New Plymouth District Council
Inglewood, Okato,
and Marfell Park Landfills
Monitoring Programme
Annual Report
2016-2017

Technical Report 2017-77

ISSN: 1178-1467 (Online)
Document: 1864229 (Word)
Document: 1913165 (Pdf)

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October 2017

Executive summary

The New Plymouth District Council (NPDC) maintains two reinstated landfills, one at Inglewood and one at Okato. Both landfills have been used in the past, and are now used as transfer stations but are also held in reserve to accept refuse, if required, as a contingency. The Inglewood landfill is located on King Road at Inglewood, in the Waiongana catchment, and the Okato landfill is located on Hampton Road at Okato, in the Kaihihi catchment.

NPDC also maintains a closed landfill, Marfell Park (Marfell) landfill in the Huatoki catchment. This landfill does not accept any waste for disposal and has been fully reinstated.

This report for the period July 2016 to June 2017 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess NPDC's environmental and consent compliance performance during the period under review. The report also details the results of the monitoring undertaken and assesses the environmental effects of NPDC's activities in regard to these closed landfills.

NPDC holds seven resource consents, which include a total of 59 conditions setting out the requirements that they must satisfy. NPDC holds three consents to discharge leachate and stormwater into various streams, two consents to discharge contaminants onto and into land, and two consents to discharge emissions into the air.

During the monitoring period, NPDC demonstrated an overall high level of environmental performance.

The Council's monitoring programme for the year under review included seven inspections, three discharge samples, 13 receiving water samples, two biomonitoring surveys of receiving waters, and one ambient air quality analysis. The biennial monitoring scheduled for the Marfell landfill site was implemented during the year under review.

During the monitoring year there were no incidents logged by Council associated with NPDC's landfills covered in this report.

Overall during the year, NPDC demonstrated a good level of environmental performance and a high level of administrative performance in relation to the Inglewood landfill consents as defined in Section 1.1.5. Although no significant environmental effects were found due to the operation of the site, the trend of increasing concentrations of nitrogen compounds in the landfill tributary and the main tributary indicate that there may be the potential for environmental effects to emerge in the future.

During the year, NPDC demonstrated an overall high level of environmental performance and a high level of administrative performance with their Marfell landfill resource consent as defined in Section 1.1.5.

During the year, NPDC demonstrated a high level of environmental performance and a high level of administrative performance in relation to the Okato landfill resource consents as defined in Section 1.1.5.

For reference, in the 2016-2017 year, 74% 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 21% demonstrated a good level of environmental performance and compliance with their consents.

In terms of overall environmental and compliance performance by the consent holder over the last several years, this report shows that the consent holder's performance remains at a good or high level in the year under review.

This report includes recommendations for the 2017-2018 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 for the period July 2016 to June 2017 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by New Plymouth District Council (NPDC) for closed landfill's in the district.

NPDC holds a consent to discharge leachate and contaminated stormwater from its closed landfill, Marfell Park (Marfell) landfill in the Huatoki catchment. This landfill does not accept waste for disposal to land and has been fully reinstated.

NPDC also hold consents to discharge solids to land, emissions to air, and leachate and contaminated stormwater to land and water, at two contingency landfills that currently operate as transfer stations. These are Inglewood landfill in the Waiongana catchment, and Okato landfill in the Kaihihi catchment. These landfills are non-operational and are fully reinstated. They do, however, retain all necessary consents to act as contingency sites if the regional landfill at Colson Road has to cease accepting waste, or there are transportation issues in the event of an emergency.

The Colson Road regional landfill remains operational. The monitoring of this facility has been reported separately since the annual report covering the 1999-2000 monitoring period

The report includes the results and findings of the monitoring programme implemented by the Council in respect of of the consents held by NPDC that relate to the discharges of leachate and stormwater within these catchments and discharges of contaminants onto and into land and emissions to air for the Inglewood and Okato sites.

One of the intents of the *Resource Management Act 1991* (RMA) is that environmental management should be integrated across all media, so that a consent holder's use of water, air, and land should be considered from a single comprehensive environmental perspective. Accordingly, the Council generally implements integrated environmental monitoring programmes and reports the results of the programmes jointly. This report discusses the environmental effects of NPDC's use of water, land and air, and is the 27th combined annual report by the Council for 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:

- consent compliance monitoring under the RMA and the Council's obligations;
- the Council's approach to monitoring sites though annual programmes;
- a summary of the resource consents held by NPDC for landfills in the Huatoki, Waiongana, and Kaihihi catchments;
- the nature of the monitoring programme in place for the period under review; and
- a summary of the status of these three landfill sites

Each of the closed/contingency landfills is then discussed in a separate section (Sections 2 to 4).

Sub-section 1(for example Section 2.1) presents:

- a general description of the landfilled site and its discharges;

- an aerial photograph or map showing the location of the former landfill; and
- an outline of the matters covered by NPDC's permit(s) for the site

Sub-section 2 presents the results of monitoring of the NPDC's activities at each of the sites during the period under review, including scientific and technical data.

Sub-section 3 discusses the results, their interpretation, and their significance for the environment.

Sub-section 4 presents recommendations to be implemented in the 2017-2018 monitoring year.

Section 5 contains a summary of recommendations for the 2017-2018 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 RMA primarily addresses environmental 'effects' which are defined as positive or adverse, temporary or permanent, past, present or future, or cumulative. Effects may arise in relation to:

a. the neighbourhood or the wider community around an activity, and may include cultural and social-economic effects;

b. physical effects on the locality, including landscape, amenity and visual effects;

c. ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;

d. natural and physical resources having special significance (for example recreational, cultural, or aesthetic); and

e. risks to the neighbourhood or environment.

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

1.1.4. Investigations, interventions, and incidents

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

The Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The incident register includes events where the individual or organisation 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).

1.1.5. Evaluation of environmental and administrative performance

Besides discussing the various details of the performance and extent of compliance by the NPDC, this report also assigns them a rating for their environmental and administrative performance during the period under review.

Environmental performance is concerned with actual or likely effects on the receiving environment from the activities during the monitoring year. Administrative performance is concerned with NPDC's approach to demonstrating consent compliance in site operations and management including the timely provision of information to Council (such as contingency plans and water take data) in accordance with consent conditions.

Events that were beyond the control of the consent holder and unforeseeable (that is a defence under the provisions of the RMA can be established) may be excluded with regard to the performance rating applied. For example loss of data due to a flood destroying deployed field equipment.

