Stratford District Council
Landfills
Monitoring Programme
Annual Report
2013-2014

Technical Report 2014-62

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Executive summary

The Stratford District Council (SDC) maintains a closed landfill located on Victoria Road at Stratford, in the Patea catchment. The landfill was closed to the public on 11 March 2002 and to commercial disposers on 23 March 2002. The site has more recently been used to dewater and dispose of oxidation pond sludge from the adjacent municipal waste water treatment plant but this activity ceased in early 2006 and the landfill was recapped and reinstated. The only external material now accepted at the landfill is soil from a local sawmill site remediation project. This activity is covered by separate consent held by a third party.

The SDC also maintains closed landfills at Douglas Rd, Huiroa, and Wingrove Rd, Pukengahu, in the Patea catchment. Both the Huiroa and Pukengahu landfills have been closed since 1991 but are still monitored with regards to maintenance and leachate discharge. These landfills are monitored on a triennial basis and monitoring was not scheduled for the 2013-2014 period.

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

SDC holds three resource consents, which include a total of 14 special conditions setting out the requirements that SDC must satisfy.

TRC's monitoring programme for the closed landfill at Stratford included four inspections, three water samples collected for physicochemical analysis, and one biomonitoring survey of receiving waters.

The monitoring showed that there were only minor effects on the environment due to the discharges at the closed landfill at Stratford.

During the period under review, SDC demonstrated a high level of environmental performance and compliance with all the resource consents. TRC received no complaints about any of the sites and no incidents were recorded.

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.

There were no incidents recorded by TRC in regards to SDC's landfill sites during the period under review.

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 (TRC) on the monitoring programme associated with resource consents held by Stratford District Council (SDC). SDC maintains closed landfills on Victoria Road, Stratford, on Douglas Road, Huiroa, and on Wingrove Road, Pukengahu. All of these sites are in the Patea catchment.

This report covers the results and findings of the monitoring programme implemented by TRC in respect of the consents held by SDC that relate to discharges of leachate and stormwater to water from the landfill at Stratford.

SDC also maintains closed landfills at Huiroa and Pukengahu. These are monitored on a triennial basis and these monitoring programmes were not active during the year under review.

One of the intents of the *Resource Management Act 1991* (RMA) is that environmental management should be integrated across all media, so that a consent holder's use of water, air, and land should be considered from a single comprehensive environmental perspective. Accordingly, TRC generally implements integrated environmental monitoring programmes and reports the results of the programmes jointly. This report discusses the environmental effects of SDC's use of water, land, and air, and is the 21st report by TRC for the landfills managed by the consent holder.

1.1.2 Structure of this report

Section 1 of this report is a background section. It sets out general information about compliance monitoring under the RMA and the TRC's obligations and general approach to monitoring sites through annual programmes, the resource consents held by SDC, the nature of the monitoring programme in place for the period under review, and a description of the activities and operations conducted at SDC landfill sites.

Sections 2-3 present the results of monitoring of the consent holder's landfills during the period under review. It includes scientific and technical data and discusses the results, their interpretation and their significance for the environment, and makes recommendations for 2014-2015 period.

Section 4 is a summary of recommendations for the 2014-2015 period.

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

1.1.3 The Resource Management Act (1991) and monitoring

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

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

In drafting and reviewing conditions on discharge permits, and in implementing monitoring programmes, TRC 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, TRC 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 TRC to continually re-evaluate its approach and that of consent holders to resource management and, ultimately, through the refinement of methods and considered responsible resource utilisation, to move closer to achieving sustainable development of the region's resources.

1.1.4 Evaluation of environmental performance

Besides discussing the various details of the performance and extent of compliance by SDC during the period under review, this report also assigns an overall rating. The categories used by TRC, 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, TRC 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 TRC 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 TRC 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 TRC 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 TRC even in the absence of environmental effects. Typically there were grounds for either a prosecution or an infringement notice.

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.

1.2 Process description

1.2.1 Stratford landfill

The Stratford District Council operated a landfill located on Victoria Road at Stratford, in the Patea catchment. The landfill was closed to the public on 11 March 2002 and to commercial disposers on 23 March 2002. All contaminated surface water from the landfill is pumped to the adjacent oxidation ponds for treatment.

In March 2004 SDC cleared a site on top of the landfill and created a bunded area for the purpose of oxidation pond sludge dewatering. This dewatering process continued through to early 2006 and the sludge was then covered and capped and the site reinstated. There has been no discharge of refuse to the landfill since 2006.

A third party currently holds a consent to discharge chromated copper arsenate (CCA) contaminated soil as base fill (under the supervision of SDC) to the landfill for re-contouring purposes. This consent has been exercised. However, due to an excess of clean overburden, further re-contouring is required.

1.2.2 Huiroa landfill

The Huiroa landfill is sited within an elbow of Douglas Road. The dump was an uncontrolled roadside landfill used by local residents to dispose of domestic waste. The site was closed in 1991 and reinstated by SDC.

1.2.3 Pukengahu landfill

The site is situated in a small gully off Wingrove Road. At the base of the gully is a small wetland area which is fed by a spring and this is culverted beneath the road and into a small unnamed stream. The dump was unmanaged but was mostly used for the discharge of domestic waste by local residents. The landfill closed in 1991 and the site was reinstated by SDC.

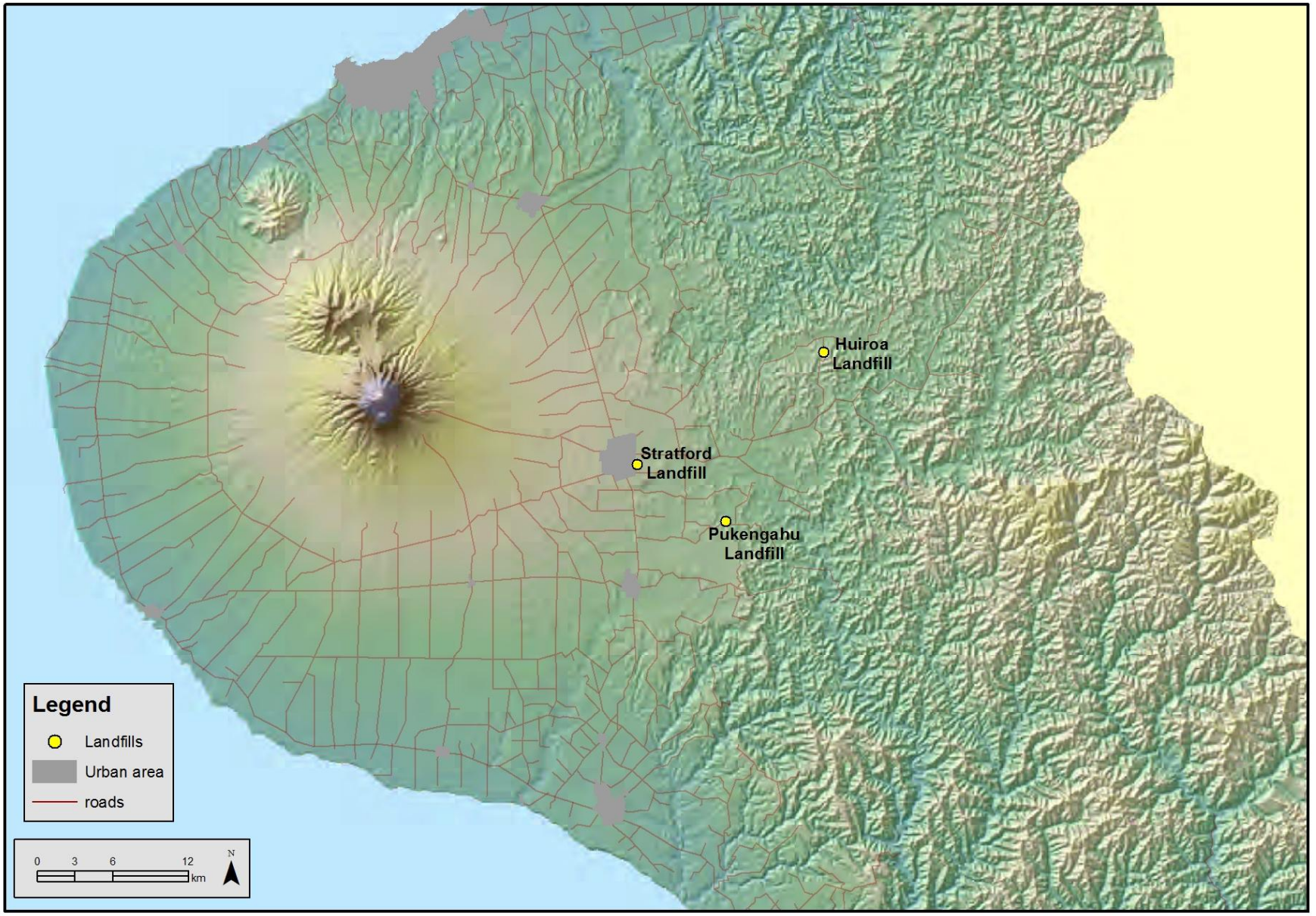

Figure 1 Regional map showing SDC landfill sites

1.3 Resource consents

1.3.1 Water discharge permits

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

SDC holds water discharge permits **3889-3, 3890-2** and **3891-2** issued by the TRC.

SDC held consent 3889-2 to cover discharge of stormwater and leachate from Stratford Municipal Landfill into the Patea River. This permit was issued by TRC on 27 February 1998 under Section 87(e) of the RMA. This consent expired on 1 June 2010. As discharges were still occurring from the landfill, an abatement notice was issued and the consent holder subsequently re-applied for a consent. Consent 3889-3 was issued by TRC on 6 December 2010. It is due to expire on 1 June 2028.

Condition one requires that the consent holder adopt best practical option to minimise effects.

Condition two requires the preparation and maintenance of a Contingency and Landfill Maintenance Plan.

Condition three requires SDC to maintain certain structures at the site.

Condition four states that the discharge shall not reduce in-stream water quality after a specified mixing zone.

Condition five is a review provision.

The permit is attached to this report in Appendix I.

SDC holds water discharge permit **3890-2** to cover discharge of stormwater and leachate from the former Huiroa landfill into an unnamed tributary of the Makuri Stream. This permit was issued by TRC on 17 October 1996 under Section 87(e) of the RMA. It is due to expire on 1 June 2016.

Condition one requires SDC to install and maintain stormwater drains on the site.

Condition two requires SDC to maintain vegetative cover on the site.

Condition three states the consent holder shall adopt the best practicable options.

