# Remediation NZ Limited
# Monitoring Programme
# Annual Report
# 2014-2015

## Technical Report 2015-68

ISSN: 1178-1467 (Online)
Document: 1597530 (Word)
Document: 1611705 (Pdf)

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February 2016

# Executive summary

Remediation NZ Ltd (RNZ) operates two worm farms, to produce vermicasts for fertiliser, at two sites in Brixton. These are at \Waitara Road in the Waiongana catchment and Pennington Road, in the Waitara catchment. RNZ also operates a drilling waste remediation, composting and vermiculture operation at Mokau Road, Uruti, in the Mimi catchment.

This report for the period July 2014-June 2015 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess the Company's environmental performance during the period under review, the results and environmental effects of RNZ's activities.

**During the monitoring period an improvement in RNZ's environmental performance was required**

The Company holds a total of eight resource consents that cover all operations carried out on the three sites. These consents include a total of 107 special conditions that set out the requirements that the Company must satisfy.

The Council's monitoring programme for the year under review included 13inspections focussing on raw materials, leachate, stormwater, and odour control, 68 water samples, 12 discharge samples, four soil samples, six groundwater samples, one freshwater biomonitoring survey, and one fish survey.

During the monitoring year it was found that the soil and groundwater associated with irrigation activities continued to exhibit elevated levels of sodium and chloride. As a result of this and the findings of last years report, RNZ undertook investigations into the Uruti site's groundwater and soil and developed a management plan to reduce effects of irrigation on soil and groundwater. The plan also provided for improved stormwater management, a higher level of monitoring of groundwater and soil, and further riparian planting.

During the monitoring year, upon responding to a complaint it was found that unauthorised discharges of drilling waste leachate to the Haehanga Stream had occurred during an overflow event. This resulted in an abatement notice and an infringement notice being issued. As a result of this event, RNZ undertook works to improve containment bunding in and around the pond treatment system. The Council also received numerous odour complaints about the site, however all these were investigated and none of these were substantiated.

RNZ demonstrated a high level of environmental performance and compliance with resource consents at its Waitara Road and Pennington Road sites. An improvement is required in RNZ's environmental performance and compliance with resource consents at its site at Uruti.

For reference, in the 2014-2015 year, 75% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level o f environmental performance and compliance with their consents, while another 22% demonstrated a good level of environmental performance and compliance with their consents.

This report includes recommendations for the 2015-2016 year.

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# 1. Introduction

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

### 1.1.1 Introduction

This report is the annual report for the period July 2014-June 2015 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by Remediation NZ Ltd (RNZ). The Company operates a worm farm at two sites at Brixton. These are at Waitara Road, Waitara, in the Waiongana catchment and Pennington, in the Waitara catchment. The Company also operates a drilling water remediation, composting, and vermiculture facility at Mokau Road, Uruti, in the Mimi catchment.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consents held by RNZ that relate to discharges of water and solids to land within the Waiongana and Waitara catchments, and the consents held by RNZ to cover emissions to air and discharges to land and water in the Mimi catchment.

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 Council has generally integrated its environmental monitoring programmes and reports the results of the programmes jointly. This report discusses the environmental effects of the RNZ's use of water, land and air, and is the 14th combined annual report by the Council for the sites.

### 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 the Company, 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/catchment.

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 2015-2016 monitoring year.

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

### 1.1.3 The Resource Management Act 1991 and monitoring

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

(a) the neighbourhood or the wider community around an activity, and may include cultural and social-economic effects;
(b) physical effects on the locality, including landscape, amenity and visual effects;
(c) ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;
(d) natural and physical resources having special significance (for example recreational, cultural, or aesthetic);
(e) risks to the neighbourhood or environment.

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

### 1.1.4 Evaluation of environmental and administrative performance

Besides discussing the various details of the performance and extent of compliance by 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 (that is a defence under the provisions of the *RMA* can be established) may be excluded with regard to the performance rating applied. For example loss of data due to a flood destroying deployed field equipment.

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

**Environmental Performance**

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

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

  For example:

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

- **Improvement required:** Likely or actual adverse effects of activities on the receiving environment were more than minor, but not substantial. There were some issues noted during monitoring, from self reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent minor non-compliant activity could elevate a minor issue to this level. Abatement notices and infringement notices may have been issued in respect of effects.

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

**Administrative performance**

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

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

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

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

For reference, in the 2014-2015 year, 75% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level o f environmental performance and compliance with their consents, while another 22% demonstrated a good level of environmental performance and compliance with their consents.

## 1.2 Process description

RNZ produces a range fertiliser products for various markets. A range of waste streams are processed and converted, via vermiculture and composting, into marketable biological products that can be safely used as a fertiliser and soil conditioner.

The operation consists of a composting and vermiculture operation at Mokau Road, Uruti, and vermiculture operations at Waitara Road and Pennington Road. The Waitara Road site also has a fertilising processing facility which blends and refines the finished products.

The Mokau Road, Uruti composting site was established in late 2001 following removal of composting operations from the old Winstone Aggregates quarry site, Manutahi Road, Bell Block (RNZ no longer operates at this site). Closure of the composting operations was due to the incompatible nature of the activity with surrounding land use (nearby residential houses), which resulted in odour incidents. The vermiculture production facilities have been operating at Waitara Road since 1998 and at the Pennington Road site since 2001.

The current site at Uruti accepts a range of waste streams including, paunch grass, poultry waste, poultry mortalities, fish carcasses, green waste and drilling waste.

The composting operation and drilling mud processing at the Mokau Rd site generates a significant amount of leachate and contaminated stormwater from three main processing areas. These are the drilling wastes pad (DWP) and two composting pads (known as 'pad 1' and 'pad 2').

Drilling muds, fluids and cuttings are mixed with sawdust or other organic material and then piled up on the remediation pad. Any rain run-off and leachate that is generated, drains into a series of ponds for treatment. Between each pond there is a baffle that skims off any floating hydrocarbons as the leachate passes through. These ponds also treat the leachate and stormwater from pad 1 where remediated drilling wastes are stored and/or processed further. The treated liquid from the pond treatment system (PTS) is then irrigated to cut and carry pasture on two irrigation areas.

Run off and leachate from composting pad 2 and a paunch grass maturation pad is pumped up to the top of a seven tier constructed wetland. Under dry conditions the water from the bottom pond of the wetland is reticulated back to the top tier of the wetland. Under high flow conditions the wetland discharges the treated stormwater/leachate and leachate to a tributary of the Haehanga Stream.

The Company also developing a pea gravel quarry at the Uruti site. Pea gravel I will be removed from a cutting high on the east side of the valley and shipped to Matamata for washing and sorting. Stormwater from the site is treated for sediment and then enters the Haehanga Stream via an unnamed tributary.

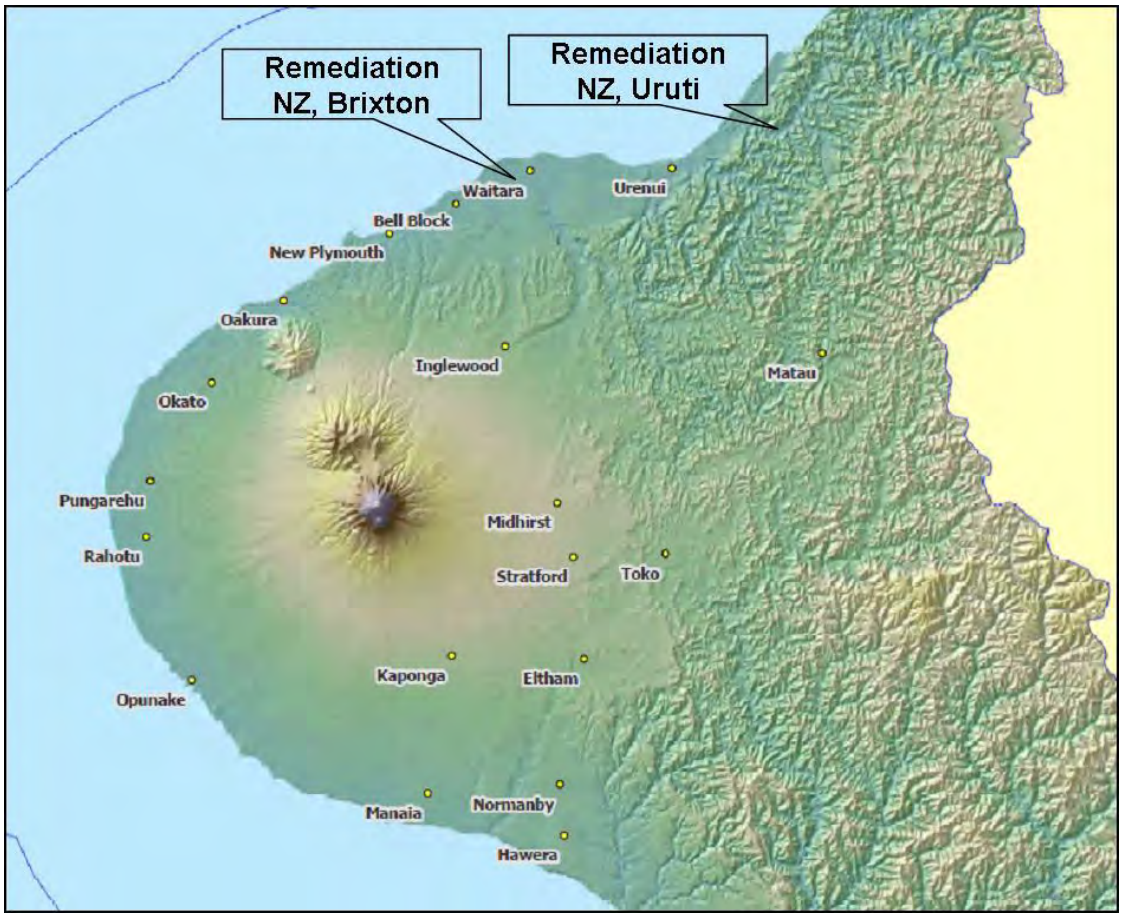


**Figure 1** Regional map showing locations of Remediation NZ's Taranaki sites


**Figure 2** RNZ site, Mokau Road, Uruti

## 1.3 Resource consents

**Table 1** Consents held by Remediation NZ

| Consent No. | Site | Purpose | Expiry Date | Review Date(s) |
|---|---|---|---|---|
| 5838-2 | Uruti | Discharge to land and water | June 2018 | Yearly |
| 5839-2 | Uruti | Discharge emissions to air | June 2018 | Yearly |
| 5938-2 | Uruti | Install culvert | June 2015 | - |
| 6211-1 | Uruti | Divert stream | June 2021 | - |
| 6212-1 | Uruti | Install culvert | June 2021 | - |
| 10063-1 | Uruti | To discharge treated stormwater (quarry) | June 2033 | June 2021 |
| 5892-2 | Brixton | Discharge to land/water | June 2020 | - |
| 5893-2 | Brixton | Discharge to land/water | June 2021 | - |

### 1.3.1 Air discharge permit - Uruti

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

RNZ holds air discharge permit **5839-2** to discharge emissions into the air, namely odour and dust, from composting operations between 1731704E-5685796N, 1733127E-5684809N, 1732277E-5685101N, 1732451E-5684624N and 1732056E-5684927N. This consent was issued to the consent holder on 30 June 2010. It is due to expire in June 2018.

The consent has 20 special conditions attached to it.

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

Special conditions 2 to 4 set restrictions on the types of waste accepted and the size of the composting pads, and condition 5 requires that records be kept of incoming waste.

Special conditions 6 and 7 deal with the requirements for the submission of and adherence to a Site Practices Plan.

Special conditions 8 and 9 require an independent report on the management of the site in regards to practices and air emissions, and special condition 10 requires that any recommendations from the report be adhered to.

Special conditions 11, 12, and 13 set out the permitted limits on the effects of discharges to air arising from the exercise of this consent.

Special conditions 14 and 15 deal with the requirements for weather monitoring and odour surveys.

Special conditions 16 and 17 set out requirements for community liaison and complaints procedures.

Special condition 18 and 19 set out the requirements for site reinstatement.

Special condition 20 is a review condition.

A copy of the permit is attached to this report in Appendix I.

### 1.3.2 Discharges to land and water – Uruti and Brixton

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.

RNZ holds water discharge permit **5838-2** to discharge: a) waste material to land for composting; and b) treated stormwater and leachate from composting operations; onto and into land in circumstances where contaminants may enter water in the Haehanga Stream catchment and directly into an unnamed tributary of the Haehanga Stream between 1731704E-5685796N, 1733127E-5684809N, 1732277E-5685101N, 1732451E-5684624N and 1732056E-5684927N. This consent was issued to the consent holder on 30 June 2010. It is due to expire in June 2018.

It has 28 special conditions.

Special condition 1 requires that the consent holder adopt the best practical option for reducing and minimising effects.

Special conditions 2 and 3 set restrictions on the types of waste accepted and the size of the composting pads, and condition 5 requires that records be kept for incoming waste.

Special conditions 4, 5 and 6 set out requirements for the maintenance of treatment systems.

Special condition 7 requires the consent holder to keep irrigation records.

Special condition 8, 9 and 10 set limits on effects arising from the irrigation of wastewater.

Special conditions 11, 12 and 13 set out requirements for the monitoring and management of soil quality in the irrigation areas.

Special conditions 14 to 17 set out requirements for the monitoring and management of groundwater quality in the irrigation areas.

Special conditions 18 and 19 deal with the maintenance and management of the pond treatment system.

Special conditions 20 and 21 deal with the maintenance and management of the wetland treatment system.

Special conditions 22 and 23 sets limits on effects arising from the wetland discharge.

Special condition 24 requires that riparian planting be maintained in accordance with the riparian plan in place.

Special condition 25 requires that the consent holder keep records of all complaints.

Special conditions 26 and 27 deal with site reinstatement.

Special condition 28 is a review condition.

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.

RNZ holds water discharge permit **10063-1** to discharge treated stormwater from a quarry site, into an unnamed tributary of the Haehanga Stream. This consent was issued to the consent holder on 9 March 2015. It is due to expire in June 2033.

It has 18 special conditions;

Special condition 1 requires the consent be exercised in accordance with information supplied with the application.

Special condition 2 requires the consent holder to notify Council prior to exercise of consent.

Special condition 3 requires the consent holder to adopt best practice.

Special condition 4 requires the consent to progressively reinstate the quarry site.

Special condition 5 limits the area of disturbed soil.

Special condition 6 limits the stormwater catchment area.

Special conditions 7, 8, and 9 deal with stormwater treatment requirements.

Special conditions 11, 12, and 13 deal with discharge quality and effects on receiving waters.

Special conditions 14 and 15 deal with management and contingency plans.

Special condition 16 deals with notification of changes in site processes.

Special conditions 17 and 18 are lapse and review conditions.

RNZ holds discharge permit **5892-1** to cover the discharge of stormwater from the worm farming operations onto and into land and into the unnamed tributary of the Waiongana Stream at the Waitara Road, Brixton site. This permit was originally issued by the Council on 7 September 2006 under Section 87(e) of the RMA. It is due to expire in June 2020.

There are 10 special conditions attached to the consent.

Special condition 1 requires the consent be exercised in accordance with information submitted in the application.

Special condition 2 requires the consent holder adopt the best practicable option to prevent or minimise adverse effects on the environment.

Special condition 3 requires the provision, upon request, of records of the nature and volume of wastes.

Special condition 4 sets a maximum hydrocarbon content on solid drilling cuttings of 5%.

Special condition 5 requires that there is no contamination of groundwater or surface water while condition 7 gives contaminant concentrations not to be exceeded in the discharge.

Special condition 6 requires that the stormwater treatment system is maintained.

Special condition 8 requires notification prior to undertaking changes to processes or operations which would change the nature or quantity of contaminants emitted from the site.

Special condition 9 requires notification of reinstatement of the site and gives guidance as to how reinstatement should be carried out to minimise effects on stormwater.

Special condition 10 explains review provisions.

RNZ holds discharge permit **5893-2** to cover the discharge of solid hydrocarbon exploration drilling wastes onto land, and to discharge stormwater from the worm farming operations onto and into land and into the unnamed tributary of the Waitara River at the Pennington Road, Brixton site. This permit was originally issued by the Council on October 2006 under Section 87(e) of the RMA. It is due to expire in June 2020.

There are 11 special conditions attached to the consent.

Special condition 1 requires the consent be exercised in accordance with information submitted in the application.

Special condition 2 requires the consent holder adopt the best practicable option to prevent or minimise adverse effects on the environment.

Special condition 3 requires, upon request, records of the nature and volume of wastes.

Special condition 4 sets a maximum hydrocarbon content on solid drilling cuttings of 5%.

Special condition 5 requires that there is no contamination of groundwater or surface water.

Special condition 6 requires the stormwater treatment system to be maintained.

Special condition 7 gives contaminant concentrations not to be exceeded in the discharge while special condition 8 describes visual effects which must not be observed below a mixing zone.

Special condition 9 requires notification prior to undertaking changes to processes or operations which would change the nature or quantity of contaminants emitted from the site.

Special condition 10 requires notification of reinstatement of the site and gives guidance as to how reinstatement should be carried out to minimise effects on stormwater.

Special condition 11 explains review provisions.

### 1.3.3 Land use consents- Uruti

Section 13(1)(a) of the RMA stipulates that no person may in relation to the bed of any lake or river use, erect, reconstruct, place, alter, extend, remove, or demolish any structure or part of any structure in, on, under, or over the bed, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. RNZ has three land use consents.

Consent **5938-1** relates to a culvert in the Haehanga Stream. This consent was granted on 5 December 2001. There are six special conditions attached to the consent.

Special condition 1 requires the consent holder to notify the Council prior to construction.

Special condition 2 requires that construction is in accordance with the application.

Special condition 3 requires the consent holder adopt the best practicable option to avoid or minimise discharge of silt or contaminants to the environment.

Special condition 4 deals with riverbed disturbance.

Special condition 5 requires the consent holder to reinstate the area when the structure is no longer required.

Special condition 6 deals with review of the consent.

Consent **6211** was granted as a retrospective consent on 26 September 2003. Relating to a diversion of the Haehanga Stream, the consent has six special conditions attached. It is due to expire in June 2021.

Special condition 1 requires the consent holder to notify the Council prior to works.

Special condition 2 requires that the realignment be carried out in accordance with the application.

Special conditions 3 and 4 require the consent holder adopt the best practicable option to avoid or minimise erosion, scouring and the discharge of silt or contaminants to water.

Special condition 5 deals with riverbed disturbance.

Special condition 6 deals with review of the consent.

Consent **6212** is for a culvert in the Haehanga Stream was also granted as a retrospective consent on 26 September 2003. It is due to expire in June 2021.

There are eight special conditions included in the consent.

Special condition 1 requires the consent holder to notify the Council prior to removal of the temporary culvert and installation of the new culvert.

Special condition 2 requires that the temporary culvert be replaced by April 2004, and that the consent holder provide designs of the proposed culvert.

Special condition 3 required that the culvert be constructed in accordance with the application and be maintained to ensure the conditions are met.

Special condition 4 requires the adoption of best practicable option to avoid or minimise adverse effects on water quality.

Special condition 5 deals with riverbed disturbance.

## 1.4 Monitoring programme

### 1.4.1 Introduction

Section 35 of the RMA sets out obligations upon the 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 Council may therefore make and record measurements of physical and chemical parameters, take samples for analysis, carry out surveys and inspections, conduct investigations, and seek information from consent holders.

The monitoring programme for RNZ's sites consisted of four primary components.

All sampling sites routinely used for chemical analysis during monitoring at Uruti are set out in Figures 2 and 3.

### 1.4.2 Programme liaison and management

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

- ongoing liaison with resource consent holders over consent conditions and their interpretation and application;
- in discussion over monitoring requirements;
- preparation for any reviews;
- renewals;
- 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 RNZ site was visited 13 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. 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 Council undertook sampling in the Haehanga Stream system at numerous sites both up and down stream of the operations at the site at Mokau Road, Uruti. The Haehanga Stream was sampled on numerous occasions, with a total of 66 water samples taken. These samples were analysed for chloride, conductivity, pH, ammonia, BOD and suspended solids. Six samples were also taken of the wetland discharge (or from the wetland's lower pond if discharge was not occurring) and a further seven samples were taken of the irrigation pond. The Council also took nine groundwater samples and four soil samples.

During this monitoring period BTEX and heavy metals analysis were undertaken on soil, groundwater and surface water samples.

### 1.4.5 Biomonitoring surveys

One macroinvertebrate biological survey was performed across six sites in the Haehanga Stream and its tributaries to determine whether or not the discharge of treated leachate and irrigation activities from the site has had a detrimental effect upon the aquatic communities of the stream. The Council also undertook one fish survey to ascertain any effects on fish health from the activities on the site.

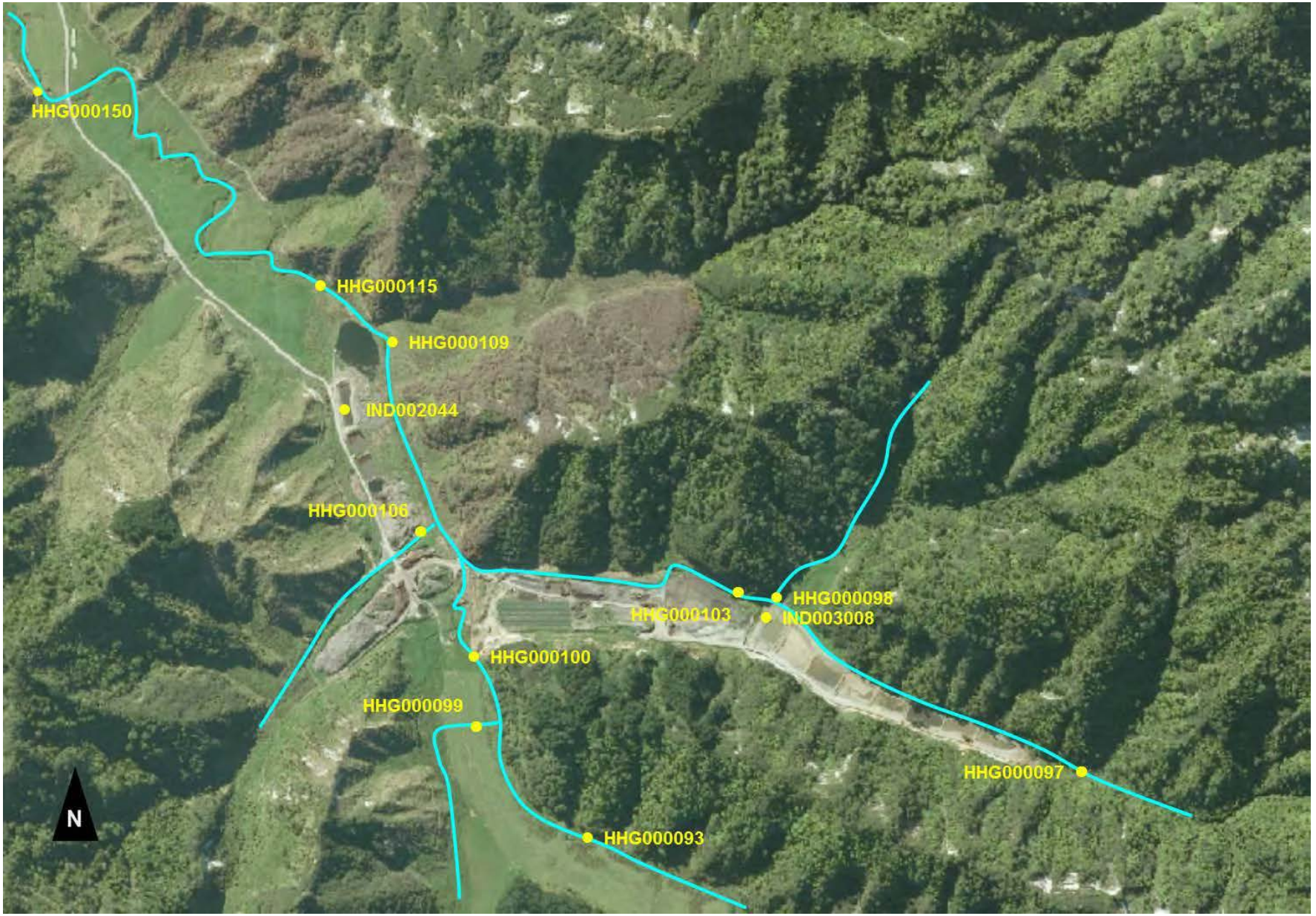


**Figure 3** Freshwater sampling sites at RNZ Uruti sites

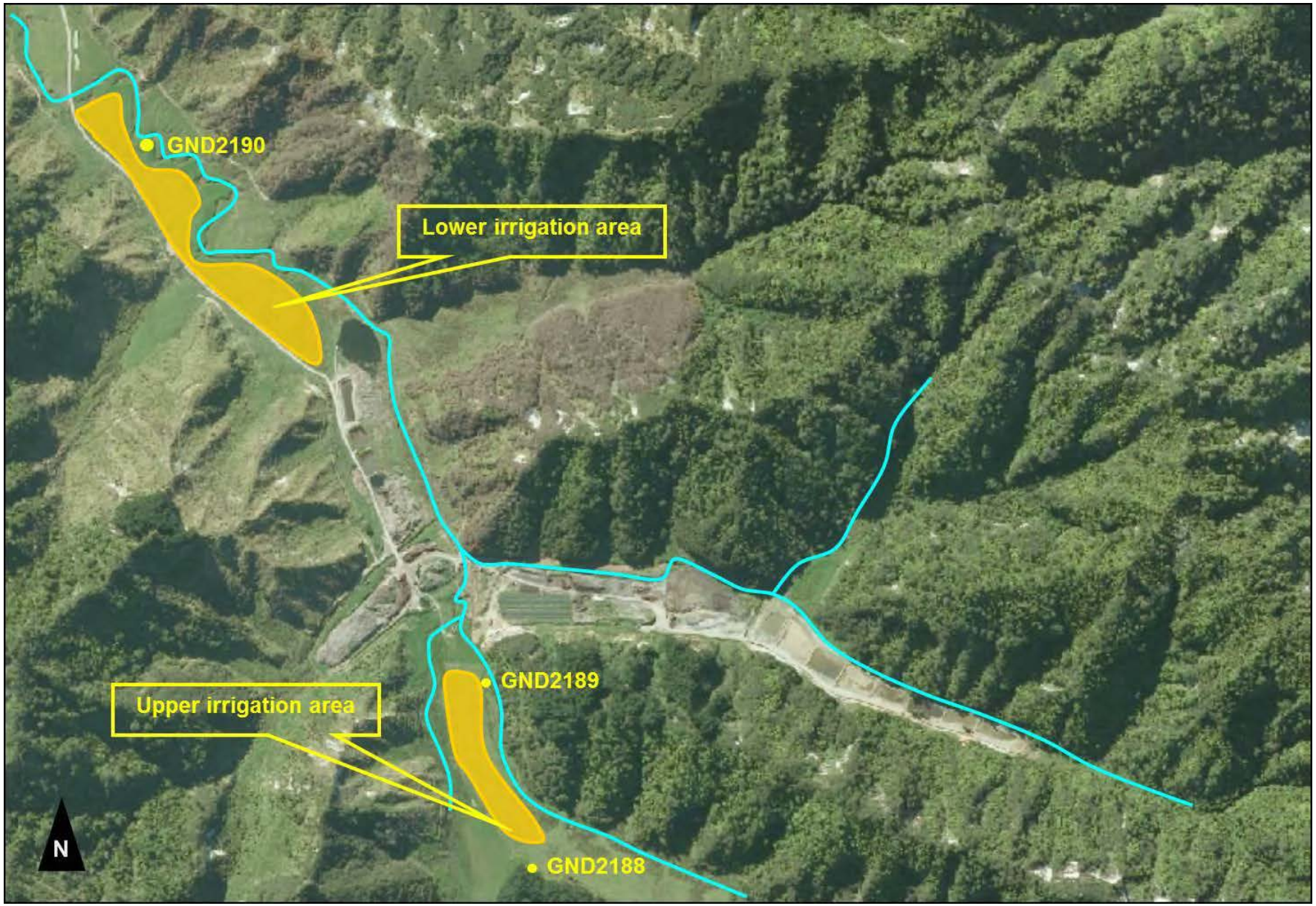


**Figure 4** Irrigation and groundwater bores at RNZ Uruti sites

# 2. Results

## 2.1 Uruti, Mokau Rd site

### 2.1.1 Inspections

#### 2.1.1.1 16 July 2014

A site inspection and sampling run was undertaken in the presence of the site manager. There were four diggers on site moving product and blending it on the DWP. The drains been all recently cleaned out. The level in the bottom irrigation pond was found to be low and the overflow pond was flowing back into irrigation pond.

There was significant amount of paunch being stored at the south end of pad 2, however the level of leachate in the pond was quite low. Paunch deliveries were expected to drop off as freezing works start to set up for calves. The wetland looked healthy and appeared to be working well, with only minor discolouration in the discharge.

There was a big pile of sawdust on pad 1 ready for blending with incoming drilling waste.

Overall site looked good, and pending sample results, appeared to be operating within consent conditions.

#### 2.1.1.2 20 August 2014

A site inspection was undertaken to follow up on works undertaken after a spill incident that occurred on 15 August 2015 (see section 2.3). A lot of oily waste had been pumped off the duck pond and back into the irrigation pond. A sucker truck was on site and this was sucking off the oil and pumping it back through the treatment system. Water from below the surface of the oily waste in the irrigation pond was being pumped out for irrigation to the lower irrigation area.

The other ponds had been cleaned out and a goose neck 'T' pipe had been installed on the pond outlet to hold back the oily waste. It was outlined by staff on site, that a tank and skimmer would be set up here remove the oil.

There were two diggers blending sawdust and composted material. A truck was carting compost from storage pile to the blending pile.

Discussions were held with the site manager about a general site clean-up and the drainage works occurring on the lower irrigation area.

#### 2.1.1.3 29 August 2014

A site visit was made to view the progress of work undertaken since the last incident. The whole site was inspected during the visit including the wetland and the groundwater bores. Works undertaken since the last visit included the cleaning out of the pond system and the installation of extra bunding around the duck pond and the DWP. Works to re-contour the top end of the lower irrigation field was also underway at the time. The groundwater bores were dipped and conductivity readings were

taken. Two of the bore caps were found to have been knocked off by stock. Weather data was also downloaded from the weather station.

A meeting was held at RNZ's Bell Block offices where short and long term improvements at the Uruti site were discussed. Short term improvements included fencing off the groundwater bores, providing more robust inwards goods data, and continuing with works currently underway. Longer term plans were to be investigated after the 2013-2014 annual report was completed.

Upon return to the office it was found that the weather data was incomplete and that wind speed and direction had not been recorded as required by consent conditions. An incident was raised and a 14 day letter was issued (see section 2.3).

#### 2.1.1.4 24 September 2014

The site was inspected in conjunction with surface water sampling. An odour survey was undertaken at the site boundary and no objectionable odours were detected. RNZ had purchased new weather station equipment and this was in the process of being set up.

The wetland was inspected and no issues were noted however upon sampling the downstream site was found to have a hydrocarbon sheen and diesel odour. Site staff indicated that there was a small diesel spill to land during the movement of a pump. The pump was located adjacent a drain that feeds the tributary and there was evidence that a clean up had taken place. A sample was taken the analysis showed that the concentration of total hydrocarbons in the tributary was less than 0.5 $g/m^3$.

There was also an area where new material had been stockpiled, which was thought to be blended drilling waste for composting, however RNZ informed the Council it was soil from a petrol station tank pull. RNZ were directed to provide more information on the soil and to move it into the pond treatment system (PTS) catchment.

Site staff had fenced the groundwater bores as required and field conductivity readings were taken using a conductivity probe. The two bores downgradient of the irrigation areas had elevated conductivity, but not to such a level as to be of concern.

The earthworks and planting done around the drilling waste pad looked good, and the stockpiled blended drilling waste appeared to have reduced in volume, indicating that RNZ was processing the waste had been outlined during earlier inspections.

#### 2.1.1.5 23 October 2014

A site visit was made to conduct a compliance monitoring inspection. No irrigation was occurring at the time of the inspection. The irrigation areas looked good and no issues were noted. The bunds adjacent the drill mud pad and alongside the stream appeared to be in good condition and were well maintained. The duck pond appeared cleaner than it did in previous inspections and was slowly recovering from the spill earlier in the year. Overall the site appeared quite clean and tidy.

#### 2.1.1.6 13 November 2014

A sampling run and inspection was undertaken in the presence of RNZ staff. The Haehanga Stream was in fresh after over night rain and was quite turbid in appearance. The paunch pad was noted to be quite full would need to be pushed back off the road.

The new track up the hill to the quarry area looked good and silt and sediment traps had been installed to treat stormwater from the quarry area prior to discharge to the Haehanga Stream. The irrigation pond and duck pond both appeared cleaner than in previous inspections and the irrigation areas also looked good and had thick grass cover.

A spill shed had been constructed been near the culvert on the way in to the site and there was also a spill trailer by the office. No issues were noted at the time of the inspection, the site looked good and no unauthorised discharges were found.

#### 2.1.1.7 9 December 2014

A site visit was made to conduct a compliance monitoring inspection. Trucks were unloading drilling muds at time of inspection. It was noted that a load of dead chickens had been dumped in first blending pond.

The interceptors between the ponds were working well and oily waste was clearly getting held back on the fourth pond down. A skimmer was set up in this pond to prevent oil entering the irrigation pond and this appeared not to have much oil on the surface. The duck pond look cleaner than the previous visit and it was noted that frogs were living in it.

#### 2.1.1.8 21 January 2015

A site visit was made to conduct a compliance monitoring inspection and to take soil water samples. The wetland was not discharging and the Haehanga Stream had very minimal flow and in some places hardly looked to be flowing.

There was new steel irrigation pipe stored next office to be used on new planned irrigation areas and also to replace existing irrigation pipe.

A digger was loading out product from pad one into truck and trailer to take back to Brixton to blend with worm beds. A lot of product from pad two had also been trucked back to Brixton. The paunch stock pile on pad two was being blended onto the worm beds.

The DWP were inspected and it was found that there was a 6000 litre tank next to the pads to receive the recovered oil from the lower treatment ponds. It was outlined that the tank gets emptied once a month by an oil recovery truck.

The interceptor pipes tween the treatment ponds and irrigation pond were working well .The level of oil in the irrigation pond appeared to be decreasing with each visit. The duck pond looked good and there was an abundance of frogs living in it. The irrigation paddocks had been topped and were ready to be cut. It was outlined that the grass would be collected and added to the composting pile.

Overall the site looked good and no issues were noted.

#### 2.1.1.9 28 January 2015

A follow up inspection was undertaken as a result of the high chloride levels found in the stream during sampling on 21 January 2015. The Haehanga Stream was walked and no discharges were found. The high levels of chlorides were discussed and it was likely it was due either groundwater intrusion in to the stream channel or the evaporation of stagnant water. Follow up samples were undertaken on 3 February 2015 and it was found that chloride levels had returned to normal after a short period of rain.

#### 2.1.1.10 12 March 2015

Inspection was undertaken of site and water samples taken in three places to be analysed for metals. The site was operating normally at the time of the inspection and no issues were noted with any of process areas or irrgigation fields.

#### 2.1.1.11 24 April 2015

A site visit was made to conduct a compliance monitoring inspection and to take soil water samples. The site appeared tidy and it was noted that there was ample sawdust stored onsite for blending drilling waste. The blending piles appeared to be well managed. The irrigation pond had a reasonable amount of freeboard in it and the irrigated areas looked healthy and well vegetated.

#### 2.1.1.12 5 June 2015

A site visit was made to conduct a compliance monitoring inspection and to take soil water samples. The Haehanga Stream was in fresh and was quite turbid. There was some ponding on the irrigation fields, but this was most likely to be a result of the heavy rain rather than irrigated fluids. During sampling it was noted that there was more oil on the surface of the irrigation pond than noted previously. A digger was turning piles of compost on the pad 1, but no odour was noted. Overall the site looked good and appeared to have performed well during the recent heavy rain.

### 2.1.2 Results of wetland discharge monitoring

Table 2 shows the results of sampling of the wetland discharge taken during the monitoring year. When the pond was discharging, a sample was taken from the discharge pipe itself to assess the nature of the liquid entering the stream. When the pond was too low for discharge to occur, a sample was taken from the pond itself to monitor the general characteristics of any potential discharge.

**Table 2** Results wetland discharge monitoring

| Date | CBODF | Chloride | Conductivity | Unionised ammonia | Ammoniacal nitrogen | Nitrate/ nitrite | pH | Suspended solids | Temp | Discharging? |
|---|---|---|---|---|---|---|---|---|---|---|
| | g/m³ | g/m³ | mS/m | g/m³ | g/m³ | g/m³ | pH | g/m³ | Deg C | |
| *Consent limit* | - | - | - | - | - | - | *6-9* | *100* | - | |
| 15 Jul 2014 | | 39.2 | 96.2 | 0.70457 | 66.6 | 0.52 | 7.7 | 170 | 9.1 | Yes |
| 24 Sep 2014 | 22 | 59.2 | 154 | 2.0576 | 118 | 0.14 | 7.8 | 41 | 12.8 | Yes |
| 13 Nov 2014 | - | 23 | 50.5 | 0.32739 | 27.7 | 0.72 | 7.6 | 19 | 13.7 | Yes |
| 21 Jan 2015 | - | 44.6 | 118 | 2.17788 | 80 | 0.01 | 7.8 | 62 | 18.9 | No |
| 24 Apr 2015 | - | 46.4 | 81.1 | 0.36921 | 46.5 | 1.11 | 7.4 | 56 | 14.5 | Yes |
| 05 Jun 2015 | 21 | 41.1 | 120 | 0.7482 | 90.2 | 0.4 | 7.6 | 38 | 8.9 | Yes |

Consent 5838-2 states the discharge shall have a pH of between 6.0 and 9.0 pH and have no greater than 100 g/m³ suspended solids. These consent limits were complied with on all sampling occasions with the exception of one suspended solids result on 15 November 2014; however no effects were noted in the stream. Also noted were the elevated levels of unionised ammonia in the samples taken on 24 September 2014 and 21 January 2015. Elevated ammonia levels can be expected during early spring as the nutrients from the winter raupo die back are being released into the wetland discharge and during dry periods when dilution is limited.

### 2.1.3 Irrigation fluid results

A sample of the irrigation pond was taken during each inspection and monitored for a range of parameters. This sampling is undertaken in part for compliance monitoring and to gain a wider understanding of the system's capacity and other potential effects that may arise from specific irrigation fluid components. Table 3 and 4 show the results of analysis.

**Table 3** Results of irrigation fluid monitoring

| Parameter | Unit | 15 Jul 2014 | 24 Sep 2014 | 13 Nov 2014 | 21 Jan 2015 | 24 Apr 2015 | 5 Jun 2015 |
|---|---|---|---|---|---|---|---|
| BOD | g/m³ | - | >800 | 940 | 580 | 1100 | 1090 |
| Calcium | g/m³ | - | - | - | - | - | 772 |
| Chloride | g/m³ | 2220 | 3590 | 2550 | 7390 | 3450 | 2070 |
| Conductivity @ 20 Deg. C | mS/m | 782 | 1200 | 913 | 1890 | 1250 | 762 |
| Hydrocarbons | g/m³ | 0.8 | - | 8.2 | 13 | <0.15 | 28000 |
| Potassium | g/m³ | 1240 | 1890 | 1480 | 2780 | 2290 | 663 |
| Magnesium | g/m³ | - | - | - | - | - | 34.8 |
| Sodium | g/m³ | 463 | 752 | 834 | 1740 | 623 | 378 |
| Ammoniacal - N | g/m³ | 14.4 | 33 | 27.5 | 81.6 | 84.6 | 50.2 |
| Unionised ammonia -N | g/m³-N | 0.06469 | 0.1398 | 0.46594 | 2.58865 | 0.23159 | - |
| pH | pH | 7.3 | 7.1 | 7.6 | 7.6 | 6.8 | No result |
| SAR | | - | - | - | - | - | 3.61465 |
| Suspended solids | g/m³ | 140 | 180 | - | - | - | - |
| Temperature | Deg. C | 9.9 | 15.3 | 18.6 | 27.2 | 18.7 | 10.9 |

Key: SAR=sodium absorption ratio

**Table 4** BTEX analysis of irrigation fluid

| Parameter | Unit | 13 Nov 2014 | 21 Jan 2015 | 24 Apr 2015 | DWSNZ MAV* |
|---|---|---|---|---|---|
| Benzene | g/m$^3$ | 0.136 | 0.0135 | 0.0072 | 0.01 |
| Ethyl benzene | g/m$^3$ | 0.0094 | 0.0017 | 0.0009 | 0.3 |
| Toluene | g/m$^3$ | 0.136 | 0.0163 | 0.0103 | 0.3 |
| meta/para-Xylene | g/m$^3$ | 0.047 | 0.0075 | 0.0046 | 0.6 (combined *m & p*) |
| ortho-xylene | g/m$^3$ | 0.0199 | 0.0033 | 0.0018 | |

**Key:** DWSNZ MAV= Drinking Water Standard NZ, Maximum Allowable Value

Consent 5838-2 requires that irrigation fluid shall not be discharged if it has a hydrocarbon level in excess of 5% (or 50,000 g/m$^3$). The sampling shows that this condition is being comfortably complied with and that the upstream treatment systems are effective at removing any hydrocarbons in the waste stream. However it is noted that the sample taken on 5 June 2015 had the highest recorded level of hydrocarbons recorded at the site. It was also noted that subsequent results (taken in the next monitoring period) were found to have far lower concentrations.

Benzene, toluene, ethylbenzene and xylenes (BTEX) concentrations were found to be below those required for drinking water standards on all occasions with the exception of samples taken on 13 November 2014 and 21 January 2015. On these occasions the level of benzene was found to exceed the drinking water standard.

The concentration of chloride reached a new maximum 7,390 g/m$^3$ in January 2015 during the dry season and this was similar to the elevated chloride level noted during the drought of 2014. The excessively high chloride levels (and associated sodicity) of the in the irrigation fluid were identified as an emerging issue in the 2013-2014 annual report. As a result the Company was required to submit a Soil and Groundwater Management Plan to address the issues arising from the high salt level in the irrigation fluid. This is discussed in more detail in section 2.1.1.2

### 2.1.4 Results of surface water monitoring

Set out below are the results of each sampling survey undertaken. Each section discusses the results in relation to water quality and consent conditions.

For context; consent conditions require that the wetland discharge shall not cause a rise of carbonaceous biochemical oxygen demand of more than 2.00 g/m$^3$ and or cause ammonia levels to exceed 0.025 g/m$^3$ at site HHG000103 (40 m downstream of the discharge). The discharge itself is required to have a suspended solid level of less than 100 g/m$^3$ and a pH of between 6.0 and 9.0.

Consent conditions also require that the irrigation of pond fluids shall not cause a rise of carbonaceous biochemical oxygen demand of more than 2.00 g/m$^3$ and or cause ammonia levels to exceed 0.025 g/m$^3$ at site HHG000100 and site HHG000150. The consent also states that irrigation shall not cause a chloride in the Haehanga Stream to exceed 150 g/m$^3$.

#### 2.1.4.1 15 July 2014

The sampling run of 15 July 2015 was undertaken under moderate flow conditions with 26 mm rain falling over the previous 72 hours. The wetland was discharging at the time of the inspection. As noted in the discharge results the wetland discharge had a higher than expected suspended solids level however this was found to be having very little impact on the tributary as shown in the suspended solids result at site HHG000103. The levels of chloride were in compliance at site HHG000150 and HHG000100, as was unionised ammonia levels at site HHG000103.

**Table 5** Chemical analyses of samples collected on 15 July 2014

| Site | CBODF | Chloride | Conductivity | HC | Unionised ammonia | Ammoniacal nitrogen | pH | Suspended solids | Temp |
|---|---|---|---|---|---|---|---|---|---|
| | g/m³ | g/m³ | mS/m @ 20 C | g/m³ | g/m³ | g/m³ | pH | g/m³ | Deg C |
| HHG000093 | <0.5 | 13.2 | 15.5 | <0.5 | 0.00042 | 0.117 | 7.3 | 11 | 6.9 |
| HHG000097 | <0.5 | 13.1 | 18.3 | - | 0.00028 | 0.095 | 7.2 | 11 | 7.1 |
| HHG000098 | 0.7 | 13 | 19 | - | 0.00034 | 0.119 | 7.2 | 4 | 7 |
| HHG000099 | <0.5 | 17.2 | 17 | - | 0.00022 | 0.077 | 7.2 | 3 | 6.6 |
| HHG000100 | <0.5 | 16.8 | 16.7 | <0.5 | 0.00041 | 0.136 | 7.2 | 6 | 7.7 |
| HHG000103 | 1.2 | 14.7 | 23.9 | - | 0.02093 | 4.66 | 7.4 | 27 | 6.8 |
| HHG000106 | 0.6 | 40.6 | 29.9 | - | 0.00452 | 1.48 | 7.2 | 12 | 7.8 |
| HHG000109 | 0.9 | 23.4 | 21.6 | - | 0.00378 | 1.06 | 7.3 | 10 | 6.8 |
| HHG000115 | 0.8 | 28.9 | 22.2 | <0.5 | 0.00328 | 1.19 | 7.2 | 10 | 6.4 |
| HHG000150 | 1 | 42.6 | 27.1 | <0.5 | 0.00185 | 1.0 | 7.0 | 10 | 7.2 |
| HHG000190 | - | 41.4 | 26 | - | 0.00184 | 0.788 | 7.1 | - | 7.3 |
| IND003008 | 21 | 39.2 | 96.2 | - | 0.70457 | 66.6 | 7.7 | 170 | 9.1 |

**Key:** - = Not measured. CBODF= filtered carbonaceous biological oxygen demand
**Bold**= non compliance

#### 2.1.4.2 24 September 2014

The sampling run of 24 September was undertaken during low to moderate flow conditions with 6.0 mm of rain falling in the previous 72 hours. All results were in compliance with the exception of the unionised ammonia result at site HHG000103. Elevations in ammonia levels have been known to occur during early spring when the raupo die off is breaking down in the wetland. Not further effects were noted downstream and all subsequent samples taken at this site were in compliance with consent conditions.

