paddocks are moved immediately. Reinspection, completed on 27 June 2013, found that the required works had been carried out.

On 18 December 2013 another complaint was received concerning odour. Investigation confirmed the presence of offensive odour beyond the boundary of the plant. However, as the consent condition requires the identification of an affected party, and the complaint was anonymous, there was no breach as defined by consent.

On 22 February 2014 the fifth complaint of the monitoring period was received, again regarding odour. Investigation did not detect any offensive or objectionable odour beyond the boundary, and so no further action was warranted. A summary of the complaints and incidents on a yearly basis is given in Table 10.

It is clear that performance has improved at the site, with no odour related enforcement action required in the reporting period. However, the detection of offensive odour beyond the boundary in late 2013 should be of concern to the consent holder, as had an affected party been identified in this case, enforcement action would have been likely.

**Table 10** Summary of unauthorised incidents in the last fourteen monitoring years

| Monitoring year | Total number of unauthorised incidents | Number of incidents related to objectionable odours | Number of non-odour related incidents | Comments |
|---|---|---|---|---|
| 2013-2014 | 2 | 2 | 0 | Two odour complaints, one of which was associated with confirmed offensive odour beyond the boundary. However due to the consent condition terminology, it was not deemed non-compliant |
| 2012-2013 | 4 | 2 | 2 | Two odour complaints, neither of which was substantiated. Two incidents relating to implementation and compliance with new consent conditions – resolved |
| 2011-2012 | 1 | 1 | 0 | One odour related incident that did not note any non-compliance |
| 2010-2011 | 0 | 0 | 0 | No recorded incidents |
| 2009-2010 | 3 | 1 | 2 | No substantiated discharges of objectionable odour, one incident relating to 'sewage fungus' in the Kahouri Stream and one technical non-compliance incident. |
| 2008-2009 | 3 | 3 | 0 | 1 substantiated discharge of objectionable odour. |
| 2007-2008 | 5 | 4 | 1 | No substantiated discharges of objectionable odour, one complaint regarding material being carried off site by birds. |
| 2006-2007 | 5 | 5 | 0 | 1 Instance of objectionable odour, and one in which non-condensable gases were vented direct to air. |
| 2005-2006 | 27 | 25 | 2 | 9 instances of objectionable odour; Odours mainly sourced from cooking of off-spec product, and discharge of inadequately treated cooking gases. Tallow spill and breach of consent condition regarding $BOD_5$ in receiving water. |
| 2004-2005 | 19 | 18 | 1 | 11 odours found to be objectionable; Odours mainly sourced from out of spec product; Some odours from worm farm (in summer). Tallow spill. |
| 2003-2004 | 5 | 5 | - | Odours from prolonged loading and venting of cooker, and problems with condenser/bio-filter. Receiving water quality BOD breach of consent. |
| 2002-2003 | 1 | 1 | - | Lack of water during cooking resulted in burning. |
| 2001-2002 | 4 | 3 | 1 | Odours due to worm farm paunch being moved. Two odour complaints were unsubstantiated. |
| 2000-2001 | 3 | 1 | 2 | Odour from out of spec product. Discharge of untreated effluent to stream due to blocked pipe; BOD exceeded in receiving water |

While the consent holder had been slow in increasing the irrigation area, this has now been completed. However, an inspection undertaken in the 2014-15 monitoring period found that the planting of riparian margins required by the consent had not yet been undertaken. The new owners have been made aware of this, and they immediately committed to being compliant with this requirement, with willow control and most planting undertaken by next winter, and the remaining planting occurring in the following year. The streams are already fenced, so this requirement has been met.

# 3. Discussion

## 3.1 Discussion of site performance

In general, Taranaki Abattoir Company's facilities were managed in a moderate manner in terms of compliance with conditions on the air discharge consent. In previous years, the most concerning issue was the processing of soft offal outside of the timeframe as defined by the consent. However, with the exception of one incident of confirmed offensive odour beyond the boundary in late 2013, compliance in this regard has improved markedly and hence the reduction in odour complaints.

Wastewater management changed over the course of the reporting period, with the gravity fed discharge to the unnamed tributary ceasing, and wastewater either being irrigated to land or discharged to the Kahouri Stream during high flow conditions. This constituted a significant financial outlay for the Company.

The discharge to the unnamed tributary was well managed, and complied with all relevant consent conditions. Following installation of the new discharge system, the wastewater has from time to time been discharged to the Kahouri Stream, and biological and water quality sampling has found that the discharge has complied with all conditions relating to instream effects. In addition, the quality of the discharge has met the requirements of the consent. However, review of the data indicates that the discharge rate has been higher than was signalled during the consent renewal process and this has the potential to result in a dilution rate less than that required by consent. Although this was not verified by water quality sampling, it is a matter that the consent holder will need to pay close attention to.

Inspections undertaken while wastewater was being irrigated to land indicated that the day to day management of the irrigation was done well. However, a review of the records indicate that not only did the application of wastewater result in a nitrogen application rate that exceeded the consented limit, the application depth also frequently exceeded the limit, primarily in the early phase. Although it appears that this has been resolved in the latter part of the reporting period, it is at the expense of the Kahouri Stream. In short, in the first half of the reporting period, the consent holder did well at prioritising the irrigation of wastewater to land, over the discharge to the stream. Unfortunately this led to the over application of nitrogen and a frequently excessive application depth. In the latter half of the reporting period, not enough emphasis was given to applying wastewater to land, although this aided compliance with the nitrogen loadings and application depth. The consent holder needs to manage the system to strike a better balance.

Compliance with the four resource consents held was generally satisfactory, other than some issues around the burial of product unsuitable for rendering. Housekeeping was generally found to be good through most of the plant during inspections.

The spreading of blood and biosolids on land, with regular addition of lime and trace minerals, has been successful. The worm farm has the potential to cause some odours to occur off site and this area needs to be managed carefully to reduce odours particularly during the summer months. This area also needs to be managed, so as to prevent birds from accessing material, and carrying it off site. The Company notifies

the Council when disturbance in the worm farm area is planned, as the disturbance has the potential to increase the discharge of odour.

During the last monitoring year covered by this report, Council received a wastewater management plan, as required by consent 5221-2, and this is currently under review. Council has in the past received a site contingency plan, which included the waste burial management plan, and the contingency plan required by consent 4055-3. This contingency plan is also currently under review.

## 3.2 Environmental effects of exercise of consents

At the beginning of the monitoring period, both water quality and biological monitoring found that the discharge of wastewater to the unnamed tributary was having a significant adverse effect on the tributary, and a notable effect on the Kahouri Stream. Once this activity ceased, monitoring documented a significant improvement in water quality and biological communities, with communities in the unnamed tributary downstream of the discharge point improving in health to the extent not recorded previously at that site.

The practice of discharging wastewater to the Kahouri Stream during high flow conditions has not caused any recorded impact on the macroinvertebrate communities of this stream, and the impact on water quality was minimal. There were increases recorded for most parameters tested, but these increases would have been short-lived, and in the one instance where it appeared non-compliant with consent conditions (CFBOD>2g/$m^3$), the actual increase was minor, as the upstream site already exceeded the consented limit. This was due to the flood flow conditions at the time of sampling.

The irrigation of wastewater was undertaken with no significant adverse effects on the environment. However, there was over application of nitrogen on the cut and carry paddocks, and water quality monitoring indicates an increase in ammoniacal nitrogen in the unnamed tributary as it flows through these cut and carry paddocks. This increase is not such that could have a lethal impact on the stream biota, but may result in increased algal growth.

In relation to air emissions, there were five incidents related to odours beyond the site boundary. Only one resulting inspection found an offensive odour beyond the boundary, but no enforcement action was taken, as no affected party could be identified.

The abstraction of water was undertaken entirely within consent conditions. Although the maximum rate exceeded the consent limit on one occasion, it was within the 5% margin of error afforded such flow recording devices. In addition, due to the short time frame and minor nature of this possible breach, it is unlikely to have caused any impact on the stream.

## 3.3 Evaluation of performance

A tabular summary of the consent holder's compliance record for the period under review is set out in Table 11 to Table 17.

**Table 11** Summary of performance for consent **0108-4** to discharge treated wastewater directly into an unnamed tributary to the Kahouri Stream

| Condition requirement | Means of monitoring during period under review | Compliance achieved? |
|---|---|---|
| 1. Best practicable option | Inspections | Yes |
| 2. Effects on the environment | Inspections and sampling | Yes |
| Overall assessment of environmental performance and compliance in respect of this consent | | High |
| Overall assessment of administrative performance in respect of this consent | | High |

**Table 12** Summary of performance for consent **7662-1** to discharge treated wastewater directly into the Kahouri Stream.

| Condition requirement | Means of monitoring during period under review | Compliance achieved? |
|---|---|---|
| 1. Best practicable option | Inspections | Yes |
| 2. Notification prior to any changes to processes | Council notified | N/A |
| 3. Prohibits the consent to be exercised while consent 0108-4 is current | Inspections | Yes |
| 4. Install flow meter | Inspections | Yes |
| 5. Meter verification documentation submitted | Liaising with consent holder | Yes |
| 6. Install staff gauge in Kahouri Stream | Inspections | Yes |
| 7. Maintain staff gauge rating curve | Inspections | Yes |
| 8. Minimise clean water entering treatment system | Inspections | Yes |
| 9. Manage worm bed to minimise discharge to treatment system | Inspections | Yes |
| 10. Prohibits the operation of aerators and stirrer while discharge occurs | Inspections | Yes |
| 11. Discharge shall only occur when flow rates are 330L/s or greater | Review of records, inspections | No |
| 12. Minimum dilution ratio of 1 part wastewater to 100 parts receiving water | Review of records, water quality sampling | Yes |
| 13. Effects on receiving water beyond the 50 m mixing zone | Water quality sampling, inspections | Yes |
| 14. Suspended solids and turbidity limits | Water quality sampling | Yes |

| Condition requirement | Means of monitoring during period under review | Compliance achieved? |
|---|---|---|
| 15. Safe site access | Inspections | Yes |
| 16. At least 200 mm of freeboard available | Inspections | Yes |
| 17. Install and maintain a permanent marker within the aerobic pond | Inspections | No |
| 18. Preference given to discharge to land | Inspections, review of records | No |
| 19. Manage wastewater treatment system to maximise quality | Inspections | Yes |
| 20. Total BOD limit | Discharge quality sampling | Yes |
| 21. Install and maintain a tap on the wastewater line | Inspections | Yes |
| 22. Monitor and record the discharge | Liaison with consent holder, review of records | Yes |
| 23. Riparian management plan | Liaison with consent holder, inspections | No |
| 24. Notification of environmental incidents | Liaison with consent holder, inspections | Yes |
| 25. Lapse of consent | Consent exercised within lapse period | N/A |
| 26. Optional review of consent | Not exercised | N/A |
| Overall assessment of environmental performance and compliance in respect of this consent<br>Overall assessment of administrative performance in respect of this consent | | Improvement Required<br>Good |

N/A = not applicable

**Table 13** Summary of performance for consent **6570-1** to discharge of degenerating raw product onto and into land in the vicinity of an unnamed tributary of the Kahouri Stream

| Condition requirement | Means of monitoring during period under review | Compliance achieved? |
|---|---|---|
| 1. Best practicable option | Inspections | Yes |
| 2. Exercise of consent shall be undertaken in accordance with application documentation | Inspections | Yes |
| 3. Notification prior to exercise of consent | Council notified | Yes |
| 4. Notification prior to burials | Council notified | No |
| 5. Supply burial management plan | Contingency plan received | Yes |
| 6. Only raw material to be disposed of in burial pits | Inspections | Yes |

| Condition requirement | Means of monitoring during period under review | Compliance achieved? |
|---|---|---|
| 7. Emergency circumstances discharges to land | Inspections | Yes |
| 8. No contaminants to enter surface water | Inspections and water quality sampling | Yes |
| 9. Prohibits adverse effects on groundwater | Inspections | Yes |
| 10. Consent holder to maintain and keep records | Request by Council for data | Yes |
| 11. Discharge to be covered within four hours | Inspections | No |
| 12. Minimum of 800mm of compacted soil to be placed on discharge wastes | Inspections | No |
| 13. Site contoured | Inspections | Yes |
| 14. Pasture re-established | Inspections | Yes |
| 15. Lapse of consent | Consent exercised within lapse period | N/A |
| 16. Optional review of consent | Not exercised | N/A |
| Overall assessment of environmental performance and compliance in respect of this consent<br>Overall assessment of administrative performance in respect of this consent | | Good<br>High |

N/A = not applicable

**Table 14** Summary of performance for consent **5221-2** to discharge treated wastewater from a treatment system onto and into land in the vicinity of an unnamed tributary of the Kahouri Stream.

| Condition requirement | Means of monitoring during period under review | Compliance achieved? |
|---|---|---|
| 1. Best practicable option | Inspections | Yes |
| 2. Notification prior to any changes to processes | Council notified | N/A |
| 3. Install flow meter | Inspections | Yes |
| 4. Meter verification documentation submitted | Liaising with consent holder | Yes |
| 5. Follow wastewater irrigation management plan | Inspections | Yes |
| 6. Update wastewater irrigation management plan | Liaising with consent holder | No |
| 7. Review wastewater irrigation management plan | Liaising with consent holder | No |

| Condition requirement | Means of monitoring during period under review | Compliance achieved? |
|---|---|---|
| 8. Designate a person to manage the irrigation system | Liaising with consent holder, inspections | Yes |
| 9. Operation of aerator and stirrer | Inspections | Yes |
| 10. Restrictions on nitrogen levels | Liaising with consent holder, inspections | No |
| 11. Wastewater irrigation management plan submitted prior to nitrogen loading | Liaising with consent holder, inspections | No |
| 12. Wastewater application must not exceed 24mm | Review of records | No |
| 13. Sodium absorption ratio shall not exceed 15 | Irrigated wastewater quality sampling | Yes |
| 14. Prohibits discharge to water from irrigation | Inspections | Yes |
| 15. Restrictions on the wastewater discharge spray zone | Inspections | Yes |
| 16. Prohibits discharge beyond the boundary of the property | Inspections | Yes |
| 17. Minimise discharge | Inspections, review of records | No |
| 18. Application of pond solids to avoid discharge to water | Inspections | Yes |
| 19. Daily discharge records | Liaising with consent holder, inspections | Yes |
| 20. Notification of any environmental incidents | Liaising with consent holder, inspections | Yes |
| 21. Notification information | Liaising with consent holder, inspections | Yes |
| 22. Optional review of consent | Not exercised | N/A |
| Overall assessment of environmental performance and compliance in respect of this consent<br>Overall assessment of administrative performance in respect of this consent | | Improvement Required<br>High |

N/A = not applicable

**Table 15** Summary of performance for consent **7660-1** to discharge uncontaminated stormwater to land, in association with mean processing, rendering and associated activities.

| Condition requirement | Means of monitoring during period under review | Compliance achieved? |
|---|---|---|
| 1. Best practicable option | Inspections | Yes |
| 2. Prevent discharge from contamination | Inspections | Yes |

| Condition requirement | Means of monitoring during period under review | Compliance achieved? |
|---|---|---|
| 3. Constituents of the discharge | Inspections, water quality sampling | Yes |
| 4. Optional review of consent | Not exercised | N/A |
| Overall assessment of environmental performance and compliance in respect of this consent | | High |
| Overall assessment of administrative performance in respect of this consent | | High |

N/A = not applicable

**Table 16** Summary of performance for consent **4055-3** to discharge emissions to air, in association with meat processing, rendering and associated activities.

| Condition requirement | Means of monitoring during period under review | Compliance achieved? |
|---|---|---|
| 1. Best practicable option | Inspections | No |
| 2. Consent holder to maintain a contingency plan | Inspections | Yes |
| 3. Submit contingency plan | Liaising with consent holder | Yes |
| 4. Notification of any changes to plant processes | Liaising with consent holder | Yes |
| 5. Prohibits fish being received or processed onsite | Inspections | Yes |
| 6. Only offal from purpose killed animals shall be received and processed onsite | Inspections | Yes |
| 7. Prohibits putrescible materials to be stored onsite | Inspections | Yes |
| 8. Emissions must be extracted to the biofilter | Inspections | No |
| 9. Discharge temperature must not exceed 35°C | Data review, inspections | Yes |
| 10. Calibration of the temperature detector | Liaising with consent holder | Yes |
| 11. Record the non-condensable gas line | Liaising with consent holder, inspections | Yes |
| 12. Minimise emissions | Inspections | No |
| 13. Prohibits objectionable or offensive odour beyond the boundary of the site to the extent where this odour causes an adverse effect | Inspections | Yes |
| 14. Prohibits objectionable or offensive dust beyond the boundary of the site | Inspections | Yes |

| Condition requirement | Means of monitoring during period under review | Compliance achieved? |
|---|---|---|
| 15. Consent holder to notify Council of any adverse environmental incidents. | Liaising with consent holder, inspections | Yes |
| 16. Optional review of consent | Not exercised | N/A |
| Overall assessment of environmental performance and compliance in respect of this consent | | Good |
| Overall assessment of administrative performance in respect of this consent | | High |

N/A = not applicable

**Table 17** Summary of performance for consent **5176-1** to take water from the Kahouri Stream for stock and yard washing purposes.

| Condition requirement | Means of monitoring during period under review | Compliance achieved? |
|---|---|---|
| 1. Best practicable option | Inspections | Yes |
| 2. Abstraction limits | Data review | Yes |
| 3. Flow metre shall be installed and maintained | Inspections | Yes |
| 4. Abstraction records | Data review | Yes |
| 5. Minimum flow in Kahouri Stream | Inspections | Yes |
| 6. Intake screened | Inspections | Yes |
| 7. Optional review of consent | Not exercised | N/A |
| Overall assessment of environmental performance and compliance in respect of this consent | | High |
| Overall assessment of administrative performance in respect of this consent | | High |

N/A = not applicable

During the reporting period, the Company demonstrated an 'improvement required' level for environmental performance and compliance with the resource consents as defined in Section 1.1.4. Although administrative performance was good overall. During the period under review there were two incidents that required formal enforcement action, due to the Company not prioritising the expansion of irrigation area, and this resulted in the over application of nitrogen to land. A number of other consent conditions were also not complied with, which individually would be considered minor. However, when considered together, it is symptomatic of a company that needs to give a higher priority to consent compliance.

It should be reiterated at this time that near the end of the reporting period, the site began a process that will eventually see a change of ownership, to Gold International Meat Holdings Limited. This consent compliance rating related entirely to Taranaki Abattoirs Limited, and Gold International Meat Holdings Ltd have displayed a willingness to comply with consent conditions, and are actively liaising with TRC in order to achieve this.

## 3.4 Recommendations from the 2009-2010 Annual Report

In the 2009-2010 Annual Report, it was recommended:

1. THAT monitoring of air emissions from Taranaki Abattoir Company (1992) Limited in the 2010-2011 year continues at the same level as in the 2009-2010 year.

2. THAT monitoring of discharges to land and water from Taranaki Abattoir Company (1992) Limited in the 2010-2012 year continues at the same level as in the 2009-2010 year, with the addition of two extra samples collected from the Kahouri Stream (sites KHI000297 & KHI000307).

3. THAT catchment scale monitoring cease from 1 July 2010.

These recommendations were implemented in the 2010-14 monitoring period.

## 3.5 Alterations to monitoring programmes for 2014-2015

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

During the reporting period significant changes were made to the consents held by the Company, and as a result, monitoring changed significantly also. With the change in ownership, there are changes proposed for plant throughput. In addition, the rendering plant is no longer operative. This indicates that there will be a need to review the monitoring programme during the 2014-15 monitoring year, as at this stage, it is unclear what operations will be undertaken on site, and of what scale. In the interim, it is recommended that monitoring of the Taranaki Abattoirs Ltd site continues at the same level as in the 2013-14 monitoring year. A recommendation to this effect is attached to this report.

## 3.6 Exercise of optional review of consent

Resource consents 5221-2, 7662-1 and 4055-3 provide for an optional review of the consent in June of any year. Conditions of these consents allow the Council to review the consent, if there are grounds. For consent 5221-2, these grounds are as follows:

a. Ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, and in particular to address any more than minor adverse effects relating to water quality issues; and
b. To determine any measures that may be appropriate to comply with condition 1 of this consent, and which are necessary to address any adverse effects relating to the wastewater discharges from the site.

For consent 7662-1, these grounds are as follows:

a. Ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, and in particular to address any more than minor adverse effects relating to water quality issues;
b. to take into account any Act of Parliament, regulation, national policy statement [including the National Policy Statement for Freshwater Management 2011], regional policy statement or regional rule which relates to limiting, recording, mitigating, setting or amending any limits or other criteria relating to nutrients, ecological health or other water quality parameters; and
c. To determine any measures that may be appropriate to comply with condition 1 of this consent, and which are necessary to address any adverse effects relating to the wastewater discharges from the site.

In considering whether to initiate a review of consent 7662-1, the Taranaki Regional Council will take into account any views received from the Department of Conservation and Fish and Game New Zealand (Taranaki Region).

For consent 4055-3, these grounds are as follows:

a. Ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, and in particular to address any more than minor adverse effects relating to odour discharges from the site; and
b. To determine any measures that may be appropriate to comply with condition 1 of this consent, and which are necessary to address any adverse effects of odour from the site.

For all consents, there is reference to condition 1, which relates to the consent holder adopting the best practicable option to prevent or minimise any adverse effects on the environment from the exercise of these consents.

Based on the results of monitoring in the period under review, and in previous years as set out in earlier annual compliance monitoring reports, it is considered that there are no grounds that require a review to be pursued or grounds to exercise the review option.

A recommendation to this effect is presented in Section 4 of this report.
However, it should be noted that the consent holder may initiate the review process, to ensure the consent(s) adequately cover change in processes, especially with regard to wastewater management.

# 4. Recommendations

1. THAT monitoring of consented activities at Taranaki Abattoirs Ltd in the 2014-2015 year continues at the same level as in 2013-2014.

2. THAT the option for a review of resource consents in June 2015, as set out in conditions of these consents not be exercised, on the grounds that they adequately cover the activities currently carried out on site.

# Glossary of common terms and abbreviations

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

| | |
|---|---|
| Al* | Aluminium. |
| As* | Arsenic. |
| 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. |
| Condy | Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m. |
| Cu* | Copper. |
| Cumec | A volumetric measure of flow- 1 cubic metre per second (1 $m^3s^{-1}$). |
| DO | Dissolved oxygen. |
| DRP | Dissolved reactive phosphorus. |
| E.coli | Escherichia coli, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample. |
| Ent | Enterococci, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre of sample. |
| F | Fluoride. |
| 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. |
| Intervention | Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring. |

| | |
|---|---|
| Investigation | Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident. |
| l/s | Litres per second. |
| MCI | Macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats. |
| mS/m | Millisiemens per metre. |
| 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. |
| O&G | Oil and grease, defined as anything that will dissolve into a particular organic solvent (e.g. hexane). May include both animal material (fats) and mineral matter (hydrocarbons). |
| Pb* | Lead. |
| 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. |
| $PM_{10}$ | Relatively fine airborne particles (less than 10 micrometre diameter). |
| 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. |
| SS | Suspended solids. |
| SQMCI | Semi quantitative macroinvertebrate community index. |
| Temp | Temperature, measured in °C (degrees Celsius). |
| Turb | Turbidity, expressed in NTU. |
| UI | Unauthorised Incident. |
| UIR | Unauthorised 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. |
| Zn* | Zinc. |

*an abbreviation for a metal or other analyte may be followed by the letters 'As', to denote the amount of metal recoverable in acidic conditions. This is taken as indicating the total amount

of metal that might be solubilised under extreme environmental conditions. The abbreviation may alternatively be followed by the letter 'D', denoting the amount of the metal present in dissolved form rather than in particulate or solid form.

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

# Bibliography and references

Taranaki Regional Council (1993): Kahouri Stream Discharge Permits Annual Monitoring Report 1993-94. Technical Report 93-17.

Taranaki Regional Council (1994): Kahouri Stream Discharge Permits Annual Monitoring Report 1993-94. Technical Report 94-48.

Taranaki Regional Council (1995): Kahouri Stream Discharge Permits Annual Monitoring Report 1994-95. Technical Report 95-75.

Taranaki Regional Council (1996): Kahouri Stream Discharge Permits Annual Monitoring Report 1995-96. Technical Report 96-37.

Taranaki Regional Council (1997): Kahouri Stream Discharge Permits Annual Monitoring Report 1996-97. Technical Report 97-42.

Taranaki Regional Council (1998): Kahouri Stream Discharge Permits Annual Monitoring Report 1997-98. Technical Report 98-89.

Taranaki Regional Council (1999): Kahouri Stream Discharge Permits Annual Monitoring Report 1998-99. Technical Report 99-60.

Taranaki Regional Council (2000): Kahouri Stream Discharge Permits Annual Monitoring Report 1999-2000. Technical Report 00-39.

Taranaki Regional Council (2001): Kahouri Stream Discharge Permits Annual Monitoring Report 2000-2001. Technical Report 01-20.

Taranaki Regional Council (2002): Kahouri Stream Monitoring Programme Annual Report 2001-2002. Technical Report 02-27.

Taranaki Regional Council (2003): Kahouri Stream Monitoring Programme Annual Report 2002-2003. Technical Report 03-26.

Taranaki Regional Council (2004): Kahouri Stream Monitoring Programme Annual Report 2003-2004. Technical Report 04-66.

Taranaki Regional Council (2005): Kahouri Stream Monitoring Programme Annual Report 2004-2005. Technical Report 05-73.

Taranaki Regional Council (2006a): Kahouri Stream Monitoring Programme Annual Report 2005-2006. Technical Report 06-69.

Taranaki Regional Council (2009a): Kahouri Stream Monitoring Programme Annual Report 2006-2007. Technical Report 07-118.

Taranaki Regional Council (2009b): Kahouri Stream Monitoring Programme Annual Report 2007-2008. Technical Report 08-93.

Taranaki Regional Council (2010): Kahouri Stream Monitoring Programme Annual Report 2008-2009. Technical Report 09-99.

# Appendix I

# Resource consents held by Taranaki Abattoirs Ltd

Consent 0108-4

TARANAKI REGIONAL COUNCIL
CHIEF EXECUTIVE
PRIVATE BAG 713
47 CLOTEN ROAD
STRATFORD
NEW ZEALAND
PHONE: 06-765 7127
FAX: 06-765 5097
www.trc.govt.nz

Please quote our file number on all correspondence

# Discharge Permit

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

| | |
|---|---|
| Name of Consent Holder: | Taranaki Abattoirs Co [1992] Limited<br>P O Box 12<br>INGLEWOOD 4347 |
| Decision Date: | 7 November 2011 |
| Commencement Date: | 7 November 2011 |

## Conditions of Consent

| | |
|---|---|
| Consent Granted: | To discharge treated wastewater directly into an unnamed tributary of the Kahouri Stream at or about (NZTM) 1709655E-5647573N |
| Expiry Date: | 1 February 2012 |
| Site Location: | 3326 Mountain Road, Stratford |
| Legal Description: | Sec 62 Manganui Dist Blk XIII Huiroa SD |
| Catchment: | Patea |
| Tributary: | Kahouri |

*For General, Standard and Special conditions pertaining to this consent please see reverse side of this document*
www.trc.govt.nz



Doc# 969434-v1

### General condition

a. The consent holder shall pay to the Taranaki Regional Council [the Council] all the administration, monitoring and supervision costs of this consent, fixed in accordance to section 36 of the Resource Management Act.

### Special conditions

### General condition

1. 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.

### Surface water quality

2. The discharge shall not give rise to the following adverse effects within the Kahouri Stream, after a mixing zone extending 50 metres below the confluence of the unnamed tributary and the Kahouri Stream:

   a) a level of filtered carbonaceous $BOD_5$ of more than 2.00 $gm^{-3}$;
   b) a level of unionised ammonia of greater than 0.025 $gm^{-3}$;
   c) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
   d) any conspicuous change in the colour or visual clarity;
   e) any emission of objectionable odour;
   f) the rendering of fresh water unsuitable for consumption by farm animals; and
   g) any significant adverse effects on aquatic life.

Signed at Stratford on 7 November 2011

For and on behalf of
Taranaki Regional Council

Director-Resource Management

TARANAKI REGIONAL COUNCIL
CHIEF EXECUTIVE
PRIVATE BAG 713
47 CLOTEN ROAD
STRATFORD
NEW ZEALAND
PHONE: 06-765 7127
FAX: 06-765 5097
www.trc.govt.nz
Please quote our file number on all correspondence

# Discharge Permit

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

| | |
|---|---|
| Name of Consent Holder: | Taranaki Abattoirs Co [1992] Limited<br>P O Box 12<br>INGLEWOOD 4347 |
| Decision Date: | 7 November 2011 |
| Commencement Date: | 7 November 2011 |

## Conditions of Consent

| | |
|---|---|
| Consent Granted: | To discharge emissions to air, namely odour and dust, in association with meat processing, rendering and associated activities including waste treatment and disposal activities between (NZTM) 1709506E-5647939, 1709815E-5647783N, 1709874E-5647570N, 1709423E-5647438N and between 1709871E-5647776N, 1710911E-5647381N, 1710905E-5647127N, 1710301E-5647038N, 1710241E-5647326N, 1710019E-5647280N |
| Expiry Date: | 1 June 2028 |
| Review Date(s): | June of any year |
| Site Location: | 3326 Mountain Road and 17 Monmouth Extension, Stratford |
| Legal Description: | Sec 62 Manganui Dist Blk XIII Huiroa SD, Pt Sec 12 Blk XIII Huiroa SD and Pt Sec 2-4 Blk I Ngaere SD |

*For General, Standard and Special conditions pertaining to this consent please see reverse side of this document*
www.trc.govt.nz

### General condition

a. The consent holder shall pay to the Taranaki Regional Council [the Council] all the administration, monitoring and supervision costs of this consent, fixed in accordance to section 36 of the Resource Management Act.

