

Remediation NZ Limited
Monitoring Programme
Annual Report
2013-2014

Technical Report 2014-53

ISSN: 0114-8184 (Print)
ISSN: 1178-1467 (Online)
Document: 1295396 (Word)
Document: 1410283 (Pdf)

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October 2014

Executive summary

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

This report for the period July 2013-June 2014 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess the Company's environmental performance during the period under review, and the results and environmental effects of the Company's activities.

The Company holds a total of seven resource consents that cover all operations carried out on the three sites. These consents include a total of 90 special conditions that set out the requirements that the Company must satisfy.

The Council's monitoring programme for the year under review included 11 inspections focussing on raw materials, leachate, stormwater, and odour control, 59 water samples, 12 discharge samples, six soil samples, nine groundwater samples, one freshwater biomonitoring survey, and one fish survey.

During the monitoring year routine compliance monitoring found that unauthorised direct discharges of irrigation fluid and drilling waste leachate to the Haehanga Stream system. These discharges resulted in abatement notices and infringement notices being issued. The Council also received one complaint about the Uruti site in regards to odour. The complaint was investigated and not substantiated.

During the monitoring year, The Council received seven complaints in regards to odours in the vicinity of RNZ's Waitara Rd and Pennington Rd sites. All of these complaints were investigated and no breaches of the Regional Air Quality Plan were found at the time of the investigations. However an abatement notice was issued on the likelihood of causing objectionable odour on one occasion.

RNZ demonstrated a high level of environmental performance and compliance with resource consents at its Waitara Road and Pennington Road sites. RNZ demonstrated a poor level of environmental performance and compliance with resource consents at its site at Uruti.

Overall, RNZ demonstrated a poor level of environmental performance.

For reference, in the 2013-2014 year, 60% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 29% demonstrated a good level of environmental performance and compliance with their consents.

This report includes recommendations for the 2014-2015 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 2013-June 2014 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; Waitara Road, Waitara, in the Waiongana catchment; and Pennington Road, Brixton, in the Waitara catchment. The Company also operates a 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)* 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 13th combined annual report by the Council for the sites.

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 through annual programmes, the resource consents held by RNZ, the nature of the monitoring programme in place for the period under review, and a description of the activities and operations conducted at the Company's sites.

Section 2 presents the results of monitoring done during the period under review, including scientific /technical data and the results of inspections and incident investigations.

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

Section 4 presents recommendations to be implemented in the 2014-2015 monitoring year.

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

1.2.1 The Resource Management Act 1991 and monitoring

The *Resource Management Act 1991* (RMA) primarily addresses environmental 'effects' which are defined as positive or adverse, temporary or permanent, past, present or future, or cumulative. Effects may arise in relation to:

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

In drafting and reviewing conditions on discharge permits, and in implementing monitoring programmes, the 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.

1.2.2 Evaluation of environmental 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 an overall rating. The categories used by the Council, and their interpretation, are as follows:

- A **high** level of environmental performance and compliance indicates that essentially there were no adverse environmental effects to be concerned about, and no, or inconsequential non-compliance with conditions.
- A **good** level of environmental performance and compliance indicates that adverse environmental effects of activities during the monitoring period were negligible or minor at most, or, 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, or, there were perhaps some items noted on inspection notices for attention but these items were not urgent nor critical, and follow-up inspections showed they have been dealt with, and any inconsequential non-compliances with conditions were resolved positively, co-operatively, and quickly.
- **Improvement required (environmental) or improvement required (administrative compliance)** (as appropriate) indicates that the Council may have

been obliged to record a verified unauthorised incident involving measurable environmental impacts, and/or, there were measurable environmental effects arising from activities and intervention by the staff was required and there were matters that required urgent intervention, took some time to resolve, or remained unresolved at the end of the period under review, and/or, there were on-going issues around meeting resource consent conditions even in the absence of environmental effects. Abatement notices may have been issued.

- **Poor performance (environmental) or poor performance (administrative compliance)** indicates generally that the Council was obliged to record a verified unauthorised incident involving significant environmental impacts, or there were material failings to comply with resource consent conditions that required significant intervention by the Council even in the absence of environmental effects. Typically there were grounds for either a prosecution or an infringement notice.

1.3 Process description

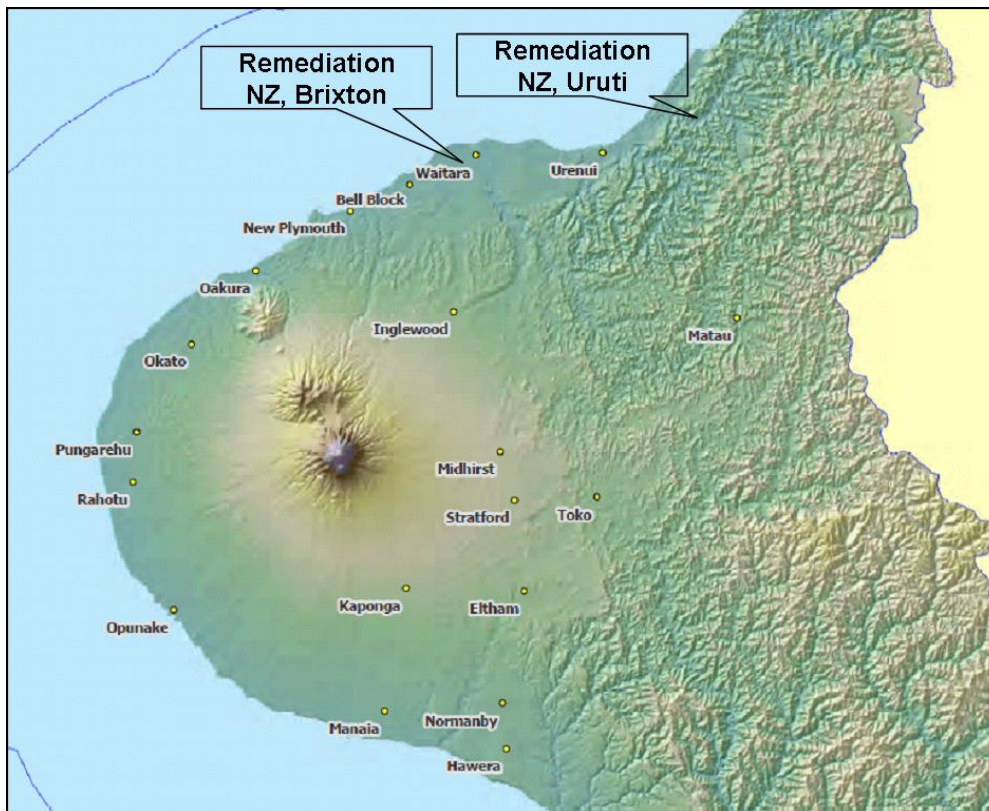


Figure 1 Regional map showing locations of Remediation NZ's Taranaki sites

RNZ produces organic fertiliser (worm casting) for national and international markets. A range of organic 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.

1.3.1 Treatment systems at Mokau Rd, Uruti

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 remediation pad and two composting pads (known as 'pad 1' and 'pad 2').

Synthetic hydrocarbon contaminated drilling muds and cuttings are piled up on the remediation pad and the liquids are allowed to drain. The runoff 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. These ponds also treat the leachate and stormwater from pad 1 where remediated drilling wastes are blended with green waste and other organic matter for composting. The treated liquid is held in the final two ponds and 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 wetland. Under dry conditions the wetland 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 and leachate to a tributary of the Haehanga Stream.



Figure 2 RNZ site, Mokau Road, Uruti

1.4 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
5938-1	Uruti	Install culvert	June 2015	-
6211-1	Uruti	Divert stream	June 2021	June 2015
6212-1	Uruti	Install culvert	June 2021	June 2015
5892-2	Brixton	Discharge to land/water	June 2020	-
5893-2	Brixton	Discharge to land/water	June 2021	June 2015

1.4.1 Air discharge permit

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.

1.4.2 Discharges to land and water

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 (varied in September 2013).

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.

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.

1.4.3 Land use consents

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.

Special condition 6 stipulates that the structure does not obstruct fish passage.

Special condition 7 requires reinstatement of the area once the structure is no longer required.

Special condition 8 deals with review of the consent.

Copies of the above permits are attached to this report in Appendix I.

1.5 Monitoring programme

1.5.1 Introduction

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

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

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

1.5.2 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.

1.5.3 Site inspections

Eleven inspections were conducted over the monitoring period. With regard to consents for the discharge to contaminants to land and 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 also surveyed for environmental effects.

1.5.4 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 six occasions, with a total of 59 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 six samples were taken of the irrigation pond. The Council also took nine groundwater samples and eight soil samples.

The Council also undertook benzene, toluene, ethyl benzene and xylene (BTEX) analysis on one four groundwater samples and one surface water sample.

1.5.5 Biomonitoring surveys

One macroinvertebrate biological surveys were 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.

Table 2 Summary of monitoring activities

Activity	Uruti	Waitara and Pennington Rd
Inspections	8	3
Freshwater samples	59	-
Groundwater samples	9	-
Soil samples	6	-
Wetland discharge samples	6	-
Irrigation pond samples	6	-
Fish surveys	1	-
Macro-invertebrate surveys	1	-

2. Results

2.1 Mokau Rd, Uruti

2.1.1 Inspections

Officers of the Council undertook site inspections of the Mokau Road site during the 2013-2014 monitoring period. The following observations were made during inspections:

2.1.1.1 14 June 2013

A site visit was made to conduct compliance monitoring inspection and to take surface water, groundwater and soil samples. It was fine at the time of the inspection with one mm rain over the previous 24 hours.

The Haehanga Stream was at moderate-low flow at the time of the inspection. The wetland was discharging at approximately 0.5 L/s and the discharge had a brown tint and no odour. There was minor amount of discolouration at the downstream site. The wetland appeared healthy; however there were large areas of raupo browning off for winter. The bottom pond had a heavy layer of duck weed.

A large amount of drilling waste had been accepted recently and this was being treated with sawdust. The bund along the tributary adjacent the drill waste drop off area was eroding near the culvert and the site manager had some concrete blocks ready to shore it up.

The irrigation areas had lush grass growth and there were no areas of ponding or grass burn noted. A sample of the irrigation pond was taken for analysis and was found have a strong hydrocarbon (HC) and anaerobic odour. There was also grey scum around the edges of the pond.

Conductivity readings were taken at every stream site and the highest level found was 26.5 mS/m at site HHG000150. Small amounts of foam were noted to be in the stream at this site also.

No odour issues were noted at the downwind boundary.

2.1.1.2 17 July 2013

Irrigators were operating at time of inspection and it was noted that some of the spray heads seemed quite close to the stream.

Samples were taken at the usual sites and foam and discolouration of the stream water was noted downstream of the upper irrigation area. Closer inspection found a split in the main irrigation pipe line resulting in wastewater running overland for approximately 40 metres and entering a tributary of the Haehanga. Photographs and samples of the discharge were taken. Further inspection in the upper irrigation area also found that a pipe had disconnected from an irrigator resulting in overland flow into the Haehanga Stream. An RNZ staff member was contacted and was informed of the problems, and the pump was switched off so repairs could be made. Further discussions were held on how some spray heads were clearly within 25 m of water

ways. RNZ staff said they would move the irrigators accordingly. An abatement notice and an infringement notice were issued (see Incident section 2.3).

2.1.1.3 30 July 2013

A re-inspection of abatement notice 12033 found that the lines to the irrigators had been repaired. At the time of re-inspection consent conditions were being complied with. RNZ staff onsite said that the repairs had been undertaken shortly after it was brought to their attention at previous inspection.

2.1.1.4 18 September 2013

A site visit was made to undertake a compliance monitoring inspection and to collect water samples. An area just to the north of the weigh bridge was being prepared for new security gates to restrict access to authorised people only. There were metal offshore drill waste containers stacked around truck wash where they had been cleaned out. The ponds looked good and the level of the big pond had dropped leaving some freeboard. No significant issues were noted with the irrigation areas. The swampy area between the ponds and the lower irrigation area was discussed. The possibility of putting novaflo or tile drain to channel the spring and then filling it in to take the depression out of the paddock was raised. Overall the site was tidy and no issues were noted.

2.1.1.5 20 November 2013

A site visit was made to undertake a compliance monitoring inspection and to take water samples.

The new security gates were in the process of being installed. A significant amount of drilling waste mixed with sawdust was piled up on the drill mud pad. Pad one was inspected and there was a pile of material contaminated with metal and offcuts. The irrigation paddocks looked good and were ready for mowing. A brief discussion was held on the works that were planned for the swampy area of the paddock.

The following action was to be taken:

- Remove the metal that had been dumped near the large pile of sawdust on pad one.

2.1.1.6 14 January 2014

A site visit was made to conduct a compliance monitoring inspection and to take water samples. The weather was fine with 13 mm rain falling over previous 72 hours and the stream system was in low flow. A truck was discharging drilling muds and a digger was operating blending in sawdust at time of inspection. A discussion was held with the digger driver and site manager on the drainage issues at the top of the lower irrigation area and the installation of novaflo in a few swampy areas on the main irrigation flats. Discussion included the installation of novaflo, and contouring the area to promote drainage and prevent irrigation inflows into the area.

2.1.1.7 13 March 2014

A site visit was made to conduct a compliance monitoring inspection and to take water samples. The weather was fine and there had been no rain for the past 25 days. The new security gate had been installed but was not yet operational. The streams on the site were at extremely low flow with areas of dry stream bed observed in the upper reaches of the operational areas. Due to extremely low water levels only four samples were taken.

New worm beds had been set up on the new pad and a large pile of paunch had been dumped on the pad. The site manager was instructed to move paunch pile back to the consented area which was done by the end of the day. Silt and sediment controls on recent earthworks were also discussed.

The irrigation paddock had been recently cut for silage and the irrigation pipes had just been set up again. The level of the irrigation and storage ponds looked good with more freeboard than usual. The sample taken from the irrigation pond appeared to contain a lot of oily waste.

Analysis of results from this inspection showed that there were very high chloride levels in the receiving water below the drill mud pads and the lower irrigation area. As a result an incident was logged and further investigations were undertaken (see incidents section 2.3)

2.1.1.8 17 May 2014

A compliance monitoring inspection undertaken after 3 days of heavy rain. The wetland looked healthy and was discharging at approximately 0.5 L/s and the discharge was a brown colour, with a small amount of discolouration in the tributary. The Haehanga was running a fresh, but the flow was largely clean and clear.

The tracks around the site were muddy and overall the site looked quite messy due to heavy recent rain and a lot of machinery and truck activity. The paunch pile needed to be pushed back away from the track edge.

There was a discharge from pad three where the two new worm beds had been laid down and sample of the discharge was taken. Samples were also taken from all the usual sample sites. Soil and groundwater samples were also taken. Actions needed to be taken were discussed with the site manager.

2.1.2 Wetland discharge monitoring results

Table 3 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 3 Results wetland discharge monitoring

Date	CBODF	Chloride	Conductivity	Unionised ammonia	Nitrate/nitrite	Ammoniacal nitrogen	pH	Suspended solids	Temp
	g/m ³	g/m ³	mS/m	g/m ³	g/m ³	g/m ³	pH	g/m ³	Deg C
<i>Consent limit</i>	-	-	-	-		-	6-9	100	-
17 Jul 2013	6.0	34.3	61.3	0.21617	1.16	19.7	7.8	19	6.5
18 Sep 2013	8.8	36.0	66.2	0.26968	0.08	23.5	7.6	36	13.3
20 Nov 2013	6.6	23.4	54.5	0.20853	0.25	17.9	7.5	27	16.6
14 Jan 2014	14	43.4	71.0	0.33851	0.02	26.6	7.5	48	17.8
13 Mar 2014	14	43.0	88.2	0.17141	0.04	34.9	7.2	95	14.2
15 May 2014	6.8	30.7	61.4	0.15451	0.5	28.8	7.4	16	9.2

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. Other parameters are measured to assist with assessing the effects the discharge may be having on the receiving water which are discussed in section 2.1.4

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. Analysis for lead, copper, chromium, and arsenic was also undertaken as the consent holder stored and processed contaminated soils on the site.

Table 4 Results of irrigation fluid monitoring

Parameter	Unit	17 Jul 2013	18 Sep 2013	20 Nov 2013	14 Jan 2014	13 Mar 2014	15 May 2014
Arsenic	g/m ³	0.007	0.011	0.008	0.009	0.016	0.023
BOD	g/m ³	230	60	33	150	280	470
Chloride	g/m ³	2200	1470	2780	2820	6260	4910
Conductivity @ 20 Deg. C	mS/m	781	521	862	898	1840	2100
Total chromium	g/m ³	<0.03	<0.03	0.06	<0.03	<0.03	<0.03
Total copper	g/m ³	0.009	0.005	0.016	0.02	0.01	<0.01
Hydrocarbons	g/m ³	152	70	420	5.4	3700	5600
Potassium	g/m ³	899	502	669	978	1787	3970
Sodium	g/m ³	666	550	818	753	1852	1168
Unionised ammonia -N	g/m ³ -N	0.15790	1.29207	0.79115	1.06715	0.59433	0.49375
Ammoniacal nitrogen-N	g/m ³ -N	34.9	39.9	43.7	38.6	40.9	44.0
Total lead		-	-	-	<0.05	<0.05	<0.05
pH	pH	7.4	8.0	7.5	7.5	7.4	7.7
Suspended solids	g/m ³	270	140	240	120	65	-
Temperature	Deg. C	6.9	15.1	22.6	28.4	22.7	9.9

Consent 5838-2 requires that irrigation fluid shall not be discharged if it has a hydrocarbon level in excess of 5% (or 50000 g/m³). 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 as the site is now accepting a far larger volume of hydrocarbon exploration drilling wastes that the level of hydrocarbons found in the irrigation ponds is rising over time. It is also noted that in this period the highest level of chloride since monitoring began in the irrigation fluid has been detected.

The increased chloride, potassium and sodium levels in the irrigation fluids are of concern as this has flow effects on soil characteristics and groundwater quality. Sections 2.1.8 and 2.1.1.0 discuss groundwater and soil results and these show that levels of chlorides and cations are increasing in the soils of both irrigation areas.

The change in composition of the irrigation fluid is almost certainly a result of the increase in drilling waste being processed at the site.

The results also show that the levels of lead, copper, chromium and arsenic have been consistently low over the monitoring period indicating that little or none of the metals from contaminated soils that were processed at the site have leached out.

Other results of note are the high levels of nutrients which are expected in such a waste stream and these are in effect treated by the process of irrigation.