**Table 6** Chemical analyses of samples collected on 24 September 2014

| Site | CBODF | Chloride | Conductivity | HC | Unionised ammonia | Ammoniacal nitrogen | pH | Suspended solids | Temp |
|---|---|---|---|---|---|---|---|---|---|
| | g/m³ | g/m³ | g/m³ | g/m³ | g/m³ | g/m³ | pH | g/m³ | Deg C |
| HHG000093 | 1.1 | 11.7 | 13.6 | - | 0.00098 | 0.205 | 7.3 | 8 | 10.8 |
| HHG000097 | 1.1 | 11.6 | 17.2 | - | 0.00085 | 0.208 | 7.3 | 41 | 8.6 |
| HHG000098 | <0.5 | 11.3 | 16 | - | 0.00059 | 0.136 | 7.3 | 35 | 9.5 |
| HHG000099 | 0.6 | 18 | 17 | - | 0.00017 | 0.031 | 7.4 | 10 | 9.8 |
| HHG000100 | <0.5 | 20.9 | 15.7 | <0.5 | 0.00027 | 0.069 | 7.2 | 54 | 11 |
| HHG000103 | 2 | 16.1 | 25.6 | <0.5 | **0.06531** | 7.42 | 7.5 | 16 | 12.8 |
| HHG000106 | 0.5 | 30.7 | 26 | - | 0.00703 | 1.19 | 7.3 | 40 | 13.6 |
| HHG000109 | 0.6 | 21.7 | 19.7 | - | 0.00756 | 1.27 | 7.3 | 14 | 13.7 |

| Site | CBODF | Chloride | Conductivity | HC | Unionised ammonia | Ammoniacal nitrogen | pH | Suspended solids | Temp |
|---|---|---|---|---|---|---|---|---|---|
| | g/m3 | g/m3 | g/m3 | g/m3 | g/m3 | g/m3 | pH | g/m3 | Deg C |
| HHG000115 | 0.7 | 24.9 | 20.7 | <0.5 | 0.00485 | 1.18 | 7.2 | 13 | 11.8 |
| HHG000150 | 0.5 | 36.1 | 23.4 | <0.5 | 0.00394 | 1.04 | 7.2 | 12 | 10.7 |
| HHG000190 | - | 31.3 | 21.4 | - | 0.00254 | 0.765 | 7.1 | - | 12 |
| IND003008 | 22 | 59.2 | 154 | - | 2.0576 | 118 | 7.8 | 41 | 12.8 |

Key: - = Not measured. CBODF= filtered carbonaceous biological oxygen demand
HC = hydrocarbons

### 2.1.4.3 13 November 2014

The sampling runoff 13 November 2014 was done during moderate to high flow conditions he wetland was discharging at a 4 L/s at the time of sampling. On this occasion all results were compliant with consent conditions

**Table 7** Chemical analyses of samples collected on 13 November 2014

| Site | CBODF | Chloride | Conductivity | HC | Unionised ammonia | Ammoniacal nitrogen | pH | Suspended solids | Temp |
|---|---|---|---|---|---|---|---|---|---|
| | g/m3 | g/m3 | g/m3 | g/m3 | g/m3 | g/m3 | pH | g/m3 | Deg C |
| HHG000093 | 0.6 | 16.9 | 13.3 | <0.5 | 0.0001 | 0.022 | 7.3 | - | 10.6 |
| HHG000097 | <0.5 | 12.6 | 16 | - | 0.0002 | 0.042 | 7.3 | 130 | 10.4 |
| HHG000098 | <0.5 | 14.9 | 14.5 | - | 0.00015 | 0.032 | 7.3 | 73 | 10.5 |
| HHG000100 | 0.5 | 15.6 | 14.1 | <0.5 | 0.00011 | 0.023 | 7.3 | - | 11.1 |
| HHG000103 | 0.6 | 15.2 | 16.3 | - | 0.009 | 1.49 | 7.4 | 57 | 10.8 |
| HHG000106 | <0.5 | 15.8 | 16.5 | - | 0.0027 | 0.337 | 7.4 | - | 14.6 |
| HHG000109 | 0.5 | 17.8 | 15.9 | - | 0.00255 | 0.407 | 7.4 | - | 11.3 |
| HHG000115 | 0.8 | 22.3 | 16.8 | <0.5 | 0.0027 | 0.541 | 7.3 | - | 11.3 |
| HHG000150 | 0.8 | 28.6 | 18.9 | <0.5 | 0.00148 | 0.488 | 7.1 | 73 | 10.8 |
| HHG000190 | - | 26.8 | 18.5 | - | 0.00088 | 0.211 | 7.2 | - | 12 |
| IND003008 | - | 23 | 50.5 | | 0.32739 | 27.7 | 7.6 | 19 | 13.7 |

Key: - = Not measured. CBODF= filtered carbonaceous biological oxygen demand
HC= Hydrocarbons

### 2.1.4.4 20 January 2015

The sampling run of 21 January 20145 was undertaken under very low flow conditions. There had been 1.0 mm rain over the 72 hours prior to sampling and the wetland was not discharging. Chloride levels downstream of the drill mud treatment areas and lower irrigation fields exceeded the 150 g/m3 consent limit, as there was only was only isolated stagnant pools of water in the stream channel it was determined that the high levels of chloride were due to evaporation or groundwater intrusion rather than from unauthorised discharges.

**Table 8** Chemical analyses of samples collected on 21 January 2015

| Site | CBODF | Chloride | Conductivity | HC | Unionised ammonia | Ammoniacal nitrogen | pH | Suspended solids | Temp |
|---|---|---|---|---|---|---|---|---|---|
| | g/m³ | g/m³ | g/m³ | g/m³ | g/m³ | g/m³ | pH | g/m³ | Deg C |
| HHG000093 | <0.5 | 17.9 | 20.9 | <0.5 | 0.00036 | 0.053 | 7.2 | - | 18.4 |
| HHG000097 | <0.5 | 12.5 | 19.1 | - | 0.00105 | 0.219 | 7.2 | 300 | 13.9 |
| HHG000098 | <0.5 | 14.1 | 20.6 | - | 0.00069 | 0.085 | 7.4 | 6 | 14.8 |
| HHG000100 | 0.8 | 55.5 | 38.5 | <0.5 | 0.00423 | 0.427 | 7.4 | - | 17.5 |
| HHG000106 | 1.4 | 157 | 71.8 | - | 0.01 | 7.07 | 6.6 | - | 16 |
| HHG000109 | 0.6 | 94.8 | 50.5 | - | 0.00051 | 0.124 | 7 | - | 18 |
| HHG000115 | 1 | 426 | 148 | <0.5 | 0.0053 | 2.7 | 6.6 | - | 20.4 |
| HHG000150 | 1 | 286 | 93.6 | <0.5 | 0.00047 | 0.082 | 7 | 6 | 22.5 |
| HHG000190 | - | 133 | 51.8 | - | 0.0003 | 0.054 | 7.1 | - | 19 |
| IND003008 | - | 44.6 | 118 | - | 2.17788 | 80 | 7.8 | 62 | 18.9 |

Key: - = Not measured. CBODF= filtered carbonaceous biological oxygen demand
Bold = non compliant
HC = hydrocarbons

#### 2.1.4.5 3 February 2015

Follow up samples were undertaken at four sites to determine whether chloride levels had returned to normal levels once the stream had recharged with recent rain. At the time of sampling the Haehanga Stream was at a moderate to high flow. The analysis found that the levels of chloride in the stream had returned to compliant levels.

**Table 9** Chemical analyses of samples collected on 13 March 2014

| Site | Chloride | Conductivity | pH | Temp |
|---|---|---|---|---|
| | g/m³ | g/m³ | pH | Deg C |
| HHG000109 | 21.1 | 21.3 | 7.3 | 18.9 |
| HHG000115 | 25.3 | 22.7 | 7.2 | 18.5 |
| HHG000150 | 30.8 | 24.1 | 7 | 19.2 |

#### 2.1.4.6 24 April 2015

The sampling run of 24 April 2015 was undertaken during low flow conditions with no rain falling over the previous 72 hours. The wetland was discharging at approximately 12 L/min. On this occasion all sites were compliant, however it was noted that due to the dry conditions, chloride levels whilst compliant, were elevated at the site downstream of the irrigation areas.

**Table 10** Chemical analyses of samples collected on 24 April 2015

| Site | CBODF | Chloride | Conductivity | HC | Unionised ammonia | Ammoniacal nitrogen | pH | Suspended solids | Temp |
|---|---|---|---|---|---|---|---|---|---|
| | g/m³ | g/m³ | g/m³ | g/m³ | g/m³ | g/m³ | pH | g/m³ | Deg C |
| HHG000093 | <0.5 | 15.3 | 17.5 | <0.5 | 0.00011 | 0.056 | 6.8 | - | 14.3 |
| HHG000097 | <0.5 | 12 | 19.8 | - | 0.00026 | 0.157 | 6.8 | 15 | 12 |
| HHG000098 | <0.5 | 13 | 20.5 | - | 0.00027 | 0.108 | 6.9 | <2 | 14.5 |
| HHG000100 | <0.5 | 51.3 | 31.8 | <0.5 | 0.00234 | 0.805 | 7 | - | 13.3 |
| HHG000103 | 0.5 | 15.9 | 26.4 | - | 0.01151 | 3.47 | 7.1 | 9 | 12 |
| HHG000106 | <0.5 | 40.5 | 33.1 | - | 0.00373 | 1.49 | 6.9 | - | 14.4 |

| Site | CBODF | Chloride | Conductivity | HC | Unionised ammonia | Ammoniacal nitrogen | pH | Suspended solids | Temp |
|---|---|---|---|---|---|---|---|---|---|
| | g/m³ | g/m³ | g/m³ | g/m³ | g/m³ | g/m³ | pH | g/m³ | Deg C |
| HHG000109 | 0.6 | 44.2 | 31.2 | - | 0.0031 | 1.03 | 7 | - | 13.8 |
| HHG000115 | 0.6 | 53.3 | 33.6 | <0.5 | 0.00252 | 0.836 | 7 | - | 13.8 |
| HHG000150 | 0.6 | 83.9 | 41.2 | <0.5 | 0.00188 | 0.706 | 6.9 | 14 | 15.2 |
| HHG000190 | - | 76.7 | 37.9 | - | 0.00122 | 0.383 | 7 | - | 14.6 |
| IND003008 | - | 46.4 | 81.1 | - | 0.36921 | 46.5 | 7.4 | 56 | 14.5 |

CBODF= filtered carbonaceous biological oxygen demand
HC = hydrocarbons
- = not measured

#### 2.1.4.7 5 June 2015

The sampling run of 5 June 2015 was done in moderate flow conditions with 16 mm rain falling over the previous 72 hours. The wetland was discharging at approximately 2 L/s. On this occasion all sites were in compliant, however it was noted that elevated levels of suspended solids found in the tributary at site HHG000100. Upon investigation this was found to be caused by a natural slip that had occurred in the upper reaches of the tributary.

**Table 11** Chemical analyses of samples collected on 5 June 2015

| Site | CBODF | Chloride | Conductivity | HC | Unionised ammonia | Ammoniacal nitrogen | pH | Suspended solids | Temp |
|---|---|---|---|---|---|---|---|---|---|
| | g/m³ | g/m³ | g/m³ | g/m³ | g/m³ | g/m³ | pH | g/m³ | Deg C |
| HHG000093 | <0.5 | 12.4 | 13.2 | <0.5 | 0.00021 | 0.08 | 7.1 | 15 | 8.6 |
| HHG000097 | <0.5 | 13.3 | 16.4 | - | 0.00021 | 0.095 | 7 | 90 | 9.4 |
| HHG000098 | <0.5 | 13.6 | 14.9 | - | 0.00014 | 0.082 | 6.9 | 55 | 9.1 |
| HHG000100 | 1.1 | 15.2 | 14.9 | <0.5 | 0.0002 | 0.097 | 7. | 620 | 8.7 |
| HHG000103 | 1.2 | 16.2 | 20.3 | - | 0.00859 | 4.04 | 7 | 32 | 9.1 |
| HHG000106 | <0.5 | 17.2 | 18.5 | - | 0.00091 | 0.41 | 7 | 65 | 9.7 |
| HHG000109 | 0.9 | 24.5 | 19.4 | - | 0.00289 | 1.38 | 7 | - | 8.9 |
| HHG000115 | 1 | 24.4 | 19.5 | <0.5 | 0.00229 | 1.1 | 7 | - | 8.8 |
| HHG000150 | 0.7 | 29 | 20.4 | <0.5 | 0.00207 | 0.967 | 7 | 260 | 9.2 |
| HHG000190 | - | 26.8 | 19.3 | - | 0.00135 | 0.775 | 6.9 | - | 9.5 |
| IND003008 | 21 | 41.1 | 120 | - | 0.7482 | 90.2 | 7.6 | 38 | 8.9 |

CBODF= filtered carbonaceous biological oxygen demand
HC = hydrocarbons
- = not measured

### 2.1.5 Groundwater monitoring

Conditions 14 -17 of consent 5838 requires that the consent holder install groundwater bores and monitor groundwater down gradient of the irrigation areas. A control bore was also established up gradient of the irrigation areas.

The bores were sampled on two occasions and the results are given in the tables below. The positions of the groundwater bores are shown in Figure 4.

**Table 12** Groundwater results from samples taken on 21 January 2015

| Parameter | Unit | GND2188 Control | GND2189 Upper irrigation area | GND2190 Lower irrigation area |
|---|---|---|---|---|
| Chloride | g/m$^3$ | 70.2 | 292 | 1290 |
| Conductivity | mS/m | 66.3 | 123 | 383 |
| Unionised ammonia | g/m$^3$ | 0.0009 | 0.00032 | 0.00003 |
| Ammoniacal nitrogen | g/m$^3$ | 0.512 | 0.481 | 0.344 |
| Nitrate/Nitrite | g/m$^3$ | <0.01 | 0.02 | <0.01 |
| pH | - | 6.7 | 6.3 | 5.4 |
| Total dissolved solids | g/m$^3$ | 513 | 951.7 | 2963.3 |
| Temperature | Deg.C | 15.9 | 15.3 | 15.5 |

**Table 13** BTEX analysis of groundwater 20 June 2014

| Parameter | Unit | GND2188 Control | GND2189 upper irrigation area | GND2190 lower irrigation area | DWSNZ MAV* |
|---|---|---|---|---|---|
| Benzene | g/m$^3$ | <0.0005 | <0.0005 | <0.0005 | 0.01 |
| Ethyl benzene | g/m$^3$ | <0.0005 | <0.0005 | <0.0005 | 0.3 |
| Toluene | g/m$^3$ | <0.0005 | <0.0005 | <0.0005 | 0.3 |
| meta/para-Xylene | g/m$^3$ | <0.0010 | <0.0010 | <0.0010 | 0.6 (combined *m & p*) |
| ortho-Xylene | g/m$^3$ | <0.0005 | <0.0005 | <0.0005 | |

* Maximum allowable value from New Zealand Drinking Water Standards

**Table 14** Groundwater results from samples taken on 30 April 2015

| Parameter | Unit | GND2188 Control | GND2189 Upper irrigation area | GND2190 Lower irrigation area |
|---|---|---|---|---|
| Chloride | g/m$^3$ | 92.2 | 133 | 1340 |
| Conductivity | mS/m | 58.8 | 48.1 | 399 |
| Unionised ammonia | g/m$^3$ | 0.00015 | 0.00004 | 0.00001 |
| Ammoniacal nitrogen | g/m$^3$ | 0.171 | 0.082 | 0.181 |
| Nitrate/Nitrite | g/m$^3$ | <0.01 | <0.01 | <0.01 |
| pH | - | 6.4 | 6.2 | 5.2 |
| Total dissolved solids | g/m$^3$ | 454.9 | 372.2 | 3087.1 |
| Temperature | Deg.C | 15.7 | 13.6 | 14.7 |

**Table 15** BTEX analysis of groundwater 30 April 2015

| Parameter | Unit | GND2188 Control | GND2189 upper irrigation area | GND2190 lower irrigation area | DWSNZ MAV |
|---|---|---|---|---|---|
| Benzene | g/m$^3$ | <0.0010 | <0.0010 | <0.0010 | 0.01 |
| Ethyl benzene | g/m$^3$ | <0.0010 | <0.0010 | <0.0010 | 0.3 |
| Toluene | g/m$^3$ | <0.0010 | <0.0010 | <0.0010 | 0.3 |
| meta/para-Xylene | g/m$^3$ | <0.002 | <0.002 | <0.002 | 0.6 (combined *m & p*) |
| ortho-Xylene | g/m$^3$ | <0.0010 | <0.0010 | <0.0010 | |

These results showed that the groundwater in both irrigation areas had elevated levels of chloride when compared to that found in the control bore. This is especially the case in bore GND2190 in the lower irrigation area.

Total dissolved solids levels indicate that the groundwater is generally suitable for dry stock watering. However the minimum guideline for dairy stock taken from Table 4.3.1 of the Australian and New Zealand Guidelines for Fresh and Marine Water Quality for palatability has been exceeded twice at bore GND2190 (lower irrigation area). Generally stock will tolerate significantly higher levels of total dissolved solids without loss of condition.

Benzene, ethylbenzene, toluene and xylene analysis found that all results were below detection limits and therefore well below the maximum allowable value from New Zealand Drinking Water Standards.

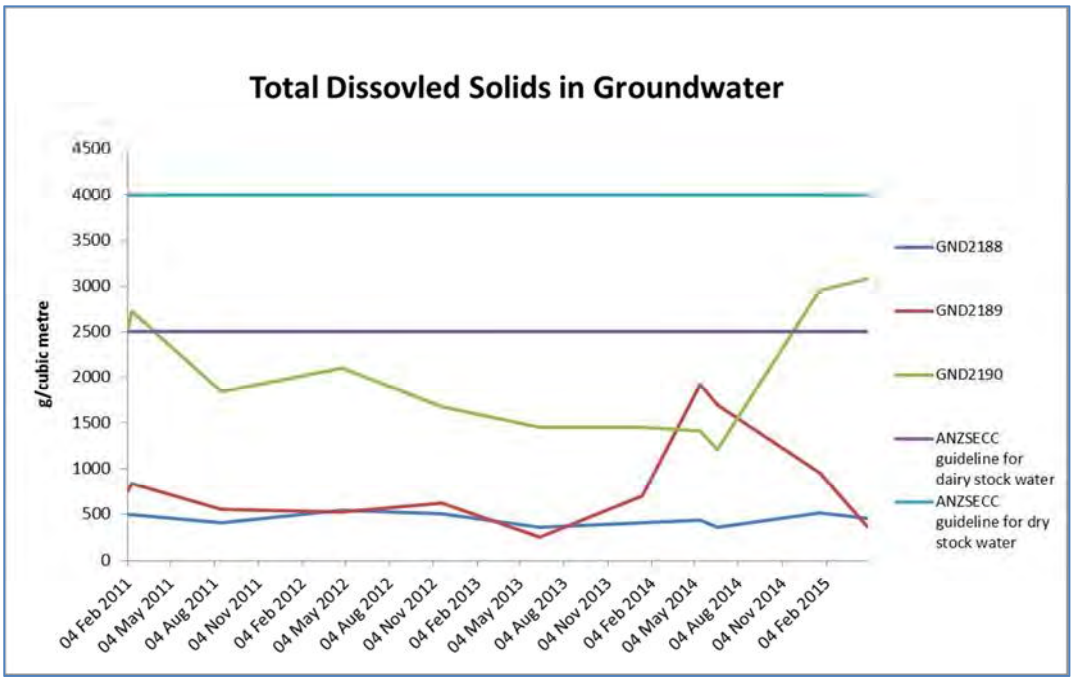


**Figure 5** Total dissolved solids in groundwater

In the 2013-2014 annual monitoring report Council directed the Company to develop a Soil and Ground water Management Plan as required by consent 5838. At the time of writing this report, the Company had undertaken significant investigations and had developed a management plan which is designed to address the issue of high chlorides in the groundwater. This plan is discussed in more detail in section 2.1.11.

### 2.1.6 Soil sampling

Conditions 11 and 12 of consent 5838-2 require that soil samples fro the irrigation areas be taken twice every year and analysed. This sampling was built into the site specific monitoring programme run by the Council.

**Table 16** Results of soil samples taken on 21 January 2015

| Parameter | Unit | **SOL000176 (upper area)** | **SOL000177 (lower area)** |
|---|---|---|---|
| Calcium | mg/kg | 70.9 | 168.6 |
| Chloride | mg/kg | 748.7 | 1934.7 |
| Conductivity | mS/m | 49.1 | 718.9 |

| Parameter | Unit | **SOL000176 (upper area)** | **SOL000177 (lower area)** |
|---|---|---|---|
| Potassium | mg/kg | 420.6 | 1093 |
| Magnesium | mg/kg | 8.7 | 14.2 |
| Sodium | mg/kg | 195.4 | 617.2 |
| pH | pH | 6.6 | 6.9 |
| Sodium Absorption ratio | - | 5.8 | 12.26 |

**Table 17** BTEX analysis of soil 21 January 2015

| Parameter | Unit | **SOL000176 (upper area)** | **SOL000177 (lower area)** | Guideline Value* |
|---|---|---|---|---|
| Benzene | mg/kg | <0.06 | <0.07 | 2.7 |
| Ethylbenzene | mg/kg | <0.07 | <0.07 | 320 |
| Toluene | mg/kg | <0.06 | <0.07 | 160 |
| meta/para-Xylene | mg/kg | <0.12 | <0.13 | 250 |
| ortho-Xylene | mg/kg | <0.06 | <0.07 | |

*Table 4.12 Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (MfE 1999)

**Table 18** Results of soil samples taken on 1 May 2015

| Parameter | Unit | **SOL000176 (upper area)** | **SOL000177 (lower area)** |
|---|---|---|---|
| Calcium | mg/kg | 238.3 | 162.4 |
| Chloride | mg/kg | 1372.7 | 1037 |
| Conductivity | mS/m | 554.3 | 93.6 |
| Hydrocarbons | mg/kg | <12 | <11 |
| Potassium | mg/kg | 705.5 | 731.1 |
| Magnesium | mg/kg | 17.1 | 12.7 |
| Sodium | mg/kg | 359 | 364 |
| Nitrate/nitrite | mg/kg | 20.62 | 21.98 |
| Ammoniacal nitrogen | mg/kg | 0.31 | 0.36 |
| pH | pH | 6.7 | 7.1 |
| Sodium Absorption ratio | - | 6.05 | 7.40 |

**Table 19** BTEX analysis of soil 1 May 2015

| Parameter | Unit | **SOL000176 (upper area)** | **SOL000177 (lower area)** | Guideline Value* |
|---|---|---|---|---|
| Benzene | mg/kg | <0.14 | <0.13 | 2.7 |
| Ethylbenzene | mg/kg | <0.14 | <0.13 | 320 |
| Toluene | mg/kg | <0.14 | <0.13 | 160 |
| meta/para-Xylene | mg/kg | <0.3 | <0.3 | 250 |
| ortho-Xylene | mg/kg | <0.14 | <0.13 | |

*Table 4.12 Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (MfE 1999)

The level of chloride in the sample taken on 21 January 2015 was the highest ever recorded as was the sodium absorption ratio (SAR).

In the 2013-2014 annual monitoring report Council directed the Company to develop a Soil and Ground water Management Plan as required by consent 5838. At the time of writing this report, the Company had undertaken significant investigations and have developed a management plan which is designed to address the issue of high levels of chloride, sodium, and SAR in the irrigated soils. This plan is discussed in more detail in section 2.1.11

BTEX or any other hydrocarbon was not detected in the soil of either of the irrigation areas.

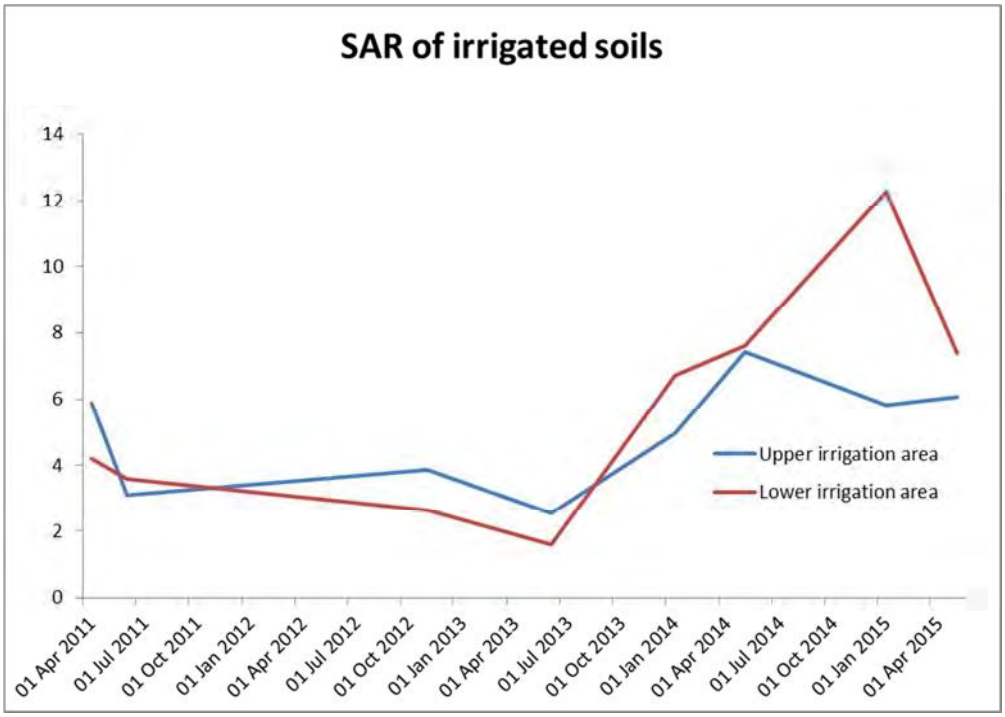


**Figure 6** Graph showing sodium absorption ratio in soil of both irrigation areas

### 2.1.7 Metals analysis

During the monitoring period, as result of public enquiries, Council undertook metals analysis in the soil, groundwater, receiving water and irrigation fluid. The results are set out in Tables 15-18 along with contextual guidelines.

**Table 20** Heavy metal analysis in irrigation fluid

| Parameter | Unit | 08 May 2015 (total metal screen analysis) | 24 Apr 2015 (dissolved metal trace analysis) | Water Standard reached |
|---|---|---|---|---|
| Total arsenic | mg/kg | 0.48 | 0.024 | Stock water (ANZSECC) |
| Total cadmium | mg/kg | <0.0053 | - | Stock water (ANZSECC) |
| Total chromium | mg/kg | 1.82 | - | Recreational (ANZSECC) |
| Total copper | mg/kg | 1 | - | NZ Drinking water (DWSNZ) |
| Total mercury | mg/kg | <0.011 | 0.00016 | NZ Drinking water (DWSNZ) |
| Total nickel | mg/kg | 0.66 | - | Stock water (ANZSECC) |

| Parameter | Unit | 08 May 2015 (total metal screen analysis) | 24 Apr 2015 (dissolved metal trace analysis) | Water Standard reached |
|---|---|---|---|---|
| Total lead | mg/kg | 0.54 | - | Stock water (ANZSECC) |
| Total zinc | mg/kg | 3.2 | - | Stock water (ANZSECC) |

**Table 21** Trace heavy metal analysis in surface water 24 April 2015

| Parameter | Unit | HHG000093 | HHG000190 | ANZSECC Guideline* |
|---|---|---|---|---|
| Dissolved arsenic | g/m$^3$ | 0.0011 | 0.0011 | 0.0024 |
| Dissolved cadmium | g/m$^3$ | <0.00005 | <0.00005 | 0.0002 |
| Dissolved chromium | g/m$^3$ | <0.0005 | 0.0005 | 0.001 |
| Dissolved copper | g/m$^3$ | 0.0022 | 0.0018 | 0.00014 |
| Dissolved mercury | g/m$^3$ | <0.00008 | <0.00008 | 0.0006 |
| Dissolved nickel | g/m$^3$ | 0.0029 | 0.0032 | 0.011 |
| Dissolved lead | g/m$^3$ | 0.00031 | 0.00019 | 0.0034 |
| Dissolved zinc | g/m$^3$ | 0.0035 | 0.0014 | 0.008 |

*ANZSECC guidelines are for 95% protection of freshwater ecosystems

**Table 22** Trace dissolved heavy metal analysis in groundwater 30 April 2015

| Parameter | Unit | GND2188 | GND2189 | GND2190 | DWSNZ MAV* |
|---|---|---|---|---|---|
| Dissolved arsenic | g/m$^3$ | <0.0010 | 0.0021 | <0.005 | 0.01 |
| Dissolved cadmium | g/m$^3$ | <0.00005 | 0.00006 | 0.00082 | 0.003 |
| Dissolved chromium | g/m$^3$ | <0.0005 | 0.0013 | <0.0010 | 0.05 |
| Dissolved copper | g/m$^3$ | 0.003 | 0.0079 | <0.003 | 0.2 |
| Dissolved mercury | g/m$^3$ | <0.00008 | <0.00008 | <0.00008 | 0.002 |
| Dissolved nickel | g/m$^3$ | 0.0018 | 0.0064 | 0.065 | 0.02 |
| Dissolved lead | g/m$^3$ | <0.00010 | 0.0029 | 0.0023 | 0.1 |
| Dissolved zinc | g/m$^3$ | 0.0091 | 0.0102 | 0.079 | 3 |

* Drinking Water Standards of New Zealand Maximum Allowable Value

**Table 23** Heavy metal analysis in soil 1 May 2015

| Parameter | Unit | SOL000176 | SOL000177 | Guideline value* | Expected back-ground range** |
|---|---|---|---|---|---|
| Total arsenic | mg/kg | 5 | 4 | 20 | - |
| Total cadmium | mg/kg | <0.10 | 0.19 | 1 | - |
| Total chromium | mg/kg | 20 | 21 | 600 | 20-50 |
| Total copper | mg/kg | 16 | 13 | 100 | 10-40 |
| Total mercury | mg/kg | <0.10 | <0.10 | 1 | - |
| Total nickel | mg/kg | 17 | 16 | 60 | 2-20 |
| Total lead | mg/kg | 13.6 | 11.7 | 300 | 2-25 |
| Total zinc | mg/kg | 73 | 73 | 300 | 40-110 |

* Soil limit concentrations from Table 4.2 of Guidelines for the safe application of biosolids to Land in New Zealand (MfE 2003)
**From Maps of total soil concentrations (background levels) of chromium, copper, lead, nickel, vanadium and zinc in the Taranaki Region (Landcare Research, 2002)

The heavy metal analysis across all media indicates that heavy metal contamination is not an issue at the site. For heavy metals and mercury, the irrigation fluid meets stock water standard and in some cases meets the New Zealand Drinking Water Standards

Maximum Allowable Values (DWSNZ MAV). All groundwater samples were found to meet DWSNZ MAV's for all the metals tested for.

Samples were also taken of surface water up and downstream of all operations at the site and no statistically significant increase in heavy metals was found between up and downstream sites. All metal concentrations found in surface water were found to be below ANZSECC guidelines for 95% protection of aquatic ecosystems.

Soil testing showed that all concentrations of all heavy metals were in the ranges of expected natural background levels.

### 2.1.8 Macroinvertebrate survey

One macroinvertebrate survey was conducted during the period under review. A summary of the survey report is given below and a full copy of the report is provided in the appendix. The locations of sampling sites are included in the appended full report.

#### 2.1.8.1 8 January 2015

The Council's standard 'streambed kick' and 'vegetation sweep' techniques were used at seven established sites to collect streambed macroinvertebrates from the Haehanga Stream catchment in order to assess whether the Remediation (NZ) Ltd composting areas had had any adverse effects on the macroinvertebrate communities of these streams. Samples were processed to provide number of taxa (richness), MCI, and $SQMCI_S$ scores for each site.

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

The macroinvertebrate survey conducted on 8 January 2015 found water flows in the Haehanga catchment to be low to very low, with a slow to steady water speed noted at all sites. Community richnesses were similar to the respective median at three sites, while the remaining four exceeded their respective median richnesses. Overall, this survey found that macroinvertebrate communities at all sites were in average health, with only subtle effects noted. No undesirable heterotrophic growths were recorded at any of the seven sites in this survey.

The two sites in the unnamed tributary were sampled for the eighth time in the current survey, and exhibited a community relatively typical of this kind of habitat. However, there were some differences between these two sites. Site T2 recorded an above average MCI score, and relatively high $SQMCI_S$ score, being the highest $SQMCI_S$ score recorded in the Haehanga stream catchment to date. Site T3 only recorded an average MCI and $SQMCI_S$ score, both lower than that recorded at site T2, significantly so for the $SQMCI_S$ score. Previous surveys have frequently recorded oligochaete worms, ostracod seed shrimps and *Chironomus* bloodworms increasing significantly in

abundance downstream of the discharge. These taxa are often associated with organically enriched discharges. In the current survey oligochaete worms, ostracod seed shrimps and *Chironomus* bloodworms all increased in abundance at site T3, coincident with the observation of a small discharge leaving the wetland.

Although the changes in community suggest that there were some impacts from the discharge, there are certain changes in taxa presence/absence that indicate that there is also a significant influence from the instream habitat. For example, site T3 recorded boatman (*Sigara*) and ostracod seed shrimps, which inhabit slow to still water, a habitat not typically inhabited by *Deleatidium* mayfly, which was absent at site T3 (but extremely abundant at site T2). In addition, the number of 'sensitive' taxa actually increased by three taxa at site T3. Overall, these observations indicate that the discharge occurring at the time of this survey was having only a subtle impact on the communities of this stream.

Some previous water quality results indicate that unionised ammonia concentrations in the unnamed tributary have at times been toxic enough to reduce the abundance of, or eliminate entirely, some of the sensitive species usually found in this stream. Results of sampling undertaken in the year prior to this survey show that most samples contained concentrations of unionised ammonia below the toxicity threshold of 0.025 $g/m^3$, with the only exception to this being a sample collected on 24 September 2014, which recorded a concentration of 0.065$g/m^3$. This shows good management of the unionised ammonia concentrations in the effluent being discharged. However, should unionised ammonia concentrations return to high levels in the winter period, an additional macroinvertebrate survey at this time may be warranted. At the very least, the water quality monitoring will need to continue so as to assist with the interpretation of macroinvertebrate results.

In general the communities in the Haehanga Stream sites had reasonable proportions of sensitive taxa. Low numbers of sensitive taxa are expected in small, silty bottomed streams such as the Haehanga Stream and the numbers of taxa were generally similar to other lowland hill country streams surveyed at similar altitude. MCI values recorded in the Haehanga Stream generally reduced in a downstream direction, with the top sites recording scores similar to that recorded in other small lowland hill country streams in the region, while sites 6 and 7 showed some deterioration.

Site 5 has exhibited poorer macroinvertebrate communities in the past compared to other sites upstream. This has suggested some level of impact from the composting operation, although the extent of adverse effects has been difficult to determine due to poor habitat quality. During the current survey, the MCI score for site 5 was 5 units greater than the median score for this site, and similar to that recorded at the next upstream Haehanga Stream site. The $SQMCI_S$ score recorded at site 5 was similar to that recorded at sites 1 and 2, also indicating no sign of deterioration. The results from the current survey indicate that *Chironomus* bloodworms were absent, suggesting that the improvement recorded since the April 2013 survey (which recorded them as abundant) has remained.

Unlike the other sites, the sample from site 6 was collected from a riffle with coarse and fine gravels, using the 'streambed kick' sampling technique. The current survey recorded an MCI score that was slightly less than the medians for the other Haehanga Stream sites, and not significantly different to that recorded at the three upstream main

stem sites. However, the $SQMCI_S$ score was significantly less than that recorded at all upstream sites. This significant reduction in $SQMCI_S$ score was primarily due to an increased abundance of 'tolerant' taxa, especially oligochaete worms and orthoclad midge larvae.

This does suggest the possibility of a subtle deterioration in water quality at this site prior to the current survey. However, the surveys undertaken at this site sampled habitat that differed to the other Haehanga Stream sites, as it was a true riffle, in that it was shallow flow tumbling over coarse and fine gravel, as opposed to deeper flow moving over macrophyte or submerged wood. This habitat difference can explain some of the differences in the taxa recorded and the increased abundance of worms, but it does not explain the drop in $SQMCI_S$ score recorded in the current survey. Physicochemical sampling indicates an increase in chlorides in this reach, and this may be related to this drop in $SQMCI_S$ score. However, this change is described as subtle, as there were still sensitive taxa present, including the 'highly sensitive' *Deleatidium* mayfly, which was recorded as abundant.

The lowest site (site 7) was sampled for the fourteenth time in this survey. There was a reduction in MCI score from that recorded upstream, but a recovery in $SQMCI_S$ scores from that recorded at site 6. When compared with historical data the community at site 7 was in average health, and indicative of little change in water quality from previous surveys, despite the fact that hydrocarbons were released from the sediment when it was disturbed at this site.

During certain previous surveys *Chironomus* blood worms have been recorded as abundant at various sites. Abundance of this taxon is usually an indication of an organic discharge, although low dissolved oxygen in the stream can also allow this taxon to dominate the community, especially when this is associated with low flows. It may be then that the sporadic appearance of *Chironomus* in abundance is at least in part related to the dissolved oxygen concentrations. Dissolved oxygen concentrations in the Haehanga have been found to be depressed at times, and during the warmer months, when there is more aquatic weed growth, dissolved oxygen may be significantly depleted at night. This is a natural occurrence in some streams that are slow flowing and weedy. Any macroinvertebrate surveys undertaken when such conditions exist could potentially record a community with fewer sensitive species, and a more abundant population of *Chironomus*. During the current survey *Chironomus* was common at sites 6 and 7. This indicates that water quality in the Haehanga catchment may have deteriorated slightly from the previous survey. It is understood that the issue of high chlorides at site 6 has been identified and is being addressed, and so water quality will hopefully continue to improve. This would be further contributed to through any on-going works to the leachate and stormwater treatment system, and improved management of the riparian margin. Any works that improve water quality are also likely to lead to an improvement in freshwater macroinvertebrate communities below the discharges, and should continue to be encouraged.

This was the only macroinvertebrate programme scheduled for the 2014-15 period. It is recommended that this level of monitoring continue, but that a provisional macroinvertebrate survey be retained in the programme, to be implemented should water quality monitoring indicate an issue.

### 2.1.9 Fish survey

On 8 and 9 January 2015, three sites were surveyed for freshwater fish in the Haehanga Stream in relation to the composting activities undertaken by Remediation NZ Ltd. Site 1 was located upstream of the site, site 2 located immediately downstream of the lowest extent of the irrigation area, and site 3 was located just upstream of State Highway 3. The survey method involved deploying baited fine and coarse mesh fyke nets and g-minnow traps at each site overnight. These nets and traps were recovered the following morning, with all fish identified, counted and measured, with eels greater than 300 mm weighed.

At the time of this survey, flow in the Haehanga Stream was low, to the extent that there was only a small amount of flow between pools at site 1. This was an improvement on that observed in the previous survey however, when there was no flowing water at site 1. The sites supported reasonable fish habitat, with deep pools and good cover, although water temperatures may occasionally exceed the thermal preference, and maximum thermal tolerance of a number of native fish species, with a water temperature of 28.3˚C recorded at site 3. Despite this low flow, there was sufficient flow to attract fish to the traps and nets, and as a result both recorded fish abundance and number of species recorded were higher than that recorded in the previous survey. Over all sites, forty-seven fish were recorded across four species. In addition, an individual whitebait was observed in the unnamed tributary, likely to be juvenile banded kokopu.

Due to the lack of fish at some sites, it is difficult to make any strong conclusions about the impact of the site on the fish communities. However, the site that would be most expected to exhibit impacts if there any, site 2, recorded three species, and the highest abundance (30 fish). Inanga, were recorded at this site for the second consecutive time, but only as one individual, which represents a reduction from the previous survey. However, this could be variation associated with the sampling method rather than an indication that the number of inanga has significantly reduced at this site. Natural variation will occur in inanga populations from year to year, as they recruit annually, and are therefore subject to numerous other factors. The individual inanga was in good physical condition indicating adequate food supply for this species. Site 3, further downstream recorded the highest species richness (four), with redfin bully recorded for the first time. Inanga were also recorded at this site. Of concern was that hydrocarbons were released from the sediment at site 3 when this sediment was disturbed.

Eels were recorded at all three sites, with the largest longfin eel being recorded at site 1, including two individuals that were over 900 mm long. The size class distribution of the eels was similar to the recorded in the previous survey, and considered to reflect the impacts of commercial eeling, which is understood to have occurred just prior to the 2013-14 survey. It is expected it will take over decade for the community to recover from this. The physical condition of the eels showed that although not many eels were collected at sites 1 or 3, no site had fish that were in better or worse condition than any other site. In addition, they did not differ markedly from that predicted. It is anticipated that this data can be a useful comparison to subsequent surveys, although it is important to consider the potential for fish condition to change with season. In addition, all fish were inspected and found to be free of physical damage or abnormalities.

During this survey, three access culverts were assessed for fish passage, and all were found to present at least some sort of barrier to fish passage. The worst culvert, located immediately above site 2, was perched and had swift flow. This would preclude the passage of a number of species, included inanga. All three culverts will need remedial works undertaken to ensure they meet the rules of the Regional Freshwater Plan for Taranaki.

Other than the barriers presented by the three access culverts, and despite the presence of hydrocarbons in the sediment at site 3, these results give no indication that the composting activities and wastewater irrigation undertaken by Remediation NZ Ltd, alongside the Haehanga Stream, have had any impact on the fish communities of this stream.
Due to the low flows in the stream at the time of this survey, it is recommended that this annual fish survey be undertaken no later than mid-January, preferably in December. It should continue on an annual basis. In addition, it is recommended consideration be given to installing continuous water temperature monitoring equipment over the summer months, to improve our understanding of how the water temperature changes in the Haehanga Stream.

### 2.1.10 Air inspections

Air inspections were carried out in conjunction with water sampling and compliance monitoring inspections.

The nature of the RNZ's operations at the Mokau site can create potentially serious odour issues. The odours noted on site were often strong and reflected the nature of the waste being processed. No offensive or objectionable odours were noted beyond the boundary during routine inspections.

Ten complaints were received in regard to odour, however none of these were substantiated.

### 2.1.11 Mokau Rd, Uruti site improvement plans

Due emerging trends in elevated chloride in groundwater and increasing chlorides and sodium in soil, Council directed RNZ to develop and submit groundwater and soil management plans (as required by consent 5838-2). RNZ contracted a consultant to undertake site investigations and this resulted in two documents being produced.

#### 2.1.11.1 Uruti Composting Facility Management Plan

This document summarises the existing monitoring data, the issues at the site and makes recommendations in regard to site management and increased monitoring to minimise effects. It also includes a tiered response to trigger levels of certain contaminant indicators to prevent over-irrigation of any given area. The plan also recommends that new irrigation areas be opened up to spread the loadings of salts to minimise effects on any given area. RNZ has since applied for a change of conditions to consent 5838-2 to allow irrigation two new areas. The changed consent now also requires more rigorous monitoring of groundwater and soil at the site.

#### 2.1.11.2 Haehanga catchment prelimanary groundwater investigation

This document provides a more in depth analysis of groundwater based on topographical surveys and existing groundwater data. The conceptual model provided in this document is based on limited data, with view to use more frequent self monitoring to improve the model in the future.

Copies of both documents area Appended to this report

## 2.2 Waitara Road and Pennington Road, Brixton


**Figure 7** Aerial view of Remediation NZ's Waitara and Pennington Rd sites

### 2.2.1 Inspections

#### 2.2.1.1 19 December 2014

A site visit was made to conduct a compliance monitoring inspection. There was slight NW wind and 2 mm of rain in previous 24 hours.

**Waitara Rd site**
All of the worm beds were covered at the time of the inspection and the areas between the worm beds had good grass growth that had been recently mowed. There were noticeable odours at the SE boundary as site staff had just moved a pile of chicken manure. No significant ponding was noted and discharges to water ways were not occurring at the time.

**Pennington Rd site**
No discharges were occurring at the time of the inspection and no odours were detected. There were a number of bark stock piles running along the northeast boundary of the site, adjacent the drain. The site manager outlined that the truck delivering the bark could not get any further away from the drain due to the muddy conditions and that the stock piles will be dragged back away from the drain in January

#### 2.2.1.2 24 April 2015

A site visit was made to conduct a compliance monitoring inspection

**Waitara Rd site**
All of the worm beds were covered at the time of the inspection and the areas between the worm beds had good grass growth. No significant ponding was noted and discharges to water ways were not occurring.

**Pennington Rd site**
No discharges were occurring at the time of the inspection and no odours were detected. There bark stock piles running along the northeast boundary of the site adjacent the drain had reduced in size now that the truck could get in. No issues were noted.

**22 June 2015**
A site visit was made to conduct a compliance monitoring inspection.

**Waitara Rd site**
All of the worm beds were covered at the time of the inspection and the areas between the worm beds had good grass growth. There were some areas of ponding as a result of the very heavy rains of over the weekend. There was some residual (trickle flow) stormwater discharging into the grate in front of main shed. The site manager outlined that the sump below the grate is pumped out on a monthly basis. The pipe at the western edge of the site had the same trickle flow. Discussion was held with the site manager about creating an updated stormwater plan and cleaning up the storage area on the south side of the shed.

**Pennington Rd site**
No discharges were occurring at the time of the inspection and no odours were detected. There site was quite muddy and had some small isolated areas of ponding due to the very heavy rains of over the weekend. Maintenance of the silt control measures were discussed with the site manager.

### 2.2.2 Air quality

Odours at the vermiculture sites are usually associated with either harvesting of vermicasts or when the worms are being fed. The processing plant tends to emit odour whenever it is in operation, but the odours are usually localised to the entrances of the buildings. No objectionable or offensive odours were detected beyond the boundaries of these properties during routine inspections. No complaints were received about the sites during the period under review.