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

Environmental Performance

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

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

For example:

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

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

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

Administrative performance

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

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

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

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

For reference, in the 2016-2017 year, 74% 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 21% demonstrated a good level of environmental performance and compliance with their consents.

1.2. Summary of resource consents

NPDC holds a total of seven consents in relation to its closed and contingency landfills. The consents held for each of the closed and contingency landfills are summarised in the following paragraphs and in Table 1, with further detail on the consents held for each landfill site provided in each subsection 1. The summary of consent condition included in each sub-section 1 may not reflect the full requirements of each condition. The consent conditions in full can be found in the resource consents, which are appended to this report (Appendix I).

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.

There are consents held by NPDC for each of the sites to allow for the discharge of leachate and stormwater.

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.

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.

There are consents held by NPDC for the Inglewood and Okato contingency landfills to allow for the discharge of contaminants to air that cover both potential discharges from historical landfilling activities, and discharges to air that may occur should the landfills be used in the event of an emergency. The consent held for the Inglewood landfill also permits the discharge of cleanfill to land at the site and this aspect of the consent is routinely exercised. The consent held for Okato also permits the discharge of cleanfill and green waste and this aspect of the consent is routinely exercised.

Table 1 Summary of consents held by NPDC

Site	Consent No.	Purpose	Review opportunities	Expires
Inglewood	3954-2	To discharge up to a total of 4,752 m3/day (55 litres/second) of leachate and stormwater from the Inglewood municipal landfill into an unnamed tributary of the Awai Stream, a tributary of the Mangaoraka Stream in the Waiongana catchment	-	1 June 2020
	4526-3	To discharge contaminants, being landfill gas, and odours associated with a landfill, into the air from the Inglewood municipal landfill	June 2020	1 June 2026
	4527-3	To discharge cleanfill and inert materials onto and into land at the Inglewood municipal landfill, and to discharge municipal refuse onto and into land at the Inglewood municipal landfill when, and only when, it cannot be discharged at the Colson Road municipal landfill	June 2020	1 June 2026
Okato	3860-3	To discharge stormwater and leachate from the Okato municipal landfill into an unnamed tributary of the Kaihihi Stream	June 2019 June 2025	1 June 2031
	4528-3	To discharge emissions into the air from the contingency discharge of solid contaminants at the Okato municipal landfill	June 2019 June 2025	1 June 2031
	4529-3	To discharge cleanfill and green waste to land and to discharge general refuse on a contingency basis to land	June 2019 June 2025	1 June 2031
Marfell	4902-2	To discharge leachate from the Marfell former landfill site via groundwater into the Mangaotuku Stream	June 2020 June 2026	1 June 2032

1.3. Monitoring programme

1.3.1. Introduction

Section 35 of the RMA sets obligations upon the Council to gather information, monitor and conduct research on the exercise of resource consents within the Taranaki region. The Council is also required to assess the effects arising from the exercising of these consents and report upon them.

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 programmes for the NPDC landfill sites consisted of four primary components as outlined below. The Inglewood and Okato landfills, where cleanfill and/or green waste is still being discharged are monitored annually. The closed Marfell site is monitored biennially and was monitored as scheduled in the 2016-2017 year.

1.3.2. 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 consent reviews, renewals or new consent applications;
- advice on the Council's environmental management strategies and content of regional plans; and
- consultation on associated matters.

1.3.3. Site inspections

A total of seven inspections were carried out across all the sites. With regard to consents for the discharge to water, inspections focused on site processes with potential or actual discharges to receiving watercourses, including contaminated stormwater. The potential for emissions to air is also considered at the time of inspection.

1.3.4. Chemical sampling

The Council took 16 discharge and receiving water and three discharge samples for physicochemical analysis during the monitoring year across all of the NPDC landfill sites covered in this report.

Ambient air quality monitoring was also carried out at the Inglewood landfill during inspection on one occasion.

1.3.5. Biomonitoring surveys

A biological survey was performed on two occasions at the Inglewood landfill in two unnamed tributaries of the Awai Stream.

Table 2 Summary of monitoring activities carried out at the NPDC landfills during the monitoring period

Landfill	Number of discharge samples	Number of receiving water samples	Number of inspections	Biomonitoring surveys	Ambient air surveys
Inglewood	2	8	4	2	1
Marfell	1	2	1	0	0
Okato	0	3	2	0	0
TOTAL	**3**	**13**	**7**	**2**	**1**

2. Inglewood landfill

2.1. Introduction

2.1.1. Site description

The Inglewood landfill opened in 1978 and operated as a municipal landfill for about 24 years.

The site had been constructed in the head of a gully in the Awai Stream catchment. As the gully was filled with refuse, cover material was progressively excavated from the side walls ahead of the fill. The underlying soil, cover and capping material at the site is clay (Taranaki Ash).

Solid waste from the Inglewood kerbside collection was disposed of at Colson Road from about 1999 and the Inglewood landfill was closed to general waste acceptance on 1 September 2006. During the period January 2005 to March 2006 solid waste from the Stratford District kerbside collection was disposed of at this site, and for three months from July 2005 to October 2005 solid waste normally disposed of at Colson Road, was disposed of here whilst remedial work was undertaken at Colson Road.

The site has continued to be used as a waste transfer station. Refuse is placed in bins for removal and disposal at the Colson Road landfill. The disposal of cleanfill is still permitted at the site, and the site has been identified as a contingency landfill in the event that refuse can not be disposed of at Colson Road.

In total approximately 1.78 ha of the site has been used for landfilling. As required by the conditions of the consent, NPDC maintains a Landfill Closure Management Plan for the site that addresses monitoring and management of the site. NPDC staff also undertakes regular inspections at the site, and the plan states that if any issues are identified they will be remediated appropriately.

The Inglewood Landfill Closure Plan states that it is suspected that when this landfill was originally developed there were no standard specifications for the siting and operation of landfills. As a result the site is not lined, nor does it have landfill gas or leachate collection systems in place.

Figure 1 shows the approximate extent of the fill and the general layout of the Inglewood landfill site. The discharge and receiving water monitoring site locations are shown in Figure 2.