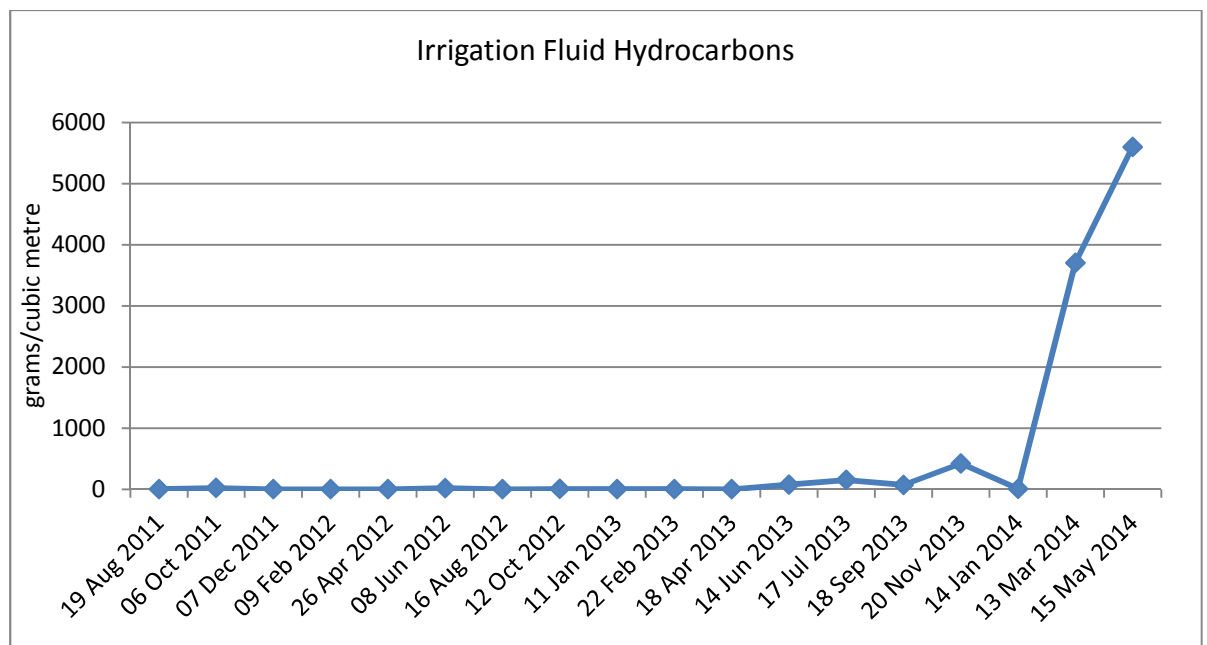


Figure 3 Graph showing rise in irrigation fluid hydrocarbons

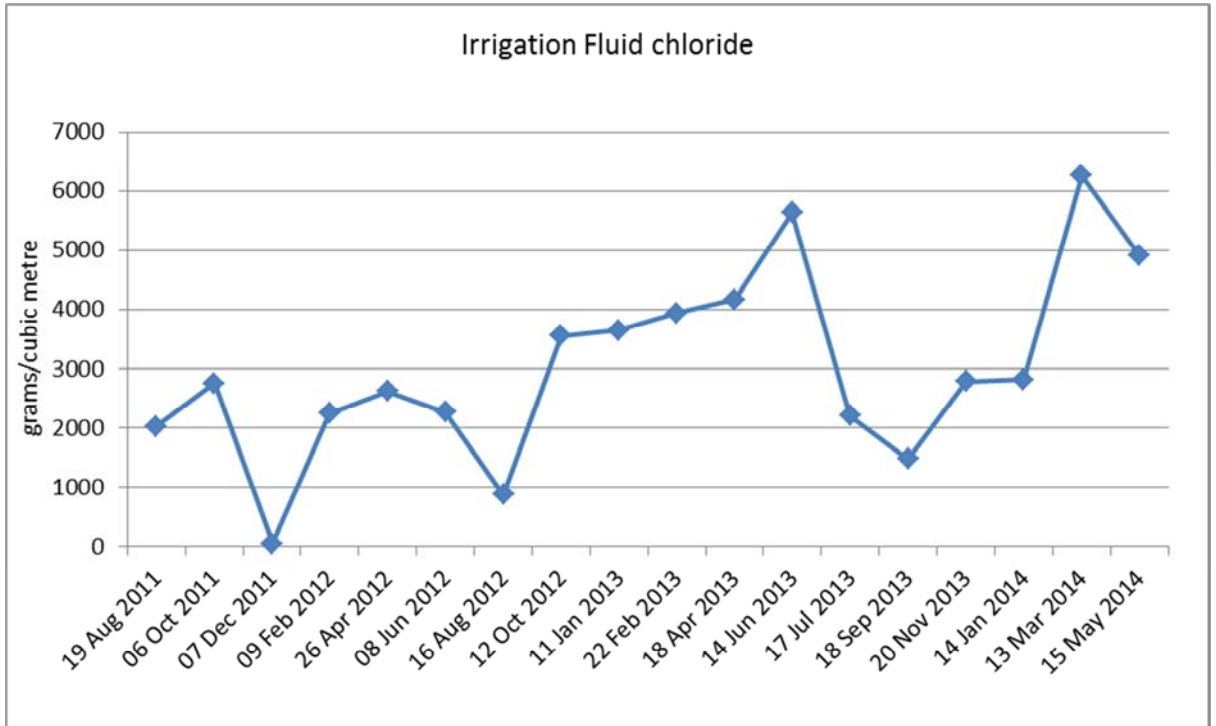


Figure 4 Graph showing rise in irrigation fluid chloride levels

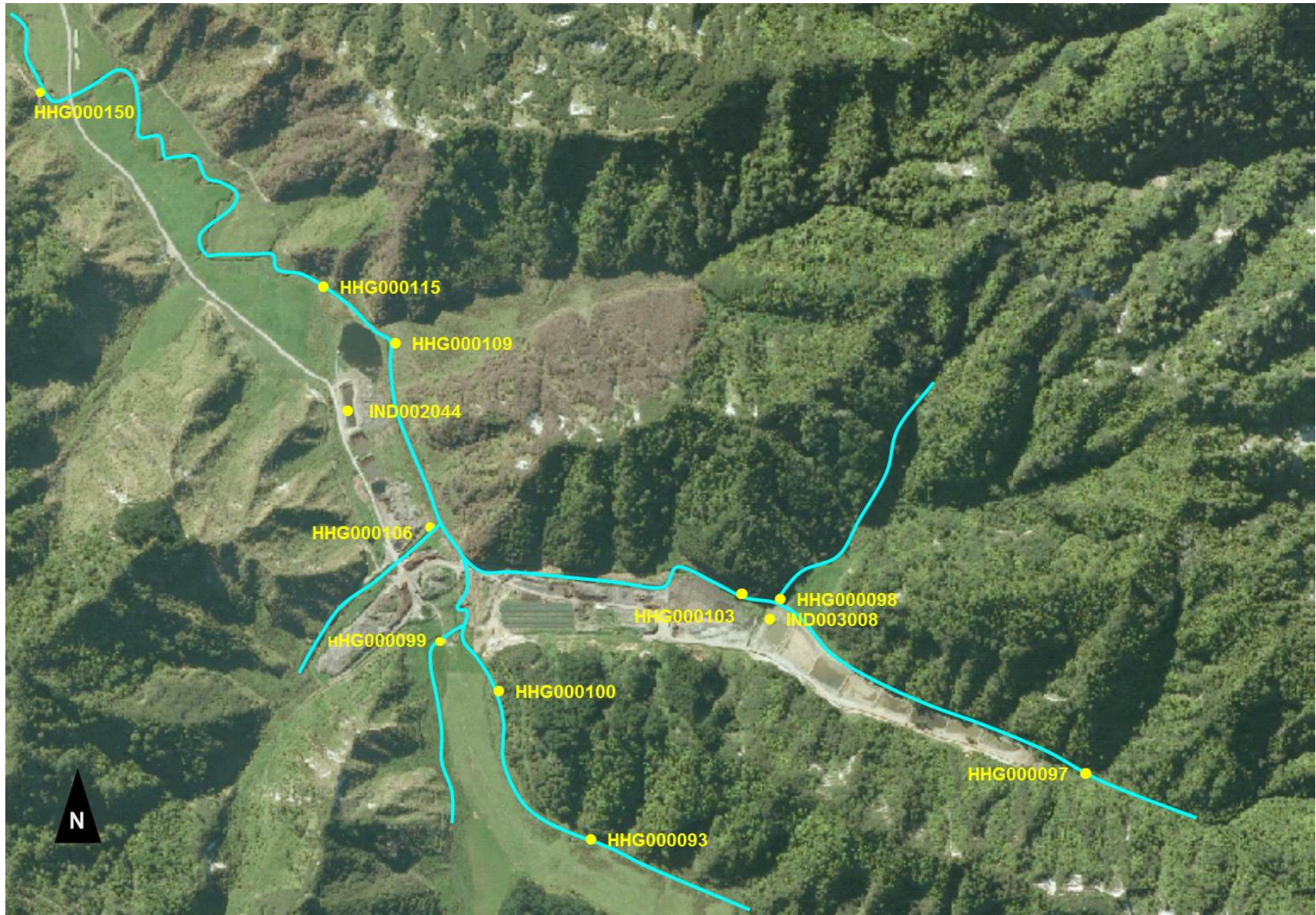


Figure 5 Aerial image of RNZ's site at Mokau Rd, Uruti showing the surface water sampling site positions

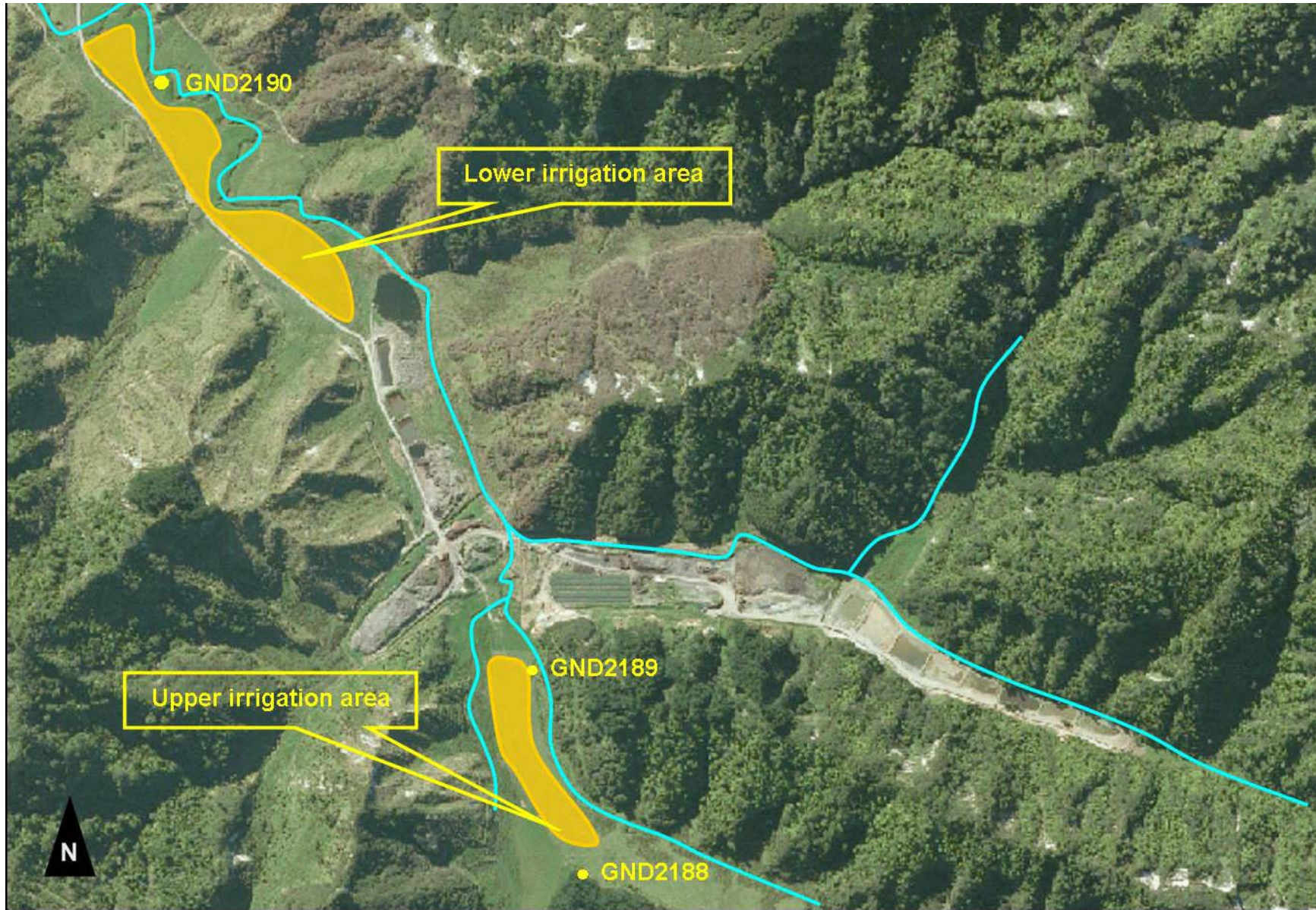


Figure 6 Irrigation sites and groundwater monitoring bores at RNZ's Mokau Rd, Uruti site

2.1.4 Results of receiving environment 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. A summary of historical and current results is then given in section 2.1.5

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/m³ and or cause ammonia levels to exceed 0.025 g/m³ 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/m³ 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/m³ and or cause ammonia levels to exceed 0.025 g/m³ at site HHG000100 and site HHG000150. The consent also states that the irrigation of pond fluids shall not cause a chloride in the Haehanga Stream to exceed 150 g/m³.

2.1.4.1 17 July 2013

The sampling run done on 17 July 2013 was done under low flow conditions with 7.0 mm rain falling over the previous 72 hours. The wetland was discharging at 0.5 L/s. Elevated levels of chloride were found at sites HHG000100 and HHG000099 and this was the result of the leaks found in the irrigation system (see incidents section 2.3). The levels of chlorides whilst higher than usual, were still under the 150 g/m³ guideline limit for the protection of aquatic ecosystems which is used to assess compliance. The leaks in the irrigation system also caused CBODF at site HHG000100 to be above the consent level of 2.5 g/m³ (see incidents section 2.3)

Table 5 Chemical analyses of samples collected on 17 July 2013

Site	CBODF	Chloride	Conductivity	HC	Unionised ammonia	Ammoniacal nitrogen	pH	Suspended solids	Temp
	g/m ³	g/m ³	g/m ³	g/m ³	g/m ³	g/m ³	pH	g/m ³	Deg C
HHG000093	<0.5	16.5	17.3	<0.5	0.00036	0.132	7.2	3	6.4
HHG000097	<0.5	12.8	18.2	*	0.00018	0.079	7.1	2	7.3
HHG000098	<0.5	13.3	17.8	*	0.00024	0.084	7.2	2	7.0
HHG000099	14	147	63.9	<0.5	0.00648	1.38	7.4	9	7.4
HHG000100	5.6	147	60.8	<0.5	0.00185	0.798	7.1	7	7.2
HHG000103	0.7	22.3	24.1	*	0.00621	1.70	7.3	5	7.1
HHG000106	<0.5	20.8	19.8	*	0.00111	0.550	7.0	14	8.4
HHG000109	0.5	35.1	24.9	*	0.00123	0.433	7.2	5	6.8
HHG000115	2.1	62.6	34.1	<0.5	0.00190	0.663	7.2	6	6.9
HHG000150	<0.5	51.4	29.8	<0.5	0.00081	0.440	7.0	5	7.2
HHG000190	*	44.5	27.2	*	0.00079	0.336	7.1	*	7.3
IND003008	6.0	34.3	61.3	*	0.21617	19.7	7.8	19	6.5

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

2.1.4.2 18 September 2013

The sampling done on 18 September 2013 was done under low flow conditions with 1.5 mm rain over the previous 72 hours. The wetland was discharging at 0.13 L/s and the discharge had no odour. The CBODF and ammonia levels at site HHG000103 were in compliance with consent conditions and chloride levels had returned to normal operational levels after the repair of the irrigation system.

Table 6 Chemical analyses of samples collected on 18 September 2013

Site	CBODF	Chloride	Conductivity	HC	Unionised ammonia	Ammoniacal nitrogen	pH	Suspended solids	Temp
	g/m ³	g/m ³	g/m ³	g/m ³	g/m ³	g/m ³	pH	g/m ³	Deg C
HHG000093	0.7	13.0	15.4	<0.5	0.00027	0.045	7.4	11	10.7
HHG000097	0.5	11.2	17.5	*	0.00033	0.085	7.3	2	7.9
HHG000098	0.6	11.8	15.6	*	0.00035	0.061	7.4	3	10.0
HHG000099	1.1	15.4	17.1	*	0.00034	0.078	7.3	96	9.6
HHG000100	0.6	22.8	18.3	*	0.00023	0.062	7.2	3	10.5
HHG000103	1.1	22.3	22.6	<0.5	0.00687	1.29	7.4	8	9.1
HHG000106	0.8	23.6	21.4	*	0.00294	0.731	7.2	12	11.5
HHG000109	0.8	26.9	21.0	*	0.00099	0.223	7.3	5	9.7
HHG000115	1.0	39.5	25.4	<0.5	0.00158	0.446	7.2	5	9.8
HHG000150	1.2	66.2	32.8	<0.5	0.00173	0.584	7.1	6	10.5
HHG000190	*	44.4	26.2	*	0.00093	0.228	7.2	*	11.7
IND003008	8.8	36.0	66.2	*	0.26968	23.5	7.6	36	13.3

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

2.1.4.3 20 November 2013

The sampling done on 20 November 2013 was done under low flow conditions with 3.5 mm of rain falling on the area over the previous 72 hours. The wetland was discharging at a trickle rate at the time of sampling. On this occasion the discharge was found to have moderate levels of CBODF and unionised ammonia. At the compliance point (HHG000103), the levels of unionised ammonia and CBODF were below those required by consent conditions. The consent holder applied to have consent 5838 varied to set a limit of instream chlorides at 150 g/m³ and this change was granted on 20 September 2013. Chloride levels at compliance sites HHG000100 and HHG000150 were below the new limit set by the varied consent.

Table 7 Chemical analyses of samples collected on 20 November 2013

Site	CBODF	Chloride	Conductivity	HC	Unionised ammonia	Ammoniacal nitrogen	pH	Suspended solids	Temp
	g/m ³	g/m ³	g/m ³	g/m ³	g/m ³	g/m ³	pH	g/m ³	Deg C
HHG000093	0.6	15.6	16.8	<0.5	0.00005	0.014	6.9	3	20.0
HHG000097	<0.5	11.2	17.4	*	0.00034	0.113	7.0	6	13.6
HHG000098	<0.5	12.0	18.4	*	0.00022	0.078	6.9	7	16.0
HHG000099	<0.5	12.2	18.8	*	0.00028	0.038	7.2	7	19.7
HHG000100	0.6	33.0	21.7	<0.5	0.00038	0.055	7.2	6	18.9
HHG000103	0.6	23.6	23.1	*	0.00194	0.554	7.0	9	15.8
HHG000105	1.8	43.4	31.5	*	0.00412	1.88	6.7	11	18.8

Site	CBODF	Chloride	Conductivity	HC	Unionised ammonia	Ammoniacal nitrogen	pH	Suspended solids	Temp
	g/m ³	g/m ³	g/m ³	g/m ³	g/m ³	g/m ³	pH	g/m ³	Deg C
HHG000109	0.6	38.5	27.0	*	0.00076	0.170	7.0	7	19.1
HHG000115	0.6	73.1	37.3	<0.5	0.00157	0.660	6.7	9	19.9
HHG000150	1.2	81.1	38.7	<0.5	0.00009	0.030	6.8	8	20.6
HHG000190	*	63.5	31.8	*	0.00025	0.040	7.1	*	20.4
IND003008	6.6	23.4	54.5	*	0.20853	17.9	7.5	27	16.6

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

2.1.4.4 14 January 2014

The sampling done on 14 January 2014 was done under low conditions. There had been 13 mm rain over the 72 hours prior to sampling and the wetland was discharging slowly. The sites downstream of the wetland discharge showed a small increase in CBODF but the levels found were within consent conditions. The level of unionised ammonia at site HHG000103 was below the consented limit of 0.025 g/m³. Chloride levels downstream of the drill mud treatment areas and lower irrigation fields were elevated but still within the 150 g/m³ consent limit.