## 2.3 Investigations, interventions, and incidents

The monitoring programme for the year was based on what was considered to be an appropriate level of monitoring, review of data, and liaison with the consent holder. During the year matters may arise which require additional activity by the Council, for example provision of advice and information, or investigation of potential or actual 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 Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The Incident Register (IR) 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 2014-2015 period, the Council was required to undertake significant additional investigations and interventions, and record incidents, in association with the Company's conditions in resource consents or provisions in Regional Plans.

### 2.3.1 Mokau Rd, Uruti Site

The Council received 10 complaints about odours from the site, however upon investigation, these were not substantiated. One further complaint was received about discolouration of the Haehanga Stream and this was investigated and attributed to a slip further upstream. One further complaint was received about diesel sheen on the stream and this was found to be the result of spill at the site. Details of all incidents and complaints are given below.

#### 2.3.1.1 15 August 2014

A complaint was received concerning diesel sheen in the Mimi River, at Uruti. Investigation found there had been a small pond overflow, at a composting site upstream, causing hydrocarbons to enter the Haehanga Stream. At the time of inspection the stream was running clear and works were being undertaken to prevent any further overflows from the settling ponds. A letter of explanation was received outlining that heavy rain had caused the pond to overflow and that a spill trailer was deployed to contain the spill. An infringement notice was issued.

#### 2.3.1.2 1 September 2014

During routine monitoring it was found that the weather station at a composting site at Uruti, was not recording weather data as required by Resource Consent 5839-2. It was noted that there was no data recorded between March 2012 and September 2015.

A letter of explanation was received outlining that the current weather station had failed due to age and a new weather station was going to be installed. The consent

holder installed a new weather station, the data from which could be accessed by the Council via the internet.

#### 2.3.1.3 24 September 2014

During routine monitoring it was found that a small diesel spill had occurred during the transport of a pump, causing diesel to flow overland into a ditch and into an unnamed tributary of the Haehanga Stream. Works were undertaken by the consent holder at the time of the spill to contain the diesel sheen. A letter of explanation was received and accepted.

#### 2.3.1.4 23 December 2014

A complaint was received about odour emanating from a composting site on Mokau Road, Uruti. An odour survey was undertaken and only a noticeable odour was found in one area but this could not be traced to the composting site. No odour was found in the valleys to the north or south.

#### 2.3.1.5 13 January 2015

A complaint was received concerning odour discharging from a worm farm at Uruti.

An odour survey was conducted at the boundary of the worm farm and at the complainant's boundary. The duty officer detected constant weak hydrocarbon odours at the boundary of the worm farm and very weak intermittent odours at the complainant's property. The odours were not considered offensive. No further action was taken.

#### 2.3.1.6 25 January 2015

A complaint was received concerning an objectionable odour from the composting operations site on Mokau Road, Uruti. An odour survey was undertaken on Mokau Road at the letter box of the address given by the complainant during our phone conversation, which was west of the composting site. Once the survey was completed no odour was detected. No odour was detected at Remediation site entrance or north east of the site entrance. No further action was taken.

#### 2.3.1.7 20 February 2015

A complaint was received concerning odour discharging from a composting facility in Uruti. An odour survey was conducted near the boundary of the complainant's property. Odour associated with composting facility could not be detected. No further action was taken.

#### 2.3.1.8 24 February 2015

A complaint was received regarding discolouration of the Haehanga stream, Uruti. Investigations found the stream to be discoloured where it comes out of the bush upstream of the composting facility most likely as a result of the heavy rainfall the night before or a natural event such as a slip. No further action was taken.

#### 2.3.1.9 27 February 2015

A complaint was received regarding odours on Mokau Rd Uruti. Investigation found that no odours associated with the composting site could be detected offsite.

#### 2.3.1.10 11 March 2015

A complaint was received concerning odour emanating from the composting site in the Uruti Valley. An odour survey was undertaken at two locations on the complainant's property and no odour was detected. A site inspection was undertaken. On-site there was a very weak hydrocarbon odour when standing next to the 1st pond however, no odour was detected beyond the site entrance. No further action taken.

#### 2.3.1.11 12 March 2015

A complaint was received concerning odour emanating from a composting site at Uruti. Upon investigation no odours could be detected.

#### 2.3.1.12 18 April 2015

A complaint was received regarding odour from a composting site at Mokau Road, Uruti. Inspection found no odour of any consequence to be found.

#### 2.3.1.13 29 June 2015

A complaint was received via phone about odour and mercaptan emissions from a composting and waste remediation site. An investigation was undertaken with gas detection equipment and no mercaptan or objectionable odours were detected.

### 2.3.2 Brixton sites

The Council received no complaints in regards to Remediation NZ's sites on Waitara Rd and Brixton Rd.

# 3. Discussion

## 3.1 Site performance

### 3.1.1 Mokau Road, Uruti

There were significant issues at the site during the monitoring period. There were two spill events (one minor one and a larger one which resulted in a complaint). The Company responded to the spills with spill equipment stored onsite, however, on both occasions Council became aware of the spill during routine monitoring or by way of complaint (rather than by self notification). The incident of 9 August 2015 resulted in an infringement notice being issued.

It was also noted that the weather station required by consent conditions was not recording data, however the consent holder rectified this in a timely manner.

Generally an improvement in the RNZ's monitoring of its own equipment, processes, and site performance would be required to prevent the re-occurrence of these site performance issues.

### 3.1.2 Pennington Road and Waitara Road sites

There were no significant issues noted at these sites with the exception that it was noted that the Stormwater Management Plan was overdue for review.

## 3.2 Environmental effects of exercise of consents

### 3.2.1 Mokau Road, Uruti

**Wetland Discharge**
During the year under review the Company complied with the consent conditions in regards to ammonia level in the unnamed tributary of the Haehanga Stream below the wetland discharge on all but one occasion during sampling. On 24 September 2014 the concentration of unionised ammonia in the stream at site HHG000103 was found to be 0.06531 g/m$^3$ (which exceeded consented limits), however, subsequent sampling indicated that this had returned to below consent levels. On one occasion the discharge was found to have slightly elevated (and non-compliant) level of suspended solids, however, only a very slight rise in solids was noted in the receiving wasters. The biomonitoring survey undertaken indicated that no significant impacts were occurring on aquatic ecosystems from this discharge.

**Surface water**
Chloride levels were found to be elevated in the stream system and this is likely to be a result of irrigation and wetland discharges. During normal operations chloride levels in the stream system were found to be below the 150 g/m$^3$ consent limit, however, during one extremely dry period chloride limits exceeding the consented limit were found at sites HHG000150 and 115. These were found to return to normal levels after a short period of rain and it was concluded that the high levels were a result of a combination groundwater intrusion and evaporation of stagnant water, rather than from non-compliant activity. It was noted that the highest chloride concentration (of 426 g/m$^3$) did not exceed the 900 g/m$^3$ instantaneous guideline value adopted by the Government of British Columbia for the protection of fresh water ecosystems.

For all other parameters the Company complied with consented limits within surface water during the monitoring year. Macroinvertebrate biomonitoring did not indicate that there was any significant adverse effect on water quality or macroinvertebrate communities at the time of the survey and the fish survey results indicated that the composting activities at the site have not had any significant impact on the fish communities. It was however noted that the culvert under the main access road is perched and not providing sufficient fish passage. It was also noted at one site 'during the fish survey' that hydrocarbon films were appearing on the surface of the water in the stream when the sediment in the bed was disturbed. This may have been residual contamination from the overflow earlier overflow event however this could not be confirmed at the time. Sediment sampling will be undertaken if such occurrences are observed again.

**Groundwater**
The groundwater results from the irrigation areas had elevated chloride levels (especially the lower area) but as discussed above, this is not currently having a significantly adverse effect of the local stream system. Total dissolved solids levels found in the groundwater indicate that the groundwater remains fit for livestock consumption. The levels of chlorides were found to be at the highest level in the groundwater bore in the lower irrigation area since monitoring began. BTEX was not detected in groundwater during the monitoring period.

**Soil**
Soil sampling indicates that the SAR of the soils of both irrigation areas continued to rise with the levels peaking in January 2015. This was also found to be the case with chloride levels, there are no consent conditions limit chloride and SAR in soils, however consent conditions required that RNZ develop and submit a Soil and Groundwater Management Plan should increasing trends of any contaminant be found. BTEX was not detected in the soil during the monitoring period.

**Metal analysis**
Heavy metal analysis was undertaken on soil, groundwater, irrigation fluid and surface water. The results show that metals levels in all the media tested were within expected limits and compiled with the relevant guidelines.

**Air**
The site was checked for odours during each inspection and no objectionable or offensive odours were noted. There were several complaints, however none of these were substantiated. In response to one complaint Council staff undertook a mercaptan survey and none was detected.

**Culverts**
During the year it was noted during biological surveys that the culvert permitted under consent 6212-1 had become perched and works are required to ensure adequate fish passage is provided.

**Conclusion**
In conclusion, the activities at the site are having effects on the receiving environment. These range from minor and emergent effects in terms of the normal operational activities, to potentially adverse effects that have been found when systems at the site failed. There have also been indications that without better management of effects in

soil and groundwater arising as a result of irrigation, there is a risk of this that this activity may cause longer term adverse effects. As discussed in section 2.1.11, RNZ has carried out investigations and developed a management plan to address this.

### 3.2.2 Pennington Road and Waitara Road sites

No adverse environmental effects on receiving waters were observed as a result of activities at the two sites. No stormwater discharges were observed during inspections and they appear only to occur during high rainfall. Both sites have reasonable levels of vegetative cover either in between the worm beds or along receiving drains which mitigate issues arising from overland flow. The Pennington Rd site also has silt controls on the site driveway. The sites are now used purely as worm farms fed with composted materials from the Mokau Road site. As RNZ no longer incorporates drilling wastes directly into the worm food in situ at the worm farms, this greatly reduces the likelihood of any environmental effects. The monitoring programme still retains a provisional sampling component if discharges are observed.

## 3.3 Evaluation of performance

A tabular summary of the Company's compliance record for the year under review is set out in Tables 18-24.

**Table 24** Summary of performance for Consent 5838-2

| Purpose: To discharge of waste to land and treated stormwater and leachate to water at Mokau Rd Uruti | | |
|---|---|---|
| Condition requirement | Means of monitoring during period under review | Compliance achieved? |
| 1. Adopt best practical option | Programme management/site inspections | No |
| 2. Only acceptable waste accepted onto site | Site inspections/review of supplied records | Yes |
| 3. DAF residue not to be accepted | Site inspections/review of supplied records | Yes |
| 4. Maintenance of stormwater systems | Site inspections | No – maintenance requested by Council |
| 5. Maintenance of treatment systems | Site inspections | No – maintenance requested by Council |
| 6. Adequate pond construction | Site inspections | Yes |
| 7. Keep and supply irrigation records | Data supplied and reviewed | Yes |
| 8. No direct discharges to occur as a result of irrigation | Site inspections /sampling | No |
| 9. Irrigated fluids not to exceed 5% hydrocarbon content | Site inspections /sampling | Yes |
| 10. Discharges not to cause adverse effects at site HHG000150 and HHG00100 | Sampling/inspection | No |

| Purpose: To discharge of waste to land and treated stormwater and leachate to water at Mokau Rd Uruti | | |
|---|---|---|
| Condition requirement | Means of monitoring during period under review | Compliance achieved? |
| 11. Soil sampling to be undertaken | Undertaken by the Council | Yes |
| 12. Submit a Soil Management Plan if requested by the Council | Plan requested and supplied | Yes |
| 13. Adhere to Soil Management Plan | Yes | Yes |
| 14. Establish groundwater monitoring bores | Site inspections | Yes |
| 15. Groundwater sampling to be undertaken | Undertaken by the Council | Yes |
| 16. Submit a Groundwater Management Plan if requested by the Council | Plan requested and supplied | N/A |
| 17. Adhere to Groundwater Management Plan | Yes | N/A |
| 18. Prepare a Pond Treatment System Management Plan | Plan received and reviewed | Yes |
| 19. Adhere to Treatment System Management Plan | Inspection | No |
| 20. Prepare a Wetland Treatment System Management Plan | Plan received and reviewed | Yes |
| 21. Adhere to Wetland Treatment System Management Plan | Inspection | Yes |
| 22. Wetland discharge not to exceed certain parameters | Sampling | No |
| 23. Wetland discharge not to cause certain effects at site HHG000103 | Sampling | No |
| 24. Maintain riparian plantings | Inspection | Yes |
| 25. Notify the Council of significant incidents on site | No notifications received | No |
| 26. Prepare a Site Reinstatement Plan prior to site closure | N/A | N/A |
| 27. Adhere to Site Reinstatement Plan | N/A | N/A |
| 28. Optional Review | Review required | N/A |
| Overall assessment of consent compliance and environmental performance in respect of this consent | | Improvement required |

N/A = not applicable

**Table 25** Summary of performance for Consent 5839-2

| Purpose: To discharge of emissions to air at Mokau Rd, Uruti | | |
|---|---|---|
| Condition requirement | Means of monitoring during period under review | Compliance achieved? |
| 1. Adopt best practical option | Programme management/site inspections | Yes |
| 2. Composting area not to exceed certain limits | Programme management/site inspections | Yes |
| 3. Only acceptable waste brought onto site | Site inspections/review of supplied records | Yes |
| 4. DAF residue not to be accepted | Site inspections/review of supplied records | Yes |
| 5. Maintain and supply an inwards good register | Data received and reviewed | Yes |
| 6. Prepare a Site Practices Plan | Plan received and reviewed | Yes |
| 7. Adhere to Site Practices Plan | Site inspections | Yes |
| 8. Arrange professional assessment of Site Practices Plan | Assessment received and reviewed | Yes |
| 9. Submit Proposed Implementation Plan | Plan received and reviewed | Yes |
| 10. Adhere to Proposed Implementation Plan | Proposals adopted and incorporated into other plans | Yes |
| 11. Dust deposition not to exceed certain limits | Not monitored- dust not noted as an issue during inspections | Not assessed |
| 12. PM10 and suspended particulate not to exceed certain limits | Not monitored- dust not noted as an issue during inspections | Not assessed |
| 13. No offensive or objectionable odour beyond the boundary | Inspection | Yes |
| 14. Install a weather station and provide data | Inspection | No |
| 15. Conduct odour surveys | Undertaken by the Council | Not required |
| 16. Hold community meeting | Meeting held in 2011-no attendees | Yes |
| 17. Notify the Council of onsite incidents | No notification received | N/A |
| 18. Prepare a Site Exit Plan prior to site closure | N/A | N/A |
| 19. Adhere to Site Exit Plan upon site closure | N/A | N/A |
| 20. Optional review | A review was not required | N/A |
| Overall assessment of consent compliance and environmental performance in respect of this consent | | Good |

**Table 26** Summary of performance for Consent 5892-2

| Purpose: To discharge of drilling solids at Waitara Road, Brixton | | |
|---|---|---|
| Condition requirement | Means of monitoring during period under review | Compliance achieved? |
| 1. Exercise of consent in accordance with information provided in application | Site inspections | Yes |
| 2. Best practicable option as described by S2 of RMA | Site inspections | Yes |
| 3. Maintain stormwater plan | Record reviewed | No-plan needs update |
| 4. Records of source, nature and volume of wastes | Records reviewed | Yes |
| 5. Solid drilling cuttings to be < 5 % hydrocarbon content | Hydrocarbons wastes no longer processed on this site | N/A |
| 6. No contamination of ground or surface water | Samples were not collected during the period under review | N/A |
| 7. Maintenance of stormwater treatment system | Site inspections | Yes |
| 8. Concentration limits on stormwater | Samples were not collected during the period under review | N/A |
| 9. Alterations to processes and operations | Site inspections did not note any changes | Yes |
| 10. Reinstatement of site | N/A | N/A |
| 11. Optional review of consent | N/A | N/A |
| Overall assessment of consent compliance and environmental performance in respect of this consent | | High |

**Table 27** Summary of performance for Consent 5893-2

| Purpose: To discharge drilling solids at Pennington Road, Brixton | | |
|---|---|---|
| Condition requirement | Means of monitoring during period under review | Compliance achieved? |
| 1. Exercise of consent in accordance with information provided in application | Site inspections | Yes |
| 2. Best practicable option as described by S2 of RMA | Site inspections | Yes |
| 3. Records of source, nature and volume of wastes | Yes | N/A |
| 4. Solid drilling cuttings to be < 5 % hydrocarbon content | No longer processed at this site | N/A |

| Purpose: To discharge drilling solids at Pennington Road, Brixton | | |
|---|---|---|
| Condition requirement | Means of monitoring during period under review | Compliance achieved? |
| 5. No contamination of ground or surface water | Site inspections, samples | Yes |
| 6. Maintenance of stormwater treatment system | Site inspections | Yes |
| 7. Concentration limits on stormwater | Samples were not collected during the period under review | N/A |
| 8. Visual impact on surface water after mixing zone | No visual impact observed during site visits | Yes |
| 9. Alterations to processes and operations | Site inspections did not note any changes | Yes |
| 10. Reinstatement of site | N/A | N/A |
| 11. Optional review of consent | No review due this period | N/A |
| Overall assessment of consent compliance and environmental performance in respect of this consent | | High |

**Table 28** Summary of performance for Consent 5938-1

| Purpose: To establish and maintain a culvert at Mokau Rd, Uruti | | |
|---|---|---|
| Condition requirement | Means of monitoring during period under review | Compliance achieved? |
| 1. Notification prior to commencement of works | No works undertaken this period | N/A |
| 2. Construction in accordance with application | Site inspections | Yes |
| 3. Best practicable option | Site inspections | Yes |
| 4. Minimisation of riverbed disturbance | Site inspections | Yes |
| 5. Reinstatement of site | N/A | N/A |
| 6. Optional review of consent | No review due this period | N/A |
| Overall assessment of consent compliance and environmental performance in respect of this consent | | High |

**Table 29** Summary of performance for Consent 6211-1

| Purpose: To realign a stream at Mokau Rd, Uruti | | |
|---|---|---|
| Condition requirement | Means of monitoring during period under review | Compliance achieved? |
| 1. Notification prior to commencement of works | No works undertaken this period | N/A |
| 2. Realignment in accordance with application | Site inspections | Yes |
| 3. Best practicable option | Site inspections | Yes |
| 4. Minimisation of discharge | Site inspections | Yes |
| 5. Minimisation of riverbed disturbance | Site inspections | Yes |
| 6. Optional review of consent | No review due this period | N/A |
| Overall assessment of consent compliance and environmental performance in respect of this consent | | High |

**Table 30** Summary of performance for Consent 6212-1

| Purpose: To establish and maintain a culvert at Mokau Rd, Uruti | | |
|---|---|---|
| Condition requirement | Means of monitoring during period under review | Compliance achieved? |
| 1. Notification prior to commencement of works | No works undertaken this period | N/A |
| 2. Replacement of temporary culvert | | N/A |
| 3. Construction in accordance with application | Site inspections | No-culvert outlet is perched |
| 4. Best practicable option | Site inspections | Yes |
| 5. Minimisation of riverbed disturbance | Site inspections | Yes |
| 6. Provision of fish passage | Site inspections | No-culvert outlet is perched |
| 7. Reinstatement of site | N/A | N/A |
| 9. Optional review of consent | No review due this period | N/A |
| Overall assessment of consent compliance and environmental performance in respect of this consent | | Improvement Required |

RNZ demonstrated a good level of environmental performance and compliance with the consents associated with its Waitara Road, and Pennington Road sites.

An improvement is required in RNZ's environmental performance and compliance with resource with consents associated with its Mokau Rd site at Uruti.

## 3.4 Recommendations from the 2013-2014 Annual Report

THAT that the 2014-2015 monitoring programme for the site at Mokau Rd, Uruti be changed to include the following;

- Monthly inspections.
- Monthly conductivity readings from the groundwater bores.
- The late summer macroinvertebrate survey to be made provisional.
- Removal of suspended solids analysis from all sites except HHG000103, HHG000098, IND003008, HHG000150 and HHG0000097.
- An annual fish survey

1. THAT the 2014-2015 monitoring programme for the Waitara Rd and Pennington Rd sites remain unchanged from that undertaken in the 2013-2014 period.

2. THAT the option for a review of resource consent 5838 in June 2015, as set out in condition 28 of the consent, be exercised, on the grounds that current conditions are not adequate for dealing with any adverse effects arising from the exercise of this consent.

3. THAT the option for a review of resource consent 5839 in June 2015, as set out in condition 20 of the consent, not be exercised, on the grounds that current conditions are adequate for dealing with any adverse effects arising from the exercise of this consent.

4. THAT the option for a review of resource consent 5893 in June 2015, as set out in condition eleven of the consent, not be exercised, on the grounds that current conditions are adequate for dealing with any adverse effects arising from the exercise of this consent.

5. THAT the option for a review of resource consent 6211 in June 2015, as set out in condition six of the consent, not be exercised, on the grounds that current conditions are adequate for dealing with any adverse effects arising from the exercise of this consent.

6. THAT the option for a review of resource consent 6212 in June 2015, as set out in condition eight of the consent, not be exercised, on the grounds that current conditions are adequate for dealing with any adverse effects arising from the exercise of this consent.

7. THAT the consent holder be required to prepare and submit a Groundwater Management Plan as provided for under condition 16 of consent 5838-2.

8. THAT the consent holder be required to prepare and submit a Soil Management Plan as provided for under condition 12 of consent 5838-2.

These recommendations were implemented in full with the exception of recommendation two which was dealt with by way of an application to change the consent by RNZ.

## 3.5 Alterations to monitoring programmes for 2015-2016

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

It is proposed that the 2015-2016 monitoring programme for the site at Mokau Rd, Uruti remain unchanged from that undertaken in the 2014-2015 period.

It is proposed that the 2015-2016 monitoring programme for the Waitara Rd and Pennington Rd sites remain unchanged from that undertaken in the 2014-2015 period.

Recommendations to this effect are attached to this report.

## 3.6 Exercise of optional review of consent

### 3.6.1 Consent 5839

Resource consent 5839 provides for an optional review of the consent in June 2016. Condition 20 allows the Council to review the consent, for the purposes of;

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;

b. To incorporate into the consent any modification to the operation and maintenance procedures or monitoring that may be necessary to deal with any adverse effects on the environment arising from changes in association with condition 9 of this consent; 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 of odour from the site.

Based on the results of monitoring in the year under review it is considered that there are no grounds that require a review to be pursued.

A recommendation to this effect is presented in Section 4 of this report.

### 3.6.2 Consent 5838

Resource consent 5838 provides for an optional review of the consent in June 2016. Condition 28 allows the Council to review the consent, for the purposes of;

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/or water quality issues;

b. To incorporate into the consent any modification to the operation and maintenance procedures or monitoring that may be necessary to deal with any adverse effects on the environment arising from changes in association with condition 9 of consent 5839-2; 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 and/or odour from the site.

It is considered that there are not grounds that require a review to be pursued. The consent holder chose to apply to have consent condition changed and during this process further protections were put in place.

A recommendation to this effect is presented in Section 4 of this report.

# 4. Recommendations

1. THAT the 2015-2016 monitoring programme for the Waitara Rd and Pennington Rd sites remain unchanged from that undertaken in the 2014-2015 period.

2. THAT the 2015-2016 monitoring programme for the site at Mokau Rd, Uruti remain unchanged from that undertaken in the 2014-2015 period.

3. THAT the option for a review of resource consent 5838 in June 2016, as set out in condition 28 of the consent, be exercised, on the grounds that current conditions are not adequate for dealing with any adverse effects arising from the exercise of this consent.

4. THAT the option for a review of resource consent 5839 in June 2016, as set out in condition 20 of the consent, not be exercised, on the grounds that current conditions are adequate for dealing with any adverse effects arising from the exercise of this consent.

# Glossary of common terms and abbreviations

The following abbreviations and terms that may have been 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. |
| CBODF | Carbonaceous biochemical oxygen demand of a filtered sample. A measure of the presence of dissolved degradable organic matter, excluding the biological conversion of ammonia to nitrate. |
| BODF | Biochemical oxygen demand of a filtered sample. |
| BTEX | Benzene, toluene, ethylbenzene and xylene (aromatic solvents found in petroleum products and wastes). |
| 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. |
| DAF | Dissolved air floatation residues (the residues from an effluent treatment system commonly used in industry. |
| DRP | Dissolved reactive phosphorus. |
| Fresh | Elevated flow in a stream, such as after heavy rainfall. |
| $g/m^3$ | Grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures. |
| HC | Hydrocarbons. |
| 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 the Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring. |
| Investigation | Action taken by the 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 |
| $PM_{10}$ | elatively 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. |
| SAR | Sodium Absorption Ratio; a measure of the suitability of water for use in agricultural irrigation, as determined by the concentrations of solids dissolved in the water. It is also a measure of the sodicity of soil, as determined from analysis of water extracted from the soil. |
| 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. |

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Taranaki Regional Council 2005: Perry Environmental Limited Monitoring Programme Annual Report 2004-2005. Technical Report 2005-12. Taranaki Regional Council, Stratford.

Taranaki Regional Council 2004: Perry Environmental Limited Monitoring Programme Annual Report 2003-2004. Technical Report 2004-26. Taranaki Regional Council, Stratford.

Taranaki Regional Council 2003: Perry Environmental Limited Monitoring Programme Annual Report 2002-2003. Technical Report 2003-37. Taranaki Regional Council, Stratford.

Taranaki Regional Council 2002: Global Vermiculture Limited Monitoring Programme Annual Report 2001-2002. Technical Report 2002-25. Taranaki Regional Council, Stratford.

# Appendix I

# Resource consents held by Remediation (NZ) Limited

# Discharge Permit

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

| | |
|---|---|
| Name of Consent Holder: | Remediation (NZ) Limited<br>P O Box 8045<br>NEW PLYMOUTH 4342 |
| Decision Date (change): | 20 September 2013 |
| Commencement Date (change): | 20 September 2013 [Granted: 27 May 2010] |

## Conditions of Consent

| | |
|---|---|
| Consent Granted: | To discharge:<br>a) waste material to land for composting; and<br>b) treated stormwater and leachate from composting operations;<br>onto and into land in circumstances where contaminants may enter water in the Haehanga Stream catchment and directly into an unnamed tributary of the Haehanga Stream |
| Expiry Date: | 1 June 2018 |
| Review Date(s): | June 2014, June 2015, June 2016, June 2017 |
| Site Location: | 1450 Mokau Road, Uruti |
| Legal Description: | Sec 34 Pt Sec 4 Blk II Upper Waitara SD |
| Grid Reference (NZTM) | Between approximate (NZTM) 1731704E-5685796N, 1733127E-5684809N, 1732277E-5685101N, 1732451E-5684624N and 1732056E-5684927N |
| Catchment: | Mimi |
| Tributary: | Haehanga |

*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 with section 36 of the Resource Management Act.

### 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.

### Acceptable wastes

2. The raw materials accepted onsite shall be limited to the following:

- Paunch grass;
- Animal manure from meat processing plant stock yards and dairy farm oxidation pond solids;
- Green vegetative wastes;
- Biosolids wastes including, but not limited to, pellets from wastewater treatment plants;
- Mechanical pulping pulp and paper residue [excluding any pulping wastes that have been subject to chemical pulping or treated or mixed with any substance or material containing chlorine or chlorinated compounds];
- Solid drilling cuttings from hydrocarbon exploration provided they are blended down to a maximum hydrocarbon content of 5.0 % total petroleum hydrocarbon within 3 days of being received onsite;
- Water based and synthetic based drilling fluids from hydrocarbon exploration provided they are blended down to a maximum hydrocarbon content of 5.0 % total petroleum hydrocarbon content within 3 days of being brought onto the site;
- Produced water from hydrocarbon exploration;
- Vegetable waste solids [being processing by-products];
- Grease trap waste [from food service industries];
- Fish skeletal and muscle residue post filleting [free from offal]; and
- Poultry industry waste [eggshells, yolks, macerated chicks and chicken mortalities].

The acceptance of any other materials shall only occur if the Chief Executive, Taranaki Regional Council advises in writing that he is satisfied on reasonable grounds that the other materials will have minimal effects beyond those materials listed above.

3. Material produced as a result of a dissolved air flotation process shall not be accepted on site.

### Maintenance of measures

4. All sediment ponds and silt traps on site, that are located upstream of the pond treatment system or wetland treatment system, shall be managed so that they are no more than 20% full of solids at any one time.

Note: For the purposes of this condition, the location of the pond treatment system and wetland treatment system are shown on Figure 1, attached as Appendix 1 of this consent.

5. All treatment measures on site shall be implemented and maintained so that:

- clearwater runoff is prevented from entering Pad 1, Pad 2 and the Drill Mud Pad; and
- all stormwater and/or leachate from Pad 1, Pad 2, the Drill Mud Pad and any other exposed areas within the composting site is directed for treatment through the Pond or Wetland Treatment System.

Note: For the purposes of this condition, the location and extent of Pad 1, Pad 2 and the Drill Mud Pad are shown on Figure 1, attached as Appendix 1 of this consent.

6. Any pond(s) used on site for the purposes of stormwater and leachate treatment shall be constructed and maintained in a manner which avoids the seepage of wastewater through the pond walls entering surface water.

**Irrigation**

7. The consent holder shall record the following information in association with irrigating wastewater to land:

a) the date, time and hours of irrigation;
b) the approximate volume of wastewater irrigated to land;
c) the source of the wastewater [e.g. Pond or Wetland Treatment System]; and
d) the location and extent where the wastewater was irrigated.

The above records shall be made available to the Chief Executive, Taranaki Regional Council, on request.

8. There shall be no direct discharge to water as a result of irrigating wastewater to land. This includes, but is not necessarily limited to, ensuring the following:

- No irrigation shall occur closer than 25 m to any surface water body;
- The discharge does not result in surface ponding;
- No spray drift enters surface water;
- The discharge does not occur at a rate at which it cannot be assimilated by the soil/pasture system; and
- The pasture cover within irrigation areas is maintained at all times.

9. Treated wastewater discharged by irrigation to land shall not have a hydrocarbon content exceeding 5 % total petroleum hydrocarbon.

10. Discharges irrigated to land shall not give rise to any of the following adverse effects in the Haehanga Stream, after a mixing zone extending 30 m from the downstream extent of the irrigation areas, being monitoring sites HHG000100 [at or about grid reference 1732295E-5684964N] and HHG000150 [at or about grid reference 1731673E-5685796N]:

a) a rise in filtered carbonaceous biochemical oxygen demand of more than 2.00 $gm^{-3}$;
b) a level of unionised ammonia greater than 0.025 $gm^{-3}$;
c) an increase in total recoverable hydrocarbons;
d) chloride levels greater than 150 $g/m^3$;
e) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
f) any conspicuous change in the colour or visual clarity;
g) any emission of objectionable odour;
h) the rendering of fresh water unsuitable for consumption by farm animals; and
i) any significant adverse effects on aquatic life.

**Soil quality**

11. Representative soil samples shall be taken from each irrigation area at intervals not exceeding six months for total petroleum hydrocarbons, chloride, sodium, total soluble salts, conductivity and the sodium absorption ratio [SAR].

12. Should the results of soil sampling, undertaken in accordance with condition 11 above, indicate an increasing trend in any of the measured parameters, the consent holder shall prepare a Soil Quality Management Plan which details how any significant adverse effects will be avoided, remedied or mitigated.

    The Management Plan shall be submitted for approval to the Chief Executive, Taranaki Regional Council, acting in a certification capacity, within three months of receiving written notice, from the Taranaki Regional Council, of the results and the requirement for a plan.

    Note: for the purposes of this condition, an 'increasing trend' will be determined by the Chief Executive, Taranaki Regional Council and is defined as a consistent increase in a parameter level over time whilst taking into account any seasonal variations between results and any extreme weather conditions that may have had any influence on results.

13. Measures outlined in the Soil Quality Management Plan, approved under condition 12 above, shall be implemented within a timeframe specified by the Chief Executive, Taranaki Regional Council.

**Groundwater quality**

14. The consent holder shall establish at least one groundwater monitoring well at each of the following locations for the purpose of monitoring the effect of the wastewater discharges on groundwater quality:

    a) up gradient of the irrigation areas in an un-impacted area;
    b) down gradient of the extent of the irrigation area situated upstream of the composting area; and
    c) down gradient of the extent of the irrigation area situated downstream of the composting area.

The design, location and establishment of the monitoring wells shall be to the reasonable approval of the Chief Executive, Taranaki Regional Council, acting in a certification capacity. The monitoring wells shall be fully established and operational within three months of the commencement date of this consent.

15. Groundwater shall be monitored at the wells approved under condition 14 at intervals not exceeding six months for total petroleum hydrocarbon, chloride, nitrate, nitrite and ammoniacal nitrogen.

16. Should the results of groundwater monitoring, undertaken in accordance with condition 15 above, indicate an increasing trend in one or more of the monitored parameters, the consent holder shall prepare a Groundwater Quality Management Plan which details how any significant adverse effects will be avoided, remedied or mitigated.

    The Management Plan shall be submitted for approval to the Chief Executive, Taranaki Regional Council, acting in a certification capacity, within three months of receiving written notice, from the Taranaki Regional Council, of the results and the requirement for a plan.

    Note: for the purposes of this condition, an 'increasing trend' will be determined by the Chief Executive, Taranaki Regional Council and is defined as a consistent increase in a parameter level over time whilst taking into account any seasonal variations between results and any extreme weather conditions that may have had any influence on results.

17. Measures outlined in the Groundwater Quality Management Plan, approved under condition 16 above, shall be implemented within a timeframe specified by the Chief Executive, Taranaki Regional Council.

**Pond Treatment System**

18. The consent holder shall prepare a Pond Treatment System Management Plan which details management practices undertaken to maximise treatment capabilities of the system. The plan shall be submitted for approval to the Chief Executive, Taranaki Regional Council, acting in a certification capacity, within one month of the commencement date of this consent.

    The Management Plan shall address, but not necessarily be limited to, the following matters:

    a) how the build up of sediment and/or sludge will be managed within the entire system, how the level of build-up will be monitored including factors that will trigger management, and the frequency of undertaking the identified measures or procedures;
    b) how overloading of the system will be prevented; and
    c) how any offensive or objectionable odours at or beyond the site boundary will be avoided in accordance with condition 13 of consent 5839-2.

19. Operations on site shall be undertaken in accordance with the Pond Treatment System Management Plan, approved under condition 18 above, except in circumstances when the Proposed Implementation Plan, approved under condition 9 of consent 5839-2, specifies otherwise.

**Wetland Treatment System**

20. The consent holder shall prepare a Wetland Treatment System Management Plan that details management practices undertaken to maximise treatment capabilities of the system. The plan shall be submitted for approval to the Chief Executive, Taranaki Regional Council, acting in a certification capacity, within one month of the commencement date of this consent.

    The Management Plan shall address, but not necessarily be limited to, the following matters:

    a) how the build up of sediment and/or sludge will be managed within the entire system, how the level of build-up will be monitored including factors which will trigger management, and the frequency of undertaking the identified measures or procedures; and
    b) how plant die-off within the system will be managed, and the frequency and/or timing of undertaking the identified measures or procedures.

21. Operations on site shall be undertaken in accordance with the Wetland Treatment System Management Plan, approved under condition 20 above.

22. The discharge from the Wetland Treatment System shall meet the following standards [at monitoring site IND003008]:

    a) the suspended solids concentration shall not exceed 100 $g/m^3$; and
    b) the pH shall be between 6.0 and 9.0.

23. Discharges from the Wetland Treatment System shall not give rise to any of the following effects in the unnamed tributary of the Haehanga Stream, after a mixing zone of 40 m, at established monitoring site HHG000103 [at or about grid reference 1732695E-5685050N]:

    a) a rise in filtered carbonaceous biochemical oxygen demand of more than 2.00 $gm^{-3}$;
    b) a level of unionised ammonia 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.

### Riparian planting

24. The consent holder shall maintain the areas of riparian planting, undertaken in accordance with option 1 of riparian management plan RMP383, 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

25. The consent holder shall keep a permanent record of any incident related to this consent that results, or could result, in an adverse effect on the environment. The consent holder shall make the incident register available to the Taranaki Regional Council on request.

    Details of any incident shall be forwarded to the Taranaki Regional Council immediately. At the grant date of this consent, the Council's phone number is 0800 736 222 [24 hour service].

### Site reinstatement

26. The consent holder shall prepare a Site Exit Plan which details how the site is going to be reinstated prior to the consent expiring or being surrendered. The Plan shall be submitted for approval to the Chief Executive, Taranaki Regional Council, acting in a certification capacity, at least 3 months prior to this consent expiring or being surrendered.

    The Site Exit Plan shall address, but not necessarily be limited to, the following matters:

    a) How the site will be reinstated so that no raw materials listed or approved under condition 2 of this consent remain on site;

    b) How the site will be reinstated so that no partially decomposed material remains on site;

    c) How any remaining leachate or sludge, resulting from the operation, will be either removed from the site, buried, treated or otherwise to avoid any adverse effects on groundwater or surface water; and

    d) Timeframes for undertaking the activities identified in association with a) to c) above.

    Note: The requirement of this condition shall not apply if the consent holder applies for a new consent to replace this consent when it expires.

27. The consent holder shall reinstate the site in accordance with the plan approved under condition 26 above prior to this consent expiring or being surrendered.

**Review**

28. 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 within one month of approving the plan required under condition 9 of consent 5839-2 and/or 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/or water quality issues;

    b) To incorporate into the consent any modification to the operation and maintenance procedures or monitoring that may be necessary to deal with any adverse effects on the environment arising from changes in association with condition 9 of consent 5839-2; 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 and/or odour from the site.

Signed at Stratford on 20 September 2013

For and on behalf of
Taranaki Regional Council

_____

**Director-Resource Management**

## Appendix 1 of consent 5838-2

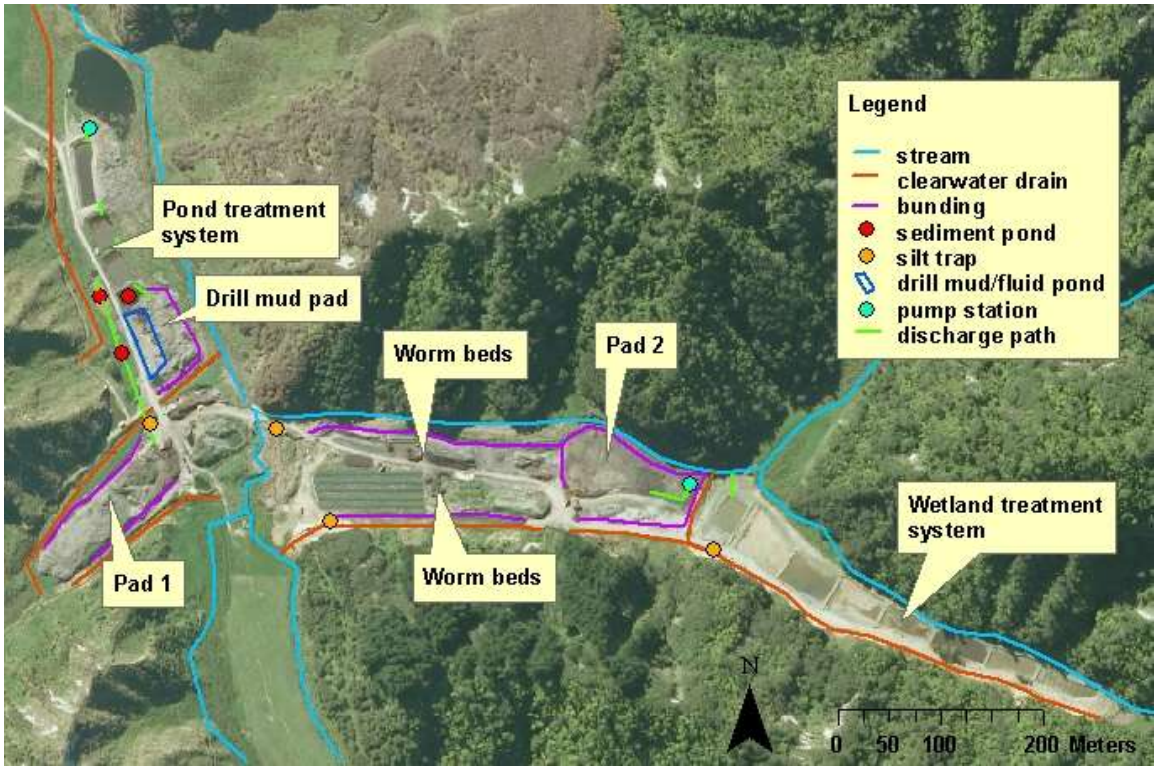


**Figure 1** The location and extent of the Pond Treatment System, Wetland Treatment System, Pads 1 and 2, and the Drill Mud Pad.

# Discharge Permit

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

| | |
|---|---|
| Name of Consent Holder: | Remediation (NZ) Limited<br>P O Box 8045<br>NEW PLYMOUTH 4342 |
| Decision Date: | 27 May 2010 |
| Commencement Date: | 18 June 2010 |

## Conditions of Consent

| | |
|---|---|
| Consent Granted: | To discharge emissions into the air, namely odour and dust, from composting operations between (NZTM) 1731704E-5685796N, 1733127E-5684809N, 1732277E-5685101N, 1732451E-5684624N and 1732056E-5684927N |
| Expiry Date: | 1 June 2018 |
| Review Date(s): | June 2011, June 2012, June 2013, June 2014, June 2015, June 2016, June 2017 |
| Site Location: | 1450 Mokau Road, Uruti |
| Legal Description: | Sec 34 Pt Sec 4 Blk II Upper Waitara SD |

*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.

### General

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 surface areas of Pad 1 and Pad 2 shall not exceed 3,500 m² and 4,000 m², respectively.

   Note: For the purposes of this condition, the location and extent of Pad 1 and Pad 2 are shown on Figure 1, attached as Appendix 1 of this consent.

### Incoming material

3. The raw materials accepted onsite shall be limited to the following:

   - Paunch grass;
   - Animal manure from meat processing plant stock yards and dairy farm oxidation pond solids;
   - Green vegetative wastes;
   - Biosolids wastes including, but not limited to, pellets from wastewater treatment plants;
   - Mechanical pulping pulp and paper residue [excluding any pulping wastes that have been subject to chemical pulping or treated or mixed with any substance or material containing chlorine or chlorinated compounds];
   - Solid drilling cuttings from hydrocarbon exploration provided they are blended down to a maximum hydrocarbon content of 5.0 % total petroleum hydrocarbon within 3 days of being received onsite;
   - Water based and synthetic based drilling fluids from hydrocarbon exploration provided they are blended down to a maximum hydrocarbon content of 5.0 % total petroleum hydrocarbon content within 3 days of being brought onto the site;
   - Produced water from hydrocarbon exploration;
   - Vegetable waste solids [being processing by-products];
   - Grease trap waste [from food service industries];
   - Fish skeletal and muscle residue post filleting [free from offal]; and
   - Poultry industry waste [eggshells, yolks, macerated chicks and chicken mortalities].

   The acceptance of any other materials shall only occur if the Chief Executive, Taranaki Regional Council advises in writing that he is satisfied on reasonable grounds that the other materials will have minimal effects beyond those materials listed above.

4. Material produced as a result of a dissolved air flotation process shall not be accepted on site.

5. The consent holder shall record the following information in association with accepting all incoming material on site:

   a) the date and time that the material is accepted;
   b) description of the material; and
   c) the approximate volumes of material.

   The above records shall be made available to the Chief Executive, Taranaki Regional Council, on request.

**Management practices**

6. The consent holder shall prepare a Site Practices Management Plan which details management practices undertaken to ensure that offensive or objectionable odours at or beyond the site boundary will be avoided in accordance with condition 13 of this consent. The plan shall be submitted for approval to the Chief Executive, Taranaki Regional Council, acting in a certification capacity, within one month of the commencement date of this consent.

   The Management Plan shall address, but not necessarily be limited to, the following matters:

   a) identification of all activities on site which have the potential to generate odour [e.g. turning compost piles, removing sludge from ponds];
   b) the conditions and/or time of day when activities identified under a) above should be undertaken [e.g. during favourable weather conditions and the identification of those conditions] and/or measures that shall be implemented to avoid odours arising [e.g. containment measures];
   c) measures undertaken to minimise odours during receiving and storing material on Pad 1 and Pad 2 and throughout the composting and vermiculture processes [e.g. method[s] used to cover material once received, how anaerobic conditions are maintained];
   d) measures undertaken to minimise odours arising in the Wetland Treatment System, and identification of the time of year and/or frequency when undertaken;
   e) measures undertaken to minimise odours arising in the Pond Treatment System and associated treatment measures [e.g. silt traps located upstream], and identification of the time of year and/or frequency when undertaken; and
   f) details of how a complaint investigation procedure shall operate, including what data shall be collected and what feedback is to be provided to the complaint.

7. Operations on site shall be undertaken in accordance with the Site Practices Management Plan, approved under condition 6 above, except in circumstances when the Proposed Implementation Plan, approved under condition 9 of this consent, specifies otherwise.

**Site audit and implementation**

8. The consent holder shall engage a suitably qualified and experienced professional to prepare and submit an Odour Assessment Report for approval to the Chief Executive, Taranaki Regional Council, acting in a certification capacity, within three months of the commencement date of this consent. The professional that the consent holder engages shall be to the reasonable approval of the Chief Executive, Taranaki Regional Council.

   The report shall include, but not necessarily be limited to, the following:

   a) The appropriateness of the management practices and control measures undertaken in avoiding offensive and/or objectionable odours arising beyond the property boundary in association with the composting processes on Pad 1;
   b) Recommendations in association with a) above;
   c) The appropriateness of the design and management of the Pond Treatment System and associated pre-treatment devices (e.g. silt ponds) in effectively managing odours arising from treating leachate derived from Pad 1 and avoiding offensive and/or objectionable odours arising beyond the property boundary; and
   d) Recommendations in association with c) above.