### Special conditions

### General conditions

1. 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.

2. On-site operations shall be undertaken in accordance with the *Contingency Plan for Taranaki Abattoir Co. [1992] Ltd and Stratford By Products Ltd*, submitted with the application (which details the management procedures to be undertaken on site to mitigate adverse odour effects), or any subsequent reviews.

   Note: Where there may be inconsistencies between the information provided within the Plan and conditions of this consent, the conditions apply.

3. The consent holder shall update and submit to the Taranaki Regional Council, the *Contingency Plan for Taranaki Abattoir Co. [1992] Ltd and Stratford By Products Ltd* every two years so that, to the satisfaction of the Chief Executive of the Taranaki Regional Council, the Plan details how discharges to air from the site will be managed to ensure compliance with conditions 13 and 14 of this consent. The Plan shall include but not necessarily be limited to:

   a) A description of the environmental effects being managed;

   b) The identification of key personnel responsible for managing and implementing the management system for mitigating adverse effects;

   c) A description of the activities on site and describe the main potential sources of odour emissions;

   d) A description of storage and treatment procedures(including specification of storage times and preservative dosing concentrations) for ensuring that only high quality raw material is processed;

   e) The identification and description of the odour and dust mitigation measures in place;

   f) The identification and description of relevant operating procedures and parameters that need to be controlled to minimise emissions;

   g) A description of contingency procedures for addressing emergency situations at the plant (such as equipment failure or spillage of raw material or chemicals) which could result in a discharge to air of odorous emissions that are offensive and objectionable beyond the boundary of the plant;

h) A description of monitoring and maintenance procedures for managing the odour mitigation measures including record keeping of control parameters and maintenance checks; and

i) Details of staff training proposed to enable staff to appropriately manage the odour mitigation measures.

4. The consent holder shall notify the Chief Executive, Taranaki Regional Council, prior to undertaking any alterations to the plant, operations or processes which may significantly change the nature or quantity of contaminants discharged to air from the site. Any such change shall then only occur following receipt of any necessary approvals under the Resource Management Act 1991.

**Process control**

5. No fish or fish parts shall be received or processed on site.

6. Only offal derived from purpose killed animals shall be received and processed on site.

7. No putrescible materials shall be stored or left in any manner on site which causes them to putrefy and create an odour nuisance.

8. Emissions produced during and on the release of all rendering cooks shall be extracted to the biofilter for treatment prior to discharge.

9. The inlet temperature of the extracted air at the duct ahead of the biofilter shall not exceed 35°C for more than 15 minutes continuously at any one time.

10. The consent holder shall calibrate the temperature detector and recorder on the non-condensable gas line on a yearly basis. The calibration results shall be provided to the Chief Executive, Taranaki Regional Council.

11. The consent holder shall maintain the temperature detector and recorder on the non-condensable gas line so that it is in effective working order at all times.

12. The consent holder shall minimise the emissions and impacts of contaminants discharged into air from the site by the proper and effective operation, supervision, maintenance and control of all equipment and processes.

**Odour**

13. There shall be no objectionable or offensive odour to the extent that it causes an adverse effect at or beyond the boundary of the site.

Notes: For the purposes of this condition:

- The site is defined as Sec 62 Manganui Dist Blk XIII Huiroa SD (Consent holder's site), and Pt Sec 12 Blk XIII Huiroa SD and Pt Secs 2-4 Blk I Ngaere SD (Gilbert Farms' site); and
- Assessment under this condition shall be in accordance with the *Good Practice Guide for Assessing and Managing Odour in New Zealand, Air Quality Report 36, Ministry for the Environment, 2003.*

### Dust

14. The discharges authorised by this consent shall not give rise to suspended or deposited dust at or beyond the boundary of the site that, in the opinion of at least one enforcement officer of the Taranaki Regional Council, is offensive or objectionable. For the purpose of this condition, discharges in excess of the following limits are deemed to be offensive or objectionable:

    a) dust deposition rate of 0.13 g/m$^2$/day; and/or

    b) suspended dust level of 3 mg/m$^3$.

    Note: For the purposes of this condition the site is defined as Sec 62 Manganui Dist Blk XIII Huiroa SD

### Incident notification

15. Any incident related to this consent that results, or could result, in an adverse effect on the environment shall be notified to the Taranaki Regional Council as soon as practicable, together with the reasons for the incident, and measures taken to mitigate the effects of the incident and prevent a recurrence.

    Note: For notification purposes, at the grant date of this consent, the Taranaki Regional Council's phone number is 0800 736 222 [24 hour service].

### Review

16. 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 in any year for any of the following purposes:

    a) Ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, and in particular to address any more than minor adverse effects relating to odour discharges from the site; and

    b) To determine any measures that may be appropriate to comply with condition 1 of this consent, and which are necessary to address any adverse effects of odour from the site.

Signed at Stratford on 7 November 2011

For and on behalf of
Taranaki Regional Council

**Director-Resource Management**

TARANAKI REGIONAL COUNCIL
CHIEF EXECUTIVE
PRIVATE BAG 713
47 CLOTEN ROAD
STRATFORD
NEW ZEALAND
PHONE: 06-765 7127
FAX: 06-765 5097
www.trc.govt.nz
Please quote our file number on all correspondence

# Discharge Permit

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

| | |
|---|---|
| Name of Consent Holder: | Taranaki Abattoirs Co [1992] Limited<br>P O Box 12<br>INGLEWOOD 4347 |
| Decision Date: | 7 November 2011 |
| Commencement Date: | 7 November 2011 |

## Conditions of Consent

| | |
|---|---|
| Consent Granted: | To discharge uncontaminated stormwater from a site used for meat processing and rendering onto and into land in a manner where it may enter the Kahouri Stream between 1709729E-5647762N, 1709817E-5647767N, 1709834E-5647703N, 1709781E-5647688N |
| Expiry Date: | 1 June 2028 |
| Review Date(s): | June 2016, June 2022 |
| Site Location: | 3326 Mountain Road, Stratford |
| Legal Description: | Sec 62 Manganui Dist Blk XIII Huiroa SD |
| Catchment: | Patea |
| Tributary: | Kahouri |

*For General, Standard and Special conditions pertaining to this consent please see reverse side of this document*
www.trc.govt.nz

### General condition

a. The consent holder shall pay to the Taranaki Regional Council [the Council] all the administration, monitoring and supervision costs of this consent, fixed in accordance to section 36 of the Resource Management Act.

## Special conditions

### General condition

1. 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.

### Water quality

2. Stormwater discharged under this consent shall be prevented from becoming contaminated from onsite processes, including by ensuring that contaminants from the rendering and/or abattoir processes do not enter the 'clean' areas of the site [being areas which do not discharge to the wastewater treatment system].

3. Constituents of the discharge shall meet the following standards shown in the following table:

| Constituent | Standard |
|---|---|
| pH | Within the range of 6.0 to 9.0 |
| Suspended solids | Concentration not greater than 100 $gm^{-3}$ |
| Total recoverable oil and grease | Concentration not greater than 15 $gm^{-3}$ |

This condition shall apply before entry of the uncontaminated stormwater into a stormwater pipe and/or into or onto land at a designated sampling point[s] approved by the Chief Executive, Taranaki Regional Council.

### Review dates

4. 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 2016 and/or 2022 for any of the following purposes:

    a) Ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, and in particular to address any more than minor adverse effects relating to water quality issues; and

b) To determine any measures that may be appropriate to comply with condition 1 of this consent, and which are necessary to address any adverse effects relating to the wastewater discharges from the site.

Signed at Stratford on 7 November 2011

For and on behalf of
Taranaki Regional Council

**Director-Resource Management**

TARANAKI REGIONAL COUNCIL
CHIEF EXECUTIVE
PRIVATE BAG 713
47 CLOTEN ROAD
STRATFORD
NEW ZEALAND
PHONE: 06-765 7127
FAX: 06-765 5097
www.trc.govt.nz
Please quote our file number on all correspondence

# Discharge Permit

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

| | |
|---|---|
| Name of Consent Holder: | Taranaki Abattoirs Co [1992] Limited<br>P O Box 12<br>INGLEWOOD 4347 |
| Decision Date: | 7 November 2011 |
| Commencement Date: | 7 November 2011 |

## Conditions of Consent

| | |
|---|---|
| Consent Granted: | To discharge treated wastewater, pond solids from a wastewater treatment system, vermicast and blood onto and into land between (NZTM)1709506E-5647939, 1709815E-5647783N, 1709874E-5647570N, 1709423E-5647438N and between 1709871E-5647776N, 1710911E-5647381N, 1710905E-5647127N, 1710301E-5647038N, 1710241E-5647326N, 1710019E-5647280N |
| Expiry Date: | 1 June 2028 |
| Review Date(s): | June of any year |
| Site Location: | 3326 Mountain Road and 17 Monmouth Road Extension, Stratford |
| Legal Description: | Sec 62 Manganui Dist Blk XIII Huiroa SD, Pt Sec 12 Blk XIII Huiroa SD and pt Sec 2-4 Blk I Ngaere SD |
| Catchment: | Patea |
| Tributary: | Kahouri |

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

### General condition

a. The consent holder shall pay to the Taranaki Regional Council [the Council] all the administration, monitoring and supervision costs of this consent, fixed in accordance to section 36 of the Resource Management Act.

### Special conditions

### General conditions

1. 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.

2. The consent holder shall notify the Chief Executive, Taranaki Regional Council, prior to making any changes to the processes or operations undertaken at the site, or chemicals used or stored on site that could alter the nature of the discharge. Any such change shall then only occur following receipt of any necessary approvals under the Resource Management Act 1991.

### Pre-activity requirements

3. Before exercising this consent the consent holder shall install, and thereafter maintain, a flow meter. The flow meter shall measure the volume of the discharge to land to an accuracy of ± 5%.

   Notes: Flow meters must be installed, and regularly maintained, in accordance with the manufacturer's specifications in order to ensure that they meet the required accuracy. Even with proper maintenance flow meters have a limited lifespan.

   A single flow meter may be installed for the purposes of meeting this condition and condition 4 of consent 7662-1 provided that the records submitted in accordance with condition 19 of this consent and condition 22 of consent 7662-1 clearly differentiate between the two receiving environments.

### Flow meter certification

4. The consent holder shall provide the Chief Executive, Taranaki Regional Council with documentation from a suitably qualified person certifying that the flow meter:

   a) has been installed and/or maintained in accordance with the manufacturers' specifications; and/or

   b) has been tested and shown to be operating to an accuracy of ± 5%.

   The documentation shall be provided:

   (i) within 30 days of the installation of a flow meter;

(ii) at other times when reasonable notice is given and the Chief Executive, Taranaki Regional Council has reasonable evidence that the flow meter may not be functioning as required by this consent; and

(iii) no less frequently than once every five years.

**Management plan**

5. The consent shall be exercised in accordance with the procedures set out in the Wastewater Irrigation Management Plan (submitted as further information to the application). In the case of any contradiction between the Plan and the conditions of this resource consent, the conditions of this resource consent shall prevail.

6. Within one month of the grant date of this consent, the consent holder shall amend and re-submit the Wastewater Irrigation Management Plan described in condition 5 of this consent so that, to the satisfaction of the Chief Executive, Taranaki Regional Council, the Plan details how the discharge will be managed to ensure that the conditions of this consent will be met. The Plan shall be amended to include, but not necessarily be limited to, the following details:
   a) how the irrigation areas will be identified [e.g. paddock numbering system or large land areas broken down into 1 ha lots and numbered] and a plan/drawing showing the location and extent of each identified area. This system shall be used for record keeping purposes under condition 19;
   b) the surface area of each irrigation area identified under clause a) above;
   c) identification of the location and extent of irrigation main lines and hydrant locations on an aerial plan/drawing; and
   d) the surface area of land required for a range of wastewater discharge volume scenarios, or a calculation which shows how the required land area will be worked out each time irrigation is initiated, to ensure that condition 10 will be met.

7. The Wastewater Irrigation Management Plan described in condition 5 of this consent shall be subject to review by the consent holder every two years from the commencement of consent, or upon two months notice by either the consent holder or the Taranaki Regional Council so that, to the satisfaction of the Chief Executive Taranaki Regional Council, the Plan details how discharges to land will be managed to ensure that the conditions of this consent are complied with. The Plan shall include but not necessarily be limited to:

   a) the results of investigating the practicalities of increasing the land area available for irrigation and/or increasing wastewater application loading rates through implementing cut and carry areas, including the provision of supporting evidence for the outcome of the investigation;
   b) designated application areas and buffer zones for streams and the property boundaries;
   c) selection of appropriate irrigation methods for different types of terrain;
   d) application rate and duration;
   e) application frequency and nitrogen loading rate;
   f) farm management and operator training;
   g) soil and herbage management;
   h) prevention of runoff and ponding;

i) minimisation and control of offsite odour and spray drift effects;
j) operational control and maintenance of the spray irrigation system;
k) monitoring of the effluent [physicochemical];
l) monitoring of soils and herbage [physicochemical];
m) monitoring of groundwater beneath and beyond the irrigated area [physicochemical] (if required in accordance with condition 11 of this consent);
n) monitoring of local water supplies and remediation;
o) mitigation measures, including riparian planting and fencing;
p) reporting monitoring data;
q) monitoring of the tributaries draining the property;
r) procedures for responding to complaints;
s) notification to the council of non-compliance with the conditions of this consent;
t) procedures for recording maintenance and repairs;
u) procedures for draining and flushing the irrigation mainlines and laterals to prevent anaerobic conditions.

The objective of the plan shall be to minimise discharges to the Kahouri Stream under consent 7662-1 and maximise discharges to land.

A copy of the reviewed Plan shall be provided to the Department of Conservation and Fish and Game New Zealand (Taranaki Region), and the Taranaki Regional Council will take into account any comments received (within a two week timeframe from when the Plan was provided).

Note: For ease of assessment, the consent holder shall highlight the areas of the reviewed Plan where changes have been made from the previous Plan.

8. The consent holder shall designate a person with the necessary qualifications and/or experience to manage the wastewater irrigation system. This person shall be regularly trained on the content and implementation of the Wastewater Irrigation Management Plan, and shall be advised immediately of any revision or additions to the wastewater irrigation management plan.

**Application restrictions**

9. The aerator and stirrer shall be operated within the final pond of the wastewater treatment system while wastewater is being irrigated to land.

10. Over any 12 month period the Total Nitrogen applied to any hectare of land as a result of the wastewater, pond solids, blood and/or vermicast discharges and any other nitrogen inputs [e.g. urea] shall be no more than:

a) 200 kg for areas used for grazing; and

b) 600 kg for areas used for cut and carry, subject to condition 11 below.

11. Prior to applying a Total Nitrogen loading that exceeds 200 kg/ha/year in accordance with condition 10 (b) above, the consent holder shall amend and re-submit the Wastewater Irrigation Management Plan described in condition 5 so that, to the satisfaction of the Chief Executive, Taranaki Regional Council, the Plan details how the discharge will be managed to ensure that the conditions of this consent will be met. The Plan shall be amended to include, but not necessarily be limited to, procedures for monitoring and reporting on soil and groundwater quality.

12. The wastewater application depth within any area of irrigation shall not exceed 24 mm over any 15 day period.

13. The sodium absorption ratio [SAR] of the wastewater shall not exceed 15.

14. There shall be no discharge to water as a result of irrigating wastewater to land. In order to ensure there is no such discharge:

    a) no irrigation shall occur closer than 25 m to any surface water body;
    b) the discharge shall not result in surface ponding that remains for more than three hours after the discharge has ceased;
    c) the discharge shall not occur on land with a slope that is likely to result in runoff; and
    d) notwithstanding condition 12, the discharge shall not occur at a rate at which it cannot be assimilated by the soil/pasture system.

15. The extent of the wastewater discharge spray zone shall be at least:

    a) 25 metres away from the bank of any surface waterbody;
    b) 50 metres away from any bore, well or spring used for water supply;
    c) 150 metres away from any dwellinghouse situated off the site, unless the written approval of the owner/occupier has been obtained to allow the discharge at a closer distance; and
    d) 15 metres from State Highway 3.

16. No discharges, including spray drift, shall occur at or beyond the boundary of any property on which the discharge is occurring.

17. As far as practicable, discharges to the Kahouri Stream shall be minimised and discharges to land under consent 5221-2 maximised. This means that even at times when 1:100 dilution can be achieved in the Kahouri Stream, discharges shall be irrigated to land unless the land is saturated and consequently is incapable of accepting the discharge.

18. The application of pond solids, vermicast and/or blood to land shall be undertaken in a manner which avoids a discharge to surface water.

**Records**

19. The consent holder shall record the following information on a daily basis in association with irrigating the wastewater to land:

    a) the date and pumping hours;

b) the volume of discharge [as measured in association with the flow meter required under condition 3];
c) the surface area of land irrigated;
d) the location[s] irrigated, using the system identified and approved under the Wastewater Irrigation Management Plan;
e) the application depth over the location[s] irrigated; and
f) the volume of Total Nitrogen applied over the location[s] irrigated [kg/ha] on any day, and a running total for each irrigation location for each calendar year.

This record shall be in an electronic format and submitted to the Taranaki Regional Council. The record format and frequency that the records are to be submitted is to be undertaken as advised by the Chief Executive, Taranaki Regional Council.

In addition, the consent holder will record the date, time and volume of other materials discharged to the irrigation area, including pond solids, blood and/or vermicast discharges and any other nitrogen inputs [e.g. urea], and will provide such records to the Chief Executive, Taranaki Regional Council, by 1 June of each year.

**Incident notification**

20. Any incident related to this consent that results, or could result, in an adverse effect on the environment shall be notified to the Taranaki Regional Council as soon as practicable, together with the reasons for the incident, and measures taken to mitigate the effects of the incident and prevent a recurrence.

21. Note: For notification purposes, at the grant date of this consent, the Taranaki Regional Council's phone number is 0800 736 222 [24 hour service].

**Review**

22. 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 in any year for any of the following purposes:

a) Ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, and in particular to address any more than minor adverse effects relating to water quality issues; and

b) To determine any measures that may be appropriate to comply with condition 1 of this consent, and which are necessary to address any adverse effects relating to the wastewater discharges from the site.

Signed at Stratford on 7 November 2011

For and on behalf of
Taranaki Regional Council

**Director-Resource Management**

TARANAKI REGIONAL COUNCIL
CHIEF EXECUTIVE
PRIVATE BAG 713
47 CLOTEN ROAD
STRATFORD
NEW ZEALAND
PHONE: 06-765 7127
FAX: 06-765 5097
www.trc.govt.nz
Please quote our file number on all correspondence

# Discharge Permit

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

| | |
|---|---|
| Name of Consent Holder: | Taranaki Abattoirs Co [1992] Limited<br>P O Box 12<br>INGLEWOOD 4347 |
| Decision Date: | 7 November 2011 |
| Commencement Date: | 7 November 2011 |

## Conditions of Consent

| | |
|---|---|
| Consent Granted: | To discharge treated wastewater directly into the Kahouri Stream at or about (NZTM) 1709705E-5647806N |
| Expiry Date: | 1 June 2028 |
| Review Date(s): | June of any year |
| Site Location: | 3326 Mountain Road, Stratford |
| Legal Description: | Sec 62 Manganui Dist Blk XIII Huiroa SD |
| Catchment: | Patea |
| Tributary: | Kahouri |

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

### General condition

a. The consent holder shall pay to the Taranaki Regional Council [the Council] all the administration, monitoring and supervision costs of this consent, fixed in accordance to section 36 of the Resource Management Act.

### Special conditions

### General conditions

1. 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.

2. The consent holder shall notify the Chief Executive, Taranaki Regional Council, prior to making any changes to the processes or operations undertaken at the site, or chemicals used or stored on site that could alter the nature of the discharge. Any such change shall then only occur following receipt of any necessary approvals under the Resource Management Act 1991.

### Pre-activity requirements

3. This consent shall not be exercised while consent 0108-4 [which authorises the discharge of wastewater to an unnamed tributary of the Kahouri Stream] is still current.

   Note: this condition does not apply during the testing phase of commissioning the system that will be used for discharging under this consent.

4. Before exercising this consent the consent holder shall install, and thereafter maintain, a flow meter. The flow meter shall measure the volume of the discharge to the Kahouri Stream to an accuracy of ± 5%.

   Notes: Flow meters must be installed, and regularly maintained, in accordance with the manufacturer's specifications in order to ensure that they meet the required accuracy. Even with proper maintenance flow meters have a limited lifespan.

   A single flow meter may be installed for the purposes of meeting this condition and condition 3 of consent 5221-2 provided that the records submitted in accordance with condition 22 of this consent and condition 19 of consent 5221-2 clearly differentiate between the two receiving environments.

### Flow meter certification

5. The consent holder shall provide the Chief Executive, Taranaki Regional Council with documentation from a suitably qualified person certifying that the flow meter :

   a) has been installed and/or maintained in accordance with the manufacturers' specifications; and/or

b) has been tested and shown to be operating to an accuracy of ± 5%.

The documentation shall be provided:

(i) within 30 days of the installation of a flow meter;

(ii) at other times when reasonable notice is given and the Chief Executive, Taranaki Regional Council has reasonable evidence that the flow meter may not be functioning as required by this consent; and

(iii) no less frequently than once every five years.

**Staff gauge installation and flow curve establishment**

6. The consent holder shall ensure that a staff gauge is installed and maintained to effectively display the water level in the Kahouri Stream at or around the point of discharge to an accuracy of 0.005 m.

7. The consent holder shall, as soon as practicable, ensure that sufficient stream flow measurements are undertaken to maintain a 'rating curve' that accurately translates the water level, as displayed on the staff gauge referenced in condition 6, to stream flow at or around the point of discharge.

Note: Work required by conditions 6 and 7 will be undertaken by the Taranaki Regional Council and all reasonable costs will be recovered from the consent holder through the annual compliance monitoring programme that is in place for the activity.

**Minimisation of wastewater**

8. All uncontaminated stormwater shall be prevented from entering the wastewater treatment ponds as far as practicable.

9. The worm bed area shall be managed to minimise leachate discharges to the pond treatment system as far as practicable [e.g. by covering the worm beds and/or vegetating land surfaces between worm bed rows] to the satisfaction of the Chief Executive, Taranaki Regional Council.

**Discharges to the Kahouri Stream [at all times]**

10. The aerator and stirrer shall not be operated within the wastewater treatment system while discharging to the Kahouri Stream.

11. Notwithstanding conditions 12 and 18 below, discharges to the Kahouri Stream shall only occur when stream flows are 330 L/s or greater.

12. A minimum dilution ratio of 1 part wastewater to 100 parts receiving water shall be maintained at all times in the receiving waters of the Kahouri Stream at the point of discharge.

13. Discharges into the Kahouri Stream shall not give rise to the following effects in the Kahouri Stream, beyond a mixing zone of 50 m:

a) a level of filtered carbonaceous $BOD_5$ of more than 2.00 $gm^{-3}$;
b) a level of unionised ammonia of greater than 0.025 $gm^{-3}$;
c) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
d) any conspicuous change in the colour or visual clarity;
e) any emission of objectionable odour;
f) the rendering of fresh water unsuitable for consumption by farm animals;
g) any significant adverse effects on aquatic life; and
h) the generation of undesirable heterotrophic growths [sewage fungus].

Note: The difference in macroinvertebrate community between the upstream control site and the potential impact site immediately below the mixing zone will be examined in order to determine if the discharge has resulted in a 'significant adverse effect on aquatic life'. This will include examining any change in the Semi-Quantitative Macroinvertebrate Community Index [SQMCI], overall composition of the community [including %EPT] and Macroinvertebrate Community Index [MCI] . Should this examination identify a significant adverse effect caused by the discharge, this will constitute a breach of this condition.

14. After allowing for reasonable mixing, within a mixing zone extending 50 m downstream of the discharge point, the discharge shall not give rise to either of the following effects in the receiving waters of the Kahouri Stream:

a) an increase in suspended solids concentration in excess of 5 $gm^{-3}$, when the stream turbidity as measured upstream of the discharge point is equal or less than 5 NTU [nephelometric turbidity units]; or

b) an increase in turbidity of more than 50% when the stream turbidity as measured upstream of the discharge point is greater than 5 NTU [nephelometric turbidity units].

15. The consent holder shall establish and maintain a safe access way to the Kahouri Stream to enable water quality samples to be taken at the compliance point stated in conditions 13 and 14 above, and at a suitable control site upstream, the location of which is to be advised by the Chief Executive, Taranaki Regional Council.

**Discharges to the Kahouri Stream after hours**

16. At least 200 mm [426 $m^3$] of freeboard must be made available within the aerobic pond at 5 pm of each working/operational day.

17. The consent holder shall install and maintain a permanent marker within the aerobic pond to show the level where the wastewater should be at or below in order to achieve the required freeboard stated under condition 16 above.

### Restrictions on times of discharge

18. As far as practicable, discharges to the Kahouri Stream shall be minimised and discharges to land under consent 5221-2 maximised. This means that even at times when 1:100 dilution can be achieved in the Kahouri Stream, discharges shall be irrigated to land unless the land is saturated and consequently is incapable of accepting the discharge.

    Note: This condition to minimise discharges to water does not apply to discharges outside of operational hours. Notwithstanding this, a 1:100 dilution must be met at all times, including outside of operational hours, in accordance with condition 12.

### Treated wastewater quality

19. The wastewater treatment system shall be managed to maximise the quality of the wastewater discharged to the Kahouri Stream.

20. After treatment in the wastewater treatment system, the discharge shall not have a concentration of total carbonaceous BOD5 greater than 110 gm-3.

    This condition shall apply before the discharge enters the Kahouri Stream at a designated sampling point[s] approved by the Chief Executive, Taranaki Regional Council.

21. The consent holder shall install a tap on the wastewater line, between the aerobic pond and the discharge point, to allow for the taking of samples in association with condition 20 above.

### Records

22. The consent holder shall monitor and record the following information on a daily basis in association with discharging wastewater to the Kahouri Stream:

    a) the date, the time, pumping hours and the rate of discharge for when discharges are manually initiated and halted, or the date or dates [when over a weekend] and the rate of discharge for automated discharges after hours;

    b) the volume of discharge [as measured in association with the flow meter required under condition 4]; and

    c) the staff gauge reading, stream flow rate and dilution ratio [wastewater : receiving water] for when discharges are manually initiated and halted [i.e. not including automated discharges after hours]. The stream flow rate shall be based on the rating curve established under condition 7.

    This record shall be in an electronic format and submitted to the Taranaki Regional Council. The record format and frequency that the records are to be submitted is to be undertaken as advised by the Chief Executive, Taranaki Regional Council.

    Note: if the discharge rate is varied on any day, then the records shall record the above information for each discharge event.

### Mitigation

23. For the mitigation purposes of this consent and consent 0108-4, the consent holder shall undertake the following:

    a) ensure that Taranaki Regional Council riparian management plan LM10/73 is reviewed by a Taranaki Regional Council Land Management Officer within one month of the grant date of this consent;

    b) complete riparian planting and fencing on both sides of all watercourses on the site in accordance with the riparian management plan reviewed under clause (a) above by 30 September 2013; and

    c) maintain the areas of riparian planting and fencing undertaken in accordance with clause (b) above for the duration of this consent, by ensuring the ongoing replacement of plants which do not survive, the eradication of weeds until the plants are well established, and the exclusion of stock from the planted areas.

### Incident notification

24. Any incident related to this consent that results, or could result, in an adverse effect on the environment shall be notified to the Taranaki Regional Council as soon as practicable, together with the reasons for the incident, and measures taken to mitigate the effects of the incident and prevent a recurrence.

    Note: For notification purposes, at the grant date of this consent, the Taranaki Regional Council's phone number is 0800 736 222 [24 hour service].

### Lapse and review dates

25. This consent shall lapse on 7 November 2016, unless the consent is given effect to before the end of that period.

26. 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 in any year for any of the following purposes:

    a) Ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, and in particular to address any more than minor adverse effects relating to water quality issues;

    b) to take into account any Act of Parliament, regulation, national policy statement [including the National Policy Statement for Freshwater Management 2011], regional policy statement or regional rule which relates to limiting, recording, mitigating, setting or amending any limits or other criteria relating to nutrients, ecological health or other water quality parameters; and

c) To determine any measures that may be appropriate to comply with condition 1 of this consent, and which are necessary to address any adverse effects relating to the wastewater discharges from the site.

In considering whether to initiate a review, the Taranaki Regional Council will take into account any views received from the Department of Conservation and Fish and Game New Zealand (Taranaki Region).