Condition four states that the discharge from the site shall not cause detrimental effect on water quality or aquatic life of the Makuri Stream.

Conditions five and six are review conditions.

The permit is attached to this report in Appendix I.

SDC holds water discharge permit **3891-2** to cover discharge of stormwater and leachate from the former Pukengahu landfill into an unnamed tributary of the

Waihapa Stream. This permit was issued by TRC on 12 February 1998 under Section 87(e) of the RMA. It is due to expire on 1 June 2016.

Condition one requires SDC to manage ground contours, final cover and illegal dumping at the site.

Condition two states that the discharge from the site shall not cause detrimental effect on water quality or aquatic life of the Waihapa Stream.

Condition three is a review provision.

The permit is attached to this report in Appendix I.

1.4 Monitoring programme

1.4.1 Introduction

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

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

Both the Huiroa and Pukengahu landfills have been closed since 1991 but are still monitored with regards to leachate discharge and site maintenance on a three yearly basis. Monitoring was undertaken in the 2011-2012 period, and is next scheduled for the 2014-2015 period as per the triennial programme.

The Stratford landfill closed in 2006 and monitoring is conducted annually.

The monitoring programmes for the SDC landfills consist of four primary components as outlined below.

1.4.2 Programme liaison and management

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

- ongoing liaison with resource consent holders over consent conditions and their interpretation and application;
- discussion over monitoring requirements;
- preparation for any reviews;
- renewals;
- new consents;
- advice on TRC's environmental management strategies and content of regional plans; and
- consultation on associated matters.

1.4.3 Site inspections

The Stratford municipal landfill site was visited on four occasions during the monitoring period. Two of the inspections were undertaken to monitor the cap condition in regards to the discharge of contaminated soil at the site.

With regard to consents for the abstraction of or discharge to water, the main points of interest were site processes with potential or actual discharges to receiving watercourses, including contaminated stormwater and process wastewaters.

1.4.4 Chemical sampling

The Patea River was sampled on one occasion, and the sample analysed for black disc transparency, biochemical oxygen demand, cadmium, chloride, conductivity, chromium, dissolved oxygen, dissolved reactive phosphorus, faecal coliforms, ammoniacal nitrogen, nitrate/nitrite nitrogen, dissolved oxygen saturation, pH, suspended solids, temperature, turbidity, and zinc.

The Taranaki Regional Council also undertook sampling of the groundwater at the Stratford landfill. Groundwater was sampled on two occasions, and the sample analysed for alkalinity, bicarbonate, chemical oxygen demand, chloride, conductivity, dissolved reactive phosphorus, faecal coliforms, ammoniacal nitrogen, nitrate, pH, temperature, water level and zinc.

1.4.5 Biomonitoring surveys

A biological survey was performed on one occasion in the Patea River to determine whether or not the Stratford landfill has had a detrimental effect upon the macroinvertebrate communities of the river.

2. Stratford landfill at Victoria Rd

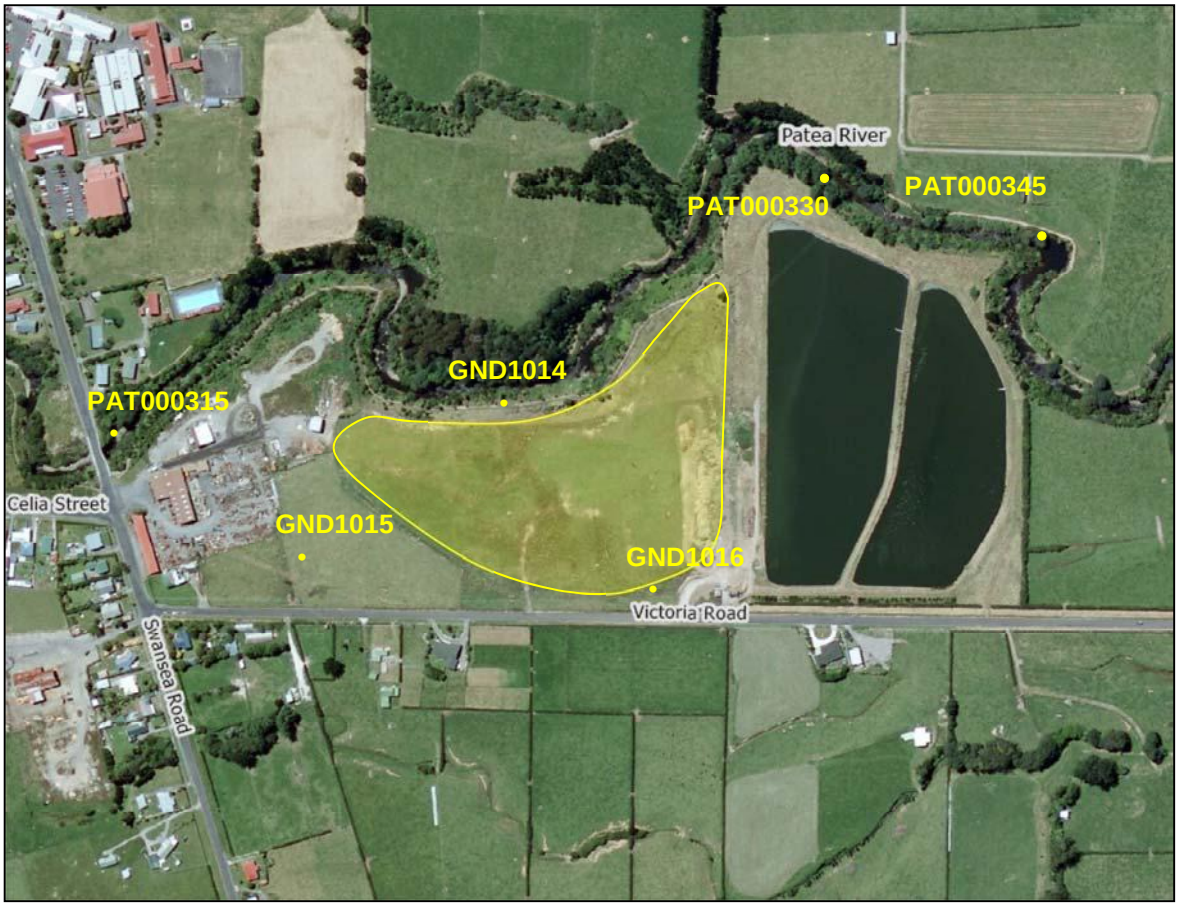

Figure 2 Stratford landfill (shaded in yellow) and sampling locations

2.1 Inspections

5 September 2013
A site visit was made to conduct a compliance monitoring inspection and to take groundwater samples. It was raining with 8 mm of rain over the past 24 hours.

The newly capped area was starting to grow grass but was still largely uncovered and quite soft underfoot (waterlogged). The northern batter was inspected and found to have a minor amount of exposed rubbish where drainage works were undertaken. This should be attended to once the new cap has stabilised and been grassed over. There were some areas where there was some minor leachate/stormwater seepage on the walking track. There were some small direct discharges occurring from the culverts under the track. No visible effects on the Patea River were noted. These discharges are permitted by rule 28 of the Regional Freshwater Plan.

The rest of the cap appeared to be in a sound condition.

25 November 2013
A site visit was made to conduct a compliance monitoring inspection. It was fine at the time of the inspection with no rain over the past 3 days.

The area capping the CCA soils has approximately 60% grass cover. The consent holder was met onsite and it was outlined the area would be re-drilled. The northern batter was inspected and remedial works had started on the areas where there had been exposed rubbish. The rest of the cap appeared to be in a sound condition and no other issues were noted.

4 March 2014
A site visit was made to conduct a compliance monitoring inspection. It was fine at the time of the inspection with no rain over the past 3 days.

The area capping the CCA soils had approximately 85% grass cover. The site manager was onsite to discuss the re-contour of the recently capped areas. Due to extra soils having been added to ensure the area was capped properly, the CCA areas were slightly higher than the adjacent areas of the original cap. This was being addressed via some surface drains to allow water to flow away. It was discussed that in one or two small areas some of the cap may have be scraped back to ensure a usable contour, and it was advised that any area that was scraped back would have to be sampled to ensure contaminated soils had not been exposed.

22 May 2014
A site visit was made to conduct a compliance monitoring inspection. It was fine at the time of the inspection with 1 mm of rain over the past 3 days.

The area capping the contaminated soil had approximately 90% grass cover. The contouring works discussed with the site manager on the last inspection had yet to be done and there were two small areas of ponding in the drain between the old and new cap. The site manager and contractor were contacted and it was outlined that works would commence once it was dry enough to get equipment in.

The rest of the cap was inspected and found to be in a sound condition, no leaking drinking troughs were noted and the cap was generally well drained.

Follow up note: During a subsequent inspection undertaken shortly after the start of the next monitoring period, works had begun and it was outlined that the site was being surveyed and the entire area was going to be constructively re-contoured with imported cover material (no scraping back required).

2.2 Results

2.2.1 Groundwater

Groundwater samples were taken from monitoring bores upslope (GND1015 and GND1016) and down slope (GND1014) of the landfill on two occasions: 30 October 2013 and 22 April 2014. The results from these samples are shown in Tables 1 and 2.

As with the results from previous samples taken from these monitoring bores, the groundwater down gradient of the landfill (as represented by bore GND1014), shows some evidence of contamination from the landfill. The graphs of historical data given in Figures 3, 4 and 5 show how bore GND1014 is affected by landfill indicator species; ammoniacal nitrogen, chloride, and zinc. The graphs also show how the levels of chloride and ammonia are apt to fluctuate against the more stable background levels found in the two bores mid and up gradient from the filled area

(more so in the case of chloride and ammoniacal nitrogen). Zinc is found to be higher in the down gradient bore but is also seen to fluctuate in the up gradient bores as well, which may indicate other local effects in the groundwater.

The affected area consists of the narrow riparian strip between the landfill and the Patea River and the contaminated groundwater eventually permeates through to the Patea River. The results of the monitoring of the Patea River, as discussed below, show that there is at most only negligible impact on Patea River water quality. This suggests that either the level of groundwater migration is not of sufficient volume to make any significant changes to the water quality of the Patea River, or that the groundwater contamination is being attenuated by its passage through the soil.