   For assisting with the above assessment, the consent holder shall provide a copy of the documents listed below to the engaged and approved professional:

   - The Taranaki Regional Council final officers report and hearing decision report for applications 5276 and 5277;
   - Consent certificates [including conditions] for consents 5838-2 and 5839-2;
   - The Pond Treatment System Management Plan approved under condition 18 of consent 5838-2; and
   - The Site Practices Management Plan approved under condition 6 of this consent.

9. The consent holder shall prepare and submit a Proposed Implementation Plan for approval to the Chief Executive, Taranaki Regional Council, acting in a certification capacity, within one month of the Odour Assessment Report being approved under condition 8 above.

   The Plan shall include, but not necessarily be limited to, the following:

   a) Management practices and/or control measures proposed to be implemented in association with the composting processes on Pad 1, of which are from the recommendations of the Odour Assessment Report, approved in accordance with condition 8;
   b) Management practices and/or control measures proposed to be implemented in association with the Pond Treatment System, of which are from the recommendations of the Odour Assessment Report, approved in accordance with condition 8;
   c) The reasons for the chosen practices and/or measures identified in accordance with a) and b) above
   d) A timeframe by when each of the practices and/or measures identified in accordance with a) and b) above will be implemented

e) Identification of appropriate management practices to ensure the on-going functionality of any chosen control measures identified in accordance with a) and b) above

10. Operations and activities on site shall be undertaken in accordance with the Proposed Implementation Plan, approved under condition 9 above.

**Dust**

11. The dust deposition rate beyond the boundary of the consent holder's site arising from the discharge shall be less than 4.0 $g/m^2/30$ days.

Note: For the purposes of this condition, the consent holder's site is defined as Sec 34 Pt Sec 4 Blk II Upper Waitara SD.

12. Any discharge to air from the site shall not give rise to any offensive, objectionable, noxious or toxic levels of dust at or beyond the boundary of the consent holder's site, and in any case, total suspended particulate matter shall not exceed 120 $\mu g/m^3$ as a 24 hour average [measured under ambient conditions] beyond the boundary of the consent holder's site.

Note: For the purposes of this condition, the consent holder's site is defined as Sec 34 Pt Sec 4 Blk II Upper Waitara SD.

**Odour**

13. The discharges authorised by this consent shall not give rise to an odour at or beyond the boundary of the consent holder's site that is offensive or objectionable.

Note: For the purposes of this condition:

- The consent holder's site is defined as Sec 34 Pt Sec 4 Blk II Upper Waitara SD; 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.*

**Monitoring**

14. The consent holder shall install a monitoring device that continuously records wind speed and direction in the area of the composting activity. The device shall be capable of logging collected data for at least six months and shall be installed and be operational within three months of the commencement date of this consent.

The data shall be provided telemetrically to the Taranaki Regional Council. If this method is not technically feasible, the data shall be provided to the Taranaki Regional Council at a frequency and a form advised by the Chief Executive, Taranaki Regional Council until such a time it is technically feasible to telemetric the data.

**Odour surveys**

15. The consent holder shall undertake an odour survey within six months of the Plan approved under condition 9 of this consent being implemented and thereafter at yearly intervals during periods when metrological conditions are most likely to result in offsite odour. The methodology for the survey shall be consistent with German Standard VDI 3940 "Determination of Odorants in Ambient Air by Field Inspection", or similar. Prior to the survey being carried out, the methodology shall be approved by the Chief Executive, Taranaki Regional Council, acting in a certification capacity.

    The results of the survey shall be provided to the Chief Executive, Taranaki Regional Council, within three months of the survey being completed.

**Community liaison**

16. The consent holder and the Director – Resource Management, Taranaki Regional Council, or his delegate, shall meet locally as appropriate, six monthly or at such other frequency as the parties may agree, with submitters to the application of this consent and any other interested party at the discretion of the Chief Executive, Taranaki Regional Council, to discuss any matter relating to the exercise of this consent, in order to facilitate ongoing community consultation.

**Incident notification**

17. The consent holder shall keep a permanent record of any incident related to this consent that results, or could result, in an adverse effect on the environment. The consent holder shall make the incident register available to the Taranaki Regional Council on request.

    Details of any incident shall be forwarded to the Taranaki Regional Council immediately. At the grant date of this consent, the Council's phone number is 0800 736 222 [24 hour service].

**Site reinstatement**

18. The consent holder shall prepare a Site Exit Plan which details how the site is going to be reinstated prior to the consent expiring or being surrendered. The Plan shall be submitted for approval to the Chief Executive, Taranaki Regional Council, acting in a certification capacity, at least 3 months prior to this consent expiring or being surrendered.

    The Site Exit Plan shall address, but not necessarily be limited to, the following matters:

    a) How the site will be reinstated so that no raw materials listed or approved under condition 3 of this consent remain on site;

    b) How the site will be reinstated so that no partially decomposed material remains on site;

    c) How any remaining leachate or sludge, resulting from the operation, will be either removed from the site, buried, treated or otherwise to avoid any adverse effects on groundwater or surface water; and

d) Timeframes for undertaking the activities identified in association with a) to c) above.

Note: The requirement of this condition shall not apply if the consent holder applies for a new consent to replace this consent when it expires.

19. The consent holder shall reinstate the site in accordance with the Plan approved under condition 18 above prior to this consent expiring or being surrendered.

**Review**

20. 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 within one month of approving the plan required under condition 9 of this consent and/or 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;

b) To incorporate into the consent any modification to the operation and maintenance procedures or monitoring that may be necessary to deal with any adverse effects on the environment arising from changes in association with condition 9 of this consent; 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 of odour from the site.

Signed at Stratford on 27 May 2010

For and on behalf of
Taranaki Regional Council

_____

**Director-Resource Management**

## Appendix 1 of consent 5839-2

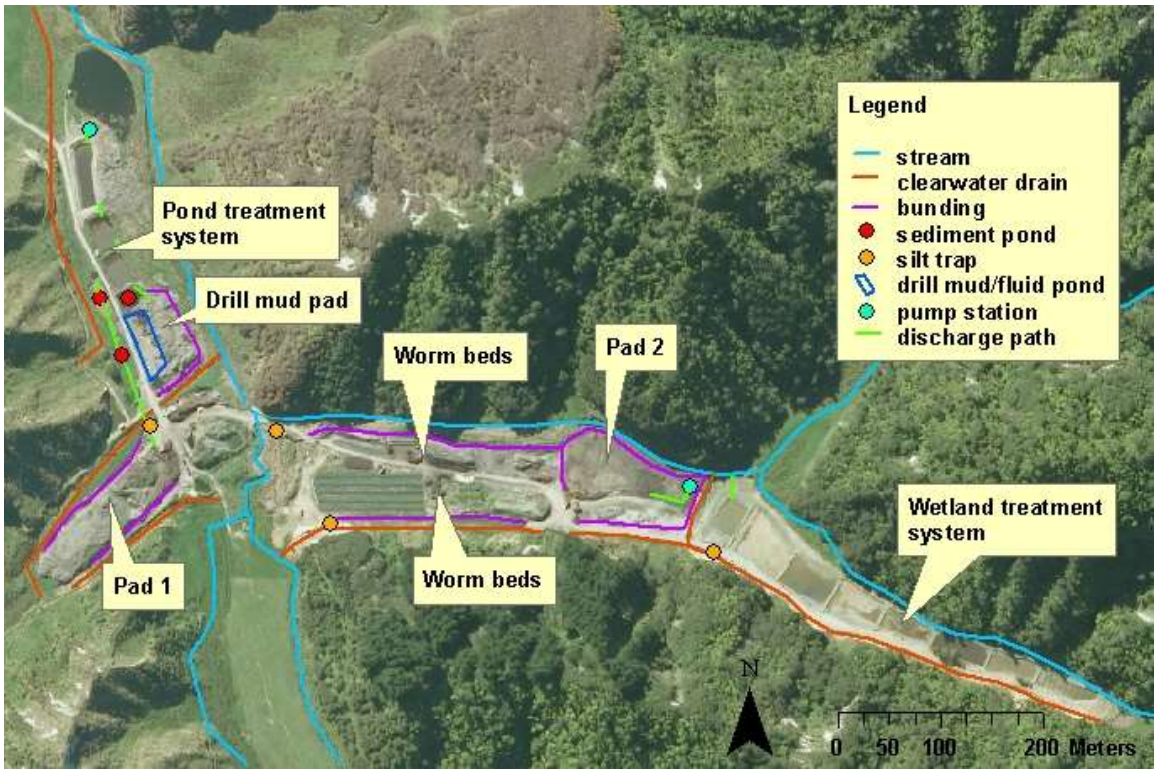


**Figure 1** The location and extent of the composting operation including Pads 1 and 2.

# Land Use Consent

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

| | |
|---|---|
| Name of Consent Holder: | Remediation (NZ) Limited<br>PO Box 8045<br>New Plymouth 4342 |
| Decision Date: | 01 September 2015 |
| Commencement Date: | 01 September 2015 |

## Conditions of Consent

| | |
|---|---|
| Consent Granted: | To use a twin culvert in the Haehanga Stream for vehicle access purposes |
| Expiry Date: | 01 June 2033 |
| Review Date(s): | June 2021 and June 2027 |
| Site Location: | 1460 Mokau Road, Uruti |
| Legal Description: | Sec 34 Pt Sec 4 Blk II Upper Waitara (site of structure) |
| Grid Reference (NZTM) | 1731706E - 5685779N |
| Catchment: | Mimi |
| Tributary: | Haehanga |

*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 all the administration, monitoring and supervision costs of this consent, fixed in accordance with section 36 of the Resource Management Act 1991.

## Special conditions

1. The consent holder shall ensure that the stream bed downstream from the structure is built up with appropriate material before 31 March 2016 to allow for fish passage and from this date forward the structure shall not prevent the passage of fish.

2. The consent holder shall maintain the structure so that:

   (a) it does not become blocked and at all times allows the free flow of water through it;
   (b) any erosion, scour or instability of the stream bed or banks is remedied by the consent holder.

3. 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 2021 and/or June 2027, 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 01 September 2015

For and on behalf of
Taranaki Regional Council

_____

A D McLay
**Director - Resource Management**

# Land Use Consent

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

| | |
|---|---|
| Name of Consent Holder: | Remediation (NZ) Limited<br>P O Box 8045<br>NEW PLYMOUTH 4342 |
| Consent Granted Date: | 26 September 2003 |

## Conditions of Consent

| | |
|---|---|
| Consent Granted: | To realign and divert the Haehanga Stream in the Mimi catchment for land improvement purposes at or about (NZTM) 1732402E-5684777N |
| Expiry Date: | 1 June 2021 |
| Review Date(s): | June 2009, June 2015 |
| Site Location: | 1460 Mokau Road, Uruti |
| Legal Description: | Pt Sec 4 Blk II Upper Waitara SD |
| Catchment: | Mimi |
| Tributary: | Haehanga |

*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 notify the Taranaki Regional Council at least 48 hours prior to and upon completion of any subsequent maintenance works that would involve disturbance of or deposition to the riverbed or discharges to water.

2. The realignment authorised by this consent shall be undertaken generally in accordance with the documentation submitted in support of the application and shall be maintained to ensure the conditions of this consent are met.

3. The consent holder shall adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to avoid or minimise erosion and scouring as a result of channel realignment.

4. The consent holder shall adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to avoid or minimise the discharge of silt or other contaminants into water or onto the riverbed and to avoid or minimise the disturbance of the riverbed and any adverse effects on water quality.

5. The consent holder shall ensure that the area and volume of riverbed disturbance shall, so far as is practicable, be minimised and any areas which are disturbed shall, so far as is practicable, be reinstated.

6. 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 2009 and/or June 2015, 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.

Transferred at Stratford on 22 September 2008

For and on behalf of
Taranaki Regional Council

_____

**Director-Resource Management**

# Land Use Consent

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

| | |
|---|---|
| Name of Consent Holder: | Remediation (NZ) Limited<br>P O Box 8045<br>NEW PLYMOUTH 4342 |
| Consent Granted Date: | 26 September 2003 |

## Conditions of Consent

| | |
|---|---|
| Consent Granted: | To erect, place, use and maintain a culvert and associated structure[s] in the bed of the Haehanga Stream in the Mimi catchment for access purposes at or about (NZTM) 1732402E-5684777N |
| Expiry Date: | 1 June 2021 |
| Review Date(s): | June 2009, June 2015 |
| Site Location: | 1460 Mokau Road, Uruti |
| Legal Description: | Pt Sec 4 Blk II Upper Waitara SD |
| Catchment: | Mimi |
| Tributary: | Haehanga |

*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 notify the Taranaki Regional Council in writing at least 48 hours prior to the commencement and upon completion of removal of the temporary culvert [being the 800mm diameter culvert] and installation of the permanent culvert and associated structures, and again at least 48 hours prior to and upon completion of any subsequent maintenance works which would involve disturbance of or deposition to the riverbed or discharges to water.

2. The consent holder shall replace the existing temporary culvert with a permanent culvert and associated structure[s] by 1 April 2004. Prior to the installation of the permanent culvert and associated structure[s] the consent holder shall forward designs of the proposed culvert and associated structure[s] for the written approval of the Chief Executive.

3. The structures authorised by this consent shall be constructed generally in accordance with the documentation submitted in support of the application and shall be maintained to ensure the conditions of this consent are met.

4. The consent holder shall adopt the best practicable option to avoid or minimise the discharge of silt or other contaminants into water or onto the riverbed and to avoid or minimise the disturbance of the riverbed and any adverse effects on water quality.

5. The consent holder shall ensure that the area and volume of riverbed disturbance shall, so far as is practicable, be minimised and any areas which are disturbed shall, so far as is practicable, be reinstated.

6. The structures, which are the subject of this consent, shall not obstruct fish passage.

7. The structures authorised by this consent shall be removed and the area reinstated if and when the structures are no longer required. The consent holder shall notify the Taranaki Regional Council at least 48 hours prior to structures removal and reinstatement.

8. 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 2009 and/or June 2015, 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.

Transferred at Stratford on 22 September 2008

For and on behalf of
Taranaki Regional Council

_____

**Director-Resource Management**

# Discharge Permit

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

| | |
|---|---|
| Name of Consent Holder: | Remediation New Zealand<br>107 Corbett Road<br>Bell Block 4373 |
| Decision Date: | 09 March 2015 |
| Commencement Date: | 09 March 2015 |

## Conditions of Consent

| | |
|---|---|
| Consent Granted: | To discharge treated stormwater from a quarry site, into an unnamed tributary of the Haehanga Stream |
| Expiry Date: | 01 June 2033 |
| Review Date(s): | June 2021 and/or June 2027 |
| Site Location: | 1460 Mokau Road, Uruti |
| Legal Description: | Sec 34 Pt Sec 4 Blk II Upper Waitara SD (Discharge source & site) |
| Grid Reference (NZTM) | 1732059E-5684796N |
| Catchment: | Mimi |
| Tributary: | Haehanga |

*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 all the administration, monitoring and supervision costs of this consent, fixed in accordance with section 36 of the Resource Management Act 1991.

## Special conditions

1. This consent authorises the discharge of treated stormwater into an unnamed tributary of the Haehanga Stream, as described in the information provided with the application, and specifically:

   a) The Assessment of Environmental Effects prepared by BTW Company Limited dated 9 January 2015; and
   b) Additional Information prepared by BTW Company Limited dated 16 February 2015.

   In the case of any contradiction between the details of information provided and the conditions of this consent, the conditions of this consent shall prevail.

2. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing, at least 48 hours prior to the exercise of this consent (including vegetation removal). Notification shall include:

   a) the consent number;
   b) a brief description of the activity consented; and
   c) the extent or stage of the activity to be commenced.

   Notification shall be emailed to worknotification@trc.govt.nz.

3. 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.

4. The consent holder shall operate and progressively reinstate the quarry site in a manner which ensures that the area of exposed, un-vegetated earth, within the quarry's stormwater catchment is kept to a minimum at all times.

5. The consent holder shall ensure that no area greater than 1 ha is exposed at any one time.

6. The stormwater discharged shall be from a catchment area not exceeding 4 ha.

7. This stormwater treatment system shall be installed before any site works commences.

8. The stormwater treatment system shall be maintained for the life of the quarry operation.

9. All stormwater shall be directed for treatment through the stormwater treatment system prior to discharge into the Haehanga Stream tributary.

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

| Constituent | Standard |
|---|---|
| pH | Within the range 6.0 to 9.0 |
| suspended solids | Concentration not greater than 100 $gm^{-3}$ |
| total hydrocarbons | Concentration not greater than 15 $gm^{-3}$ |

This condition shall apply before entry of the treated stormwater into the receiving waters at a designated sampling point approved by the Chief Executive, Taranaki Regional Council.

11. The pH may exceed 9.0 if the exceedance is a result photosynthetic activity within the detention ponds, but in any case the discharge shall not result in the pH of the receiving water increasing by more than 0.5 pH units after allowing for a mixing zone of 25 metres.

12. After allowing for reasonable mixing, within a mixing zone extending 500 metres downstream of any discharge point, the discharge shall not give rise to any of the following effects in the receiving waters:

    a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
    b) any conspicuous change in the colour or visual clarity;
    c) any emission of objectionable odour;
    d) the rendering of fresh water unsuitable for consumption by farm animals;
    e) any significant adverse effects on aquatic life.

13. After allowing for reasonable mixing, within a mixing zone extending 500 metres downstream of any discharge point, the discharge shall not give rise to any of the following effects in the receiving waters:

    a) an increase in the suspended solids concentration within the unnamed tributary of the Haehanga Stream in excess of 10 grams per cubic metres when the turbidity as measured immediately upstream of the discharge point is equal to or less than 5 NTU (nephelometric turbidity units); or

    b) an increase in the turbidity within the unnamed tributary of the Haehanga Stream of more than 50%, where the stream turbidity measured upstream if the discharge is greater than 5 NTU, as determined using NTU (nephelometric turbidity units).

14. The consent holder shall maintain and regularly update a 'Contingency Plan' that details measures and procedures that will be undertaken to prevent, and to avoid environmental effects from, a spillage or any discharge of contaminants not authorised by this consent. The plan shall be approved by the Chief Executive, Taranaki Regional Council, acting in a certification capacity.

15. The site shall be operated in accordance with a 'Management Plan' prepared by the consent holder and approved by the Chief Executive, Taranaki Regional Council, acting in a certification capacity. The plan shall detail how the site is to be managed to minimise the contaminants that become entrained in the stormwater and shall include as minimum:

    a) the loading and unloading of materials;
    b) maintenance of conveyance systems;
    c) general housekeeping; and
    d) management of the interceptor system.

    A Stormwater Management Plan template is available in the Environment section of the Taranaki Regional Council's web site www.trc.govt.nz.

16. 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 the 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 approval under the Resource Management Act. Notification shall include the consent number, a brief description of the activity consented and an assessment of the environmental effects of any changes, and be emailed to consents@trc.govt.nz.

17. This consent shall lapse on 31 March 2020, 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.

18. 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 2021 and/or June 2027, 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 09 March 2015

For and on behalf of
Taranaki Regional Council

A D McLay
**Director - Resource Management**

# Discharge Permit

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

| | |
|---|---|
| Name of Consent Holder: | Remediation (NZ) Limited<br>P O Box 8045<br>NEW PLYMOUTH 4342 |
| Consent Granted Date: | 7 September 2006 |

## Conditions of Consent

| | |
|---|---|
| Consent Granted: | To discharge stormwater from worm farming operations onto and into land and into an unnamed tributary of the Waiongana Stream at or about (NZTM) 1705949E-5679907N |
| Expiry Date: | 1 June 2020 |
| Review Date(s): | June 2008, June 2014 |
| Site Location: | 96 Waitara Road, Brixton, Waitara |
| Legal Description: | Lot 1 DP 19670 Blk III Paritutu SD |
| Catchment: | Waiongana |

*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. This consent shall be exercised generally in accordance with the information submitted in support of applications 1559 and 4037. In the case of any contradiction between the documentation submitted in support of applications 1559 and 4037 and the conditions of this consent, the conditions of this consent shall prevail.

2. At all times the consent holder shall adopt the best practicable option, as defined in section 2 of the Act, to prevent or minimise any actual or likely adverse effect on the environment associated with worm farming activities and the discharge of stormwater onto and into land.

3. Within three months of granting of this consent the consent holder shall prepare and maintain a stormwater management plan to the satisfaction of the Chief Executive, Taranaki Regional Council. This plan shall be updated as required by any significant changes to plant processes.

4. The consent holder shall keep and make available to the Chief Executive, Taranaki Regional Council, upon request, records of the nature and volume of all wastes received at the site; such records to be kept for at least 12 months.

5. The exercise of this consent shall not result in any contamination of groundwater or surface water, other than as provided for in special condition 6 of this consent.

6. The stormwater treatment system shall be maintained to the satisfaction of the Chief Executive, Taranaki Regional Council.

   The following concentrations shall not be exceeded within the discharge effluent:

| **Component** | **Concentration** |
|---|---|
| pH (range) | 6.5-8.5 |
| suspended solids | 100 $gm^{-3}$ |

This condition shall apply prior to any stormwater prior to leaving the site into the neighbouring drain, at a designated sampling point approved by the Chief Executive, Taranaki Regional Council.

7. After allowing for reasonable mixing, with a mixing zone extending seven times the width of the receiving waters downstream of the discharge point, the discharge shall not give rise to any of the following effects in the receiving waters of the unnamed tributary:

   a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
   b) any conspicuous change in the colour or visual clarity;
   c) any emission or objectionable odour;
   d) the rendering of fresh water unsuitable for consumption by farm animals;
   e) any significant adverse effects on aquatic life.

8. The consent holder shall ensure that except when discharging, windrows shall be covered at all times.

9. Prior to undertaking any alterations to the processes or operations which significantly change the nature or quantity of contaminants emitted from the site, the consent holder shall consult with the Chief Executive, Taranaki Regional Council, and shall obtain any necessary approvals under the Resource Management Act 1991.

10. The Chief Executive, Taranaki Regional Council, shall be advised in writing at least 48 hours prior to the reinstatement of the site and the reinstatement shall be carried out so as to minimise effects on stormwater quality, and to meet the criteria of Tables 4.11, 4.14 & 4.20 of the Ministry for the Environment (1999) document 'Guidelines for Assessing & Managing Petroleum Hydrocarbon Contaminated sites in N.Z.'.

11. 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 2008 and/or June 2014, 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.

Transferred at Stratford on 22 September 2008

For and on behalf of
Taranaki Regional Council

_____

**Director-Resource Management**

# Discharge Permit

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

| | |
|---|---|
| Name of Consent Holder: | Remediation (NZ) Limited<br>P O Box 8045<br>NEW PLYMOUTH 4342 |
| Consent Granted Date: | 12 October 2006 |

## Conditions of Consent

| | |
|---|---|
| Consent Granted: | To discharge solid hydrocarbon exploration drilling wastes onto land for worm farming operations and to discharge stormwater from worm farming operations onto and into land and into an unnamed tributary of the Waitara River at or about (NZTM) 1706208E-5679875N |
| Expiry Date: | 1 June 2021 |
| Review Date(s): | June 2009, June 2015 |
| Site Location: | 6 Pennington Road, Waitara |
| Legal Description: | Lot 1 DP 18170 Blk V Waitara SD |
| Catchment: | Waitara |

*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 exercise of this consent shall be undertaken generally in accordance with the documentation submitted in support of applications 1560 and 4038. In the case of any contradiction between the documentation submitted in support of applications 1560 and 4038 and the conditions of this consent, the conditions of this consent shall prevail.

2. At all times the consent holder shall adopt the best practicable option, as defined in section 2 of the Act, to prevent or minimise any actual or likely adverse effect on the environment associated with worm farming activities and the discharge of solid hydrocarbon exploration drilling wastes onto land including effects to surface water and groundwater.

3. The consent holder shall keep and make available to the Chief Executive, Taranaki Regional Council, upon request, records of the nature and volume of all wastes received at the site; such records to be kept for at least 12 months.

4. The solid drilling cuttings from hydrocarbon exploration shall not exceed a maximum hydrocarbon content of 5.0% total petroleum hydrocarbon prior to mixing or incorporation

5. The exercise of this consent shall not result in any contamination of groundwater or surface water, other than as provided for in special conditions 7 and 8 of this consent.

6. The stormwater treatment system shall be maintained to the satisfaction of the Chief Executive, Taranaki Regional Council.

7. The following concentrations shall not be exceeded within the discharge effluent:

| **Component** | **Concentration** |
|---|---|
| pH (range) | 6.5-8.5 |
| suspended solids | 100 $gm^{-3}$ |
| total recoverable hydrocarbons [infrared spectroscopic technique] | 15 $gm^{-3}$ |

This condition shall apply prior to the entry of the stormwater into the receiving waters of the unnamed tributary, at a designated sampling point approved by the Chief Executive, Taranaki Regional Council.

8. After allowing for reasonable mixing within a mixing zone extending downstream of the discharge point to the Pennington Road culvert the discharge shall not give rise to any of the following effects in the receiving waters of the unnamed tributary:

   a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
   b) any conspicuous change in the colour or visual clarity;
   c) any emission of objectionable odour;
   d) the rendering of fresh water unsuitable for consumption by farm animals;
   e) any significant adverse effects on aquatic life.

9. That prior to undertaking any alterations to the processes or operations which significantly change the nature or quantity of contaminants emitted from the site, the consent holder shall consult with the Chief Executive, Taranaki Regional Council, and shall obtain any necessary approvals under the Resource Management Act 1991.

10. The Chief Executive, Taranaki Regional Council, shall be advised in writing at least 48 hours prior to the reinstatement of the site and the reinstatement shall be carried out so as to minimise effects on stormwater quality, and to meet the criteria of Tables 4.11, 4.14 & 4.20 of the Ministry for the Environment (1999) document 'Guidelines for Assessing & Managing Petroleum Hydrocarbon Contaminated sites in N.Z.'.

11. 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 2009 and/or June 2015, 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.

Transferred at Stratford on 22 September 2008

For and on behalf of
Taranaki Regional Council

_____

**Director-Resource Management**

# Appendix II

# Biomonitoring reports

| | |
|---|---|
| To | Scott Cowperthwaite, Job Manager |
| From | Bart Jansma; Scientific Officer |
| Report No | BJ258 |
| Document No | 1545047 |
| Date | 24 July 2015 |

# Biomonitoring of the Haehanga Stream in relation to discharges from the Remediation (NZ) Limited composting site at Uruti, January 2015

## Introduction

Remediation (NZ) Ltd operates a composting facility in the Haehanga Valley, Uruti (previously owned by Perry Environmental Ltd who was preceded by Global Vermiculture Ltd). Raw materials are trucked to the site for composting, on a purpose built composting pad for a period of 35-40 days. Synthetic hydrocarbon contaminated drilling muds and cuttings are also received on site. They are piled up and the liquids are allowed to drain, then blended with green waste and other organic matter. Composted material is transported off site by trucks to Remediation (NZ) Ltd's worm farming operations at Waitara Road and Pennington Road.

This survey was the only survey scheduled for the 2014-2015 monitoring year. At the time of this survey, there were two composting pads. The south-west pad (referred to as composting pad 1 in this report) has been established and operating for some years, and is where the synthetic muds are blended with green waste and other organic matter. A second pad northeast of the original composting pad, which became operational in the summer of 2005 is referred to as composting pad 2.

Both composting pads are bunded, with all surface stormwater and leachate contained and directed to treatment ponds. Water from the settling pond is recycled back to the composting material if and when required to maintain a moist composting environment. The runoff from composting pad 1 is treated in the series of ponds. Between each pond, there is a baffle that skims off any floating hydrocarbons as the leachate passes through. The treated liquid in the final pond, located just upstream of site 5 (HHG000115), is then irrigated to pasture. This irrigation system was installed prior to the November 2005 biological survey.

Prior to February 2008, no discharges of stormwater or leachate directly entered the Haehanga Stream or its tributaries. However, after that date, the site has since been permitted to discharge treated stormwater and compost leachate to the unnamed tributary of the Haehanga Stream. This comes from composting pad 2, where leachate is pumped up to the top of a seven tier wetland, which was constructed in late 2007. Under dry conditions the wetland water from the bottom pond of the wetland is reticulated back to the upper tier of the wetland. Under high flow conditions the wetland discharges to a tributary of the Haehanga Stream.

In addition to this discharge from the wetland, there is some potential for seepage from the composting pads and irrigation area to enter groundwater, and for stormwater runoff to escape the collection system, and thus gravitate toward the surface watercourses at the site.

A baseline survey of five sites was conducted in October 2002 in relation to the composting operation (Dunning, 2003). At the time of this earlier survey, only composting pad 1 was operational, and sites were established for both the existing and proposed composting pads. Unnamed tributaries of the Haehanga Stream flow adjacent to (and down gradient of) both composting pads and flow into the Haehanga Stream downstream of the composting areas (Figure 1). Since this baseline survey, significant changes have occurred on site, leading to sampling sites being moved, or sampling at some sites to be discontinued. Any changes to sampling sites made prior to the current survey have been discussed in previous reports, referenced below

The current biological survey was conducted to monitor the effects of discharges from the composting site to the Haehanga Stream and tributaries in relation to composting areas (pads 1 & 2), the irrigation of treated liquid to land, and the discharge of treated stormwater and leachate to the unnamed tributary. In the May 2012 survey an additional site was included (HHG000150), at the downstream extent of the irrigation area. This site is now referred to as site 6, with HHG000112 now referred to as site 5. This constitutes a change, as HHG000112 was previously referred to as site 6.

## Methods

Two different sampling techniques were used to collect streambed macroinvertebrates in this survey. The 'vegetation sweep' sampling technique was used at sites 1, 2 and 7, and the Council's standard 'streambed kick' sampling technique was used at site 6. A combination of the 'streambed kick' and 'vegetation sweep' sampling techniques was used at sites T2, T3 and 5 (Table 1). The 'streambed kick' and 'vegetation sweep' techniques are very similar to Protocol C1 (hard-bottomed, semi-quantitative) and C2 (soft-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark *et al*, 2001).

Two of the sites surveyed were previously established in the baseline survey (sites 1 and 2) (Dunning, 2003). Site T2 and T3 were sampled for the eighth time during the current survey, while site 5 has been sampled since January 2005 and site 7 since February 2007. Site 6 was sampled for the fifth time in the current survey.

**Table 1** Biomonitoring sites in the Haehanga Stream catchment

| Site | Site Code | Location | Sampling Method |
|---|---|---|---|
| 1 | HHG000093 | Upstream of extended irrigation area | Vegetation sweep |
| 2 | HHG000100 | Downstream of extended irrigation area | Vegetation sweep |
| T2 | HHG000098 | Upstream of wetland discharge point | Kick-sweep |
| T3 | HHG000103 | Downstream of wetland discharge point | Kick-sweep |
| 5 | HHG000115 | 25 m downstream of last pond and swale collection area | Kick-sweep |
| 6 | HHG000150 | 30 m downstream of lower irrigation area | Streambed Kick |
| 7 | HHG000190 | 50 metres upstream of State Highway 3 bridge | Vegetation sweep |

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. |

Stark (1985) developed a scoring system for macroinvertebrate taxa according to their sensitivity to organic pollution in stony New Zealand streams (MCI). Recently, a similar scoring system has been developed for macroinvertebrate taxa found in soft bottomed streams (Stark and Maxted, 2004, 2007) (SBMCI). The SBMCI has been used in a number of biomonitoring reports since its inception, and results to date suggest that it is not as effective at assessing the impacts of organic pollution as the MCI. For example, results from the February 2008 Mangati survey found a relatively unchanged SBMCI score at a site which had thick growths of sewage fungus (Jansma, 2008c). Therefore this index is considered less appropriate for the assessment of macroinvertebrate communities possibly affected by industrial discharges. Any subsequent reference to MCI refers to the MCI.

Highly 'sensitive' taxa were assigned the highest scores of 9 or 10, while the most 'tolerant' forms scored 1 and 0.1 in hard bottomed and soft bottomed streams respectively. The sensitivity scores for certain taxa found in hard bottomed streams have been modified in accordance with Taranaki experience. By averaging the scores obtained from a list of taxa taken from one site and multiplying by a scaling factor of 20, a Macroinvertebrate Community Index (MCI) value was obtained. The MCI is a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. More 'sensitive' communities inhabit less polluted waterways.

A gradation of biological water quality conditions based upon MCI ranges has been adapted for Taranaki streams and rivers from Stark's classification (Stark, 1985 and Boothroyd & Stark, 2000). This is as follows:

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

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


**Figure 1** Location of biomonitoring sites in the Haehanga Stream catchment

Sub-samples of algal and detrital material 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 is an indicator of organic enrichment within a stream.

## Results and Discussion

During the present survey, water temperatures in the Haehanga Stream catchment ranged from 19.7°C to 25.5°C, although later in the day, a temperature of 28.3°C was recorded. This is outside of the upper thermal tolerances of some macroinvertebrate taxa, including some occasionally recorded in the Haehanga Stream catchment (Quinn et al, 1994)). This survey was undertaken in summer, when flows in the catchment were low to very low. The flow was yellow and cloudy at all sites sampled in the current survey. This cloudiness is typical of the Haehanga Stream, with associated brown discolouration. This cloudiness and discolouration is primarily caused through tannins and suspended solids entering via groundwater and tributary inflows, rather than a point source discharge from the wormfarm. However, at times tannins are also provided through the wetland discharge, which can also result in some discolouration. During the current survey only a very small discharge was leaving the wetland. This discharge was not recorded in the discharge log kept by the consent holder, with this log indicating that no discharge had occurred since 1 December 2014.

Due to the low flows, riffle habitat was only available for sampling at site 6. The substrate at site 6 comprised predominantly of coarse gravels, with fine gravel and cobbles, which enabled the 'streambed kick' sampling technique to be employed. The remaining sites were sampled using either the 'vegetation sweep' sampling technique, or a combination of the 'vegetation sweep' and 'streambed kick' sampling techniques. The underlying substrate at these sites comprised predominantly of silt, with the addition of some hard substrate, including either hard clay, gravels or wood and root.

All sites supported aquatic vegetation, and this growth was observed at the edges of the stream at sites T2, T3, 2 and 6, and throughout the stream at the remaining three sites. Sites 1, 5 and 7 supported only patchy growths of filamentous algae while sites 2, T2 and T3 had only a slippery algal film on the substrate. Site 6 had algal mats in patches and widespread growths of filamentous algae.

No undesirable heterotrophic growths were recorded at any of the seven sites in this survey.

Of concern was the release of hydrocarbons from the sediment when this sediment was disturbed. This was noted only at site 7, while undertaking a fish survey on the same day.

### Macroinvertebrate communities

Only a small number of macroinvertebrate surveys have been conducted at these sites. Monitoring has been conducted in other small lowland hill country streams in Taranaki surveyed at similar altitudes (TRC, 1999 (statistics updated 2014)) and these have been compared with the current results in Table 2. Table 2 gives summary statistics for the sites, while Table 3 provides a complete taxa list for the current survey.

**Table 2** Number of taxa, MCI and $SQMCI_S$ values recorded in the Haehanga Stream catchment together with a summary of results from control sites in other small lowland hill country streams (LOWL) between 25-49 MASL, in Taranaki (TRC, 1999) (Updated to October 2014).

| Site | Number of previous surveys | Numbers of taxa | | | MCI values | | | $SQMCI_S$ values | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Median | Range | Current | Median | Range | Current | Median | Range | Current |
| LOWL* | 19 | 22 | 18-30 | - | 78 | 68-109 | - | 4.0 | 2.7-6.1 | - |
| 1 | 10 | 22 | 19-25 | 27 | 71 | 68-78 | 73 | 3.9 | 2.7-4.2 | 3.6 |
| 2 | 18 | 19 | 17-23 | 23 | 74 | 62-87 | 80 | 4.0 | 2.7-4.4 | 3.8 |
| T2 | 7 | 22 | 20-30 | 24 | 84 | 79-92 | 90 | 4.0 | 4.6-5.5 | 6.2 |
| T3 | 7 | 26 | 24-32 | 32 | 83 | 78-93 | 81 | 4.4 | 3.5-5.4 | 4.3 |
| 5 | 17 | 19 | 6-28 | 23 | 72 | 53-83 | 77 | 2.8 | 1.1-4.1 | 3.4 |
| 6 | 4 | 21 | 16-24 | 20 | 72 | 68-79 | 73 | 3.0 | 2.9-3.1 | 1.7 |
| 7 | 13 | 20 | 12-30 | 23 | 71 | 62-82 | 67 | 3.2 | 1.3-4.3 | 3.8 |

*$SQMCI_S$ median and range based on only 18

### Site 1 – Upstream of expanded irrigation area

This site, sampled intermittently since 2002, was re-introduced to the monitoring programme in 2010, prior to the irrigation of wastewater onto land between sites 1 and 2. Irrigation on this land has since occurred, and as such site 1 becomes the upstream control site, and site 2 becomes an impact site.

A moderately high taxa richness was recorded at this site (27), which was five taxa more than the median, and the highest richness recorded at this site to date. The community comprised a relatively high proportion of tolerant taxa (67%) which resulted in a 'poor' MCI score of 73 units. This is five units higher than the minimum score recorded previously at this site and two units above the median score. Although this is a 'poor' score, it is a reflection of the low and slow flows and vegetation habitat sampled. This score is not dissimilar to the median MCI score for other similar lowland streams, indicating that although this score is low, it is relatively typical for streams of this nature.

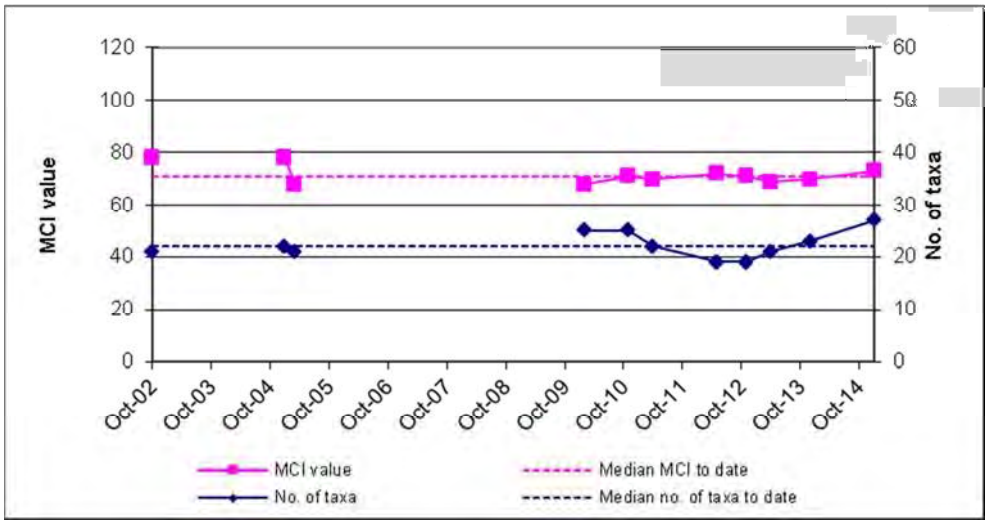


**Figure 2** Taxa numbers and MCI recorded to date at site 1

The community was dominated by an extremely abundant and 'tolerant' taxon, (snail (*Potamopyrgus*). Other dominant 'tolerant' taxa included oligochaete worms, snail (*Physa*), seed shrimps (Ostracoda), damselfly larvae (*Xanthocnemis*) and Empidid midge larvae). One 'sensitive' taxon was also abundant, the amphipod (*Paracalliope*). The dominance of 'tolerant' taxa resulted in a low $SQMCI_S$ score of 3.6 units, 0.2 unit higher than the previous survey but within the range of previously recorded scores (Table 2). It was also not significantly different

to the median for other sites in similar small lowland streams.

Overall, this indicates that the water quality of the Haehanga Stream prior to it flowing into the Remediation NZ composting site was of average quality, and that the community was strongly influenced by the low and slow flows, and the shallow gradient of this stream.

**Site 2 – Downstream of extended irrigation area**

At site 2 in the Haehanga Stream, upstream of all composting areas, 23 macroinvertebrate taxa were recorded. This was four taxa more than that recorded in the previous survey and the median for this site (Table 2). The community was dominated by four 'tolerant' taxa, (snails (*Physa* and *Potamopyrgus*), ostracod seed shrimp and damselfly larvae (*Xanthocnemis*)), and one 'sensitive' taxon, (stick cased caddisfly (*Triplectides*)) (Table 3).

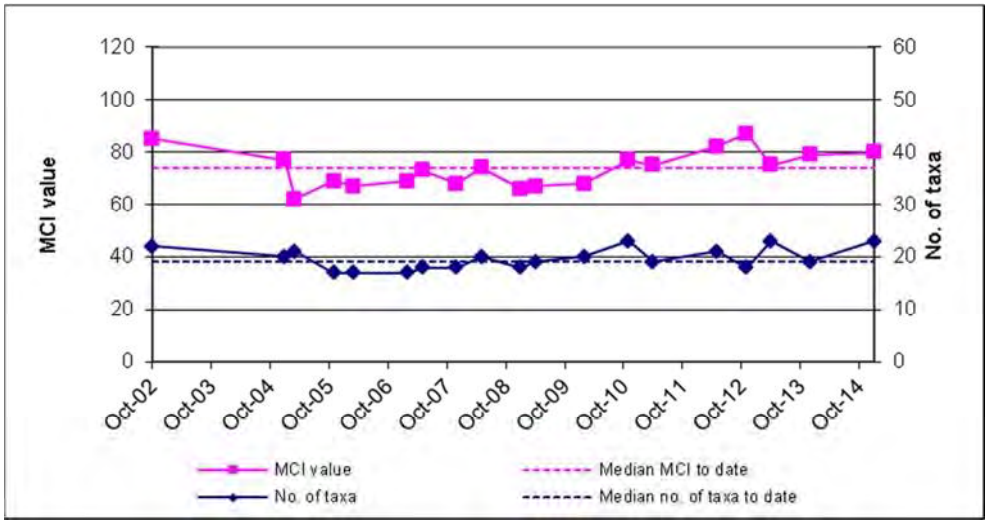


**Figure 3** Taxa numbers and MCI recorded to date at site 2

The MCI value of 80 units reflected a moderate proportion of sensitive taxa in the community at this site (43%). However, this result is better than typical for this site, being six units higher than the median for this site (Table 2). It was also similar to that recorded in the previous summer survey (Figure 3). The $SQMCI_S$ value at this site (3.8) was slightly less than the median value, and reflected the fact that the community supported an extremely abundant population of *Potamopyrgus* snails (Table 2,Table 3).

The results from this survey indicate a 'poor' community, similar to that recorded in most previous surveys. This is not surprising when the available habitat is considered. Habitat was considered poor during the current survey, as there was little flow. Overall, it is apparent that the primary influence on the community is the very low flow observed at the time of the survey. The fact that one 'sensitive' taxon was recorded in abundance is supportive of the conclusion of reasonable preceding water quality with no discernible impacts from the irrigation of wastewater to land between sites 1 and 2.

**Table 3** Macroinvertebrate fauna of the Haehanga Stream catchment, sampled in relation to Remediation (NZ) Ltd on 8 January 2015.

| Taxa List | Site Number | MCI score | Site 1 | Site 2 | Site5 | Site 6 | Site 7 | Site T2 | Site T3 |
|---|---|---|---|---|---|---|---|---|---|
| | Site Code | | HHG000093 | HHG000100 | HHG000115 | HHG000150 | HHG000190 | HHG000098 | HHG000103 |
| | Sample Number | | FWB15009 | FWB15010 | FWB15011 | FWB15012 | FWB15013 | FWB15014 | FWB15015 |
| PLATYHELMINTHES | *Cura* | 3 | R | - | - | - | - | - | - |
| NEMERTEA | Nemertea | 3 | R | - | - | - | - | - | - |
| NEMATODA | Nematoda | 3 | R | - | - | - | - | - | - |
| ANNELIDA | Oligochaeta | 1 | A | R | A | XA | C | - | A |
| | Lumbricidae | 5 | R | - | R | R | - | R | - |
| HIRUDINEA | Hirudinea | 3 | R | - | - | - | - | - | - |
| MOLLUSCA | *Gyraulus* | 3 | - | - | - | - | A | - | - |
| | Lymnaeidae | 3 | R | - | - | - | - | - | - |
| | *Physa* | 3 | A | VA | C | - | VA | C | C |
| | *Potamopyrgus* | 4 | XA | XA | VA | R | XA | A | A |
| | Sphaeriidae | 3 | C | - | - | - | - | - | - |
| CRUSTACEA | Copepoda | 5 | - | R | - | - | - | - | - |
| | Cladocera | 5 | - | - | - | - | R | - | - |
| | Ostracoda | 1 | VA | A | C | C | A | - | C |
| | *Paracalliope* | 5 | VA | R | C | - | R | XA | C |
| | *Paranephrops* | 5 | - | - | - | - | - | R | - |
| EPHEMEROPTERA | *Austroclima* | 7 | R | R | - | - | - | - | - |
| | *Deleatidium* | 8 | - | R | C | A | - | XA | - |
| | *Zephlebia group* | 7 | R | R | - | - | - | XA | A |
| PLECOPTERA | *Acroperla* | 5 | - | - | - | - | - | R | - |
| ODONATA | *Xanthocnemis* | 4 | VA | VA | A | - | A | R | R |
| | *Aeshna* | 5 | R | - | - | - | - | - | - |
| | *Hemicordulia* | 5 | R | - | - | - | - | - | - |
| HEMIPTERA (BUGS) | *Anisops* | 5 | - | - | - | - | R | R | VA |
| | *Microvelia* | 3 | - | R | - | - | R | R | R |
| | *Saldula* | 5 | R | - | - | - | R | - | R |
| | *Sigara* | 3 | - | - | - | R | C | - | A |
| COLEOPTERA | Dytiscidae | 5 | - | - | R | - | - | A | A |
| | Hydrophilidae | 5 | C | R | R | - | R | - | C |
| | Ptilodactylidae | 8 | - | - | - | R | - | R | - |
| | Scirtidae | 8 | - | - | - | - | - | - | R |
| TRICHOPTERA | *Hydrobiosis* | 5 | - | R | R | R | - | - | R |
| | *Polyplectropus* | 6 | - | - | R | - | - | A | VA |
| | *Psilochorema* | 6 | - | - | R | R | - | C | A |
| | *Oxyethira* | 2 | C | R | R | R | R | - | - |
| | *Paroxyethira* | 2 | C | C | R | - | A | - | - |
| | *Triplectides* | 5 | R | A | R | - | VA | - | R |
| DIPTERA | *Paralimnophila* | 6 | - | - | - | - | - | - | R |
| | *Chironomus* | 1 | - | - | - | C | C | - | C |
| | *Corynoneura* | 3 | C | C | - | - | - | R | R |
| | Orthocladiinae | 2 | R | C | A | XA | A | A | A |
| | *Polypedilum* | 3 | R | - | A | R | C | VA | A |
| | Tanypodinae | 5 | - | R | - | R | R | - | R |
| | Tanytarsini | 3 | - | - | - | - | R | - | - |
| | Culicidae | 3 | - | - | C | C | - | A | A |
| | Dolichopodidae | 3 | - | - | - | R | - | - | - |
| | *Paradixa* | 4 | R | C | R | - | R | A | A |
| | Empididae | 3 | A | R | C | R | C | C | R |
| | Muscidae | 3 | - | - | - | C | - | R | R |
| | Sciomyzidae | 3 | - | - | - | - | - | - | R |
| | *Austrosimulium* | 3 | - | R | A | A | - | A | VA |
| | Stratiomyidae | 5 | - | - | - | - | - | - | R |
| | Tanyderidae | 4 | - | - | R | R | - | - | - |
| ACARINA | Acarina | 5 | - | C | - | - | - | R | R |
| | No of taxa | | 27 | 23 | 23 | 20 | 23 | 24 | 32 |
| | MCI | | 73 | 80 | 77 | 73 | 67 | 90 | 81 |
| | SQMCIs | | 3.6 | 3.8 | 3.4 | 1.7 | 3.8 | 6.2 | 4.3 |
| | EPT (taxa) | | 3 | 5 | 5 | 3 | 1 | 5 | 5 |
| | %EPT (taxa) | | 11 | 22 | 22 | 15 | 4 | 21 | 16 |
| 'Tolerant' taxa | 'Moderately sensitive' taxa | | | | 'Highly sensitive' taxa | | | | |

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

**Site T2 – upstream of the wetland discharge**

Twenty-four macroinvertebrate taxa were recorded at site T2 in an unnamed tributary of the Haehanga Stream, upstream of the wetland discharge point. This was a similar to the median richness for this site and for control sites in similar streams (Table 2, Figure 4). However, it was six taxa fewer than that recorded in the previous survey. Good water quality had preceded this survey, as indicated by the presence of two 'highly sensitive' taxa in the community, and the abundance of numerous 'sensitive' taxa.