Table 8 Chemical analyses of samples collected on 15 January 2014

Site	CBODF	Chloride	Conductivity	HC	Unionised ammonia	Ammoniacal nitrogen	pH	Suspended solids	Temp
	g/m ³	g/m ³	g/m ³	g/m ³	g/m ³	g/m ³	pH	g/m ³	Deg C
HHG000093	0.6	13	14.6	<0.5	0.00016	0.023	7.2	3	18.6
HHG000097	<0.5	9.8	16.5	*	0.00036	0.079	7.2	15	13.2
HHG000098	0.6	10.3	16.8	*	0.00022	0.044	7.2	6	14.6
HHG000099	0.6	11.8	16.5	*	0.00012	0.019	7.2	7	17.1
HHG000100	0.6	20.7	16.8	<0.5	0.00017	0.027	7.2	69	17.8
HHG000103	1.1	26.5	23	*	0.00385	0.562	7.3	65	15.6
HHG000106	1.4	44.6	31	*	0.0085	1.24	7.2	270	18.7
HHG000109	0.7	36.4	24.1	*	0.00125	0.229	7.1	5	18.7
HHG000115	0.9	57.0	31.6	<0.5	0.00193	0.452	7	5	18.5
HHG000150	1.3	96.5	44.6	<0.5	0.00179	0.475	6.9	7	19.9
HHG000190	*	75.6	37	*	0.00157	0.336	7	*	19.7
IND003008	14	43.4	71	*	0.33851	26.6	7.5	48	17.8

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

2.1.4.5 13 March 2014

The sampling done on 13 March was done under very low flow conditions with no rain for 10 days. Parts of the stream system had dried up completely so a reduced sampling run was done. The sampling found extremely high levels of chloride and ammonia in the stream around the drilling waste treatment area. As a result an incident was logged and the site was investigated to find the cause (please see section 2.3). This investigation resulted in an infringement notice being issued.

Table 9 Chemical analyses of samples collected on 13 March 2014

Site	CBODF	Chloride	Conductivity	HC	Unionised ammonia	Ammoniacal nitrogen	pH	Suspended solids	Temp
	g/m ³	g/m ³	g/m ³	g/m ³	g/m ³	g/m ³	pH	g/m ³	Deg C
HHG000109	4.4	<i>2750</i>	837	*	0.20584	24.8	7.4	12	15.1
HHG000115	0.7	<i>2290</i>	685	*	0.00140	0.396	6.7	18	15.7
HHG000150	<0.5	507	172	<0.5	0.00019	0.035	7.1	7	18.6
HHG000190	*	237	81.6	*	0.00007	0.014	7.1	*	17.3
IND003008	14	43	88.2	*	0.17141	34.9	7.2	95	14.2

Key: *= Not measured. CBODF= filtered carbonaceous biological oxygen demand HC = hydrocarbons
Bold= non compliance with consent conditions
Italics= non-compliance with the RMA

2.1.4.6 15 May 2014

The sampling done on 15 May 2014 was done in moderate to high flow conditions with 36 mm of rain falling over the previous 72 hours. The wetland was discharging at approximately 30 L/min. On this occasion all sites were in compliance and all sites had chloride levels below 50 g/m³.

Table 10 Chemical analyses of samples collected on 15 May 2014

Site	CBODF	Chloride	Conductivity	HC	Unionised ammonia	Ammoniacal nitrogen	pH	Suspended solids	Temp
	g/m ³	g/m ³	g/m ³	g/m ³	g/m ³	g/m ³	pH	g/m ³	Deg C
HHG000093	<0.5	13	15.4	<0.5	0.00008	0.046	6.9	5	9.7
HHG000097	<0.5	13	18.4	*	0.00006	0.036	6.9	8	9.6
HHG000098	<0.5	13.4	16.5	*	0.00015	0.082	6.9	8	9.9
HHG000100	<0.5	17.5	16.7	*	0.0001	0.047	7	4	9.6
HHG000099	<0.5	17.2	15.8	<0.5	0.00007	0.025	7.1	6	9.6
HHG000103	0.6	18.7	19.7	*	0.00383	1.27	7.1	18	10.7
HHG000106	<0.5	39.2	27	*	0.00584	1.42	7.2	14	11.8
HHG000109	0.8	22.3	19.2	*	0.00195	0.435	7.3	10	9.9
HHG000115	0.7	23	19.1	*	0.0014	0.396	7.2	18	9.8
HHG000150	<0.5	34	22.1	<0.5	0.00069	0.297	7	8	10.3
HHG000190	*	31.8	21.1	<0.5	0.00036	0.184	6.9	*	10.9
IND003008	6.8	30.7	61.4	*	0.15451	28.8	7.4	16	9.2

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

2.1.5 Summary of water quality monitoring

Figures 7 to 10 show that during the monitoring year the levels of filtered carbonaceous oxygen demand (BODCF) and unionised ammonia at compliance points HHG000103, and HHG000150 were within consent limits on all sampling occasions. Levels of BODCF exceeded consent limits on one occasion during an incident involving a leaking irrigation pipe (see incidents section 2.3).

It should be noted that for Figures 8, 9 and 10 the consent limits shown are derived by applying the provision of consent conditions which state that the discharge shall not raise the instream filtered carbonaceous oxygen demand by more than 2.00 g/m^3 . Subsequently the consent limit lines shown in Figures 8, 9, and 10 are derived by adding 2 g/m^3 to the filtered carbonaceous biological oxygen demand result obtained from the site immediately upstream of the discharges. During the year under review the limits for ammonia at HHG000103 (Figure 6) were complied with as was the limit of filtered carbonaceous biological oxygen demand at site HHG000150 (Figure 5). There was a non compliance (shown as the large spike on the right of Figure 7) in regards to the level of filtered carbonaceous oxygen demand at site HHG000100 and this was the result of a leaking irrigation pipe (see incidents section 2.3). Please also note that the graphs show all historical data as well as the data from this monitoring period.

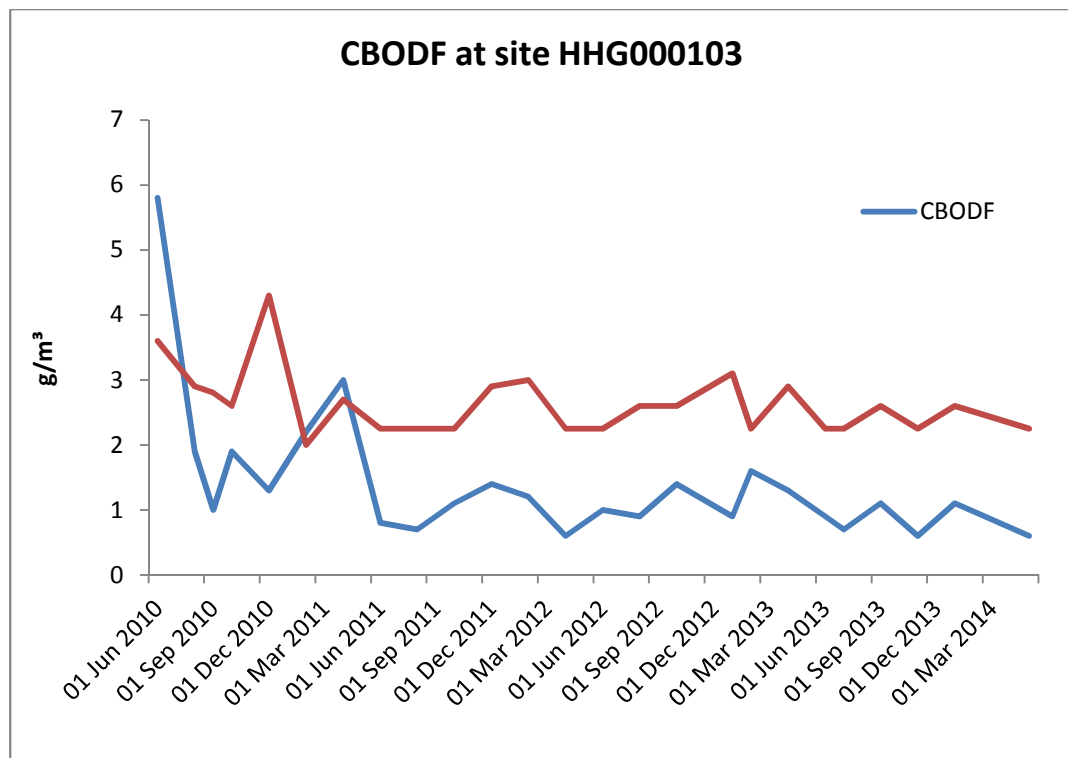


Figure 7 Graph showing historical and current CBODF levels at compliance point HHG000103 in relation to consent condition limits
 (* limit is derived from CBODF level at site HHG000098 + 2.0 g/m^3)

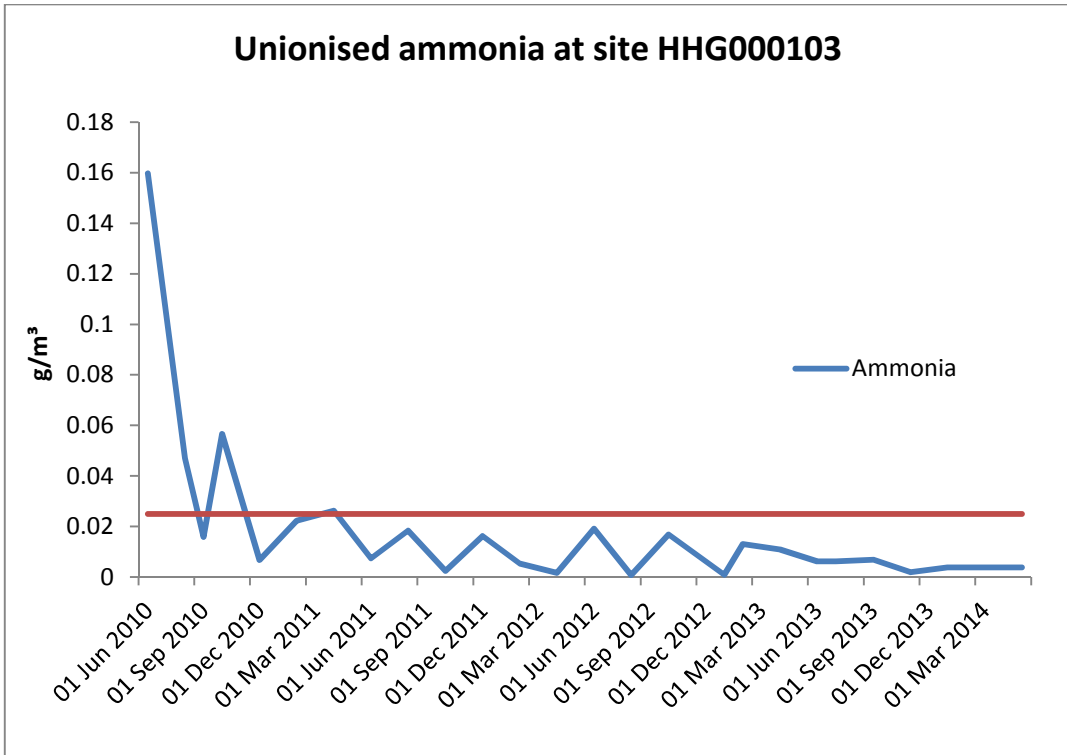


Figure 8 Graph showing historical and current unionised ammonia levels at compliance point HHG000103 in relation to consent condition limits

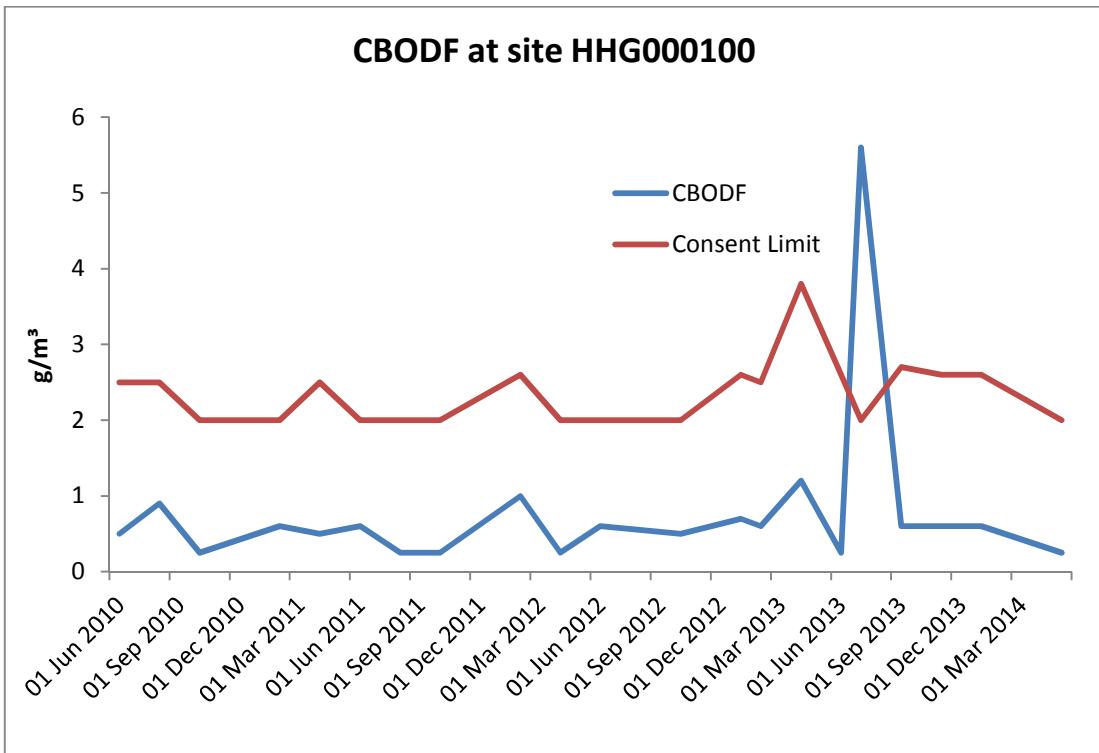


Figure 9 Graph showing historical and current CBODF levels at compliance point HHG000100 in relation to consent condition limit

(* limit is derived from CBODF level at site HHG000093 + 2.0 g/m³)

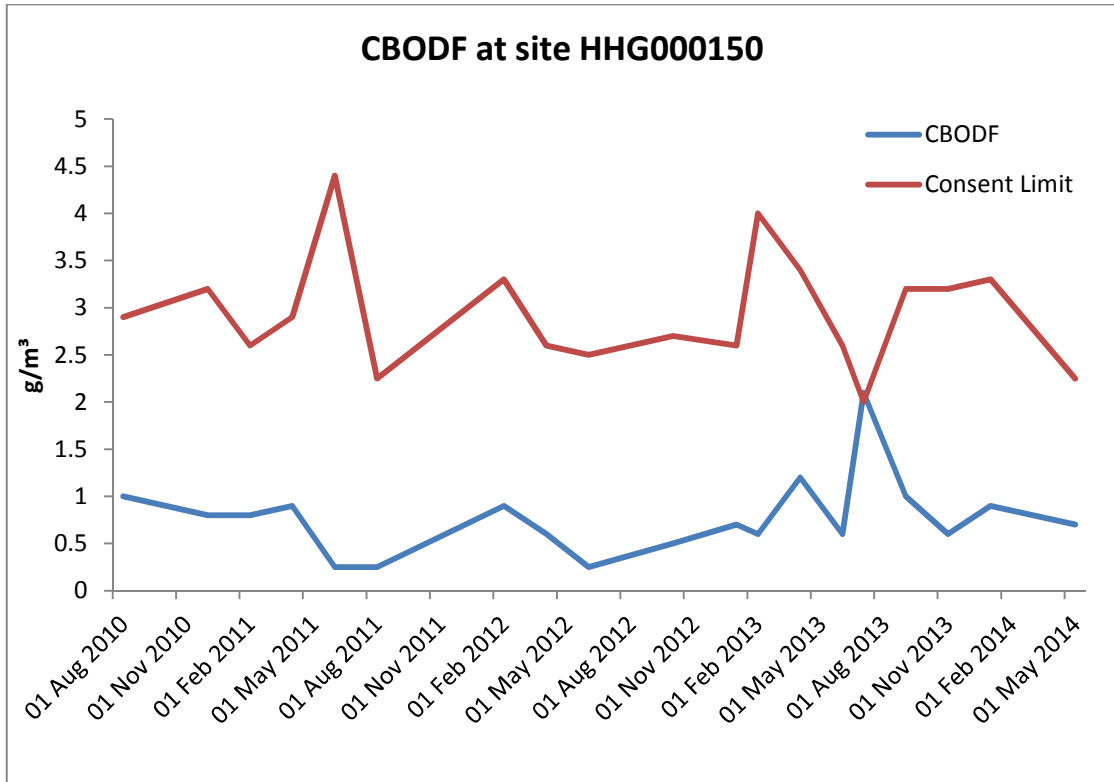


Figure 10 Graph showing historical and current CBODF levels at compliance point HHG000150 in relation to consent condition limits
 (* limit is derived from CBODF level at site HHG00115 + 2.0 g/m³)

Generally chloride levels in the receiving waters tend to increase downstream of the irrigation areas as a result of a high level of chloride found in the irrigation fluid. The wetland discharge also contains a moderate level of chloride from the presence of hydrochloric acid in the paunch grass leachate it treats, and this also contributes the overall loading to the stream system.

Prior to 20 September 2013 consent 5838-2 (condition 10) required that there shall be no adverse rise in instream chloride levels at compliance points HHG000100 (downstream of upper irrigation area) and HHG000115 (downstream of lower irrigation area). As no specific quantitative limit was sent in the consent, a limit of 150 g/m³ chloride was adopted (in line with the guideline for 30 day average chloride level for protection of aquatic life, Government of British Columbia). To clarify this, the consent holder applied to have this limit included in condition 10 of consent 5838-2 and this change was granted on 20 September 2013.

During the period under review this new consent condition was exceeded on one occasion at site HHG000115 and this was in relation to an incident on 13 March 2014 when leaks in the bund around the drilling waste treatment pad was found to be allowing leachate to enter the Haehanga Stream. During this incident and one other irrigation leakage incident on 17 July 2013 high chlorides were also found in other parts of the stream (please see incidents section 2.3).