Signed at Stratford on 7 November 2011

For and on behalf of
Taranaki Regional Council

**Director-Resource Management**

Consent 5176-1

TARANAKI REGIONAL COUNCIL
CHIEF EXECUTIVE
PRIVATE BAG 713
47 CLOTEN ROAD
STRATFORD
NEW ZEALAND
PHONE: 06-765 7127
FAX: 06-765 5097
www.trc.govt.nz

Please quote our file number on all correspondence

# Water Permit

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

Name of Consent Holder: Taranaki Abattoir Company [1992] Limited
P O Box 12
INGLEWOOD

★ Change To Conditions Date: 19 May 2008 [Granted: 28 August 1997]

## Conditions of Consent

★ Consent Granted: To take water from the Kahouri Stream in the Patea catchment for stock and yard washing purposes at or about (NZTM) 1709741E-5647780N

Expiry Date: 1 June 2016

Review Date(s): June 2010

Site Location: Mountain Road North, Stratford

Legal Description: Sec 62 Manganui Dist Blk XIII Huiroa SD

Catchment: Patea

Tributary: Kahouri

*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

### Condition 1 [changed]

1. At all times the consent holder shall adopt the best practicable option to prevent or minimise any actual or likely adverse effect on the environment associated with the abstraction of water from the Kahouri Stream, including, but not limited to, the efficient and conservative use of water.

### Condition 2 [changed]

2. The volume of water abstracted shall not exceed 178 cubic metres per day, at a rate no greater than 3.25 litres/second.

### Condition 3 [new]

3. Before exercising this consent the consent holder shall install, and thereafter maintain, a water meter that measures and records the rate and volume of water taken to an accuracy of ± 5%.

### Condition 4 [previously condition 3]

4. The resource consent holder shall maintain records of abstraction including date, pumping rates and volume abstracted, and shall make these records available to the Chief Executive, Taranaki Regional Council, upon request.

### Condition 5 [new]

5. The taking of water authorised by this consent shall be managed to ensure that the flow in the Kahouri Stream immediately below the intake point is no less than 109 litres per second. No taking shall occur when the flow is less than 109 litres per second.

**Condition 6 [new]**

6. The consent holder shall ensure that the intake structure is appropriately screened to avoid the entrainment of fish.

**Condition 7 [changed - Previously condition 4]**

7. The Taranaki Regional Council may review, under section 128 and section 129 of the Resource Management Act 1991, any or all of the conditions of this consent by giving notice of review during the month of June 2010 for the purpose of ensuring that the conditions are adequate to deal with any significant adverse effects on the environment arising from the exercise of this consent, which either were 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 19 May 2008

For and on behalf of
Taranaki Regional Council

Director-Resource Management

Consent 6570-1

TARANAKI REGIONAL COUNCIL

CHIEF EXECUTIVE
PRIVATE BAG 713
47 CLOTEN ROAD
STRATFORD
NEW ZEALAND
PHONE 06-765 7127
FAX 06-765 5097

Please quote our file number on all correspondence

# Discharge Permit

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

| | |
|---|---|
| Name of Consent Holder: | Taranaki Abattoir Company [1992] Limited<br>P O Box 12<br>INGLEWOOD |
| Consent Granted Date: | 24 March 2005 |

## Conditions of Consent

| | |
|---|---|
| Consent Granted: | To discharge degenerating raw product onto and into land in the vicinity of an unnamed tributary of the Kahouri Stream in the Patea catchment at or about GR: Q20:197-093 |
| Expiry Date: | 1 June 2022 |
| Review Date(s): | June 2005, June 2006, June 2007, June 2008, June 2010, June 2016 |
| Site Location: | 3396 Mountain Road, Stratford |
| Legal Description: | Sec 62 Manganui Dist Blk XIII Huiroa SD |
| Catchment: | Patea |
| Tributary: | Kahouri |

*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 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.

2. The exercise of this consent shall be undertaken generally in accordance with the documentation submitted in support of application 3576. In the case of any contradiction between the documentation submitted in support of application 3576 and the conditions of this consent, the conditions of this consent shall prevail.

3. The consent holder shall notify the Chief Executive, Taranaki Regional Council, prior to the exercise of this consent.

4. The consent holder shall notify the Chief Executive, Taranaki Regional Council as soon as practicable in advance of all burials.

5. By 1 June 2005, the consent holder shall provide a waste burial management plan, to the approval of the Chief Executive, Taranaki Regional Council, outlining the management of the system, which shall demonstrate the ability of the consent holder to comply with consent conditions and shall address the following matters:

   a) nature of wastes discharged;
   b) discharge control;
   c) waste cover;
   d) addition of hydrated lime to stabilise the wastes;
   e) minimisation and control of odour effects offsite;
   f) stormwater control;
   g) site re-instatement and after care (including maintaining the integrity of the cover material);
   h) site contouring;
   i) procedures for responding to complaints;
   j) notification to the Council of non-compliance with the conditions of this consent.

6. Only raw degenerating material shall be disposed of to the burial pit(s).

7. Raw degenerating material shall only be discharged onto and into land at the site in an emergency situation and only after other options, such as diversion to an alternative site, have been pursued to the satisfaction of the Chief Executive, Taranaki Regional Council.

8. The exercise of this consent, including the design and management of the burial site and system, shall not lead to or be liable to lead to contaminants entering a surface water body.

9. No adverse effects shall occur to groundwater in the vicinity of the discharge, as a result of this consent

10. The consent holder shall keep records of quantities and types of wastes discharged, and the dates of exercising this consent and shall make such records available to the Chief Executive, Taranaki Regional Council upon request.

11. The discharged material shall be covered within a period of four hours or less so as to avoid the generation of offensive offsite odours.

12. At the completion of the disposal operation a low permeability, clean, compacted soil cover with a minimum thickness of 800 millimetres shall be placed over the discharged wastes.

13. The cover material and surrounding land shall be contoured such that all stormwater is directed away from the disposal area to the satisfaction of the Chief Executive, Taranaki Regional Council.

14. The disposal area shall be rehabilitated and pasture re-established to the satisfaction of the Chief Executive, Taranaki Regional Council.

15. This consent shall lapse on the expiry of five years after the date of issue of this consent, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

16. 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 2005 and/or 2006 and/or 2007 and/or 2008 and/or 2010 and/or June 2016, 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 24 March 2005

For and on behalf of
Taranaki Regional Council

**Director-Resource Management**

# Appendix II

# Biomonitoring reports

| | |
|---|---|
| **To** | Bart Jansma, Scientific Officer |
| **From** | Bart Jansma, Scientific Officer |
| **Document** | 1401418 |
| **Report No** | BJ238 |
| **Date** | 2 September 2014 |

# Biomonitoring of the Kahouri Stream in relation to Taranaki Abattoirs, February 2014.

## Introduction

This was the second of two biomonitoring surveys undertaken in the 2013-2014 year for the Taranaki Abattoir site. This survey was performed to monitor the health of the macroinvertebrate community of the Kahouri Stream in relation to wastewater management at the Taranaki Abattoirs site. Wastewater from the Taranaki Abattoir site is directed to a two pond treatment system, and is either irrigated to land when soil conditions allow, or discharged to the Kahouri Stream at a time of high flow and adequate dilution. The Kahouri Stream was monitored to determine whether the direct discharge of wastewater during high flows has affected the macroinvertebrate communities of the stream.

The results of surveys previously conducted in relation to the Taranaki Abattoir site are discussed in the references at the end of this report. Included is a baseline survey of the Kahouri Stream, undertaken in September 2011.

It should be noted that the relevant consent (7662-1) includes the following statement:

"The difference in macroinvertebrate community between the upstream control site and the potential impact site immediately below the mixing zone will be examined in order to determine if the discharge has resulted in a 'significant adverse effect on aquatic life'. This will include examining any change in the Semi-Quantitative Macroinvertebrate Community Index [SQMCI], overall composition of the community [including %EPT] and Macroinvertebrate Community Index [MCI]. Should this examination identify a significant adverse effect caused by the discharge, this will constitute a breach of this condition."

This report will undertake the examination of results stipulated by this consent.

## Methods

The standard '400 ml kick-sampling' technique was used to collect streambed macroinvertebrates from three established sites in the Kahouri Stream and two sites in the unnamed tributary (Table 1, Figure 1) on 25 February 2014. 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 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) = estimated 20-99 individuals;
VA (very abundant) = estimated 100-499 individuals;
XA (extremely abundant) = estimated 500 individuals or more.

**Table 1** Biomonitoring sites in the Kahouri Stream sampled in relation to Taranaki Abattoirs

| Site number | Site code | Location |
|---|---|---|
| 1 | KHI000297 | Kahouri Stream, 150 m u/s of abattoir and SH3 |
| 2 | KHI000300 | Kahouri Stream, SH3, approx. 95m downstream of discharge point |
| 3 | KHI000305 | Kahouri Stream, 85 m d/s of site 2 |

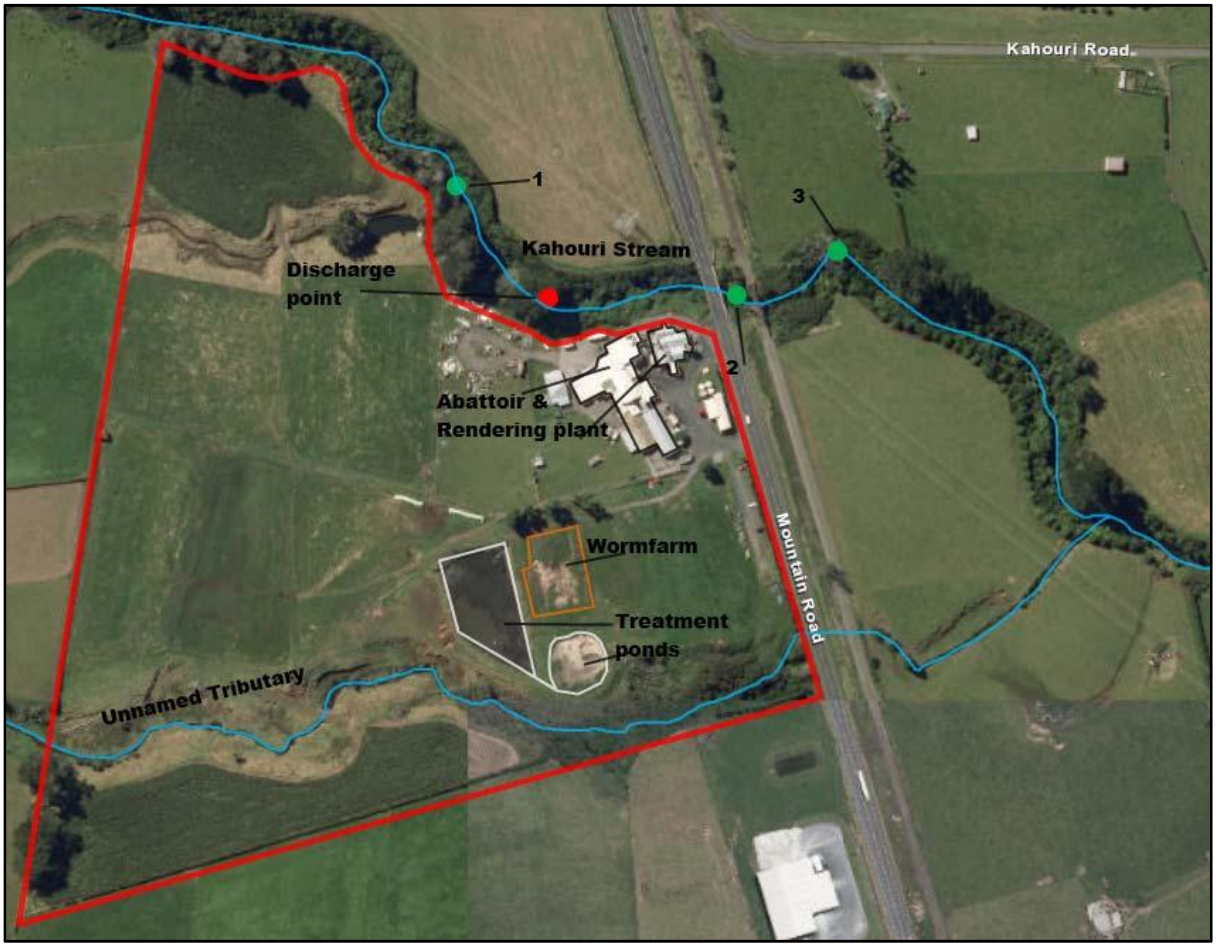


**Figure 1** Taranaki Abattoirs site layout and biomonitoring sites, in relation to the discharge point

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. Averaging the scores assigned to the taxa found at a site, and multiplying the average by a scaling factor of 20 produces a Macroinvertebrate Community Index (MCI) value.

The MCI was designed as a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. MCI results can also reflect the effects of

warm temperatures, slow current speeds and low dissolved oxygen levels, because the taxa capable of tolerating these conditions generally have low sensitivity scores. Usually more 'sensitive' communities (with higher MCI values) inhabit less polluted waterways. The use of this index in non-stony streams is possible if results are related to physical habitat (good quality muddy/weedy sites tend to produce lower MCI values than good quality stony sites).

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, therefore $SQMCI_s$ values range from 1 to 10, while MCI values range from 20 to 200.

In addition to assessing these indices, the number of Ephemopterans (mayflies), Plecopterans (stoneflies) and Trichopterans (caddisflies) in the community were taken into account when considering any differences between communities. These are referred to as EPT taxa.

Sub-samples of periphyton (algae and other micro flora) taken from the macroinvertebrate samples 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 these organisms can be an indicator of organic enrichment within a stream.

## Results and discussion

At the time of this late morning survey the Kahouri Stream had a very low flow, owing to the relatively long period of recession, with the last flood event of three times the median flow occurring 35 days prior to the sampling date. The relatively steep gradient resulted in a swift flow at all three sites. This flow was uncoloured and clear, with, the cloudiness typical for this stream, due to the naturally occurring high iron oxide content, being absent during the current survey. The stream bed material at all sites comprised predominantly boulders, cobbles and coarse gravels, with smaller proportions of fine gravels and sand.

Periphyton was present as patchy mats at site 1, but only a slippery film of algae was noted at sites 2 and 3, owing primarily to the partial or complete shading enjoyed by these sites. Patchy growths of moss were present at these sites also.

No sewage fungus was observed on the bed of the stream, and the absence of sewage fungus was confirmed through microscopic examination.

Company records indicate that prior to this survey, the last time wastewater was discharged to the Kahouri Stream was on 9 February 2014, 16 days prior to this survey. On this day, 1150$m^3$ of wastewater was discharged to the Kahouri Stream.

## Macroinvertebrate communities

Previous surveys performed in the vicinity of Taranaki Abattoirs have indicated that the macroinvertebrate communities of the Kahouri Stream are generally in good condition with relatively high numbers of taxa and MCI values. Results of previous surveys performed in

the vicinity of Taranaki Abattoirs are summarised in Table 2, together with current results and the full results are shown in Table 3.

**Table 2** Summary of the numbers of taxa, MCI and $SQMCI_S$ values recorded previously in the Kahouri Stream, together with current results. Included for reference are summary statistics for site C (KHI000307), which is located 50m downstream of the unnamed tributary, approximately 300m downstream of site 3.

| Site | Number of previous surveys | Numbers of taxa | | | MCI values | | | $SQMCI_S$ values | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Median | Range | Current Survey | Median | Range | Current Survey | N | Median | Range | Current Survey |
| C | 25 | 27 | 17-35 | - | 108 | 96-120 | - | 13 | 4.8 | 3.5-6.8 | - |
| 1 | 26 | 26 | 17-35 | 20 | 115 | 106-130 | 112 | 17 | 6.4 | 5.5-7.4 | 7.4 |
| 2 | 7 | 22 | 13-28 | 25 | 116 | 108-123 | 114 | 4 | 7.3 | 7.0-7.7 | 7.2 |
| 3 | 4 | 25 | 19-27 | 21 | 114 | 109-114 | 110 | 4 | 7.2 | 6.7-7.6 | 7.1 |

**Table 3** Macroinvertebrate fauna of the Kahouri Stream, current survey

| Taxa List | Site Number | MCI score | 1 | 2 | 3 |
|---|---|---|---|---|---|
| | Site Code | | KHI000297 | KHI000300 | KHI000305 |
| | Sample Number | | FWB14170 | FWB14171 | FWB14172 |
| ANNELIDA (WORMS) | Oligochaeta | 1 | R | R | C |
| MOLLUSCA | *Potamopyrgus* | 4 | - | R | - |
| CRUSTACEA | *Paranephrops* | 5 | R | - | - |
| EPHEMEROPTERA (MAYFLIES) | *Austroclima* | 7 | VA | A | C |
| | *Coloburiscus* | 7 | VA | VA | XA |
| | *Deleatidium* | 8 | XA | XA | XA |
| | *Nesameletus* | 9 | VA | VA | A |
| | *Zephlebia group* | 7 | C | C | A |
| PLECOPTERA (STONEFLIES) | *Acroperla* | 5 | - | R | - |
| | *Megaleptoperla* | 9 | - | R | - |
| | *Spaniocerca* | 8 | - | - | R |
| | *Zelandoperla* | 8 | C | R | C |
| COLEOPTERA (BEETLES) | Elmidae | 6 | VA | VA | VA |
| | Hydraenidae | 8 | C | A | C |
| MEGALOPTERA (DOBSONFLIES) | *Archichauliodes* | 7 | A | A | A |
| TRICHOPTERA (CADDISFLIES) | *Aoteapsyche* | 4 | A | A | A |
| | *Costachorema* | 7 | C | C | R |
| | *Hydrobiosis* | 5 | C | C | C |
| | *Confluens* | 5 | C | R | - |
| | *Oxyethira* | 2 | - | - | R |
| | *Pycnocentria* | 7 | - | C | - |
| | *Triplectides* | 5 | - | R | - |
| DIPTERA (TRUE FLIES) | *Aphrophila* | 5 | A | VA | VA |
| | Hexatomini | 5 | - | R | - |
| | Orthocladiinae | 2 | C | A | R |
| | *Polypedilum* | 3 | R | R | C |
| | Tanypodinae | 5 | R | R | R |
| | *Austrosimulium* | 3 | R | R | C |
| | Tanyderidae | 4 | - | - | R |
| | | No of taxa | 20 | 25 | 21 |
| | | MCI | 112 | 114 | 110 |
| | | SQMCIs | 7.4 | 7.2 | 7.1 |
| | | EPT (taxa) | 10 | 14 | 10 |
| | | %EPT (taxa) | 50 | 56 | 48 |
| 'Tolerant' taxa | 'Moderately sensitive' taxa | 'Highly sensitive' taxa | | | |

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

## Site 1 (KHI000297)

A less than average community richness of 20 macroinvertebrate taxa was found at site 1, upstream of the Taranaki Abattoir site. This was six taxa less than the median number of

taxa from previous surveys at this site (Table 2) but similar to that recorded in the previous survey (Figure 2). The community was characterised by two 'highly sensitive' taxa (*Deleatidium* and *Nesameletus* mayflies), five 'moderately sensitive' taxa (*Austroclima* and *Coloburiscus* mayflies, elmid beetles, *Archichauliodes* dobson fly larvae and *Aphrophila* cranefly) and one 'tolerant' taxon (net-spinning caddisfly *Aoteapsyche*) (Table 3). This is similar to that recorded in most previous surveys.

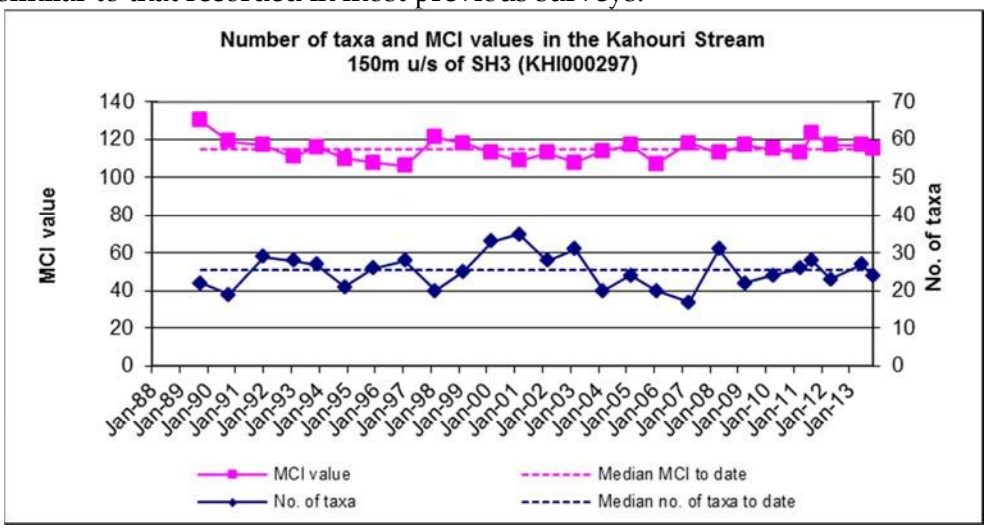


**Figure 2** Number of taxa and MCI values in the Kahouri Stream at site 1 (KHI000297)

The moderate proportion of 'sensitive' taxa (75% of total richness) in the community resulted in a MCI score of 112 units, which was similar to the long term median of past surveys' scores at this site, and similar to that recorded in most previous surveys (Table 2, Table 3, Figure 2). The dominance (numerically) of sensitive taxa, particularly mayflies, accounted for the high $SQMCI_s$ value (7.4 units), a good result, and 1.0 unit higher than the median (Table 2), a statistically significant result (Stark, 1998). There were ten EPT taxa in the community, comprising 50% of the taxa recorded. This indicates good preceding water quality.

## Site 2 (KHI000300)

This site was sampled for the fourth time since the discharge of wastewater began upstream. Located at State Highway 3, approximately 95m downstream of the discharge point, this site would be expected to show the greatest impact (if any) of the discharge of wastewater to the Kahouri Stream. A moderate community richness of 25 taxa was recorded at this site, five more than that recorded at site 1 in the current survey, but similar to the median richness for this site (Table 2). The community was characterised by three 'highly sensitive' taxa (*Deleatidium* and *Nesameletus* mayflies and hydraenid beetles), five 'moderately sensitive' taxa (*Austroclima* and *Coloburiscus* mayflies, elmid beetles, *Archichauliodes* dobsonfly larvae and *Aphrophila* cranefly); and two 'tolerant' taxa (net-spinning caddisfly *Aoteapsyche* and orthoclad midges). The community comprised 76% 'sensitive' taxa, resulting in an MCI score of 114 units, an insignificant rise of two units from that recorded at site 1 and similar to the median for this site (Table 2).

There was little difference in $SQMCI_S$ score compared with site 1 upstream, with a slight decrease to 7.2 units (Table 2). This lack of change reflects the similarities in dominant taxa, and the fact that there was only one significant change in individual taxon abundance. In addition, %EPT was very similar to that recorded at site 1 (56%)

The similarity in %EPT, MCI and $SQMCI_S$ scores reflect that the communities of site 1 and 2 were very similar, indicating no impact from the discharge of wastewater between the two sites.

### Site 3

Site 3 is located another 85m downstream of site 2, and is situated amongst a rapid dominated by large boulders. This is the fifth time that this site has been sampled. Twenty-one taxa were recorded at this site, similar to that recorded at sites 1 and 2 upstream. As with sites 1 and 2, 'highly sensitive' *Deleatidium* mayflies were extremely abundant. Other taxa recorded in abundance included one 'highly sensitive' taxon (*Nesameletus* mayflies), five 'moderately sensitive taxa (*Coloburiscus* and *Zephlebia* mayflies, elmid beetles, *Archichauliodes* dobsonfly larvae and *Aphrophila* cranefly) and one 'tolerant' taxon (net-spinning caddisfly *Aoteapsyche*)..

The moderate proportion of sensitive taxa in the community (67%), resulted in an MCI score of 110 units, less than that recorded at sites 1 and 2, but not statistically significantly so (Stark, 1998). Overall, the difference in MCI score between this site and that recorded at site 1 is similar to that recorded in the baseline survey, indicating no impact from the discharge of wastewater upstream. The $SQMCI_S$ score is similar to that recorded upstream (7.1 units), reflecting the similar community compositions. This result is also significantly higher than the median $SQMCI_S$ score recorded at site C downstream, also reflecting a lack of organic enrichment at site 3. Furthermore, there was little difference in %EPT with that recorded at site 1.

Overall, this survey indicates that although there may be some slight deterioration in community health in a downstream direction, this is natural, and not related to any discharge from the Taranaki Abattoirs site.

## Summary and conclusions

The Council's standard 'kick-sampling' technique was used to collect streambed macroinvertebrates from three sites in the Kahouri Stream in relation to the Taranaki Abattoirs site on 25 February 2014. This survey was performed to monitor the health of the macroinvertebrate community of the Kahouri Stream in relation to wastewater management at the Taranaki Abattoirs site. Since late 2011, wastewater has been irrigated to land when soil conditions allow, or discharged to the Kahouri Stream at a time of high flow and adequate dilution. Samples were sorted and identified to provide the 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. It may be used in soft-bottomed streams to detect trends over time. The $SQMCI_S$ takes into account taxa abundance as well as sensitivity to pollution, and may reveal more subtle changes in communities, particularly if non-organic impacts are occurring.

Significant differences in either MCI or $SQMCI_S$ between sites indicate the degree of adverse effects (if any) of discharges being monitored.

During this summer survey, the three sites sampled in the Kahouri Stream recorded little variation in taxa richness, and the MCI scores and $SQMCI_S$ scores were very similar, both to each other and with regard to the MCI score, to the median recorded at site 1 upstream. In addition, these sites were largely dominated by the same taxa, with very few significant differences in individual taxon abundance between sites. The results of this survey also did not differ markedly from that recorded in the baseline survey, suggesting little change in communities since the discharge of wastewater commenced. The $SQMCI_S$ scores were all well above the median score recorded at site 1, and significantly higher than that recorded at site C. This also indicates a lack of organic enrichment at these sites. Overall, this survey indicates that although there may be a slight deterioration in community health in a downstream direction, this is natural, and not related to any discharge from the Taranaki Abattoirs site. This was supported by the absence of sewage fungus, as determined by microscopic inspection of the samples.

Overall, the Kahouri Stream was in good condition, and with regards to the statement in the consent, an examination of the MCI, $SQMCI_S$ scores and the %EPT found no indication of a significant adverse effect caused by the discharge, and as such, there was no breach of condition 13 of consent 7662-1.

## References


Dunning K, 2002: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2002. TRC report KD124

Fowles C & Moore S, 2004: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2004. TRC report CF332.

Fowles C & Hope K, 2006: Biomonitoring of the Kahouri Stream and an unnamed tributary, February 2006. TRC report CF405.

Hope K, 2005: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2005. TRC report KH035.

Jansma, B, 2009a: Biomonitoring of the Kahouri Stream and an unnamed tributary, April 2007. TRC report BJ052.

Jansma, B, 2009b: Biomonitoring of the Kahouri Stream and an unnamed tributary, May 2008. TRC report BJ053.

Jansma, B, 2010: Biomonitoring of the Kahouri Stream and an unnamed tributary, April 2009. TRC report BJ088.

Jansma, B, 2011: Biomonitoring of the Kahouri Stream and an unnamed tributary, April 2010. TRC report BJ142.

Jansma, B 2014: Biomonitoring of the Kahouri Stream and an unnamed tributary, April 2011. TRC report BJ233.

Jansma, B, 2014: Baseline biomonitoring of the Kahouri Stream in relation to Taranaki Abattoirs, September 2011. TRC Report BJ234.

Jansma, B, 2014: Biomonitoring of the Kahouri Stream and an unnamed tributary in relation to Taranaki Abattoirs, May 2012. TRC Report BJ235.

Jansma, B, 2014: Biomonitoring of the Kahouri Stream and an unnamed tributary in relation to Taranaki Abattoirs, June 2013. TRC Report BJ236.

Jansma, B, 2014: Biomonitoring of the Kahouri Stream in relation to Taranaki Abattoirs, November 2013. TRC Report BJ237.

McWilliam H, 2000: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2000. TRC report HM225

McWilliam H, 2001: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2001. TRC report HM242

Moore S, 2003: Biomonitoring of the Kahouri Stream and an unnamed tributary, 24 March 2003. TRC report SM583

Stark JD, 1985: A macroinvertebrate community index of water quality for stony streams. Water and Soil Miscellaneous Publication No. 87.

Stark JD, 1998: SQMCI: a biotic index for freshwater macroinvertebrate coded abundance data. New Zealand Journal of Marine and Freshwater Research 32(1): 55-66.

Stark JD, 1999: An evaluation of Taranaki Regional Council's SQMCI biomonitoring index. Cawthron Institute, Nelson. Cawthron Report No. 472.

Stark JD, Boothroyd IKG, Harding JS, Maxted JR, Scarsbrook MR, 2001: Protocols for sampling macroinvertebrates in wadeable streams. New Zealand Macroinvertebrate Working Group Report No. 1. Prepared for the Ministry for the Environment. Sustainable Management Fund Project No. 5103. 57p.