The taxa which dominated this community were different to that at site 2. Only one taxon, 'tolerant' snails (*Potamopyrgus*) was abundant at both sites 2 and T2. Other 'tolerant' taxa recorded in abundance at T2 were sandfly larvae (*Austrosimulium*), midge larvae (orthoclads, *Polypedilum* and *Paradixa*) and mosquito larvae (Culicidae). Four 'moderately sensitive' taxa were also recorded in abundance (amphipods (*Paracalliope*), mayflies (*Zephlebia* group), dytiscid beetles and caddisfly larvae (*Polyplectropus*)), as was one 'highly sensitive' taxon (mayfly (*Deleatidium*)) (Table 3).

This community had a moderate MCI score (90) compared to sites 1 and 2, reflecting the improved proportion of sensitive taxa present (50%). This MCI score is twelve units higher than the median MCI score for control sites in similar streams, three units higher than that recorded in the previous survey. The $SQMCI_S$ value of 6.2 was good for this type of stream, and significantly higher than the median for control sites in other lowland streams at a similar altitude (TRC, 1999). It is also the highest $SQMCI_S$ value recorded at any site included in this survey to date, due primarily to the extreme abundance of 'highly sensitive' *Deleatidium*.

This stream typically has better MCI and $SQMCI_S$ scores than the Haehanga Stream sites, and it is considered that this is a direct reflection of the difference in headwater character. Site T2 is located near to the source of this stream, which rises from a swampy spring, and flows through a short channel which is well shaded. In contrast, sites 1 and 2 in the Haehanga Stream are located in excess of 1.5 km downstream of the source of this stream, below which the stream is relatively unshaded and unprotected.

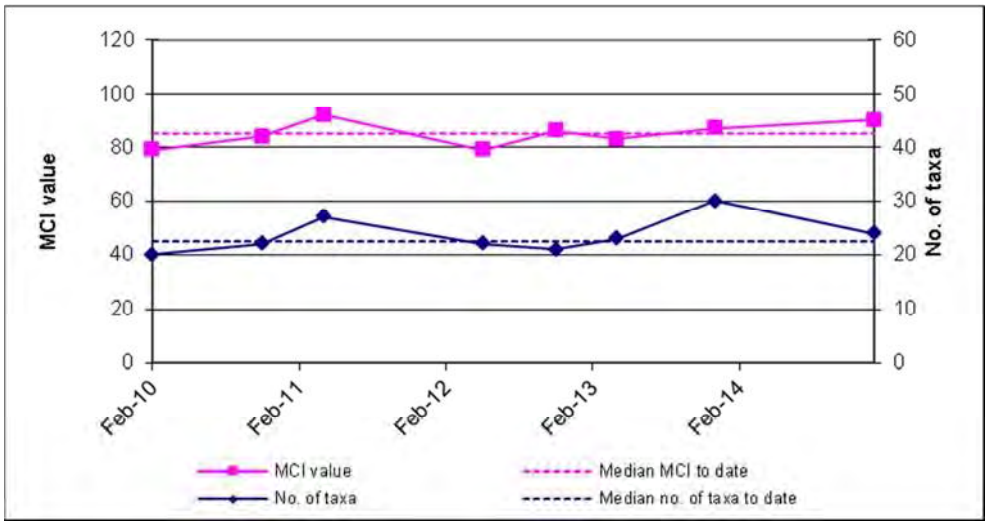


**Figure 4** Taxa numbers and MCI recorded to date at site T2

**Site T3 – downstream of the wetland discharge point**

This is the eighth time that macroinvertebrates have been sampled at this site, located approximately 20 metres downstream of the wetland discharge. Thirty-two taxa were recorded at this site. This is eight taxa more than what was recorded in the previous survey and that recorded upstream at site T2 (Table 2, Figure 5).

The community was characterised by five 'moderately sensitive' taxa; (mayfly (*Zephlebia* group), backswimmer (*Anisops*), dytiscid beetles and free-living caddis (*Polyplectropus* and *Psilochorema*)), and eight 'tolerant' taxa, (oligochaete worms, snails (*Potamopyrgus*), water boatman (*Sigara*), midge larvae (orthoclads, *Polypedilum* and *Paradixa*) and sandfly larvae (*Austrosimulium*)) (Table 3). This site had a slightly higher proportion of sensitive taxa (53 %) than site T2 upstream, resulting in the reduced MCI score (81). Although this is not a statistically significant result (Stark, 1998), it is a reduction, and suggests some impact from the wetland discharge. This conclusion is supported by some changes in communities, including the significant increase in the abundance of *Chironomus* bloodworms and oligochaete worms, and the significant decrease in abundance of the highly sensitive mayfly *Deleatidium*. These changes in community also resulted in a significant decrease in $SQMCI_S$ score (of 1.9 units) between site T2 and T3. The $SQMCI_S$ score of 4.3 was an insignificant (Stark, 1998) 0.1 unit less than the median for this site and an insignificant 0.3 unit higher than the median $SQMCI_S$ score for similar streams at comparative altitudes (TRC, 1999).

Although the changes in community are a likely reflection that there were some impacts from the discharge, there are certain changes in taxa presence/absence that indicate that there is also a significant influence from the instream habitat. For example, site T3 recorded boatman (*Sigara*) and ostracod seed shrimps, which inhabit slow to still water, a habitat not typically inhabited by *Deleatidium* mayfly, which was absent at site T3 (but extremely abundant at site T2). In addition, the number of 'sensitive' taxa actually increased by three taxa at site T3. Overall, these observations indicate that the discharge occurring at the time of this survey was having only a subtle impact on the communities of this stream.

Some previous water quality results indicate that unionised ammonia concentrations in the unnamed tributary have at times been toxic enough to reduce the abundance of, or eliminate entirely, some of the sensitive species usually found in this stream. Results of sampling undertaken in the year prior to this survey show that most samples contained concentrations of unionised ammonia below the toxicity threshold of 0.025 $g/m^3$, with the only exception to this being a sample collected on 24 September 2014, which recorded a concentration of 0.065$g/m^3$. This shows good management of the unionised ammonia concentrations in the effluent being discharged. However, should unionised ammonia concentrations return to high levels in the winter period, an additional macroinvertebrate survey at this time may be warranted. At the very least, the water quality monitoring will need to continue so as to assist with the interpretation of macroinvertebrate results.

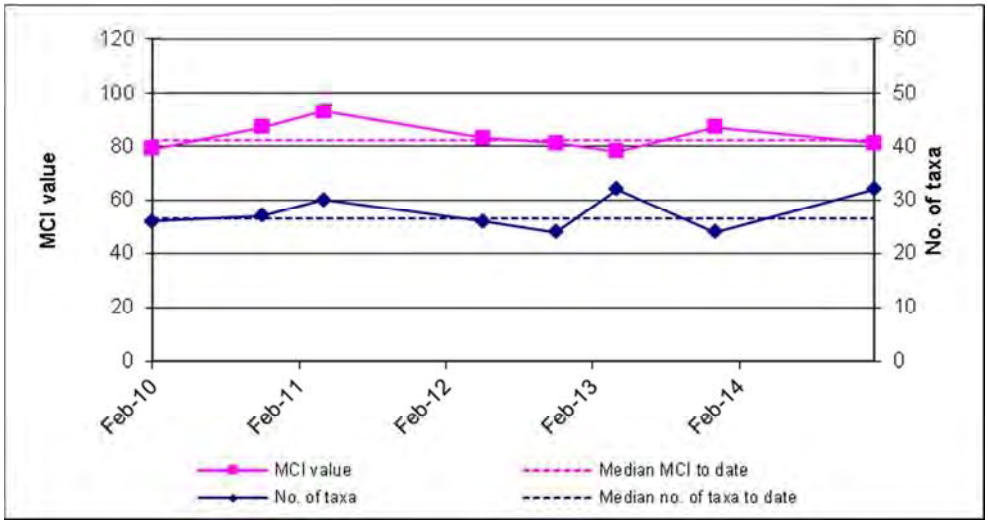


**Figure 5** Taxa numbers and MCI recorded to date at site T3

### Site 5 – downstream of all pond discharges

At site 5 in the Haehanga Stream, 25 m downstream of all wastewater ponds, 23 taxa were recorded, five taxa more than the median of the seventeen previous surveys (Table 2, Figure 3). Six 'tolerant' taxa dominated the community at this downstream site (oligochaete worms, snails (*Potamopyrgus*), damselfly larvae (*Xanthocnemis*), midge larvae (orthoclads and *Polypedilum*) and sandfly larvae (*Austrosimulium*). Unlike the previous survey, no 'moderately sensitive' taxa were recorded in abundance (Table 3). The numerical dominance of very abundant 'tolerant' *Potamopyrgus* snails, coupled with a number of abundant but more 'tolerant' taxa resulted in a $SQMCI_S$ score of 3.4 units, a statistically insignificant 0.6 unit higher than the median for this site, but 0.4 unit less than that recorded at site 2 (Stark, 1998). The MCI score (77) was a only 5 units greater than the median score for this site, six units less than that recorded in the previous survey (Figure 6), and three units less than that recorded at site 2 upstream in the current survey. This is a reflection of the decreased proportion of 'sensitive' taxa in the community (39 %), which was 4% lower than at the upstream site 2 (Table 2).

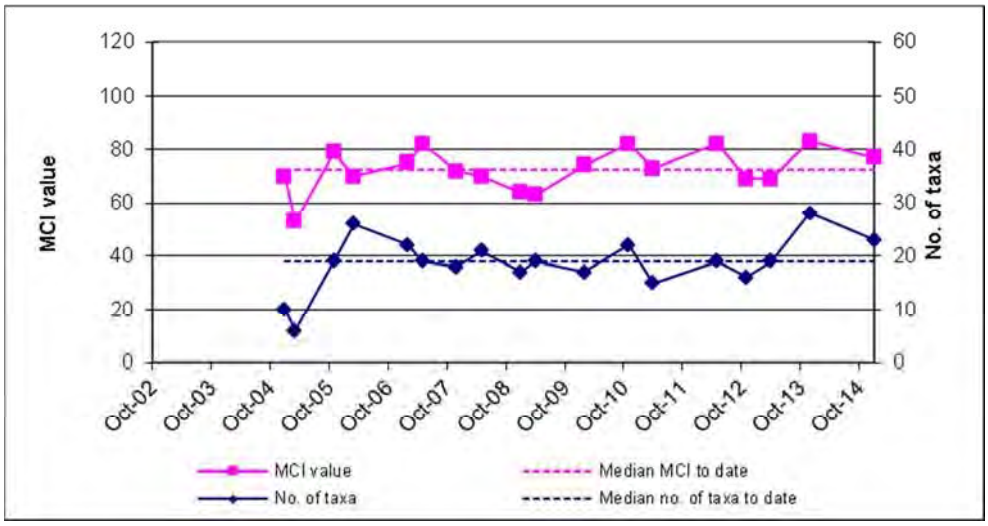


**Figure 6** Number of taxa and MCI scores recorded to date at Site 5

Some previous surveys have recorded changes in abundance of individual taxa, which can be interpreted as being an indication of organic enrichment of the stream. Such changes included *Chironomus* blood worms becoming abundant at this site. The results from the current survey indicate that *Chironomus* blood worms were absent at the time of the survey. In total, significant changes in abundance were recorded for six taxa, including an increase in three two 'tolerant' taxa.

**Site 6 – Downstream of effluent irrigation area**

A moderate richness of 20 taxa were recorded at this site, located downstream of the effluent irrigation area. The community was dominated by three 'tolerant' taxa (extremely abundant oligochaete worms and orthoclad midges and abundant sandfly larvae (*Austrosimulium*)), and one 'highly sensitive' taxon (mayfly (*Deleatidium*)). There was no change in the number of 'tolerant' taxa (14) from that recorded at site 5, but there was a decrease in the number of 'sensitive' taxa (6 taxa compared to 9 recorded at site 5). This resulted in a four unit drop in MCI score. This MCI score (73) was not significantly different to that recorded at site 5 upstream and not significantly different to the median for control sites in other lowland streams at a similar altitude (TRC, 1999), and also not significantly different to the median score for the other Haehanga Stream sites (Table 2).

The $SQMCI_S$ score was primarily influenced by the extremely abundant oligochaete worms and orthoclad midge larvae. This resulted in a $SQMCI_S$ score of 1.7 units, which was significantly less than that recorded at site 1, and that recorded at sites 2 and 5 upstream. This result was also significantly less than that recorded in the previous survey, and was primarily due to an increased abundance of 'tolerant' taxa, especially oligochaete worms and orthoclad midge larvae.

This does suggest the possibility of a subtle deterioration in water quality at this site prior to the current survey. However, the surveys undertaken at this site sampled habitat that differed to the other Haehanga Stream sites, as it was a true riffle, in that it was shallow flow tumbling over coarse and fine gravel, as opposed to deeper flow moving over macrophyte or submerged wood. This habitat difference can explain some of the differences in the taxa recorded and the increased abundance of worms, but it does not explain the drop in $SQMCI_S$ score recorded in the current survey. Physicochemical sampling indicates an increase in chlorides in this reach, and this may be related to this drop in $SQMCI_S$ score. However, this change is described as subtle, as there were still sensitive taxa present, including the abundant *Deleatidium* mayfly.

**Site 7 – Downstream of all site activities**

This site exhibited moderate taxa richness (23), similar to as the median, and one taxon more than the previous survey undertaken at this site. The 'poor' MCI score of 67 was due to the community comprising 70% 'tolerant' taxa, of which five were abundant (snails (*Physa* and *Potamopyrgus*), ostracod seed shrimp, damselfly larvae (*Xanthocnemis*), purse caddisfly (Paroxyethira) and orthoclad midge larvae. 'Moderately sensitive' *Triplectides* caddisfly were also recorded in abundance at this site in the current survey. The MCI score of 67 less than that recorded in the previous survey, by ten units, which although a large drop, is not a statistically significant result (Stark, 1998) (Table 2 and Table 7), and not significantly different to the median score for this site. The extreme abundance of 'tolerant' *Potamopyrgus* snails and numerical dominance of six other 'tolerant' taxa resulted in a $SQMCI_S$ of 3.8, 0.6 unit higher than the median for this site and similar to that recorded in the previous survey. This is the tenth time in the last eleven surveys where above median $SQMCI_S$ scores have been recorded at this site.

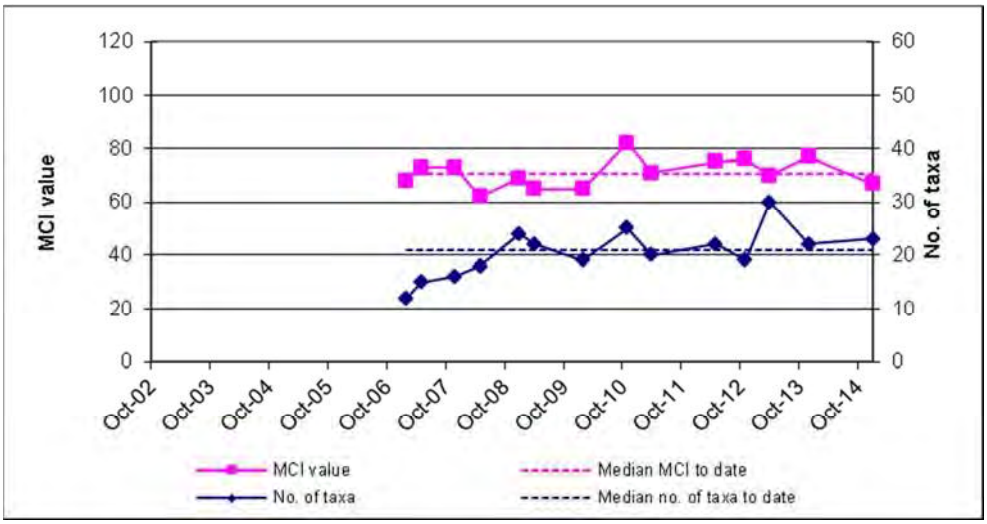


**Figure 7** Number of taxa and MCI scores recorded to date at Site 7

When compared with site 6 upstream, the MCI score was similar, while the $SQMCI_S$ score improved significantly, due mainly to the reduced abundances of oligochaete worms and orthoclad midge larvae. A total of twelve significant differences in individual taxon abundance were recorded between sites 6 and 7, most of which indicate slight differences in habitat, including flow conditions, substrate and macrophyte cover. Overall, this indicates little difference in water quality, despite the fact that hydrocarbons were released from the sediment when it was disturbed at this site.

During some previous surveys, concern was raised regarding an extreme abundance of *Chironomus* blood worm larvae at this site. Such abundance usually only occurs where there is a significant organic discharge, which the *Chironomus* blood worm larvae feed upon. It was noted that should this result be repeated in subsequent surveys, further investigation will be required. Dissolved oxygen readings were subsequently taken in the stream, and this found that there may be periods of low dissolved oxygen, especially when weed beds are well established, such as in summer. This is natural, and related to the shallow gradient of the stream, and can be exacerbated during low flows. It is likely that the sporadic abundance of *Chironomus* is related to the low dissolved oxygen concentrations within the stream, rather than the discharge of organic wastes upstream. *Chironomus* was recorded as common at this site in the current survey.

## Conclusions

The Council's standard 'streambed kick' and 'vegetation sweep' techniques were used at seven established sites to collect streambed macroinvertebrates from the Haehanga Stream catchment in order to assess whether the Remediation (NZ) Ltd composting areas had had any adverse effects on the macroinvertebrate communities of these streams. Samples were processed to provide number of taxa (richness), MCI, and $SQMCI_S$ scores for each site.

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

The macroinvertebrate survey conducted on 8 January 2015 found water flows in the Haehanga catchment to be low to very low, with a slow to steady water speed noted at all sites. Community richnesses were similar to the respective median at three sites, while the remaining four exceeded their respective median richnesses. Overall, this survey found that macroinvertebrate communities at all sites were in average health, with only subtle effects noted. No undesirable heterotrophic growths were recorded at any of the seven sites in this survey.

The two sites in the unnamed tributary were sampled for the eighth time in the current survey, and exhibited a community relatively typical of this kind of habitat. However, there were some differences between these two sites. Site T2 recorded an above average MCI score, and relatively high $SQMCI_S$ score, being the highest $SQMCI_S$ score recorded in the Haehanga stream catchment to date. Site T3 only recorded an average MCI and $SQMCI_S$ score, both lower than that recorded at site T2, significantly so for the $SQMCI_S$ score. Previous surveys have frequently recorded oligochaete worms, ostracod seed shrimps and *Chironomus* bloodworms increasing significantly in abundance downstream of the discharge. These taxa are often associated with organically enriched discharges. In the current survey oligochaete worms, ostracod seed shrimps and *Chironomus* bloodworms all increased in abundance at site T3, coincident with the observation of a small discharge leaving the wetland.

Although the changes in community suggest that there were some impacts from the discharge, there are certain changes in taxa presence/absence that indicate that there is also a significant influence from the instream habitat. For example, site T3 recorded boatman (*Sigara*) and ostracod seed shrimps, which inhabit slow to still water, a habitat not typically inhabited by *Deleatidium* mayfly, which was absent at site T3 (but extremely abundant at site T2). In addition, the number of 'sensitive' taxa actually increased by three taxa at site T3. Overall, these observations indicate that the discharge occurring at the time of this survey was having only a subtle impact on the communities of this stream.

Some previous water quality results indicate that unionised ammonia concentrations in the unnamed tributary have at times been toxic enough to reduce the abundance of, or eliminate entirely, some of the sensitive species usually found in this stream. Results of sampling undertaken in the year prior to this survey show that most samples contained concentrations of unionised ammonia below the toxicity threshold of 0.025 $g/m^3$, with the only exception to this being a sample collected on 24 September 2014, which recorded a concentration of 0.065$g/m^3$. This shows good management of the unionised ammonia concentrations in the effluent being discharged. However, should unionised ammonia concentrations return to high levels in the winter period, an additional macroinvertebrate survey at this time may be warranted. At the very least, the water quality monitoring will need to continue so as to assist with the interpretation of macroinvertebrate results.

In general the communities in the Haehanga Stream sites had reasonable proportions of sensitive taxa. Low numbers of sensitive taxa are expected in small, silty bottomed streams such as the Haehanga Stream and the numbers of taxa were generally similar to other lowland hill country streams surveyed at similar altitude. MCI values recorded in the Haehanga Stream generally reduced in a downstream direction, with the top sites recording

scores similar to that recorded in other small lowland hill country streams in the region, while sites 6 and 7 showed some deterioration.

Site 5 has exhibited poorer macroinvertebrate communities in the past compared to other sites upstream. This has suggested some level of impact from the composting operation, although the extent of adverse effects has been difficult to determine due to poor habitat quality. During the current survey, the MCI score for site 5 was 5 units greater than the median score for this site, and similar to that recorded at the next upstream Haehanga Stream site. The $SQMCI_S$ score recorded at site 5 was similar to that recorded at sites 1 and 2, also indicating no sign of deterioration. The results from the current survey indicate that *Chironomus* bloodworms were absent, suggesting that the improvement recorded since the April 2013 survey (which recorded them as abundant) has remained.

Unlike the other sites, the sample from site 6 was collected from a riffle with coarse and fine gravels, using the 'streambed kick' sampling technique. The current survey recorded an MCI score that was slightly less than the medians for the other Haehanga Stream sites, and not significantly different to that recorded at the three upstream main stem sites. However, the $SQMCI_S$ score was significantly less than that recorded at all upstream sites. This significant reduction in $SQMCI_S$ score was primarily due to an increased abundance of 'tolerant' taxa, especially oligochaete worms and orthoclad midge larvae.

This does suggest the possibility of a subtle deterioration in water quality at this site prior to the current survey. However, the surveys undertaken at this site sampled habitat that differed to the other Haehanga Stream sites, as it was a true riffle, in that it was shallow flow tumbling over coarse and fine gravel, as opposed to deeper flow moving over macrophyte or submerged wood. This habitat difference can explain some of the differences in the taxa recorded and the increased abundance of worms, but it does not explain the drop in $SQMCI_S$ score recorded in the current survey. Physicochemical sampling indicates an increase in chlorides in this reach, and this may be related to this drop in $SQMCI_S$ score. However, this change is described as subtle, as there were still sensitive taxa present, including the 'highly sensitive' *Deleatidium* mayfly, which was recorded as abundant.

The lowest site (site 7) was sampled for the fourteenth time in this survey. There was a reduction in MCI score from that recorded upstream, but a recovery in $SQMCI_S$ scores from that recorded at site 6. When compared with historical data the community at site 7 was in average health, and indicative of little change in water quality from previous surveys, despite the fact that hydrocarbons were released from the sediment when it was disturbed at this site.

During certain previous surveys *Chironomus* blood worms have been recorded as abundant at various sites. Abundance of this taxon is usually an indication of an organic discharge, although low dissolved oxygen in the stream can also allow this taxon to dominate the community, especially when this is associated with low flows. It may be then that the sporadic appearance of *Chironomus* in abundance is at least in part related to the dissolved oxygen concentrations. Dissolved oxygen concentrations in the Haehanga have been found to be depressed at times, and during the warmer months, when there is more aquatic weed growth, dissolved oxygen may be significantly depleted at night. This is a natural occurrence in some streams that are slow flowing and weedy. Any macroinvertebrate surveys undertaken when such conditions exist could potentially record a community with fewer sensitive species, and a more abundant population of *Chironomus*. During the current survey *Chironomus* was common at sites 6 and 7. This indicates that water quality in the

Haehanga catchment may have deteriorated slightly from the previous survey. It is understood that the issue of high chlorides at site 6 has been identified and is being addressed, and so water quality will hopefully continue to improve. This would be further contributed to through any on-going works to the leachate and stormwater treatment system, and improved management of the riparian margin. Any works that improve water quality are also likely to lead to an improvement in freshwater macroinvertebrate communities below the discharges, and should continue to be encouraged.

This was the only macroinvertebrate programme scheduled for the 2014-15 period. It is recommended that this level of monitoring continue, but that a provisional macroinvertebrate survey be retained in the programme, to be implemented should water quality monitoring indicate an issue.

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# Memorandum

**To** Scott Cowperthwaite, Scientific Officer
**From** Bart Jansma, Scientific Officer
**Report No** BJ254
**Document** 1534071
**Date** 2 July 2015

# Fish Survey of the Haehanga Stream in relation to discharges from the Remediation (NZ) Limited composting site at Uruti, January 2015

## Introduction

Remediation (NZ) Ltd operates a composting facility in the Haehanga Valley, Uruti (previously owned by Perry Environmental Ltd who was preceded by Global Vermiculture Ltd). Raw materials are trucked to the site for composting, on a purpose built composting pad for a period of 35-40 days. Synthetic hydrocarbon contaminated drilling muds and cuttings are also received on site. They are piled up and the liquids are allowed to drain, then blended with green waste and other organic matter. Composted material is transported off site by trucks to Remediation (NZ) Ltd's worm farming operations at Waitara Road and Pennington Road.

This survey is the second fish survey undertaken in the Haehanga Stream, in relation to this site. It was included for the first time in the 13-14 monitoring period as a replacement for the late summer macroinvertebrate programme, as flow rates have been slowly reducing over time, inhibiting macroinvertebrate sample collection. On this occasion, the fish survey was undertaken concurrent with the spring/early summer macroinvertebrate survey. Results from previous surveys are detailed in the references.

The first few surveys will provide results that essentially represent baseline conditions, and over time it is expected that fish monitoring will document the health of the fish communities, and whether there is any fluctuation in community health as a result of the operations at the composting site. Fish surveys are useful long term indicators of ecosystem health, as most fish live longer than a year, and as such may reflect chronic impacts from the composting site, should there be any.

## Methods

In this survey, three sites were surveyed in the Haehanga Stream. Site 1 was located upstream of all composting and waste disposal activities, site 2 was located immediately downstream of the lower irrigation area, while site 3 was located just upstream of State Highway 3. Details of the sites surveyed are given in Table 1 and the locations of the sites surveyed in relation to the site are shown in Figure 1.

The fish populations were sampled using fyke nets (Photo 1) and g-minnow traps. At each site, five g-minnow traps were set, and baited with marmite. They were set overnight,

among macrophytes or alongside woody debris. Two fyke nets were also set at each site, a standard mesh (25mm) net and a fine mesh (13mm), with the standard mesh set downstream, in attempt to intercept any large eels moving up from downstream. Both fyke nets were baited with fish food pellets. These nets were also set overnight. All fish caught were identified, counted and measured, and any eels longer than 300mm were also weighed, using electronic scales that measured to the nearest 20 grams. All nets and traps were deployed on the afternoon of 8 January 2015, and retrieved midmorning on 9 January 2015.

**Table 1** Sampling sites surveyed in the Haehanga Stream in relation to the Remediation NZ composting operations

| Site | Site code | Location |
|---|---|---|
| 1 | HHG000093 | Upstream of all composting and waste water irrigation areas |
| 2 | HHG000150 | 30 meters downstream of Remediation NZ irrigation area |
| 3 | HHG000190 | 50 metres upstream of State Highway 3 bridge |

## Results and Discussion

At the time of this survey, the Haehanga Stream had a low flow, and there was discernible flow at all sites. This represents an improvement from that observed in the previous survey, which found that the stream was not flowing at site 1 due to extremely low flows. As a result of the observations made during that survey, the timing of the current survey was moved forward, with the intention of sampling in higher flow. All sites contained moderate fish habitat, with deep pools, and macrophyte beds, although site 2 only had macrophytes on the edge. The substrate of the surveyed pools comprised primarily of thick silt, with some large logs present at site 3. All sites had at least some undercut banks, but there was no overhanging vegetation at any site, other than long grass.

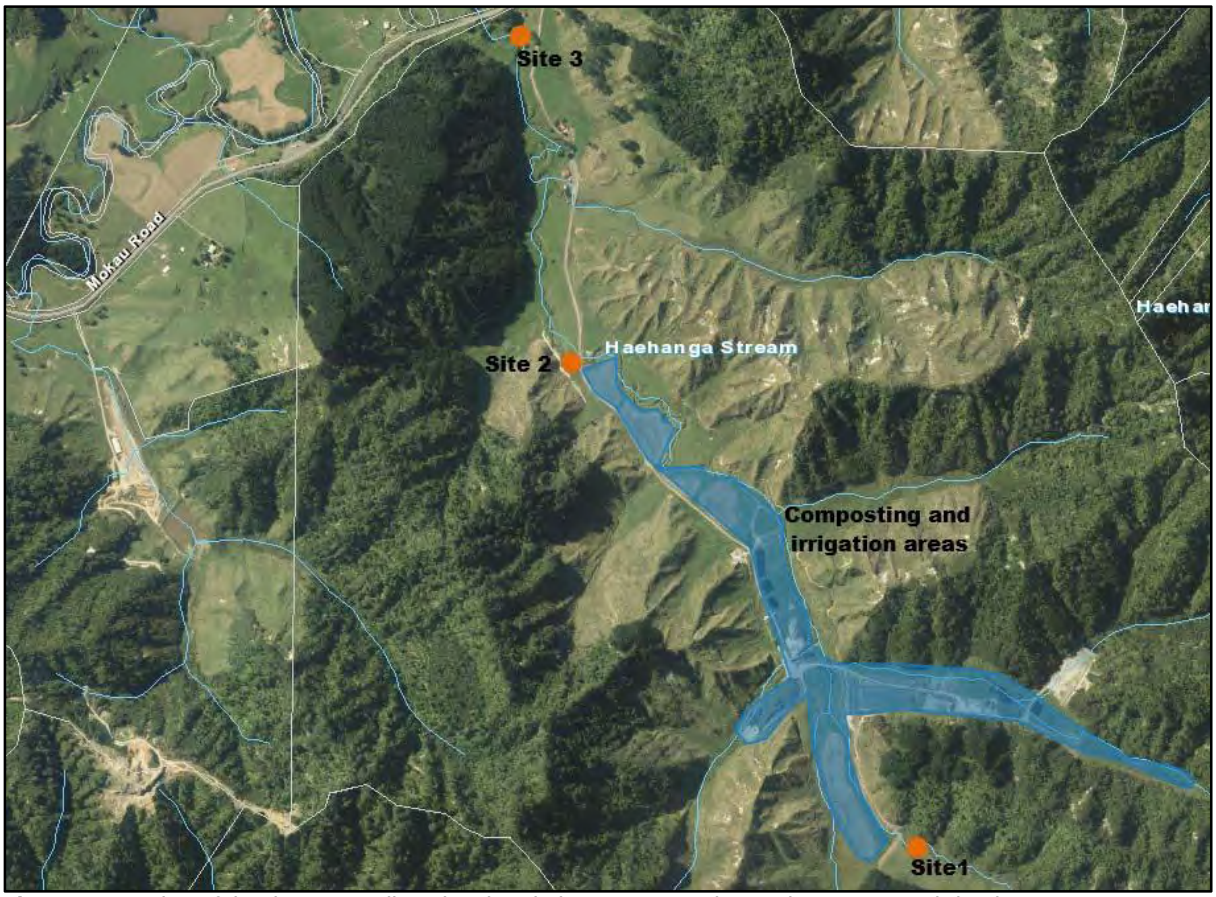


**Figure 1** Location of the three sampling sites in relation to composting and waste water irrigation areas.

**Photo 1** A fyke net, set at site 2, Haehanga Stream.

It should be noted that water temperatures were recorded as high as 28.3˚C during this survey, well above the thermal preference, and near to the maximum thermal tolerance of a number of native fish species (Richardson, Boubee and West, 1994)). The full results of the fish survey are shown in Table 2.

**Table 2** Results of the fish survey undertaken in the Haehanga Stream in relation to Remediation NZ's composting operations.

| Site: | | Site 1 | | Site 2 | | Site 3 | |
|---|---|---|---|---|---|---|---|
| Net/Trap type: | | Fyke net | G-minnow trap | Fyke net | G-minnow trap | Fyke net | G-minnow trap |
| Number of minutes fished: | | 2470 | 6125 | 2370 | 5925 | 2125 | 5225 |
| Longfin eel (*Anguilla dieffenbachii*) | Number | 4 | - | 12 | - | 2 | - |
| | Length range (mm) | 577-1045 | - | 365-802 | - | 485-672 | - |
| | Weight range (kg) | 0.5-2.7 | - | 0.1-1.04 | - | 0.26-0.74 | - |
| Shortfin eel (*Anguilla australis*) | Number | - | 1 | 17 | - | 3 | - |
| | Length range (mm) | - | 195 | 210-754 | - | 510-790 | - |
| | Weight range (kg) | - | - | 0.02-0.9 | - | 260-980 | - |
| Inanga (*Galaxias maculatus*) | Number | - | - | 1 | - | 6 | - |
| | Length range (mm) | - | - | 86 | - | 69-99 | - |
| Redfin bully (*Gobiomorphus huttoni)* | Number | - | - | - | - | 1 | - |
| | Length range (mm) | - | - | - | - | 70 | - |
| Total number of species | | 2 | | 3 | | 4 | |
| Total number of fish | | 5 | | 30 | | 12 | |

Site 1

This site recorded the lowest number of species of this survey with two species recorded, being longfin and shortfin eel. It is likely that this result reflects two factors. First, the reduced flow at this site which results in reduced habitat. Secondly, barriers to fish passage observed downstream will have prevented fish migrating upstream to this site. This has serious implication for inanga, as this species is a short lived species, and migrates downstream annually to spawn, with juveniles migrating upstream during the whitebait season. This site recorded the largest eels of this survey, with two of the five eels being over 900mm long.

This site is intended as a control site to compare the downstream results to. Due to the lack of fish passage, it cannot be considered a true control site. In addition, if a culvert does not provide for the passage of fish, it is non-compliant and must be remediated. Therefore it is recommended that the site operator is made aware of these barriers to fish passage, which are discussed in more detail below, and required to take steps to remediate them.

Site 2

This site, located immediately downstream of the lowest irrigation area, contained the second highest species richness (3) and the highest abundance (30) of the three sites surveyed. Inanga, were recorded at this site for the second consecutive time, but only as one individual, which represents a reduction from the previous survey. However, this could be variation associated with the sampling method rather than an indication that the number of inanga has significantly reduced at this site. Natural variation will occur in inanga populations from year to year, as they recruit annually, and are therefore subject to numerous other factors. The individual inanga was in good physical condition indicating adequate food supply for this species.

Twenty-nine eels were captured, of which seventeen were shortfin eels, one being relatively large at 754mm and 0.90kg and twelve were longfin eels, including an individual 802mm long weighing 1.04kg. This represents an increase from the number of eels recorded in the previous survey, which recorded only five eels. This may suggest that the barrier to fish passage posed by the access culvert immediately upstream of this site (Photo 2) has become more significant, reducing the passage of eels, or that the population recorded in the previous survey was depressed for some reason. This abundance of eels may also explain the reduced abundance of inanga, as eels are known to predate on other fish, including while in a fyke net.

These results provide no indication of impacts as a result of the composting activities or wastewater irrigation upstream.

Site 3

Located just upstream of State Highway, this site provides some perspective, in that it would provide an indication as to the extent of influence from the upstream composting activities. This site contained some of the best habitat, with large logs, deep water and undercut banks. These three habitat features are frequently used by nocturnal fish as cover. Of concern was the release of hydrocarbons from the sediment when this sediment was disturbed (Photo 3).

**Photo 2** The access culvert immediately upstream of site 2.

Twelve fish were recorded at this site, with inanga being the most abundant, with six individuals recorded. As with the inanga recorded at site 2, these inanga were in good physical condition. Two longfin eels and three shortfin eels were also recorded, as was an individual redfin bully. This is the first record of redfin bully from the two fish surveys undertaken in this stream. Overall, these results are an improvement from that recorded in the previous survey, which recorded only three eels. This site recorded the highest species richness (four) of the survey and coupled with the fact that there was an improved abundance of fish from the previous survey, there was no indication that impacts from the upstream composting operations extend to this site, despite the presence of hydrocarbons in the sediment.

Size class distribution

Assessing the size class distribution of fish populations can provide a useful perspective on fish recruitment, and the long term health of the community. For example, if recruitment was restricted, then there would be a lack of young fish. However, it can be influenced by other activities such as people feeding eels, or commercial eeling operations. It is therefore recommended that no such activities take place on the consent holder's property. It should also be noted that good numbers of fish are needed to support strong conclusions, and therefore only the size class distribution of eels are discussed.

**Photo 3** A hydrocarbon sheen that resulted from the release of hydrocarbons from the sediment at site 3 when this sediment was disturbed.

Figure 2 shows that although there were a higher number of eels recorded during the 2014-15 survey than that recorded in the 2013-14 survey, the size class distribution was similar, with the community largely dominated by eels less than 700mm long. This is consistent with the impacts of commercial eeling, which is understood to have occurred just prior to the 2013-14 survey. The community will take some time to recover from the impacts of commercial eeling, as commercial eeling methods (fyke netting) are so efficient that 75% of the eels in a fished area can be caught in a single night, and as a result it can take a decade or more for the eels population at such a site to recover (PCE, 2013). It should be noted that the sampling methodology is unlikely to record eels smaller than 150mm.

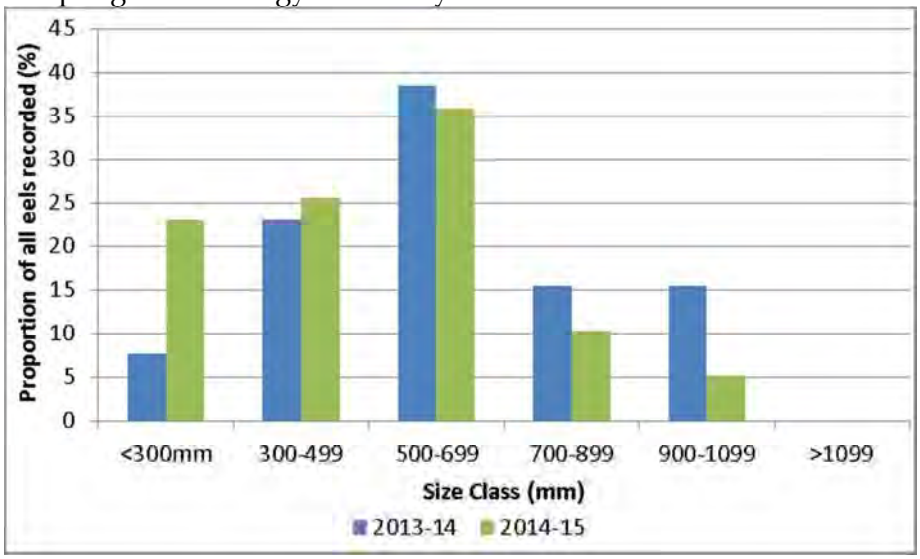


**Figure 2** The size class distribution of all eels captured at all sites over the two surveys undertaken to date.

Fish condition

The composting activities undertaken alongside the Haehanga Stream have the potential to release a range of substances to the stream, including some which have toxic effects on the fauna of the stream. The degree of toxicity can range from acute, resulting in quick death, to chronic, where repeated exposure over time may result in the fauna becoming sick, and/or leaving the area. Eels captured in this survey were measured and weighed. Using this data it is possible to gauge the physical condition of the fish, which can be a useful indication of fish health. If fish at one site were in poorer condition than others in the same stream, then it would be expected that the sick fish of the same length would be lighter.

Figure 3 shows that although not many eels were collected at some sites, no site had fish that were in better or worse condition than any other site. In addition, they did not differ markedly from that predicted by Jellyman *et al* (2013). The trend lines in Figure 3 used the equation from table 1 for longfin eel and table 3 for shortfin eel found in Jellyman *et al* (2013). It is anticipated that this data can be a useful comparison to subsequent surveys, although it is important to consider the potential for fish condition to change with season.

In addition to length and weight measurements, each fish was inspected for obvious physical damage or abnormalities. Other than where one eel had some of its tail bitten off by another eel presumably while in the fyke net, no such features were noted. The observation of fish condition does not indicate an impact on the fish communities from the activities at the Remediation NZ site.

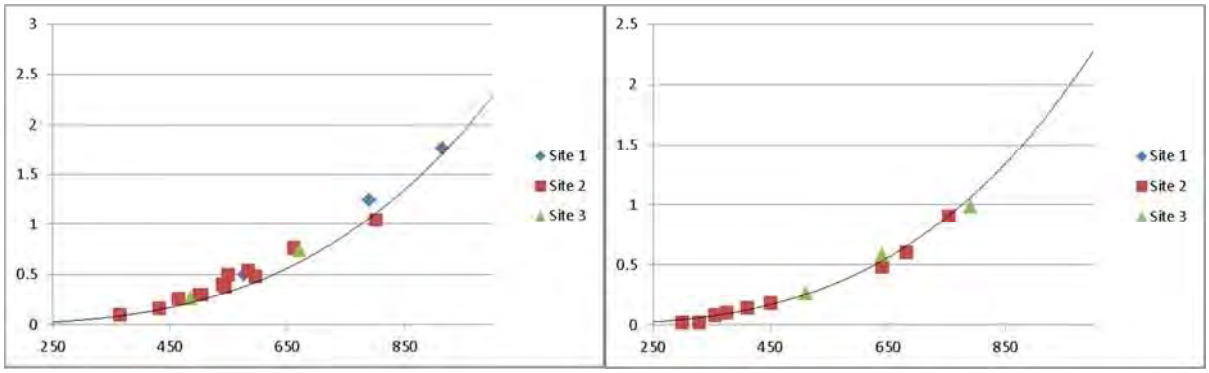


**Figure 3** Longfin eel condition (left) and shortfin eel condition (right) in the Haehanga Stream, 8/9 January 2015. Weight (Kg) is on the y-axis, length (mm) on the x-axis. The trend line is the predicted weight, using equations from Jellyman *et al* 2013.

Fish Passage

During the survey, three access culverts were inspected, and assessed for fish passage. The locations of these culverts are summarised in Table 3. It was noted that all culverts impeded fish passage in some way.

Culvert 1, on the Haehanga Stream near the composting pads, had a shallow and swift flow, which would inhibit poorer swimmers such as inanga. The outlet of this culvert is also too steep and water speeds too swift, and only suitable for climbing species.

Culvert 2 was perched, and also not suitable for swimming species. However, while undertaking macroinvertebrate monitoring, whitebait were observed upstream of this

**Table 3** Culverts assessed for fish passage during the current fish survey

| Culvert number | Location | GPS reference |
|---|---|---|
| 1 | Haehanga Stream, near composting pads | 1732285-5685087 |
| 2 | Unnamed tributary, immediately upstream of Haehanga Stream | 1732291-5685098 |
| 3 | Haehanga Stream, at downstream extent of irrigation area | 1731707-5685778 |

culvert, likely to be juvenile banded kokopu. This species is a good climbing species and highly adept at negotiating barriers that swimming species cannot pass.

Culvert 3 was the greatest barrier observed on this occasion, with both culvert outlets significantly perched and shallow flows through the culvert. This would be best remediated by increasing the height of the riffle that leaves this pool, using large cobble substrate. The intention would be to lift the water level of the pool so that the outlet of the culverts is inundated, and preferably so that water also backs up into the culvert, to provide for poorer swimming species, such as inanga.