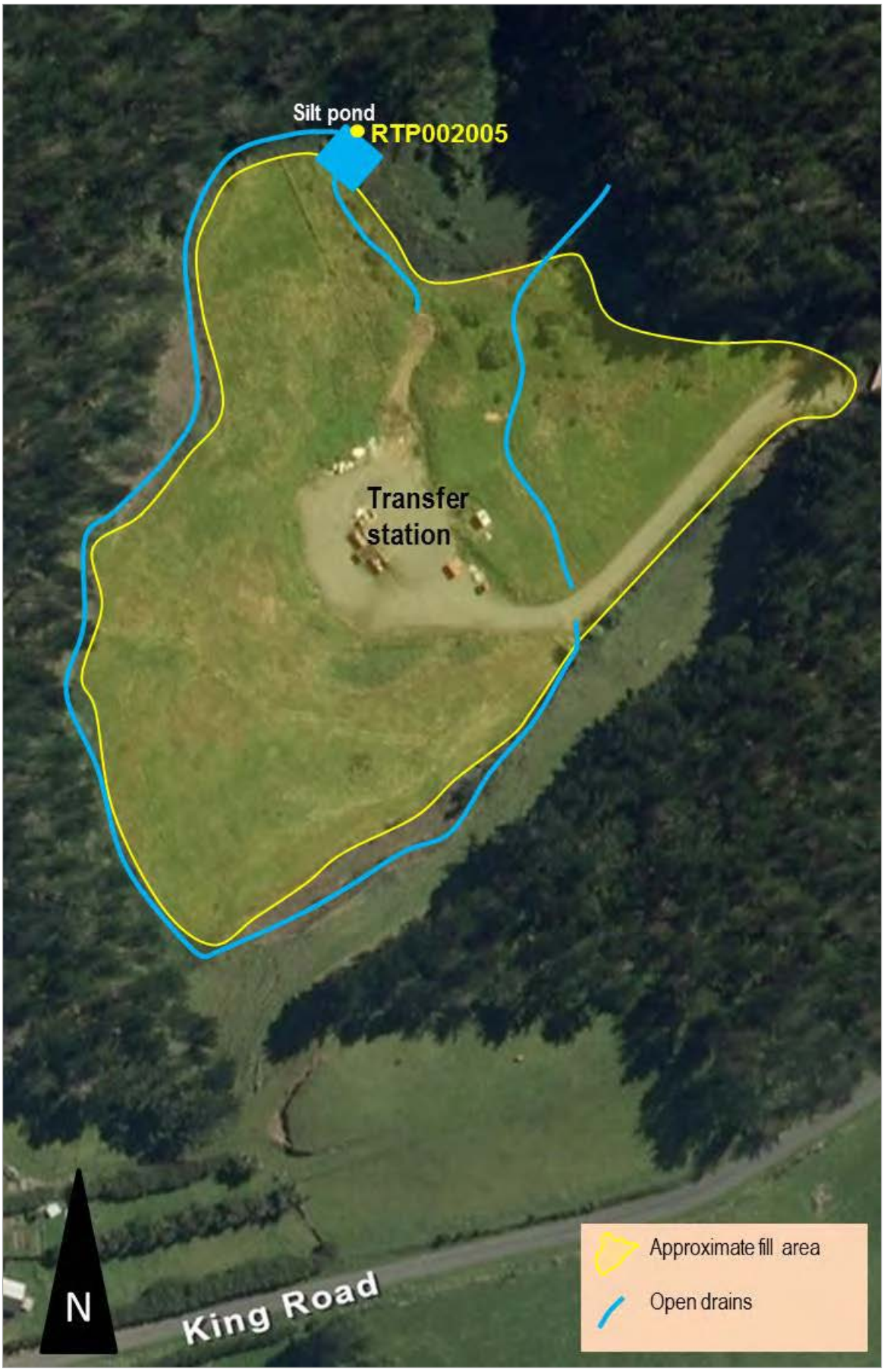

Figure 1 Site layout at Inglewood contingency landfill

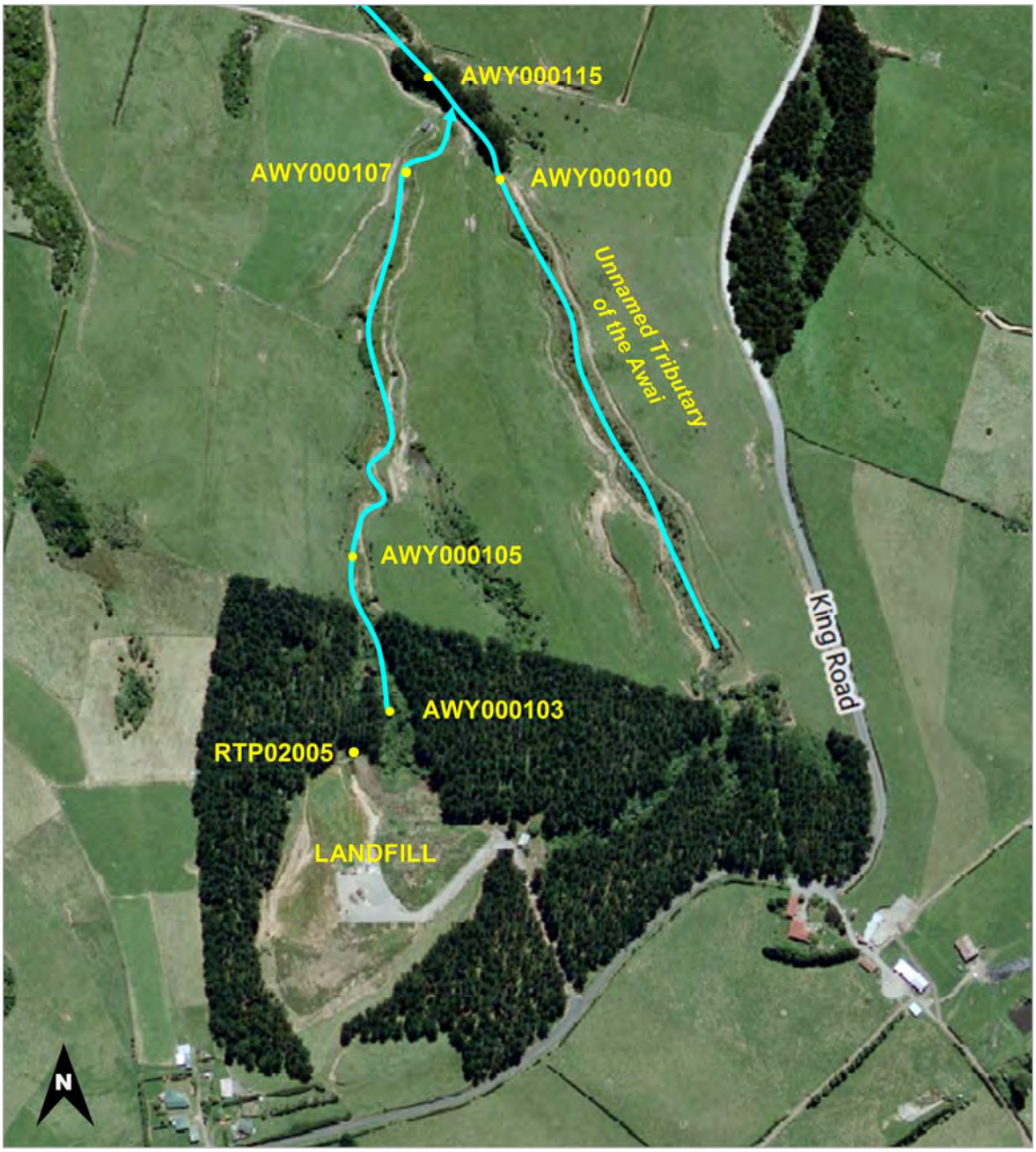

Figure 2 Inglewood landfill and receiving water sampling sites

2.1.2. Resource consents

2.1.2.1. Water abstraction permit

NPDC holds water discharge permit **3954-2** to cover the discharge of up to a total of 4,752 m^3/day or 55 L/s of leachate and stormwater from the Inglewood municipal landfill to an unnamed tributary of the Awai Stream, a tributary of the Mangaoraka Stream, in the Waiongana catchment. This permit was issued by the Council on 18 February 2002 under Section 87(e) of the RMA. It is due to expire on 1 June 2020.

It has eight conditions:

Condition 1 requires that a site contingency plan be prepared, maintained and adhered to.

Condition 2 requires the consent holder to prepare a landfill operations and management plan.

Condition 3 states that the consent holder shall prepare a landfill closure management plan by 1 June 2007 or three months prior to the closure of the landfill.

Condition 4 allows for changes to management plans relating to the landfill.

Conditions 5, 6 and 7 relate to monitoring of water associated with the site, leachate and stormwater collection and discharge, and discharge effects on aquatic life or receiving water quality respectively.

Condition 8 allows for the review, amendment, deletion or addition to the conditions of the resource consent.

A copy of this consent is included in Appendix I of this report.

This summary of consent conditions may not reflect the full requirements of each condition. The consent conditions in full can be found in the resource consent(s) which is/are appended to this report.

2.1.2.2. Air discharge permit

The NPDC holds air discharge consent **4526-3** to discharge emissions into the air from the Inglewood municipal landfill site. This permit was issued by the Council on 20 March 2007 under Section 87(e) of the RMA. It is due to expire on 1 June 2026. It has four conditions:

Conditions 1 and 2 require the submission of a contingency plan and management plan.

Condition 3 requires that NPDC notifies the Council of any changes to its operations at the site.

Condition 4 is a review condition.

A copy of this consent is included in Appendix I of this report.

This summary of consent conditions may not reflect the full requirements of each condition. The consent conditions in full can be found in the resource consent(s) which is/are appended to this report.

2.1.2.3. Discharge of wastes to land

NPDC holds water discharge permit **4527-3** to discharge cleanfill and inert materials onto and into land at the Inglewood municipal landfill and to discharge municipal refuse onto and into land when, and only when, it cannot be discharged at the Colson Road municipal landfill. The consent expires on 1 June 2026. It has 12 conditions:

Condition 1 requires that the consent holder adopts the best practicable option.