TRC, 1999: Some statistics from the Taranaki Regional Council database (FWB) of freshwater macroinvertebrate surveys performed during the period from January 1980 to 31 December 1998. Technical Report 99-17.

**To** Bart Jansma, Scientific Officer
**From** Bart Jansma, Scientific Officer
**Document** 1385311
**Report No** BJ233
**Date** 6 August 2014

# Biomonitoring of the Kahouri Stream and unamed tributary in relation to Taranaki Abattoirs, April 2011

## Introduction

This was the only biomonitoring survey undertaken in the 2010-2011 year for the Taranaki Abattoir site. This survey was previously undertaken under the Kahouri Catchment monitoring programme, which was discontinued following the 2009-2010 monitoring period. At the time of this survey, all wastewater from the Taranaki Abattoir site was directed to a two pond treatment system, and discharged to an unnamed tributary of the Kahouri Stream. In addition to this, the site discharged degenerating product to land adjacent to this unnamed tributary, which has the potential to impact the stream through shallow groundwater seepage.

The results of surveys previously conducted in relation to this site discussed in the references at the end of this report.

## Methods

The standard '400 ml kick-sampling' technique was used to collect streambed macroinvertebrates from two established sites in the Kahouri Stream and two sites in the unnamed tributary that receives the discharge from Taranaki Abattoirs (Table 1, Figure 1) on 13 April 2011. 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 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) | = estimated 20-99 individuals; |
| VA (very abundant) | = estimated 100-499 individuals; |
| XA (extremely abundant) | = estimated 500 individuals or more. |

**Table 1** Biomonitoring sites in the Kahouri Stream and unnamed tributary sampled in relation to Taranaki Abattoirs

| Site number | Site code | Location |
|---|---|---|
| A | KHI000297 | Kahouri Stream, 150 m u/s of abattoir and SH3 |
| B1 | KHI000301 | Abattoir Tributary, u/s abattoir discharge |
| B2 | KHI000302 | Abattoir Tributary, ~50m d/s abattoir discharge |
| C | KHI000307 | Kahouri Stream, 50 m d/s of tributary receiving abattoir discharge |

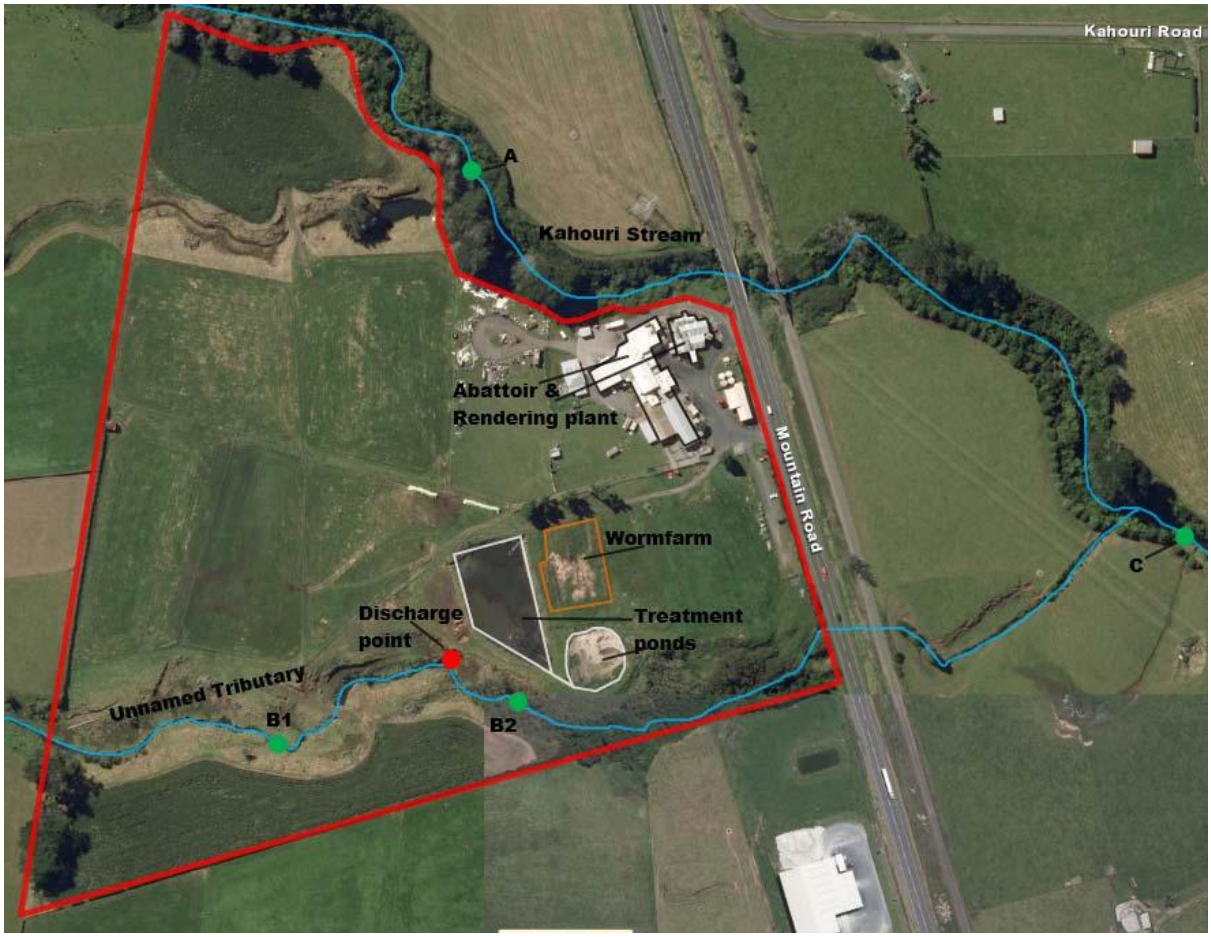


**Figure 1** Taranaki Abattoirs site layout and biomonitoring sites, in relation to the discharge point

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. Averaging the scores assigned to the taxa found at a site, and multiplying the average by a scaling factor of 20 produces a Macroinvertebrate Community Index (MCI) value.

The MCI was designed as a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. MCI results can also reflect the effects of warm temperatures, slow current speeds and low dissolved oxygen levels, because the taxa capable of tolerating these conditions generally have low sensitivity scores. Usually more 'sensitive' communities (with higher MCI values) inhabit less polluted waterways. The use of this index in non-stony streams is possible if results are related to physical habitat (good quality muddy/weedy sites tend to produce lower MCI values than good quality stony sites).

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, therefore $SQMCI_s$ values range from 1 to 10, while MCI values range from 20 to 200.

Sub-samples of periphyton (algae and other micro flora) taken from the macroinvertebrate samples 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 these organisms can be an indicator of organic enrichment within a stream.

## Results and discussion

At the time of this afternoon survey the Kahouri Stream had a moderate flow, despite having been in a relatively long period of recession, with the last flood event of three times the median flow occurring 27 days prior to the sampling date. The relatively steep gradient resulted in a swift flow at both sites. This flow was uncoloured but cloudy, and the stream bed material at both sites comprised predominantly boulders, cobbles and gravels, with a small proportion of sand.

Periphyton was present as a slippery film at site A, while at site B, both algal mats and filaments were present in patches. Both sites supported patchy growths of moss, despite site A being completely shaded, and site B being partially shaded.

The unnamed tributary had an uncoloured and clear flow at site B1, which became cloudy downstream of the discharge at site B2. Both sites had a moderate and swift flow, over a substrate that was dominated by fine and coarse gravel, with some cobble, sand and silt also present. Site B1 was unshaded, while site B2 was completely shaded. Both sites supported patchy growths of periphyton, but no moss. Observation of the bed at site B2 indicated that sewage fungus may have been present, but it was not as obvious as that noted in previous surveys. The presence of sewage fungus was confirmed through microscopic examination, with dense growths of protozoa noted. No such growths were noted at any of the other sites sampled, nor were they noted in the samples collected through microscopic examination.

## Macroinvertebrate communities

Previous surveys performed in the vicinity of Taranaki Abattoirs have indicated that the macroinvertebrate communities of the Kahouri Stream are generally in good condition with relatively high numbers of taxa and MCI values. Although only a small number of surveys have been undertaken in the unnamed tributary, these surveys provide a clear indication of effects from the wastewater discharge, primarily in reduced $SQMCI_S$ scores. Results of previous surveys performed in the vicinity of Taranaki Abattoirs are summarised in Table 2, together with current results and the full results are shown in Table 3.

**Table 2** Summary of the numbers of taxa, MCI and $SQMCI_S$ values recorded previously in the Kahouri Stream and unnamed tributary, together with current results

| Site | Number of previous surveys | Numbers of taxa | | | MCI values | | | $SQMCI_S$ values | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Median | Range | Current Survey | Median | Range | Current Survey | N | Median | Range | Current Survey |
| A | 21 | 25 | 17-35 | 26 | 114 | 106-130 | 113 | 12 | 6.4 | 5.5-6.9 | 6.9 |
| C | 24 | 28 | 17-35 | 26 | 108 | 96-120 | 104 | 12 | 4.8 | 3.5-6.2 | 6.8 |
| B1 | 3 | 21 | 19-21 | 23 | 111 | 110-125 | 116 | 3 | 6.5 | 6.2-6.7 | 7.4 |
| B2 | 3 | 23 | 21-26 | 24 | 101 | 101-105 | 101 | 3 | 2.8 | 1.9-4.3 | 3.4 |

**Table 3** Macroinvertebrate fauna of the Kahouri Stream and unnamed tributary, current survey

| Taxa List | Site Number | MCI score | A | C | B1 | B2 |
|---|---|---|---|---|---|---|
| | Site Code | | KHI000297 | KHI000307 | KHI000301 | KHI000302 |
| | Sample Number | | FWB11185 | FWB11186 | FWB11183 | FWB11184 |
| ANNELIDA | Oligochaeta | 1 | A | A | A | XA |
| | Lumbricidae | 5 | - | - | R | VA |
| MOLLUSCA | *Ferrissia* | 3 | - | - | - | R |
| | *Potamopyrgus* | 4 | - | R | - | - |
| CRUSTACEA | *Paranephrops* | 5 | - | - | - | R |
| EPHEMEROPTERA | *Austroclima* | 7 | A | C | C | C |
| | *Coloburiscus* | 7 | XA | XA | VA | VA |
| | *Deleatidium* | 8 | XA | XA | XA | VA |
| | *Nesameletus* | 9 | A | A | VA | C |
| | *Zephlebia group* | 7 | C | - | R | C |
| PLECOPTERA | *Megaleptoperla* | 9 | - | - | R | - |
| | *Zelandobius* | 5 | R | - | C | - |
| | *Zelandoperla* | 8 | R | R | - | - |
| COLEOPTERA | Elmidae | 6 | A | VA | VA | A |
| | Dytiscidae | 5 | - | R | - | - |
| | Hydraenidae | 8 | R | C | R | - |
| | Ptilodactylidae | 8 | R | - | A | C |
| MEGALOPTERA | *Archichauliodes* | 7 | A | A | A | C |
| TRICHOPTERA | *Aoteapsyche* | 4 | VA | VA | A | A |
| | *Costachorema* | 7 | C | C | R | R |
| | *Hydrobiosis* | 5 | C | C | C | A |
| | *Orthopsyche* | 9 | - | - | C | - |
| | *Beraeoptera* | 8 | R | C | - | - |
| | *Confluens* | 5 | C | R | - | - |
| | *Oecetis* | 4 | - | - | - | R |
| | *Pycnocentria* | 7 | R | - | - | - |
| | *Pycnocentrodes* | 5 | R | - | - | - |
| DIPTERA | *Aphrophila* | 5 | VA | A | A | C |
| | Eriopterini | 5 | R | C | C | A |
| | Hexatomini | 5 | - | R | - | C |
| | *Chironomus* | 1 | - | R | - | R |
| | Orthocladiinae | 2 | C | A | R | R |
| | *Polypedilum* | 3 | C | C | C | C |
| | Tanypodinae | 5 | - | R | - | - |
| | Empididae | 3 | R | R | C | - |
| | *Austrosimulium* | 3 | C | C | R | C |
| | Tanyderidae | 4 | R | C | - | C |
| | | No of taxa | 26 | 26 | 23 | 24 |
| | | MCI | 113 | 104 | 116 | 101 |
| | | SQMCIs | 6.9 | 6.8 | 7.4 | 3.4 |
| | | EPT (taxa) | 14 | 10 | 11 | 9 |
| | | %EPT (taxa) | 54 | 38 | 48 | 38 |

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

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

## Site A (KHI000297)

An average community richness of 26 macroinvertebrate taxa was found at site A, upstream of the Taranaki Abattoir site. This was similar to the median number of taxa from previous surveys at this site (Table 2) and a slight improvement on that recorded on most previous surveys (Figure 2). The community was characterised by two 'highly sensitive' taxa (*Deleatidium* and *Nesameletus* mayflies), five 'moderately sensitive' taxa (*Coloburiscus* and *Austroclima* mayflies, Elmid beetles, *Archichauliodes* dobsonfly and *Aphrophila* cranefly) and two 'tolerant' taxa (oligochaete worms and *Aoteapsyche* caddisfly) (Table 3). This is very similar to that recorded in the previous survey.

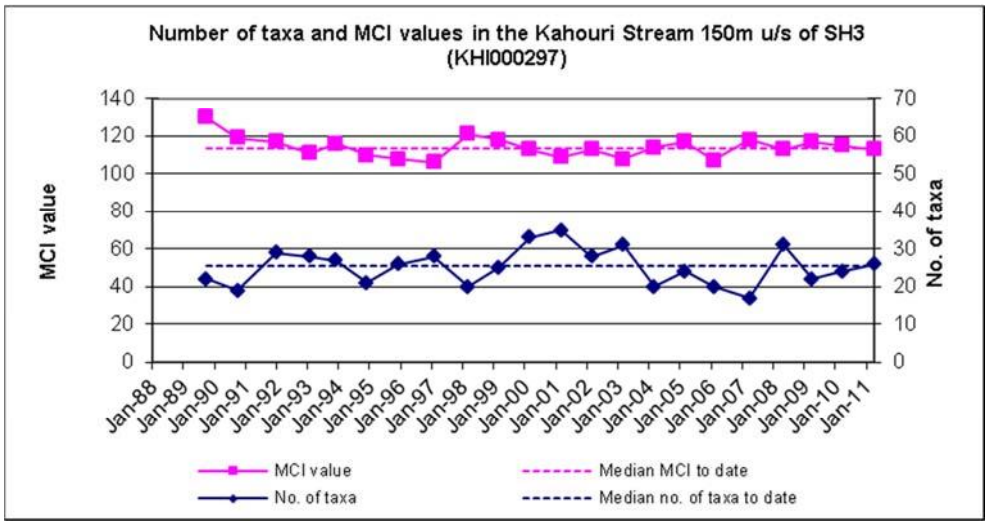


**Figure 2** Number of taxa and MCI values in the Kahouri Stream at site A (KHI000297)

The moderately high proportion of 'sensitive' taxa (73% of total richness) in the community resulted in a MCI score of 113 units, which was very similar to the long term median of past surveys' scores at this site (Table 2, Table 3). The dominance (numerically) of sensitive taxa, particularly mayflies, accounted for the high $SQMCI_s$ value (6.9 units), equal to the previous maximum value recorded at this site (Table 2), recorded in the 2009 survey.

## Site C (KHI000307)

This site was located in the Kahouri Stream 50 m downstream of the tributary receiving the wastewater discharge from Taranaki Abattoirs. It is also 600 m downstream from site A. A moderate community richness of 26 taxa was recorded at this site, similar to the median number of taxa recorded from previous surveys (Figure 3, Table 3). The community was characterised by two 'highly sensitive' taxa (*Deleatidium* and *Nesameletus* mayflies), four 'moderately sensitive' taxa (*Austroclima* and *Coloburiscus* mayflies, elmid beetles, *Archichauliodes* dobsonfly, and *Aphrophila* cranefly); and three 'tolerant' taxa (oligochaete worms, *Aoteapsyche* caddisfly and orthoclad midges).

There was little difference in $SQMCI_S$ score compared with site A upstream, with a reduction of only 0.1 unit (Table 2). This lack of change reflects the similarities in dominant taxa, and the fact that there were only two significant changes in abundance. This is despite the increase in periphyton growth observed, which could be related to an increase in dissolved nutrients, sourced from the abattoir wastewater discharge. Previous reports have highlighted this increase in periphyton at site C, and it was well illustrated in the 2009 survey (Jansma, 2010). Although previous surveys have indicated the possibility of

deterioration from site A, the current SQMCIs score of 6.8 is a good result, being significantly higher than the median for this site (Stark, 1998), and the highest recorded at this site to date (Table 2).

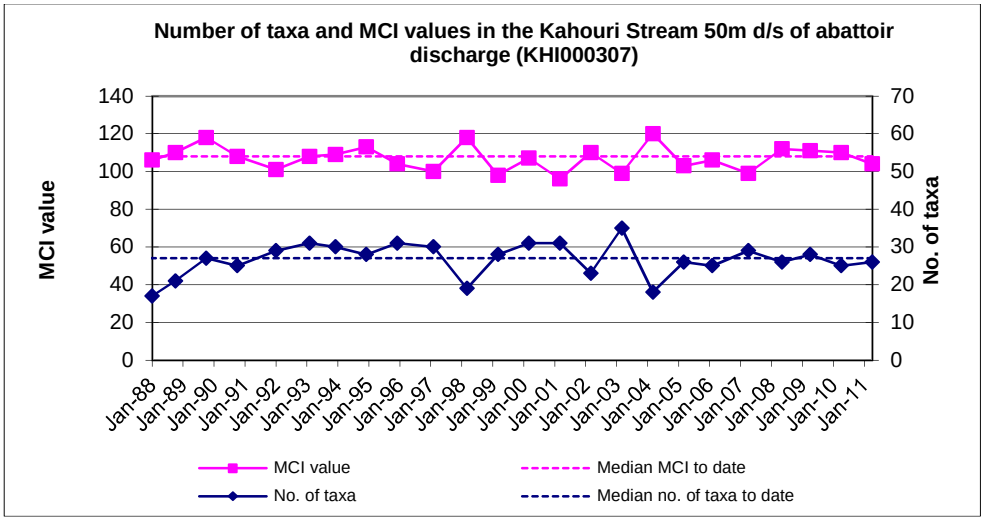


**Figure 3** Number of taxa and MCI values in the Kahouri Stream at site C (KHI000307)

There was a slightly lower proportion of 'sensitive' taxa at site C, which resulted in a MCI score of 104, an insignificant 9 unit drop from site A (Table 2) (Stark, 1998). This MCI score was 4 units less than the median of previous surveys at this site, and 6 units less than that recorded in the previous survey (Figure 3). Combined with the SQMCIs result, this is indicative of little if any impacts of the Taranaki Abattoir tributary on the macroinvertebrate communities in this reach of the Kahouri Stream, despite the fact that the stream had experienced a relatively long period of stable flows preceding this survey.

During this survey, undesirable heterotrophic growths were not observed on the bed, and neither were they detected during microscopic examination of the invertebrate sample. This also suggests reduced impact at this site from that recorded in the previous survey.

## Site B1

The abattoir tributary was sampled for the fourth time in this survey. Considering the good substrate, relatively good riparian shading and proximity to the Kahouri Stream, it is expected that this site supports a healthy macroinvertebrate community. This is supported by the results of all surveys undertaken including the current survey, with site B1 having a moderate community richness of 23 taxa. Within this community, were six 'highly sensitive' taxa, three of which were present in abundance (*Nesameletus* and *Deleatidium* mayfly larvae and ptilodactylid beetles) (Table 3). This is indicative of very good preceding water quality. Other abundant taxa included four 'moderately sensitive' taxa (*Coloburiscus* mayfly larvae, elmid beetle larvae, *Archichauliodes* dobsonfly and *Aphrophila* craneflies) and two 'tolerant' taxa (oligochaete worms and *Aoteapsyche* caddisfly) (Table 3).

The relatively high proportion of 'sensitive' taxa in the community (74%) produced an MCI score of 116, and the numerical dominance of 'sensitive' taxa produced a SQMCIs score of 7.4. Both of these scores are very good, and reflective of a very healthy macroinvertebrate community, especially when considering the stream does not emanate from within the National Park, and also the predominant land use within the catchment (dairy farming). The

MCI score and $SQMCI_S$ score are both the highest of all sites sampled during the current survey. This indicates very good preceding water quality in this tributary, a generally typical result for this site (Figure 4).

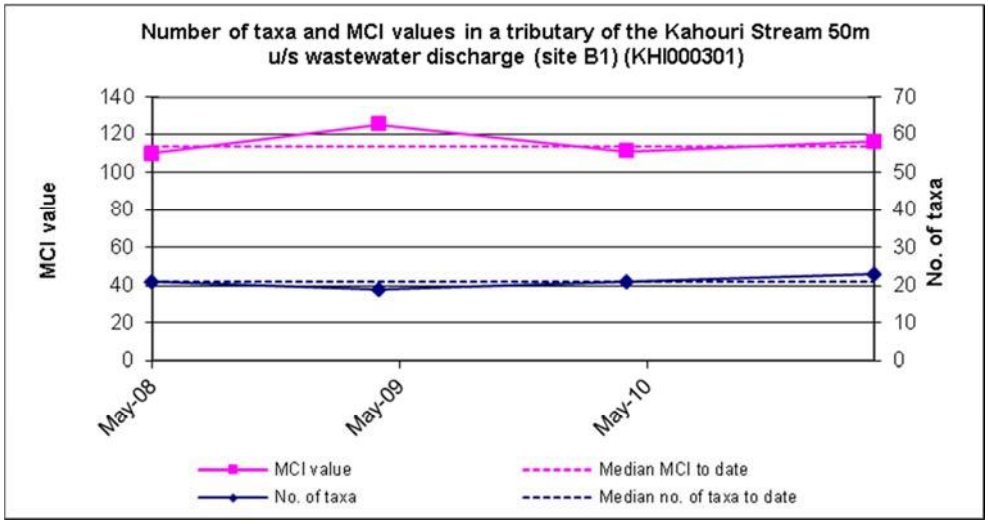


**Figure 4** Number of taxa and MCI values in the unnamed tributary at site B1 (KHI000301)

## Site B2

Downstream of the abattoir discharge, the good substrate and relatively good shade continue, suggesting that a macroinvertebrate community similar to that at site B1 should be present.

There was a similar community richness (24), but the community was made up of a smaller proportion of 'sensitive' taxa (63%). Changes in the community composition, including a net increase in 'tolerant' taxa resulted in a statistically significant drop in MCI score at site B2, to 101 (Stark, 1998). Although this is still a moderate result considering the nature of the stream, it is an indication that this community is significantly different to that upstream, the primary cause of which is the wastewater discharge from the abattoir. This result is typical for this stream, which has seen little change in taxa richness or MCI score across the four surveys undertaken to date (Table 2, Figure 5).

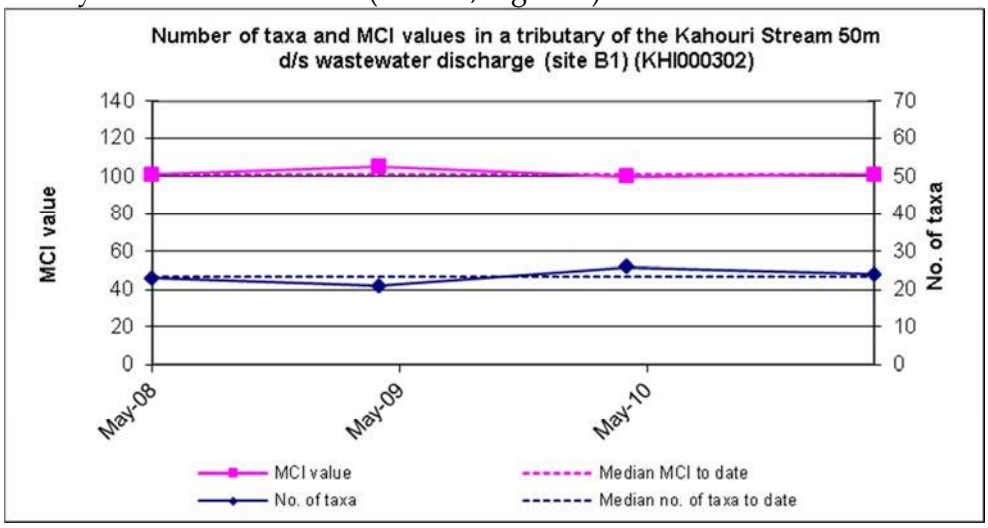


**Figure 5** Number of taxa and MCI values in the unnamed tributary at site B2 (KHI000302)

In addition, significant changes in relative abundances of certain taxa, in particular the significant increase in 'tolerant' oligochaete and lumbricid worms, coupled with reductions in abundance of most 'highly sensitive' taxa, resulted in a significantly reduced $SQMCI_S$ score of 3.4 (Stark, 1998). This result is 4.0 units lower than that recorded at site B1, and this represents a strong deterioration in water quality.

This severe deterioration is best reflected by the significant increase in worms at site B2, in particularly oligochaete worms, and also the appearance of *Chironomus* bloodworms, which were absent at site B1 (Table 3). Oligochaete worms abundant at site B1, but increased significantly in abundance, to be extremely abundant at site B2. *Chironomus* bloodworms and oligochaete worms often significantly increase in abundance where a streams assimilative capacity is overloaded by an organic discharge, and such situations are often accompanied by the presence of sewage fungus. Sewage fungus was not observed at the time of sampling, but was confirmed as present under magnification, and the fact that *Chironomus* blood worms were present and oligochaete worms were extra abundant at site B2 during this survey indicates that the discharge from the Taranaki Abattoir wastewater ponds was having a strong adverse impact on the receiving tributary. However, there was reduced abundance of *Chironomus* bloodworms from the last survey, and this indicates that the adverse impact is less severe as previously recorded.

## Summary and conclusions

The Council's standard 'kick-sampling' technique was used at four sites to collect streambed macroinvertebrates from the Kahouri Stream and an unnamed tributary in relation to the Taranaki Abattoirs site on 13 April 2011. Samples were sorted and identified to provide the 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. It may be used in soft-bottomed streams to detect trends over time. The $SQMCI_S$ takes into account taxa abundance as well as sensitivity to pollution, and may reveal more subtle changes in communities, particularly if non-organic impacts are occurring.

Significant differences in either MCI or $SQMCI_S$ between sites indicate the degree of adverse effects (if any) of discharges being monitored.

During this late summer survey, the two sites sampled in the Kahouri Stream recorded taxa richness and MCI scores that were similar to their respective medians, but improved $SQMCI_S$ scores (a statistically significant improvement for site C), downstream of the abattoir tributary confluence.

Previous surveys have recorded some deterioration at site C, and this was primarily attributed to an increase in algal growth, related directly to the nutrient input sourced from the abattoir discharge. The current survey however shows little deterioration between sites A and C, and there was no sewage fungus observed on site, or detected by microscopic analysis of the sample. These results suggest a reduced impact at site C from that recorded in the previous survey.

During this survey, the abattoir tributary was sampled for the fourth time. The upstream site (B1) has consistently recorded good taxa richness, MCI scores and $SQMCI_S$ scores. This pattern has continued in the current survey, with this site recording the highest MCI and $SQMCI_S$ scores of this survey, indicating good preceding water quality.

Previous surveys have consistently recorded a significant impact at site B2, downstream of the wastewater discharge. This has been repeated in the current survey, when changes in the community composition resulted in a statistically significant drop in MCI score, to 101 (Stark, 1998). Although this is still a moderate result considering the nature of the stream, it is an indication that this community is significantly different to that upstream, the primary cause of which is the wastewater discharge from the abattoir.

In addition to this significant reduction in MCI score, there was a very large drop of four units in $SQMCI_S$ score. This was due to a significant increase in 'tolerant' oligochaete and lumbricid worms, coupled with reductions in abundance of most 'highly sensitive' taxa. In addition, *Chironomus* bloodworms were present at site B2. *Chironomus* bloodworms and oligochaete worms often significantly increase in abundance where a streams assimilative capacity is overloaded by an organic discharge, and such situations are often accompanied by the presence of sewage fungus. Sewage fungus was not observed at the time of sampling, but was confirmed as present under magnification, and the fact that *Chironomus* blood worms were present and oligochaete worms were extra abundant at site B2 during this survey indicates that the discharge from the Taranaki Abattoir wastewater ponds was having a strong adverse impact on the receiving tributary. However, there was reduced abundance of *Chironomus* bloodworms from the last survey, and this indicates that the adverse impact is less severe as previously recorded.

Overall, the Kahouri Stream was in good condition, with little discernible impact from the abattoirs activities. However, the unnamed tributary continues to record an impact from the abattoir wastewater discharge, although this impact was less severe as that previously recorded.

## References


Dunning K, 2002: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2002. TRC report KD124

Fowles C & Moore S, 2004: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2004. TRC report CF332.

Fowles C & Hope K, 2006: Biomonitoring of the Kahouri Stream and an unnamed tributary, February 2006. TRC report CF405.

Hope K, 2005: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2005. TRC report KH035.