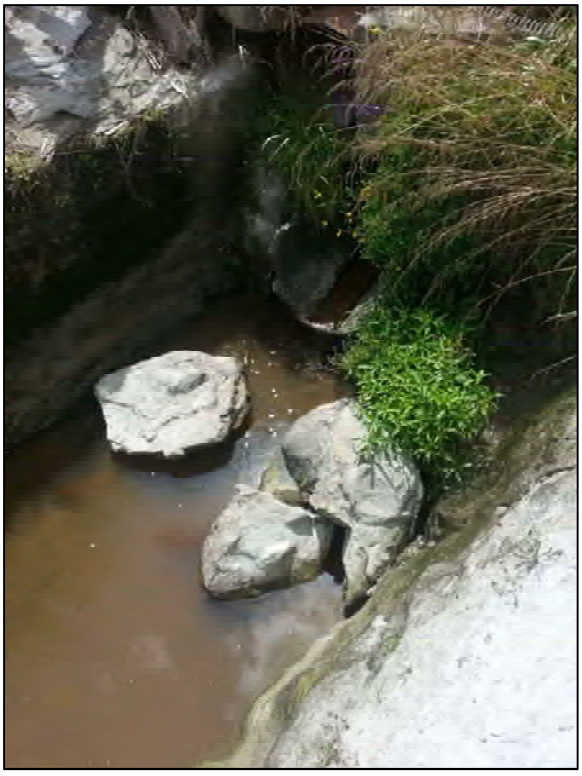

**Photo 4** Culvert 1 (above) and culvert 2 (left) on 9 January 2015

## Summary and conclusions

On 8 and 9 January 2015, three sites were surveyed for freshwater fish in the Haehanga Stream in relation to the composting activities undertaken by Remediation NZ Ltd. Site 1 was located upstream of the site, site 2 located immediately downstream of the lowest extent of the irrigation area, and site 3 was located just upstream of State Highway 3. The survey method involved deploying baited fine and coarse mesh fyke nets and g-minnow traps at each site overnight. These nets and traps were recovered the following morning, with all fish identified, counted and measured, with eels greater than 300mm weighed.

At the time of this survey, flow in the Haehanga Stream was low, to the extent that there was only a small amount of flow between pools at site 1. This was an improvement on that observed in the previous survey however, when there was no flowing water at site 1. The sites supported reasonable fish habitat, with deep pools and good cover, although water temperatures may occasionally exceed the thermal preference, and maximum thermal tolerance of a number of native fish species, with a water temperature of 28.3˚C recorded at site 3. Despite this low flow, there was sufficient flow to attract fish to the traps and nets, and as a result both recorded fish abundance and number of species recorded were higher than that recorded in the previous survey. Over all sites, forty-seven fish were recorded across four species. In addition, an individual whitebait was observed in the unnamed tributary, likely to be juvenile banded kokopu.

Due to the lack of fish at some sites, it is difficult to make any strong conclusions about the impact of the site on the fish communities. However, the site that would be most expected to exhibit impacts if there any, site 2, recorded three species, and the highest abundance (30 fish). Inanga, were recorded at this site for the second consecutive time, but only as one individual, which represents a reduction from the previous survey. However, this could be variation associated with the sampling method rather than an indication that the number of inanga has significantly reduced at this site. Natural variation will occur in inanga populations from year to year, as they recruit annually, and are therefore subject to numerous other factors. The individual inanga was in good physical condition indicating adequate food supply for this species. Site 3, further downstream recorded the highest species richness (four), with redfin bully recorded for the first time. Inanga were also recorded at this site. Of concern was that hydrocarbons were released from the sediment at site 3 when this sediment was disturbed.

Eels were recorded at all three sites, with the largest longfin eel being recorded at site 1, including two individuals that were over 900mm long. The size class distribution of the eels was similar to the recorded in the previous survey, and considered to reflect the impacts of commercial eeling, which is understood to have occurred just prior to the 2013-14 survey. It is expected it will take over decade for the community to recover from this. The physical condition of the eels showed that although not many eels were collected at sites 1 or 3, no site had fish that were in better or worse condition than any other site. In addition, they did not differ markedly from that predicted. It is anticipated that this data can be a useful comparison to subsequent surveys, although it is important to consider the potential for fish condition to change with season. In addition, all fish were inspected and found to be free of physical damage or abnormalities.

During this survey, three access culverts were assessed for fish passage, and all were found to present at least some sort of barrier to fish passage. The worst culvert, located immediately above site 2, was perched and had swift flow. This would preclude the passage

of a number of species, included inanga. All three culverts will need remedial works undertaken to ensure they meet the rules of the Regional Freshwater Plan for Taranaki.

Other than the barriers presented by the three access culverts, and despite the presence of hydrocarbons in the sediment at site 3, these results give no indication that the composting activities and wastewater irrigation undertaken by Remediation NZ Ltd, alongside the Haehanga Stream, have had any impact on the fish communities of this stream.

Due to the low flows in the stream at the time of this survey, it is recommended that this annual fish survey be undertaken no later than mid-January, preferably in December. It should continue on an annual basis. In addition, it is recommended consideration be given to installing continuous water temperature monitoring equipment over the summer months, to improve our understanding of how the water temperature changes in the Haehanga Stream.

## References


Jansma, B. 2014: Fish survey of the Haehanga Stream in relation to discharges from the Remediation (NZ) Limited composting site at Uruti, March 2014

Jellyman, PG, Booker, DJ, Crow, SK, Bonnett, ML & Jellyman, DJ. 2013. Does one size fit all? An evaluation of length-weight relationships for New Zealand's freshwater fish species. *New Zealand Journal of Marine and Freshwater Research* 47: 450-468.

McDowall, R.M., 2000: The Reed Field Guide to New Zealand Freshwater Fishes. Reed books, Reed Publishing (New Zealand) Ltd. 224pp.

Parliamentary Commissioner for the Environment, 2013: On a pathway to extinction? An investigation into the status and management of the longfin eel. Wellington, New Zealand.

Richardson, J, Boubee, J.A.T. and West, D.W 1994. Thermal tolerance and preference of some native New Zealand freshwater fish. *New Zealand Journal of Marine and Freshwater Research* 28: 399-407.

# Appendix III

# External laboratory analysis reports

Hill Laboratories
BETTER TESTING BETTER RESULTS

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# ANALYSIS REPORT

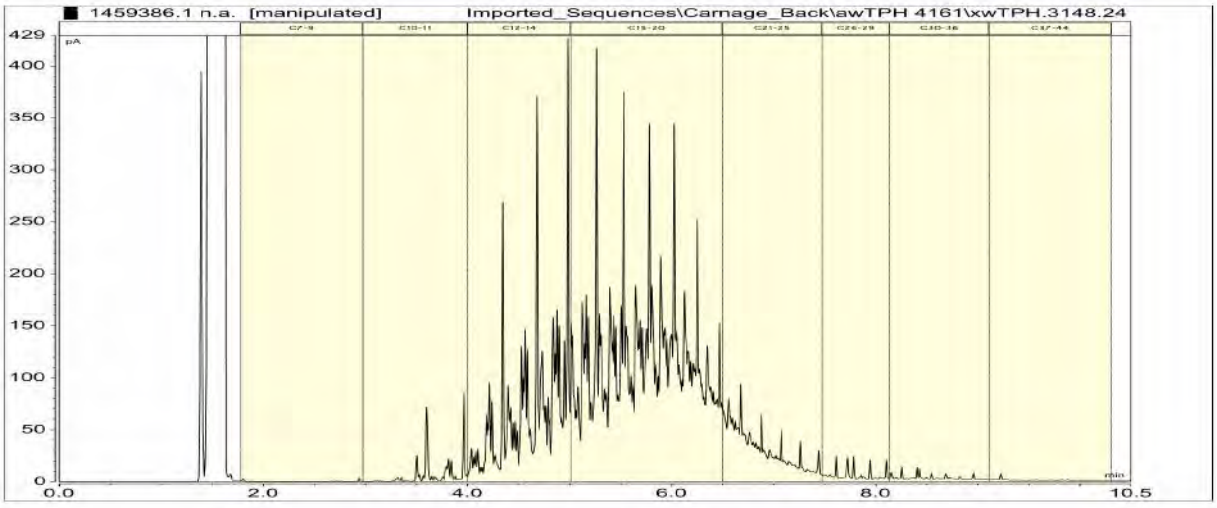


| | | | | |
|---|---|---|---|---|
| **Client:** | Taranaki Regional Council | **Lab No:** | 1459386 | SPv1 |
| **Contact:** | Scott Cowperthwaite | **Date Registered:** | 06-Aug-2015 | |
| | C/- Taranaki Regional Council | **Date Reported:** | 12-Aug-2015 | |
| | Private Bag 713 | **Quote No:** | 58989 | |
| | STRATFORD 4352 | **Order No:** | 52414 | |
| | | **Client Reference:** | Remediation NZ BTEX | |
| | | **Submitted By:** | Scott Cowperthwaite | |

**Sample Type: Aqueous**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Name:** | | IND002044<br>05-Aug-2015<br>10:27 am | | | | |
| **Lab Number:** | | 1459386.1 | | | | |
| BTEX Trace in Water by Purge&Trap GC-MS | | | | | | |
| Benzene | g/m³ | 0.0195 | - | - | - | - |
| Toluene | g/m³ | 0.042 | - | - | - | - |
| Ethylbenzene | g/m³ | 0.0036 | - | - | - | - |
| m&p-Xylene | g/m³ | 0.021 | - | - | - | - |
| o-Xylene | g/m³ | 0.0088 | - | - | - | - |
| Total Petroleum Hydrocarbons in Water | | | | | | |
| C7 - C9 | g/m³ | 0.7 | - | - | - | - |
| C10 - C14 | g/m³ | 240 | - | - | - | - |
| C15 - C36 | g/m³ | 640 | - | - | - | - |
| Total hydrocarbons (C7 - C36) | g/m³ | 880 | - | - | - | - |

1459386.1
IND002044 05-Aug-2015 10:27 am
Client Chromatogram for TPH by FID




# SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

**Sample Type: Aqueous**

| Test | Method Description | Default Detection Limit | Sample No |
|---|---|---|---|

| Sample Type: Aqueous | | | |
|---|---|---|---|
| **Test** | **Method Description** | **Default Detection Limit** | **Sample No** |
| BTEX Trace in Water by Purge&Trap GC-MS | Direct purge & trap, GC-MS analysis<br>[KBIs:28233,2694] | 0.00010 g/m³ | 1 |
| Total Petroleum Hydrocarbons in Water* | Hexane extraction, GC-FID analysis<br>US EPA 8015B/MfE Petroleum Industry Guidelines<br>[KBIs:2803,10734] | 0.10 - 0.7 g/m³ | 1 |

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.



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Client Services Manager - Environmental Division

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# ANALYSIS REPORT

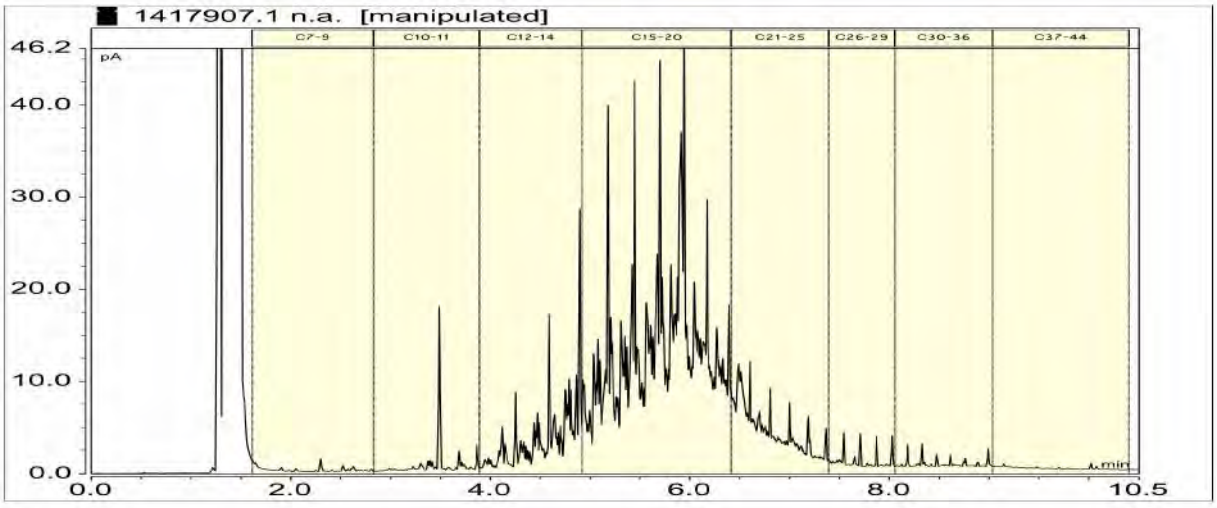


| | | | | |
|---|---|---|---|---|
| **Client:** | Taranaki Regional Council | **Lab No:** | 1417907 | SPv1 |
| **Contact:** | Scott Cowperthwaite | **Date Registered:** | 28-Apr-2015 | |
| | C/- Taranaki Regional Council | **Date Reported:** | 06-May-2015 | |
| | Private Bag 713 | **Quote No:** | 58989 | |
| | STRATFORD 4352 | **Order No:** | 50490 | |
| | | **Client Reference:** | | |
| | | **Submitted By:** | Scott Cowperthwaite | |

**Sample Type: Aqueous**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Name:** | | IND002044<br>24-Apr-2015<br>11:04 am | | | | |
| **Lab Number:** | | 1417907.1 | | | | |
| BTEX Trace in Water by Purge&Trap GC-MS | | | | | | |
| Benzene | g/m³ | 0.0072 | - | - | - | - |
| Toluene | g/m³ | 0.0103 | - | - | - | - |
| Ethylbenzene | g/m³ | 0.0009 | - | - | - | - |
| m&p-Xylene | g/m³ | 0.0046 | - | - | - | - |
| o-Xylene | g/m³ | 0.0018 | - | - | - | - |
| Total Petroleum Hydrocarbons in Water | | | | | | |
| C7 - C9 | g/m³ | < 0.15 | - | - | - | - |
| C10 - C14 | g/m³ | 5.3 | - | - | - | - |
| C15 - C36 | g/m³ | 29 | - | - | - | - |
| Total hydrocarbons (C7 - C36) | g/m³ | 34 | - | - | - | - |

1417907.1
IND002044 24-Apr-2015 11:04 am
Client Chromatogram for TPH by FID




# SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

**Sample Type: Aqueous**

| Test | Method Description | Default Detection Limit | Sample No |
|---|---|---|---|

| Sample Type: Aqueous | | | |
|---|---|---|---|
| **Test** | **Method Description** | **Default Detection Limit** | **Sample No** |
| BTEX Trace in Water by Purge&Trap GC-MS | Direct purge & trap, GC-MS analysis<br>[KBIs:28233,2694] | 0.00010 g/m³ | 1 |
| Total Petroleum Hydrocarbons in Water* | Hexane extraction, GC-FID analysis<br>US EPA 8015B/MfE Petroleum Industry Guidelines<br>[KBIs:2803,10734] | 0.10 - 0.7 g/m³ | 1 |

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Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.



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# ANALYSIS REPORT



| | | | |
|---|---|---|---|
| **Client:** | Taranaki Regional Council | **Lab No:** | 1417905 SPv1 |
| **Contact:** | Scott Cowperthwaite | **Date Registered:** | 28-Apr-2015 |
| | C/- Taranaki Regional Council | **Date Reported:** | 05-May-2015 |
| | Private Bag 713 | **Quote No:** | 68418 |
| | STRATFORD 4352 | **Order No:** | 50490 |
| | | **Client Reference:** | RNZ Uruti Irrigation Trace Mercury |
| | | **Submitted By:** | Scott Cowperthwaite |

**Sample Type: Aqueous**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Name:** | | IND2044<br>24-Apr-2015<br>11:04 am | | | | |
| **Lab Number:** | | 1417905.1 | | | | |
| Total Mercury | g/m³ | 0.00016 | - | - | - | - |

# SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

**Sample Type: Aqueous**

| Test | Method Description | Default Detection Limit | Sample No |
|---|---|---|---|
| Total Mercury | Bromine Oxidation followed by Atomic Fluorescence. US EPA Method 245.7, Feb 2005. | 0.00008 g/m³ | 1 |

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

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# ANALYSIS REPORT



| | | | |
|---|---|---|---|
| **Client:** | Taranaki Regional Council | **Lab No:** | 1417906 SPv1 |
| **Contact:** | Scott Cowperthwaite | **Date Registered:** | 28-Apr-2015 |
| | C/- Taranaki Regional Council | **Date Reported:** | 04-May-2015 |
| | Private Bag 713 | **Quote No:** | 68278 |
| | STRATFORD 4352 | **Order No:** | 50490 |
| | | **Client Reference:** | RNZ Uruti dissolved Metals |
| | | **Submitted By:** | Scott Cowperthwaite |

**Sample Type: Aqueous**

| Sample Name: | | HHG000190 24-Apr-2015 9:13 am | HHG000093 24-Apr-2015 9:48 am | | | |
|---|---|---|---|---|---|---|
| **Lab Number:** | | 1417906.1 | 1417906.2 | | | |
| Individual Tests | | | | | | |
| Dissolved Mercury | g/m³ | < 0.00008 | < 0.00008 | - | - | - |
| Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn | | | | | | |
| Dissolved Arsenic | g/m³ | 0.0011 | 0.0011 | - | - | - |
| Dissolved Cadmium | g/m³ | < 0.00005 | < 0.00005 | - | - | - |
| Dissolved Chromium | g/m³ | 0.0005 | < 0.0005 | - | - | - |
| Dissolved Copper | g/m³ | 0.0018 | 0.0022 | - | - | - |
| Dissolved Lead | g/m³ | 0.00019 | 0.00031 | - | - | - |
| Dissolved Nickel | g/m³ | 0.0032 | 0.0029 | - | - | - |
| Dissolved Zinc | g/m³ | 0.0014 | 0.0035 | - | - | - |

# SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

**Sample Type: Aqueous**

| Test | Method Description | Default Detection Limit | Sample No |
|---|---|---|---|
| Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn | 0.45µm filtration, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00005 - 0.0010 g/m³ | 1-2 |
| Dissolved Mercury | 0.45µm filtration, bromine oxidation followed by atomic fluorescence. US EPA Method 245.7, Feb 2005. | 0.00008 g/m³ | 1-2 |

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# ANALYSIS REPORT



| | | | |
|---|---|---|---|
| **Client:** | Taranaki Regional Council | **Lab No:** | 1420884 SPv1 |
| **Contact:** | Scott Cowperthwaite | **Date Registered:** | 02-May-2015 |
| | C/- Taranaki Regional Council | **Date Reported:** | 11-May-2015 |
| | Private Bag 713 | **Quote No:** | 68278 |
| | STRATFORD 4352 | **Order No:** | 50534 |
| | | **Client Reference:** | RNZ Uruti GW BTEX/Trace metals |
| | | **Submitted By:** | Scott Cowperthwaite |

**Sample Type: Aqueous**

| Sample Name: | | GND2188 01-May-2015 8:45 am | GND2189 01-May-2015 10:20 am | GND2190 01-May-2015 10:40 am | | |
|---|---|---|---|---|---|---|
| **Lab Number:** | | 1420884.1 | 1420884.2 | 1420884.3 | | |
| Individual Tests | | | | | | |
| Dissolved Mercury | g/m³ | < 0.00008 | < 0.00008 | < 0.00008 | - | - |
| Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn | | | | | | |
| Dissolved Arsenic | g/m³ | < 0.0010 | 0.0021 | < 0.005 | - | - |
| Dissolved Cadmium | g/m³ | < 0.00005 | 0.00006 | 0.00082 | - | - |
| Dissolved Chromium | g/m³ | < 0.0005 | 0.0013 | < 0.0010 | - | - |
| Dissolved Copper | g/m³ | 0.0030 | 0.0079 | < 0.003 | - | - |
| Dissolved Lead | g/m³ | < 0.00010 | 0.0029 | 0.0023 | - | - |
| Dissolved Nickel | g/m³ | 0.0018 | 0.0064 | 0.065 | - | - |
| Dissolved Zinc | g/m³ | 0.0091 | 0.0102 | 0.079 | - | - |
| BTEX in Water by Headspace GC-MS | | | | | | |
| Benzene | g/m³ | < 0.0010 | < 0.0010 | < 0.0010 | - | - |
| Toluene | g/m³ | < 0.0010 | < 0.0010 | < 0.0010 | - | - |
| Ethylbenzene | g/m³ | < 0.0010 | < 0.0010 | < 0.0010 | - | - |
| m&p-Xylene | g/m³ | < 0.002 | < 0.002 | < 0.002 | - | - |
| o-Xylene | g/m³ | < 0.0010 | < 0.0010 | < 0.0010 | - | - |

# SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

**Sample Type: Aqueous**

| Test | Method Description | Default Detection Limit | Sample No |
|---|---|---|---|
| Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn | 0.45µm filtration, ICP-MS, trace level. APHA 3125 B 21st ed. 2005. | 0.00005 - 0.0010 g/m³ | 1-3 |
| BTEX in Water by Headspace GC-MS | Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629] | 0.0010 - 0.002 g/m³ | 1-3 |
| Dissolved Mercury | 0.45µm filtration, bromine oxidation followed by atomic fluorescence. US EPA Method 245.7, Feb 2005. | 0.00008 g/m³ | 1-3 |

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# ANALYSIS REPORT



| | | | | |
|---|---|---|---|---|
| **Client:** | Taranaki Regional Council | **Lab No:** | 1420867 | SPv1 |
| **Contact:** | Scott Cowperthwaite | **Date Registered:** | 02-May-2015 | |
| | C/- Taranaki Regional Council | **Date Reported:** | 11-May-2015 | |
| | Private Bag 713 | **Quote No:** | 68279 | |
| | STRATFORD 4352 | **Order No:** | 5053U | |
| | | **Client Reference:** | RNZ Uruti Soil Metals | |
| | | **Submitted By:** | Rae West | |

**Sample Type: Soil**

| | | Sample Name: | SOL000176<br>01-May-2015<br>10:20 am | SOL000177<br>01-May-2015 9:00<br>am | | | |
|---|---|---|---|---|---|---|---|
| | | **Lab Number:** | 1420867.1 | 1420867.2 | | | |
| Individual Tests | | | | | | | |
| Dry Matter | g/100g as rcvd | | 58 | 64 | - | - | - |
| Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg | | | | | | | |
| Total Recoverable Arsenic | mg/kg dry wt | | 5 | 4 | - | - | - |
| Total Recoverable Cadmium | mg/kg dry wt | | < 0.10 | 0.19 | - | - | - |
| Total Recoverable Chromium | mg/kg dry wt | | 20 | 21 | - | - | - |
| Total Recoverable Copper | mg/kg dry wt | | 16 | 13 | - | - | - |
| Total Recoverable Lead | mg/kg dry wt | | 13.6 | 11.7 | - | - | - |
| Total Recoverable Mercury | mg/kg dry wt | | < 0.10 | < 0.10 | - | - | - |
| Total Recoverable Nickel | mg/kg dry wt | | 17 | 16 | - | - | - |
| Total Recoverable Zinc | mg/kg dry wt | | 73 | 73 | - | - | - |
| BTEX in Soil by Headspace GC-MS | | | | | | | |
| Benzene | mg/kg dry wt | | < 0.14 | < 0.13 | - | - | - |
| Toluene | mg/kg dry wt | | < 0.14 | < 0.13 | - | - | - |
| Ethylbenzene | mg/kg dry wt | | < 0.14 | < 0.13 | - | - | - |
| m&p-Xylene | mg/kg dry wt | | < 0.3 | < 0.3 | - | - | - |
| o-Xylene | mg/kg dry wt | | < 0.14 | < 0.13 | - | - | - |
| Total Petroleum Hydrocarbons in Soil | | | | | | | |
| C7 - C9 | mg/kg dry wt | | < 12 | < 11 | - | - | - |
| C10 - C14 | mg/kg dry wt | | < 30 | < 30 | - | - | - |
| C15 - C36 | mg/kg dry wt | | < 50 | < 50 | - | - | - |
| Total hydrocarbons (C7 - C36) | mg/kg dry wt | | < 80 | < 80 | - | - | - |

# SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

**Sample Type: Soil**

| Test | Method Description | Default Detection Limit | Sample No |
|---|---|---|---|
| Environmental Solids Sample Preparation | Air dried at 35°C and sieved, <2mm fraction.<br>Used for sample preparation.<br>May contain a residual moisture content of 2-5%. | - | 1-2 |
| Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg | Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level. | 0.10 - 4 mg/kg dry wt | 1-2 |
| BTEX in Soil by Headspace GC-MS | Solvent extraction, Headspace GC-MS analysis<br>US EPA 8260B. Tested on as received sample<br>[KBIs:5782,26687,3629] | 0.05 - 0.10 mg/kg dry wt | 1-2 |
| Total Petroleum Hydrocarbons in Soil | Sonication extraction in DCM, Silica cleanup, GC-FID analysis<br>US EPA 8015B/MfE Petroleum Industry Guidelines. Tested on as received sample<br>[KBIs:5786,2805,10734] | 8 - 60 mg/kg dry wt | 1-2 |

| Sample Type: Soil | | | |
|---|---|---|---|
| **Test** | **Method Description** | **Default Detection Limit** | **Sample No** |
| Dry Matter (Env) | Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. US EPA 3550. (Free water removed before analysis). | 0.10 g/100g as rcvd | 1-2 |
| Total Recoverable digestion | Nitric / hydrochloric acid digestion. US EPA 200.2. | - | 1-2 |

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# ANALYSIS REPORT



| | | | | |
|---|---|---|---|---|
| **Client:** | Taranaki Regional Council | **Lab No:** | 1375783 | SPv1 |
| **Contact:** | Scott Cowperthwaite | **Date Registered:** | 22-Jan-2015 | |
| | C/- Taranaki Regional Council | **Date Reported:** | 28-Jan-2015 | |
| | Private Bag 713 | **Quote No:** | 61923 | |
| | STRATFORD 4352 | **Order No:** | 48921 | |
| | | **Client Reference:** | RNZ Papa Pad Testing | |
| | | **Submitted By:** | Scott Cowperthwaite | |

## Sample Type: Soil

| Sample Name: | | SOL000176 21-Jan-2015 9:15 am | SOL000177 21-Jan-2015 11:15 am | | | |
|---|---|---|---|---|---|---|
| **Lab Number:** | | 1375783.1 | 1375783.2 | | | |
| Individual Tests | | | | | | |
| Dry Matter | g/100g as rcvd | 74 | 69 | - | - | - |
| BTEX in Soil by Headspace GC-MS | | | | | | |
| Benzene | mg/kg dry wt | < 0.06 | < 0.07 | - | - | - |
| Toluene | mg/kg dry wt | < 0.06 | < 0.07 | - | - | - |
| Ethylbenzene | mg/kg dry wt | < 0.06 | < 0.07 | - | - | - |
| m&p-Xylene | mg/kg dry wt | < 0.12 | < 0.13 | - | - | - |
| o-Xylene | mg/kg dry wt | < 0.06 | < 0.07 | - | - | - |
| Total Petroleum Hydrocarbons in Soil | | | | | | |
| C7 - C9 | mg/kg dry wt | < 9 | < 10 | - | - | - |
| C10 - C14 | mg/kg dry wt | < 20 | < 20 | - | - | - |
| C15 - C36 | mg/kg dry wt | < 40 | < 40 | - | - | - |
| Total hydrocarbons (C7 - C36) | mg/kg dry wt | < 70 | < 70 | - | - | - |

## Sample Type: Aqueous

| Sample Name: | | GND2188 21-Jan-2015 9:15 am | GND2189 21-Jan-2015 10:15 am | GND2190 21-Jan-2015 11:00 am | IND2044 21-Jan-2015 10:40 am | |
|---|---|---|---|---|---|---|
| **Lab Number:** | | 1375783.3 | 1375783.4 | 1375783.5 | 1375783.6 | |
| BTEX Trace in Water by Purge&Trap GC-MS | | | | | | |
| Benzene | $g/m^3$ | < 0.0005 | < 0.0005 | < 0.0005 | 0.0135 | - |
| Toluene | $g/m^3$ | < 0.0005 | < 0.0005 | < 0.0005 | 0.0163 | - |
| Ethylbenzene | $g/m^3$ | < 0.0005 | < 0.0005 | < 0.0005 | 0.0017 | - |
| m&p-Xylene | $g/m^3$ | < 0.0010 | < 0.0010 | < 0.0010 | 0.0075 | - |
| o-Xylene | $g/m^3$ | < 0.0005 | < 0.0005 | < 0.0005 | 0.0033 | - |

# SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

## Sample Type: Soil

| Test | Method Description | Default Detection Limit | Sample No |
|---|---|---|---|
| BTEX in Soil by Headspace GC-MS | Solvent extraction, Headspace GC-MS analysis US EPA 8260B. Tested on as received sample [KBIs:5782,26687,3629] | 0.05 - 0.10 mg/kg dry wt | 1-2 |
| Total Petroleum Hydrocarbons in Soil | Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines. Tested on as received sample [KBIs:5786,2805,10734] | 8 - 60 mg/kg dry wt | 1-2 |
| Dry Matter (Env) | Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. US EPA 3550. (Free water removed before analysis). | 0.10 g/100g as rcvd | 1-2 |

| Sample Type: Aqueous | | | |
|---|---|---|---|
| **Test** | **Method Description** | **Default Detection Limit** | **Sample No** |
| BTEX Trace in Water by Purge&Trap GC-MS | Direct purge & trap, GC-MS analysis [KBIs:28233,2694] | 0.00010 g/m$^3$ | 3-6 |

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.



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# ANALYSIS REPORT



| | | | | |
|---|---|---|---|---|
| **Client:** | Taranaki Regional Council | **Lab No:** | 1072392 | SPv1 |
| **Contact:** | Scott Cowperthwaite | **Date Registered:** | 22-Nov-2012 | |
| | C/- Taranaki Regional Council | **Date Reported:** | 05-Dec-2012 | |
| | Private Bag 713 | **Quote No:** | 52382 | |
| | STRATFORD 4352 | **Order No:** | | |
| | | **Client Reference:** | Remediation NZ, Uruti | |
| | | **Submitted By:** | Scott Cowperthwaite | |

## Sample Type: Soil

| | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Name:** | | S02000177 → should be S0L000177 (TRC123746)<br>21-Nov-2012<br>10:00 am | | | | |
| **Lab Number:** | | 1072392.1 | | | | |
| Individual Tests | | | | | | |
| Dry Matter | g/100g as rcvd | 63 | - | - | - | - |
| BTEX in Soil by Headspace GC-MS | | | | | | |
| Benzene | mg/kg dry wt | < 0.08 | - | - | - | - |
| Toluene | mg/kg dry wt | < 0.08 | - | - | - | - |
| Ethylbenzene | mg/kg dry wt | < 0.08 | - | - | - | - |
| m&p-Xylene | mg/kg dry wt | < 0.15 | - | - | - | - |
| o-Xylene | mg/kg dry wt | < 0.08 | - | - | - | - |
| Total Petroleum Hydrocarbons in Soil | | | | | | |
| C7 - C9 | mg/kg dry wt | < 12 | - | - | - | - |
| C10 - C14 | mg/kg dry wt | < 30 | - | - | - | - |
| C15 - C36 | mg/kg dry wt | < 50 | - | - | - | - |
| Total hydrocarbons (C7 - C36) | mg/kg dry wt | < 90 | - | - | - | - |

## Sample Type: Aqueous

| | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Name:** | | GWD2189 → should be GWD2190 (TRC123743)<br>21-Nov-2012<br>11:43 am | | | | |
| **Lab Number:** | | 1072392.2 | | | | |
| BTEX Trace in Water by Purge&Trap GC-MS | | | | | | |
| Benzene | $g/m^3$ | < 0.0005 | - | - | - | - |
| Toluene | $g/m^3$ | < 0.0005 | - | - | - | - |
| Ethylbenzene | $g/m^3$ | < 0.0005 | - | - | - | - |
| m&p-Xylene | $g/m^3$ | < 0.0010 | - | - | - | - |
| o-Xylene | $g/m^3$ | < 0.0005 | - | - | - | - |
| Total Petroleum Hydrocarbons in Water | | | | | | |
| C7 - C9 | $g/m^3$ | < 0.10 | - | - | - | - |
| C10 - C14 | $g/m^3$ | < 0.2 | - | - | - | - |
| C15 - C36 | $g/m^3$ | < 0.4 | - | - | - | - |
| Total hydrocarbons (C7 - C36) | $g/m^3$ | < 0.7 | - | - | - | - |

# SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

## Sample Type: Soil

| Test | Method Description | Default Detection Limit | Samples |
|---|---|---|---|
| BTEX in Soil by Headspace GC-MS | Solvent extraction, Headspace GC-MS analysis<br>US EPA 8260B. Tested on as received sample | - | 1 |

| Sample Type: Soil | | | |
|---|---|---|---|
| **Test** | **Method Description** | **Default Detection Limit** | **Samples** |
| Total Petroleum Hydrocarbons in Soil | Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines. Tested on as received sample | - | 1 |
| Dry Matter (Env) | Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. US EPA 3550. (Free water removed before analysis). | 0.10 g/100g as rcvd | 1 |

| Sample Type: Aqueous | | | |
|---|---|---|---|
| **Test** | **Method Description** | **Default Detection Limit** | **Samples** |
| BTEX Trace in Water by Purge&Trap GC-MS | Direct purge & trap, GC-MS analysis | - | 2 |
| Total Petroleum Hydrocarbons in Water | Hexane extraction, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines | - | 2 |

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.



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# ANALYSIS REPORT



| | | | | |
|---|---|---|---|---|
| **Client:** | Taranaki Regional Council | **Lab No:** | 1058595 | SPv1 |
| **Contact:** | Scott Cowperthwaite | **Date Registered:** | 13-Oct-2012 | |
| | C/- Taranaki Regional Council | **Date Reported:** | 17-Oct-2012 | |
| | Private Bag 713 | **Quote No:** | 51709 | |
| | STRATFORD 4352 | **Order No:** | 35164 | |
| | | **Client Reference:** | Remediation NZ Uruti | |
| | | **Submitted By:** | Scott Cowperthwaite | |

**Sample Type: Aqueous**

| Sample Name: | | 123210<br>12-Oct-2012<br>11:20 am | 123212<br>12-Oct-2012<br>11:10 am | | | |
|---|---|---|---|---|---|---|
| **Lab Number:** | | 1058595.1 | 1058595.2 | | | |
| BTEX Trace in Water by Purge&Trap GC-MS | | | | | | |
| Benzene | g/m³ | < 0.0005 | - | - | - | - |
| Toluene | g/m³ | < 0.0005 | - | - | - | - |
| Ethylbenzene | g/m³ | < 0.0005 | - | - | - | - |
| m&p-Xylene | g/m³ | < 0.0010 | - | - | - | - |
| o-Xylene | g/m³ | < 0.0005 | - | - | - | - |
| BTEX in Water by Headspace GC-MS | | | | | | |
| Benzene | g/m³ | - | 0.022 | - | - | - |
| Toluene | g/m³ | - | 0.052 | - | - | - |
| Ethylbenzene | g/m³ | - | 0.0058 | - | - | - |
| m&p-Xylene | g/m³ | - | 0.032 | - | - | - |
| o-Xylene | g/m³ | - | 0.0137 | - | - | - |
| Total Petroleum Hydrocarbons in Water | | | | | | |
| C7 - C9 | g/m³ | - | < 0.4 | - | - | - |
| C10 - C14 | g/m³ | - | < 1.0 | - | - | - |
| C15 - C36 | g/m³ | - | < 2 | - | - | - |
| Total hydrocarbons (C7 - C36) | g/m³ | - | < 4 | - | - | - |



**Analyst's Comments**

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

# SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

**Sample Type: Aqueous**

| Test | Method Description | Default Detection Limit | Samples |
|---|---|---|---|
| BTEX Trace in Water by Purge&Trap GC-MS | Direct purge & trap, GC-MS analysis | - | 1 |
| BTEX in Water by Headspace GC-MS | Headspace GC-MS analysis, US EPA 8260B | - | 2 |
| Total Petroleum Hydrocarbons in Water | Hexane extraction, GC-FID analysis<br>US EPA 8015B/MfE Petroleum Industry Guidelines | - | 2 |

# Appendix IV

# RNZ Uruti Improvement documents

# *REPORT*

## Haehanga Catchment Preliminary Groundwater Investigation





btw company
surveyors . planners . engineers . landscape architects

# Haehanga Catchment Preliminary Groundwater Investigation

Remediation New Zealand

## Disclaimer



**Reviewed**

| | | |
|---|---|---|
| **Report Author** | Greg Larkin, Environmental Scientist, BSc Ecology and MSc in Environmental Science | 1-7-2015 Date |
| **Reviewed by** | Sheridan Standen, Environmental Advisor, BSc in Environmental Studies and Geology | 2-7-2015 Date |

# CONTENTS

# TABLES



# FIGURES

# 1 INTRODUCTION

## 1.1 Scope

This report has been prepared for Remediation New Zealand Limited by BTW Company. This short technical report summarises available information relating to groundwater investigations in the Haehanga Catchment, adjacent to the Remediation New Zealand Uruti Composting Facility.

For a full site description and environment setting, readers are directed to the Uruti Composting Facility Management Plan. This report is a follow up investigation to further detail groundwater interactions beneath the composting facility. The investigation comprised a desktop review of available information from the three monitoring bores on site combined with soil profiles and bore permeability tests undertaken on site.

## 1.2 Objectives

The primary objective of the investigation was to provide addition information to support management of the groundwater resource beneath the Uruti Composting Facility.

Specific objectives were to:

- Undertake a topographical survey of the site;
- Level survey the three monitoring bore heights in Mean Sea Level (MSL) to allow groundwater elevations to be calculated;
- Undertake bore permeability tests so that groundwater velocities could be determined;
- Make recommendations for future groundwater/hydrogeological monitoring to assist site management, and;
- Produce a preliminary or unconfirmed Conceptual Site Model

# 2 GROUNDWATER SITE WORKS

### *2.1.1 Monitoring Bore Description*

In February 2011, three monitoring bores (GND 2188, 2189 & 2190) were advanced on site, using a 600mm solid stem auger attached to a hydraulic digger (Cowperthwaite, pers comms 2015). The bores were advanced to 4.10metres below ground level (mbgl) for GND 2188, 3.3 m for GND 2189 and 3.45 m for GND 2190. Slotted 51.8 mm diameter PVC pipe was installed in each monitoring bore.

Monitoring bore locations are shown on the site plan in Figure 2.1-2.3. Monitoring bore construction details are in Appendix A. Photographs of the well construction are presented in Appendix B.

Although the bores were advanced under a supervision of a hydrogeologist, bore logs and/or description of the soils and aquifer properties encountered were not recorded. From available site photos taken on the day of installation, the full length of the screen appears to be slotted. This is in contrast to the design specification in Appendix A. Details related to the filter pack, cementing and/or gravel around the screen are also not accurately known. The influence this data gap has on bore development, permeability tests and velocity calculations is uncertain.


**Figure 2.1:Uruti Composting Topography Survey-lower part of site. Green dot denotes GND 2190 and reduced level**


**Figure 2.2:Uruti Composting Topography Survey-middle part of site. Green dot denotes GND 2189 and reduced level**

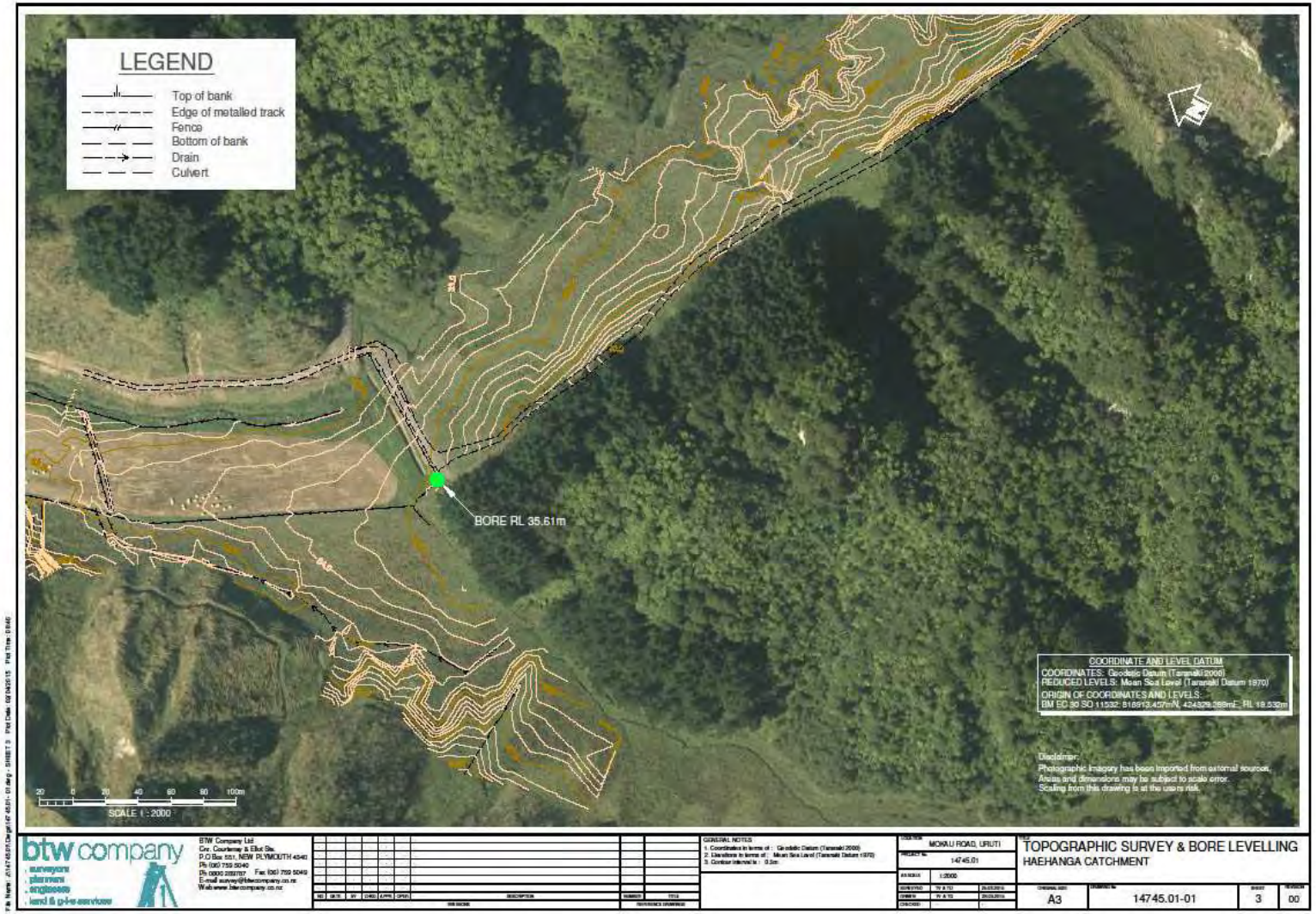



**Figure 2.3:Uruti Composting Topography Survey-upper part of site. Green dot denotes GND 2188 and reduced level**

### 2.1.2 Topographic Survey and Conceptual Site Model

GND 2188, GND 2189 and GND 2190 bores heights were surveyed by BTW Company surveyors on January 8th 2015. The survey established coordinates relative to Geodetic Datum (Taranaki 2000) and the elevation of the top of the casing relative to Mean Sea Level (Taranaki Datum 1970). BTW Company recorded spot heights adjacent each monitoring bores to corroborate surface elevation adjacent the bores.

The Topographic Survey formed the basis of the preliminary Conceptual Site Model (CSM) in Appendix D. The CSM was developed in Civil3E software, with all elevations in Mean Sea Level to the Taranaki 2000 Geodetic Datum. At present the CSM is unconfirmed and requires significantly more input to identify other potential contaminate sources and likely downstream receptors, both ecological and human. The preliminary CSM has however, defined the general hydrological setting in terms of hydraulic gradients down the Haehanga Stream, groundwater direction and hydrogeological interactions with the Uruti Composting Facility.

### 2.1.3 Soil and Aquifer Properties

For a description of the shallow soils encountered on the Uruti Composting Facility to two metres below ground level (mbgl), readers are directed to Section 2.3 in Uruti Composting Facility Management Plan. In brief, the soils encountered across the site were dominated by orthic brown/grey silty soils with increasing clay content at lower elevations across the site and with increasing depth. Surface soils to 250 mm deep were dominated by light brown loams and grey silty topsoil. However, between 250 mm and 1500-2000 mm, soils were characterised as silty clay with medium plasticity, traces of orange clay material, smaller particle sizes and soils were generally more friable. The shallow groundwater table was not encountered on the day of sampling but soils were generally damp below 0.5-0.75 mbgl.

Currently, detailed lithology of the site below 2000mm has not been determined as bore logs were not undertaken at the advancement of the monitoring bores. Subsequently, information which is critical to determining groundwater velocities including aquifer depth, confining structures and aquifer properties below 2000 mm deep were estimated from site visits, the topographic survey and observation of site staff during construction activities. The influence that aquifer properties below 2 metres have on groundwater velocities is uncertain, in terms of over and/or under estimating velocities. For the current groundwater velocity calculations, the aquifer properties were estimated as ‘Silty Clay’, with an effective soil porosity of 0.01 or 1% to the base of the aquifer (McWorter and Sunada 1977).

Well construction information is also limited but deemed critical to the analysis of slug test data, and as such several of the perimeters required for the Bouwer and Rice Method (1970) were estimated from the monitoring well schematic (Appendix A). These parameters were screen length, base of aquifer and the annular fill above the screen. It is therefore highly recommended that all future monitoring bores installed onsite, accurate bore logs and lithology below 2 m be described, along with accurate bore construction information as to allow recalculation of groundwater velocities.

### 2.1.4 Groundwater Level Gauging

The monitoring bores (GND 2188, 2189 & 2190) have been gauged for depth of water between 9 and 10 times, from February 2011 to January 2015. Groundwater level data is presented in Table 2.1 and 2.2.