Conditions 2, 3, 4 and 5 stipulate the requirements regarding the adherence to the information supplied in the consent applications and the landfill management plan and the maintenance of the management plan.

Condition 6 stipulates the maximum water content of sludges to be disposed.

Conditions 7 and 8 define the term “cleanfill”.

Condition 9 stipulates that discharge to land shall not result in any contaminants entering surface water.

Conditions 10 and 11 require that stormwater and leachate systems are maintained.

Condition 12 is a lapse condition.

A copy of this consent is included in Appendix I of this report.

This summary of consent conditions may not reflect the full requirements of each condition. The consent conditions in full can be found in the resource consents, which are appended to this report.

2.2. Results

2.2.1. Site inspections

13 October 2016

The site was inspected in fine weather with light easterly wind conditions.

The cap was well grassed with no ponding, cracking or exposed refuse noted. Heavy rain the previous day had left the cap damp underfoot. It was observed that the remediated crack area was re-grassing well and was nearly indistinguishable from the surrounding area. The batters were well vegetated with no cracking or slumping evident. No damage was noted from rabbits or grazing stock.

The stormwater drains were tidy and generally free draining, although there was a minor amount of ponded water in the eastern drains. Blackberry and other vegetation that had the potential to obstruct the flow appeared to have been sprayed recently. The leachate drains were discharging at a very low (trickle) flow. The discharge was relatively clear with some iron oxide sheen present. The leachate collection pond was a turbid light brown colour and was full. It was discharging at approximately 1 L/s. No downstream effects were noted in the receiving water as a result of the discharge.

The transfer station was tidy and well-maintained. A contractor was on site managing customers at the time of inspection.

No unauthorised cleanfill or green waste material was found on site. There was no cleanfill stockpiled, and there did not appear to be any fresh material in the small pile of green waste that was present on site.

The fencing was permanent and in good condition. The road signage was visible and the pile of green waste dumped at the gate during the previous monitoring period had now been removed.

No odour or dust issues were noted either on or off the site. A methane survey was carried out across the site and around the perimeter using the MultiRAE gas detector. No methane or hydrogen sulphide was detected either on or off site.

1 December 2016

The site was inspected in fine, calm weather conditions. The cap was found to be well-grassed and intact. The ground was dewy underfoot, with no sign of ponding following the recent wet weather. The batters were intact and well vegetated. No slumping, cracking or exposed refuse were noted on either the cap or the batters. There was no sign of stock damage.