Jansma, B, 2009a: Biomonitoring of the Kahouri Stream and an unnamed tributary, April 2007. TRC report BJ052.

Jansma, B, 2009b: Biomonitoring of the Kahouri Stream and an unnamed tributary, May 2008. TRC report BJ053.

Jansma, B, 2010: Biomonitoring of the Kahouri Stream and an unnamed tributary, April 2009. TRC report BJ088.

Jansma, B, 2011: Biomonitoring of the Kahouri Stream and an unnamed tributary, April 2010. TRC report BJ142.

McWilliam H, 2000: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2000. TRC report HM225

McWilliam H, 2001: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2001. TRC report HM242

Moore S, 2003: Biomonitoring of the Kahouri Stream and an unnamed tributary, 24 March 2003. TRC report SM583

Stark JD, 1985: A macroinvertebrate community index of water quality for stony streams. Water and Soil Miscellaneous Publication No. 87.

Stark JD, 1998: SQMCI: a biotic index for freshwater macroinvertebrate coded abundance data. New Zealand Journal of Marine and Freshwater Research 32(1): 55-66.

Stark JD, 1999: An evaluation of Taranaki Regional Council's SQMCI biomonitoring index. Cawthron Institute, Nelson. Cawthron Report No. 472.

Stark JD, Boothroyd IKG, Harding JS, Maxted JR, Scarsbrook MR, 2001: Protocols for sampling macroinvertebrates in wadeable streams. New Zealand Macroinvertebrate Working Group Report No. 1. Prepared for the Ministry for the Environment. Sustainable Management Fund Project No. 5103. 57p.

TRC, 1999: Some statistics from the Taranaki Regional Council database (FWB) of freshwater macroinvertebrate surveys performed during the period from January 1980 to 31 December 1998. Technical Report 99-17.

| | |
|---|---|
| **To** | Bart Jansma, Scientific Officer |
| **From** | Bart Jansma, Scientific Officer |
| **Document** | 1396114 |
| **Report No** | BJ234 |
| **Date** | 28 August 2014 |

# Baseline biomonitoring of the Kahouri Stream in relation to Taranaki Abattoirs, September 2011

## Introduction

This was the first of two biomonitoring surveys undertaken in the 2011-2012 year for the Taranaki Abattoir site. This survey was performed to establish the baseline health of the macroinvertebrate community of the Kahouri Stream prior to any discharge of wastewater from the Taranaki Abattoir site. At the time of this survey, all wastewater from the Taranaki Abattoir site was directed to a two pond treatment system, and discharged to an unnamed tributary of the Kahouri Stream. However, it is intended to change this system that will irrigate wastewater to land when soil conditions allow, or to discharge to the Kahouri Stream at a time of high flow and adequate dilution. Monitoring of the Kahouri Stream will be undertaken to determine whether this direct discharge is affecting the macroinvertebrate communities, and this survey is intended to establish baseline conditions to aid this assessment.

The results of surveys previously conducted in relation to the Taranaki Abattoir site are discussed in the references at the end of this report.

It should be noted that the relevant consent (7662-1) includes the following statment:

"The difference in macroinvertebrate community between the upstream control site and the potential impact site immediately below the mixing zone will be examined in order to determine if the discharge has resulted in a 'significant adverse effect on aquatic life'. This will include examining any change in the Semi-Quantitative Macroinvertebrate Community Index [SQMCI], overall composition of the community [including %EPT] and Macroinvertebrate Community Index [MCI]. Should this examination identify a significant adverse effect caused by the discharge, this will constitute a breach of this condition."

This report will provide baseline data to inform the examination of future results stipulated by this consent.

## Methods

The standard '400 ml kick-sampling' technique was used to collect streambed macroinvertebrates from two established sites and one newly established site in the Kahouri Stream (Table 1, Figure 1) on 8 September 2011. 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 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) | = estimated 20-99 individuals; |
| VA (very abundant) | = estimated 100-499 individuals; |
| XA (extremely abundant) | = estimated 500 individuals or more. |

**Table 1** Biomonitoring sites in the Kahouri Stream sampled in relation to Taranaki Abattoirs

| Site number | Site code | Location |
|---|---|---|
| A | KHI000297 | Kahouri Stream, 150 m u/s of abattoir and SH3 |
| B | KHI000300 | Kahouri Stream, SH3, approx. 95m downstream of discharge point |
| C | KHI000305 | Kahouri Stream, 85 m d/s of SH3 |

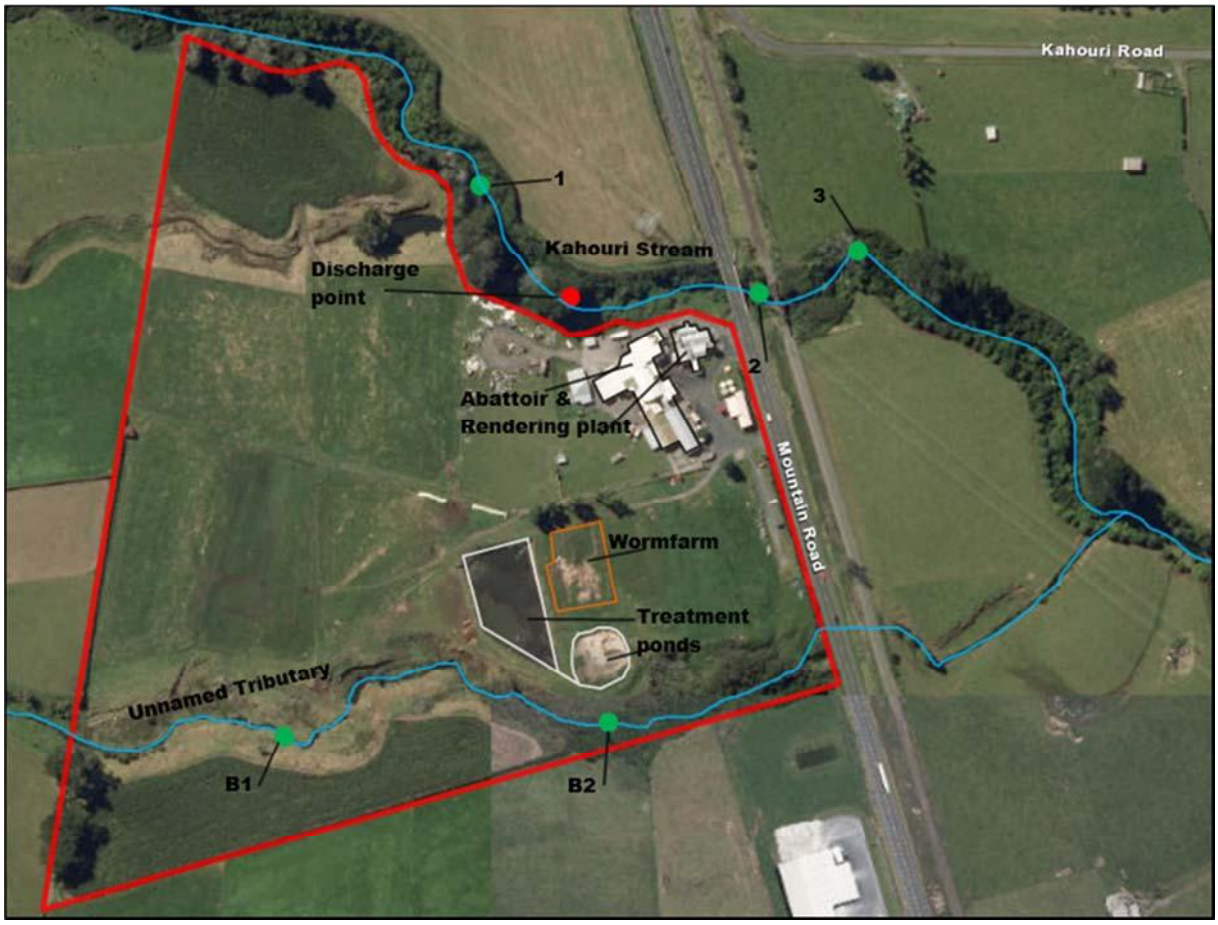


**Figure 1** Taranaki Abattoirs site layout and biomonitoring sites, in relation to the discharge point

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.

Averaging the scores assigned to the taxa found at a site, and multiplying the average by a scaling factor of 20 produces a Macroinvertebrate Community Index (MCI) value.

The MCI was designed as a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. MCI results can also reflect the effects of warm temperatures, slow current speeds and low dissolved oxygen levels, because the taxa capable of tolerating these conditions generally have low sensitivity scores. Usually more 'sensitive' communities (with higher MCI values) inhabit less polluted waterways. The use of this index in non-stony streams is possible if results are related to physical habitat (good quality muddy/weedy sites tend to produce lower MCI values than good quality stony sites).

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, therefore $SQMCI_s$ values range from 1 to 10, while MCI values range from 20 to 200.

In addition to assessing these indices, the number of Ephemopterans (mayflies), Plecopterans (stoneflies) and Trichopterans (caddisflies) in the community were taken into account when considering any differences between communities. These are referred to as EPT taxa.

Sub-samples of periphyton (algae and other micro flora) taken from the macroinvertebrate samples 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 these organisms can be an indicator of organic enrichment within a stream.

## Results and discussion

At the time of this afternoon survey the Kahouri Stream had a moderate flow, despite having been in a relatively long period of recession, with the last flood event of three times the median flow occurring 20 days prior to the sampling date. The relatively steep gradient resulted in a steady to swift flow at all sites. This flow was uncoloured but cloudy, and the stream bed material at all sites comprised predominantly boulders, cobbles and coarse gravels, with smaller proportions of fine gravels and sand.

Periphyton was present as a slippery film at all three sites, owing primarily to the partial or complete shading enjoyed by these sites. Patchy growths of moss were present at these sites also.

No sewage fungus was observed on the bed of the stream, and this was confirmed through microscopic examination.

## Macroinvertebrate communities

Previous surveys performed in the vicinity of Taranaki Abattoirs have indicated that the macroinvertebrate communities of the Kahouri Stream are generally in good condition with relatively high numbers of taxa and MCI values. Results of previous surveys performed in the vicinity of Taranaki Abattoirs are summarised in Table 2, together with current results and the full results are shown in Table 3.

**Table 2** Summary of the numbers of taxa, MCI and $SQMCI_S$ values recorded previously in the Kahouri Stream, together with current results. Included for reference are summary statistics for site C (KHI000307), which is located 50m downstream of the unnamed tributary, approximately 300m downstream of site 3.

| Site | Number of previous surveys | Numbers of taxa | | | MCI values | | | $SQMCI_S$ values | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Median | Range | Current Survey | Median | Range | Current Survey | N | Median | Range | Current Survey |
| 1 | 22 | 26 | 17-35 | 28 | 114 | 106-130 | 123 | 13 | 6.4 | 5.5-6.9 | 7.4 |
| 2 | 3 | 21 | 13-23 | 24 | 114 | 108-123 | 119 | - | - | - | 7.4 |
| 3 | - | - | - | 25 | - | - | 114 | - | - | - | 7.2 |
| C | 25 | 27 | 17-35 | - | 108 | 96-120 | - | 13 | 4.8 | 3.5-6.8 | - |

### Site 1 (KHI000297)

A near-average community richness of 28 macroinvertebrate taxa was found at site 1, upstream of the Taranaki Abattoir site. This was similar to the median number of taxa from previous surveys at this site (Table 2) and a slight improvement on that recorded in most previous surveys (Figure 2). The community was characterised by three 'highly sensitive' taxa (*Deleatidium* and *Nesameletus* mayflies and *Beraeoptera* beetles), six 'moderately sensitive' taxa (*Coloburiscus*, *Austroclima* and *Zephlebia* mayflies, Elmid beetles, *Archichauliodes* dobsonfly and *Aphrophila* cranefly) and one 'tolerant' taxon (*Aoteapsyche* caddisfly) (**Error! Not a valid bookmark self-reference.**). This is very similar to that recorded in the previous survey.

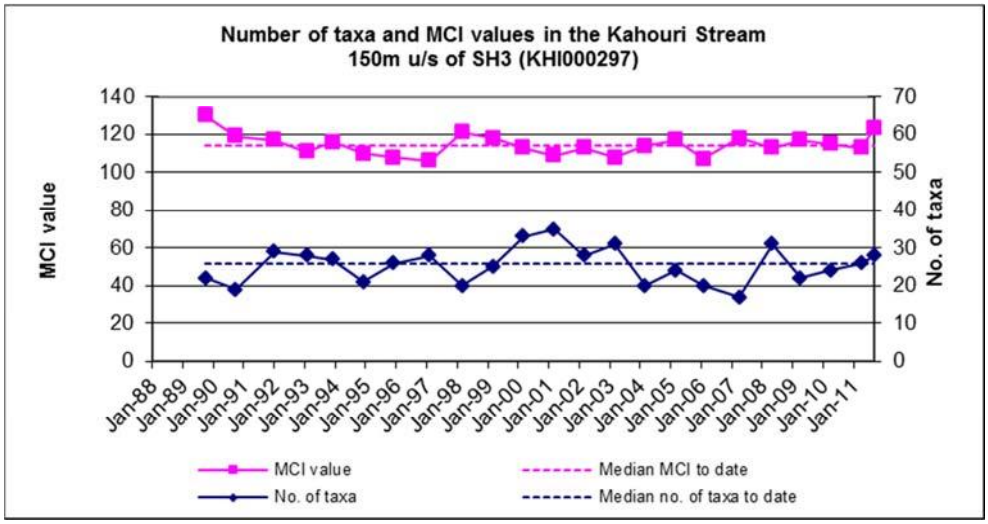


**Figure 2** Number of taxa and MCI values in the Kahouri Stream at site 1 (KHI000297)

The moderately high proportion of 'sensitive' taxa (86% of total richness) in the community resulted in a MCI score of 123 units, which was nine units higher than the long term median of past surveys' scores at this site, and the second highest score recorded to date, second only to the very first survey undertaken in 1989 (Table 2, **Error! Not a valid bookmark self-reference.**). The dominance (numerically) of sensitive taxa, particularly mayflies, accounted

for the high $SQMCI_s$ value (7.4 units), 0.5 units higher than the previous maximum value recorded at this site (Table 2), and statistically significantly higher than the median (Stark, 1998). There were seventeen EPT taxa in the community, comprising 61% of the taxa recorded.

**Table 3** Macroinvertebrate fauna of the Kahouri Stream, current survey

| Taxa List | Site Number | MCI score | 1 | 2 | 3 |
|---|---|---|---|---|---|
| | Site Code | | KHI000297 | KHI000300 | KHI000305 |
| | Sample Number | | FWB11230 | FWB11231 | FWB11232 |
| ANNELIDA (WORMS) | Oligochaeta | 1 | - | C | R |
| | Lumbricidae | 5 | R | - | - |
| MOLLUSCA | *Potamopyrgus* | 4 | - | - | R |
| EPHEMEROPTERA (MAYFLIES) | *Ameletopsis* | 10 | - | R | - |
| | *Austroclima* | 7 | VA | C | A |
| | *Coloburiscus* | 7 | XA | VA | XA |
| | *Deleatidium* | 8 | XA | XA | XA |
| | *Ichthybotus* | 8 | R | - | - |
| | *Nesameletus* | 9 | VA | A | C |
| | *Zephlebia group* | 7 | A | C | A |
| PLECOPTERA (STONEFLIES) | *Acroperla* | 5 | R | R | C |
| | *Zelandobius* | 5 | R | C | C |
| | *Zelandoperla* | 8 | R | C | C |
| COLEOPTERA (BEETLES) | Elmidae | 6 | A | VA | R |
| | Hydraenidae | 8 | C | C | C |
| | Hydrophilidae | 5 | - | - | R |
| | Ptilodactylidae | 8 | R | - | R |
| MEGALOPTERA (DOBSONFLIES) | *Archichauliodes* | 7 | A | A | C |
| TRICHOPTERA (CADDISFLIES) | *Aoteapsyche* | 4 | A | C | A |
| | *Costachorema* | 7 | C | C | C |
| | *Hydrobiosis* | 5 | R | R | - |
| | *Orthopsyche* | 9 | C | - | - |
| | *Psilochorema* | 6 | R | - | - |
| | *Beraeoptera* | 8 | A | R | C |
| | *Confluens* | 5 | R | R | - |
| | *Pycnocentria* | 7 | R | - | C |
| | *Pycnocentrodes* | 5 | - | R | - |
| DIPTERA (TRUE FLIES) | *Aphrophila* | 5 | A | C | A |
| | Eriopterini | 5 | C | C | - |
| | *Maoridiamesa* | 3 | - | - | R |
| | Orthocladiinae | 2 | C | - | A |
| | *Polypedilum* | 3 | C | R | C |
| | Tanypodinae | 5 | R | R | R |
| | Empididae | 3 | R | C | - |
| | *Austrosimulium* | 3 | - | - | R |
| | | No of taxa | 28 | 24 | 25 |
| | | MCI | 123 | 119 | 114 |
| | | SQMCIs | 7.4 | 7.4 | 7.2 |
| | | EPT (taxa) | 17 | 15 | 12 |
| | | %EPT (taxa) | 61 | 63 | 48 |

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

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

## Site 2 (KHI000300)

This site was sampled for the fourth time in this survey, but the first time since 1998. Located at State Highway 3, approximately 95m downstream of the intended discharge point, this site would be expected to show the greatest impact (if any) of the discharge of wastewater to the Kahouri Stream. A moderate community richness of 24 taxa was recorded at this site, similar to the median number recorded upstream, and only four taxa less than that recorded at site 1 in the current survey (Site 1 (KHI000297)

A near-average community richness of 28 macroinvertebrate taxa was found at site 1, upstream of the Taranaki Abattoir site. This was similar to the median number of taxa from previous surveys at this site (Table 2) and a slight improvement on that recorded in most previous surveys (Figure 2). The community was characterised by three 'highly sensitive' taxa (*Deleatidium* and *Nesameletus* mayflies and *Beraeoptera* beetles), six 'moderately sensitive' taxa (*Coloburiscus*, *Austroclima* and *Zephlebia* mayflies, Elmid beetles, *Archichauliodes* dobsonfly and *Aphrophila* cranefly) and one 'tolerant' taxon (*Aoteapsyche* caddisfly) (**Error! Not a valid bookmark self-reference.**). This is very similar to that recorded in the previous survey.

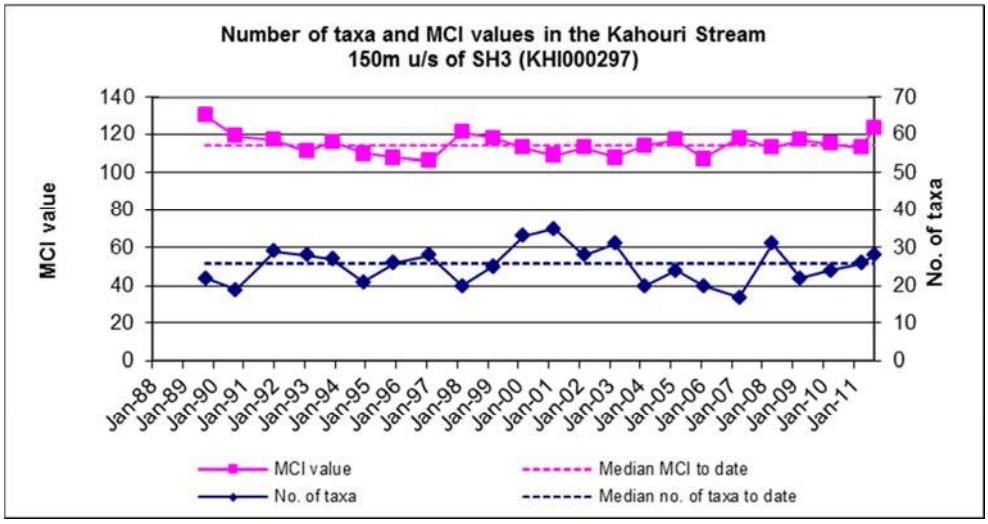


**Figure 2** Number of taxa and MCI values in the Kahouri Stream at site 1 (KHI000297)

The moderately high proportion of 'sensitive' taxa (86% of total richness) in the community resulted in a MCI score of 123 units, which was nine units higher than the long term median of past surveys' scores at this site, and the second highest score recorded to date, second only to the very first survey undertaken in 1989 (Table 2, **Error! Not a valid bookmark self-reference.**). The dominance (numerically) of sensitive taxa, particularly mayflies, accounted for the high SQMCIs value (7.4 units), 0.5 units higher than the previous maximum value recorded at this site (Table 2), and statistically significantly higher than the median (Stark, 1998). There were seventeen EPT taxa in the community, comprising 61% of the taxa recorded.

**Table 3**). The community was characterised by two 'highly sensitive' taxa (*Deleatidium* and *Nesameletus* mayflies), three 'moderately sensitive' taxa (*Coloburiscus* mayflies, elmid beetles, and *Archichauliodes* dobsonfly); but no 'tolerant' taxa. The lack of abundant 'tolerant' taxa is somewhat unusual for this stream, but a reflection of good preceding water quality. The

community comprised 83% 'sensitive' taxa, resulting in an MCI score of 119 units, only four units less than that recorded at site 1.

There was no difference in $SQMCI_S$ score compared with site 1 upstream, with an equivalent score of 7.2 units (Table 2). This lack of change reflects the similarities in dominant taxa, and the fact that there were few significant changes in abundance. In addition, %EPT was very similar to that recorded at site 1 (63%)

The similarity in %EPT, MCI and $SQMCI_S$ scores indicates that site 1 makes a good control site, and that if a change is detected at site 2 following a discharge of wastewater, it may be possible to attribute this change to the discharge.

### Site 3

Site 3 is located another 85m downstream of site 2, and is situated amongst a rapid dominated by large boulders, and this is the first time that this site has been sampled. Twenty-five taxa were recorded at this site, similar to that recorded at sites 1 and 2 upstream. As with sites 1 and 2, 'highly sensitive' *Deleatidium* mayfly were recorded as extremely abundant. Other taxa recorded in abundance included four 'moderately sensitive taxa (*Austroclima, Coloburiscus* and *Zephlebia* mayflies and *Aphrophila* cranefly) and two 'tolerant' taxa (net spinning caddisfly *Aoteapsyche* and orthoclad midge larvae).

The moderate proportion of sensitive taxa in the community (72%), resulted in an MCI score of 114 units, less than that recorded at sites 1 and 2, but not statistically significantly so (Stark, 1998).This score was higher than the median recorded at site C downstream, and this reflects the impacts that the abattoir tributary had on the Kahouri Stream at this point. This provides a good comparison, for when wastewater is discharged between sites 1 and 2 in the future. The $SQMCI_S$ score is similar to that recorded upstream (7.2 units), reflecting the similar community compositions. Furthermore, although there was some difference in %EPT with that recorded at site 1, this is caused primarily by changes in rarities i.e. those taxa represented by less than five individuals.

Overall, this survey indicates that although there may be some slight deterioration in community health in a downstream direction, these sites are similar enough to ensure any impacts of the wastewater discharge will be detected, should such impacts occur with sufficient intensity.

## Summary and conclusions

The Council's standard 'kick-sampling' technique was used at three sites to collect streambed macroinvertebrates from the Kahouri Stream in relation to the Taranaki Abattoirs site on 8 September 2011. This survey was performed to establish the baseline health of the macroinvertebrate community of the Kahouri Stream prior to any discharge of wastewater from the Taranaki Abattoir site, with an impending change to how the abattoir site will be disposing of their effluent. Samples were sorted and identified to provide the 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. It may be used in soft-bottomed streams to detect trends over time. The $SQMCI_S$ takes into account taxa abundance as well as

sensitivity to pollution, and may reveal more subtle changes in communities, particularly if non-organic impacts are occurring.

Significant differences in either MCI or $SQMCI_S$ between sites indicate the degree of adverse effects (if any) of discharges being monitored.

During this early spring survey, the three sites sampled in the Kahouri Stream recorded taxa richness, MCI scores and $SQMCI_S$ scores that were very similar, both to each other and to the respective medians recorded at site 1 upstream.

Overall, the Kahouri Stream was in good condition, and this survey indicates that although there may be some slight deterioration in community health in a downstream direction, these sites are similar enough to ensure any impacts of the wastewater discharge will be detected, should such impacts occur with sufficient intensity.

## References


Dunning K, 2002: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2002. TRC report KD124

Fowles C & Moore S, 2004: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2004. TRC report CF332.

Fowles C & Hope K, 2006: Biomonitoring of the Kahouri Stream and an unnamed tributary, February 2006. TRC report CF405.

Hope K, 2005: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2005. TRC report KH035.

Jansma, B, 2009a: Biomonitoring of the Kahouri Stream and an unnamed tributary, April 2007. TRC report BJ052.

Jansma, B, 2009b: Biomonitoring of the Kahouri Stream and an unnamed tributary, May 2008. TRC report BJ053.

Jansma, B, 2010: Biomonitoring of the Kahouri Stream and an unnamed tributary, April 2009. TRC report BJ088.

Jansma, B, 2011: Biomonitoring of the Kahouri Stream and an unnamed tributary, April 2010. TRC report BJ142.

Jansma, B 2014: Biomonitoring of the Kahouri Stream and an unnamed tributary, April 2011. TRC report BJ233.

McWilliam H, 2000: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2000. TRC report HM225

McWilliam H, 2001: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2001. TRC report HM242

Moore S, 2003: Biomonitoring of the Kahouri Stream and an unnamed tributary, 24 March 2003. TRC report SM583

Stark JD, 1985: A macroinvertebrate community index of water quality for stony streams. Water and Soil Miscellaneous Publication No. 87.

Stark JD, 1998: SQMCI: a biotic index for freshwater macroinvertebrate coded abundance data. New Zealand Journal of Marine and Freshwater Research 32(1): 55-66.

Stark JD, 1999: An evaluation of Taranaki Regional Council's SQMCI biomonitoring index. Cawthron Institute, Nelson. Cawthron Report No. 472.

Stark JD, Boothroyd IKG, Harding JS, Maxted JR, Scarsbrook MR, 2001: Protocols for sampling macroinvertebrates in wadeable streams. New Zealand Macroinvertebrate Working Group Report No. 1. Prepared for the Ministry for the Environment. Sustainable Management Fund Project No. 5103. 57p.

TRC, 1999: Some statistics from the Taranaki Regional Council database (FWB) of freshwater macroinvertebrate surveys performed during the period from January 1980 to 31 December 1998. Technical Report 99-17.

| | |
|---|---|
| **To** | Bart Jansma, Scientific Officer |
| **From** | Bart Jansma, Scientific Officer |
| **Document** | 1398106 |
| **Report No** | BJ235 |
| **Date** | 2 September 2014 |

# Biomonitoring of the Kahouri Stream and an unnamed tributary in relation to Taranaki Abattoirs, May 2012.

## Introduction

This was the second of two biomonitoring surveys undertaken in the 2011-2012 year for the Taranaki Abattoir site. This survey was performed to monitor the health of the macroinvertebrate community of the Kahouri Stream and unnamed tributary in relation to wastewater management at the Taranaki Abattoirs site. In late 2011 there was a significant change to the management of wastewater at this site. The direct discharge of wastewater to the unnamed tributary stopped, and a new system was installed. Wastewater from the Taranaki Abattoir site continues to be directed to a two pond treatment system, and is now irrigated to land when soil conditions allow, or discharged to the Kahouri Stream at a time of high flow and adequate dilution. The Kahouri Stream was monitored to determine whether the direct discharge of wastewater during high flows has affected the macroinvertebrate communities, while the unnamed tributary has been monitored to document any recovery from the removal of wastewater.

The results of surveys previously conducted in relation to the Taranaki Abattoir site are discussed in the references at the end of this report. Included is a baseline survey of the Kahouri Stream, undertaken in September 2011.

It should be noted that the relevant consent (7662-1) includes the following statement:

"The difference in macroinvertebrate community between the upstream control site and the potential impact site immediately below the mixing zone will be examined in order to determine if the discharge has resulted in a 'significant adverse effect on aquatic life'. This will include examining any change in the Semi-Quantitative Macroinvertebrate Community Index [SQMCI], overall composition of the community [including %EPT] and Macroinvertebrate Community Index [MCI]. Should this examination identify a significant adverse effect caused by the discharge, this will constitute a breach of this condition."

This report will undertake the examination of results stipulated by this consent.