Table 2.1:Haehanga Catchment Groundwater Gauging Data

| Well ID | Date | Well TOC reduced level (m amsl) | Depth to water (m below TOC) | Groundwater Elevation (mamsl) |
|---|---|---|---|---|
| GND2188 | 4/02/2011 | 35.61 | 0.89 | 34.72 |
| GND2189 | 4/02/2011 | 30.82 | 0.89 | 29.93 |
| GND2190 | 4/02/2011 | 24.90 | 0.95 | 23.95 |
| | | | | |
| GND2188 | 11/02/2011 | 35.61 | 0.88 | 34.73 |
| GND2189 | 11/02/2011 | 30.82 | 0.81 | 30.01 |
| GND2190 | 11/02/2011 | 24.90 | 0.97 | 23.93 |
| | | | | |
| GND2188 | 19/08/2011 | 35.61 | 0.76 | 34.85 |
| GND2189 | 19/08/2011 | 30.82 | 0.75 | 30.07 |
| GND2190 | 19/08/2011 | 24.90 | 0.75 | 24.15 |
| | | | | |
| GND2188 | 26/04/2012 | 35.61 | 1.40 | 34.21 |
| GND2189 | 26/04/2012 | 30.82 | 0.71 | 30.11 |
| GND2190 | 26/04/2012 | 24.90 | No data | No data |
| | | | | |
| GND2188 | 21/11/2012 | 35.61 | 1.27 | 34.34 |
| GND2189 | 21/11/2012 | 30.82 | 0.74 | 30.08 |
| GND2190 | 21/11/2012 | 24.90 | 0.86 | 24.04 |
| | | | | |
| GND2188 | 14/06/2013 | 35.61 | 0.83 | 34.78 |
| GND2189 | 14/06/2013 | 30.82 | 0.61 | 30.21 |
| GND2190 | 14/06/2013 | 24.90 | 0.60 | 24.31 |
| | | | | |
| GND2188 | 14/01/2014 | 35.61 | 1.00 | 34.61 |
| GND2189 | 14/01/2014 | 30.82 | 0.94 | 29.89 |
| GND2190 | 14/01/2014 | 24.90 | 0.94 | 23.97 |
| | | | | |
| GND2188 | 15/05/2014 | 35.61 | 0.70 | 34.91 |
| GND2189 | 15/05/2014 | 30.82 | 0.40 | 30.42 |
| GND2190 | 15/05/2014 | 24.90 | | |
| | | | | |
| GND2188 | 11/12/2014 | 35.61 | 0.43 | 35.18 |
| GND2189 | 11/12/2014 | 30.82 | 0.28 | 30.54 |
| GND2190 | 11/12/2014 | 24.90 | 0.24 | 24.67 |
| | | | | |
| GND2188 | 8/01/2015 | 35.61 | 1.22 | 34.39 |
| GND2189 | 8/01/2015 | 32.80 | 1.06 | 31.74 |
| GND2190 | 8/01/2015 | 24.90 | 1.30 | 23.60 |
| | | | | |

| | | | | |
|---|---|---|---|---|
| GND2188 | 30/04/2015 | 35.61 | 0.703 | 34.91 |
| GND2189 | 30/04/2015 | 30.82 | 0.553 | 30.27 |
| GND2190 | 30/04/2015 | 24.90 | 0.71 | 24.19 |

**Table 2.2:Seasonal Groundwater Levels in the Haehanga Catchment**

| | | | | |
|---|---|---|---|---|
| **GND2188** | Min Groundwater RL | 34.21 | Max Groundwater RL | 35.18 |
| **GND2189** | Min Groundwater RL | 29.76 | Max Groundwater RL | 30.54 |
| **GND2190** | Min Groundwater RL | 23.60 | Max Groundwater RL | 24.67 |
| **GND2188** | Summer RL | 34.60 | Winter RL | 34.85 |
| **GND2189** | Summer RL | 30.05 | Winter RL | 30.23 |
| **GND2190** | Summer RL | 24.15 | Winter RL | 24.23 |

### *2.1.5 Groundwater Velocity*

To establish groundwater velocities through the shallow groundwater table, BTW Company staff undertook two bore permeability tests on the monitoring bores GND 2188 and GND 2190 (January 8th 2015).

The 'slug test' method requires removal of a set amount of water, where after recovery of water levels is timed with a stopwatch. The four litre 'slug' was removed by a high rate vacuum pump, and the recovering water level was determined with a calibrated electronic dip tape. Both monitoring bores did not fully recover to their initial water levels after 100 minutes. GND 2188 recorded sudden surges in water levels after several minutes, with erratic variability in water levels during the timed recovery phase. User error and dip failure were ruled out as both BTW Company technicians corroborated the water level measurements and operation of the electronic dip tape in a bucket of water. Groundwater levels in GND 2190 fluctuated in the initial three minutes after 'slug' removal but in the next one hour and 14 minutes water levels stabilised but never fully recovered to initial water level. However, final water levels only measured 10mm below the initial water level.

The erratic water levels in GND 2188 during recovery phase of the 'slug test 'are represented in Figure 2.4.

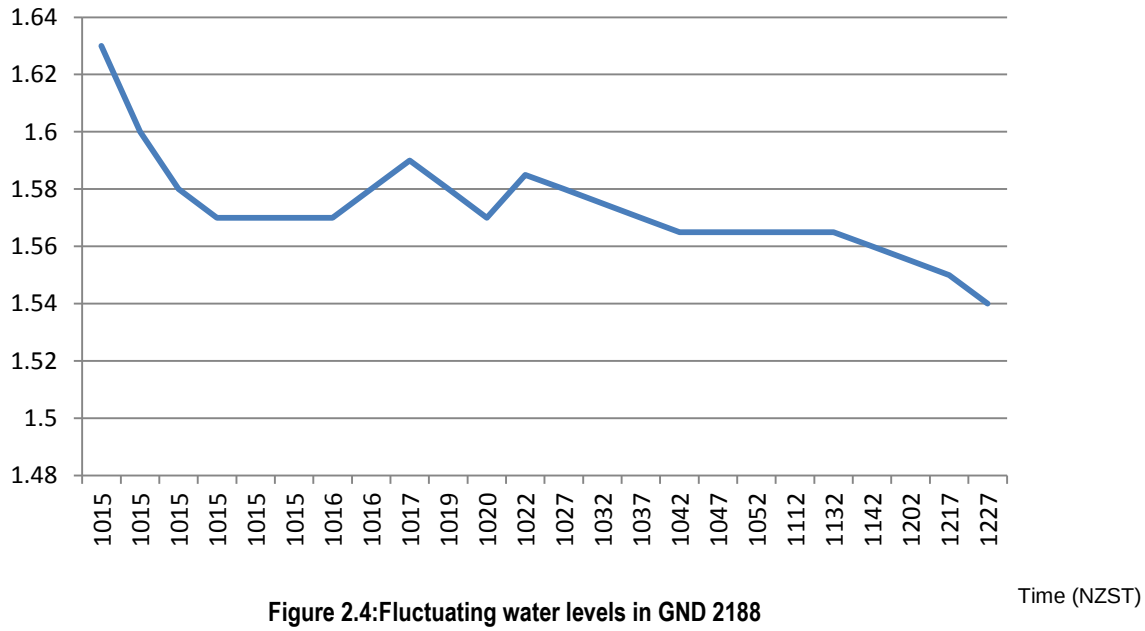



**Figure 2.4:Fluctuating water levels in GND 2188**

Due to the inconsistencies recorded in GND 2188, only permeability calculations were undertaken for GND 2190. These calculations were undertaken using the Bouwer and Rice method (1976) available from free software from the USGS website (http://pubs.usgs.gov/of/2002/ofr02197/index.html) and the online Bouwer and Rice calculator (http://www.groundwatersoftware.com/calculator_11_slugtest.htm).

The following calculations were then used to determine hydraulic gradient and linear groundwater velocity following Darcy's Law:

$$i = \frac{dh}{dl} = \frac{h_2 - h_1}{\text{length}}$$

where

$i$ is the hydraulic gradient (dimensionless),

$dh$ is the difference between two hydraulic heads (Length in metres), and

$dl$ is the flow path length between the two piezometers (Length in metres)

Whereas

Groundwater velocity (v) based on Darcy's law and the velocity equation of hydraulics is given

by:

$v = Ki/n$

where;

K is hydraulic conductivity,

i is hydraulic gradient in the direction of groundwater flow

n is effective soil porosity (function of grain size and sorting).

Based on these parameters above, average hydraulic gradients and linear groundwater velocities have been estimated. Hydraulic gradients have be determined from the groundwater reduced levels in the monitoring bores GND 2188 to GND 2190 and distances between bores taken from the Topographic Survey (Figure 2.1-2.3).

Yielding:

K= 2.24* $10^{-6}$ or 0.00000224 m/sec

i= average 0.01196

n= 0.01 or 1 % for Silty Clay (McWorter and Sunada, 1977).

**Table 2.3;Groundwater Velocities in the Haehanga Catchment**

| Hydraulic Gradient | Average velocity (m/day) |
|---|---|
| 0.01196 | 0.2315 |

Table 2.3 above outlines average hydraulic gradients and average groundwater velocities adjacent GND 2190. Due to the limited groundwater gauging data for Winter and Spring months (3 occasions) it's as yet uncertain the impact what higher groundwater elevations have on hydraulic gradients across the Haehanga Catchment, and whether this impacts groundwater velocities. Furthermore, the velocities estimates in Table 2.3 are likely an underestimate for the middle to upper parts of the Haehanga Catchment, which has steeper topography therefore, higher hydraulic gradients and are overlain by more porous silty loamy/clay soils.

### *2.1.6 Groundwater- Surface water interactions*

The interaction between the shallow groundwater table and the Haehanga Stream is a function of the elevation of the water table adjacent the Haehanga streambed. For example, if groundwater elevations in the monitoring bores are greater than the stream bed elevation, in all probability the stream will be gaining water from the shallow groundwater table. Conversely, streams can lose water from the groundwater table by outflow during periods of low groundwater levels when stream flows are high.

The degree of connection between the Haehanga Stream and the unconfined groundwater table changes laterally in space over differing reaches of the stream and over time. As the shallow groundwater table responds to recharge from rainfall, previously losing reaches become gaining reaches (Table 2.4). For example the reach of Haehanga Stream adjacent GND 2190 in December 11th 2015 and April 30th 2015 was probably losing to the Haehanga Stream. Both time periods coincided with 102 and 59 mm of rainfall in the preceding two days, with elevated soil moistures in the range of 44 and 45 %. Conversely, prior to January 8th 2015, Uruti received only 1 mm of rain in the previous eight days, with soil moistures at 32 %, this would have resulted in minimal outflow 'gaining' from the Haehanga Stream to the groundwater table.

**Table 2.4:Stream and Groundwater Elevations (msl)**

| Date | Bore | Bore elevation | Stream Elevation | GW elevation | Groundwater Connectivity |
|---|---|---|---|---|---|
| 30-04-2015 | GND 2188 | 35.61 | 35 | 34.907 | Gaining from stream |
| 30-04-2015 | GND 2189 | 30.82 | 30 | 30.267 | Losing to Stream |
| 30-04-2015 | GND 2190 | 24.9 | 24 | 24.19 | Losing to Stream |
| | | | | | |
| 08/01/2015 | GND 2188 | 35.61 | 35 | 34.39 | Gaining from stream |
| 08/01/2015 | GND 2189 | 30.82 | 30 | 31.74 | Losing to Stream |
| 08/01/2015 | GND 2190 | 24.9 | 24 | 23.6 | Gaining from stream |
| | | | | | |
| 11/12/2014 | GND 2188 | 35.61 | 35 | 35.18 | Losing to Stream |
| 11/12/2014 | GND 2189 | 30.82 | 30 | 30.54 | Losing to Stream |
| 11/12/2014 | GND 2190 | 24.9 | 24 | 24.665 | Losing to Stream |

# 3 DISCUSSION

This preliminary groundwater investigation in the Haehanga Catchment recorded the clay soils form a semi-impervious shallow groundwater table overlain by more porous silty loamy-clays. The shallow groundwater table has been recorded between 0.25 metres below ground level (mbgl) at lower elevations of the site and 0.43 mbgl at higher elevations. The greatest depth to the groundwater table was recorded on GND 2188 on April 26th 2012 at 1.4 mbgl. The average depth to the groundwater table adjacent GND 2190 (most down-gradient bore) is 0.81mbgl. Therefore the shallow groundwater table is in almost constant interaction with the more porous loamy silty-clay's.

Seasonal differences are evident in groundwater elevations across the site, with the Winter-Spring months recording higher groundwater elevations. The groundwater flow pattern most likely is subdued to the overall topography, and flowing in a down valley gradient. Groundwater velocities have been estimated in the order of 0.2315 m/day. However, due to inconsistences in slug test data, only permeability calculation for one monitoring bore GND 2190 (lower part of the site) could be assessed. It must be noted that the Clay content of the soil profile was higher adjacent GND 2190 compared to the mid and upper parts of the site. Higher groundwater velocities would be expected through the more porous loamy soils adjacent GND 2189 and GND 2188.

The close hydraulic connection between the Haehanga Stream and the shallow groundwater has been documented as observed by Regional Council Staff. Rainfall recharge to groundwater is influenced by the hydraulic properties of the overlying soils, with the soils storage capacity the main characteristic to determine the recharge rate. At present rainfall recharge estimates which may influence potential contaminate loadings to the shallow groundwater table have not be made.

Appendix C goes some way to document how discharge/outflow events (i.e no rainfall, decreased soil moistures) and continued leachate irrigation results in elevated chloride concentrations in both the surface and groundwater resources. During these discharge events, where stream-flows are low over the summer months, the shallow groundwater table is most likely losing water to the Haehanga Stream. Therefore, limited water within the shallow groundwater table and the Haehanga Stream appears unable to attenuate the continued drainage losses of chloride through the soil profile as a result of continued irrigation.

Although outside the budgetary scope of the current investigation some consideration should be given to determine the 'time lag' of transport of chloride (and other contaminates) through the hydrological system as a response to outflow events in summer. At summer low flow periods, there is likely a greater potential of elevated chloride loadings to the Haehanga Stream and other downstream receptors. The downstream impact to stream biota has yet to be quantified as continuous 'time series' groundwater and surfacewater data are current unavailable.

The preliminary Conceptual Site Model has been developed (Appendix D) but as yet is not confirmed. The CSM has identified potential hydrogeological 'exposure pathways' for contaminates in the Haehanga Catchment, such as the chloride loaded porous surface soils being in direct contact with the shallow water table, and the reaches of Haehanga Stream 'gaining' water from the groundwater table, adjacent GND 2190 in the lower irrigation zone. However, considerable more information is required to confirm the CSM, in particular the identification of downstream receptors for all contaminates potential leaving the site, not only chloride but also metal and hydrocarbons contaminates.

# 4 RECOMMENDATIONS

The following recommendations aim to improve the management of water resources in the Haehanga Stream. These recommendations are additional to the recommendations made in the Uruti Composting Facility Management Report.

Specific recommendations include;

- Undertaking groundwater levels (and conductivity) measurements daily in the existing and proposed monitoring bores.
- Incorporate and align groundwater gauging data with surface water data (quantity and quality) with meteorological information to develop a Uruti Composting Facility Monitoring Plan.
- After 12 months of data collection, use the Monitoring Plan above as the basis for a catchment impact assessment, with the following goals

    1. Assess the potential adverse effects to downstream receptors in the Haehanga and Mimi River.
    2. Use the monitoring data to gauge the success of the previously recommended site improvements outlined in the Uruti Composting Facility Site Management Plan.
    3. Update and confirm the preliminary Conceptual Site Model with the monitoring data. The CSM will assist in future investigations on site, with emphasis on the transport of potential contaminates through the Haehanga hydrological system to important downstream receptors, such as the regionally significant Mimi Stream.
    4. Use the updated groundwater and stream flow monitoring and meteorological data to calculate rainfall recharge rates, and then model chloride 'fate and transport' through the soil profile to surface waters.

- Ensure that all future monitoring bores advanced onsite be done so by an approved drilling contractor, so that accurate bore logs and lithology can be determined.
- It is also recommended that the groundwater velocity calculation be updated once the lithology and bore construction data is ascertained for any bores advanced in the upper parts of the site.

## 4.1 Limitations

BTW Company has prepared this report for RNZ using available data sources, generally accepted practise and standards at the time it was prepared (June 2015). It is noted that the following limitations exist in the data potentially impacting on hydrogeological interpretation.

Information in this report cannot be used or reproduced without the prior authorisation of BTW Company. The following limitations are also acknowledged;

- The lack of lithology data and bore construction information. It is accepted that bore logs are only an indication of inferred ground conditions at the specific location. However, without this data aquifer properties were estimated as clay to the base of the aquifer. For example, although the clay above 2000 mm appears continuous, uncertainty exists at greater depths to whether the clay forms a continuous layer or more permeable loamy/organic soils exist. However, in all probability the underlying papa mudstone would be a deeper confining layer across the catchment. Papa outcrops in the Haehanga Stream substrate are commonplace and observation of staff during construction activities suggest basement geology is between 3-6 metres deep.

- Therefore, the aquifer depths required to calculate the Bouwer and Rice Method (1976) were estimated from general site observations, and from interpreting spot heights from the topographic survey.

# REFERENCES

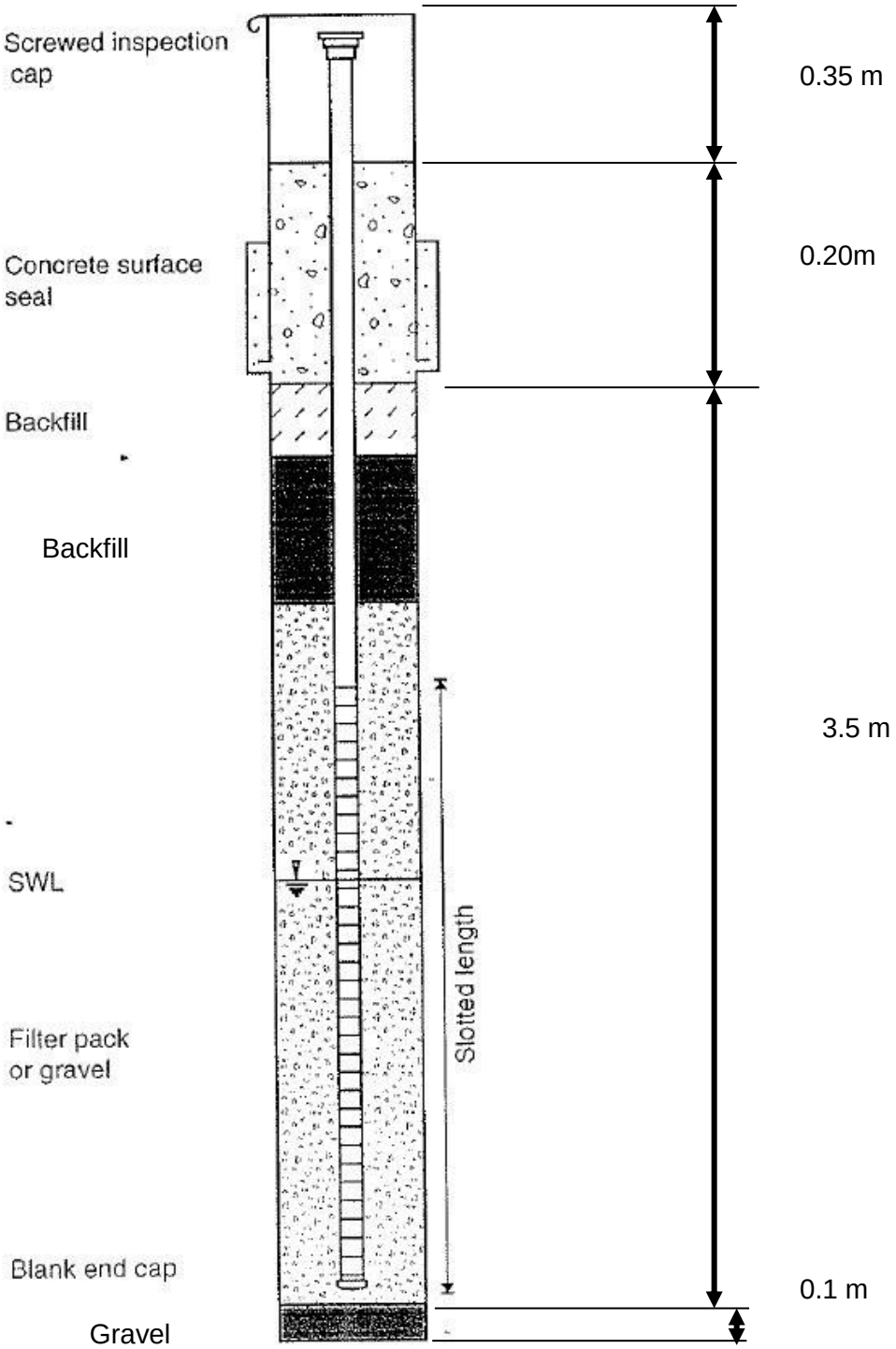
Bouwer, H. and R.C. Rice, 1976. A slug test method for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells, Water Resources Research, vol. 12, no. 3, pp. 423-428.

Cowperthwaite, S. 2015 Personal Communication with Author. Taranaki Regional Council, Scientific Officer

McWorter, D.B, Sunada,D.K 1977. Ground-Water Hydrology and Hydraulics. Water Resources Publications, Colorado.

# APPENDIX A MONITORING WELLS- REMEDIATION NEW ZEALAND- URUTI

## Monitoring wells – Remediation New Zealand - Uruti



CASING and SCREENS:
PVC: 51.8mm (2-in) satisfactory,
slotted screen.
Steel, Teflon

The location of the three monitoring wells are approximately at:

MW 1 – Baseline at 1732369 E – 5684631 N **GND2188**

MW2 – Irrigation area 1 at 1732302 E – 5684926 N **GND2189**

MW3 – Irrigation area 2 at 1731851 E – 5685677 N **GND2190**

**Monitoring well installation**

- Final depths should be measured and recorded
- The slotted portion of the pipe should start 0.2m below the ground level as per the schematic. This is not the case in all the bores.
- The top of the monitoring well should be capped to prevent contaminants entering the bore
- The top of the casing should be 300 mm above the ground and sealed so that potential contaminants or small animals cannot get in.
- A 2 meters perimeter fence should be erected around the monitoring well ( i.e, 0.5 x 0.5 x0.5 x 0.5)

# APPENDIX B MONITORING BORE INSTALLATION

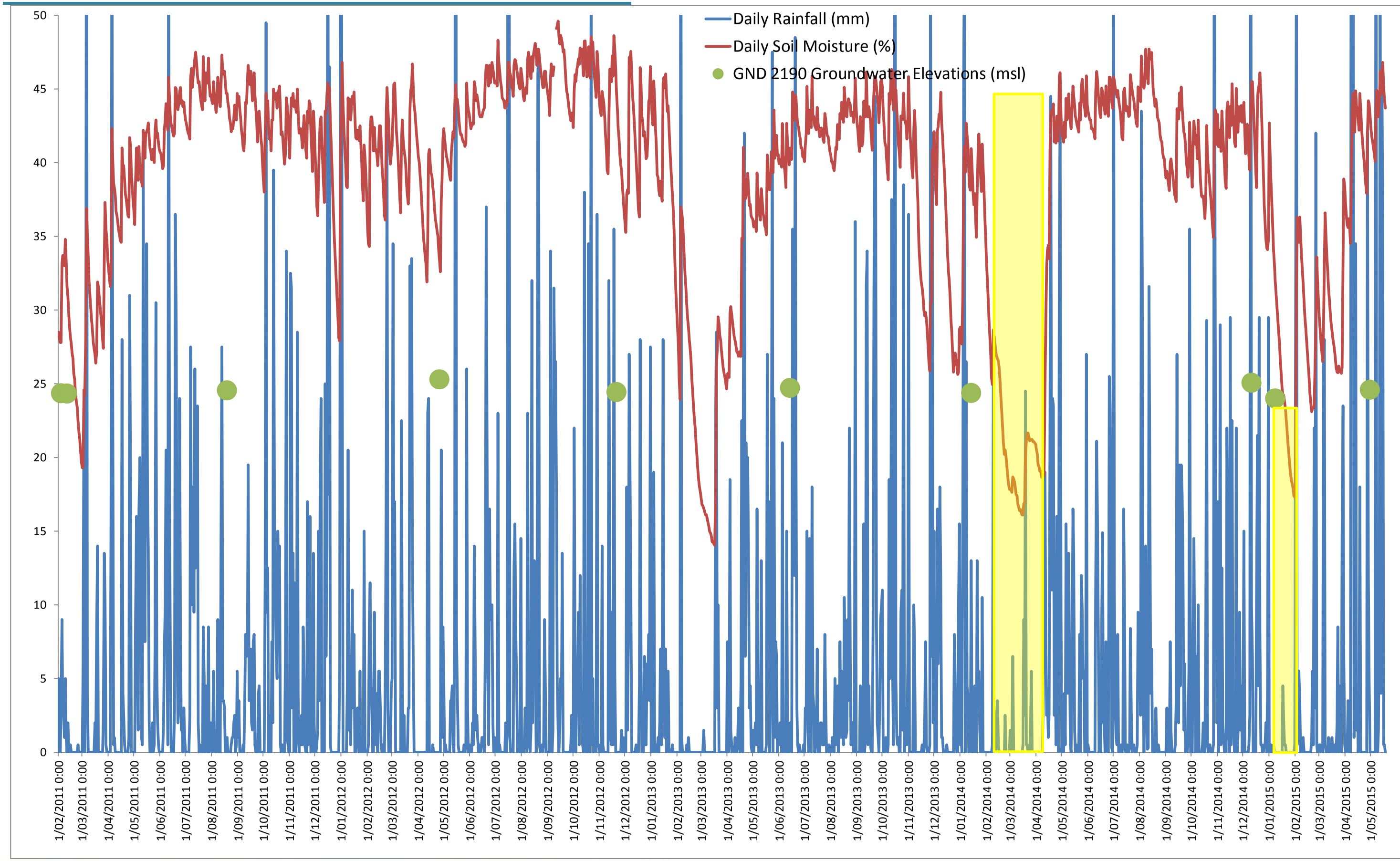
# APPENDIX C SOIL MOISTURE AND RAINFALL RECHARGE ON CHLORIDE CONCENTRATIONS IN GROUNDWATER

**Preliminary Summary**

Examination of soil moistures (2003-2015), rainfall statistics, and available water chemistry data record elevated chloride within groundwater during periods of low rainfall and soil moistures (groundwater discharge to stream). During these periods groundwater levels (and most probably stream levels) are reduced (Table 2.1 & 2.2) and there is limited water within the hydrological system to attenuate the irrigated leachate. For example, the highly elevated chloride concentrations recorded in March 2014 in the Haehanga Stream and the monitoring bore GND 2190, coincided with the second lowest monthly rainfall total between 2003 and 2014, a very low soil moisture of 18% (yellow bars in figure below).

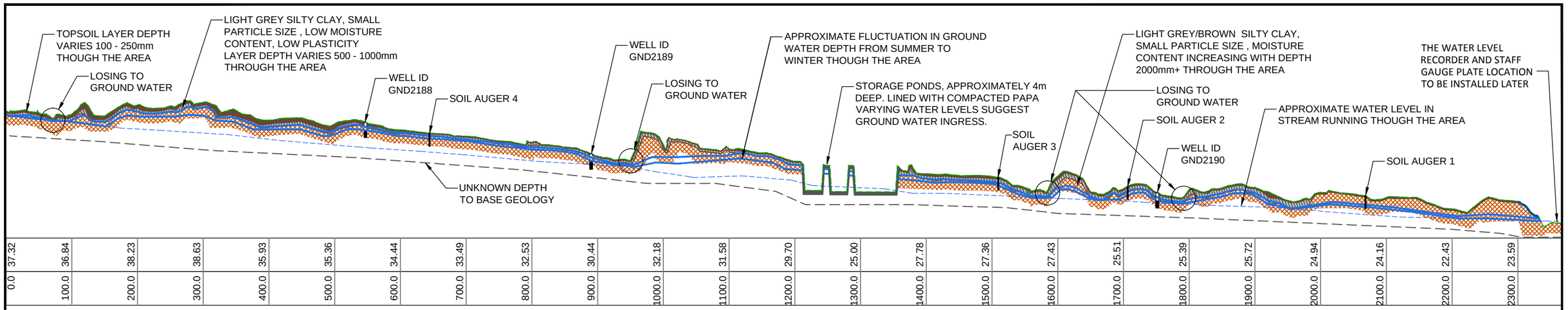
It is therefore, recommended that the following be considered:

- Once the water level recorder site has been installed in the Haehanga Stream, a full hydrogeological investigation should be undertaken in 12 months. This investigation should incorporate all the updated data streams including rainfall, soil moisture, groundwater elevations and Haehanga Stream discharge volumes. This will assist in quantifying potential drainage losses and/or adverse effects from the Uruti Composting Facility to surface water receptors downstream.




**Uruti at Kaka Road Monthly Rainfall and Soil Moistures, yellow bars denote elevated Chloride concentrations in the Haehanga Stream and monitoring bore GND 2190**

# APPENDIX D PRELIMINARY UNCONFIRMED CONCEPTUAL SITE MODEL




PROFILE
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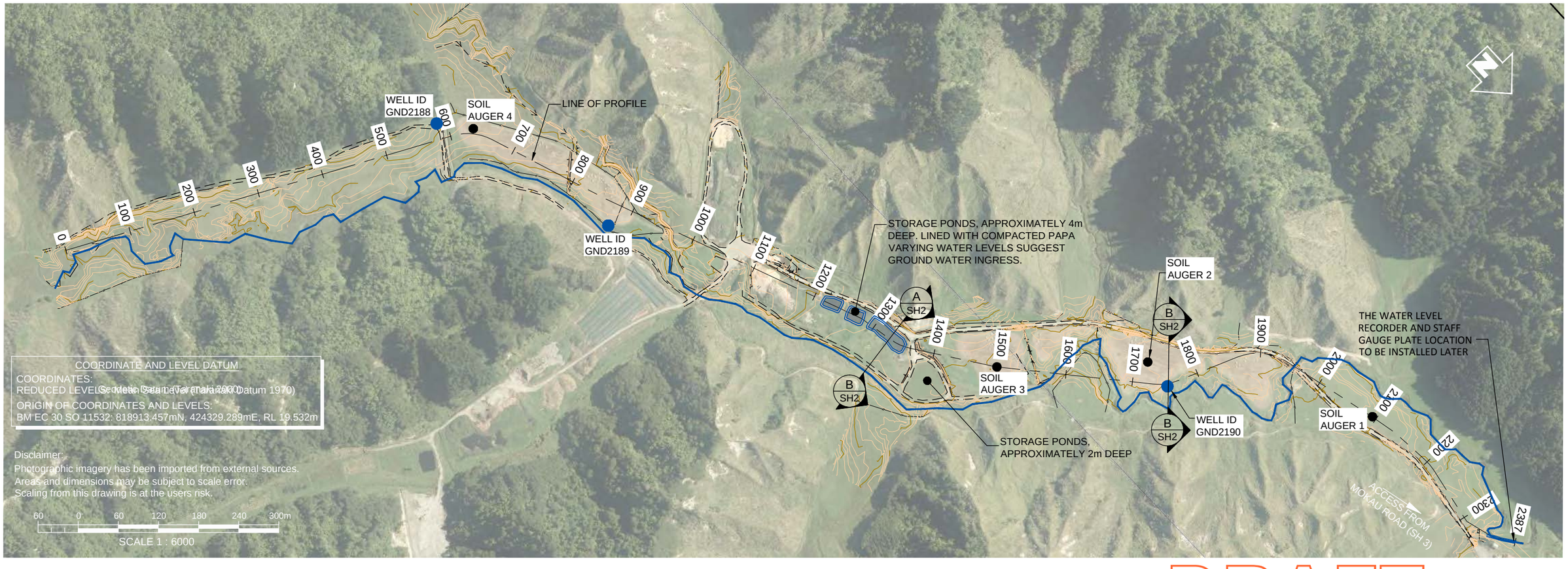
SCALE 1:600 (A3) HORIZONTAL




COORDINATE AND LEVEL DATUM
COORDINATES:
Geodetic Datum Taranaki 2000
REDUCED LEVELS: Mean Sea Level (Taranaki Datum 1970)
ORIGIN OF COORDINATES AND LEVELS:
BM EC 30 SO 11532: 818913.457mN, 424329.289mE, RL 19.532m

Disclaimer:
Photographic imagery has been imported from external sources.
Areas and dimensions may be subject to scale error.
Scaling from this drawing is at the users risk.

60 0 60 120 180 240 300m
SCALE 1 : 6000

PLAN
SCALE 1:6000 (A3)

DRAFT

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. planners
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| NO | DATE | BY | CHKD | APPR | OPER | DESCRIPTION |
|---|---|---|---|---|---|---|

REVISIONS

| NUMBER | TITLE |
|---|---|

REFERENCE DRAWINGS

GENERAL NOTES
1. Coordinates in terms of : Geodetic Datum (Taranaki 2000)
2. Elevations in terms of : Mean Sea Level (Taranaki Datum 1970)
3. Contour interval is : 0.5m

| | | |
|---|---|---|
| LOCATION | MOKAU ROAD, URUTI | |
| PROJECT No. | 14745.01 | |
| A3 SCALE | 1:6000 | |
| SURVEYED | TV & TD | 25.03.2015 |
| DRAWN | LV | 24.06.15 |
| CHECKED | - | - |

TITLE
REMEDIATION (NZ) LTD
SOIL PROPERTIES
PLAN AND PROFILE

| ORIGINAL SIZE | DRAWING No | SHEET | REVISION |
|---|---|---|---|
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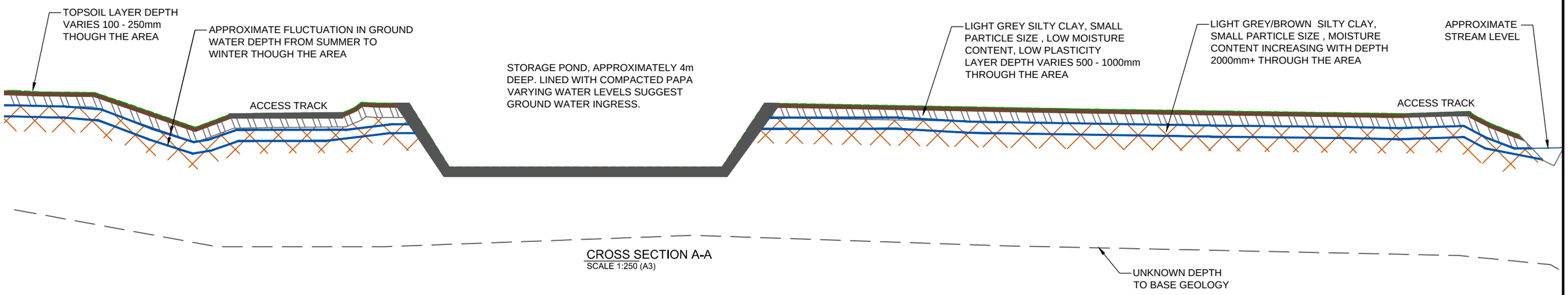


CROSS SECTION A-A
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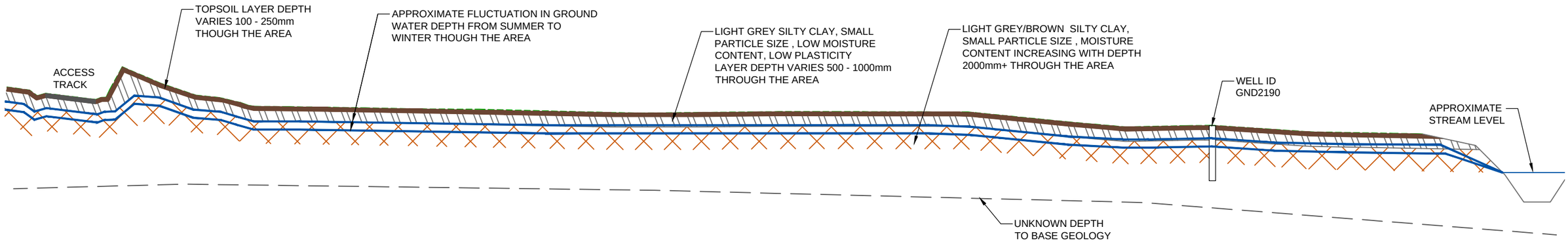


CROSS SECTION B-B
SCALE 1:250 (A3)

DRAFT

File Name: J:\14745.01\Dwgs\14745.01- 03.dwg - OVERVIEW Plot Date: 30/06/2015 Plot Time: 09:54

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| NO | DATE | BY | CHKD. | APPR. | OPER. | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | | | | |

REVISIONS

| NUMBER | TITLE |
|---|---|
| | |

REFERENCE DRAWINGS

GENERAL NOTES
1. Coordinates in terms of :
2. Elevations in terms of :
3. Contour interval is :

| | | |
|---|---|---|
| LOCATION | MOKAU ROAD, URUTI | |
| PROJECT No. | 14745.01 | |
| A3 SCALE | 1:250 | |
| SURVEYED | TV & TD | 25.03.2015 |
| DRAWN | LV | 24.06.15 |
| CHECKED | - | - |

TITLE
REMEDIATION (NZ) LTD
SOIL PROPERTIES
CROSS SECTIONS

| ORIGINAL SIZE | DRAWING No | SHEET | REVISION |
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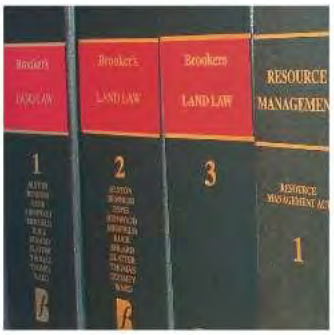
# *REPORT*

## Uruti Composting Facility Management Plan




btw company
surveyors . planners . engineers . land & g·i·s services

# Uruti Composting Facility Management Plan

Remediation New Zealand

**Reviewed**

| | | |
|---|---|---|
| **Report Author** | | |
| | Greg Larkin, Environmental Scientist , BSc Ecology and MSc in Environmental Science | Date |
| **Reviewed by** | | |
| | Dave Bolger, Senior Environmental Advisor, BSc Physical Geography and Environmental Science | Date |

# EXECUTIVE SUMMARY

BTW Company has been engaged by Remediation New Zealand (RNZ) to undertake an environmental data review of its Uruti Composting Facility in North Taranaki. The primary objective of the report was to develop a site management plan with operational recommendations to improve soil and groundwater resources in the Haehanga Catchment.

The main points of the environmental data review can be summarised by the following main points:

- Surface soils across the site are dominated by semi-porous silty clay-loams, overlying more impervious clay soils
- Soils below 2000 mm have not been characterised
- Chloride concentrations in the soil beneath the irrigation zone are highly elevated compared to non-irrigated areas
- The shallow groundwater table is in direct connection with semi-porous loamy silty-clay
- Due to high rates of irrigation loading, shallow groundwater beneath the Uruti Composting Facility Site are moderately impacted with Chloride contamination
- Site layout, hydrogeological interactions, soil types and rainfall also influence the level of Chlorides observed in the soil, groundwater resources and the Haehanga Stream environment
- Offsite impacts have not been quantified and where not part of the scope of this report

The Uruti Composting Facility Management Plan was developed to improve the performance of the composting facility. The plan incorporates both landuse and management controls such as operational thresholds, monitoring timeframes and remediation options. These are considered necessary to ensure compliance with consent conditions and to mitigate adverse effects on the receiving environment.

The plan was developed in conjunction with RNZ and Taranaki Regional Council (TRC), and closely adheres to relevant national and international guidelines and standards.

The plan framework is based on a three tier decision tree which guides site operation. The tiered response was developed because of simplicity but also allows increased monitoring effort and reviews of site performance to minimise risks from drainage losses to groundwater and accumulation of hydrocarbon constituents within the soil. Within each tier, specific constituent threshold values for the operation have been set to protect the soil and groundwater.

The tiered operational plan also provides remediation options should the irrigation zones reach tier 2 and 3. Potential remediation options focus on irrigation and soil management.

The Uruti Composting Management Plan also makes recommends a range of site improvements with attached implementation timeframes. BTW Company considers the recommendations and timeframes necessary to improve the management of site and to reduce offsite adverse environmental effects.

Specific Site Improvements include;

- Storage dam to provide a clean water source for summer time irrigation
- Increased irrigations zone (currently pending consent variation)
- Stormwater improvements
- Predisposal and pre irrigation sampling
- Haehanga Stream riparian planting
- Deferred irrigation
- Haehanga Stream irrigation setback (25m)

# CONTENTS

# TABLES



# FIGURES

# 1 INTRODUCTION

## 1.1 Background

BTW Company has been engaged by Remediation NZ Limited (RNZ) to undertake a review of its land disposal and composting site in the Haehanga Catchment at Uruti, in North Taranaki. The review covers a synopsis of available environmental and operational data with a view to recommend steps to develop soil and groundwater management plans for the site.

The report does not aim to assess the potential adverse effects to downstream ecological receptors such as fish or invertebrate values, but rather focuses on management improvements at the Composting Site. It is envisaged as part of the upcoming consent variation to increase the irrigation areas, that a separate Assessment of Environmental Effects (AEE) will be undertaken for that consent application.

### *1.1.1 Activity Description*

The Remediation NZ facility at Uruti processes compost material and drilling mud and fluid, from both WBM and SBM waste streams. The hydrocarbon exploration material is stockpiled on the Drill Mud Pad (DMP), where the leachate is then captured and treated in the series of ponds. The three ponds are separated by baffles whereby surface hydrocarbons are skimmed and removed back to the hydrocarbon pile. The treated leachate is held in two final ponds and then irrigated to pasture on the two irrigation areas, one upstream of the DMP and one immediately downstream of the DMP. A seven tier wetland is also used to treat run off and leachate from the composting pad 2 but only discharges treated stormwater in high flow conditions.

The estimated total capacity of the three treatment ponds is approximately 10310 $m^3$, whereas average pumping rates are in the order of 30,000 litres per hour, during daylight hours only. This equates to 6.75 days to pump the final treatment pit of 5360 $m^3$ pit.

### *1.1.2 Environmental/Management Issue*

The Taranaki Regional Council's (TRC) historical monitoring data recorded most of the parameters tested at the Uruti site were within their consent requirements (TRC monitoring report, 2013-2014). However, concentrations of Chlorides had increased significantly in early-2014 in both irrigation fluid, groundwater and surface water samples, alongside increased sodicity of the soils beneath the irrigation areas.

The sources of the increasing Chlorides and hydrocarbons were attributed to changes to the composition and volumes of the irrigation fluid, as a result of the increases in hydrocarbon exploration waste being processed and disposed of at the site.

The following sections of the report concentrate on the issue of elevated Chlorides at the Uruti Composting site. It is acknowledged there may be potentially other contaminates of concern which may require future attention.

# 2 ENVIRONMENTAL DATA SYNOPSIS

## 2.1 Catchment

The Remediation NZ Uruti composting facility is located in the Haehanga Catchment in North Taranaki. The Haehanga Stream is a tributary of the Mimi River, a regional significant river and important recreational whitebait fishery. The Haehanga Catchment covers 5.73 $km^2$ (TRC explorer), with monthly rainfall averaging 176 mm. In the areas, outside the composting facility land use is dominated by extensive dry stock and sheep grazing on introduced grasslands on the valley floors. Whereas on the steep valley sides and ridgelines, exotic forests, introduced scrub and regenerating native vegetation exists. The catchment geology in the Mimi and Haehanga is dominated by Papa mudstones which are easily eroded resulting in poor water clarity in most of the water ways.

## 2.2 Haehanga Stream

The Haehanga Stream is an entrenched meandering stream below the site, but adjacent to the composting facility the stream has been modified and channelized to provide drainage away from composting activities. The stream was relocated and channelized on to the north-eastern side of the valley adjacent the current Drill Mud Pad (DMP). Numerous groundwater seeps are obvious across the site and adjacent the Haehanga Stream and its tributary. Immediately upstream of the DMP the Haehanga Stream branches into four separate tributaries, the largest tributary flowing in a south-eastern direction.

Substrate in the Haehanga Stream is a mixture of fine sediments such as clays in the slower flowing margins and pools and courser sands and gravel in the riffles habitats. Papa mudstones exist as a basement substrate of the stream at several locations. Stream substrates reflect the catchment geology with Papa dominating the ridges and cliff areas which are eroding and clayey loams on the side flanks and valley floors. The depth to the basement 'papa' mudstone in the Haehanga has not been accurately defined but is estimated between 3-6 metres below ground level (mbgl).

## 2.3 Soils

### *2.3.1 Classification*

Soils in the Haehanga Catchment are classified as Orthic brown soils from the Whangamona Complex loams, which have a high clay content (NZ Soils Classification, V4). Orthic brown soils have a weakly structured sub soil, which is common on slopes or young land surfaces. Brown soils have a brown or yellow-brown subsoil below a dark grey-brown topsoil. The brown colour is caused by thin coatings of iron oxides weathered from the parent material. Brown soils occur in places where summer drought is uncommon and which are not waterlogged in winter. They are the most extensive soils covering 43% of New Zealand's landmass.

### *2.3.2 Soil Profiles*

On the 8th January 2015, BTW Company staff undertook soil profile and structural analysis at four sites across the site including the proposed new area for irrigation immediately upstream of the site entrance. Soil profiles were ascertained with a hand auger and each horizon classified.

The location of soil sampling points are shown in Figure 2.1 and results are contained in Appendix A.

### 2.3.3 Soil Chemistry

The TRC has undertaken five sets of soil samples between 2011 and 2014, and these results are summarised in Figure 2.2. The soil chemistry data records an increasing pattern of chloride concentrations with the samples collected in April 2014, recording 1161 and 1559 mg/kg of Chloride, respectively. The movement of soluble ions in soils, such as Chloride relies on convection and diffusion fluxes. For chloride leaching it's the downward convection associated to adequate rainfall (and irrigation) which results in rapid movement through the soil, whereby it can be deeply leached, particularly in soil profiles less than one metre deep. This can result in increasing Chloride concentrations down the soil profile.

BTW company undertook four soil samples at two depths within the lower and upper irrigation areas (8th Jan 2015), and a single 'background' sample from the proposed irrigation area. These results are summarised in Appendix B and Figure 2.3. Soils samples were undertaken at 250 mm (Upper) and at 1.0 m (Lower) deep and their location was identical to the soil profile sites.