Table 1 Results of the Stratford landfill groundwater quality survey 30 October 2013

Parameter	Unit	GND1014 down- gradient	GND1015 up- gradient	GND1016 up- gradient
Alkalinity	g/m^3	605	30	27
Arsenic	g/m^3	<0.001	0.001	<0.001
Chloride	g/m^3	34.2	12.4	11.4
Chemical oxygen demand	g/m^3	49	6	<5
Conductivity	mS/m	115	14.2	9.6
Chromium	g/m^3	<0.03	<0.03	<0.03
Copper	g/m^3	<0.01	<0.01	<0.01
Dissolved reactive phosphorus	g/m^3	0.004	<0.003	<0.003
Ammoniacal nitrogen	g/m^3-N	54	0.016	0.003
Nitrate/nitrite nitrogen	g/m^3-N	0.05	4.17	0.97
pH		6.6	6.2	5.9
Temperature	Deg. C	15	13.3	13.1
Dissolved zinc	g/m^3	0.009	0.008	0.009

*= not measured

Table 2 Results of the Stratford landfill groundwater quality survey, 22 April 2014

Parameter	Unit	GND1014 down- gradient	GND1015 up- gradient	GND1016 up- gradient
Alkalinity	g/m^3	470	42	35
Arsenic	g/m^3	0.006	<0.001	<0.001
Chloride	g/m^3	28.5	10.1	9.6
Chemical oxygen demand	g/m^3	34	<5	<5
Conductivity	mS/m	91.0	14.1	10.5
Chromium	g/m^3	<0.03	<0.03	<0.03
Copper	g/m^3	<0.01	<0.01	<0.01
Dissolved reactive phosphorus	g/m^3	0.009	0.008	0.007
Unionised ammonia	g/m^3-N	0.06470	0.00000	0.00001
Ammoniacal nitrogen	g/m^3-N	48.9	0.009	0.015
Nitrate/nitrite nitrogen	g/m^3-N	0.03	2.49	0.57
pH	pH	6.6	6.1	6.0
Temperature	Deg. C	15.1	14.8	15.4
Dissolved zinc	g/m^3	0.042	0.009	0.012

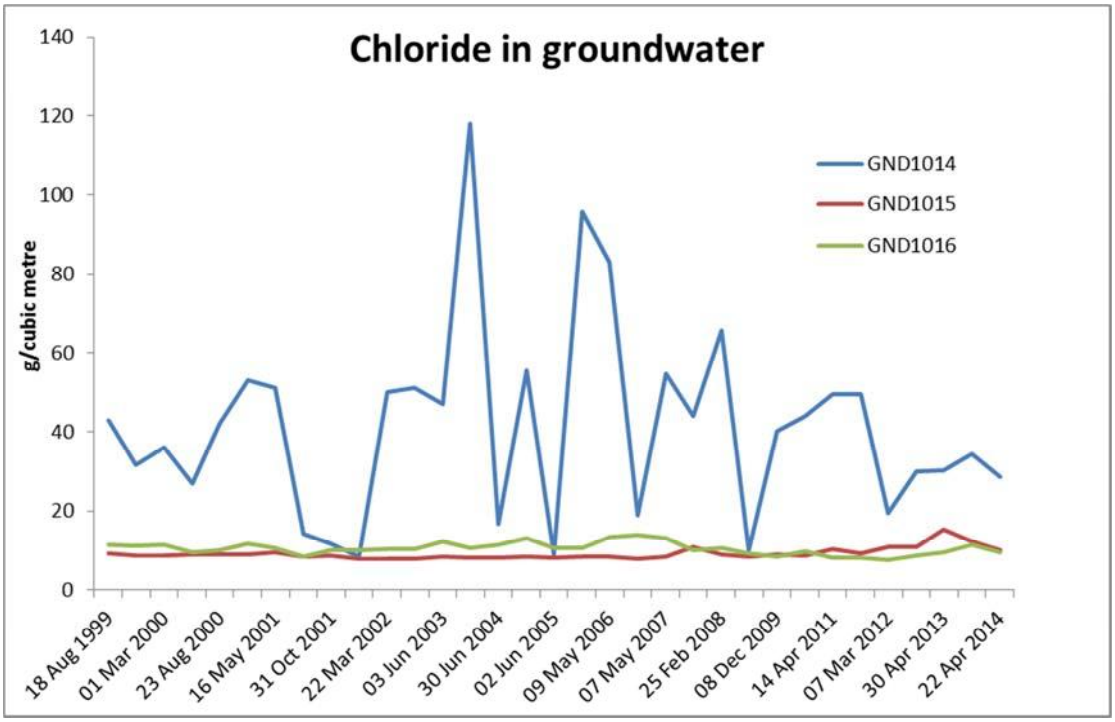

Figure 3 Graph showing chloride levels in groundwater at Stratford Landfill

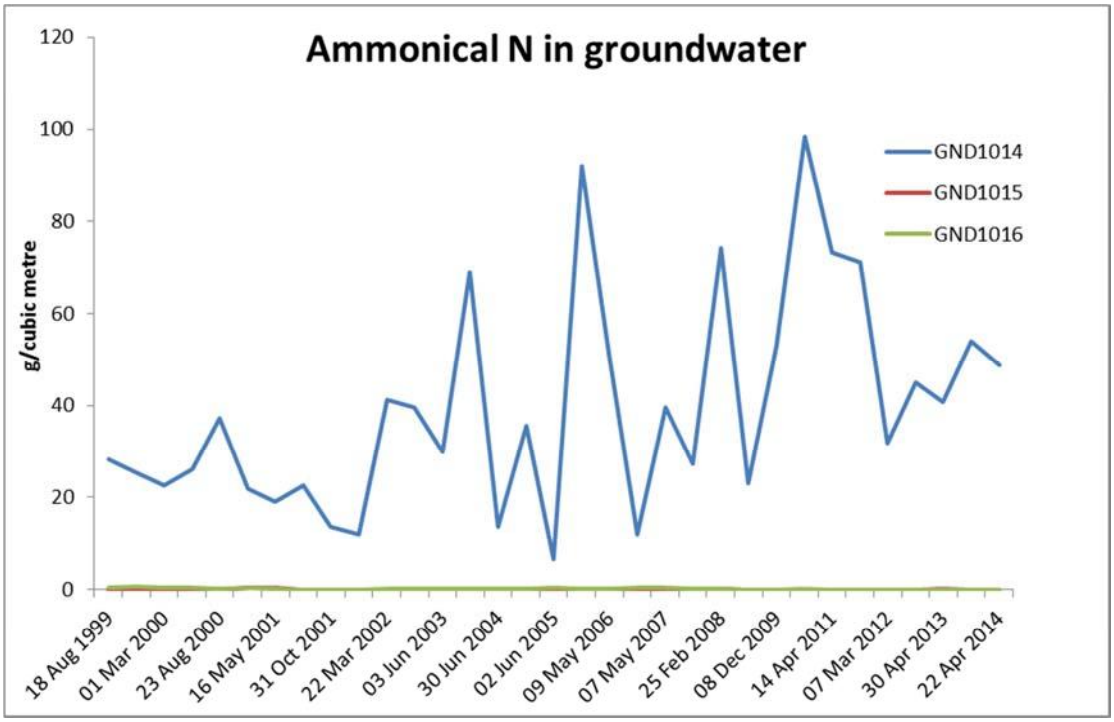

Figure 4 Graph showing ammoniacal nitrogen levels in groundwater at Stratford Landfill

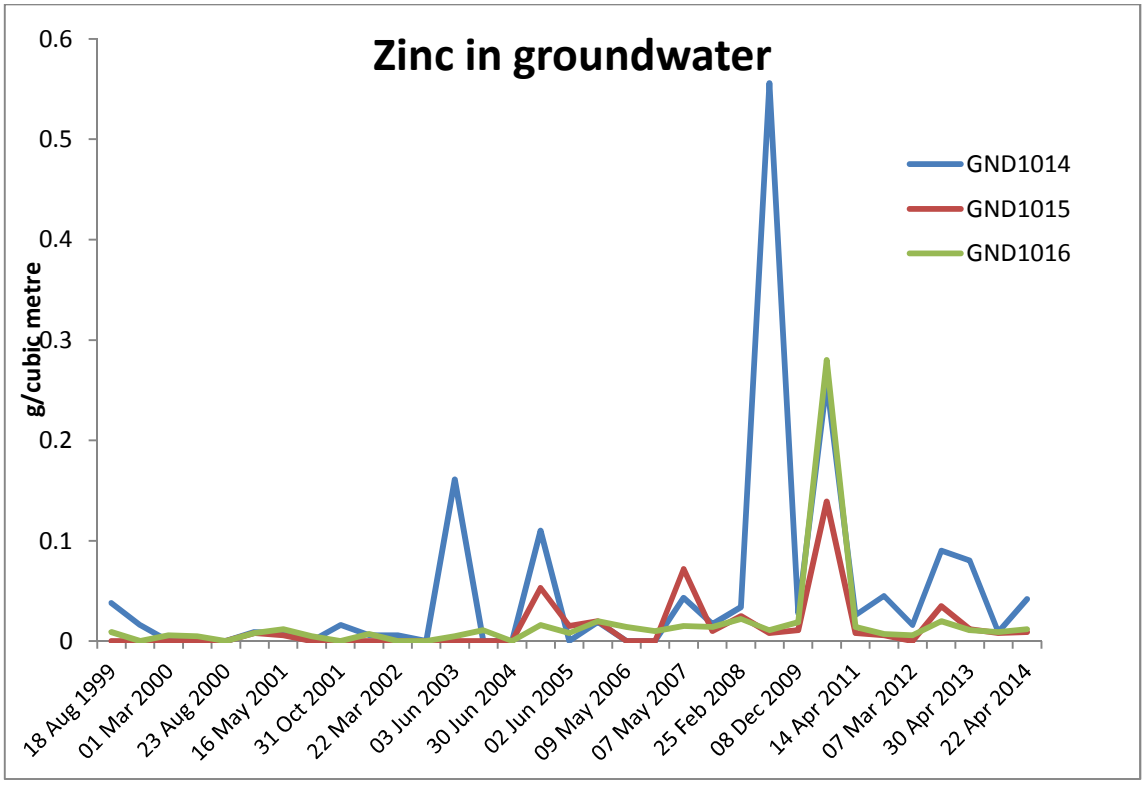

Figure 5 Graph showing zinc levels in groundwater at Stratford Landfill

2.2.2 Surface waters

Samples were collected from the Patea River on 18 February 2014 and the results are set out in Table 3 below. This sampling was undertaken in conjunction with the monitoring of the Stratford waste water treatment plant (WWTP).

As with the results from previous monitoring periods, the results from this period indicate that the Stratford landfill had only a very minor, if not negligible, effect on the water quality of the Patea River.

In relation to the parameters tested for, there was no significant difference in water quality between the upstream and downstream sites. There was a slight rise in ammoniacal nitrogen, however the level of unionised ammonia downstream of the landfill was well below the 0.025 g/m^3 guideline for the long term protection of aquatic ecosystems.