## Methods

The standard '400 ml kick-sampling' technique was used to collect streambed macroinvertebrates from three established sites in the Kahouri Stream and two sites in the unnamed tributary (Table 1, Figure 1) on 24 May 2012. 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 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) | = estimated 20-99 individuals; |
| VA (very abundant) | = estimated 100-499 individuals; |
| XA (extremely abundant) | = estimated 500 individuals or more. |

**Table 1** Biomonitoring sites in the Kahouri Stream sampled in relation to Taranaki Abattoirs

| Site number | Site code | Location |
|---|---|---|
| 1 | KHI000297 | Kahouri Stream, 150 m u/s of abattoir and SH3 |
| 2 | KHI000300 | Kahouri Stream, SH3, approx. 95m downstream of discharge point |
| 3 | KHI000305 | Kahouri Stream, 85 m d/s of site 2 |
| B1 | KHI000301 | Abattoir Tributary, u/s abattoir discharge |
| B2 | KHI000302 | Abattoir Tributary, ~50m d/s abattoir discharge |

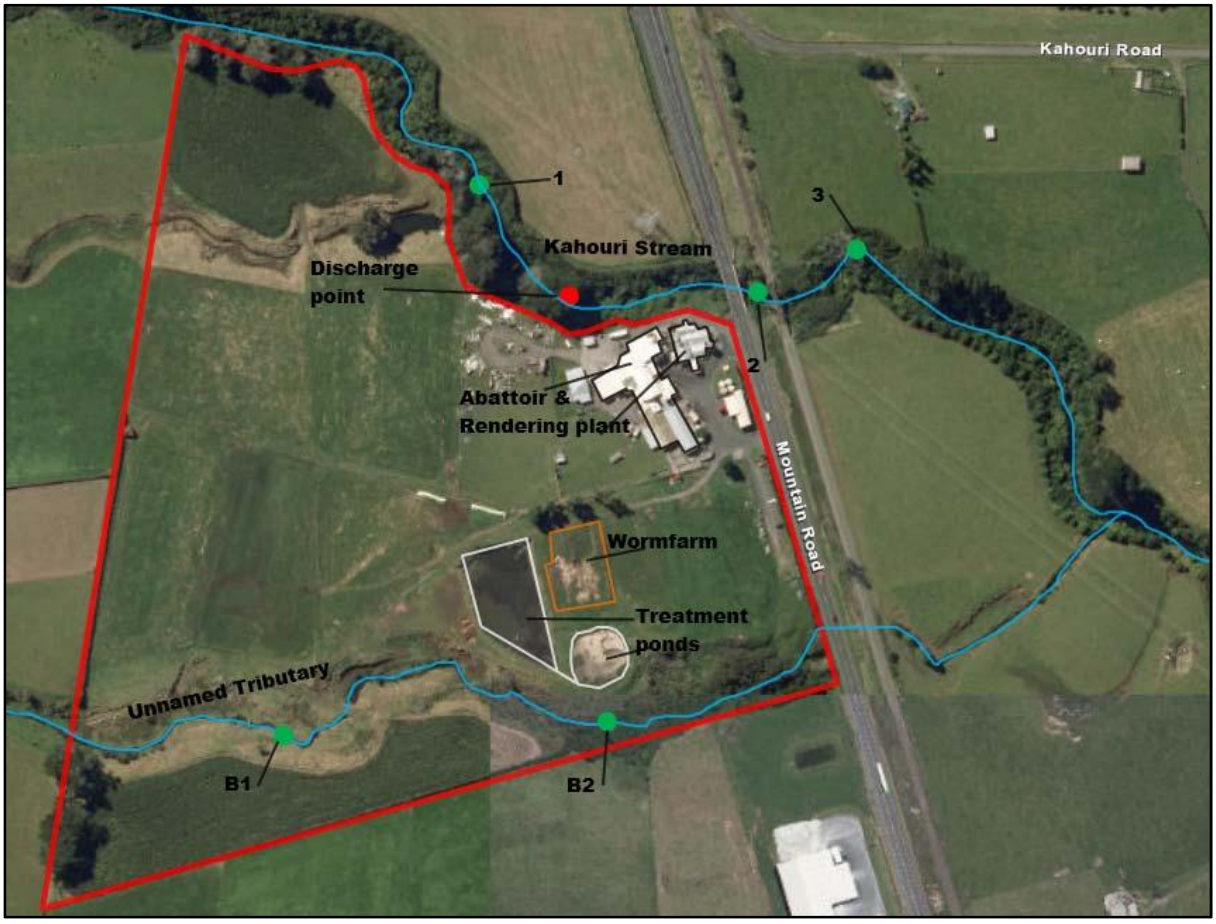


**Figure 1** Taranaki Abattoirs site layout and biomonitoring sites, in relation to the discharge point

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.

Averaging the scores assigned to the taxa found at a site, and multiplying the average by a scaling factor of 20 produces a Macroinvertebrate Community Index (MCI) value.

The MCI was designed as a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. MCI results can also reflect the effects of warm temperatures, slow current speeds and low dissolved oxygen levels, because the taxa capable of tolerating these conditions generally have low sensitivity scores. Usually more 'sensitive' communities (with higher MCI values) inhabit less polluted waterways. The use of this index in non-stony streams is possible if results are related to physical habitat (good quality muddy/weedy sites tend to produce lower MCI values than good quality stony sites).

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, therefore $SQMCI_s$ values range from 1 to 10, while MCI values range from 20 to 200.

In addition to assessing these indices, the number of Ephemopterans (mayflies), Plecopterans (stoneflies) and Trichopterans (caddisflies) in the community were taken into account when considering any differences between communities. These are referred to as EPT taxa.

Sub-samples of periphyton (algae and other micro flora) taken from the macroinvertebrate samples 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 these organisms can be an indicator of organic enrichment within a stream.

## Results and discussion

At the time of this afternoon survey the Kahouri Stream had a moderate flow, owing to the relatively short of recession, with the last flood event of three times the median flow occurring 7 days prior to the sampling date. The relatively steep gradient resulted in a swift flow at all three sites. This flow was uncoloured but cloudy, with the cloudiness typical for this stream, due to high iron oxide precipitate naturally present. The stream bed material at all sites comprised predominantly boulders, cobbles and coarse gravels, with smaller proportions of fine gravels and sand.

Periphyton was present as a slippery film at all three sites, owing primarily to the partial or complete shading enjoyed by these sites. Patchy growths of moss were present at these sites also.

In the unnamed tributary, a moderate, uncoloured but cloudy flow was noted. Substrate was much finer than that observed in the Kahouri Stream, with cobbles, and gravels predominating, with some sand and silt also. A special note was made at the time of sampling about the presence of fine sediment on the streambed, possibly as a result of bank slumping upstream. Both sites supported only a thin film of periphyton, and no moss.

Upstream there was no shading, due to an absence of overhanging vegetation, while downstream there was partial shading.

No sewage fungus was observed on the bed of either stream, and the absence of sewage fungus was confirmed through microscopic examination.

Company records indicate that prior to this survey, the last time wastewater was discharged to the Kahouri Stream was on 15 and 16 May 2012, eight days prior to this survey. On this occasion, 1170m$^3$ of wastewater was discharged to the Kahouri Stream.

## Macroinvertebrate communities

Previous surveys performed in the vicinity of Taranaki Abattoirs have indicated that the macroinvertebrate communities of the Kahouri Stream are generally in good condition with relatively high numbers of taxa and MCI values. Results of previous surveys performed in the vicinity of Taranaki Abattoirs are summarised in Table 2, together with current results and the full results are shown in Table 3.

**Table 2** Summary of the numbers of taxa, MCI and SQMCI$_S$ values recorded previously in the Kahouri Stream, and unnamed tributary together with current results. Included for reference are summary statistics for site C (KHI000307), which is located 50m downstream of the unnamed tributary, approximately 300m downstream of site 3.

| Site | Number of previous surveys | Numbers of taxa | | | MCI values | | | SQMCI$_S$ values | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Median | Range | Current Survey | Median | Range | Current Survey | N | Median | Range | Current Survey |
| C | 25 | 27 | 17-35 | - | 108 | 96-120 | - | 13 | 4.8 | 3.5-6.8 | - |
| 1 | 23 | 26 | 17-35 | 23 | 114 | 106-130 | 117 | 14 | 6.4 | 5.5-7.4 | 7.3 |
| 2 | 4 | 22 | 13-24 | 19 | 117 | 108-123 | 116 | 1 | 7.4 | 7.4 | 7.7 |
| 3 | 1 | 25 | 25 | 27 | 114 | 114 | 113 | 1 | 7.2 | 7.2 | 7.6 |
| B1 | 4 | 21 | 19-23 | 22 | 114 | 110-125 | 118 | 4 | 6.6 | 6.2-7.4 | 6.6 |
| B2 | 4 | 24 | 21-26 | 25 | 101 | 101-105 | 106 | 4 | 3.1 | 1.9-4.3 | 6.4 |

**Table 3** Macroinvertebrate fauna of the Kahouri Stream and the unnamed tributary, current survey

| Taxa List | Site Number | MCI score | 1 | 2 | 3 | B1 | B2 |
|---|---|---|---|---|---|---|---|
| | Site Code | | KHI000297 | KHI000300 | KHI000305 | KHI000301 | KHI000302 |
| | Sample Number | | FWB12281 | FWB12282 | FWB12283 | FWB12284 | FWB12285 |
| ANNELIDA | Oligochaeta | 1 | R | - | R | C | A |
| MOLLUSCA | *Ferrissia* | 3 | - | - | - | - | R |
| | *Potamopyrgus* | 4 | - | R | - | - | - |
| CRUSTACEA | Talitridae | 5 | - | - | R | - | - |
| EPHEMEROPTERA | *Austroclima* | 7 | A | C | C | R | C |
| | *Coloburiscus* | 7 | VA | VA | VA | VA | VA |
| | *Deleatidium* | 8 | XA | XA | XA | VA | VA |
| | *Nesameletus* | 9 | A | VA | VA | A | A |
| | *Zephlebia group* | 7 | R | C | C | C | C |
| PLECOPTERA | *Acroperla* | 5 | - | - | - | R | - |
| | *Zelandobius* | 5 | - | - | R | - | C |
| | *Zelandoperla* | 8 | C | C | R | R | - |
| COLEOPTERA | Elmidae | 6 | VA | A | A | A | A |
| | Hydraenidae | 8 | R | R | - | R | R |
| | Hydrophilidae | 5 | R | - | - | - | - |
| | Ptilodactylidae | 8 | - | - | R | R | R |
| MEGALOPTERA | *Archichauliodes* | 7 | C | C | C | C | A |
| TRICHOPTERA | *Aoteapsyche* | 4 | A | A | A | C | A |
| | *Costachorema* | 7 | R | R | R | R | R |
| | *Hydrobiosis* | 5 | C | R | R | C | C |
| | *Orthopsyche* | 9 | R | - | R | C | C |
| | *Beraeoptera* | 8 | C | - | A | - | - |
| | *Confluens* | 5 | A | C | C | - | - |
| | *Pycnocentria* | 7 | - | - | C | - | - |
| | *Pycnocentrodes* | 5 | R | R | R | - | - |
| DIPTERA | *Aphrophila* | 5 | A | A | A | C | A |
| | Eriopterini | 5 | R | - | R | C | C |
| | *Paralimnophila* | 6 | - | - | - | R | R |
| | Orthocladiinae | 2 | - | C | R | A | C |
| | *Polypedilum* | 3 | R | - | C | R | R |
| | Empididae | 3 | R | R | C | A | A |
| | Psychodidae | 1 | - | - | - | - | R |
| | *Austrosimulium* | 3 | R | R | R | - | R |
| | Tanyderidae | 4 | - | - | R | - | R |
| | | No of taxa | 23 | 19 | 27 | 22 | 25 |
| | | MCI | 117 | 116 | 113 | 118 | 106 |
| | | SQMCIs | 7.3 | 7.7 | 7.6 | 6.6 | 6.4 |
| | | EPT (taxa) | 13 | 11 | 15 | 11 | 10 |
| | | %EPT (taxa) | 57 | 58 | 56 | 50 | 40 |
| 'Tolerant' taxa | 'Moderately sensitive' taxa | | | | 'Highly sensitive' taxa | | |

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

## Site 1 (KHI000297)

A near-average community richness of 23 macroinvertebrate taxa was found at site 1, upstream of the Taranaki Abattoir site. This was similar to the median number of taxa from previous surveys at this site (Table 2) but a slight deterioration on that recorded in the most recent surveys (Figure 2). The community was characterised by two 'highly sensitive' taxa (*Deleatidium* and *Nesameletus* mayflies), five 'moderately sensitive' taxa (*Coloburiscus* and *Austroclima* mayflies, elmid beetles, *Confluens* caddisfly and *Aphrophila* cranefly) and one 'tolerant' taxon (*Aoteapsyche* caddisfly) (Table 3). This is very similar to that recorded in the previous survey.

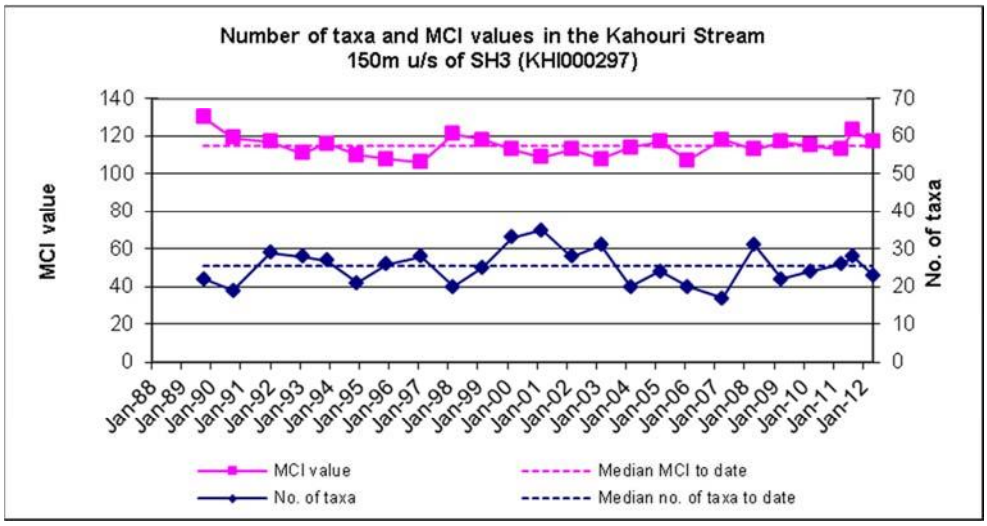


**Figure 2** Number of taxa and MCI values in the Kahouri Stream at site 1 (KHI000297)

The moderately high proportion of 'sensitive' taxa (78% of total richness) in the community resulted in a MCI score of 117 units, which was only three units higher than the long term median of past surveys' scores at this site, and similar to that recorded in most previous surveys (Table 2, Table 3, Figure 2). The dominance (numerically) of sensitive taxa, particularly mayflies, accounted for the high $SQMCI_s$ value (7.3 units), the second highest score recorded to date, and statistically significantly higher than the median (Stark, 1998) (Table 2). There were thirteen EPT taxa in the community, comprising 57% of the taxa recorded. This indicates good preceding water quality.

## Site 2 (KHI000300)

This site was sampled for the fifth time in this survey, but for only the second time since 1998. Located at State Highway 3, approximately 95m downstream of the discharge point, this site would be expected to show the greatest impact (if any) of the discharge of wastewater to the Kahouri Stream. A moderate community richness of 19 taxa was recorded at this site, four taxa less than that recorded at site 1 in the current survey, but within the range of previously richnesses recorded at site 1 (Table 3). The community was characterised by two 'highly sensitive' taxa (*Deleatidium* and *Nesameletus* mayflies), three 'moderately sensitive' taxa (*Coloburiscus* mayflies, elmid beetles, and *Aphrophila* mayfly); and one 'tolerant' taxon (*Aoteapsyche* caddisflies). The community comprised 74% 'sensitive' taxa, resulting in an MCI score of 116, only one unit less than that recorded at site 1.

There was little difference in $SQMCI_s$ score compared with site 1 upstream, with a slight increase to 7.7 units (Table 2). This lack of change reflects the similarities in dominant taxa,

and the fact that there were few significant changes in abundance In addition, %EPT was very similar to that recorded at site 1 (58%).

The similarity in %EPT, MCI and $SQMCI_S$ scores indicate that the communities of site 1 and 2 were very similar, indicating no impact from the discharge of wastewater between the two sites.

### Site 3

Site 3 is located another 85m downstream of site 2, and is situated amongst a rapid dominated by large boulders. This is the second time that this site has been sampled. Twenty-seven taxa were recorded at this site, slightly more than that recorded at sites 1 and 2 upstream. As with sites 1 and 2, 'highly sensitive' *Deleatidium* mayfly were recorded as extremely abundant. Other taxa recorded in abundance included two 'highly sensitive' taxa (*Nesameletus* mayflies and *Beraeoptera* beetles), three 'moderately sensitive taxa (*Coloburiscus* mayflies, elmid beetles and *Aphrophila* cranefly) and one 'tolerant' taxon (net spinning caddisfly *Aoteapsyche*).

The moderate proportion of sensitive taxa in the community (74%), resulted in an MCI score of 113 units, less than that recorded at sites 1 and 2, but not statistically significantly so (Stark, 1998), although this score was higher than the median recorded at site C downstream. Overall, the difference in MCI score between this site and that recorded at site 1 is similar to that recorded in the baseline survey, indicating no impact from the discharge of wastewater upstream. The $SQMCI_S$ score is similar to that recorded upstream (7.6 units), reflecting the similar community compositions. Furthermore, there was little difference in %EPT with that recorded at site 1.

Overall, this survey indicates that although there may be some slight deterioration in community health in a downstream direction, this is natural, and not related to any discharge from the Taranaki Abattoirs site.

### Site B1

The abattoir tributary was sampled for the fifth time in this survey. Considering the good substrate, relatively good riparian shading and proximity to the Kahouri Stream, it is expected that this site supports a healthy macroinvertebrate community. This is supported by the results of all surveys undertaken including the current survey, with site B1 having a moderate community richness of 22 taxa. Within this community, were six 'highly sensitive' taxa, two of which were present in abundance (*Nesameletus* and *Deleatidium* mayfly larvae) (**Error! Reference source not found.**). This is indicative of very good preceding water quality. Other abundant taxa included two 'moderately sensitive' taxa (*Coloburiscus* mayfly larvae and elmid beetle larvae) and two 'tolerant' taxa (orthoclad and empidid midge larvae) (**Error! Reference source not found.**).

The relatively high proportion of 'sensitive' taxa in the community (77%) produced an MCI score of 118 units, and the numerical dominance of 'sensitive' taxa produced a $SQMCI_S$ score of 6.6. Both of these scores are good, and reflective of a healthy macroinvertebrate community, especially when considering the stream does not emanate from within the National Park, and also the predominant land use within the catchment (dairy farming). The MCI score is the highest of all sites sampled during the current survey. This indicates very

good preceding water quality in this tributary, a generally typical result for this site (Figure 3).

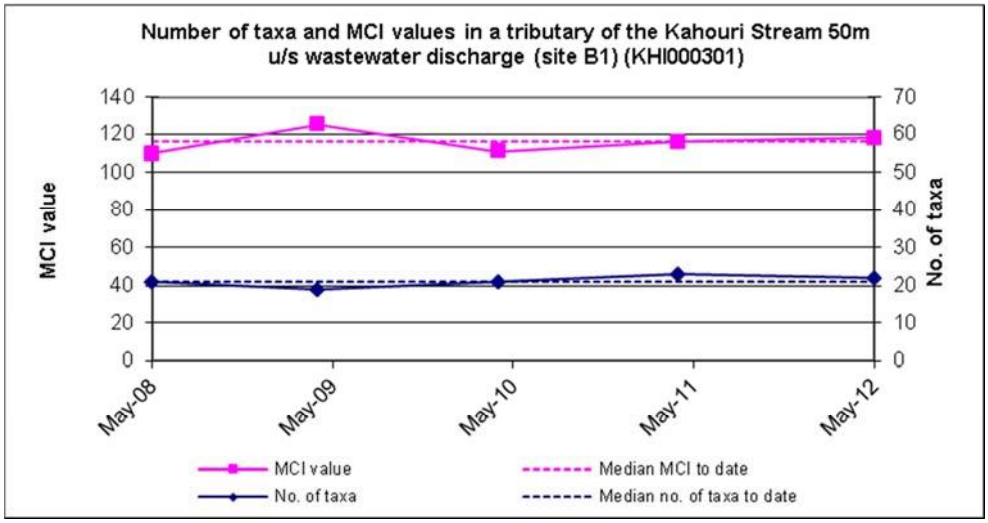


**Figure 3** Number of taxa and MCI values in the unnamed tributary at site B1 (KHI000301)

## Site B2

Downstream of the abattoir discharge, the good substrate and relatively good shade continue, suggesting that a macroinvertebrate community similar to that at site B1 should be present.

There was a similar community richness (25), but the community was made up of a smaller proportion of 'sensitive' taxa (64%). Changes in the community composition, including a net increase in 'tolerant' taxa resulted in a statistically significant drop in MCI score at site B2, to 106 (Stark, 1998). Although this is still a moderate result considering the nature of the stream, it is an indication that this community is different to that upstream. However, it indicates a slight improvement on that recorded in the previous surveys, and is the highest MCI score recorded at this site to date (Table 2, Figure 4).

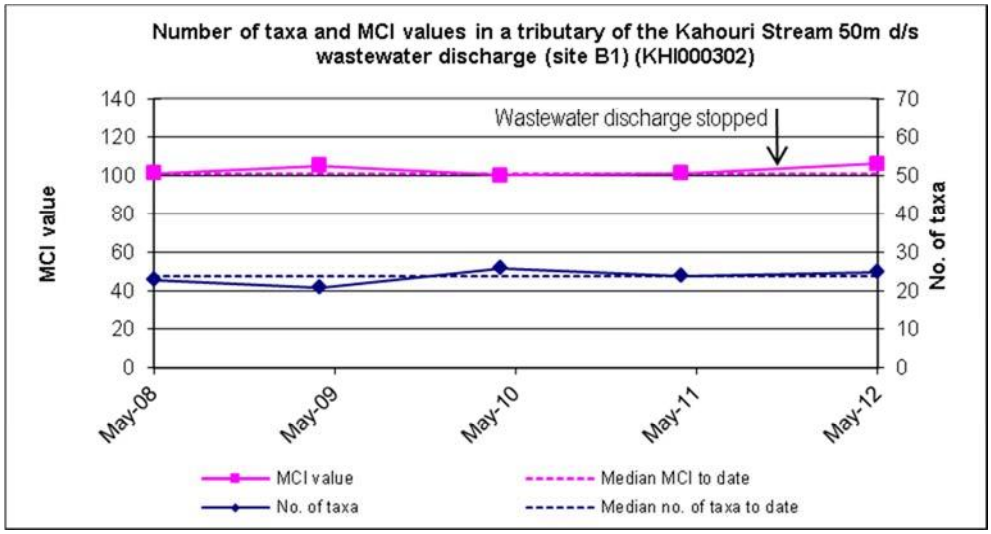


**Figure 4** Number of taxa and MCI values in the unnamed tributary at site B2 (KHI000302)

In contrast to previous surveys however, there were few significant changes in relative abundances of certain taxa. Of particular note was that there was no significant increase in 'tolerant' oligochaete and lumbricid worms, nor were there significant reductions in abundance of 'highly sensitive' taxa. This has resulted in a very similar $SQMCI_S$ score of 6.4, a statistically significant improvement of 3.0 units from that recorded in the previous survey, and 3.3 units higher than the median for this site (Stark, 1998) (Figure 5). This indicates significant improvement in community health at this site.

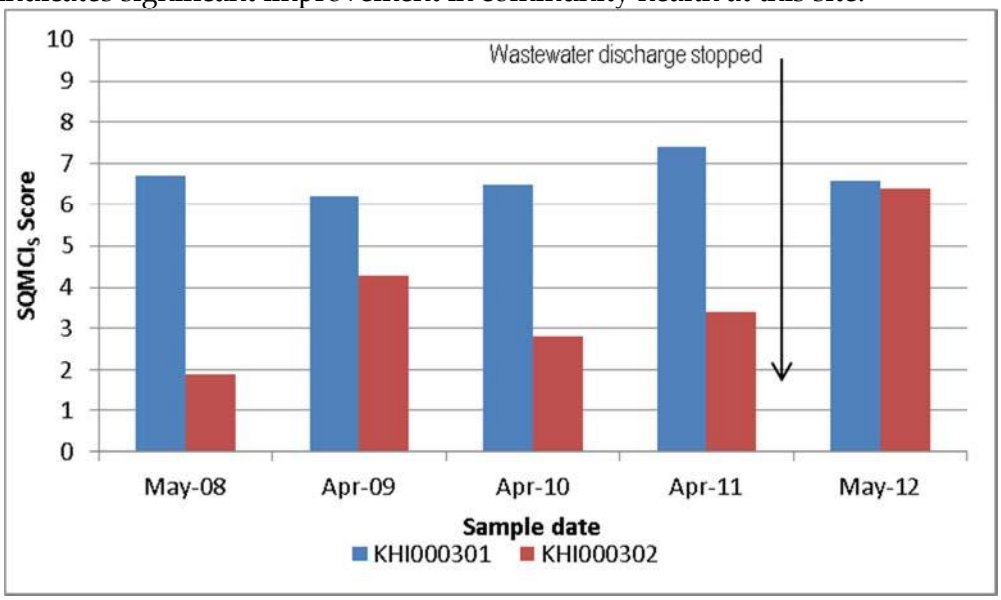


**Figure 5** $SQMCI_S$ scores recorded at site B1 and B2 since May 2008

Although the MCI score continues to indicate a slight reduction in invertebrate community health at site B2 (when compared with site B1), the current score indicates a slight improvement on previous surveys. The $SQMCI_S$ on the other hand indicates significant improvement, owing primarily to reduced abundances of 'tolerant' taxa, coupled with improved abundances of 'sensitive' taxa. This can be directly attributed to the fact that wastewater is no longer discharged to this tributary, resulting in a significant improvement in macroinvertebrate community health. This is supported by the absence of sewage fungus, which was neither observed at the time, nor detected through microscopic examination.

## Summary and conclusions

The Council's standard 'kick-sampling' technique was used to collect streambed macroinvertebrates at three sites in the Kahouri Stream and two sites in an unnamed tributary in relation to the Taranaki Abattoirs site on 24 May 2012. This survey was performed to monitor the health of the macroinvertebrate community of the Kahouri Stream and unnamed tributary in relation to wastewater management at the Taranaki Abattoirs site. In late 2011 there was a significant change to the management of wastewater at this site, with the direct discharge of wastewater to the unnamed tributary stopped, and wastewater now irrigated to land when soil conditions allow, or discharged to the Kahouri Stream at a time of high flow and adequate dilution. Samples were sorted and identified to provide the 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. It may be used in soft-bottomed

streams to detect trends over time. The $SQMCI_S$ takes into account taxa abundance as well as sensitivity to pollution, and may reveal more subtle changes in communities, particularly if non-organic impacts are occurring.

Significant differences in either MCI or $SQMCI_S$ between sites indicate the degree of adverse effects (if any) of discharges being monitored.

During this autumn survey, the three sites sampled in the Kahouri Stream recorded some variation in taxa richness, but the MCI scores and $SQMCI_S$ scores were very similar, both to each other and to the respective medians recorded at site 1 upstream. In addition, these sites were largely dominated by the same taxa, with very few significant differences in individual taxon abundance between sites. The results of this survey also did not differ markedly from that recorded in the baseline survey, suggesting little change in communities since the discharge of wastewater commenced. Overall, this survey indicates that although there may be a slight deterioration in community health in a downstream direction, this is natural, and not related to any discharge from the Taranaki Abattoirs site.

During this survey, the abattoir tributary was sampled for the fifth time, but the first since the discharge of wastewater stopped. The upstream site (B1) has consistently recorded good taxa richness, MCI scores and $SQMCI_S$ scores. This pattern has continued in the current survey, with this site recording the highest MCI scores of this survey, indicating good preceding water quality.

Previous surveys have consistently recorded a significant impact at site B2, downstream of the wastewater discharge. Although this has been repeated in the current survey in terms of MCI score, the actual MCI score recorded at site B2 was the highest recorded at this site to date. The $SQMCI_S$ on the other hand indicates significant improvement, owing primarily to reduced abundances of 'tolerant' taxa, coupled with improved abundances of 'sensitive' taxa. This can be directly attributed to the fact that wastewater is no longer discharged to this tributary, resulting in a significant improvement in macroinvertebrate community health. This is supported by the absence of sewage fungus, which was neither observed at the time, nor detected through microscopic examination.

Overall, the Kahouri Stream was in good condition, and with regards to the statement in the consent, an examination of the MCI, SQMCIS scores and the %EPT found no indication of a significant adverse effect caused by the discharge, and as such, there was no breach of condition 13 of consent 7662-1. The health of the unnamed tributary has improved significantly since the removal of the wastewater discharge, and this is expected to continue.

## References

Dunning K, 2002: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2002. TRC report KD124

Fowles C & Moore S, 2004: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2004. TRC report CF332.

Fowles C & Hope K, 2006: Biomonitoring of the Kahouri Stream and an unnamed tributary, February 2006. TRC report CF405.

Hope K, 2005: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2005. TRC report KH035.

Jansma, B, 2009a: Biomonitoring of the Kahouri Stream and an unnamed tributary, April 2007. TRC report BJ052.

Jansma, B, 2009b: Biomonitoring of the Kahouri Stream and an unnamed tributary, May 2008. TRC report BJ053.

Jansma, B, 2010: Biomonitoring of the Kahouri Stream and an unnamed tributary, April 2009. TRC report BJ088.

Jansma, B, 2011: Biomonitoring of the Kahouri Stream and an unnamed tributary, April 2010. TRC report BJ142.

Jansma, B 2014: Biomonitoring of the Kahouri Stream and an unnamed tributary, April 2011. TRC report BJ233.