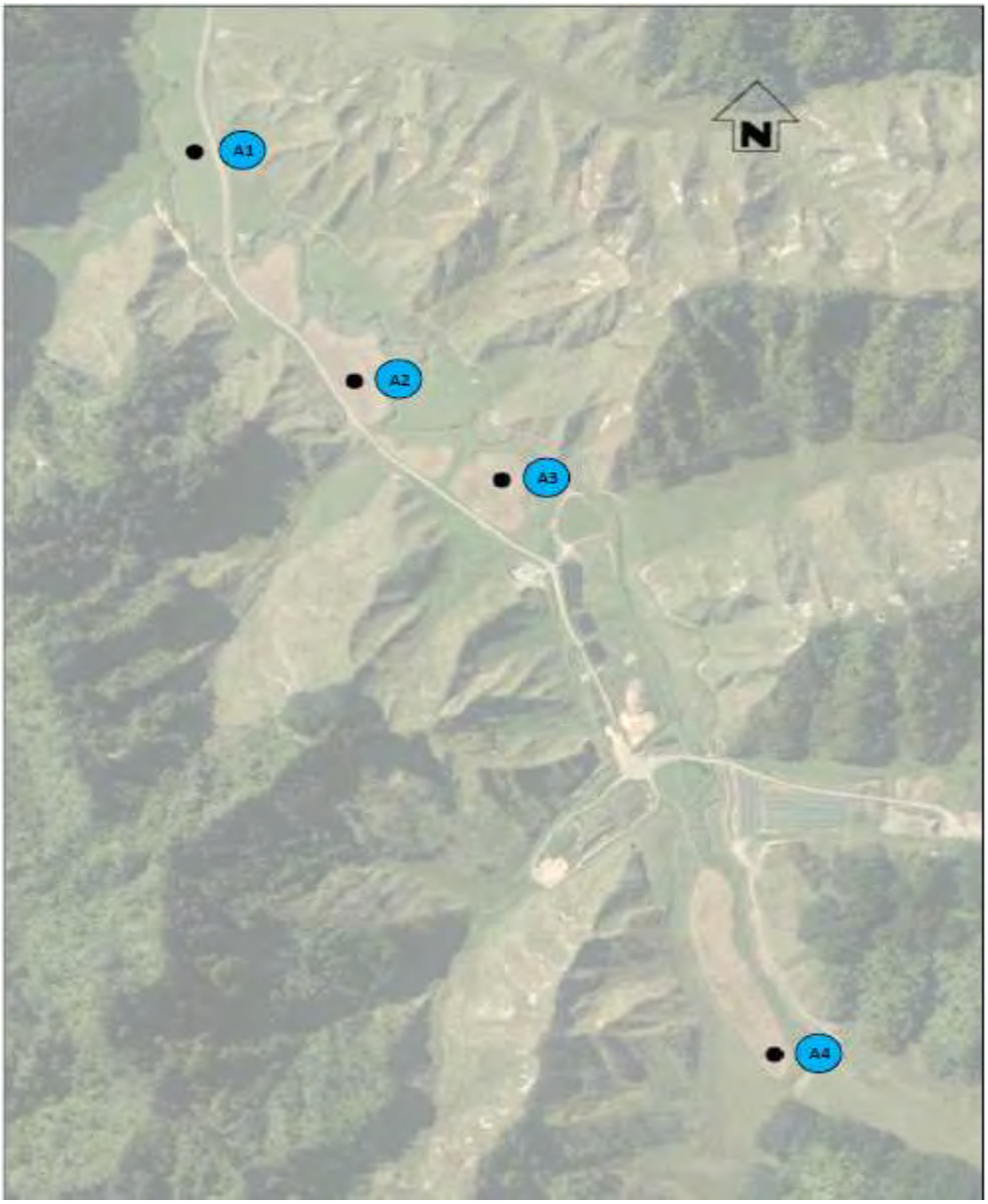



**Figure 2.1: BTW Company Soil Sample and Auger Test Holes**

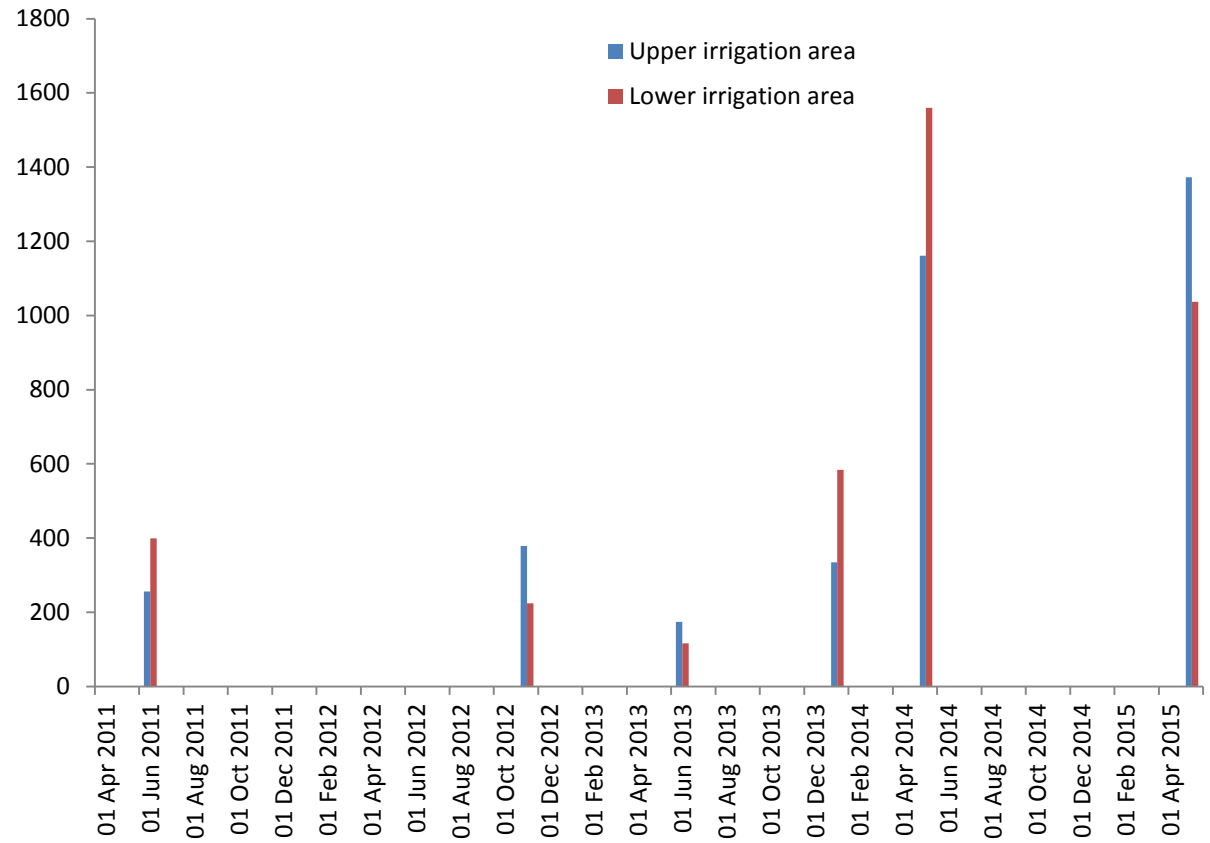



**Figure 2.2: TRC soil samples for Chloride at Uruti Composting Facility (mg/kg)**

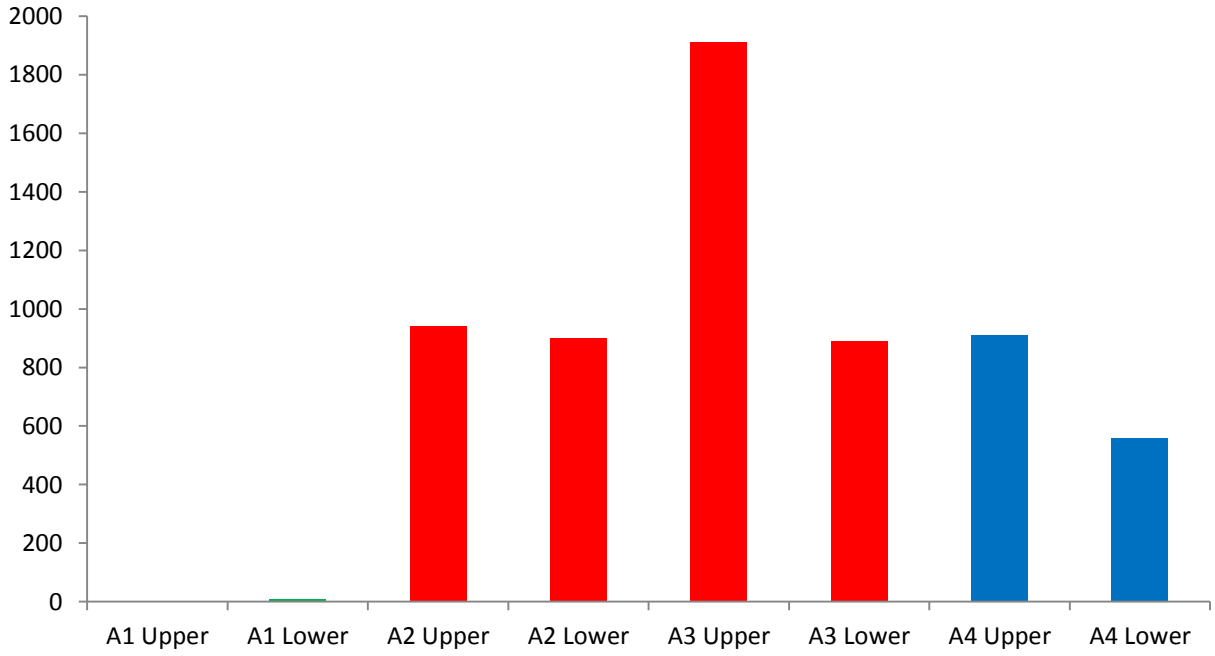



**Figure 2.3: BTW Company Chloride soil profiles at Uruti Composting Facility (mg/kg)**

The TRC results show that elevated chloride concentrations exist within the soil profile, initial in the lower irrigation area in 2014, then the upper irrigation area in 2015. These concentrations are consistent with BTW Company soil samples (Figure 2.3) which recorded Chloride concentrations between 1600-1910 mg/kg in the top 250 mm and 890 mg/kg at 1.0 metre deep. The difference in the Chloride concentration down the soil profile is interesting given Chlorides general nature of increasing down the soil profile. A explanation for the recorded decrease of Chloride down the soil profile may lie in the porous silty/loamy clay are in direct contact with the shallow groundwater table below 0.5-0.75 metres below ground level. This would result in drainage losses to the shallow groundwater table and probable movement down-gradient.

The BTW Company soil samples also recorded very acidic soil (pH 4.9 to 4.6) beneath the irrigation zones as well as in the background sample. A single sample undertaken by Perry Environmental Staff in 2003 prior to any development of the site is consistent with these samples, indicating that soil pH was very acidic pH=4.2. The Cation Exchange Capacity of the soil was also very low, which indicates the soils can only retain low levels of cations (Potassium, Ca, Mg and Na), and thus have limited nutrient retention. This in all probability allows the negatively charged Cl- to be further leached from the profile by severe rainfall.

The importance of higher CEC values allows acid soils to be more easily neutralised. However, for silt clay loams as in the Haehanga which have low CEC, soils will take longer to neutralise until the CEC is increased. It is therefore recommended options be investigated to increase the CEC of the soil beneath irrigation zones, such as improving the organic matter to enhance nutrient retention and to minimise losses to groundwater.

## 2.4 Irrigation fluid/Leachate

Figure 2.4 below summarises Chloride samples of the Irrigation fluid from 2011 to October 2014.

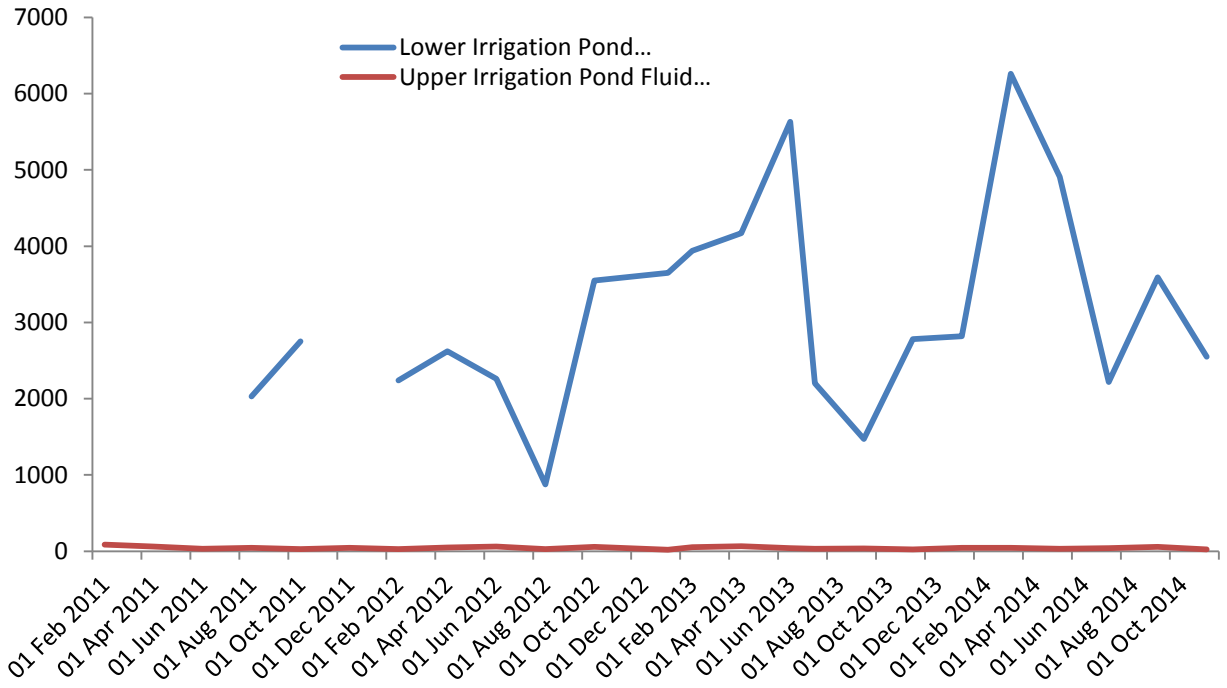



**Figure 2.4: Irrigation fluid Chloride Concentrations (mg/L)**

The irrigation fluid samples record large variations in Chloride concentrations with a pronounced peak in March-2014, which is consistent with all other environment data collected at that time. Following early-2014, Chloride concentrations within the fluid have dropped significant but remain between 2220 and 3600mg/l. However, as predisposal samples have not been undertaken, it is difficult to determine if the changes in Chlorides are attributed to increased hydrocarbon volumes and other material accepted at the site, and/or other operation issues, such as the treatment pit reaching capacity and yielding a low grade leachate for irrigation, particularly over summer.

The TRC has undertaken Sodium Absorption Ratio analysis on the irrigation fluid four times between September 18th 2013 and March 13th 2014. Concentrations of Calcium, Magnesium and Sodium were sampled, and the SAR calculated with the ratio between Ca, Mg and Na generally consistent. The results are summarised in Table 2.1

**Table 2.1: Irrigation Fluid SAR**

| Date | CA (g/m3) | MG(g/m3) | NA(g/m3) | SAR |
|---|---|---|---|---|
| 18 Sep 2013 | 260 | 30.6 | 550 | 8.59631 |
| 20 Nov 2013 | 518 | 43.9 | 818 | 9.27120 |
| 14 Jan 2014 | 673 | 43.5 | 753 | 7.59885 |
| 13 Mar 2014 | 1576 | 90.6 | 1852 | 12.27860 |

Leachate levels within the final DMP oscillate in response to irrigation but also surface and potentially groundwater recharge, evaporation and direct rainfall input. Typically, levels in the DMP are higher in the wetter months and lower in the late summer months. Due to evaporation over summer (and less rainfall or surface water ingress) the quality of the leachate over the summer months can be degraded (Larkin, G pers obs, 2014-15). This is partly reflected in the Irrigation SAR samples with the two highest SAR calculations in January and March, whereas the lowest Irrigation SAR values are for Spring.

### *2.4.1 Irrigator Loading Rates*

The following table is a summary of the available irrigator flow volumes, nozzle spray flow rates, pump capacity and a basic hydraulic loading rate for Chloride fluid based on the Irrigator fluid/leachate samples (IND002244). The hydraulic loading rate takes the assumption that the lower irrigation area averages three hectares, and is based on two Chloride concentrations in the Irrigator Fluid; 1) 2000 mg/L (Lower Limit) and 2) 6000 mg/L (Upper Limit).

The hydraulic areal loading rate equation is = pump flow ($m^3$/day)/Area (ha)

**Table 2.2: Uruti Composting Facility Operational Data**

| Feature | Volume |
|---|---|
| Pump Capacity (litres per hour) | 33000 |
| Pump Capacity (litres per second) | 9.16 |
| Pump Capacity 8 hrs pumping (litres per day) | 264000 |
| Lower Irrigation area Areal Loading (litres/ha/day) | 88000 |
| Lower Irrigation area Areal Loading (litres/$m^2$/day) | 8.8 |
| Lower Irrigation area Chloride Loading if irrigator fluid is 2000 mg/L (mg/l/$m^2$) | 17600 |
| Lower Irrigation area Chloride Loading irrigator fluid is 6000 (mg/l/$m^2$) | 52800 |

Note: the loading rates do not take into account biases encountered from differences in nozzle spray, head differences and variable pumping speeds.

## 2.5 Haehanga Stream Chloride Concentrations

Surface water quality in the Haehanga Stream and its tributaries has been undertaken by the Taranaki Regional Council since 2002 at nine sites. Chloride concentrations within surface water show a clear increase in concentrations downstream of the site, with an increase of chloride adjacent discharge sites, the downstream irrigation area and in the receiving environment in March 2014. Chloride concentrations post-March 2014 then significantly decreased, with all sites well below the consented limits for Chlorides in all samples (mg/l). Figure 2.5 Chloride Concentrations in Haehanga Catchment 2011.

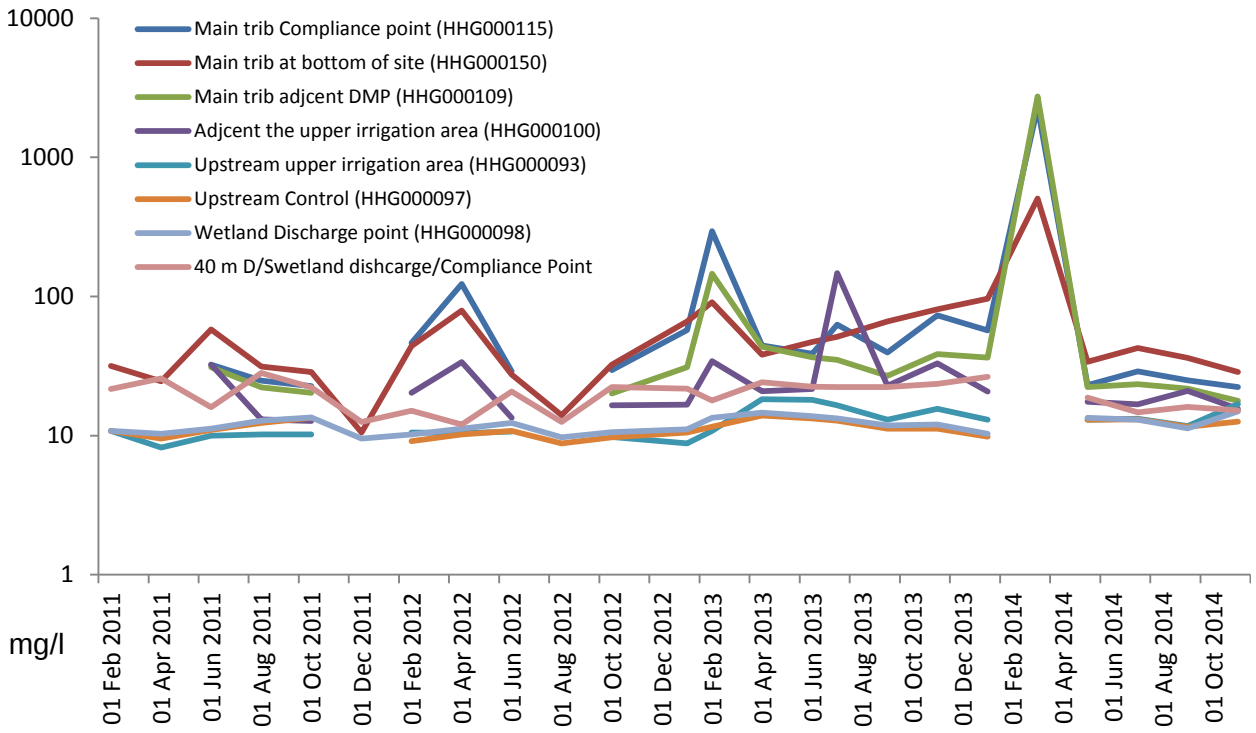



**Figure 2.5: Haehanga Stream Chloride Concentrations (mg/L)**

## 2.6 Chloride Concentrations in Groundwater

The below section summarises the two years of data from three monitoring bores at the composting facility; GND 2188 upstream (control site), GND 2189 upstream irrigation area (impact site) and GND 2190 the downstream irrigation area (impact site). Groundwater concentrations show a clear impact from chloride concentrations via drainage losses, with the upstream control site recording greatly reduced chloride levels compared to the impact monitoring bores adjacent and downstream of irrigation zones.

The TRC monitoring data was last undertaken in 30th April 2015, with Chloride concentrations recorded at 1340 mg/l in GND 2190. Chloride concentrations in GND 2189 recorded a decrease from 292 to 133 mg/l, with the upstream control bore GND 2188 consistently recording low concentrations of Chloride.

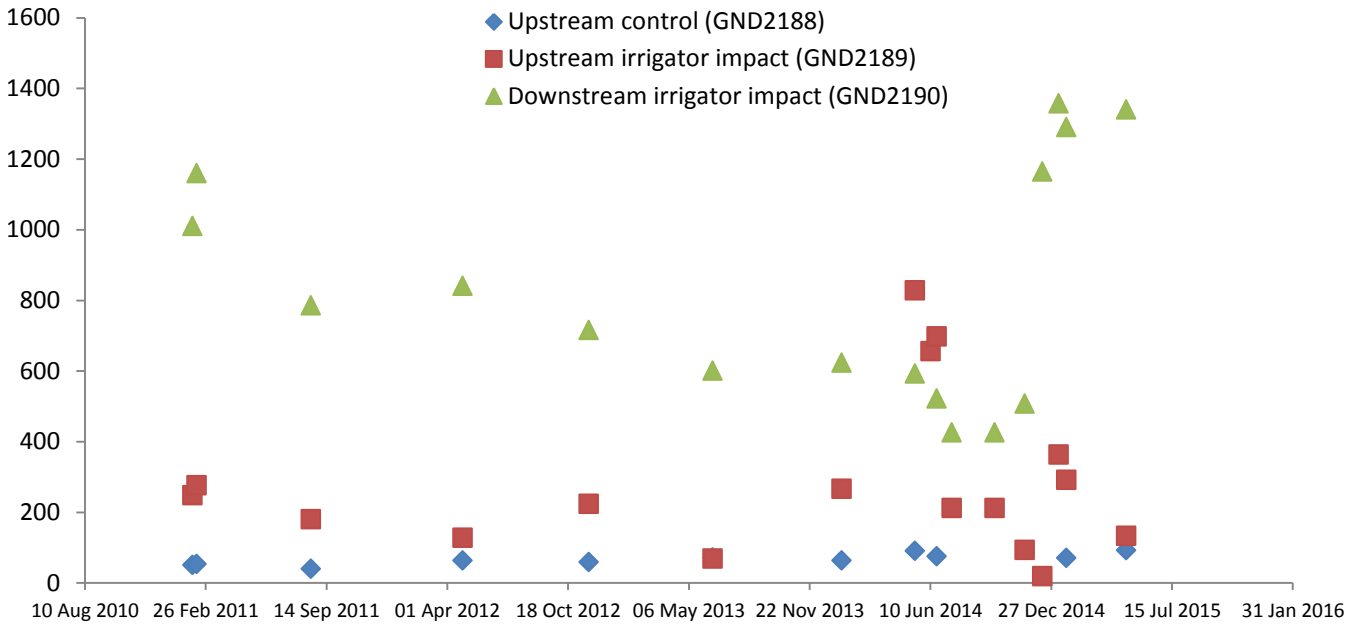



**Figure 2.6: Groundwater Chloride Concentrations at Uruti Composting Facility**

For a summary on the hydrogeology of beneath the Uruti Composting Facility readers are directed to the Haehanga Catchment Preliminary Groundwater Investigation.

# 3 URUTI COMPOSTING FACILITY SITE MANAGEMENT PLAN

The following section of the document focuses on operational management of the site with particularly emphasis on improvements to the irrigation process, stormwater management on site and a reduction in drainage losses to groundwater and surface waters. The plan incorporates both landuse and management controls such as operational thresholds, monitoring timeframes and remediation options as considered necessary to ensure compliance with consent conditions and mitigating adverse effects on the receiving environment.

The plan was developed in conjunction with RNZ and TRC and closely adheres to relevant national and international guidelines and standards.

The framework is based on a three tier decision tree which guides site operation. The tiered response was developed because of simplicity but also allows increased monitoring efforts and reviews of site performance to minimise risks from drainage losses to groundwater and accumulation of hydrocarbon constituents within the soil.

Within each of the operational tiers, specific constituent threshold values for the operation have been set to protect the soil and groundwater. Caution is advised that these values set for constituents are upper limits, and RNZ should not view these levels as recommended targets but should aim to operate well within these values to safeguard the operation, and reduce potential environmental effects on and off site.

## 3.1 Site Operational Plan

The site operational plan framework is summarised in the Tables 3.1 & 3.2. It uses a simple three tier approach with threshold values to guide irrigation and site activities.

**Table 3.1: Uruti Composting Facility Site Operational Plan**

| Tier | Operation Status of irrigated area |
|---|---|
| One | Surveillance or normal operation of site |
| Two | Alert or increased level of monitoring with deferred irrigation |
| Three | Action or remediation options initiated and irrigation ceases |

Once a trigger or threshold value is met within a specific tier, RNZ management would make the decision to operate within the next tier level until monitoring data provides sufficient evidence that an irrigation area could either go down or up a level as per the tier system.

| Tier | Receptor | Target or Trigger | Monitoring frequency | Timeline for Change | Reference for Guideline |
|---|---|---|---|---|---|
| One | Leachate Fluid | $Cl^-$(Chloride)- 0-2000 mg/l results in a Areal Loading of approximately up to 17600 mg/l/$m^2$/day | Weekly | N/A as standard operation phase | |
| | | TPH (Total Hydrocarbon) 0-2500 mg/l (½ of 5% TPH consent limit) | Monthly | N/A as standard operation phase | |
| | Soil | $Cl^-$(Chloride)- 0-700 mg/kg (based on the surrender criteria for NZ landfarms soil criteria)<br><br>**Note Sodium Absorption Ratio 0-6** | Monthly | N/A as standard operation phase | |
| | | TPH (Total Hydrocarbon) upper limits of each hydrocarbon fraction<br><br>C7 – C9 2700mg/kg<br><br>C10 – C14 58mg/kg<br><br>C15 – C36 4000mg/kg | 3 Monthly | N/A as standard operation phase | Ministry for the Environment, Guidelines for Assessing and Managing Petroleum Hydrocarbon contaminated sites in New Zealand. Tier 1 acceptance criteria for TPH Agriculture use All. Soil type Silty Clay. |
| | Groundwater | $Cl^-$(Chloride)- 0-1000 mg/L or Conductivity of 350 µS/m | Bimonthly in GND 2189 & 2190 | N/A as standard operation phase | |
| | | TPH (Total Hydrocarbon)<br><br>All fractions of Hydrocarbons under | Biennially | N/A as standard operation phase | |

| | | | | | |
|---|---|---|---|---|---|
| | | detectable levels (essentially background level) | | | |
| Two | Soil | $Cl^-$(Chloride)- 700- 1800 mg/kg<br><br>**Note Sodium Absorption Ratio in the range of 6-18** | Monthly | If the Chlorides within the soil stay within this tier for 6 months, consider moving to Tier 3- remediation options<br><br>Consider clean water irrigation to allow recovery from elevated SAR | |
| | | TPH (Total Hydrocarbon)<br><br>Total hydrocarbon concentration shall be less the 20,000 mg/kg dry weight at any point | Monthly | Upper limit for bioremediation to be effective for hydrocarbons, leachate fluid to contain no TPH. | Canada's Drilling Waste Management directive 050 (ERCB, 2012) |
| | Leachate Fluid | Cl-(Chlorides) -2000 to 10,000mg/L<br><br>TPH (Total Hydrocarbons)-2500-3000 mg/L | Monthly | If rainfall and soil moisture are expected to increase, irrigation can continue, however, if drier period are forecast, irrigation should cease especially over the summer months. | |
| | Groundwater | Cl-(Chlorides) -1000- 2000mg/L<br><br>Or conductivity 350- 700 µS/m | Monthly | All irrigation to cease on this zone.<br><br>Note: If chlorides within the monitoring bores (GND 2189 & 2190) remain in this range for six months, consider moving to Tier 3 remediation options. | |
| Three | Soil | $Cl^-$(Chloride)- >1800mg/kg<br><br>**Note Sodium Absorption Ratio >18** | Monthly | Initiate soil remediation measures (see Section 5) alongside clean water irrigation. | Cavanagh et al (2014) |

| | | | | | |
|---|---|---|---|---|---|
| | | TPH (Total Hydrocarbons)<br><br>Above 20,000 mg/kg | Monthly | Initiate soil remediation measures (see Section 5) | |
| | Groundwater | $Cl^-$(Chlorides) > 2000mg/L or Conductivity > 700 µS/m | Monthly | Initiate groundwater remediation measure (see section 5) | |

***Sodium absorption ratio** (**SAR**) is a measure of the suitability of water for use in agricultural irrigation as determined by the concentrations of solids dissolved in the water. It is also a measure of the **sodicity** of soil, as determined from analysis of water extracted from the soil. When SAR rises above 12 to 15, physical soil problems begin to arise such as loss of soil structure, and decreases in infiltration and permeability.

# 4 SITE IMPROVEMENTS

This section of the management plan is designed to outline recommended improvements and additional management techniques which will support the site operational plan. Time lines for implantation are also included from the date this document is formalised.

## 4.1 Storage Dam

To continue irrigation during periods of low rainfall and to provide clean water to be mixed with leachate fluid a storage dam is considered a necessary management option to provide this clean water. The dam will be a clean water source upstream of all irrigation areas (Red Line in Figure 4.1). It's use will also be a remediation step in Tier 2 and 3 but will depend on water availability, soil moistures on site, predicted and seasonal variation in rainfall totals.

It is envisaged the lined storage dam will have a capacity of approximately 3500 $m^3$ to allow for 15 days of storage which equates 250$m^3$ per day of clean irrigation water. It is planned to irrigate primarily over the summer months when groundwater and surfacewater resources are limited.

The use of the current 'duck pond' immediately adjacent the final leachate pond should also be investigated to be incorporated into the irrigation plan. The pond has 4,800 $m^3$ of storage capacity of clean water which will further enhance irrigation of clean water on the irrigation areas. The use of clean water irrigation on chloride impacted soil has been used previously overseas, as an in-situ remediation step to soil health (Alberta Environment, 2001, Daily & Whalen, 2005).

**Timeline for implementation = 6 months**

## 4.2 Increased Irrigation Area

A suggested management control for the Uruti Site is to increase the irrigation area, from currently five hectares to over 11 hectares. By increasing the irrigation areas, a decrease in loading of any elevated constituents is envisaged, and also provide a management option to semi-retire areas before they are returned to the active irrigation area. Having greater area would provide options, without the need to overload one area.

It is envisaged that following the adoption of this site management plan, RNZ will apply for a resource consent variation to developed Phase 1. As part of that application it's highly recommended RNZ develop an irrigation plan which will integrate the new irrigation zones into the decision tree to minimise irrigation zones becoming overloaded (Table 4.1). The proposed Phase 2 irrigation zones will be incorporated into the irrigation plan over the next two years and be closely monitored by RNZ (See figure 4.2 and 4.3 for the proposed new irrigation areas).

**Timeline for Implementation (Phase 1) = 2 months based on approval of consent variation**

**Timeline for Implementation (Phase 2) = 24 months based on performance of the site, the outcomes of the increased monitoring effort (soil, groundwater, surfacewater and hydrological data)**

**Table 4.1: Proposed Irrigation Zones**

| Irrigation Zone | Total Area (ha) | Irrigation Phase | Timeline for inclusion in Irrigation Plan |
|---|---|---|---|
| A | 1.68 | Phase 2 | 24 months |
| B | 2.15 | Phase 2 | 24 months |
| C | 1.37 | Phase 2 | 24 months |
| D | 2.48 | Phase 2 | 24 months |
| E | 1 | Phase 1 | 2 months |
| F | 2.63 | Phase 1 | 2 months |
| **Total** | **11.31** | | |

**Figure 4.1: Proposed Irrigation Areas C, D & F and Storage Dam in red**

**Figure 4.2: Proposed Irrigation Area A, B & E**

## 4.3 Stormwater Improvements

The location of the Drill Mud Pits (DMP) also influences the volume of fluid which are required to be irrigated for several reasons. The DMP's are located on the flat valley floor between two steep papa ridgelines, in a location which is topographical constricted. This results in an accumulation of both surfacewater, stormwater flows and likely groundwater having to pass the DMP en-route to the Haehanga Stream. Through this section of the Uruti Composting Site, the shallow groundwater table is approximately 0.5-0.75 metres below ground level, whereas the final DMP pit is 4 metres deep (See Conceptual Site Model in Haehanga Groundwater Investigation). The Haehanga Streambed level is also above the base of the final DMP. Previous compression tests on the freshly compressed papa recorded 0.91 permeability, but it's uncertain the current DMP integrity after several years of site operation. Although outside the scope of this Site Management Plan the hydrological connectivity between the DMP, the shallow groundwater table and the Haehanga Stream should then be investigated further.

It is also recommended the following be investigated to improve stormwater across the site:

- Investigate the placement of a drainage ditch behind pad one down the western side of the access road to avoid the DMP to drain stormwater directly to the main culvert on the Haehanga Stream.

- Realigned the DMP so that there is clear separation between the solids pile and the fluids, to stop stormwater draining into the area and whereby 'clear water' is directed away from the treatment pits.

- Ensure the DMP's are lined to reduce potential contaminate losses to groundwater/surface water.

- Place water level gauges on the final leachate pond alongside flow meters on the irrigator pump as to accurately define pond capacity, discharge rates and irrigation loading rates. This should be undertaken in conjunction with regularly sampling of the irrigation fluid prior

to disposal and where possible defer irrigation if hydrocarbon constituents are elevated (see later comments on Irrigation Plan).

**Timeline for Implementation = 3-6 months**

## 4.4 Riparian Protection

To mitigate the potential for any overland flow of contaminates discharging into the Haehanga Stream it is recommended that an earth bund be constructed along the length of the stream and it's tributary. It is considered the riparian protection zone should be a minimum of 5 metres from the stream bank and then fenced and planted with appropriate species. The planting would also provide shade for the Haehanga Stream biota.

**Timeline for Implementation = 12 months**

## 4.5 Deferred Irrigation Management

It is recommended the management of the site consider deferred leachate irrigation under certain environmental conditions. The combination of a poor leachate quality in summer and limited attenuation in the hydrological cycle results in reduced site performance. The site performance over the summer months represents an increased probability of off-site environmental effects being recorded. By instigating deferred irrigation over the critical summer months potential adverse effect can be minimised. It's recommended that RNZ in the development of their irrigation plan consider this option in combination with the storage dam.

**Timeline for Implementation = 6 months**

## 4.6 Setback from Haehanga Stream

Recommended best practice is to incorporate a 25 meter setback from any surface water body in relation to irrigating fluid. We suggest this management technique would obviously reduce any potential overland flow from the irrigation fluid into the stream in conjunction with a planted bund. Also this management option would create a buffer and natural attenuation zone for contaminate migration towards the stream, which would likely reduce any impacts on the Haehanga Stream. Setback requirements are a standard management requirement for discharges closes to water bodies, and often enforced by Regional Councils.

**Timeline for Implementation = Immediate for Phase 1 Consent Variation granted**

## 4.7 Pre disposal Analysis

We recommend RNZ consider implementing an acceptance criterion for any new source of waste material entering the site. This procedure could be easily implemented and provides data of the level of constituents entering the site.

This management option provides not only business certainty to RNZ but will also allow consideration for future irrigation plans from potential issues arising from hydrocarbon fluids entering the site. RNZ could request laboratory results of the proposed material to be disposed and specify certain parameters for constituents like Hydrocarbons and Chloride for acceptance. Predisposal samples are common practice and considered best practice, with all costs usually incurred by the company requesting disposal.

**Timeline for Implementation = Immediately after Phase 1 Consent Variation granted**

# 5 TIER 2 AND 3 REMEDIATION OPTIONS

If monitoring results from tier 1 & 2 (normal and alert operation) indicate contaminate levels are continually increasing, i.e SAR, Hydrocarbon and Chloride increases, such that a Tier 3 response is required, mitigation and remediation should be initiated.

## 5.1 Remediation Options

Due to the sensitive nature of the Uruti Site in relation to shallow groundwater effects, proximity to the surface water of the Haehanga Stream, and downstream to the regionally significant Mimi River any in-situ remediation must be approached with extreme caution.

Potential mitigation steps are summarised below, however, it's recognised that a full site remediation plan may be required before selection of suitable remediation method(s) are finalised.

**Table 5.1: Mitigation and Management Options for Uruti Composting Site**

| Options | Consideration of use | Caveats |
|---|---|---|
| 1. Irrigation Management/Source Mitigation<br><br>Addition of $CaC0_3$ or dissolved gypsum in the irrigation fluid to increase the soil pH and CEC to reduce sodicity. Also reduce the high salt content in the irrigation fluid. | Possibly only a short term solution on semi-retired irrigation zones, as a greater potential for Chloride concentrations to remain in the soil and not leached to groundwater. | On soils with low pH (4-5.2) may require multiple applications to be effective.<br><br>Need field trials to verify, starting with lower irrigation zone already in Tier 2. |
| 2. Irrigation Management<br><br>Addition and mixing of clean low salt content water from the storage dam to decrease the chloride loadings within the irrigation fluid. | Due to limited rainfall recharge of the shallow groundwater table over the summer months will require most leachate mixing to occur in late Dec-March.<br><br>Literature suggests a mixture with 20% leachate is most effective to control soil salinity, reduce the effects on plant growth and soil structure, such as reduced porosity and degraded soil structure. | Requires enough storage within the dam to allow use if no sustained rainfall for 15 days<br><br>Scheduling leachate irrigation in response to soil moisture increases and high evapotranspiration losses<br><br>May have strict regulatory constraints as off-site effects requires assessment, particular ecological and cultural receptors in the Mimi River |
| 3. Irrigation and Groundwater Management<br><br>Subsequent flushing with clean irrigation water to increase the leaching and drainage losses to GW and Surface water bodies | Due to limited rainfall recharge of the shallow groundwater table over the summer months will require irrigation to occur in late Dec-March. | Requires enough storage within the dam to allow use if no sustained rainfall for at least 15 days<br><br>If the Groundwater and Surface water resources such as the Mimi River are deemed to have high value this method requires considerable scrutiny.<br><br>May have strict regulatory constraints as off-site effects requires assessment |

| | | |
|---|---|---|
| 4. Soil Management<br><br>Excavation of salt contaminated soil and disposal onsite | Contaminated soil maybe reincorporated into composting activities, such as up on Pad 2 (sawdust and compost pad) | Cost effectiveness needs scrutiny |
| 5. Soil Management<br><br>Addition of liquid/solid calcium/Gypsum or similar to replace the sodium in soil. | The loss through the soil profile to groundwater of the additions of Calcium/Gypsum.<br><br>Is natural precipitation enough over the year to exceed evaporation, if not don't use.<br><br>May require multiple applications of calcium which may have unpredicted effects.<br><br>Normally only used when shallow groundwater is not present | What are the downstream uses of groundwater, what are the effect of the increased of chloride in GW and Haehanga Stream.<br><br>May require a groundwater fate and transport model to determine off site effects to surface waters |
| 6. Soil Management<br><br>Other soil amendments such as organic matter, humus, if the soil have low pH and EC | Has good potential as composting facility will have material on site, hence capital costs are low | Requires further investigation and trials onsite, but recommend all zones currently in Tier 2 |
| 7. Soil Management<br><br>Plantation of shore rotation woody crops which are salt tolerant | Investigation what plant species would be practical | The use of bio-sorption techniques requires more investigation as the natural acidic clay soil with low pH will limited uptake of chlorides.<br><br>May be feasible once soil pH are neutralised |

# 6 CONCLUSION

BTW Company was engaged by RNZ to provide a report outlining management and procedural controls with an aim to improve site performance. A significant part of the project was to provide the Taranaki Regional Council with a site management plan to improve soil and groundwater conditions to mitigate potential environmental effects beyond the site boundary.

The report is not an assessment of environmental effects but rather a procedural document for RNZ to assist in the development of a Uruti Composting Site Irrigation Plan and associated monitoring plan.

The outcomes from the initial environmental data review can be summarised by the main points below.

- Both soil and groundwater resources are recording elevated levels of chlorides ($Cl^-$) as a result of prolonged irrigation of the leachate fluid.
- The quality of the irrigation leachate over the summer months is often degraded
- Chloride concentrations in the Haehanga Stream are usually below consent conditions, but in March 2014, multiple sampling sites were over consent limits.
- Over the summer months there is limited water in the hydrological cycle to attenuate the irrigated leachate.

The report developed the Uruti Composting Facility site management plan. The three tier plan features operational triggers which govern monitoring requirements and/or remediation options. The three tiers can be summarised by;

1. Normal site operation- weekly and monthly sampling of leachate fluid, soil quality and groundwater resources.
2. Alert level of site operation- increased level of monitoring with deferred irrigation on areas which are deemed overloaded for certain constituents. If monitoring results suggest no improvements in the levels of contaminates after six months it would be recommended moving to Tier 3 response.
3. Action level of site operation-irrigation to cease on all affected areas. Initiate remediation efforts to improve health of soil and groundwater resources.

BTW Company also highly recommended site improvement options with attached timeframes, which are summarised below:

- A water storage dam - to allow mixing with irrigation leachate and to provide a clean water irrigation source on areas which require remediation (tier 3)
- Increase irrigation areas - Phase 1 Consent Variation
- Stormwater improvements, riparian edge protection and deferred irrigation
- Haehanga Stream setbacks
- Predisposal and pre-irrigation samples

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# APPENDIX A BTW SOIL PROFILES

## SCALA PENETROMETER, AUGER & SHEAR VANE TEST SHEET

Client: Remediation NZ
Client Contact: Kerry O'Neil
Location: Unsl
Test Date: 8/01/2015

BTW Job No: 14745
BTW Project Manager: Luke Bunn
Tested By: Luke Bunn

Test Location: A1

| Depth (mm) | Description | Log |
|---|---|---|
| 0-200 | Light brown/grey silty topsoil | |
| 200-2000 | Light gray silty clay, traces of brown/orange clay material, small particle size, friable, low moisture content, low plasticity | |
| 1000 | Low-medium moisture content, medium plasticity | |
| 1500 | Increase in clay content, light brown/gray in color | |
| 2000 | End Auger | |

Auger 1: depth 0.8m

Auger 1: depth 1.5m

## SCALA PENETROMETER, AUGER & SHEAR VANE TEST SHEET

Client: Remediation NZ
Client Contact: Kerry O'Neill
Location: Urutī
Test Date: 9/01/2015

BTW Job No: 14745
BTW Project Manager: Luke Bunn
Tested By: Luke Bunn

Test Location: A2

| Depth (mm) | Description | Log |
|---|---|---|
| 0-100 | Light brown/grey silty topsoil | |
| 100-1800 | Light gray silty clay, traces of brown/orange clay material, small particle size, friable, low moisture content, low plasticity | |
| 1100 | Increase in clay content, Light brown/gray in color, medium moisture content, medium plasticity | |
| 2000 | End Auger | |

Auger 2: depth 1.0m

## SCALA PENETROMETER, AUGER & SHEAR VANE TEST SHEET

Client: Remediation NZ
Client Contact: Kerry O'Neill
Location: Unsl
Test Date: 8/01/2015

BTW Job No: 14745
BTW Project Manager: Luke Bunn
Tested By: Luke Bunn

Test Location: **A3**

| Depth (mm) | Description | Log |
|---|---|---|
| 0-200 | Light brown/grey silty topsoil | |
| 200-2000 | Light grey/brown silty clay, small particle size, friable, low-medium moisture content, medium plasticity, traces of dark brown clay material | |
| 800 | Increase in clay content, light brown/grey in color | |
| 1500 | Increase in moisture content, increase in plasticity, reduction in clay content, light grey/brown color | |
| 2000 | End Auger | |

Auger 3: depth 0.5m

Auger 3: depth 1.2m

## SCALA PENETROMETER, AUGER & SHEAR VANE TEST SHEET

Client: Remediation NZ
Client Contact: Kerry O'Neil
Location: Unit
Test Date: 8/01/2015

BTW Job No: 14745
BTW Project Manager: Luke Bunn
Tested By: Luke Bunn

Test Location: **A4**

| Depth (mm) | Description | Log |
|---|---|---|
| 0-150 | Light brown/grey silty topsoil | |
| 150-2000 | Light grey silty clay, small particle size, friable, low moisture content, low plasticity | |
| 500 | Increase in clay content, light grey/brown in color, low-medium moisture content, low-medium plasticity | |
| 1000 | Medium-high moisture content, medium-high plasticity | |
| 2000 | End Auger | |

Auger 4: depth 0.3m

Auger 4: depth 1.5m