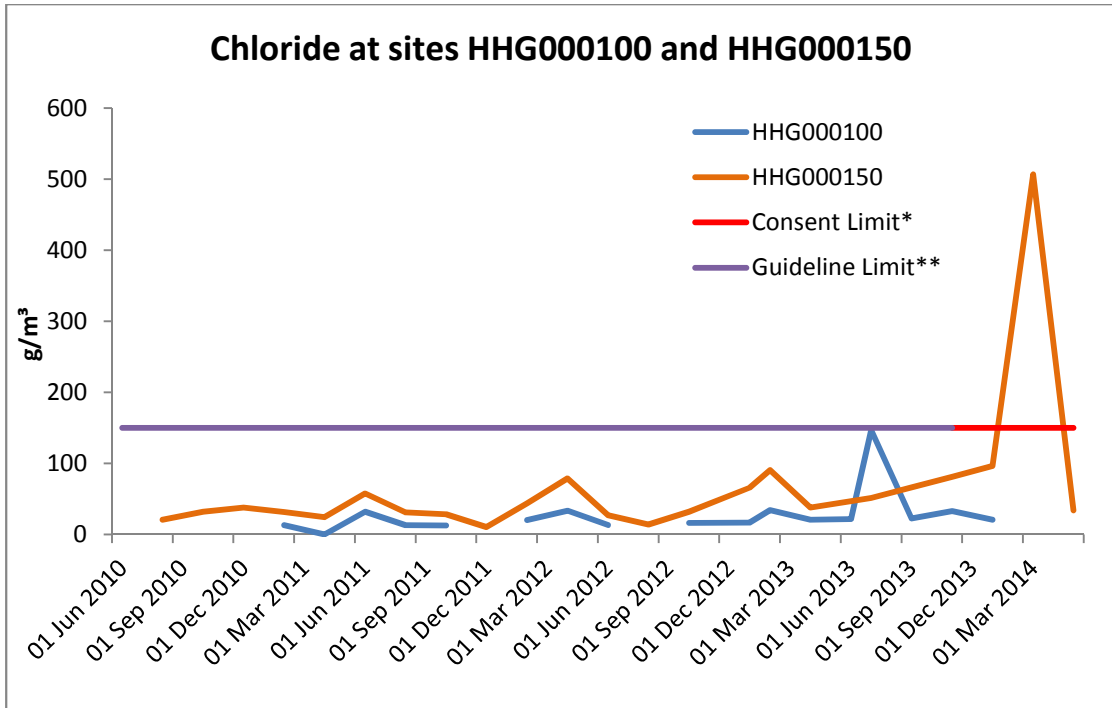


Figure 11 Graph showing chloride levels at compliance points HHG000100 and HHG000150.

*Consent Limit in force since 20 September 2013

** Guideline for 30 day average chloride level for protection of aquatic life, Government of British Columbia of 150 g/m³ used prior to 20 September 2013.

Excluding the incidents mentioned above, instream chloride levels downstream of all the operational areas of the site generally were found to be below 80 g/m³.

In Section 2.1.6 that discusses groundwater it is noted that the chloride level in the groundwater in the irrigation areas exhibit far higher concentrations than those in the control bore in the upper irrigation area.

2.1.6 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.

2.1.6.1 18 December 2013

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 RNZ composting areas have 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 18 December 2013 found water flows in the Haehanga catchment to be very low, with a slow water speed noted at all sites except site 6. Community richnesses were similar to the median for two sites, while the remaining five either equalled or exceeded their previous maximum richnesses recorded. Overall, this survey found that macroinvertebrate communities at all sites were in average health. 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 seventh time in the current survey, and exhibited a community typical of this kind of habitat. Site T2 and site T3 had the same MCI score, however the SQMCI_s score decreased significantly at site T3. This was a result of the reduced abundance of two 'sensitive' taxa, especially mayfly, (*Zephlebia* group). There were five significant changes in taxon abundance from site T2 to site T3, which were not necessarily indicative of impacts caused by the discharge from the wetland. Previous surveys have frequently recorded oligochaete worms, ostracod seed shrimps and *Chironomus* blood worms increasing significantly in abundance downstream of the discharge. These taxa are often associated with organically enriched discharges. In the current survey only oligochaete worms increased in abundance, while *Chironomus* blood worms were absent at both sites. Ostracod seed shrimps were rare at site T2 and absent at site T3. Overall, these observations indicate that the discharge has not had significant impact on the communities.

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 all six samples taken contained concentrations of unionised ammonia below the toxicity threshold of 0.025 g/m³. 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 indicated that the macroinvertebrate communities were in similar health when compared with other small lowland hill country streams in the region.

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 a significant 12 units greater than the median score for this site, and four units more than that recorded at the next upstream Haehanga Stream site. The same SQMCI_s score was recorded at both site 5 and upstream site 2, indicating no sign of deterioration. The results from the current survey indicate that *Chironomus* blood worms were absent, unlike the previous survey where they were abundant.

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 not significantly different to the medians for the other Haehanga Stream sites, and not significantly different to that recorded at the three upstream main stem sites. The SQMCI_s score was not significantly less than site one, but was significantly less than what was recorded at sites 2 and 5. This significant reduction in SQMCI_s score can be attributed to a change in sampling method and variations in habitat rather than to a deterioration from the upstream sites. Overall, unless physicochemical sampling indicates a reduction in water quality at this site, it appears that the irrigation of wastewater upstream of this site has not lead to a reduction in invertebrate health at this site.

The lowest site (site 7) was sampled for the 13th time in this survey. There was little difference in MCI and SQMCI_s scores between sites 7 and sites 5 and 6. When compared with historical data the community at site 7 was in average to above average health, and indicative of little change in water quality from previous surveys.

Of some concern during certain previous surveys was the abundance of *Chironomus* blood worms 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 not present at any of the seven sites sampled. This indicates that water quality in the Haehanga catchment has not deteriorated from the previous survey, and overall continues to improve, possibly contributed to by on-going works to the leachate and stormwater treatment system, and improved management of the riparian margin. These works are likely to lead to an improvement in freshwater macroinvertebrate communities below the discharges, and should continue to be encouraged.

Due to the low flows experienced in the current survey, it was decided to forgo the second macroinvertebrate survey, and undertake a fish monitoring survey instead. It is recommended that this continue in subsequent years, but that both surveys be undertaken in early summer, preferably December.

It is also recommended that provisional macroinvertebrate surveys be retained in the programme, to be implemented should water quality monitoring indicate an issue.

2.1.7 Fish survey

On 27 and 28 March 2014, three sites were surveyed for freshwater fish in the Haehanga Stream in relation to the composting activities undertaken by RNZ. 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 also.

At the time of this survey, flow in the Haehanga Stream was extremely low, to the extent that there was no surface flow between pools at site 1. This not only reduced the amount of habitat available, but also reduced the effectiveness of the bait set in the nets and traps. As a result a total of only three species was recorded.

Due to the lack of fish, it is very 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 are any, site 2, recorded the most species (3), and the most fish (16). This was the only site to record inanga, and they were relatively numerous. This is because inanga are a schooling species, and therefore when present, are likely to be recorded in high numbers. All but one of these inanga were captured in the fine mesh fyke net, with one individual captured in a g-minnow trap. Of note was the physical condition of the inanga. These fish were in very good condition, with well developed gonads. This indicates that these fish were trapped due to the low flows, as normally inanga in this condition would have migrated downstream in preparation for spawning.

Eels were recorded at all three sites, although only longfin eel was recorded at site 1, including two individuals that were almost one metre long. The physical condition of the eels showed that although not many eels were collected, 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.

These results give no indication that the composting activities and wastewater irrigation undertaken by RNZ, 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 in early summer, preferably December. This survey could be undertaken in conjunction with the annual macroinvertebrate survey. In addition, it is proposed a provisional macroinvertebrate survey be included in the programme, to be undertaken in late summer, should water quality monitoring find that there may have been an impact on the stream fauna.

2.1.8 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 11 Groundwater results from samples taken on 14 January 2014

Parameter	Unit	GND2188 Control	GND2190 Lower irrigation area	GND2189 Upper irrigation area
Chloride	g/m ³	63.5	623	266
Conductivity	mS/m	52.5	188	90.4
Water level	mbgl*	<0.5	<0.5	<0.5
Ammoniacal nitrogen	g/m ³	1.0	0.935	0.935
Unionised ammonia	g/m ³	0.00052	0.00007	0.00009
Nitrate/Nitrite	g/m ³	0.325	0.398	0.157
pH		6.6	5.7	6.2
Total dissolved solids	g/m ³	406.2	1454.6	699.4
Temperature	Deg.C	17.7	15.8	15.6

*Meters below ground level

Table 12 Groundwater results from samples taken on 15 May 2014

Parameter	Unit	GND2188 Control	GND2190 Lower irrigation area	GND2189 Upper irrigation area
Chloride	g/m ³	90.5	593	828
Conductivity	mS/m	57	182	248
Unionised ammonia	g/m ³	0.00003	0.00009	0.00001
Ammoniacal nitrogen	g/m ³	0.048	0.239	0.263
Nitrate/Nitrite	g/m ³	8.52	0.01	0.08
pH	pH	6.2	6.1	5.2
Total dissolved solids	g/m ³	441	1408.2	1918.8
Temperature	Deg.C	16.2	13.4	13.4

These results showed that the groundwater in both irrigation areas had elevated levels of chloride when compared to that found in the control bore. These increased levels are almost certainly the result of the irrigation of fluids drained from drilling wastes that accumulated in the irrigation pond (see section 2.1.3). Elevated chloride levels have been noted in the Haehanga Stream during the monitoring year and these are commented on in section 2.1.3.

Total dissolved solids levels indicate that the groundwater is suitable for stock watering with the upper level found only on one occasion (in the historical data) being above the minimum guideline taken from Table 4.3.1 of the Australian and New Zealand Guidelines for Fresh and Marine Water Quality for palatability. Generally stock will tolerate significantly higher levels of total dissolved solids without loss of condition.

Of note in this year's results is that the level of chloride and total dissolved solids in the upper irrigation area is rising whilst the lower areas levels appear to be decreasing.

Under Consent 5838, the Council may request that the consent holder provide a Groundwater Management Plan if increasing values of contaminants are observed over time. The levels of chloride in bore GND2189 have shown three consecutive increases from June 2013 to January 2014. Based on this and the rate at which contaminants have been seen to increase, it is the Council's belief that the consent holder would benefit from having a better understanding of the effects on groundwater as a result of irrigation. This report will therefore recommend that the consent holder be required to develop and adhere to a Groundwater Management Plan.

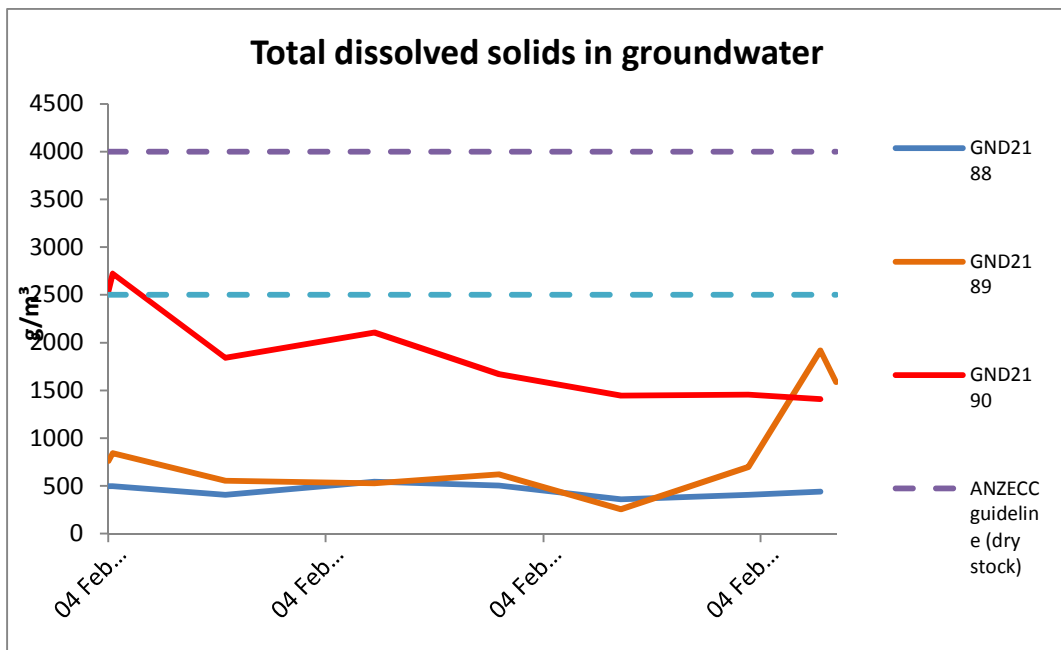


Figure 12 Historical total dissolved levels in groundwater

2.1.9 BTEX sampling (receiving waters)

Council undertook benzene, toluene, ethyl benzene and xylene (BTEX) on one surface water sample, and four groundwater samples.

All BTEX components were found to be below detection levels at in all samples taken with the exception of a very low level of meta-xylene found in bore GND2190 (lower irrigation area).

All receiving water BTEX results for this period were far below that required by the Maximum allowable value (MAV) in New Zealand Drinking water.

Table 13 Results of BTEX analysis 14 Jan 2014

Parameter	Unit	HHG000150 d/s lower irrigation area surface water	GND2190 lower irrigation area groundwater	Guideline Value (water)*
Benzene	ppm	<0.0005	<0.0005	0.01
Ethyl benzene	ppm	<0.0005	<0.0005	0.3
Toluene	ppm	<0.0005	<0.0005	0.3
meta-Xylene	ppm	<0.0005	0.001	0.6 (combined <i>m & p</i>)
para-Xylene	ppm	<0.0005	<0.0005	

* MAV's from New Zealand Drinking Water Standards

Table 14 Results of BTEX analysis 20 June 2014

Parameter	Unit	GND2188 Control	GND2189 upper irrigation area groundwater	GND2190 lower irrigation area groundwater	Guideline Value (water)*
Benzene	ppm	< 0.0005	< 0.0005	< 0.0005	0.01
Ethyl benzene	ppm	< 0.0005	< 0.0005	< 0.0005	0.3
Toluene	ppm	< 0.0005	< 0.0005	< 0.0005	0.3
meta-Xylene	ppm	< 0.0010	< 0.0010	< 0.0010	0.6 (combined <i>m & p</i>)
para-Xylene	ppm	< 0.0005	< 0.0005	< 0.0005	

* MAV's from New Zealand Drinking Water Standards

2.1.10 Soil sampling

2.1.10.1 Receiving soil (irrigation areas)

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

Table 15 Results of soil samples taken from SOL000177 (lower irrigation area)

Parameter	Unit	14 Jan 2014	15 May 2014
Calcium	mg/kg	121	245.4
Chloride	mg/kg	584	1559.6
Conductivity	mS/m	277	105
Hydrocarbons	mg/kg	<4	14.8
Potassium	mg/kg	281.4	641.6
Magnesium	mg/kg	10.4	22.0
Sodium	mg/kg	286	463.3
Nitrate/nitrite	mg/kg	0.23	0.42
pH	pH	6.9	6.5
Sodium Absorption ratio	-	6.7	7.6

Table 16 Results of soil samples taken from SOL000176 (upper irrigation area)

Parameter	Unit	14 Jan 2014	15 May 2014
Calcium	mg/kg	89.9	159.2
Chloride	mg/kg	335	1161.4
Conductivity	mS/m	170	75.8
Hydrocarbons	mg/kg	6	15
Potassium	mg/kg	121.3	419.1
Magnesium	mg/kg	8.8	14
Sodium	mg/kg	184	363.5
Nitrate/nitrite	mg/kg	0.99	0.26
pH	pH	6.3	6.2
Sodium Absorption ratio	-	4.9	7.40

The results show that there are low levels of hydrocarbons in the soil at both sites, and these levels are well below the guideline level for agricultural use. The last three samples at both sites have shown increases in cations and chlorides and also in the sodium absorption ratio. The graph below illustrates these increases in the upper irrigation area and similar trends (not graphed) are found in the lower irrigation area. The increase in these contaminants is most likely a result of the increased inflow of drilling waste at the site over the last year. Also shown to be increasing is the sodium absorption ratio or sodicity of the soil. This measures the ratio of the cations of magnesium, calcium and sodium. Soils with a sodicity of over 13 may require treatment to be used to grow sodium tolerant crops.

The level of chloride in both soil irrigation areas were also shown to rise during the monitoring year with the lower irrigation area returning a result of 1559 mg/kg. Any further increases may cause toxic effects to soil biota and fauna.

A graph showing the sharp increase in sodicity in the irrigated soils is shown in Figure 14.