Jansma, B, 2014: Baseline biomonitoring of the Kahouri Stream in relation to Taranaki Abattoirs, September 2011. TRC Report BJ234.

McWilliam H, 2000: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2000. TRC report HM225

McWilliam H, 2001: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2001. TRC report HM242

Moore S, 2003: Biomonitoring of the Kahouri Stream and an unnamed tributary, 24 March 2003. TRC report SM583

Stark JD, 1985: A macroinvertebrate community index of water quality for stony streams. Water and Soil Miscellaneous Publication No. 87.

Stark JD, 1998: SQMCI: a biotic index for freshwater macroinvertebrate coded abundance data. New Zealand Journal of Marine and Freshwater Research 32(1): 55-66.

Stark JD, 1999: An evaluation of Taranaki Regional Council's SQMCI biomonitoring index. Cawthron Institute, Nelson. Cawthron Report No. 472.

Stark JD, Boothroyd IKG, Harding JS, Maxted JR, Scarsbrook MR, 2001: Protocols for sampling macroinvertebrates in wadeable streams. New Zealand Macroinvertebrate Working Group Report No. 1. Prepared for the Ministry for the Environment. Sustainable Management Fund Project No. 5103. 57p.

TRC, 1999: Some statistics from the Taranaki Regional Council database (FWB) of freshwater macroinvertebrate surveys performed during the period from January 1980 to 31 December 1998. Technical Report 99-17.

| | |
|---|---|
| **To** | Bart Jansma, Scientific Officer |
| **From** | Bart Jansma, Scientific Officer |
| **Document** | 1398489 |
| **Report No** | BJ236 |
| **Date** | 2 September 2014 |

# Biomonitoring of the Kahouri Stream and an unnamed tributary in relation to Taranaki Abattoirs, June 2013.

## Introduction

This was the only biomonitoring survey undertaken in the 2012-2013 year for the Taranaki Abattoir site. This survey was performed to monitor the health of the macroinvertebrate community of the Kahouri Stream and unnamed tributary in relation to wastewater management at the Taranaki Abattoirs site. In late 2011 there was a significant change to the management of wastewater at this site. The direct discharge of wastewater to the unnamed tributary stopped, and a new system was installed. Wastewater from the Taranaki Abattoir site continues to be directed to a two pond treatment system, and is now irrigated to land when soil conditions allow, or discharged to the Kahouri Stream at a time of high flow and adequate dilution. The Kahouri Stream was monitored to determine whether the direct discharge of wastewater during high flows has affected the macroinvertebrate communities, while the unnamed tributary has been monitored to document any recovery from the removal of wastewater.

The results of surveys previously conducted in relation to the Taranaki Abattoir site are discussed in the references at the end of this report. Included is a baseline survey of the Kahouri Stream, undertaken in September 2011.

It should be noted that the relevant consent (7662-1) includes the following statement:

"The difference in macroinvertebrate community between the upstream control site and the potential impact site immediately below the mixing zone will be examined in order to determine if the discharge has resulted in a 'significant adverse effect on aquatic life'. This will include examining any change in the Semi-Quantitative Macroinvertebrate Community Index [SQMCI], overall composition of the community [including %EPT] and Macroinvertebrate Community Index [MCI]. Should this examination identify a significant adverse effect caused by the discharge, this will constitute a breach of this condition."

This report will undertake the examination of results stipulated by this consent.

## Methods

The standard '400 ml kick-sampling' technique was used to collect streambed macroinvertebrates from three established sites in the Kahouri Stream and two sites in the unnamed tributary (Table 1, Figure 1) on 12 June 2013. 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 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) | = estimated 20-99 individuals; |
| VA (very abundant) | = estimated 100-499 individuals; |
| XA (extremely abundant) | = estimated 500 individuals or more. |

**Table 1** Biomonitoring sites in the Kahouri Stream sampled in relation to Taranaki Abattoirs

| Site number | Site code | Location |
|---|---|---|
| 1 | KHI000297 | Kahouri Stream, 150 m u/s of abattoir and SH3 |
| 2 | KHI000300 | Kahouri Stream, SH3, approx. 95m downstream of discharge point |
| 3 | KHI000305 | Kahouri Stream, 85 m d/s of site 2 |
| B1 | KHI000301 | Abattoir Tributary, u/s abattoir discharge |
| B2 | KHI000302 | Abattoir Tributary, ~50m d/s abattoir discharge |

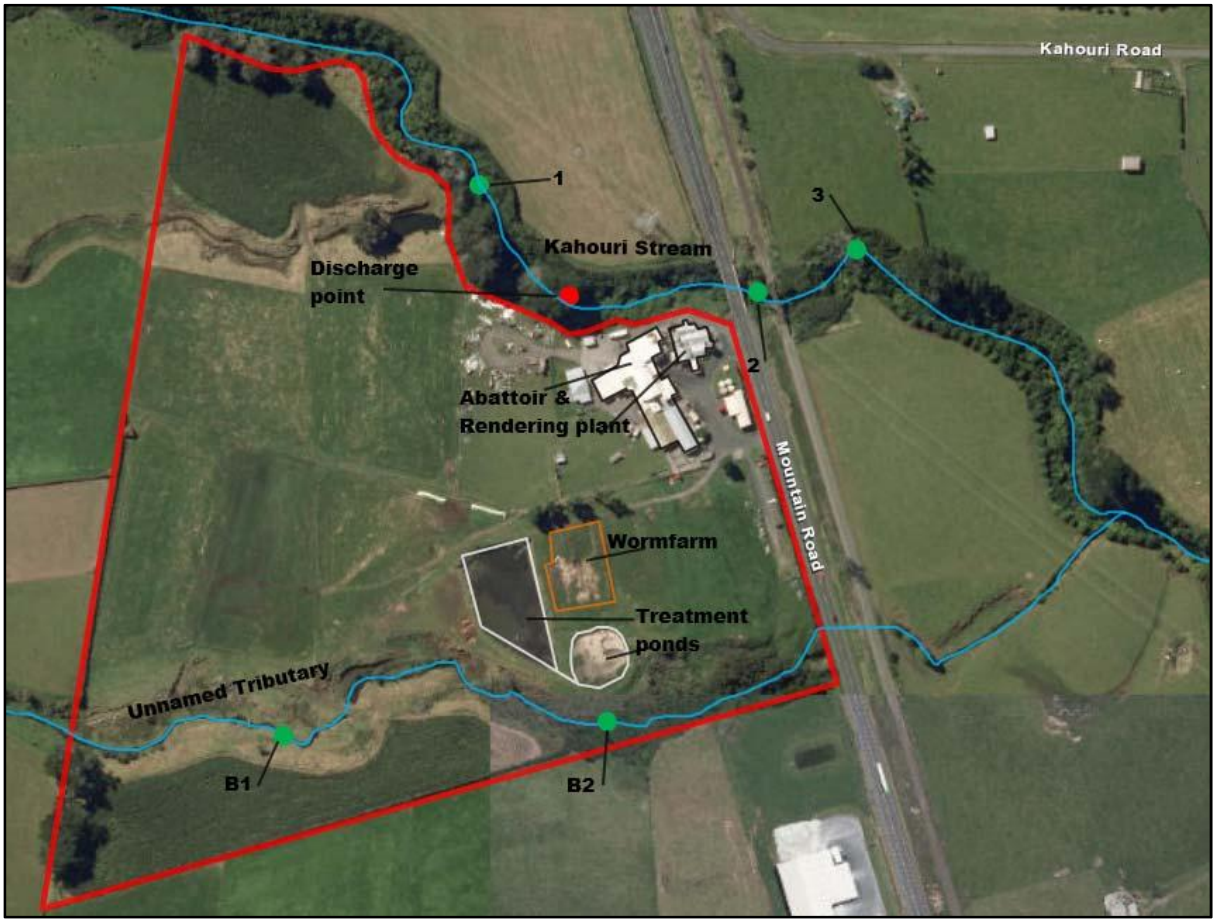


**Figure 1** Taranaki Abattoirs site layout and biomonitoring sites, in relation to the discharge point

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.

Averaging the scores assigned to the taxa found at a site, and multiplying the average by a scaling factor of 20 produces a Macroinvertebrate Community Index (MCI) value.

The MCI was designed as a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. MCI results can also reflect the effects of warm temperatures, slow current speeds and low dissolved oxygen levels, because the taxa capable of tolerating these conditions generally have low sensitivity scores. Usually more 'sensitive' communities (with higher MCI values) inhabit less polluted waterways. The use of this index in non-stony streams is possible if results are related to physical habitat (good quality muddy/weedy sites tend to produce lower MCI values than good quality stony sites).

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, therefore $SQMCI_s$ values range from 1 to 10, while MCI values range from 20 to 200.

In addition to assessing these indices, the number of Ephemopterans (mayflies), Plecopterans (stoneflies) and Trichopterans (caddisflies) in the community were taken into account when considering any differences between communities. These are referred to as EPT taxa.

Sub-samples of periphyton (algae and other micro flora) taken from the macroinvertebrate samples 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 these organisms can be an indicator of organic enrichment within a stream.

## Results and discussion

At the time of this early afternoon survey the Kahouri Stream had a moderate flow, owing to the relatively short of recession, with the last flood event of three times the median flow occurring 7 days prior to the sampling date. The relatively steep gradient resulted in a swift flow at all three sites. This flow was uncoloured but cloudy, with the cloudiness typical for this stream, due to the naturally occurring high iron oxide content. The stream bed material at all sites comprised predominantly boulders, cobbles and coarse gravels, with smaller proportions of fine gravels and sand.

Periphyton was present as a slippery film at all three sites, owing primarily to the partial or complete shading enjoyed by these sites. Patchy growths of moss were present at these sites also.

In the unnamed tributary, a moderate, uncoloured and clear flow was noted. Substrate was much finer than that observed in the Kahouri Stream, with cobbles and gravels predominating, with some sand and silt also. Both sites supported only a thin film of periphyton, and no moss. Upstream there was no shading, due to an absence of overhanging vegetation, while downstream there was partial shading.

No sewage fungus was observed on the bed of either stream, and the absence of sewage fungus was confirmed through microscopic examination.

Company records indicate that prior to this survey, the last time wastewater was discharged to the Kahouri Stream was on 10 June 2013, two days prior to this survey. There was also a discharge on the 5th and 6th of June, and in total, 1040m$^3$ of wastewater was discharged to the Kahouri Stream in the week preceding this survey.

## Macroinvertebrate communities

Previous surveys performed in the vicinity of Taranaki Abattoirs have indicated that the macroinvertebrate communities of the Kahouri Stream are generally in good condition with relatively high numbers of taxa and MCI values. Results of previous surveys performed in the vicinity of Taranaki Abattoirs are summarised in Table 2, together with current results and the full results are shown in Table 3.

**Table 2** Summary of the numbers of taxa, MCI and SQMCI$_S$ values recorded previously in the Kahouri Stream, and unnamed tributary together with current results. Included for reference are summary statistics for site C (KHI000307), which is located 50m downstream of the unnamed tributary, approximately 300m downstream of site 3.

| Site | Number of previous surveys | Numbers of taxa | | | MCI values | | | SQMCI$_S$ values | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Median | Range | Current Survey | Median | Range | Current Survey | N | Median | Range | Current Survey |
| C | 25 | 27 | 17-35 | - | 108 | 96-120 | - | 13 | 4.8 | 3.5-6.8 | - |
| 1 | 24 | 26 | 17-35 | 27 | 115 | 106-130 | 117 | 15 | 6.4 | 5.5-7.4 | 6.8 |
| 2 | 5 | 21 | 13-24 | 28 | 116 | 108-123 | 118 | 2 | 7.6 | 7.4-7.7 | 7.0 |
| 3 | 2 | 26 | 25-25 | 25 | 114 | 113-114 | 114 | 2 | 7.4 | 7.2-7.6 | 6.7 |
| B1 | 5 | 21 | 19-23 | 26 | 116 | 110-125 | 116 | 5 | 6.6 | 6.2-7.4 | 7.1 |
| B2 | 5 | 24 | 21-26 | 24 | 101 | 101-106 | 115 | 5 | 4 | 1.9-6.4 | 7.1 |

**Table 3** Macroinvertebrate fauna of the Kahouri Stream and the unnamed tributary, current survey

| Taxa List | Site Number | MCI score | 1 | 2 | 3 | B1 | B2 |
|---|---|---|---|---|---|---|---|
| | Site Code | | KHI000297 | KHI000300 | KHI000305 | KHI000301 | KHI000302 |
| | Sample Number | | FWB13214 | FWB13215 | FWB13216 | FWB13217 | FWB13218 |
| NEMERTEA | Nemertea | 3 | - | R | - | - | - |
| ANNELIDA | Oligochaeta | 1 | C | R | R | C | C |
| | Lumbricidae | 5 | - | R | - | - | R |
| CRUSTACEA | *Paranephrops* | 5 | - | - | R | - | - |
| EPHEMEROPTERA | *Ameletopsis* | 10 | R | R | - | - | - |
| | *Austroclima* | 7 | C | C | C | VA | C |
| | *Coloburiscus* | 7 | XA | XA | XA | VA | XA |
| | *Deleatidium* | 8 | VA | VA | VA | VA | VA |
| | *Nesameletus* | 9 | VA | VA | A | VA | VA |
| | *Zephlebia group* | 7 | C | C | C | C | C |
| PLECOPTERA | *Acroperla* | 5 | R | - | - | - | - |
| | *Zelandobius* | 5 | R | R | R | A | C |
| | *Zelandoperla* | 8 | C | R | - | R | R |
| COLEOPTERA | Elmidae | 6 | A | VA | A | VA | VA |
| | Hydraenidae | 8 | C | C | C | R | C |
| | Ptilodactylidae | 8 | - | R | R | C | C |
| | Scirtidae | 8 | - | - | - | R | - |
| MEGALOPTERA | *Archichauliodes* | 7 | A | A | A | A | A |
| TRICHOPTERA | *Aoteapsyche* | 4 | VA | A | VA | C | A |
| | *Costachorema* | 7 | R | R | R | C | R |
| | *Hydrobiosis* | 5 | - | - | R | R | R |
| | *Orthopsyche* | 9 | - | R | R | C | A |
| | *Psilochorema* | 6 | R | - | - | - | - |
| | *Beraeoptera* | 8 | R | R | R | - | - |
| | *Confluens* | 5 | C | R | R | - | - |
| | *Oxyethira* | 2 | - | - | - | R | R |
| | *Pycnocentria* | 7 | C | C | C | R | R |
| | *Pycnocentrodes* | 5 | R | - | - | - | - |
| | *Zelolessica* | 7 | - | - | - | R | - |
| DIPTERA | *Aphrophila* | 5 | A | A | A | A | A |
| | Eriopterini | 5 | R | R | - | R | C |
| | *Limonia* | 6 | - | - | R | - | - |
| | *Harrisius* | 6 | R | - | - | - | - |
| | Orthocladiinae | 2 | C | R | R | R | R |
| | *Polypedilum* | 3 | A | R | C | R | R |
| | Tanypodinae | 5 | - | R | - | - | - |
| | Empididae | 3 | C | A | C | C | R |
| | Psychodidae | 1 | - | - | R | - | - |
| | *Austrosimulium* | 3 | - | R | - | R | - |
| | Tanyderidae | 4 | R | - | - | - | - |
| | No of taxa | | 27 | 28 | 25 | 26 | 24 |
| | MCI | | 117 | 118 | 114 | 116 | 115 |
| | SQMCIs | | 6.8 | 7.0 | 6.7 | 7.1 | 7.1 |
| | EPT (taxa) | | 16 | 14 | 13 | 13 | 12 |
| | %EPT (taxa) | | 59 | 50 | 52 | 50 | 50 |

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

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

## Site 1 (KHI000297)

A near-average community richness of 27 macroinvertebrate taxa was found at site 1, upstream of the Taranaki Abattoir site. This was similar to the median number of taxa from previous surveys at this site (Table 2) and a slight recovery from that recorded in the previous survey (Figure 2). The community was characterised by two 'highly sensitive' taxa (*Deleatidium* and *Nesameletus* mayflies), four 'moderately sensitive' taxa (*Coloburiscus* mayflies, elmid beetles, *Archichauliodes* dobson fly larvae and *Aphrophila* cranefly) and two 'tolerant' taxa (*Aoteapsyche* caddisfly and *Polypedilum* midge larvae) (Table 3). This is very similar to that recorded in the previous survey.

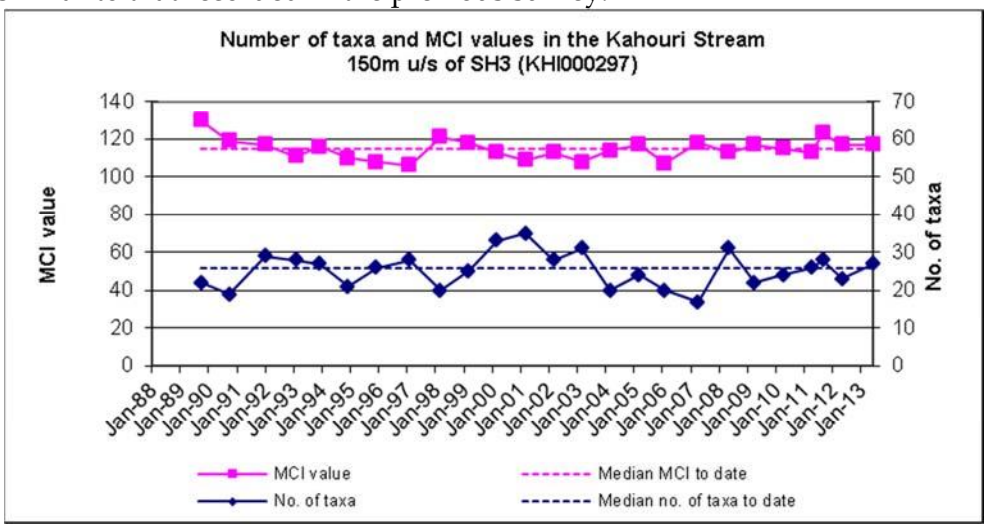


**Figure 2** Number of taxa and MCI values in the Kahouri Stream at site 1 (KHI000297)

The moderately high proportion of 'sensitive' taxa (78% of total richness) in the community resulted in a MCI score of 117 units, which was only two units higher than the long term median of past surveys' scores at this site, and similar to that recorded in most previous surveys (Table 2, Table 3, Figure 2). The dominance (numerically) of sensitive taxa, particularly mayflies, accounted for the high $SQMCI_s$ value (6.8 units), a good result, and 0.4 unit higher than the median (Table 2). There were sixteen EPT taxa in the community, comprising 59% of the taxa recorded. This indicates good preceding water quality.

## Site 2 (KHI000300)

This site was sampled for the sixth time in this survey, but for only the second time since the discharge of wastewater began upstream. Located at State Highway 3, approximately 95m downstream of the discharge point, this site would be expected to show the greatest impact (if any) of the discharge of wastewater to the Kahouri Stream. A moderately high community richness of 28 taxa was recorded at this site, one taxon more than that recorded at site 1 in the current survey, and four more than the previous maximum richness previously richnesses recorded at this site (Table 3). This richness was well within the range recorded at site 1 however. The community was characterised by two 'highly sensitive' taxa (*Deleatidium* and *Nesameletus* mayflies), three four 'moderately sensitive' taxa (*Coloburiscus* mayflies, elmid beetles, *Archichauliodes* dobson fly larvae and *Aphrophila* mayfly); and two 'tolerant' taxa (*Aoteapsyche* caddisflies and empidid midge larvae). The community comprised 75% 'sensitive' taxa, resulting in an MCI score of 118, only one unit higher than that recorded at site 1, a statistically insignificant result (Stark, 1998).

There was little difference in $SQMCI_S$ score compared with site 1 upstream, with a slight increase to 7.0 units (Table 2). This lack of change reflects the similarities in dominant taxa, and the fact that there were few significant changes in abundance. In addition, %EPT was very similar to that recorded at site 1 (50%)

The similarity in %EPT, MCI and $SQMCI_S$ scores reflect that the communities of site 1 and 2 were very similar, indicating no impact from the discharge of wastewater between the two sites.

### Site 3

Site 3 is located another 85m downstream of site 2, and is situated amongst a rapid dominated by large boulders. This is the third time that this site has been sampled. Twenty-five taxa were recorded at this site, slightly less than that recorded at sites 1 and 2 upstream. As with sites 1 and 2, 'highly sensitive' *Deleatidium* mayfly were recorded as extremely abundant. Other taxa recorded in abundance included one 'highly sensitive' taxon (*Nesameletus* mayflies), four 'moderately sensitive taxa (*Coloburiscus* mayflies, elmid beetles, *Archichauliodes* dobson fly larvae and *Aphrophila* cranefly) and one 'tolerant' taxon (net spinning caddisfly *Aoteapsyche*).

The moderate proportion of sensitive taxa in the community (76%), resulted in an MCI score of 114 units, less than that recorded at sites 1 and 2, but not statistically significantly so (Stark, 1998). This result was higher than the median recorded at site C downstream. Overall, the difference in MCI score between this site and that recorded at site 1 is similar to that recorded in the baseline survey, indicating no impact from the discharge of wastewater upstream. The $SQMCI_S$ score is similar to that recorded upstream (6.7 units), reflecting the similar community compositions. Furthermore, there was little difference in %EPT with that recorded at site 1.

Overall, this survey indicates that although there may be some slight deterioration in community health in a downstream direction, this is natural, and not related to any discharge from the Taranaki Abattoirs site.

### Site B1

The abattoir tributary was sampled for the sixth time in this survey. Considering the good substrate, relatively good riparian shading and proximity to the Kahouri Stream, it is expected that this site supports a healthy macroinvertebrate community. This is supported by the results of all surveys undertaken including the current survey, with site B1 having a moderately high community richness of 26 taxa. Within this community, were seven 'highly sensitive' taxa, two of which were present in abundance (*Nesameletus* and *Deleatidium* mayfly larvae) (Table 3). This is indicative of very good preceding water quality. Other abundant taxa included six 'moderately sensitive' taxa (*Austroclima* and *Coloburiscus* mayfly larvae, *Zelandobius* stonefly, elmid beetle larvae, *Archichauliodes* dobson fly larvae and *Aphrophila* cranefly) and but no 'tolerant' taxa (Table 3).

The relatively high proportion of 'sensitive' taxa in the community (73%) produced an MCI score of 116 units, and the numerical dominance of 'sensitive' taxa produced a $SQMCI_S$ score of 7.1 units. Both of these scores are good, and reflective of a healthy macroinvertebrate community, especially when considering the stream does not emanate from within the National Park, and also the predominant land use within the catchment (dairy farming). The

$SQMCI_S$ score is the highest equal of all sites sampled during the current survey. This indicates very good preceding water quality in this tributary, a generally typical result for this site (Figure 3).

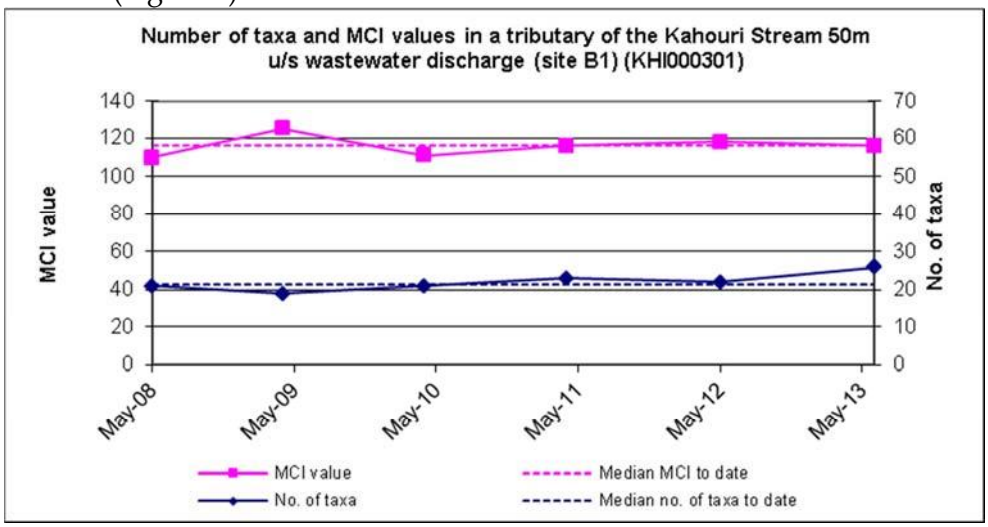


**Figure 3** Number of taxa and MCI values in the unnamed tributary at site B1 (KHI000301)

## Site B2

Downstream of the abattoir discharge, the good substrate and relatively good shade continue, suggesting that a macroinvertebrate community similar to that at site B1 should be present.

There was a similar community richness (24), and the community was made up of a larger proportion of 'sensitive' taxa (75%). There were few changes in community composition, with all taxa recorded at site B2 also present at site B1, with the exception of one rarity. This resulted in an MCI score which was very similar to that recorded at B1 (115) (Stark, 1998). This is the first survey to record an MCI score at site B2 which is within ten units of that recorded at site B1, and the current MCI score is nine units higher than the previous maximum score recorded at this site, which was recorded in the previous survey (Table 2, Figure 4). This result is also significantly higher than the median for this site. This indicates a significant improvement in invertebrate community health following the removal of the wastewater discharge upstream.

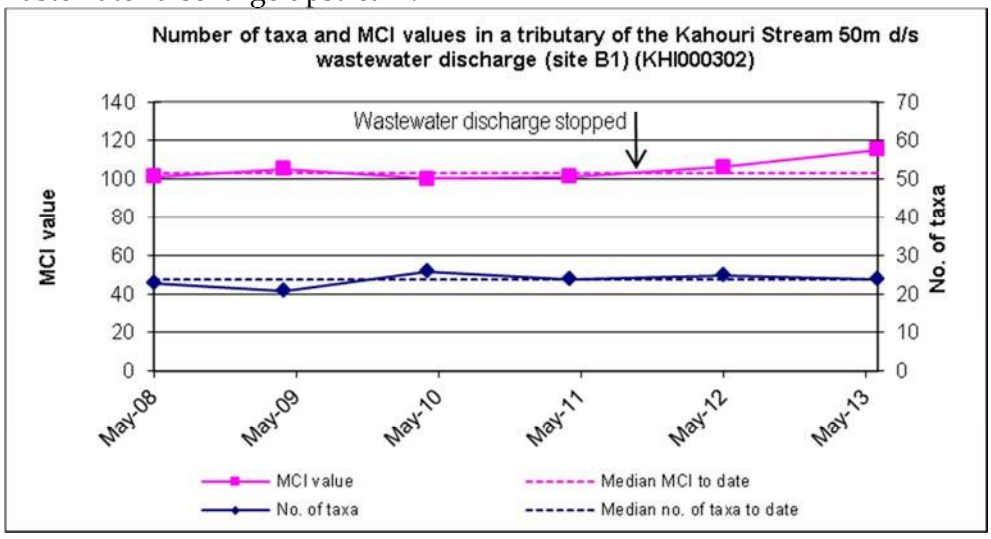

**Figure 4** Number of taxa and MCI values in the unnamed tributary at site B2 (KHI000302)

In contrast to surveys undertaken while wastewater was being discharged to this tributary, there were few significant changes in relative abundances of certain taxa. Of particular note was that there was no significant increase in 'tolerant' oligochaete and lumbricid worms, nor were there significant reductions in abundance of 'highly sensitive' taxa. This has resulted in an equivalent $SQMCI_S$ score of 7.1, a 0.7 unit increase from that recorded in the previous survey, and 3.7 units higher than the median for this site (Stark, 1998) (Figure 5). This indicates significant improvement in community health at this site.

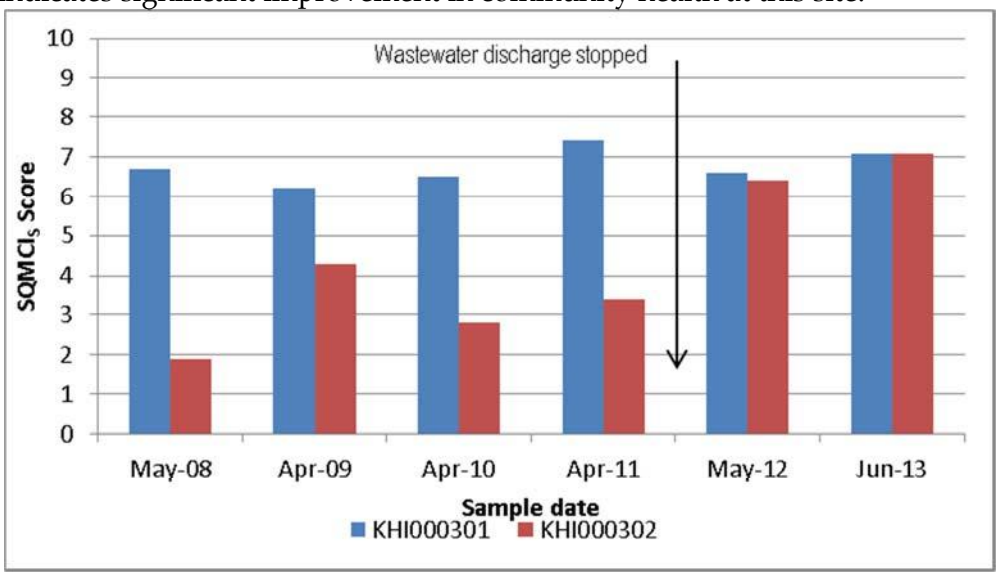


**Figure 5** $SQMCI_S$ scores recorded at site B1 and B2 since May 2008

The MCI score no longer indicates any reduction in invertebrate community health at site B2 (when compared with site B1), and the current score indicates significant improvement on previous surveys. The $SQMCI_S$ also indicates significant improvement, owing primarily to reduced abundances of 'tolerant' taxa, coupled with improved abundances of 'sensitive' taxa. This can be directly attributed to the fact that wastewater is no longer discharged to this tributary, resulting in a significant improvement in macroinvertebrate community health. This is supported by the absence of sewage fungus, which was neither observed at the time, nor detected through microscopic examination. It is reasonable to conclude that the stream has fully recovered, and therefore it is recommended that monitoring of the unnamed tributary be discontinued.