The stormwater drains were grassed and free draining. The gorse and other vegetation that had been partially obstructing the southernmost drain at the previous inspection had been sprayed. The leachate collection system was well-contained and tidy, although the leachate drains contained a minor amount of ponded water following the recent wet weather. The leachate pond was a turbid, light brown colour. The pond level was high, and it was discharging at an estimated rate of 0.2 L/s.

The transfer station was open at the time of inspection, with three customers and one operator on site. The area was tidy and well maintained. It was observed that the operator continued to be proactive in his approach to site maintenance, and NPDC was informed that this was appreciated.

No unauthorised cleanfill or green waste material was found at the site at the time of the inspection.

The fencing around the site was permanent and intact. The site was well secured and signage was visible and well maintained. No stock were grazing the site at the time of inspection, and it was noted that the weed spraying appeared to have been undertaken recently. No odour or dust issues were noted.

Samples were collected from the leachate pond and downstream receiving water sites. There were no visible effects noted downstream of the landfill discharge.

15 February 2017

The site was inspected in fine weather with calm wind conditions.

The cap was again found to be intact and well-vegetated. No evidence of cracking, slumping, or exposed refuse was observed on either the cap or the batters, which were both tidy and grassed. There was no sign of rabbit or stock damage.

The stormwater drains were clear, well vegetated and dry. There were no signs of recent discharges despite the wet weather the previous day.

The leachate drains were clear, with some ponded water contained in the northernmost drain, although this was not discharging to the leachate pond. The pond itself was nearly full, with approximately 0.4 m of freeboard available. It was not discharging to the stream at the time of inspection. The discharge channel was clear and free draining. Samples of the turbid, light brown leachate contained in the pond were collected during the inspection, along with receiving water samples. No visible effects were noted downstream of the discharge point.

The transfer station was not open at the time of inspection and it was found to be in a tidy condition. No recent disposals of cleanfill or green waste were apparent at the site, and no unauthorised material was noted. NPDC were informed that the on going housekeeping and weed/gorse spraying was working well.

The site was secure and well fenced. There were no sheep grazing the site at the time of inspection. No odour or dust issues were noted.

2 May 2017

The site was inspected in fine weather and calm wind conditions after a period of heavy rain.

It was found that the cap had a thick grass cover and there was no evidence of cracking or subsidence. No issues were noted in regards to exposed refuse, odour or ponding.

The stormwater and leachate drains were relatively clear, although well-vegetated. There was a discharge occurring from the site to the unnamed tributary of the Awai Stream at the time of inspection.

The site was secure and well-fenced, with no stock grazing at the site at the time of inspection. The transfer station was closed and found to be clean and tidy.

It was noted that access to monitoring site AWY000103 was overgrown and was considered to require maintenance prior to the next inspection.

The following action was to be taken

Clear overgrown vegetation from the access to monitoring site AWY000103 prior to the next inspection.

2.2.2. Results of stormwater/leachate monitoring

Two samples were taken from the stormwater/leachate pond during the monitoring period. The results are presented in Table 3 together with a summary of the historical data..

It has previously been found that the pond only discharges directly into the landfill tributary after heavy rain, as accumulated water in the pond tends to be lost to evaporation and seepage. This means that there is usually a significant amount of freeboard present at any given time.

During the year under review the pond was found to be discharging at the time of inspection on 1 December 2016, but not on 15 February 2017 and therefore on this occasion the leachate/stormwater sample was collected from the pond immediately upstream of the pond outlet.

Table 3 Chemical analysis of samples taken from the Inglewood landfill leachate/stormwater pond (site RTP002005)

Parameter	Unit	01 Dec 2016	15 Feb 2017[a]	Minimum	Maximum	Median	Number
Ammoniacal nitrogen	g/m³ N	8.07	11.0	0.01	73.3	5.36	26
Biochemical oxygen demand	g/m³	0.9	2.6	0.6	850	2.6	25
Conductivity @ 20'C	mS/m@20C	43.8	48.3	13.3	208	38.8	26
Nitrate/nitrite nitrogen	g/m³ N	1.89	0.88	-	-	-	2
pH	pH	7.1	7.0	6.7	8.5	7.3	26
Temperature	Deg.C	18.3	18.0	4.8	18.3	13.0	25
Total nitrogen	g/m³ N	11.3	12.1	-	-	-	2
Turbidity	NTU	6.5	27	1.5	58	3.5	10
Un-ionised ammonia	g/m³	0.0427	0.04525	0.00005	0.04525	0.00163	15
Zinc Dissolved	g/m³	0.012	<0.005	0.005	0.63	0.008	26

Key : a sampled from the pond as no discharge was occurring

As with the autumn samples collected after heavy rainfall in the 2013-2014 and 2014-2015 years, the ammoniacal nitrogen concentrations of the samples collected during the year under review were again elevated when compared the 2009-2012 and 2015-2016 results (Figure 3).