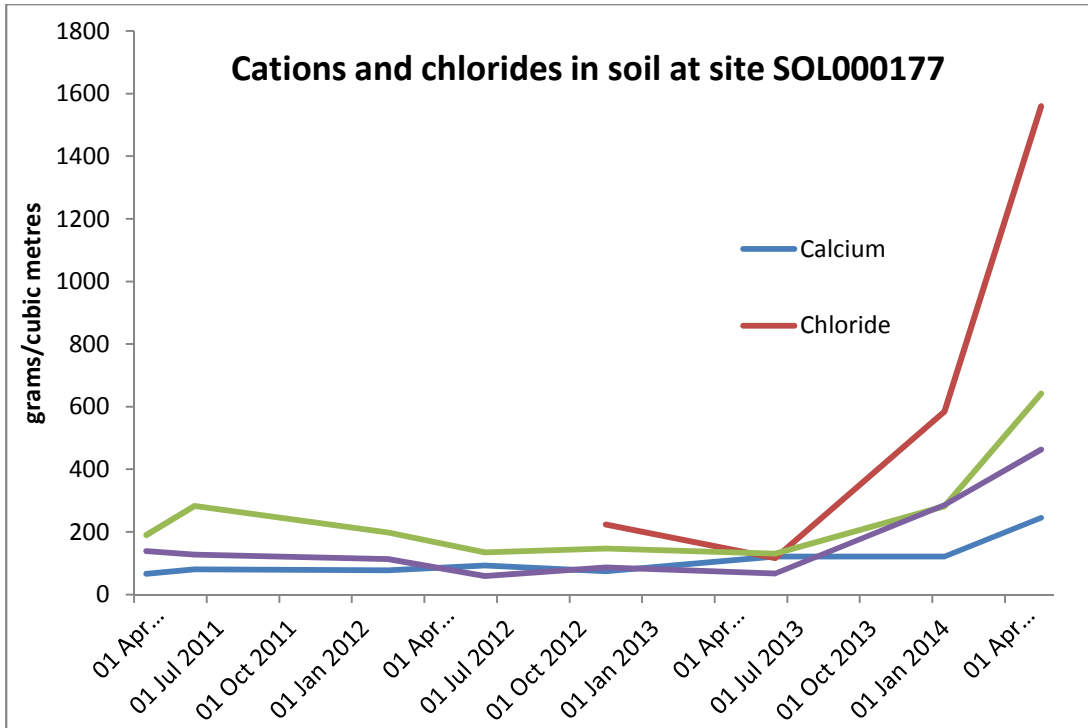


Figure 13 Graph showing cation and chloride levels in the lower irrigation area soil

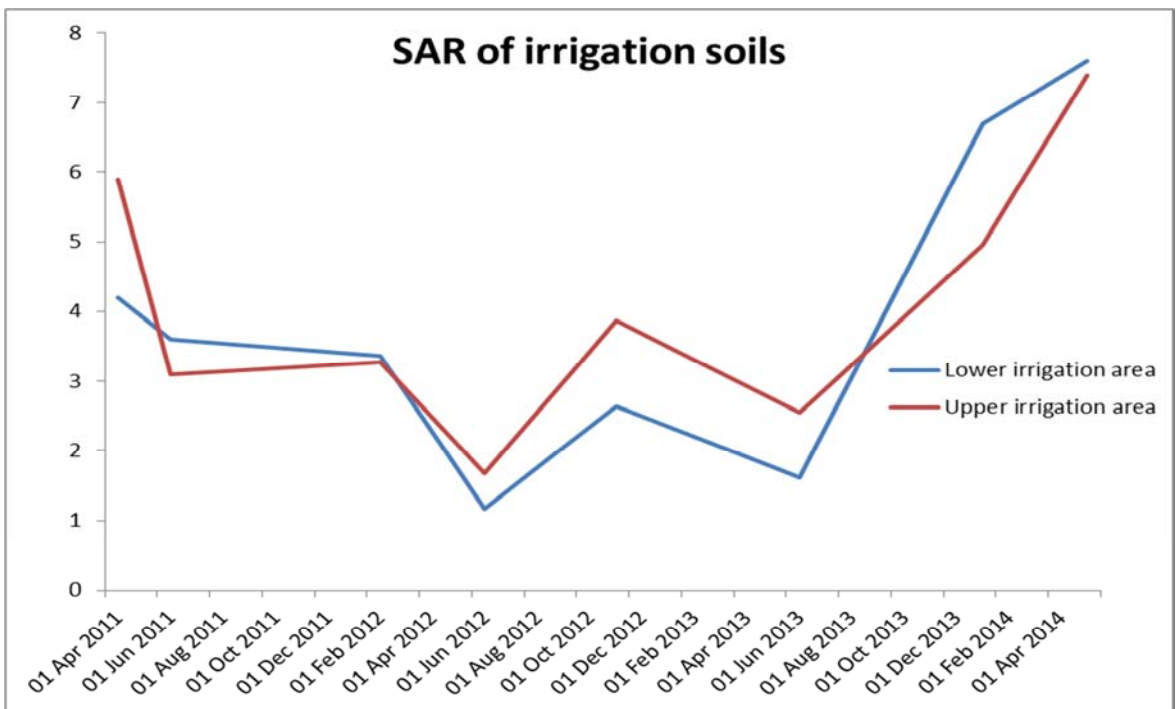


Figure 14 Graph showing sodium absorption ratio in both irrigation areas soil

Even though the sodicity levels are not currently high enough to cause immediate concern, there is concern that the data indicates that the sodicity of the soil is increasing significantly and at a reasonably fast rate. Similarly the levels of chloride are approaching levels of concern. It is therefore recommended that the consent holder be required to submit a Soil Management Plan as required under consent 5838 to manage the issue.

2.1.10.2 Drilling waste pad papa

Four soil samples were taken from the papa pad of the drill waste pad. These sites were situated between treatment ponds and at the time covered with a layer of sawdust blended drilling waste. The areas served as access tracks to the stock piles for vehicles and machinery that move and blend the wastes. The waste was scraped back to the papa and cores were taken at 0-150 mm and 150-300 mm and analysed for BTEX, ethylene glycol, chloride and methanol. During the sampling it was noted that the papa was extremely hard and appeared to have very low permeability which is reflected in the dry matter contents of >80 g/100g. All of the hydrocarbon based compounds tested for were below detection limits indicating that the non-polar phase (hydrocarbon phase) is not penetrating the compressed papa. One sample had slightly elevated chloride levels indicating that some aqueous phase migration is occurring, however the sample taken at 150mm -300mm at the same site indicates attenuation is occurring in the upper levels of the papa pad. The results of the analysis are given in the table below.

Table 17 Results of soil samples taken from the drilling waste pad 20 June 2014

		SOL000189		SOL000190	
Parameter	Unit	0-150 mm	150-300 mm	0-150 mm	150-300 mm
Benzene	mg/kg dry wt	<0.05	<0.05	<0.05	<0.05
Chloride	mg/kg dry wt	790	530	95	80
Dry Weight	g/100g	85	83	82	82
Ethyl benzene	mg/kg dry wt	<0.05	<0.05	<0.05	<0.05
Ethylene Glycol	mg/kg dry wt	<10	<10	<10	<10
Methanol	mg/kg dry wt	<10	<10	<10	<10
Toluene	mg/kg dry wt	<0.05	<0.05	<0.05	<0.05
m-Xylene	mg/kg dry wt	<0.05	<0.10	<0.10	<0.10
o-p Xylene	mg/kg dry wt	<0.10	<0.10	<0.10	<0.10



Figure 15 Sampling of drill waste treatment pad papa

2.1.11 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.

2.1.12 Data review

During the period under review the consent holder provided site input data which the Council reviewed to assess compliance in regards to the types of waste being accepted. The data review in conjunction with observations made during site inspections found no evidence that unacceptable wastes were being discharged at the Uruti site. One item was queried and this was found to be soil contaminated with drilling waste from a well site bund and deemed to be of similar nature to the drilling cuttings already permitted to be accepted at the site.

2.2 Waitara Road and Pennington Road, Brixton

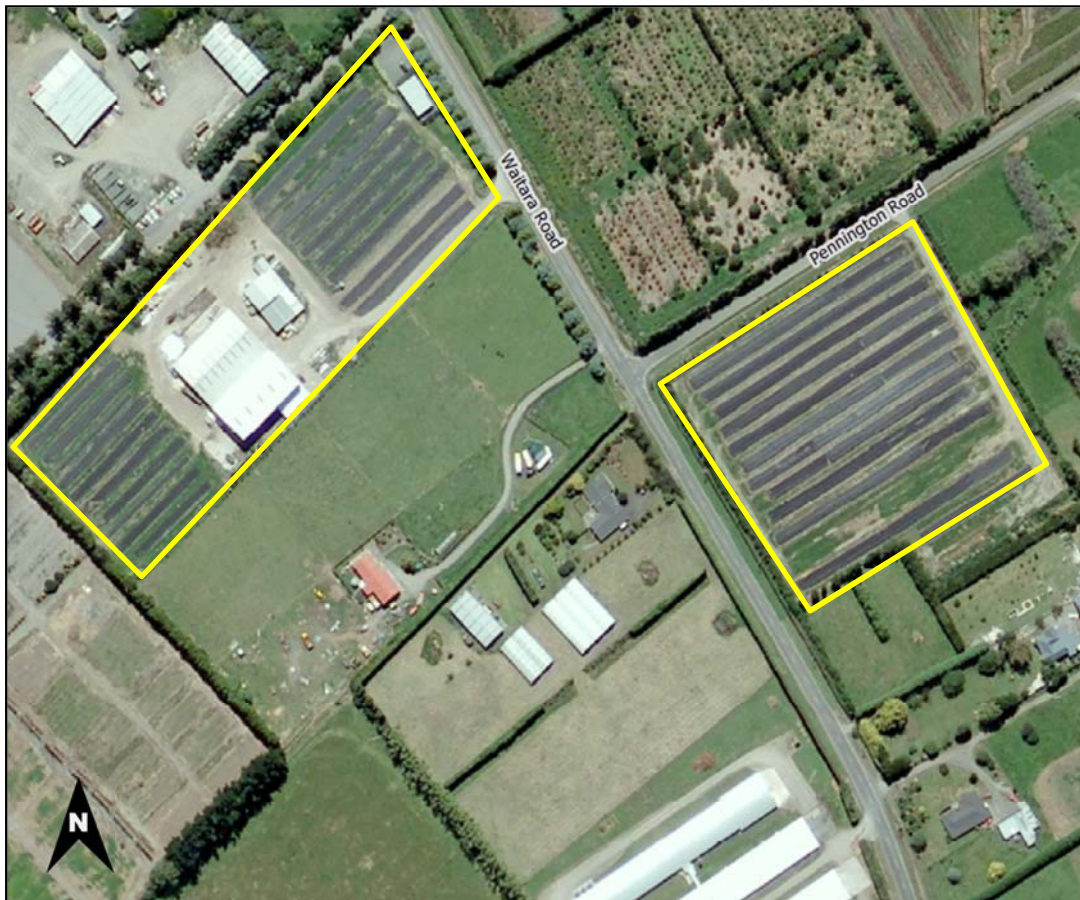


Figure 16 Aerial view of Remediation NZ's Waitara and Pennington Rd sites

2.2.1 Inspections

Three inspections were carried during the monitoring period. The inspections focused on stormwater discharges and potential contaminant sources.

2.2.1.1 15 July 2013

A site visit was made to conduct a compliance monitoring inspection. There was a SW wind and 3.0 mm of rain had fallen over the previous 24 hours.

Waitara Rd: 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. The site manager said that all the covers had blown off during the storm on the previous night. There were no issues in regards or run-off or leachate noted. Product was being turned in the storage shed and there was a very strong odour within 10 m of the doorway, but only noticeable odours were detected at the boundary.

Pennington Rd: No discharges were occurring at the time of the inspection and no odours were detected.

2.2.1.2 14 October 2013

A site visit was made to conduct a compliance monitoring inspection. There was a SW wind and 33 mm rain had fallen over the previous 24 hours.

Waitara Rd: All of the worm beds except two were covered at the time of the inspection and the areas between the worm beds had good grass growth that had been recently mowed. A digger was working on two of the rows. There were strong odours around the open worm beds and the shed doors. An odour survey was conducted at the downwind boundary and no odours were detected.

Pennington Rd: No discharges were occurring at the time of the inspection and no odours were detected.

2.2.1.3 30 January 2014

A site visit was made to conduct a compliance monitoring inspection. There was slight NW wind and no rain for the past 3 days.

Waitara Rd: 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. An odour survey was conducted at the downwind boundary and no objectionable odours were detected. There was a small pool of leachate in the drain near the sheds entrance but no discharges were occurring from the site.

Pennington Rd: No discharges were occurring at the time of the inspection and no odours were detected.

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.

There were seven complaints in regard to odour from these sites during the monitoring period, none of which was substantiated, however an abatement notice was issued as objectionable odour beyond the boundary was likely to occur (see Incidents - Section 2.3). RNZ does not hold air consent for either of the sites but must comply with the Regional Air Quality Plan.

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 e.g. 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 Unauthorised Incident Register (UIR) includes events where the company concerned has itself notified the Council. The register contains details of any investigation and corrective action taken.

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

Two incidents were logged by the Council in regards to breaches of consent conditions, identified during routine compliance monitoring surveys at the Uruti site. As a result of these breaches, enforcement action was taken. The Council also responded to one complaint in regards to odour at the Uruti site, however this was not substantiated.

The Council responded to seven complaints in regards to odour at the Brixton Rd site. After investigation no objectionable odours were found, however an abatement notice was issued on one occasion on the likelihood that a breach of the Regional Air Quality Plan would occur.

2.3.1 Uruti site

Incident 23757

On 17 July 2013 during a compliance monitoring inspection it was found that the composting site was not operating within resource consent conditions. A split mainline resulted in wastewater flowing overland into a tributary of the Haehanga Stream. Abatement Notice 12033 was issued requiring works to be undertaken to repair the line. Sample results indicated that the leak was causing contaminants to enter the water. Re-inspection found that the abatement notice was being complied with at the time of inspection. An infringement notice was also issued.

Incident 30356

During analysis of samples taken on 13 March 2014, it was found that chloride levels were above allowable limits in resource consent conditions at the composting site in Uruti. Upon investigation it was found that the drill waste pad bund running along the stream bank was leaking contaminants into the stream. Subsequent routine monitoring showed that works had been undertaken to rectify the problem. An infringement notice was issued.

Incident 30793

On 23 June 2014 a complaint was received regarding odour discharging off-site at RNZ Uruti site. Investigation found that a slight odour was detectable off-site. The odour was not considered offensive or objectionable and therefore authorised under resource consent 5839-2.

2.3.2 Brixton site

Incident 30121

On 17 December 2013 at 12:00 AM complaint was received concerning an odour emanating from the worm farm on Waitara Road, Brixton. An odour survey was undertaken and there were no noticeable odours emanating beyond the site boundary at time of investigation. No breaches of the Regional Air Quality plan were found.

Incident 30139

On 17 December 2013 a complaint was received regarding objectionable odour discharging beyond the boundary of a site used for the storage, blending and distribution of fertilisers and soil conditioners. An odour survey conducted at the complainant's property found no odours attributable to the composting operations. Light and intermittent pungent odours were found beyond the site boundary along Waitara Road, the odour was not considered objectionable at the time. No breaches of Regional Air Quality plan were found.

Incident 30133

On 18 December 2013 a complaint was received regarding objectionable odours discharging beyond the boundary of a site used for the storage, blending and distribution of fertilisers and soil conditioners. An inspection undertaken in response to the odour complaints received, and an odour survey conducted beyond the site boundary found essentially constant odours attributable to site activities, The odour was found to be an earthy odour with acrid undertones. No breaches of the Regional Air Quality plan were found.

Incident 30125

On 19 December 2013 a complaint received regarding odour in the Waitara Rd area. Upon inspection a Council officer found an intermittent westerly with a pungent compost aroma present on Waitara Road. Heavy machinery could be heard from the site located at 96 Waitara Rd while an odour survey was conducted. Staff at the site outlined that that compost materials had been applied to the worm beds immediately prior to the Council arriving on site. Present on site also was a large open shed with Osflo materials being stored, no odour controls are in place. At the time of inspection there was no breach to the Regional Air Quality Plan, however it was deemed highly likely a breach would occur and an abatement notice to this effect was issued.

Incident 30157

On 23 December 2013 a complaint received regarding odour in the Pennington Rd area. No odour was found at the complainant's address at the time of inspection. No breaches of Regional Air Quality plan were found.

Incident 30143

On 30 December 2013 a complaint was received regarding odour and flies from the Waitara Road, worm farm. Investigation found that no odour was being emitted from the property and the complaint was mostly in relation to a large number of flies entering the complainant's nearby residence. Inspection found flies were breeding on the compost storage heaps at the worm farm. The staff at the site agreed to address

this issue the following day. No breaches of the Regional Air Quality plan were found.

Incident 30393

On 30 January 2014 a complaint was received concerning odour emanating from a worm farm on Waitara Road, Brixton. An odour survey was undertaken and only noticeable odour was found at the complainant's property. No breaches of the Regional Air Quality plan were found.

3. Discussion

3.1 Discussion of site performance

3.1.1 Mokau Road, Uruti

There were significant issues at the site during the monitoring period. Irrigation lines were found to be leaking and in poor repair and the containment bund on the drill waste pad were also found to be leaking. These issues resulted in discharges of contaminants into the stream system and resulted in infringement notices being issued. It is also noted that there has been an increase in the amount of drilling waste accepted at the site when compared to other monitoring periods. Whilst this has not been quantified, it is evidenced by the largest stockpiles of blended drilling waste on the treatment pad ever seen since the granting of consent 5838-2. There is a concern that the increased drilling waste input and the presence of the large stockpile is having cumulative effects on the treatment system and this is further evidenced by higher than usual levels of hydrocarbons, chloride, potassium and sodium found in the irrigation fluids. These in turn appear to be having flow on effects such as increased levels of sodium, potassium, chloride and sodium absorption ratio (SAR) in the soil of both irrigation areas and increasing levels of chloride in the upper irrigation area. During the preparation of this report there was another incident at the site where after rain the pond treatment system overflowed resulting in oily waste entering into the Haehanga Stream and causing oily films in the Mimi Stream which may have been in part due the drilling waste pad been operated at its full capacity. Whilst there is no consent condition that limits the amount of waste on the pad, the Site Practices Plan submitted under consent conditions does say that all compostable material is to be moved to the appropriate pad and formed into windrows. The timely blending of the drill waste/sawdust material with greenwaste, followed by composting and its removal from the site, would most likely reduce the pressures on the treatment system and the environment.

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 issues in regards to odour complaints at the Waitara Rd site where the bulk of the product processing occurs. No breaches of the Regional Air Quality Plan were found however an abatement notice was issued on the likelihood that a breach would occur. The complaints were limited to a short period around late December and early January and no other complaints were received during the rest of the monitoring period. The pattern of complaints may indicate that the consent holder should exercise more care during the warmer months.

3.2 Environmental effects of exercise of consents

3.2.1 Mokau Road, Uruti

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. The level of unionized ammonia in the tributary was below

the guideline value for aquatic health of 0.025 g/m³ on all the occasions it was sampled during the year. The biomonitoring survey undertaken indicated that no significant impacts were occurring on aquatic ecosystems from this discharge.

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 100 g/m³, however during two periods in the year, chloride levels were found to be very high as a result of leaks in the containment bund and irrigation lines. During the incident where the containment bund was leaking, chlorides rose as high as 2290 g/m³ which exceeds the 900 g/m³ instantaneous guideline value adopted by the Government of British Columbia for the protection of fresh water. Levels this high are likely to have had adverse effects on the environment and freshwater aquatic ecosystems and this was exacerbated by the fact the stream system was in very low flow at the time of the incident.

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 indicate that the composting activities at the site have not had any impact on the fish communities.

The groundwater results from the irrigation areas have 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. Overall there seems to be a downward trend in the levels of chloride in the lower irrigation field groundwater whilst the upper field is showing an increase. This report will recommend that groundwater conductivity reading be taken at every inspection to assess the level of chlorides on a more regular basis. As there has been three consecutive rises in chloride on the upper irrigation field groundwater, this report will also recommend that the consent holder be required to submit a groundwater management plan as provided for in consent 5838.

BTEX analysis of the groundwater and receiving water found no detectable levels of these contaminants and it is recommended that BTEX analysis be undertaken on at least one soil sample per year from each irrigation field.

Soil sampling indicates that there are decreasing levels of sodicity and chloride. This is most likely the result of the increased levels of these contaminants in the irrigation fluids and/or and increased irrigation volumes. Whilst the levels are not high in themselves, they do represent a change in the characteristics of the soil itself and there are indications in the data that the level of sodicity is trending upwards. It is therefore recommended that the consent holder be required to submit a Soil Management Plan as required under consent 5838.

In conclusion, the activities at the site are having effects on the receiving environment. These range from minor in terms of the normal operational activities, to adverse effects that have been found when systems at the site failed. There have also been indications that there may be future issues in terms of soil and groundwater quality unless better management of the processes at the site and an understanding of its limitations are demonstrated by the consent holder.

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.

Several odour complaints were received and no breaches of the Regional Air Quality Plan were found, however an abatement notice was issued on the likelihood that a breach would occur.