## Summary and conclusions

The Council's standard 'kick-sampling' technique was used to collect streambed macroinvertebrates at three sites in the Kahouri Stream and two sites in an unnamed tributary in relation to the Taranaki Abattoirs site on 12 June 2013. This survey was performed to monitor the health of the macroinvertebrate community of the Kahouri Stream and unnamed tributary in relation to wastewater management at the Taranaki Abattoirs site. In late 2011 there was a significant change to the management of wastewater at this site, with the direct discharge of wastewater to the unnamed tributary stopped, and wastewater now irrigated to land when soil conditions allow, or discharged to the Kahouri Stream at a time of high flow and adequate dilution. Samples were sorted and identified to provide the 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. It may be used in soft-bottomed streams to detect trends over time. The $SQMCI_S$ takes into account taxa abundance as well as sensitivity to pollution, and may reveal more subtle changes in communities, particularly if non-organic impacts are occurring.

Significant differences in either MCI or $SQMCI_S$ between sites indicate the degree of adverse effects (if any) of discharges being monitored.

During this autumn survey, the three sites sampled in the Kahouri Stream recorded little variation in taxa richness, and the MCI scores and $SQMCI_S$ scores were very similar, both to each other and to the respective medians recorded at site 1 upstream. In addition, these sites were largely dominated by the same taxa, with very few significant differences in individual taxon abundance between sites. The results of this survey also did not differ markedly from that recorded in the baseline survey, suggesting little change in communities since the discharge of wastewater commenced. Overall, this survey indicates that although there may be a slight deterioration in community health in a downstream direction, this is natural, and not related to any discharge from the Taranaki Abattoirs site.

During this survey, the abattoir tributary was sampled for the sixth time, but the second since the discharge of wastewater stopped. The upstream site (B1) has consistently recorded good taxa richness, MCI scores and $SQMCI_S$ scores. This pattern has continued in the current survey, with this site recording the highest $SQMCI_S$ scores of this survey, indicating good preceding water quality.

Previous surveys have consistently recorded a significant impact at site B2, downstream of the wastewater discharge. The current survey has recorded an MCI score only one unit less than that recorded upstream, and an equivalent $SQMCI_S$ score. The MCI score no longer indicates any reduction in invertebrate community health at site B2 (when compared with site B1), and the current score indicates significant improvement on previous surveys. The $SQMCI_S$ also indicates significant improvement, owing primarily to reduced abundances of 'tolerant' taxa, coupled with improved abundances of 'sensitive' taxa. This can be directly attributed to the fact that wastewater is no longer discharged to this tributary, resulting in a significant improvement in macroinvertebrate community health. This is supported by the absence of sewage fungus, which was neither observed at the time, nor detected through microscopic examination. It is reasonable to conclude that the stream has fully recovered, and therefore it is recommended that monitoring of the unnamed tributary be discontinued.

Overall, the Kahouri Stream was in good condition, and with regards to the statement in the consent, an examination of the MCI, $SQMCI_S$ scores and the %EPT found no indication of a significant adverse effect caused by the discharge, and as such, there was no breach of condition 13 of consent 7662-1. The health of the unnamed tributary has improved significantly since the removal of the wastewater discharge, and this is expected to continue.

## References

Dunning K, 2002: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2002. TRC report KD124

Fowles C & Moore S, 2004: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2004. TRC report CF332.

Fowles C & Hope K, 2006: Biomonitoring of the Kahouri Stream and an unnamed tributary, February 2006. TRC report CF405.

Hope K, 2005: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2005. TRC report KH035.

Jansma, B, 2009a: Biomonitoring of the Kahouri Stream and an unnamed tributary, April 2007. TRC report BJ052.

Jansma, B, 2009b: Biomonitoring of the Kahouri Stream and an unnamed tributary, May 2008. TRC report BJ053.

Jansma, B, 2010: Biomonitoring of the Kahouri Stream and an unnamed tributary, April 2009. TRC report BJ088.

Jansma, B, 2011: Biomonitoring of the Kahouri Stream and an unnamed tributary, April 2010. TRC report BJ142.

Jansma, B 2014: Biomonitoring of the Kahouri Stream and an unnamed tributary, April 2011. TRC report BJ233.

Jansma, B, 2014: Baseline biomonitoring of the Kahouri Stream in relation to Taranaki Abattoirs, September 2011. TRC Report BJ234.

Jansma, B, 2014: Biomonitoring of the Kahouri Stream and an unnamed tributary in relation to Taranaki Abattoirs, May 2012. TRC Report BJ235.

McWilliam H, 2000: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2000. TRC report HM225

McWilliam H, 2001: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2001. TRC report HM242

Moore S, 2003: Biomonitoring of the Kahouri Stream and an unnamed tributary, 24 March 2003. TRC report SM583

Stark JD, 1985: A macroinvertebrate community index of water quality for stony streams. Water and Soil Miscellaneous Publication No. 87.

Stark JD, 1998: SQMCI: a biotic index for freshwater macroinvertebrate coded abundance data. New Zealand Journal of Marine and Freshwater Research 32(1): 55-66.

Stark JD, 1999: An evaluation of Taranaki Regional Council's SQMCI biomonitoring index. Cawthron Institute, Nelson. Cawthron Report No. 472.

Stark JD, Boothroyd IKG, Harding JS, Maxted JR, Scarsbrook MR, 2001: Protocols for sampling macroinvertebrates in wadeable streams. New Zealand Macroinvertebrate

Working Group Report No. 1. Prepared for the Ministry for the Environment. Sustainable Management Fund Project No. 5103. 57p.

TRC, 1999: Some statistics from the Taranaki Regional Council database (FWB) of freshwater macroinvertebrate surveys performed during the period from January 1980 to 31 December 1998. Technical Report 99-17.

| | |
|---|---|
| **To** | Bart Jansma, Scientific Officer |
| **From** | Bart Jansma, Scientific Officer |
| **Document** | 1398495 |
| **Report No** | BJ237 |
| **Date** | 2 September 2014 |

# Biomonitoring of the Kahouri Stream in relation to Taranaki Abattoirs, November 2013.

## Introduction

This was the first of two biomonitoring surveys undertaken in the 2013-2014 year for the Taranaki Abattoir site. This survey was performed to monitor the health of the macroinvertebrate community of the Kahouri Stream in relation to wastewater management at the Taranaki Abattoirs site. Wastewater from the Taranaki Abattoir site is directed to a two pond treatment system, and is either irrigated to land when soil conditions allow, or discharged to the Kahouri Stream at a time of high flow and adequate dilution. The Kahouri Stream was monitored to determine whether the direct discharge of wastewater during high flows has affected the macroinvertebrate communities of the stream.

The results of surveys previously conducted in relation to the Taranaki Abattoir site are discussed in the references at the end of this report. Included is a baseline survey of the Kahouri Stream, undertaken in September 2011.

It should be noted that the relevant consent (7662-1) includes the following statement:

"The difference in macroinvertebrate community between the upstream control site and the potential impact site immediately below the mixing zone will be examined in order to determine if the discharge has resulted in a 'significant adverse effect on aquatic life'. This will include examining any change in the Semi-Quantitative Macroinvertebrate Community Index [SQMCI], overall composition of the community [including %EPT] and Macroinvertebrate Community Index [MCI]. Should this examination identify a significant adverse effect caused by the discharge, this will constitute a breach of this condition."

This report will undertake the examination of results stipulated by this consent.

## Methods

The standard '400 ml kick-sampling' technique was used to collect streambed macroinvertebrates from three established sites in the Kahouri Stream and two sites in the unnamed tributary (Table 1, Figure 1) on 14 November 2013. 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 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).

**Table 1** Biomonitoring sites in the Kahouri Stream sampled in relation to Taranaki Abattoirs

| Site number | Site code | Location |
|---|---|---|
| 1 | KHI000297 | Kahouri Stream, 150 m u/s of abattoir and SH3 |
| 2 | KHI000300 | Kahouri Stream, SH3, approx. 95m downstream of discharge point |
| 3 | KHI000305 | Kahouri Stream, 85 m d/s of site 2 |

Macroinvertebrate taxa found in each sample were recorded as:

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

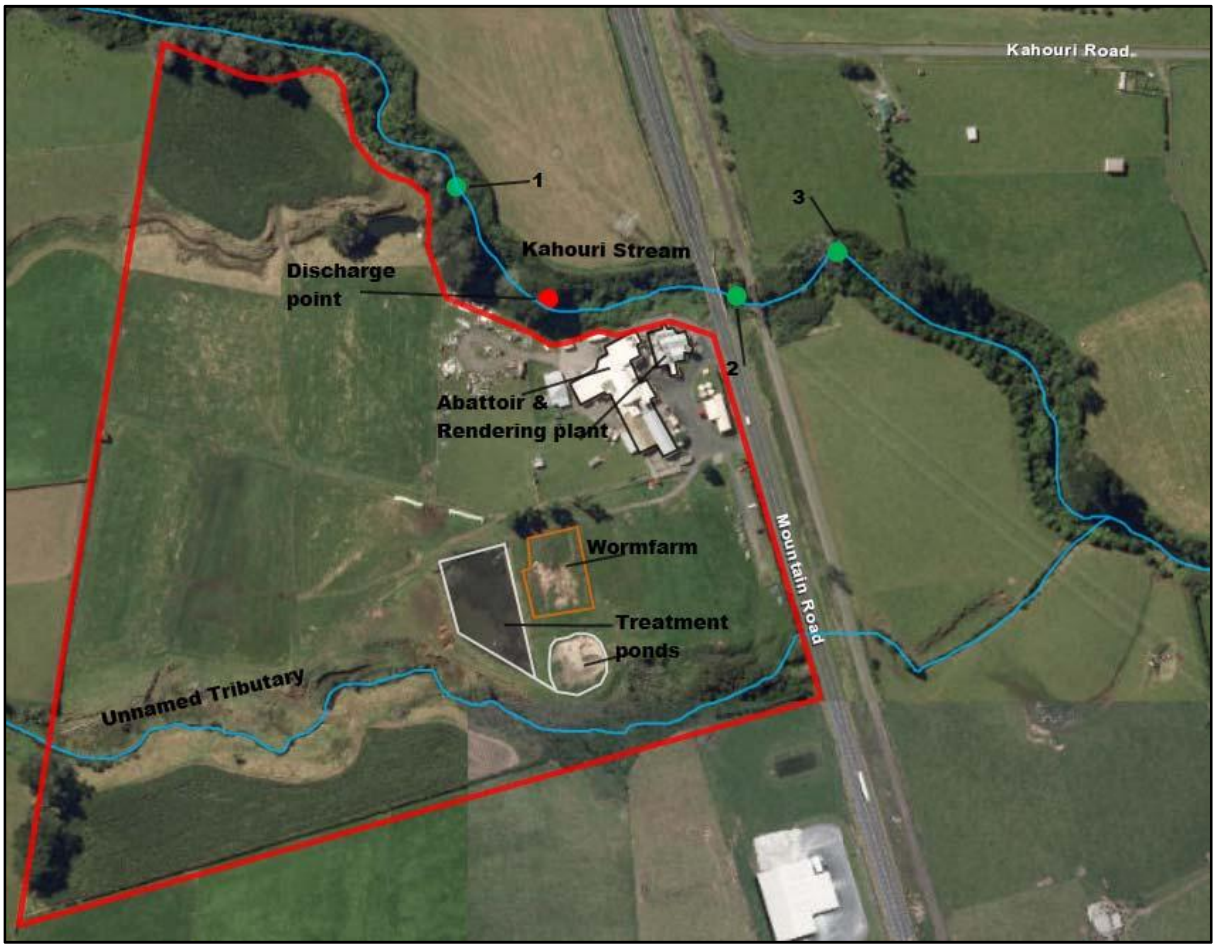


**Figure 1** Taranaki Abattoirs site layout and biomonitoring sites, in relation to the discharge point

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. Averaging the scores assigned to the taxa found at a site, and multiplying the average by a scaling factor of 20 produces a Macroinvertebrate Community Index (MCI) value.

The MCI was designed as a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. MCI results can also reflect the effects of

warm temperatures, slow current speeds and low dissolved oxygen levels, because the taxa capable of tolerating these conditions generally have low sensitivity scores. Usually more 'sensitive' communities (with higher MCI values) inhabit less polluted waterways. The use of this index in non-stony streams is possible if results are related to physical habitat (good quality muddy/weedy sites tend to produce lower MCI values than good quality stony sites).

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, therefore $SQMCI_s$ values range from 1 to 10, while MCI values range from 20 to 200.

In addition to assessing these indices, the number of Ephemopterans (mayflies), Plecopterans (stoneflies) and Trichopterans (caddisflies) in the community were taken into account when considering any differences between communities. These are referred to as EPT taxa.

Sub-samples of periphyton (algae and other micro flora) taken from the macroinvertebrate samples 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 these organisms can be an indicator of organic enrichment within a stream.

## Results and discussion

At the time of this early afternoon survey the Kahouri Stream had a moderate flow, owing to the relatively short of recession, with the last flood event of three times the median flow occurring 13 days prior to the sampling date. The relatively steep gradient resulted in a swift flow at all three sites. This flow was uncoloured and clear, with, the cloudiness typical for this stream, due to the naturally occurring high iron oxide content, being absent during the current survey. The stream bed material at all sites comprised predominantly boulders, cobbles and coarse gravels, with smaller proportions of fine gravels and sand.

Periphyton was present as patchy mats at sites 1 and 2, but only a slippery film of algae was noted at site 3, owing primarily to the partial or complete shading enjoyed by these sites. Patchy growths of moss were present at these sites also. No sewage fungus was observed on the bed of the stream, and the absence of sewage fungus was confirmed through microscopic examination.

Company records indicate that prior to this survey, the last time wastewater was discharged to the Kahouri Stream was on 7 November 2013, seven days prior to this survey. On this day, 1470$m^3$ of wastewater was discharged to the Kahouri Stream.

## Macroinvertebrate communities

Previous surveys performed in the vicinity of Taranaki Abattoirs have indicated that the macroinvertebrate communities of the Kahouri Stream are generally in good condition with relatively high numbers of taxa and MCI values. Results of previous surveys performed in

the vicinity of Taranaki Abattoirs are summarised in Table 2, together with current results and the full results are shown in Table 3.

**Table 2** Summary of the numbers of taxa, MCI and $SQMCI_S$ values recorded previously in the Kahouri Stream, together with current results. Included for reference are summary statistics for site C (KHI000307), which is located 50m downstream of the unnamed tributary, approximately 300m downstream of site 3.

| Site | Number of previous surveys | Numbers of taxa | | | MCI values | | | $SQMCI_S$ values | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Median | Range | Current Survey | Median | Range | Current Survey | N | Median | Range | Current Survey |
| C | 25 | 27 | 17-35 | - | 108 | 96-120 | - | 13 | 4.8 | 3.5-6.8 | - |
| 1 | 25 | 26 | 17-35 | 24 | 115 | 106-130 | 115 | 16 | 6.4 | 5.5-7.4 | 7.4 |
| 2 | 6 | 22 | 13-28 | 22 | 117 | 108-123 | 115 | 3 | 7.4 | 7.0-7.7 | 7.1 |
| 3 | 3 | 25 | 25-27 | 19 | 114 | 113-114 | 109 | 3 | 7.2 | 6.7-7.6 | 7.1 |

**Table 3** Macroinvertebrate fauna of the Kahouri Stream, current survey

| Taxa List | Site Number | MCI score | 1 | 2 | 3 |
|---|---|---|---|---|---|
| | Site Code | | KHI000297 | KHI000300 | KHI000305 |
| | Sample Number | | FWB13313 | FWB13314 | FWB13315 |
| ANNELIDA (WORMS) | Oligochaeta | 1 | C | R | - |
| MOLLUSCA | *Potamopyrgus* | 4 | - | R | - |
| EPHEMEROPTERA (MAYFLIES) | *Austroclima* | 7 | A | A | A |
| | *Coloburiscus* | 7 | XA | VA | XA |
| | *Deleatidium* | 8 | XA | VA | VA |
| | *Nesameletus* | 9 | A | A | C |
| | *Zephlebia group* | 7 | C | C | A |
| PLECOPTERA (STONEFLIES) | *Acroperla* | 5 | - | R | R |
| | *Zelandobius* | 5 | R | - | R |
| | *Zelandoperla* | 8 | R | R | - |
| COLEOPTERA (BEETLES) | Elmidae | 6 | A | A | A |
| | Hydraenidae | 8 | C | C | - |
| | Ptilodactylidae | 8 | R | - | - |
| MEGALOPTERA (DOBSONFLIES) | *Archichauliodes* | 7 | A | C | C |
| TRICHOPTERA (CADDISFLIES) | *Aoteapsyche* | 4 | C | C | C |
| | *Costachorema* | 7 | R | R | R |
| | *Hydrobiosis* | 5 | R | - | R |
| | *Orthopsyche* | 9 | R | - | - |
| | *Beraeoptera* | 8 | C | C | R |
| | *Confluens* | 5 | R | C | - |
| | *Pycnocentria* | 7 | - | R | - |
| | *Pycnocentrodes* | 5 | R | R | - |
| DIPTERA (TRUE FLIES) | *Aphrophila* | 5 | C | A | C |
| | *Maoridiamesa* | 3 | - | R | R |
| | Orthocladiinae | 2 | C | C | R |
| | *Polypedilum* | 3 | R | - | R |
| | Empididae | 3 | - | - | R |
| | Psychodidae | 1 | R | - | - |
| | *Austrosimulium* | 3 | R | R | R |
| | No of taxa | | 24 | 22 | 19 |
| | MCI | | 115 | 115 | 109 |
| | SQMCIs | | 7.4 | 7.1 | 7.1 |
| | EPT (taxa) | | 14 | 13 | 11 |
| | %EPT (taxa) | | 58 | 59 | 58 |

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

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

## Site 1 (KHI000297)

A near-average community richness of 24 macroinvertebrate taxa was found at site 1, upstream of the Taranaki Abattoir site. This was similar to the median number of taxa from previous surveys at this site (Table 2) and similar to that recorded in the previous survey (Figure 2). The community was characterised by two 'highly sensitive' taxa (*Deleatidium* and *Nesameletus* mayflies), four 'moderately sensitive' taxa (*Austroclima* and *Coloburiscus* mayflies, elmid beetles and *Archichauliodes* dobson fly larvae) and no 'tolerant' taxa (Table 3). This represents a slight reduction in the number of abundant taxa when compared with previous surveys, possibly reflecting the frequent floods that preceded this survey.

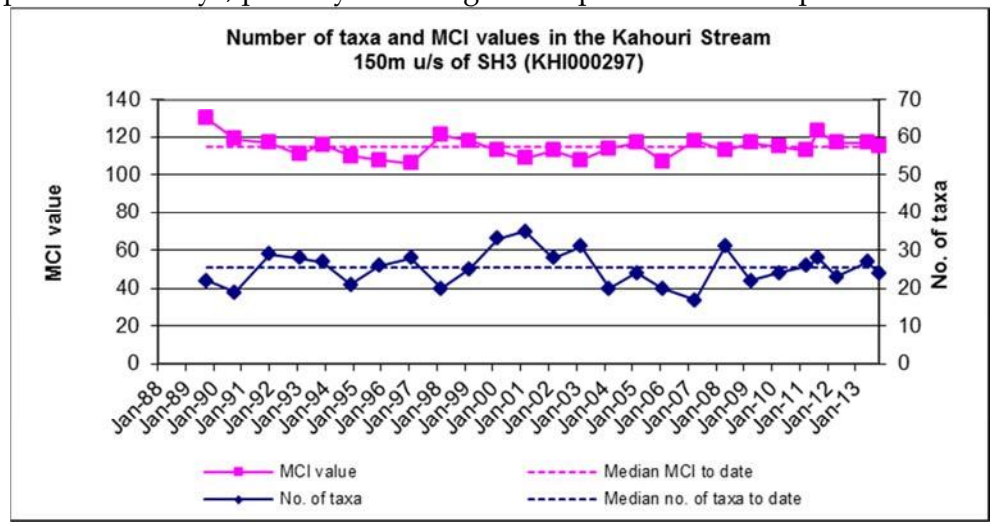


**Figure 2** Number of taxa and MCI values in the Kahouri Stream at site 1 (KHI000297)

The moderate proportion of 'sensitive' taxa (75% of total richness) in the community resulted in a MCI score of 115 units, which was equal to the long term median of past surveys' scores at this site, and similar to that recorded in most previous surveys (Table 2, Table 3, Figure 2). The dominance (numerically) of sensitive taxa, particularly mayflies, accounted for the high $SQMCI_s$ value (7.4 units), a good result, and 1.0 unit higher than the median (Table 2), a statistically significant result (Stark, 1998). There were fourteen EPT taxa in the community, comprising 58% of the taxa recorded. This indicates good preceding water quality.

## Site 2 (KHI000300)

This site was sampled for the third time since the discharge of wastewater began upstream. Located at State Highway 3, approximately 95m downstream of the discharge point, this site would be expected to show the greatest impact (if any) of the discharge of wastewater to the Kahouri Stream. A moderate community richness of 22 taxa was recorded at this site, two less than that recorded at site 1 in the current survey, but equal to the median richness for this site (Table 2). The community was characterised by two 'highly sensitive' taxa (*Deleatidium* and *Nesameletus* mayflies), four 'moderately sensitive' taxa (*Austroclima* and *Coloburiscus* mayflies, elmid beetles and *Aphrophila* mayfly); but no 'tolerant' taxa. The community comprised 73% 'sensitive' taxa, resulting in an MCI score of 115 units, equal to that recorded at site 1 and similar to the median for this site (Table 2).

There was little difference in $SQMCI_S$ score compared with site 1 upstream, with a slight decrease to 7.1 units (Table 2). This lack of change reflects the similarities in dominant taxa,

and the fact that there were no significant changes in abundance. In addition, %EPT was very similar to that recorded at site 1 (58%)

The similarity in %EPT, MCI and $SQMCI_S$ scores reflect that the communities of site 1 and 2 were very similar, indicating no impact from the discharge of wastewater between the two sites.

### Site 3

Site 3 is located another 85m downstream of site 2, and is situated amongst a rapid dominated by large boulders. This is the fourth time that this site has been sampled. Nineteen taxa were recorded at this site, slightly less than that recorded at sites 1 and 2 upstream. As with sites 1 and 2, 'highly sensitive' *Deleatidium* mayfly were recorded in abundance, although not as abundant as that recorded in previous surveys, reflecting the frequent flushing flows that preceded this survey. Other taxa recorded in abundance included four 'moderately sensitive taxa (*Austroclima, Coloburiscus* and *Zephlebia* mayflies and elmid beetles) but no 'tolerant' taxa.

The moderate proportion of sensitive taxa in the community (68%), resulted in an MCI score of 109 units, less than that recorded at sites 1 and 2, but not statistically significantly so (Stark, 1998). This result was similar to the median recorded at site C downstream, although the changes in taxa are not necessarily indicative of organic enrichment, and are considered to in fact reflect the frequent flushing flows that preceded this survey. Overall, the difference in MCI score between this site and that recorded at site 1 is similar to that recorded in the baseline survey, indicating no impact from the discharge of wastewater upstream. The $SQMCI_S$ score is similar to that recorded upstream (7.1 units), reflecting the similar community compositions. Furthermore, there was little difference in %EPT with that recorded at site 1.

Overall, this survey indicates that although there may be some slight deterioration in community health in a downstream direction, this is natural, and not related to any discharge from the Taranaki Abattoirs site.

## Summary and conclusions

The Council's standard 'kick-sampling' technique was used to collect streambed macroinvertebrates from three sites in the Kahouri Stream in relation to the Taranaki Abattoirs site on 14 November 2013. This survey was performed to monitor the health of the macroinvertebrate community of the Kahouri Stream in relation to wastewater management at the Taranaki Abattoirs site. Since late 2011, wastewater has been irrigated to land when soil conditions allow, or discharged to the Kahouri Stream at a time of high flow and adequate dilution. Samples were sorted and identified to provide the 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. It may be used in soft-bottomed streams to detect trends over time. The $SQMCI_S$ takes into account taxa abundance as well as sensitivity to pollution, and may reveal more subtle changes in communities, particularly if non-organic impacts are occurring.

Significant differences in either MCI or $SQMCI_S$ between sites indicate the degree of adverse effects (if any) of discharges being monitored.

During this spring survey, the three sites sampled in the Kahouri Stream recorded little variation in taxa richness, and the MCI scores and $SQMCI_S$ scores were very similar, both to each other and to the respective medians recorded at site 1 upstream. In addition, these sites were largely dominated by the same taxa, with very few significant differences in individual taxon abundance between sites. The results of this survey also did not differ markedly from that recorded in the baseline survey, suggesting little change in communities since the discharge of wastewater commenced. However, there was a subtle reduction in the number of abundant taxa, and also in abundance of some taxa typically recorded in abundance at these sites. This is a reflection of the frequent flushing flows that preceded this survey. Overall, this survey indicates that although there may be a slight deterioration in community health in a downstream direction, this is natural, and not related to any discharge from the Taranaki Abattoirs site. This was supported by the absence of sewage fungus, as determined by microscopic inspection of the samples.

Overall, the Kahouri Stream was in good condition, and with regards to the statement in the consent, an examination of the MCI, $SQMCI_S$ scores and the %EPT found no indication of a significant adverse effect caused by the discharge, and as such, there was no breach of condition 13 of consent 7662-1.

## References


Dunning K, 2002: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2002. TRC report KD124

Fowles C & Moore S, 2004: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2004. TRC report CF332.

Fowles C & Hope K, 2006: Biomonitoring of the Kahouri Stream and an unnamed tributary, February 2006. TRC report CF405.

Hope K, 2005: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2005. TRC report KH035.

Jansma, B, 2009a: Biomonitoring of the Kahouri Stream and an unnamed tributary, April 2007. TRC report BJ052.

Jansma, B, 2009b: Biomonitoring of the Kahouri Stream and an unnamed tributary, May 2008. TRC report BJ053.

Jansma, B, 2010: Biomonitoring of the Kahouri Stream and an unnamed tributary, April 2009. TRC report BJ088.

Jansma, B, 2011: Biomonitoring of the Kahouri Stream and an unnamed tributary, April 2010. TRC report BJ142.

Jansma, B 2014: Biomonitoring of the Kahouri Stream and an unnamed tributary, April 2011. TRC report BJ233.

Jansma, B, 2014: Baseline biomonitoring of the Kahouri Stream in relation to Taranaki Abattoirs, September 2011. TRC Report BJ234.

Jansma, B, 2014: Biomonitoring of the Kahouri Stream and an unnamed tributary in relation to Taranaki Abattoirs, May 2012. TRC Report BJ235.

Jansma, B, 2014: Biomonitoring of the Kahouri Stream and an unnamed tributary in relation to Taranaki Abattoirs, June 2013. TRC Report BJ236.

McWilliam H, 2000: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2000. TRC report HM225

McWilliam H, 2001: Biomonitoring of the Kahouri Stream and an unnamed tributary, March 2001. TRC report HM242

Moore S, 2003: Biomonitoring of the Kahouri Stream and an unnamed tributary, 24 March 2003. TRC report SM583

Stark JD, 1985: A macroinvertebrate community index of water quality for stony streams. Water and Soil Miscellaneous Publication No. 87.

Stark JD, 1998: SQMCI: a biotic index for freshwater macroinvertebrate coded abundance data. New Zealand Journal of Marine and Freshwater Research 32(1): 55-66.

Stark JD, 1999: An evaluation of Taranaki Regional Council's SQMCI biomonitoring index. Cawthron Institute, Nelson. Cawthron Report No. 472.

Stark JD, Boothroyd IKG, Harding JS, Maxted JR, Scarsbrook MR, 2001: Protocols for sampling macroinvertebrates in wadeable streams. New Zealand Macroinvertebrate Working Group Report No. 1. Prepared for the Ministry for the Environment. Sustainable Management Fund Project No. 5103. 57p.

TRC, 1999: Some statistics from the Taranaki Regional Council database (FWB) of freshwater macroinvertebrate surveys performed during the period from January 1980 to 31 December 1998. Technical Report 99-17.