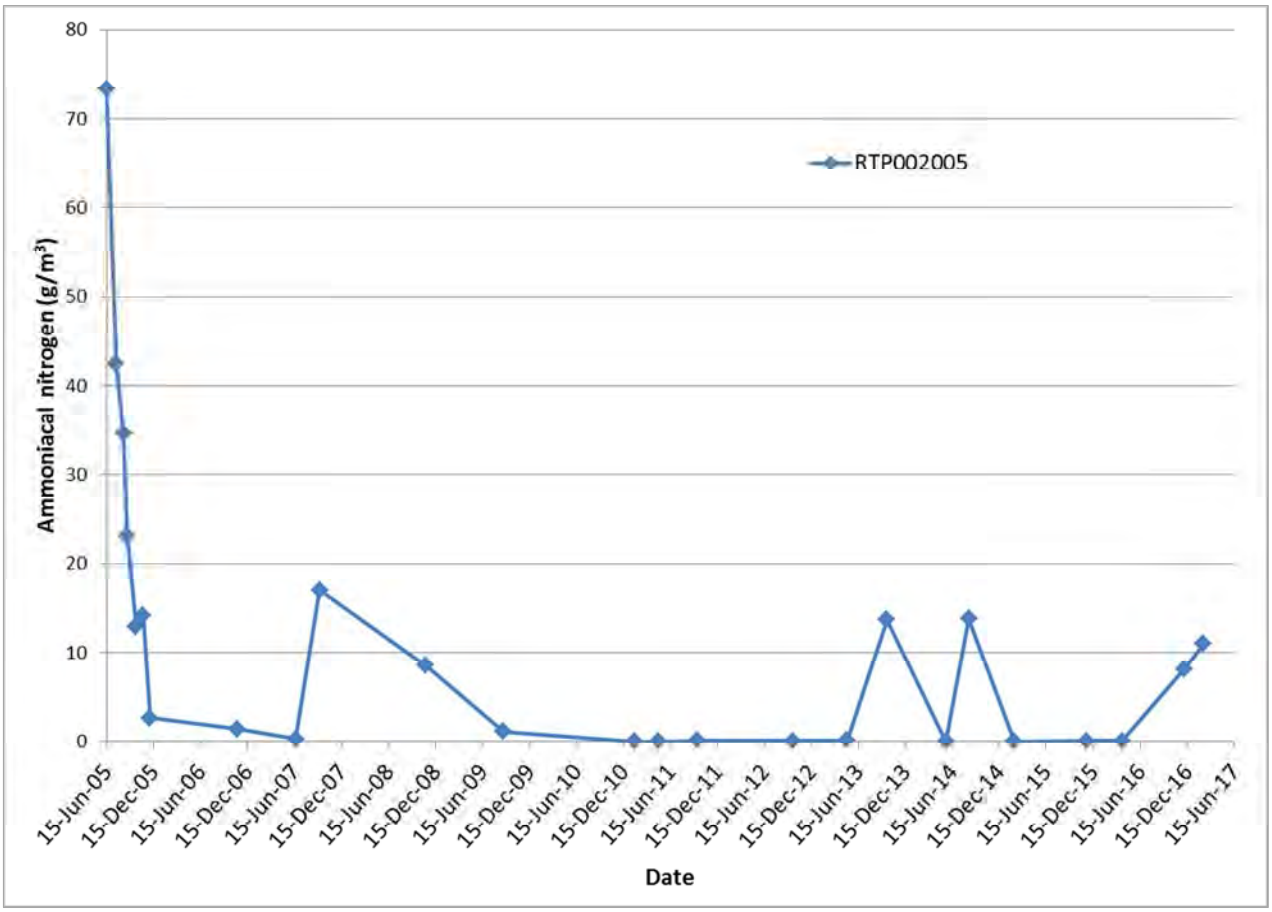

Figure 3 Ammoniacal nitrogen concentration of the Inglewood landfill stormwater/leachate (RTP002005) for monitoring to date

The higher values obtained may have been the result of one or more of a number of factors including: the surrounding area and the drain being cleared of vegetation, the dying sprayed vegetation in the stormwater drains, recent grazing, and/or additional stormwater infiltration causing increased leachate generation. Increased leachate generation is considered to be an unlikely cause as the cap was remediated during the 2014-2015 year, and was found to be intact and well vegetated during the year under review.

The receiving water results d are discussed in Section 2.2.3 and indicate that, due to the relative flow rates and results, this low flow discharge (estimated at 0.2 L/s on 1 December 2016 and not discharging on 14 February 2017) is unlikely to be responsible for the elevated ammoniacal nitrogen concentrations found in the landfill tributary immediately below the culvert outlet (site AWT000103).

At this stage there are no significant adverse effects being found in the receiving waters, however nitrate/nitrite nitrogen and total nitrogen analyses have been added to the suite of parameters determined. This has been done to aid with the interpretation of results and identifying any trends that may emerge.

2.2.3. Results surface water sampling

2.2.3.1. Chemical analysis

Receiving water sampling was undertaken at sites AWY00100, AWY100115, AWY000103 and AWY000115 on two occasions (1 December 2016 and 15 February 2017). The locations of these monitoring sites are shown in Figure 2 and the results of the chemical analysis of the samples are presented in Table 4 and Table 5.

Table 4 Chemical analysis of the Awai Stream tributaries sites on 1 December 2016

Parameter	Unit	AWY000103	AWY000105	AWY000100	AWY000115
		30 m d/s of landfill (culvert discharge)	130m d/s of landfill	u/s of confluence of landfill trib	d/s of confluence of landfill trib
Alkalinity	g/m^3 $CaCO_3$	264	64	19	36
BOD	g/m^3	33	4.1	<0.5	1.0
Conductivity	mS/m	54.7	24.2	9.2	14.8
Dissolved oxygen	g/m^3	6.58	5.15	8.74	8.42
Dissolved reactive phosphorus	g/m^3-P	<0.003	<0.003	<0.003	<0.003
Acid soluble iron	g/m^3	55.5	0.22	0.38	0.21
Total mercury	g/m^3	-	<0.0001	-	-
Acid soluble manganese	g/m^3	8.45	0.18	0.04	0.04
Unionised ammonia	g/m^3-N	0.05742	0.00212	0.00003	0.00005
Ammoniacal nitrogen	g/m^3-N	18.5	0.362	0.010	0.009
Nitrate/nitrite nitrogen	g/m^3-N	0.38	6.83	0.49	3.12
pH	pH	7.0	7.2	6.9	7.2
Temperature	Deg C	14.2	16.6	15.7	16.2
Total nitrogen	g/m^3-N	21.4	7.72	0.88	3.54
Turbidity	NTU	520	0.54	2.6	1.1
Dissolved zinc	g/m^3	<0.005	<0.005	<0.005	<0.005

Table 5 Chemical analysis of the Awai Stream tributaries sites on 15 February 2017

Parameter	Unit	AWY000103	AWY000105	AWY000100	AWY000115
		30 m d/s of landfill (culvert discharge)	130m d/s of landfill	u/s of confluence of landfill trib	d/s of confluence of landfill trib
Alkalinity	g/m^3 $CaCO_3$	293	68	22	43
BOD	g/m^3	1.3	3.6	<0.5	0.5
Conductivity	mS/m	62.7	26.0	9.3	16.8
Dissolved oxygen	g/m^3	7.0	5.73	8.04	8.48
Dissolved reactive phosphorus	g/m^3-P	0.009	0.016	0.008	0.055
Acid soluble iron	g/m^3	22.3	0.22	0.52	0.18
Total mercury	g/m^3	-	<0.0001	-	-
Acid soluble manganese	g/m^3	7.31	0.11	0.05	0.05
Unionised ammonia	g/m^3-N	0.11342	0.0005	0.00002	<0.00001
Ammoniacal nitrogen	g/m^3-N	25.8	0.089	0.007	<0.003
Nitrate/nitrite nitrogen	g/m^3-N	0.80	7.78	0.50	3.53
pH	pH	7.1	7.2	6.9	7.2
Temperature	Deg C	15.8	16.0	15.3	15.6
Total nitrogen	g/m^3-N	25.4	7.79	0.55	3.68
Turbidity	NTU	300	2.1	2.4	1.5
Dissolved zinc	g/m^3	<0.005	<0.005	<0.005	<0.005

As with previous results, the discharge from the culvert below the landfill exhibits leachate contamination as indicated by the high levels of conductivity, alkalinity, iron, manganese, ammoniacal nitrogen and ammonia.