Figure six (below) is a graph of ammoniacal ammonia data gathered over the past 20 years. As Stratford WWTP had an upgrade in 2009, the discharge point of the WWTP was moved so the sites used in this report to monitor the downstream effects of the landfill also changed (hence the change of site in the Figure six in 2009) . Whilst there is some separation in the sites in terms of location, the graph indicates that a similar, stable, and modest rise in ammoniacal nitrogen has occurred in the Patea River as result of the landfill's presence. The highest level of ammonia found downstream of the landfill since monitoring began was 0.126 g/m^3, which under ambient pH and temperature conditions, would not exceed the 0.025 g/m^3 unionised ammonia guideline for the long term protection of aquatic ecosystems.

Table 3 Results of the Stratford landfill water quality survey

Parameter	Units	19 February 2014	
		Above landfill PAT000315	Below landfill PAT000345
Black disc transparency	m	2.88	2.79
Biochemical oxygen demand	g/m^3	0.8	0.6
Filtered biochemical oxygen demand	g/m^3	<0.5	<0.5
Cadmium (dissolved)	g/m^3	<0.005	<0.005
Chloride	g/m^3	8.5	8.5
Conductivity	mS/m	9.6	9.7
Chromium (dissolved)	g/m^3	<0.03	<0.03
Dissolved oxygen	g/m^3	9.2	9.2
Dissolved reactive phosphorus	g/m^3-P	0.026	0.024
Faecal coliforms	/100ml	150	290
Unionised ammonia	g/m^3-N	0.00064	0.00132
Ammoniacal nitrogen	g/m^3-N	0.035	0.07
Dissolved oxygen saturation	%	97	98
pH	pH	7.7	7.7
Suspended solids	g/m^3	9	<2
Temperature	Deg.C	16.5	17
Turbidity	NTU	3.6	0.85
Dissolved zinc	g/m^3	<0.005	<0.005

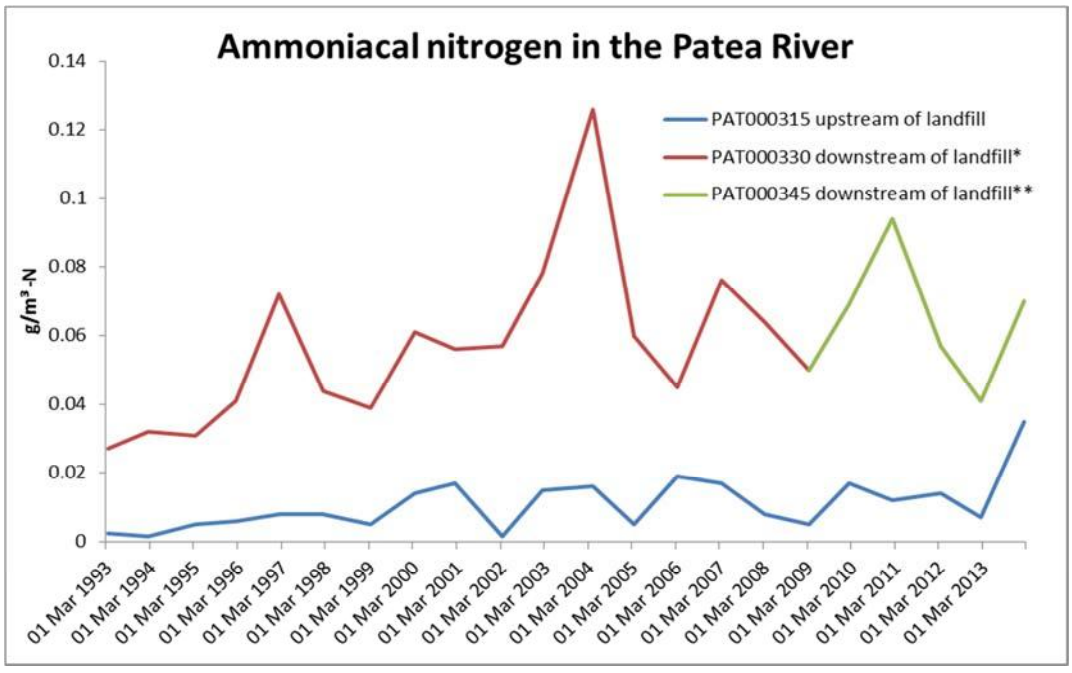

Figure 6 Graph showing ammoniacal nitrogen levels in the Patea Stream up and down stream of the landfill.

**Downstream site prior to WWTP upgrade*
***Downstream site after WWTP upgrade*

2.2.3 Biomonitoring

Taranaki Regional Council's standard 'kick-sampling' technique was used at four established sites to collect streambed macroinvertebrates from the Patea River. Samples were sorted and identified and the number of taxa (richness), Macroinvertebrate Community Index (MCI) score and Semi Quantitative Macroinvertebrate Community Index ($SQMCI_S$) score were calculated 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.

This scheduled summer, 2014 macroinvertebrate survey (which has complemented previous additional assessments of the upgraded system performance) indicated that the discharge of treated oxidation ponds wastes from the upgraded Stratford WWTP system had had localised effects on the macroinvertebrate communities of the Patea River under summer low river flow conditions prior to recovery at the site 2.4 km downstream of the discharge. Some subtle changes in macroinvertebrate communities' compositions were recorded between the upstream 'control' site and sites downstream of the newly relocated outfall from the WWTP but no major changes in community structures. However, there were no significant effects associated with seepages from the closed landfill site.

The macroinvertebrate communities of the Patea River contained slightly higher proportions of 'sensitive' taxa at the two upstream sites. 'Tolerant' taxa were more predominant proportionately at the two sites downstream of the relocated WWTP discharge. Dominant taxa composition was relatively similar at all four sites although proportionately tending toward more 'moderately sensitive' and 'tolerant' taxa in a downstream direction, through the surveyed reach of the river. Taxonomic richnesses (numbers of taxa) varied by 7 taxa at the four sites in this summer survey and were slightly lower at all but one of these sites than those found by the previous summer (2013) survey. However, similar proportions of 'tolerant' taxa were present at sites downstream of the WWTP discharge compared to the previous summer survey under slightly more widespread periphyton cover of the river bed at the time of this latest survey.

MCI and $SQMCI_S$ scores indicated that the upstream communities were of 'good' health (TRC, 2014) and typical of conditions recorded in summer in the mid reaches of similar Taranaki ringplain rivers. Stream communities downstream of the WWTP discharges were of 'fair' to 'good' generic health and were similar to those documented in this reach by most previous surveys during summer recession low flow conditions.

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 TRC for example provision of advice and information, or investigation of potential or actual causes of non-compliance or failure to maintain good practices. A pro-active approach that in the first instance avoids issues occurring is favoured.

TRC 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 consent holder concerned has itself notified TRC. 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, TRC must be able to prove by investigation that the identified consent holder is indeed the source of the incident (or that the allegation cannot be proven).

In the 2013-2014 period, it was not necessary for TRC to undertake significant additional investigations and interventions, or record incidents, in association with non compliance by SDC with conditions in resource consents or provisions in Regional Plans in relation to activities at the Victoria Rd landfill site.

2.4 Discussion

2.4.1 Discussion of site performance

In terms of the management of the landfill, no issues were noted during the monitoring period. The site had good vegetative cover and new capped areas had stabilised. Due to the extra capping soil that was laid due to cross contamination during the discharge of the CCA soils, the cap still requires surface drains in and around the crown of the east batter to ensure drainage. At the time of the preparation of this report SDC was in the process of having the site surveyed with a view to reinstate the cap profile which would result in further capping of the CCA soil discharge area. Alby M, the third party consent holder that discharged the CCA soils at the site, is cooperating with SDC in this matter.

2.4.2 Environmental effects of exercise of consents

Groundwater bore GND1014 continues to exhibit some signs of contamination, however there is no evidence from surface water sampling or biomonitoring that the discharge of groundwater is having a significant effect on the Patea River. There was no evidence of odour or dust problems at the site during any inspection.

2.4.3 Evaluation of performance

A tabular summary of the SDC's compliance record for the year under review in regard to the Stratford landfill set out in Table 4.

Table 4 Summary of performance for Consent 3889 discharge of leachate and stormwater

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Adopt best practical option	Site specific monitoring programme – programme supervision	Yes
2. Prepare a Contingency and Maintenance Plan	Site specific monitoring programme – programme supervision	Yes
3. Maintain landfill site	Site specific monitoring programme – inspection	Yes
4. Effects beyond mixing zone	Water quality monitoring of the Patea River upstream and downstream of the landfill	Yes
5. Review	N/A	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		High

During the year, SDC demonstrated a high level of environmental performance and compliance with the resource consents for the Stratford landfill.

2.4.4 Recommendations from the 2012-2013 Annual Report

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

THAT monitoring of the Stratford landfill in the 2013-2014 year continue at the same level as in 2012-2013 period.

The monitoring programme was implemented as recommended.

2.4.5 Alterations to monitoring programmes for 2014-2015

In designing and implementing the monitoring programmes for air/water discharges in the region, the Taranaki Regional Council has taken into account the extent of information made available by previous authorities, its relevance under the Resource Management Act, the obligations of the Act in terms of monitoring emissions/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/discharging to the environment.

It is proposed that for 2014-2015, the monitoring programme remain unchanged from the 2013-2014 period.

A recommendation to this effect is presented in Section 2.5 of this report and summary of recommendations is given in Section 4.

2.5 Recommendation

THAT monitoring of the Stratford landfill in the 2014-2015 year continue at the same level as in 2013-2014 period.

3. Huiroa and Pukengahu landfills

These closed landfills (shown in Figure 7 and 8) are monitored on a triennial basis. Inspections and sampling were not scheduled for this monitoring year and are next due in the 2014-2015 year.