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 18 Summary of performance for Consent 5838-2 - 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	Yes
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 – the Council required maintenance
5. Maintenance of treatment systems	Site inspections	No – the Council required maintenance
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
11. Soil sampling to be undertaken	Undertaken by the Council	Yes
12. Submit a Soil Management Plan if requested by the Council	Plan not requested	N/A
13. Adhere to Soil Management Plan	N/A	N/A

Condition requirement	Means of monitoring during period under review	Compliance achieved?
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 not yet requested	N/A
17. Adhere to Groundwater Management Plan	N/A	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	Yes
23. Wetland discharge not to cause certain effects at site HHG000103	Sampling	Yes
24. Maintain riparian plantings	Inspection	Yes
25. Notify the Council of significant incidents on site	No notifications received	N/A
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		Poor

N/A = not applicable

Table 19 Summary of performance for Consent 5839-2 - 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

Condition requirement	Means of monitoring during period under review	Compliance achieved?
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	Station installed and recording data. Data not supplied
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 20 Summary of performance for Consent 5892-2 - 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

Condition requirement	Means of monitoring during period under review	Compliance achieved?
3. Records of source, nature and volume of wastes	Records reviewed	Yes
4. Solid drilling cuttings to be < 5 % hydrocarbon content	Hydrocarbons wastes no longer processed on this site	N/A
5. No contamination of ground or surface water	Samples were not collected during the period under review	N/A
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. Alterations to processes and operations	Site inspections did not note any changes	Yes
9. Reinstatement of site	N/A	N/A
10. Optional review of consent	N/A	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		High

Table 21 Summary of performance for Consent 5893-2 - discharge of 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
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

Condition requirement	Means of monitoring during period under review	Compliance achieved?
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 22 Summary of performance for Consent 5938-1 - establishment of 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 23 Summary of performance for Consent 6211-1 – stream realignment 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 24 Summary of performance for Consent 6212-1 - establishment of 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	Yes-fish pass on culvert
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		Good

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

RNZ demonstrated a poor level of environmental performance and compliance with resource with consents associated with its Mokau Rd site at Uruti.

Overall RNZ demonstrated a poor level of environmental performance and compliance.

3.4 Recommendations from the 2012-2013 Annual Report

In the 2012-2013 Annual Report, it was recommended:

1. THAT the 2013-2014 monitoring programme for the site at Mokau Rd, Uruti remain unchanged from that undertaken in the 2013-2014 period.
2. THAT the 2013-2014 monitoring programme for the Waitara Rd and Pennington Rd sites remain unchanged from that undertaken in the 2013-2014 period.
3. THAT the option for a review of resource consent 5838 in June 2014, as set out in condition 28 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 5839 in June 2014, 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.

5. THAT the option for a review of resource consent 5893 in June 2014, 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.
6. THAT the option for a review of resource consent 6211 in June 2014, 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.
7. THAT the option for a review of resource consent 6212 in June 2014, 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.

These recommendations were implemented in full.

3.5 Alterations to monitoring programmes for 2014-2015

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

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

It is proposed that the 2014-2015 monitoring programme for the Waitara Rd and Pennington Rd sites remain unchanged from that undertaken in the 2013-2014 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 2015. 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 2014. 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.

Based on the results of monitoring in the year under review it is considered that there are grounds that require a review to be pursued. The grounds are;

1. That the amount of drilling waste being accepted is far greater than was occurring when the consent was granted and that a limit to the amount of drill waste material being accepted and/or being stored on the treatment pad may be required to ensure the site is not being run over its capacity.

2. That that it has been identified (via the incidents that have occurred) that the chloride limits at site HHG000100 and HHG000150 are insufficient and that these limits should applied to any part of the stream system on the site.

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

3.6.3 Consent 5893

Resource consent 5893 provides for an optional review of the consent in June 2014. Condition eleven allows the Council to review the consent, for the purposes 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.

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.

3.6.4 Consent 6211

Resource consent 6211 provides for an optional review of the consent in June 2014. Condition six allows the Council to review the consent, for the purposes 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.

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.

3.6.5 Consent 6212

Resource consent 6212 provides for an optional review of the consent in June 2014. Condition eight allows the Council to review the consent, for the purposes of ensuring that the 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.

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.

4. Recommendations

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

1. Monthly inspections.
 2. Monthly conductivity readings from the groundwater bores.
 3. The late summer macroinvertebrate survey to be made provisional.
 4. Removal of suspended solids analysis from all sites except HHG000103, HHG000098, IND003008, HHG000150 and HHG0000097.
 5. 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.

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.
BODCF	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).
bund	A wall around a tank to contain its contents in the case of a leak.
cfu	Colony forming units. A measure of the concentration of bacteria usually expressed as per 100 millilitre sample.
COD	Chemical oxygen demand. A measure of the oxygen required to oxidise all matter in a sample by chemical reaction.
Condy	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m.
Cu*	Copper.
Cumec	A volumetric measure of flow- 1 cubic metre per second (1 m ³ s ⁻¹).
DO	Dissolved oxygen.
DAF	Dissolved air floatation residues (the residues from an effluent treatment system commonly used in industry).
DRP	Dissolved reactive phosphorus.
<i>E.coli</i>	<i>escherichia coli</i> , an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
Ent	Enterococci, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre of sample.
F	Fluoride.
FC	Faecal coliforms, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
Fresh	Elevated flow in a stream, such as after heavy rainfall.
g/m ³	Grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
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	relatively fine airborne particles (less than 10 micrometre diameter)
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
RMA	Resource Management Act 1991 and including all subsequent amendments.
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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Appendix I

Resource consents held by Remediation (NZ) Limited



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

Please quote our file number
on all correspondence

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
P O Box 8045
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*

Consent 6212-1

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

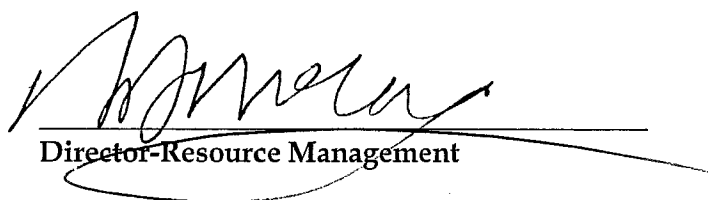
1. The consent holder shall notify the Taranaki Regional Council in writing at least 48 hours prior to the commencement and upon completion of removal of the temporary culvert [being the 800mm diameter culvert] and installation of the permanent culvert and associated structures, and again at least 48 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.

Consent 6212-1

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



CHIEF EXECUTIVE
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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
P O Box 8045
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*

www.trc.govt.nz

Doc# 515053-v1

Consent 6211-1

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.

Consent 6211-1

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

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Name of
Consent Holder: Remediation (NZ) Limited
P O Box 8045
NEW PLYMOUTH 4342

Consent Granted
Date: 5 December 2001

Conditions of Consent

Consent Granted: To erect, place, use and maintain a twin culvert in, on and over the bed of the Haehanga Stream in the Mimi catchment for vehicle access purposes at or about (NZTM) 1731701E-5685876N

Expiry Date: 1 June 2015

Review Date(s): June 2003, June 2009

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*

www.trc.govt.nz

Doc# 515040-v1

Consent 5938-1

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 and upon completion of any subsequent maintenance works which would involve disturbance of or deposition to the riverbed or discharges to water.
2. The structure[s] 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.
3. 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.
4. 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.
5. The structure[s] authorised by this consent shall be removed and the area reinstated, if and when the structure[s] are no longer required. The consent holder shall notify the Taranaki Regional Council at least 48 hours prior to structure[s] removal and reinstatement.

Consent 5938-1

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 2003 and/or June 2009, 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~~



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**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
P O Box 8045
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*

Consent 5893-2

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

Consent 5893-2

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



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Discharge Permit
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Taranaki Regional Council

Name of
Consent Holder: Remediation (NZ) Limited
P O Box 8045
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*

Consent 5892-2

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


Consent 5892-2

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
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Taranaki Regional Council

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Name of
Consent Holder: Remediation (NZ) Limited
P O Box 8045
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*

Consent 5839-2

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 complainant.
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

Consent 5839-2

- 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/m²/30 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 µg/m³ 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

Consent 5839-2

- 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.

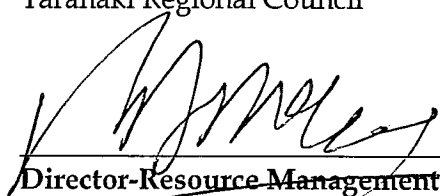
19. The consent holder shall reinstate the site in accordance with the Plan approved under condition 18 above prior to this consent expiring or being surrendered.

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

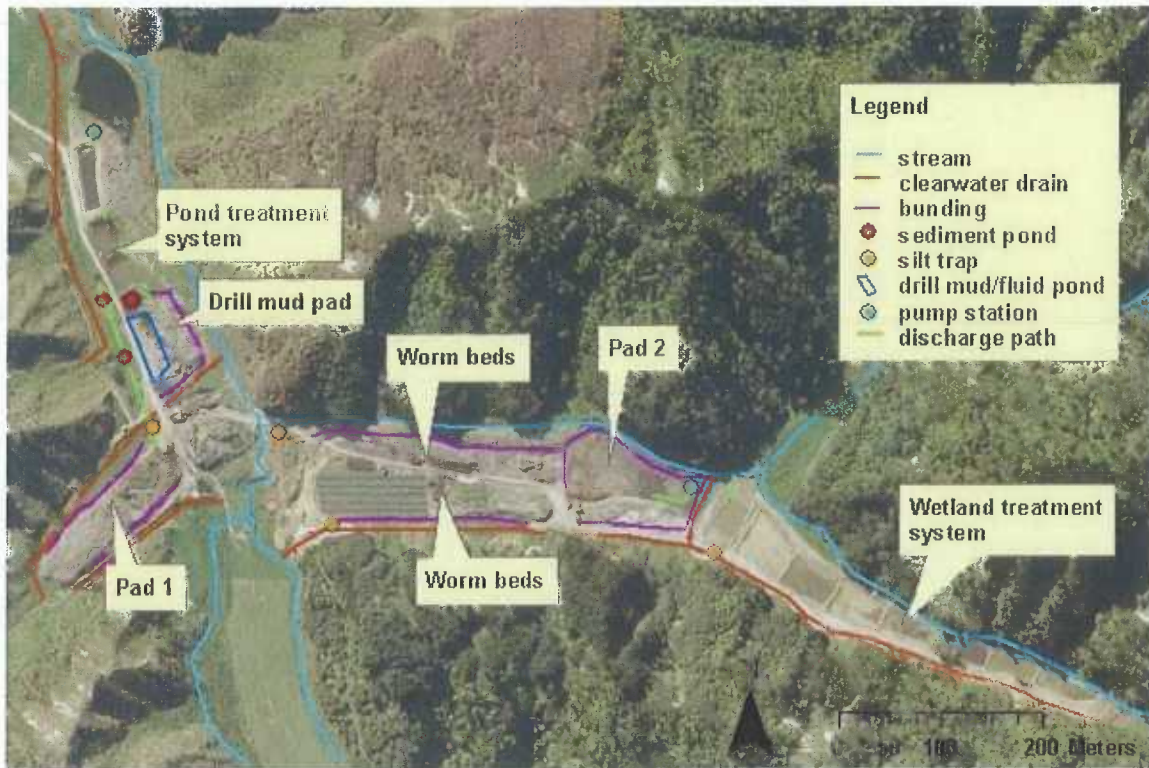


Figure 1 The location and extent of the composting operation including Pads 1 and 2.



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

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

Please quote our file number
on all correspondence

Name of
Consent Holder: Remediation (NZ) Limited
P O Box 8045
NEW PLYMOUTH 4342

Decision Date: 27 May 2010

Commencement
Date: 18 June 2010

Conditions of Consent

Consent Granted: 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 approximate [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

Catchment: Mimi

Tributary: Haehanga

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

Doc# 774164-v1

General condition

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

Special conditions

General

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.

Consent 5838-2

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) an increase in chloride levels;
 - 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.

Consent 5838-2

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/m³; 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:

Consent 5838-2

- 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 27 May 2010

For and on behalf of
Taranaki Regional Council



Director-Resource Management

Appendix 1 of consent 5838-2

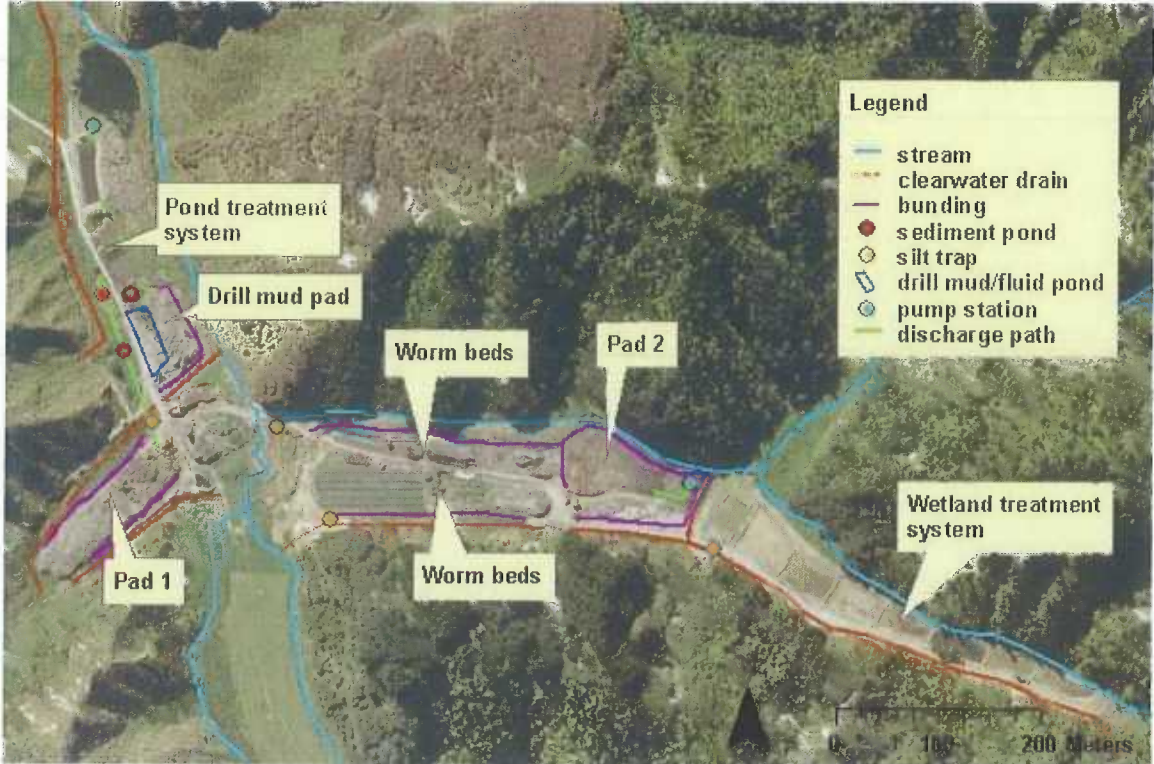


Figure 1 The location and extent of the Pond Treatment System, Wetland Treatment System, Pads 1 and 2, and the Drill Mud Pad.

Appendix II
Biomonitoring report

To Scott Cowperthwaite, Job Manager
From Scientific Officers; Brooke Thomas and Bart Jansma
Report No BT018
Document No 1378086
Date 29 July 2013

Biomonitoring of the Haehanga Stream in relation to discharges from the Remediation (NZ) Limited composting site at Uruti, December 2013

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 first of two surveys programmed for completion in the 2013-2014 monitoring period. 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 and 2, 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 were used at sites T2, T3, 5 and 7 (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 seventh 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 fourth 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	Kick-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.

HHG000190 ~1900m DS
HHG000150 ~ 675m DS

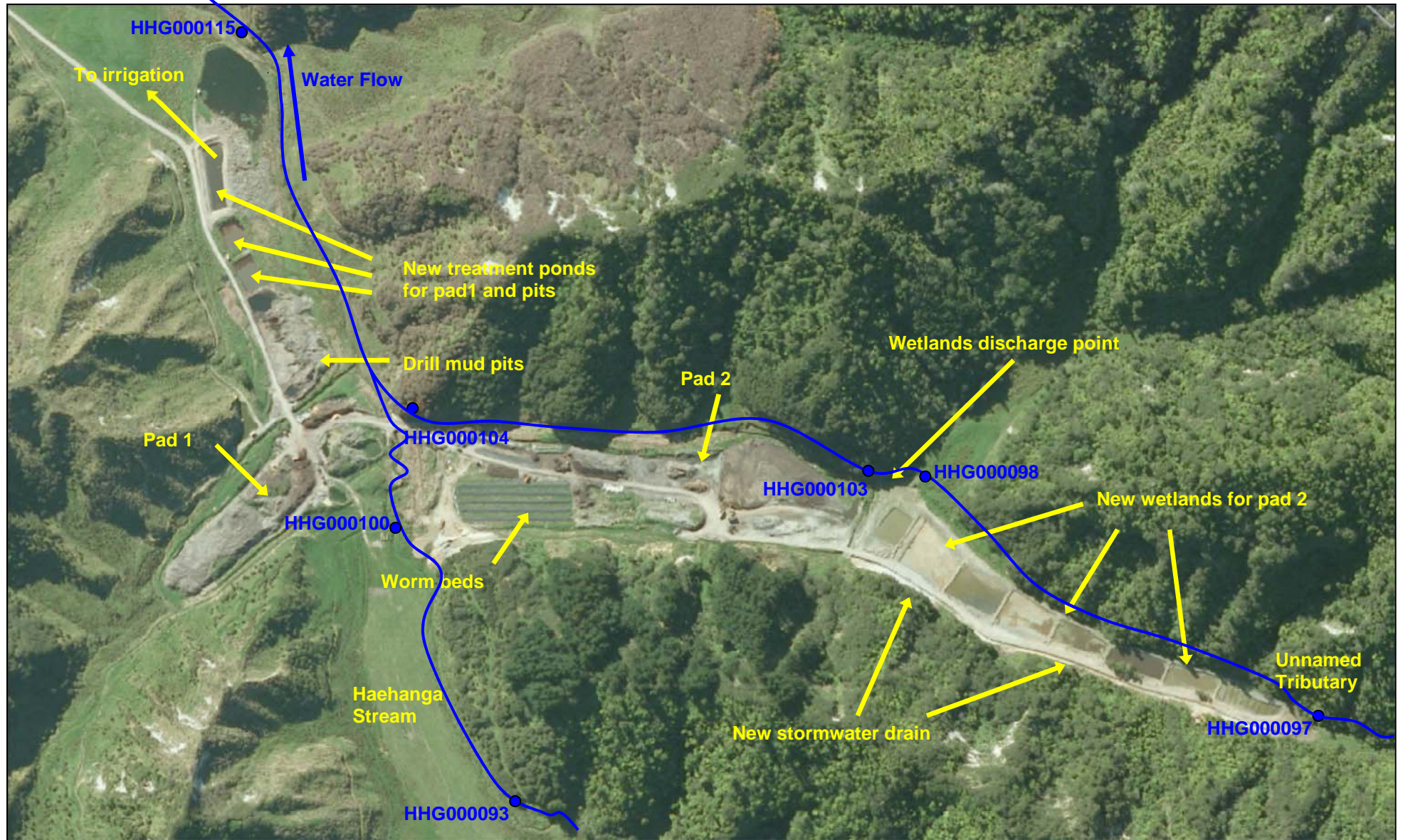


Figure 1 Location of biomonitoring sites in the Haehanga Stream catchment

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 16.0°C to 21.7°C. This survey was undertaken in early summer, when flows in the catchment were very low. The flow was clear and uncoloured at site 1 and clear and yellow at site 2. The flows at sites 5, 6 and 7 were yellow and cloudy, and at sites T2 and T3, brown and cloudy. Typically, cloudiness is recorded in 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. The wetland was not discharging at the time of the survey.