The biochemical oxygen demand of the sample collected at AWY000103 collected on 1 December 2016 (33 g/m^3) was a new maximum for this monitoring site. On this occasion the biochemical oxygen demand of the stormwater/leachate sample had a biochemical oxygen demand of only 0.9 g/m^3, indicating that shallow stormwater/leachate was not responsible for this increase.

With the exception of nitrate/nitrite nitrogen, the levels of contaminants found 130 m downstream of the discharge (at site AWY000105) are far lower, indicating that the intervening wetland is being effective at reducing contaminant levels. The higher nitrate/nitrite nitrogen at site AMY000105 when compared to AMY000103 is due to the oxidation of the ammoniacal nitrogen in the landfill tributary. However, it is noted that although the nitrate/nitrite nitrogen concentration had increased, the total nitrogen in the waterbody had decreased to one third of the upstream value at the time of both surveys during the year under review.

Figure 4 shows the ammoniacal nitrogen results for the stormwater/leachate pond (RTP002005) and the landfill tributary below the culvert outlet (AWY000103). During the year under review the concentration was much lower in the pond than in this tributary. This has been a consistent finding since September 2005, and continues to indicate that ammoniacal nitrogen is entering the landfill tributary via another route, potentially via shallow groundwater.

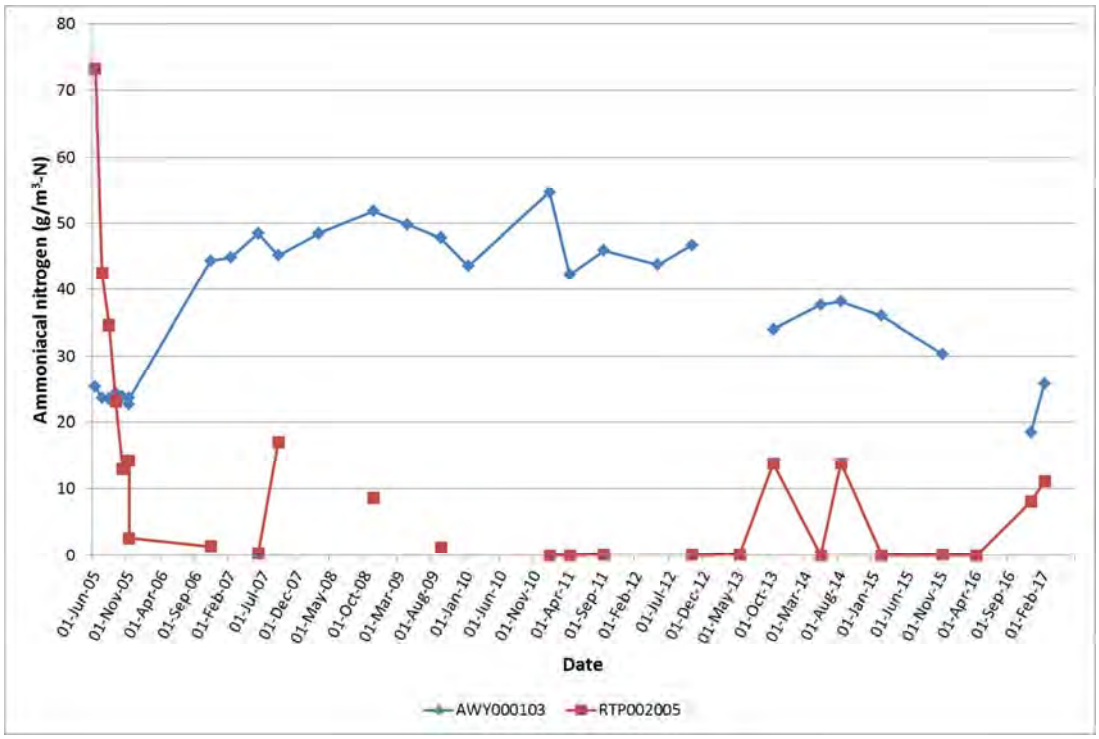

Figure 4 Ammoniacal nitrogen concentration between the Inglewood landfill stormwater/leachate (RTP002005) and the tributary below the culvert outlet (AWY000103)

It is also noted that the unionised ammoniacal nitrogen concentration has been consistently above the 0.025 g/m^3 guideline adopted by the Council to protect aquatic organisms from chronic effects at the culvert outlet. From a review of the historical results, it appears that there has been an emerging trend of increasing levels of this contaminant at this site. It is however noted that, for the most part, this is generally assimilated in the wetland area, and the concentrations found at the lower end of the landfill tributary are normally well below this guideline value (Figure 5).