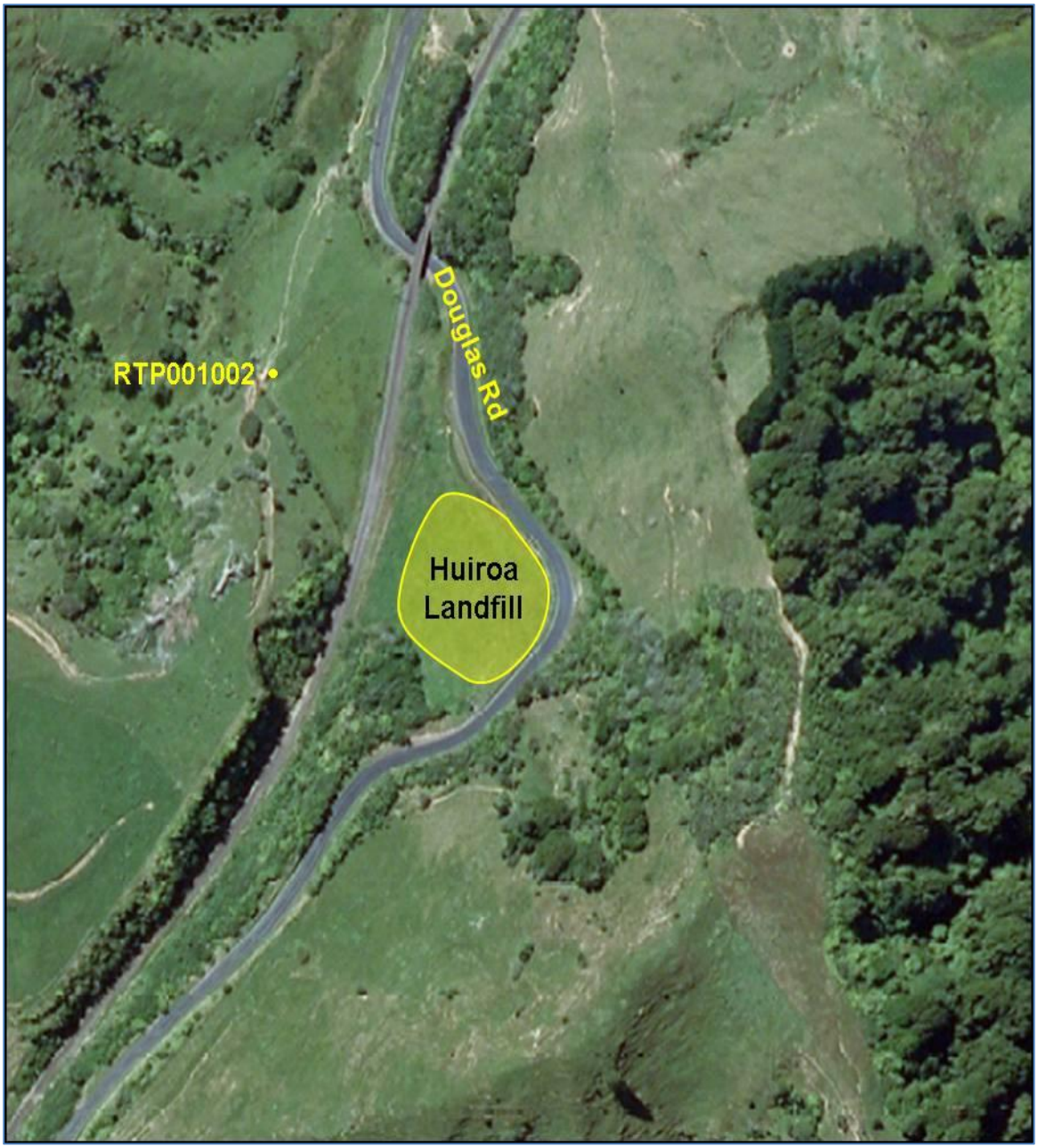

Figure 7 Huiroa landfill and sampling site

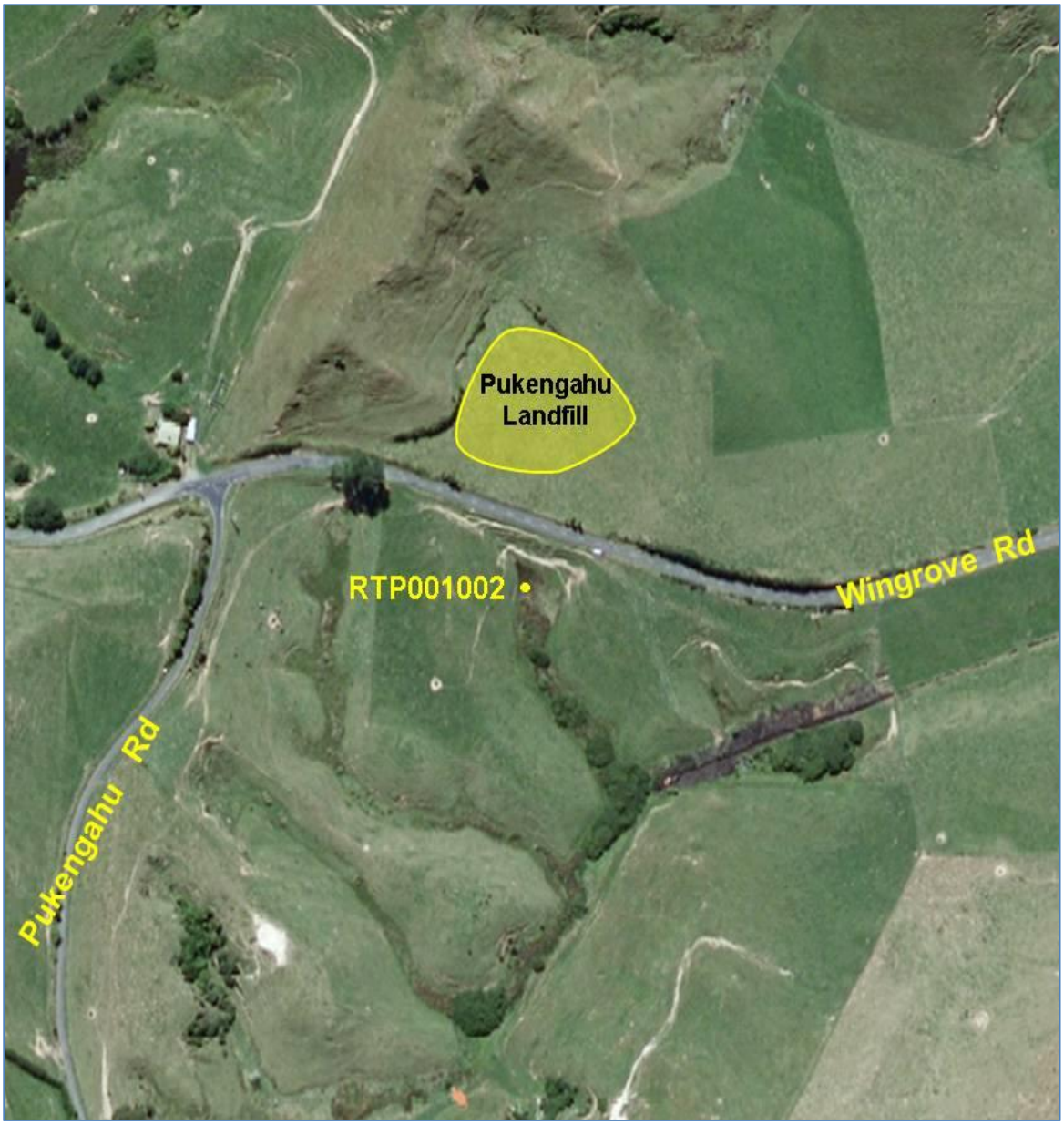

Figure 8 Pukengahu landfill and sampling site

3.1 Investigations, interventions, and incidents

In the 2013-2014 period, it was not necessary for the Council to undertake significant additional investigations and interventions, or record incidents, in association with non compliance by Stratford District Council with conditions in resource consents or provisions in Regional Plans in relation to the Pukengahu and Huiroa landfill sites during the monitoring period.

3.2 Recommendation

That the triennial monitoring programme for the Huiroa and Pukengahu landfills remain unchanged with monitoring to be next implemented in the 2014-2015 period.

4. Summary of recommendations

4.1 Stratford landfill

THAT monitoring of the Stratford landfill in the 2014-2014 year continue at the same level as in 2013-2014 period.

4.2 Huiroa and Pukengahu landfills

THAT the triennial monitoring programme for the Huiroa and Pukengahu landfills remain unchanged with monitoring next to be implemented in the 2014-2015 period.

Glossary of common terms and abbreviations

The following abbreviations and terms that may have been used within this report:

Biomonitoring	Assessing the health of the environment using aquatic organisms.
BOD	Biochemical oxygen demand. A measure of the presence of degradable organic matter, taking into account the biological conversion of ammonia to nitrate.
BODF	Biochemical oxygen demand of a filtered sample.
Bund	A wall around a tank to contain its contents in the case of a leak.
CBOD	Carbonaceous biochemical oxygen demand. A measure of the presence of degradable organic matter, excluding the biological conversion of ammonia to nitrate.
cfu	Colony forming units. A measure of the concentration of bacteria usually expressed as per 100 millilitre sample.
COD	Chemical oxygen demand. A measure of the oxygen required to oxidise all matter in a sample by chemical reaction.
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.
DO	Dissolved oxygen.
DRP	Dissolved reactive phosphorus.
E.coli	*Escherichia coli,* an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
Ent	Enterococci, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre of sample.
F	Fluoride.
FC	Faecal coliforms, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
Fresh	Elevated flow in a stream, such as after heavy rainfall.
g/m^3	Grammes per cubic metre, and equivalent to milligrammes per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred.
Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring.
Investigation	Action taken by Council to establish what were the circumstances/ events surrounding an incident including any allegations of an incident
l/s	Litres per second.
MCI	Macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats.

mS/m	Millisiemens per metre.
Mixing zone	The zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point.
NH_4	Ammonium, normally expressed in terms of the mass of nitrogen (N).
NH_3	Unionised ammonia, normally expressed in terms of the mass of nitrogen (N).
NO_3	Nitrate, normally expressed in terms of the mass of nitrogen (N).
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water.
O&G	Oil and grease, defined as anything that will dissolve into a particular organic solvent (for example 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 subsequent amendments.
SQMCI	Semi quantitative macroinvertebrate community index.
SS	Suspended solids.
Temp	Temperature, measured in °C (degrees Celsius).
Turb	Turbidity, expressed in NTU.
UI	Unauthorised Incident.
UIR	Unauthorised Incident Register – contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
Zn*	Zinc.