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. Substrate at site 1 comprised fully of silt.

All sites supported aquatic vegetation, and this growth was observed at the edges of the stream at site 6, and throughout the stream at the remaining six sites. Sites 2 did not support any obvious algal growth, while sites T2, T3 and 5 supported mats of algae. Sites 6 and 7 supported both mats and filaments of algae, while site 1 only supported patches of filamentous algae.

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

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 2013)) 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) in Taranaki (TRC, 1999) (Updated to October 2013).

Site	Number of previous surveys	Numbers of taxa			MCI values			SQMCI _s values		
		Median	Range	Current	Median	Range	Current	Median	Range	Current
LOWL*	17	22	18-27	-	78	68-109	-	4.0	2.7-6.1	-
1	9	21	19-25	23	71	68-78	70	3.9	2.7-4.2	3.4
2	17	19	17-23	19	73	62-87	79	3.9	2.7-4.4	4.1
T2	6	22	20-27	30	84	79-92	87	4.9	4.6-5.5	5.1
T3	6	27	24-32	24	82	78-93	87	4.5	3.5-5.4	3.9
5	16	19	6-26	28	71	53-82	83	2.8	1.1-3.8	4.1
6	3	22	16-24	19	70	68-73	79	3.0	2.9-3.1	2.9
7	12	20	12-30	22	71	62-82	77	3.1	1.3-4.3	3.7

*SQMCI_s median and range based on only 16

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 moderate taxa richness was recorded at this site (23), which was two taxa more than the median, and within the range of previous results. The community comprised a relatively high proportion of tolerant taxa (70%) which resulted in a 'poor' MCI score of 70 units. This is only two units higher than the minimum score recorded previously at this site, and considered a reflection of the very 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.

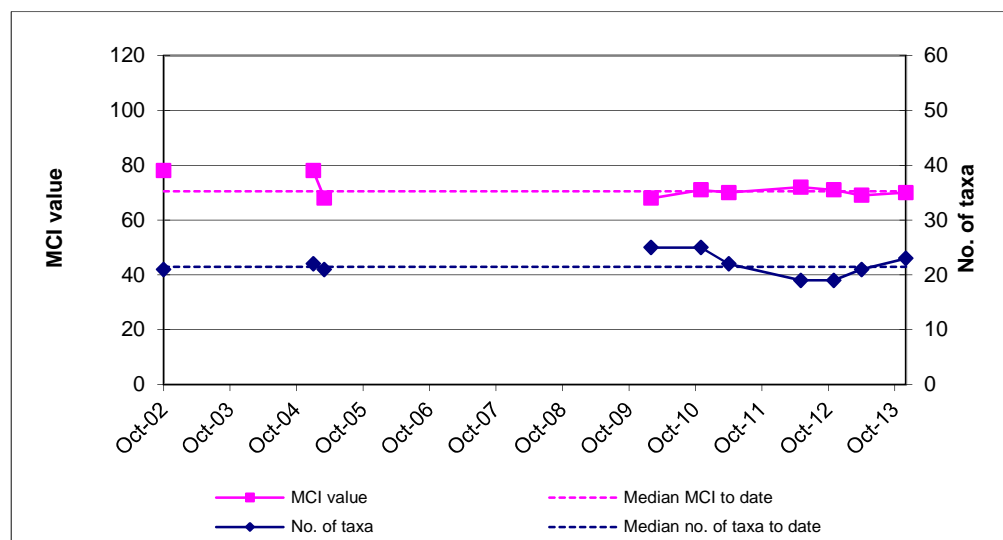


Figure 2 Taxa numbers and MCI recorded to date at site 1

The community was dominated by an extremely abundant and 'tolerant' taxon, (snail (*Potamopyrgus*). Other dominant 'tolerant' taxa included; (Oligochaete worms, snails (*Physa*), seed shrimps (Ostracoda), damselfly larvae (*Xanthocnemis*) and Empidid midge larvae). One 'sensitive' taxon was also abundant, the amphipod (*Paracalliope*).The dominance of many 'tolerant' taxa resulted in a low SQMCI_s score of 3.4 units, 0.8 unit less than the previous survey and the maximum score recorded at this site, 0.5 unit lower than the median of previous surveys, and 0.6 unit lower than 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 the primary influence on the community was the very 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, 19 macroinvertebrate taxa were recorded. This was four taxa less than that recorded in the previous survey and equal to the median for this site (Table 2). The community was dominated by two 'tolerant' taxa, (snails (*Potamopyrgus*) and damselfly larvae (*Xanthocnemis*)), and one 'sensitive' taxon, (stick cased caddisfly (*Triplectides*)) (Table 3).

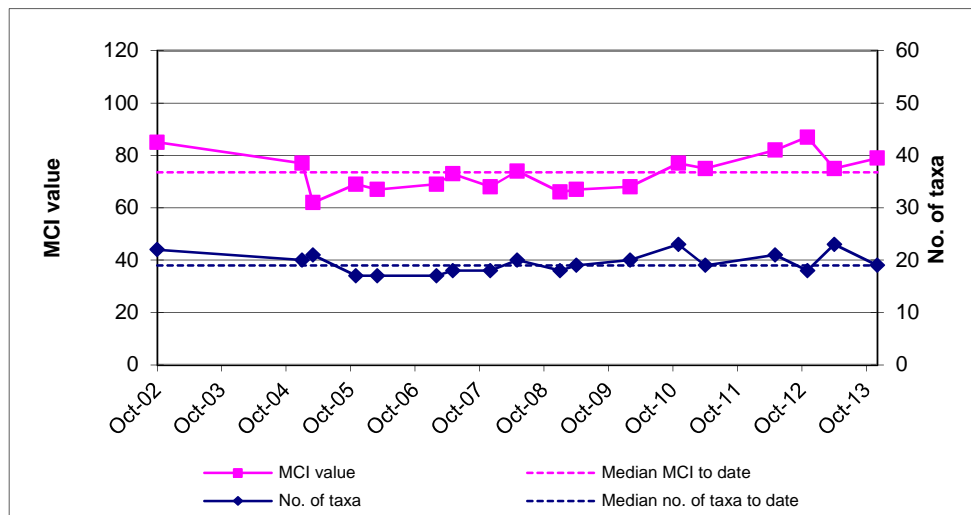


Figure 3 Taxa numbers and MCI recorded to date at site 2

The MCI value of 79 units reflected a moderate proportion of sensitive taxa in the community at this site (37%). However, this result is better than typical for this site, being six units higher than the median for this site, and four units more than that recorded in the previous survey (Table 2, Figure 3). The SQMCI_s value at this site (4.1) was slightly greater than the median value, and reflected the fact that the community supported an extremely abundant population of *Potamopyrgus* snails and was dominated by two 'tolerant' taxa and one 'sensitive' taxon (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 18 December 2013.

Taxa List	Site Number	MCI score	Site 1	Site 2	Site T2	Site T3	Site 5	Site 6	Site 7
	Site Code		HHG000093	HHG000100	HHG000098	HHG000103	HHG000115	HHG000150	HHG000190
	Sample Number		FWB13387	FWB13388	FWB13389	FWB13390	FWB13391	FWB13392	FWB13393
PLATYHELMINTHES (FLATWORMS)	<i>Cura</i>	3	R	-	-	-	R	C	R
NEMERTEA	Nemertea	3	C	-	-	-	-	-	-
NEMATODA	Nematoda	3	R	-	-	-	R	-	-
ANNELIDA (WORMS)	Oligochaeta	1	VA	C	C	VA	VA	XA	VA
	Lumbricidae	5	-	-	-	R	C	-	-
HIRUDINEA (LEECHES)	Hirudinea	3	R	C	-	-	C	-	-
MOLLUSCA	Lymnaeidae	3	R	-	R	R	-	-	R
	<i>Physa</i>	3	A	R	C	R	R	-	C
	<i>Potamopyrgus</i>	4	XA	XA	XA	XA	XA	XA	XA
	Sphaeriidae	3	C	-	-	-	-	R	-
CRUSTACEA	Ostracoda	1	VA	C	R	-	C	R	R
	<i>Paracalliope</i>	5	VA	C	XA	VA	A	C	VA
	<i>Paranephrops</i>	5	-	-	-	-	-	R	-
EPHEMEROPTERA (MAYFLIES)	<i>Austroclima</i>	7	-	-	-	-	R	-	-
	<i>Deleatidium</i>	8	-	R	A	C	VA	VA	C
	<i>Nesameletus</i>	9	-	-	R	-	-	-	-
	<i>Zephlebia group</i>	7	R	R	XA	A	-	-	-
PLECOPTERA (STONEFLIES)	<i>Acroperla</i>	5	-	-	R	-	-	-	
ODONATA (DRAGONFLIES)	<i>Xanthocnemis</i>	4	VA	VA	C	R	A	-	A
	<i>Aeshna</i>	5	-	R	-	-	R	-	-
	<i>Hemicordulia</i>	5	R	R	-	-	-	-	-
	<i>Procordulia</i>	5	-	-	-	-	R	-	-
HEMIPTERA (BUGS)	<i>Anisops</i>	5	-	-	R	R	-	-	-
	<i>Microvelia</i>	3	-	-	R	R	-	-	-
	<i>Saldula</i>	5	R	-	-	-	-	-	-
	<i>Sigara</i>	3	-	R	-	-	-	-	-
COLEOPTERA (BEETLES)	Elmidae	6	-	-	-	-	-	R	-
	Dytiscidae	5	-	-	C	R	R	-	R
	Hydrophilidae	5	C	R	-	-	-	-	R
	Staphylinidae	5	-	-	R	-	-	-	-
TRICHOPTERA (CADDISFLIES)	<i>Hydrobiosis</i>	5	-	-	-	-	C	C	R
	<i>Polypectropus</i>	6	-	-	A	C	R	-	-
	<i>Psilochorema</i>	6	-	-	C	A	R	R	-
	<i>Oxyethira</i>	2	-	-	R	-	-	R	R
	<i>Paroxyethira</i>	2	C	C	-	-	R	-	-
	<i>Tripletides</i>	5	C	VA	-	C	A	-	A
DIPTERA (TRUE FLIES)	<i>Aphrophila</i>	5	-	-	-	-	-	R	R
	Eriopterini	5	-	-	R	R	-	-	-
	Hexatomini	5	-	-	R	-	-	-	-
	<i>Paralimnophila</i>	6	-	-	R	C	R	R	C
	<i>Corynoneura</i>	3	-	-	R	-	-	-	-
	Orthoclaadiinae	2	C	C	C	C	C	VA	A
	<i>Polypedium</i>	3	R	-	-	C	R	C	R
	Tanypodinae	5	R	-	C	C	R	-	R
	Culicidae	3	-	-	A	C	-	-	-
	<i>Paradixa</i>	4	-	C	VA	C	R	-	R
	Empididae	3	VA	R	A	C	C	R	C
	Ephydriidae	4	-	-	R	-	-	-	-
	<i>Austrosimulium</i>	3	R	-	VA	A	A	C	VA
Tanyderidae	4	-	-	-	-	R	C	-	
ACARINA (MITES)	Acarina	5	-	R	R	-	-	-	
No of taxa			23	19	30	24	28	19	22
MCI			70	79	87	87	83	79	77
SQMCI			3.4	4.1	5.1	3.9	4.1	2.9	3.7
EPT (taxa)			2	3	6	5	6	3	3
%EPT (taxa)			9	16	20	21	21	16	14
'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

Thirty macroinvertebrate taxa were recorded at site T2 in an unnamed tributary of the Haehanga Stream, upstream of the wetland discharge point. This was a new maximum for this site. This was eight taxa higher than the median for control sites in similar streams (Table 2, Figure 4), and seven higher than that recorded in the previous survey. Good water quality had preceded this survey, as indicated by the presence of a number of ‘moderately sensitive’ taxa in the community many in abundance.

The taxa which dominated this community were different to that at site 2. Only one taxon, ‘tolerant’ snails (*Potamopyrgus*) were abundant at both sites 2 and T2. Other ‘tolerant’ taxa included (sandfly larvae (*Austrosimulium*), Empidid midge larvae, mosquito larvae (Culicidae) and Dixid midge larvae). Three ‘moderately sensitive’ taxa in abundance included; (amphipods (*Paracalliope*), mayflies (*Zephlebia* group) and caddisfly larvae (*Polypsectropus*)). One ‘highly sensitive’ taxon was abundant, (single-gilled mayfly (*Deleatidium*)) (Table 3).

This community had a moderate MCI score (87) compared to sites 1 and 2, reflecting the improved proportion of sensitive taxa present (43%). This MCI score is nine units higher than the median MCI score for control sites in similar streams, and four units higher than that recorded in the previous survey. The SQMCI_s value of 5.1 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 in this survey.

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.

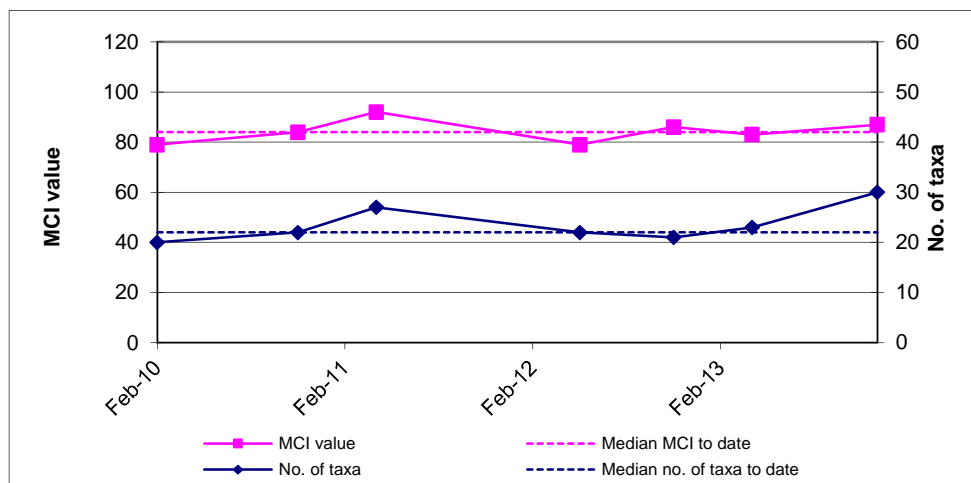


Figure 4 Taxa numbers and MCI recorded to date at site T2

Site T3 – downstream of the wetland discharge point

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

The community was characterised by three 'moderately sensitive' taxa; (amphipods (*Paracalliope*), mayfly (*Zephlebia* group) and free-living caddis (*Psilochorema*)), and three 'tolerant' taxa, (Oligochaete worms, snails (*Potamopyrgus*) and sandfly larvae (*Austrosimulium*)) (Table 3). This site had the same proportion of sensitive taxa (50 %) as site T2 upstream, resulting in the same MCI score (87), suggesting little impact from the wetland discharge. However, as there was a greater numerical dominance of 'sensitive' taxa at site T2 there was a significant decrease in SQMCI_s score (of 1.2 units) between site T2 and T3. The SQMCI_s score of 3.9 was an insignificant (Stark, 1998) 0.6 unit less than the median for this site and an insignificant 0.1 unit less than the median SQMCI_s score for similar streams at comparative altitudes (TRC, 1999).

The changes in sensitive taxa abundances were not necessarily indicative of impacts caused by the discharge from the wetland. Previous surveys have frequently recorded Oligochaete worms, Ostracod seed shrimps and *Chironomus* blood worms increasing significantly in abundance downstream of the discharge. These taxa are often associated with organically enriched discharges. In the current survey only one 'tolerant' taxon, Oligochaete worms increased in abundance, while *Chironomus* blood worms were absent at both sites. In addition, the number of 'sensitive' taxa only decreased by three taxa. Overall, these observations indicate that the 14 December 2013 discharge, (four days prior to the survey) has not had an 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 samples contained concentrations of unionised ammonia below the toxicity threshold of 0.025 g/m³. 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.

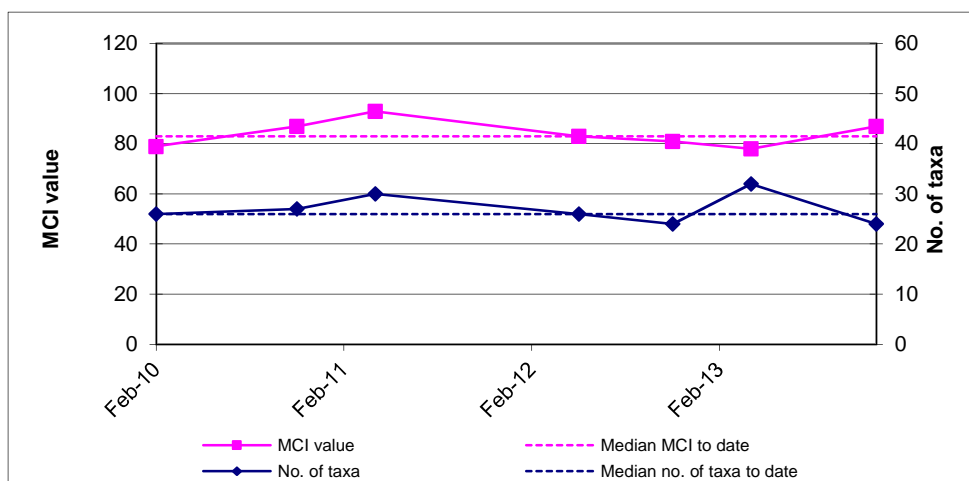


Figure 5 Taxa numbers and MCI recorded to date at site T3

Site 5 – downstream of all pond discharges

At site 5 in the Haehanga Stream, 25 m downstream of all wastewater ponds, 28 taxa were recorded, nine taxa more than the median of the sixteen previous surveys (Table 2, Figure 6).

Four 'tolerant' taxa dominated the community at this downstream site (sandfly larvae (*Austrosimulium*), damselfly larvae (*Xanthocnemis*), Oligochaete worms and snails (*Potamopyrgus*)), and three 'moderately sensitive' taxa (amphipod (*Paracalliope*), mayfly (*Deleatidium*) and stick cased caddis (*Triplectides*) (Table 3). The numerical dominance of 'tolerant' *Potamopyrgus* snails and Oligochaete worms was alleviated by the numerical dominance of the 'highly sensitive' mayfly taxon *Deleatidium* which resulted in a SQMCI_S score of 4.1, a statistically significant 1.3 units higher than the median for this site, and the same as what was recorded at site 2 (Stark, 1998). The MCI score (83), was a significant 12 units greater than the median score for this site and 14 units greater than that recorded in the previous survey (Figure 6), and four units greater than that recorded at site 2 upstream in the current survey. This is a reflection of the increased proportion of 'sensitive' taxa in the community (46 %), which was 4% greater than at the upstream site 2 (Table 2).