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

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

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Appendix I

Resource consents held by Stratford District Council

TRK983891

TARANAKI REGIONAL COUNCIL

PRIVATE BAG 713
47 CLOTON ROAD
STRATFORD
NEW ZEALAND
PHONE 0-6-765 7127
FAX 0-6-765 5097

DISCHARGE PERMIT

Pursuant to the RESOURCE MANAGEMENT ACT 1991 a resource consent is hereby granted by the Taranaki Regional Council

Name of Consent Holder:	STRATFORD DISTRICT COUNCIL PO BOX 320 STRATFORD
Renewal Granted Date:	12 February 1998

CONDITIONS OF CONSENT

Consent Granted:	TO DISCHARGE UP TO 910 CUBIC METRES/DAY [84 LITRES/SECOND] OF STORMWATER AND LEACHATE FROM THE FORMER PUKENGAHU LANDFILL INTO AN UNNAMED TRIBUTARY OF THE WAIHAPA STREAM IN THE PATEA CATCHMENT AT OR ABOUT GR: Q20:292-016
Expiry Date:	1 June 2016
Review Date[s]:	June 2004 and June 2010
Site Location:	FORMER LANDFILL, WINGROVE ROAD, STRATFORD
Legal Description:	ROAD RESERVE WINGROVE ROAD PUKENGAHU BLK VII NGAERE SD

Catchment:	PATEA	343.000
Tributary:	WAIHAPA UNNAMED TRIBUTARY	343.280

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

TRK983891

General conditions

a) That on receipt of a requirement from the General Manager, Taranaki Regional Council (hereinafter the General Manager), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) That 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) That 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. THAT the consent holder shall ensure, to the satisfaction of the General Manager, Taranaki Regional Council, that:

a) the site contours are maintained so that no ponding, damming or retention of water occurs on the site;
b) the integrity of the cover is maintained so as to minimise infiltration of stormwater; and
c) access to the site is restricted so that illegal dumping of wastes is discouraged.

2. THAT allowing for a mixing zone of 50 metres downstream of the discharge, the discharge shall not give rise to any of the following effects in the unnamed tributary of the Waihapa Stream:

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 effects on aquatic life.

3. THAT the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during the month of June 2004 and/or June 2010, 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 consent, which were not foreseen at the time the application was considered and which it was not appropriate to deal with at that time.

Signed at Stratford on 12 February 1998

For and on behalf of
TARANAKI REGIONAL COUNCIL

DIRECTOR—RESOURCE MANAGEMENT

TRK963890

COPY

TARANAKI REGIONAL COUNCIL

PRIVATE BAG 713
47 CLOTON ROAD
STRATFORD
NEW ZEALAND
PHONE 0-6-765 7127
FAX 0-6-765 5097

DISCHARGE PERMIT

Pursuant to the RESOURCE MANAGEMENT ACT 1991 a resource consent is hereby granted by the Taranaki Regional Council

Name of Consent Holder:	STRATFORD DISTRICT COUNCIL PO BOX 320 STRATFORD
Renewal Granted Date:	17 October 1996

CONDITIONS OF CONSENT

Consent Granted:	TO DISCHARGE UP TO 230 CUBIC METRES/DAY [20 LITRES/SECOND] OF STORMWATER AND LEACHATE FROM A FORMER LANDFILL SITE ONTO AND INTO LAND IN THE VICINITY OF AN UNNAMED TRIBUTARY OF THE MAKURI STREAM IN THE PATEA CATCHMENT AT OR ABOUT GR: Q20:370-150
Expiry Date:	1 June 2016
Review Date[s]:	June 2004 and June 2010
Site Location:	HUIROA LANDFILL, DOUGLAS ROAD, DOUGLAS
Legal Description:	ROAD RESERVE BLK IX NGATIMARU SD

Catchment:	PATEA	343.000
Tributary:	MAKURI UNNAMED TRIBUTARY	343.250

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

TRK963890

COPY

GENERAL CONDITIONS

(a) That on receipt of a requirement from the General Manager, Taranaki Regional Council (hereinafter the General Manager), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

(b) That 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) That 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;
(ii) charges for the carrying out of the Council's functions under section 35 in relation to this consent; and
(iii) charges authorised by regulations.

SPECIAL CONDITIONS

1. THAT the consent holder shall install and maintain stormwater drains and ground contours at the site, to the satisfaction of the General Manager, Taranaki Regional Council, in order to minimise stormwater movement across, or ponding on the site, and the maintenance of soil cover on the site.

2. THAT the consent holder shall maintain an adequate vegetative cover on the site, to the satisfaction of the General Manager, Taranaki Regional Council, to prevent dust emission or stormwater erosion of the site.

3. THAT the consent holder shall at all times adopt the best practicable option to prevent or minimise any adverse effect or any likely adverse effect on the environment associated with the discharges of leachate from the site. Without restriction or limitation, the best practicable option shall include the measures specified in conditions 1 and 2 above.

4. THAT the discharge shall not give rise to any of the following effects in the receiving waters of the unnamed tributary of the Makuri Stream:

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.

5. THAT the Taranaki Regional Council may review any or all of the conditions of this consent should further chemical sampling of the unnamed tributary of the Makuri Stream reveal levels of contamination resulting in or likely to result in significant adverse environmental effects.

TRK963890

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TARANAKI REGIONAL COUNCIL

PRIVATE BAG 713
47 CLOTON ROAD
STRATFORD
NEW ZEALAND
PHONE 0-6-765 7127
FAX 0-6-765 5097

6. THAT the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during June 2004 and/or June 2010, 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 consent, which were not foreseen at the time the application was considered and which it was not appropriate to deal with at the time.

Signed at Stratford on 17 October 1996

For and on behalf of
TARANAKI REGIONAL COUNCIL

OPERATIONS MANAGER

COBA

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

Discharge Permit

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

Name of Consent Holder:	Stratford District Council P O Box 320 STRATFORD 4352
Decision Date:	6 December 2010
Commencement Date:	6 December 2010

Conditions of Consent

Consent Granted:	To discharge leachate into land and into groundwater adjacent to the Patea River at or about (NZTM) 1712119E-5644346N
Expiry Date:	1 June 2028
Review Date(s):	June 2016, June 2022
Site Location:	Swansea Road, Stratford
Legal Description:	Lots 5-6 DP Pt Lot 4 DP 1942 Lot 2 DP 11213 Blk II Ngaere SD [Discharge source & site]
Catchment:	Patea

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

General condition

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

Special conditions

1. The consent holder shall at all time adopt the best practical option as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any actual or likely adverse effect on the environment associated with the discharge of contaminants from the site.

2. Before 31 March 2011 the consent holder shall submit a Landfill Maintenance and Contingency Plan to the satisfaction to the Chief Executive of the Taranaki Regional Council that;

   a) sets out the requirements and scheduling for the maintenance of the landfill cap;

   b) identifies all other structures on the site [drains, stock watering troughs, and groundwater bores etc] that require ongoing maintenance and sets out requirements and scheduling for their maintenance;

   c) outlines the proposed responses to inadvertent exposure of refuse, significant cap disturbance, and leachate breakouts; and

   d) provides a list of contact details for all appropriate staff and agencies to be contacted during an emergency at the site.

3. In addition to adhering to the Landfill Maintenance and Contingency Plan as required by condition 2, the consent holder shall at all times take all reasonable steps to ensure;

   a) that the cap is contoured is maintained in a manner that prevents ponding, stormwater infiltration and minimises leachate production;

   b) that the cap retains a reasonable cover of appropriate vegetation;

   c) that any stock water troughs on the site are maintained to ensure that they do not leak or overflow;

   d) that any existing drains or other diversion structures are kept clear and functional; and

   e) that the cap depth is maintained to the original specifications as set out in the Swansea Street Sanitary Landfill Management Plan of 1992.

4. That downstream of the discharge zone in the Patea River , beyond grid reference 1712256E-5644543N, the discharge shall not give rise to any of the following effects in the receiving waters of the Patea River:

   a) the production of any conspicuous oil or grease films, scums or foams or floatable or suspended materials;
   b) any conspicuous change in 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 effects of aquatic life.

5. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2016 and/or June 2022, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 6 December 2010

For and on behalf of
Taranaki Regional Council

Director-Resource Management

Appendix II

Biomonitoring report

To Monitoring Manager - Environmental Quality, K Brodie
From Scientific Officer, C R Fowles
Doc No 1321172
Report No CF604
Date March 2014

Summer biomonitoring of the Patea River in relation to the Stratford District Council's upgraded Wastewater Treatment Plant, February 2014

Introduction

The upgrading of the wastewater treatment plant (WWTP) completed in 2009, required by conditions attached to the renewed consent 0196 (TRC, 2013), has been the subject of an additional investigative assessment of the upgrade's effectiveness in terms of system performance and its impacts on the receiving waters of the Patea River. A component of the assessment included two spring biomonitoring surveys of the river specifically in association with the upgraded treatment system and relocated, improved outfall structure (some 600 m downstream of the sealed-off original outfall). The summer survey (CF486) performed soon after completion of the WWTP upgrade, and the subsequent spring, 2009 (CF491), scheduled summer, 2010 (CF501), spring, 2010 (CF517), and summer, 2011(CF526) surveys completed the requisite assessments. Subsequently, summer surveys (including the current survey) have been requirements of scheduled monitoring programmes for compliance monitoring purposes.

Methods

The standard '400 ml kick sampling' technique was used to collect streambed (benthic) macroinvertebrates from three established sites and one more recently established site in the Patea River (illustrated in Figures 1 and 2), on 18 February 2014.

These sites were:

Site No	Site code	GPS reference	Location
1	PAT 000315	E1711801 N5644382	Swansea Road bridge (upstream of landfill and oxidation ponds' discharge)
2	PAT 000330	E1712403 N5644580	Upstream of WWTP discharge (and downstream of landfall)
3a	PAT 000350	E1712956 N5644292	Approximately 130 m downstream of the WWTP new outfall
4	PAT 000356	E1714497 N5645112	Approximately 1 km upstream of the Kahouri Stream confluence

The upgrade to the WWTP system had included a new outfall (via rock rip-rap) to the river located a further 600m downstream of the original discharge point. The original site 3 was not required for the purpose of the current survey as no discharge from the sealed 'old' outfall was occurring at the time nor had any recent leakages occurred.

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

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using protocol P1 of

NZMWG protocols for sampling macroinvertebrates in wadeable streams (Stark et al, 2001). Macroinvertebrate taxa found in each sample were recorded as:

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

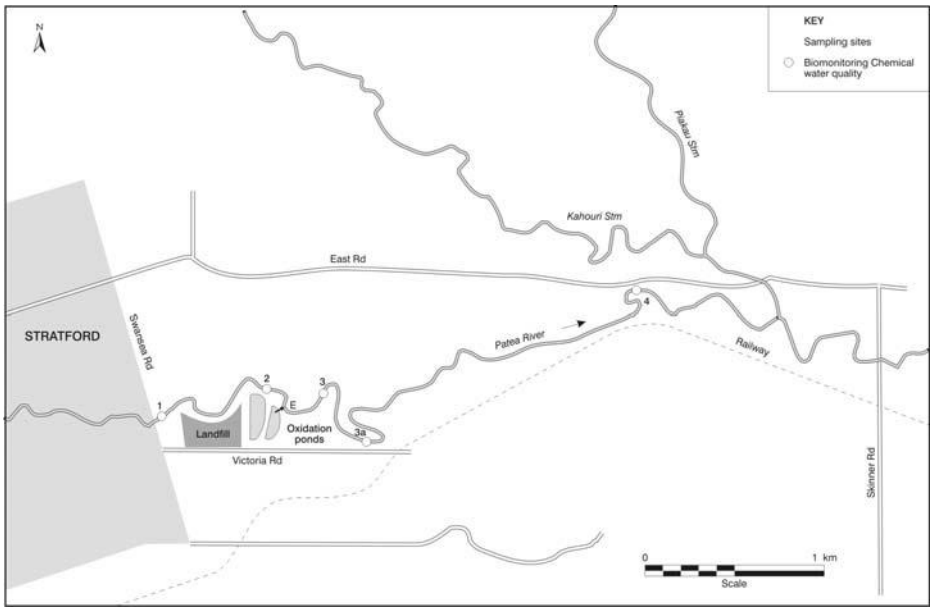

Figure 1 Biomonitoring sites in the Patea River in relation to Stratford landfill and oxidation ponds discharge

Figure 2 Aerial photo of site and location of sampling sites

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

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

Where necessary sub-samples of algal and detrital material taken from the macroinvertebrate samples were scanned 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 these organisms is an indicator of organic enrichment within a stream or river.

Results and discussion

This survey was performed on 18 February, 2014 during a low recession flow, 28 days after a fresh in excess of 3x median flow and 44 days after a fresh in excess of 7x median flow during a dry late summer period. River flow at Skinner Road was 0.94 m^3/sec representing a flow well below the average monthly mean February flow (2.78 m^3/sec) but above the minimum mean monthly flow for February (0.64 m^3/sec) recorded for the period 1978-2013. This flow was slightly higher (by about 0.07 m^3/sec) than the flow at the time of the previous biomonitoring survey in late summer, 2013.

Periphyton mats were patchy at sites 1 and 2 and widespread at sites 3a and 4, while filamentous algal growth was patchy at sites 3a and 4 with none recorded at sites 1 and 2. Patchy moss was recorded on the stony substrate at all sites except site 4. The algal component of the oxidation ponds discharge appeared moderate with rapid dispersion in the river downstream of the outfall and no algae were trapped or deposited amongst the river substrates at either of the downstream sites. Only site 3a did not have partial shading. Water temperatures ranged from 15.6°C to 16.9°C over the four sites at the time of this early to mid morning survey. The discharge via the rock rip-rap at the new outfall was slightly turbid and pale green in appearance and caused a slight visual increase in turbidity in the river at sites 3a and 4 downstream of the outfall.

Macroinvertebrate communities

A summary of the results of previous surveys is presented in Table 1.

Table 1 Summary of macroinvertebrate taxa numbers and MCI values for previous surveys performed between February 1985 and November 2013

Site	No of surveys	Taxa numbers		MCI Values	
		Range	Median	Range	Median
1	43	20-33	26	98-130	110
2	31	11-36	24	96-119	105
3a	7	21-29	23	100-110	101
4	38	17-31	24	82-116	98

Survey results since February 1986 are illustrated in Figure 2, while the results of the current survey are presented in Table 2 and discussed beneath.

Table 2 Macroinvertebrate fauna of the Patea River in relation to Stratford District Council WWTP discharge and closed landfill leachate discharges sampled on 18 February, 2014

Taxa List	Site Number	MCI score	1	2	3a	4
	Site Code		PAT000315	PAT000330	PAT000350	PAT000356
	Sample Number		FWB14128	FWB14129	FWB14130	FWB14131
PLATYHELMINTHES (FLATWORMS)	*Cura*	3	-	-	R	-
ANNELIDA (WORMS)	Oligochaeta	1	C	R	VA	A
MOLLUSCA	*Potamopyrgus*	4	R	R	-	R
CRUSTACEA	Cladocera	5	-	-	C	-
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	R	C	R	R
	Coloburiscus	7	VA	A	A	A
	Deleatidium	8	XA	XA	VA	VA
	Nesameletus	9	A	A	A	C
	Zephlebia group	7	R	R	-	-
PLECOPTERA (STONEFLIES)	*Stenoperla*	10	R	-	-	-
	Zelandoperla	8	C	R	R	R
HEMIPTERA (BUGS)	*Saldula*	5	-	-	R	-
COLEOPTERA (BEETLES)	Elmidae	6	A	A	A	C
	Hydraenidae	8	A	R	C	C
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	A	C	A	A
TRICHOPTERA (CADDISFLIES)	*Aoteapsyche*	4	VA	VA	VA	XA
	Costachorema	7	A	A	A	A
	Hydrobiosis	5	C	C	C	A
	Neurochorema	6	R	-	R	-
	Psilochorema	6	R	-	-	-
	Olinga	9	R	-	-	-
	Oxyethira	2	R	-	C	R
	Pycnocentrodes	5	R	-	C	R
	Triplectides	5	-	R	-	-
DIPTERA (TRUE FLIES)	*Aphrophila*	5	VA	A	A	A
	Chironomus	1	-	-	C	-
	Maoridiamesa	3	A	A	VA	VA
	Orthocladiinae	2	A	A	XA	VA
	Polypedilum	3	-	R	R	-
	Tanypodinae	5	R	-	R	R
	Tanytarsini	3	R	R	C	C
	Empididae	3	-	R	R	C
	Muscidae	3	R	-	C	A
	Austrosimulium	3	C	A	R	C
	Tanyderidae	4	-	-	R	-
ACARINA (MITES)	Acarina	5	-	-	-	R
		No of taxa	27	22	29	24
		MCI	111	105	95	100
		SQMCIs	6.8	6.9	3.4	4.3
		EPT (taxa)	14	10	10	9
		%EPT (taxa)	52	45	34	38

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

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

The results from the current survey (Table 2) indicated faunal richnesses ranging from two taxa below (site 2) to 6 taxa above (site 3a) median richnesses (ranging from 22 to 29 taxa) present at the four river sites. These taxa numbers were well within ranges previously recorded (Table 1) at the three longer established sites (1, 2 and 4). The richness at the most recently established site (site 3a) was equal with the maximum richness recorded by the few surveys at this site to date.

The range of taxa richnesses was generally typical of richnesses recorded by previous surveys which have been recorded under summer, more widespread periphyton cover and tending toward low flow conditions.

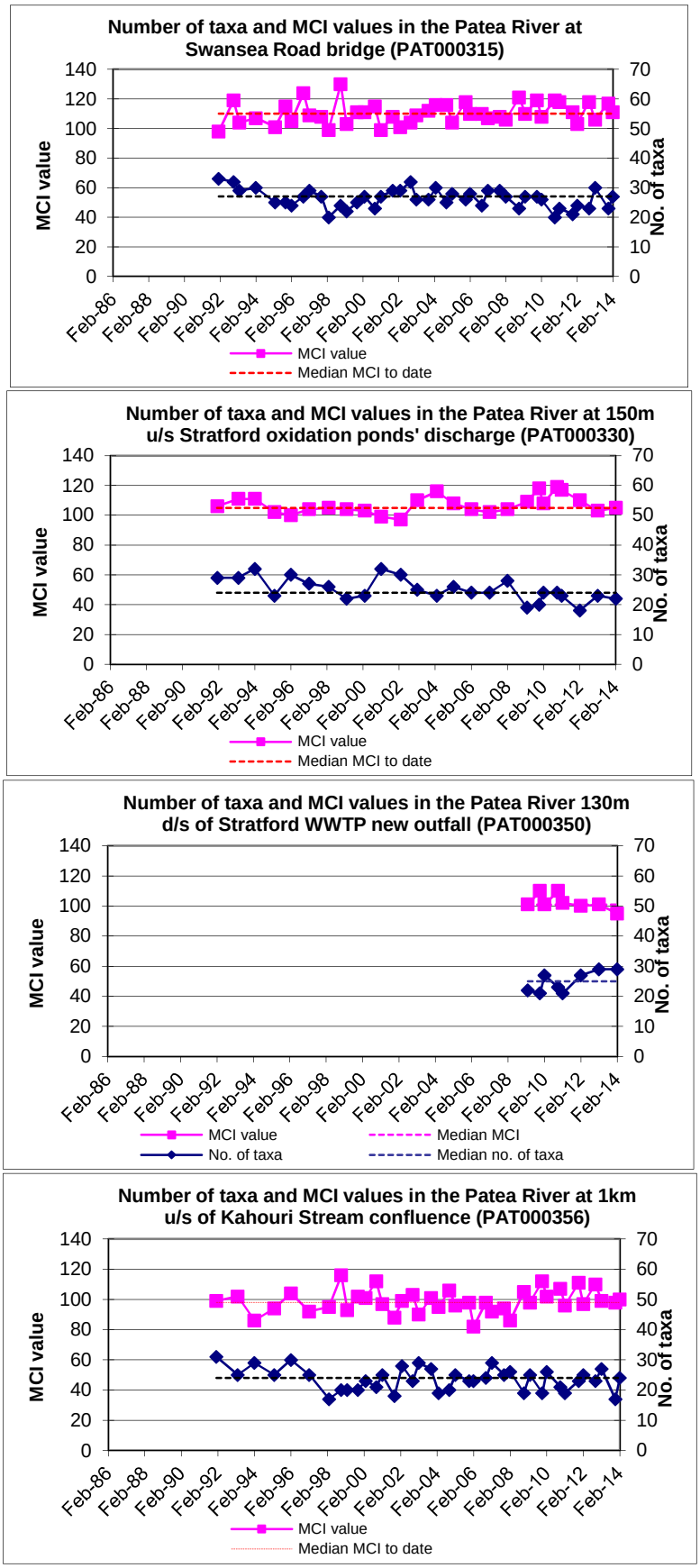

Figure 3 Taxa richness and MCI scores recorded to date at the Patea River sites

Sites upstream of the WWTP discharge (sites 1 and 2)