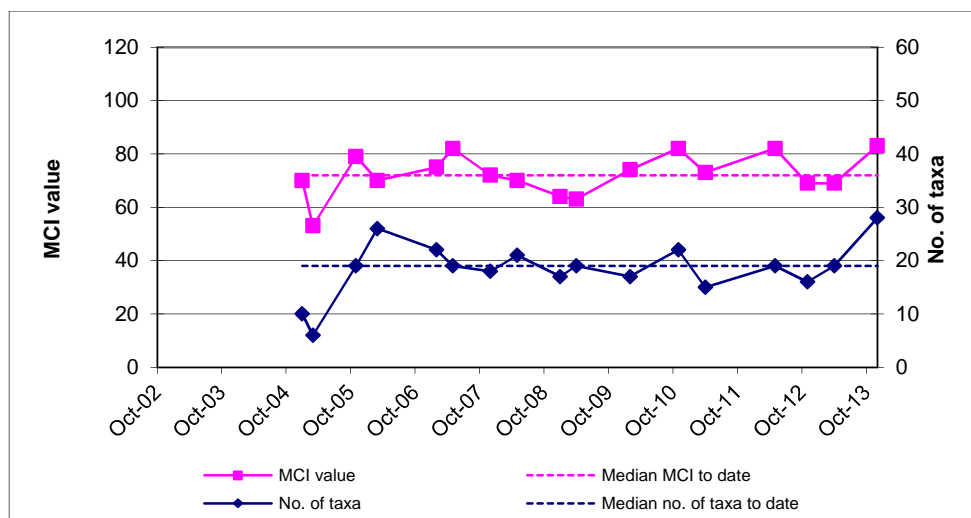


Figure 6 Number of taxa and MCI scores recorded to date at Site 5

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 three taxa, including an increase in two 'tolerant' taxa and one 'highly sensitive' taxon, mayfly '*Deleatidium*'.

Site 6 – Downstream of effluent irrigation area

A moderate 19 taxa were recorded at this site, located downstream of the effluent irrigation area. The community was dominated by three 'tolerant' taxa (Oligochaete worms, snails (*Potamopyrgus*) and Orthoclad midges), and one 'highly sensitive' taxon (mayfly (*Deleatidium*)). There was a slight decrease in the number of 'tolerant' taxa (11) from that recorded at site 5 (15), and also a decrease in the number of 'sensitive' taxa (8 taxa compared to 13 recorded at site 5). This resulted in a four unit drop in MCI score. This MCI score (79) 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 *Potamopyrgus* snails. This resulted in a SQMCI_S score of 2.9 units, which was not

significantly less than that recorded at site 1, but significantly less than that recorded at sites 2 and 5 upstream. This result was similar to that recorded in the previous survey, and was primarily due to an increased abundance of Oligochaete worms.

The previous three 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. Unless physicochemical sampling indicates a reduction in water quality at this site, it appears that the irrigation of wastewater upstream of this site has not lead to a reduction in invertebrate health at this site.

Site 7 – Downstream of all site activities

This site exhibited moderate taxa richness (22), the same as the median, and eight taxa fewer than the previous survey undertaken at this site. The ‘poor’ MCI score of 77 was due to the community comprising 59% ‘tolerant’ taxa, of which five were abundant (Oligochaete worms, snails (*Potamopyrgus*), damselfly larvae (*Xanthocnemis*), Orthoclad midge larvae and sandfly larvae (*Austrosimulium*). ‘Moderately sensitive’ *Paracalliope* amphipods and *Triplectides* caddisfly were also recorded in abundance at this site in the current survey. The MCI score of 77 is insignificantly (7 units) higher than that recorded in the previous survey (Stark, 1998) (Table 2, 7), and not significantly different to the median score for this site. The extreme abundance of ‘tolerant’ *Potamopyrgus* snails and numerical dominance of four other ‘tolerant’ taxa resulted in a SQMCI_S of 3.7, 0.6 unit higher than the median for this site but 0.6 units less than the previous survey’s score. This is the ninth time in the last ten surveys where above median SQMCI_S scores have been recorded at this site.

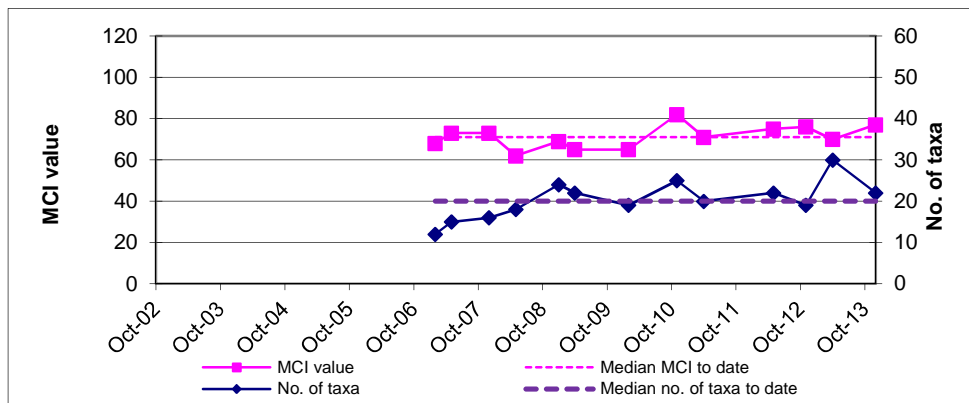


Figure 7 Number of taxa and MCI scores recorded to date at Site 7

When compared with site 6 upstream, the MCI score was similar, while the SQMCI_S score improved (though not statistically significantly), due mainly to the increase in abundances of ‘sensitive’ amphipods (*Paracalliope*) and stick cased caddis (*Triplectides*) and reduced abundances of Oligochaete worms. A total of seven 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.

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 not recorded 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 have 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 18 December 2013 found water flows in the Haehanga catchment to be very low, with a slow water speed noted at all sites except site 6. Community richnesses were similar to the median for two sites, while the remaining five either equalled or exceeded their previous maximum richnesses recorded. Overall, this survey found that macroinvertebrate communities at all sites were in average health. 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 seventh time in the current survey, and exhibited a community typical of this kind of habitat. Site T2 and site T3 had the same MCI score, however the SQMCI_s score decreased significantly at site T3. This was a result of the reduced abundance of two 'sensitive' taxa, especially mayfly, (*Zephlebia* group). There were five significant changes in taxon abundance from site T2 to site T3, which were not necessarily indicative of impacts caused by the discharge from the wetland. Previous surveys have frequently recorded oligochaete worms, ostracod seed shrimps and *Chironomus* blood worms increasing significantly in abundance downstream of the discharge. These taxa are often associated with organically enriched discharges. In the current survey only oligochaete worms increased in abundance, while *Chironomus* blood worms were absent at both sites. Ostracod seed shrimps were rare at site T2 and absent at site T3. Overall, these observations indicate that the discharge has not had significant impact on the communities.

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 all six samples taken contained

concentrations of unionised ammonia below the toxicity threshold of 0.025 g/m³. 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 indicated that the macroinvertebrate communities were in similar health when compared with other small lowland hill country streams in the region.

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 a significant 12 units greater than the median score for this site, and four units more than that recorded at the next upstream Haehanga Stream site. The same SQMCI_s score was recorded at both site 5 and upstream site 2, indicating no sign of deterioration. The results from the current survey indicate that *Chironomus* blood worms were absent, unlike the previous survey where they were abundant.

Unlike the other sites, the sample from site 6 was collected from of a riffle with coarse and fine gravels, using the 'streambed kick' sampling technique. The current survey recorded an MCI score that was not significantly different to the medians for the other Haehanga Stream sites, and not significantly different to that recorded at the three upstream main stem sites. The SQMCI_s score was not significantly less than site one, but was significantly less than what was recorded at sites 2 and 5. This significant reduction in SQMCI_s score can be attributed to a change in sampling method and variations in habitat rather than to a deterioration from the upstream sites. Overall, unless physicochemical sampling indicates a reduction in water quality at this site, it appears that the irrigation of wastewater upstream of this site has not lead to a reduction in invertebrate health at this site.

The lowest site (site 7) was sampled for the thirteenth time in this survey. There was little difference in MCI and SQMCI_s scores between sites 7 and sites 5 and 6. When compared with historical data the community at site 7 was in average to above average health, and indicative of little change in water quality from previous surveys.

Of some concern during certain previous surveys was the abundance of *Chironomus* blood worms 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 not present at any of the seven sites sampled. This indicates that water quality in the Haehanga catchment has not deteriorated from the previous survey, and overall continues to improve, possibly contributed to by on-going works to the leachate and stormwater treatment system, and improved management of the riparian margin. These works are likely to lead to an improvement in freshwater macroinvertebrate communities below the discharges, and should continue to be encouraged.

Due to the low flows experienced in the current survey, it was decided to forgo the second macroinvertebrate survey, and undertake a fish monitoring survey instead. It is recommended that this continue in subsequent years, but that both surveys be undertaken in early summer, preferably December. It is also recommended that provisional macroinvertebrate surveys 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 BJ232
Document 1380251
Date 25 July 2014

Fish Survey of the Haehanga Stream in relation to discharges from the Remediation (NZ) Limited composting site at Uruti, March 2014

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 first 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.

The current survey essentially constitutes a baseline survey, 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.

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

The fish populations were sampled using fyke nets 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 capture 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. All nets and traps were deployed on 27 March 2014, and retrieved on 28 March 2014.

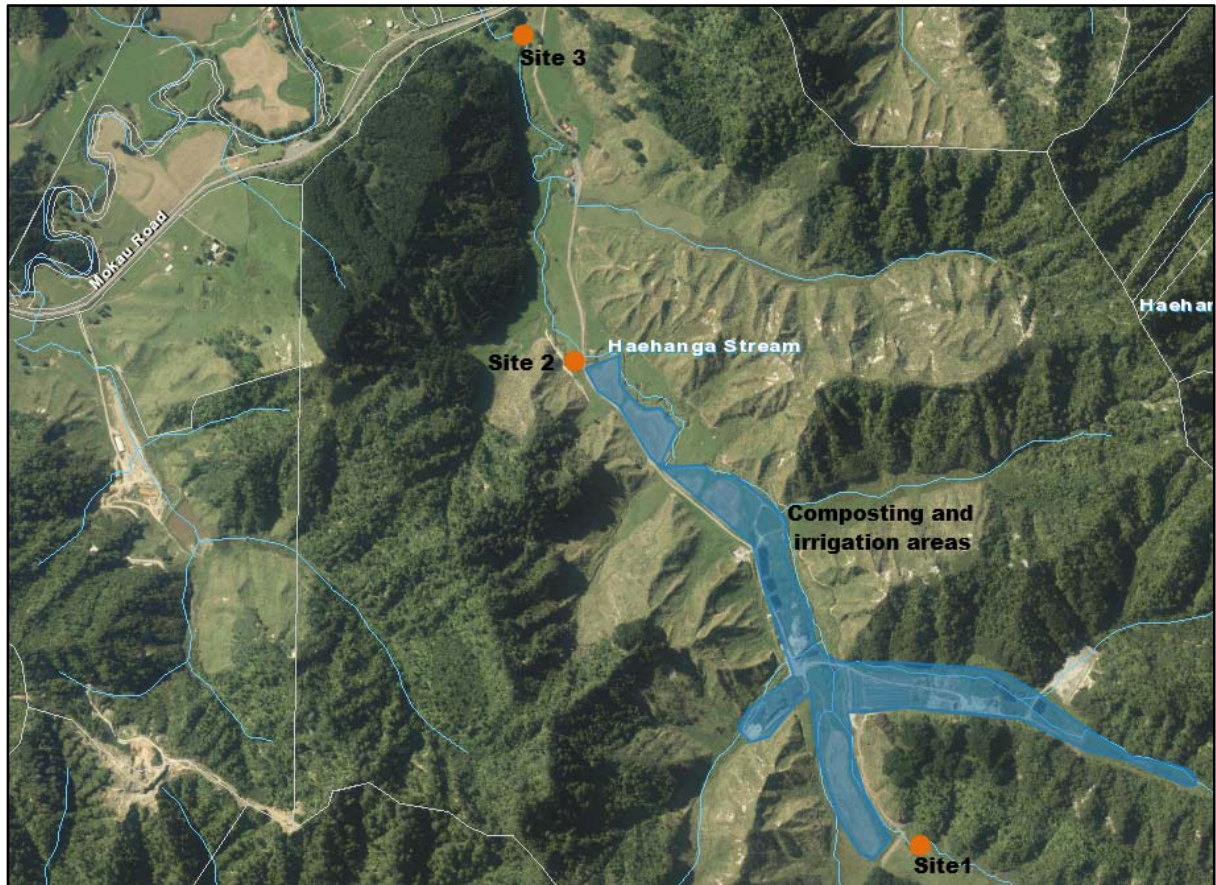


Figure 1 Location of the three sampling sites in relation to composting and waste water irrigation areas.

Results and Discussion

At the time of this survey, the Haehanga Stream had an extremely low flow, to the extent that there was no flow at site 1, upstream. Despite this, there was still moderate habitat present, in the form of deep pools, and extensive macrophyte beds. 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.

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. Number of fish (size range(mm))

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:		810	2025	810	2025	780	1950
Longfin eel (<i>Anguilla dieffenbachii</i>)	Number	4	-	1	-	1	-
	Length range (mm)	478-980	-	539	-	431	-
	Weight range (kg)	0.24-2.52	-	0.46	-	0.18	-
Shortfin eel (<i>Anguilla australis</i>)	Number	-	-	4	-	2	-
	Length range (mm)	-	-	287-838	-	603-768	-
	Weight range (kg)	-	-	0.04-0.98	-	0.50-0.90	-
Inanga (<i>Galaxias maculatus</i>)	Number	-	-	10	1	-	-
	Length range (mm)	-	-	110-123	116	-	-
Total number of species		1		3		2	
Total number of fish		5		16		3	



Photo 1 An inanga, recorded at site 2 in the Haehanga Stream

Site 1

This site recorded the lowest number of species of this survey, with only one species recorded, being longfin eel. It is likely that this result reflects the lack of flow at this site, which not only results in a reduction in habitat, but also as the sampling method relies on water current carrying the bait scent downstream, for the fish to follow up and into the net or trap. This site recorded the largest eels of this survey, with two of the four eels being just less than one metre long.

This site is intended as a control site to compare the downstream results to. Due to the lack of flow at this site in the current survey, it will be difficult to compare the results. Therefore it is recommended that future surveys are timed for early summer, ideally December, when there should be more flow in the stream.

Site 2

This site, located immediately downstream of the lowest irrigation area, contained the highest species richness (3) and the highest abundance (16) of the three sites surveyed. This was the only site to record inanga, and they were relatively numerous. This is because inanga area a schooling species, and therefore when present, are likely to be recorded in

high numbers. All but one of these inanga were captured in the fine mesh fyke net, with one individual captured in a g-minnow trap. Of note was the physical condition of the inanga. These fish were in very good condition, with well developed gonads. This indicates that these fish were trapped due to the low flows, as normally inanga in this condition would have migrated downstream in preparation for spawning. Five eels were captured, of which four were shortfin eels, one being relatively large at 838mm and 0.98kg. 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 present, deep water and undercut banks. These three habitat features are frequently used by nocturnal fish as cover.

Only three fish were recorded at this site, two shortfin eels and one longfin eel. As with the upstream sites, this low fish diversity and abundance is likely to be related to the low flows present at the time of this survey. As there were few fish captured, it is difficult to draw any conclusions. However, there is no indication that impacts from the upstream composting operations extend to this site.

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 2 shows that although not many eels were collected, 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 2 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.

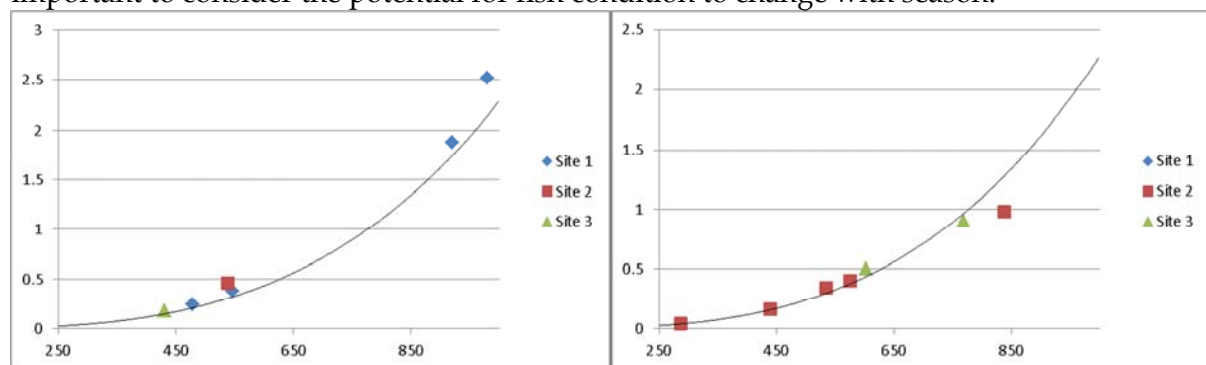


Figure 2 Longfin eel condition (left) and shortfin eel condition (right) in the Haehanga Stream, 27/28 March 2014. Weight is on the x-axis, length on the y-axis. The trend line is the predicted weight, using equations from Jellyman *et al* 2013.

In addition to length and weight measurements, each fish was inspected for obvious physical damage or abnormalities. No such features were noted. The observation of fish condition indicates that there is no impact on the fish communities from the activities at the Remediation NZ site.

Summary and conclusions

On 27 and 28 March 2014, 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 also.

At the time of this survey, flow in the Haehanga Stream was extremely low, to the extent that there was no surface flow between pools at site 1. This not only reduced the amount of habitat available, but also reduced the effectiveness of the bait set in the nets and traps. As a result a total of only three species was recorded.

Due to the lack of fish, it is very 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 the most species (3), and the most fish (16). This was the only site to record inanga, and they were relatively numerous. This is because inanga are a schooling species, and therefore when present, are likely to be recorded in high numbers. All but one of these inanga were captured in the fine mesh fyke net, with one individual captured in a g-minnow trap. Of note was the physical condition of the inanga. These fish were in very good condition, with well developed gonads. This indicates that these fish were trapped due to the low flows, as normally inanga in this condition would have migrated downstream in preparation for spawning.

Eels were recorded at all three sites, although only longfin eel was recorded at site 1, including two individuals that were almost one metre long. The physical condition of the eels showed that although not many eels were collected, 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.

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 in early summer, preferably December. This survey could be undertaken in conjunction with the annual macroinvertebrate survey. In addition, it is proposed a provisional macroinvertebrate survey be included in the programme, to be undertaken in late summer, should water quality monitoring find that there may have been an impact on the stream fauna.

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