The macroinvertebrate communities of this reach of the river upstream of the WWTP discharge (and adjacent to the landfill) were of moderately high richness (22 to 37 taxa) and characterised by up to three 'highly sensitive' taxa [mayflies (extremely abundant *Deleatidium*; and *Nesameletus*) and hydraenid beetles]; up to five 'moderately sensitive' taxa [mayfly (*Coloburiscus*), elmid beetles, dobsonfly (*Archichauliodes*), free-living caddisfly (*Costachorema*), and cranefly (*Aphrophila*)]; and up to four 'tolerant' taxa [net-building caddisfly (*Aoteapsyche*), midges (orthoclads and *Maoridiamesa*), and sandfly (*Austrosimulium*)]. These dominant taxa were very similar to those dominant at the time of the previous summer survey (CF575) but one more in number of 'moderately sensitive' and two more in number of 'tolerant' taxa. In comparison with spring surveys at the times of past summer surveys, a lower ratio of 'sensitive' to 'tolerant' taxa generally has characterised these communities associated with the extensive periphyton assemblages typical of the mid and lower reaches of Taranaki rivers and streams during periods of low recession flows. The presence of up to six 'highly sensitive' taxa at these two sites within this surveyed reach of the river was indicative of relatively good preceding physicochemical water quality upstream and adjacent to the Stratford landfill and WWTP under summer, low recession flow conditions. MCI scores (111 and 105 units) reflected the significant proportions of 'sensitive taxa (67% and 59%) comprising the fauna at these sites, with these scores within one unit of medians of previously recorded scores (Table 1). These scores were 4 units (site 1) and a 10 units (site 2) lower than scores predicted for sites at these altitudes (280 to 300 m asl) but 3 to 8 units higher than predicted for sites this distance from the National Park (12.9 to 13.6 km) in ringplain rivers (Stark & Fowles, 2009). These scores categorised these sites as having 'good' generic river health (TRC, 2014) at the time of this summer survey, and not different to that expected under summer low flow conditions at these two sites (Figure 2). The single significant difference in individual taxon abundance between sites (very similar $SQMCI_s$ scores), together with a typical relatively small downstream decrease in MCI score, were indicative of no recent impacts of the adjacent closed landfill on the macroinvertebrate communities of this reach of the river.

Sites downstream of the WWTP new discharge outfall (sites 3a and 4)

These sites' macroinvertebrate communities differed in taxa richnesses by five taxa and were within the range and/or higher than richnesses at the two sites upstream of the outfall. The communities were characterised by up to two 'highly sensitive' taxa [very abundant mayfly (*Deleatidium*); and another mayfly (*Nesameletus*)]; up to six 'moderately sensitive' taxa [mayfly (*Coloburiscus*), elmid beetles, dobsonfly (*Archichauliodes*), free-living caddisflies (*Costachorema* and *Hydrobiosis*), and cranefly (*Aphrophila*)]; and up to five 'tolerant' taxa [oligochaete worms, net-building caddisfly (*Aoteapsyche*), muscid flies, and midges (orthoclads and *Maoridiamesa*)]. There were few significant differences between sites in characteristic taxa with two 'tolerant' taxa (cladocerans and *Chironomus* midges) decreasing in abundance at site 4. However, there were several significant differences in individual taxon abundances between the two sites (2 and 3a) nearest to the WWTP discharge. These included increase abundances in two 'moderately sensitive' taxa (cladocerans and stony-cased caddisfly) and five 'tolerant' taxa (oligochaete worms, algal-piercing caddisfly, *Chironomus* and orthoclad midges, and muscid flies); some of which are wastewater pond fauna with others associated with the increased periphyton streambed cover. Decreases in the proportion of 'sensitive' taxa (55% and 58% of faunal numbers) resulted in decreases (of 10 and 5 units) in the MCI scores between site 2 (upstream of the WWTP discharge) and sites 3a and 4 (95 and 100 units). At site 3a this score was close to significantly lower than the scores obtained in the river reach immediately upstream of the discharge from the WWTP but not at site 4 particularly taking into account the

distance of this site further downstream. These differences in scores were indicative of some recent impacts of the upgraded WWTP wastes discharge on the macroinvertebrate fauna in the surveyed reach of the Patea River, although downstream sites' scores were within 6 units of the relevant medians of past scores. The score at site 3a was 5 MCI units lower than recorded previously (by seven surveys) at this site although it was only one unit lower than the historical minimum recorded at the site (2) upstream of the discharge. There was a minimal difference in MCI scores (an increase of 5 units) between the two adjacent downstream sites (3a and 4) and the overall fall in MCI scores (11 units) over a distance of 4.3 km between the 'control' site (1) and furthest downstream site (4) was insignificant given the distance between these two sites. Several more subtle changes in community compositions resulted in a significant decrease in $SQMCI_s$ score of 3.5 units immediately downstream of the new outfall (site 3a) but some recovery in $SQMCI_s$ score (increase of 0.9 unit) at site 4 predominantly was due to increased abundances within three 'tolerant' (dominant) taxa and decreased abundance within one dominant 'highly sensitive' mayfly taxon.

The MCI scores categorised sites 3a and 4 as having 'fair' and 'good' generic river health (TRC, 2014) at the time of this summer survey, which was consistent with river health often recorded by previous surveys. These scores (95 and 100 units) were a significant 17 units and 10 units lower than predicted for sites at these altitudes (265 and 250 m asl) in ringplain rivers but insignificantly 6 units below to equal with predicted scores for these sites 14.8 km and 17.2 km downstream of the National Park boundary (Stark and Fowles, 2009).

The 11 unit difference in MCI scores between sites 1 ('control') and site 4 over a river distance of 4.3km represented an insignificant 8 unit larger difference than predicted for this reach of the Patea River some 13 to 17 km below the National Park boundary (Stark and Fowles, 2009), but the 10 units difference between sites (2 and 3a) adjacent to the discharge was indicative of some recent impacts of the WWTP point source discharge under summer, low flow conditions.

Riverbed heterotrophic growth assessment

Microscopic assessment of material from the riverbed at the four sampling sites indicated that there were no unusual heterotrophic growths present in the river at the two upstream and two downstream sites during a period of summer low recession flow conditions. This was consistent with the visual absence of such growths noted at all sites at the time of the survey. Also there was no increase in algal deposition at the site downstream of the new relocated outfall and benthic algal substrate cover was mainly patchy over most of the reach surveyed.

Conclusions

Typical macroinvertebrate communities' richnesses were surveyed at the four Patea River sites during a low flow recession period in the latter part of summer and under conditions of patchy to widespread mats of periphyton river substrate cover and patchy filamentous algae. This summer survey was performed as a component of the scheduled monitoring programme in relation to the assessment of compliance of the relatively recently upgraded WWTP with consent conditions. Minor discolouration of the river's reach below the WWTP's newly located discharge was apparent and there was no algal deposition on the river bed, as a result of the lower algal concentration in the upgraded partitioned second oxidation pond cells. Faunal communities upstream of the WWTP discharge had higher percentages of 'sensitive' taxa whereas communities at downstream sites had slightly increased percentages of 'tolerant' taxa. However, there were subtle differences in dominant (characteristic) taxa between these

four sites' communities with a tendency toward proportionately slightly more 'tolerant' dominant taxa in a downstream direction.

MCI scores were similar to scores generally typical of mid-catchment ringplain rivers in Taranaki, particularly those found during summer low flow conditions and showed a moderate range (16 units) along the four sites through the 4.5 km reach of the Patea River. No impacts of seepage from the Stratford landfill (situated between sites 1 and 2) were indicated by the faunal composition at these sites. An increase in number of 'tolerant' taxa, together with slightly fewer 'sensitive' taxa downstream of the WWTP's recently relocated discharge, resulted in lower MCI scores at these sites, which were insignificant over the distance of the furthest site downstream but more significant in the immediate vicinity of the discharge before some recovery further downstream. There were several significant changes in individual taxon abundances but fewer amongst dominant taxa as reflected in a reduction in $SQMCI_s$ value between sites 2 and 3a of 3.5 units and sites 2 and 4 of 2.6 units. These lower $SQMCI_s$ scores at sites 3a and 4 (up to 2.4 km downstream of the wastewater discharge) reflected lower abundances in certain 'highly sensitive' taxa and increased numbers of 'tolerant' oligochaete worms and midges in particular.

No 'undesirable heterotrophic growths were found on the substrate of the river at the sites surveyed downstream of the discharge under these summer low recession flow conditions and there was no apparent deposition of oxidation ponds' algae on the river bed.

Effects of discharges on the macroinvertebrate communities of the Patea River vary in relation to the treatment provided by the WWTP, dilution available in the receiving waters, preceding climatic conditions and the microfloral component of the wastewaters. Such variations in effects have been documented by previous summer biomonitoring surveys with this summer survey illustrating some effects (bordering on significant at the boundary of the mixing zone), during a low recession flow period, below the discharge from the relocated rock riprap outfall following the WWTP upgrade.

Summary

The Council's standard 'kick-sampling' technique was used at four established sites to collect streambed macroinvertebrates from the Patea River. Samples were sorted and identified and the number of taxa (richness), MCI score and $SQMCI_S$ score were calculated 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.

This scheduled summer, 2014 macroinvertebrate survey (which has complemented previous additional assessments of the upgraded system performance) indicated that the discharge of treated oxidation ponds wastes from the upgraded Stratford WWTP system had had localised effects on the macroinvertebrate communities of the Patea River under summer low river flow conditions prior to recovery at the site 2.4 km downstream of the discharge. Some subtle changes in macroinvertebrate communities' compositions were recorded between the upstream 'control' site and sites downstream of the newly relocated outfall from the WWTP

but no major changes in community structures. However, there were no significant effects associated with seepages from the closed landfill site.

The macroinvertebrate communities of the Patea River contained slightly higher proportions of 'sensitive' taxa at the two upstream sites. 'Tolerant' taxa were more predominant proportionately at the two sites downstream of the relocated WWTP discharge. Dominant taxa composition was relatively similar at all four sites although proportionately tending toward more 'moderately sensitive' and 'tolerant' taxa in a downstream direction, through the surveyed reach of the river, however. Taxonomic richnesses (numbers of taxa) varied by 7 taxa at the four sites in this summer survey and were slightly lower at all but one of these sites than those found by the previous summer (2013) survey. However, similar proportions of 'tolerant' taxa were present at sites downstream of the WWTP discharge compared to the previous summer survey under slightly more widespread periphyton cover of the river bed at the time of this latest survey.

MCI and $SQMCI_S$ scores indicated that the upstream stream communities were of 'good' health (TRC, 2014) and typical of conditions recorded in summer in the mid reaches of similar Taranaki ringplain rivers. Stream communities downstream of the WWTP discharges were of 'fair' to 'good' generic health and were similar to those documented in this reach by most previous surveys during summer recession low flow conditions.

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