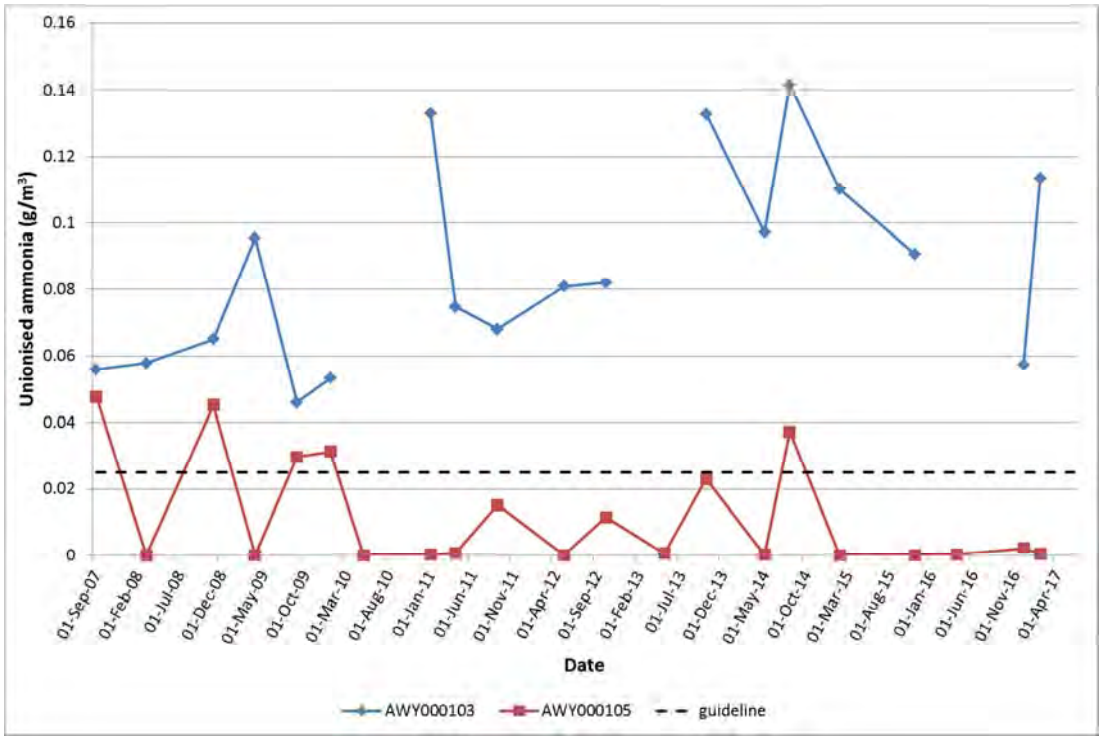

Figure 5 Unionised ammonia concentration in the landfill tributary below Inglewood landfill

The concentration range above which acute toxic effects may be seen for New Zealand native fish, for example a fish kill, is 0.75 to 2.35 g/m^3, and the levels of unionised ammonia found at all monitoring sites during the year under review were well below this concentration range. Although the unionised ammonia concentration was found to be above the 0.025 g/m^3 guideline at the lower end of the tributary on occasion, this has not happened in recent years.

Figure 6 shows that there has generally been little, if any, effect found on the unionised ammonia concentration of the larger (main) tributary (site AWY000115). Any changes that have been found have not been of environmental significance.

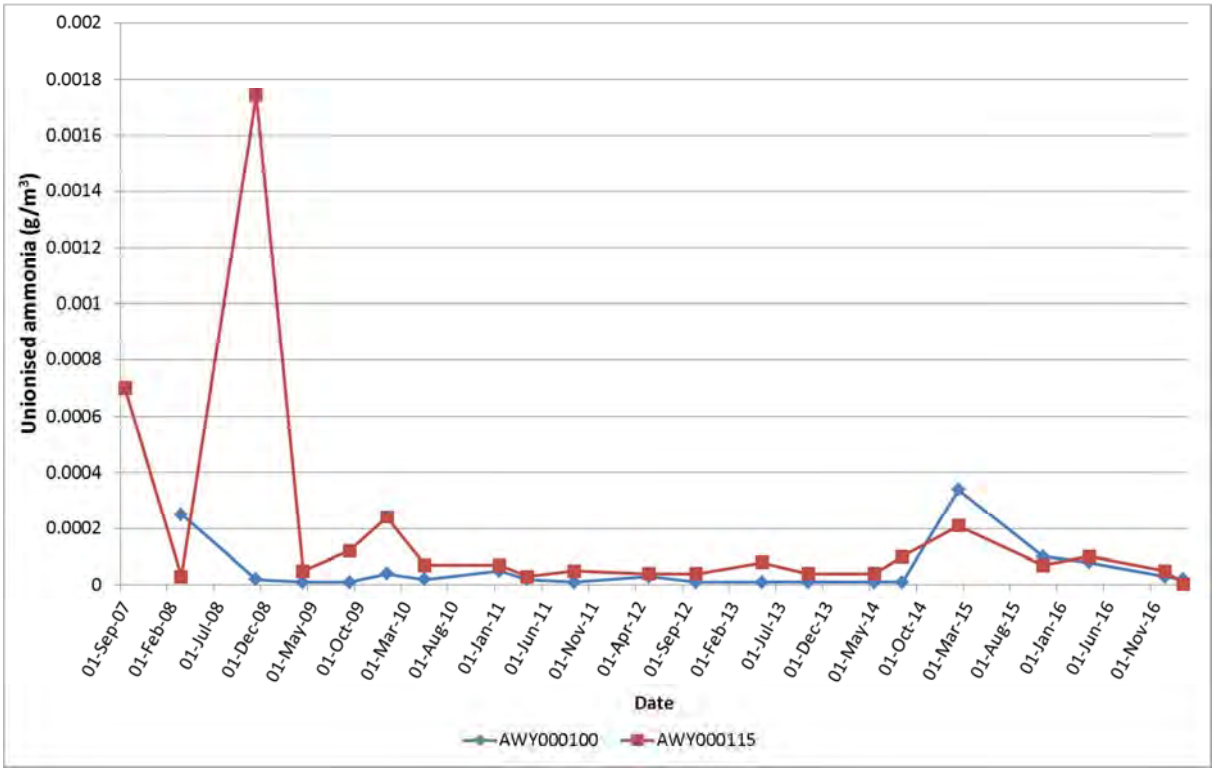

Figure 6 Unionised ammonia concentration in the main tributary below Inglewood landfill

The main unnamed tributary that receives the discharge from the landfill tributary displays slight elevations in conductivity, pH, alkalinity and ammoniacal nitrogen and nitrite/nitrate nitrogen at AWY000115 when compared to the upstream site (AWY000100). These minor increases have been noted in previous monitoring years and have been considered most likely a result of the presence of the landfill and from inputs from stock grazing in the area immediately downstream of the landfill site.

A review of the historical data also shows that the difference in the nitrate/nitrite nitrogen concentrations between sites AWY000100 and AWY000115 appears to be increasing (Figure 7). Due to the changes observed in recent years in the ammoniacal nitrogen and nitrate/nitrite concentrations at the various sites, total nitrogen has recently been included in the suite of analyses performed. The changes in total nitrogen concentration found at the surface water sampling sites in the main tributary during the year under review are similar to those observed for the nitrate/nitrite nitrogen.

The current levels of contaminants found in the main tributary are not uncommon within agricultural areas and would therefore be considered a minor effect, at most, on the aquatic environment.

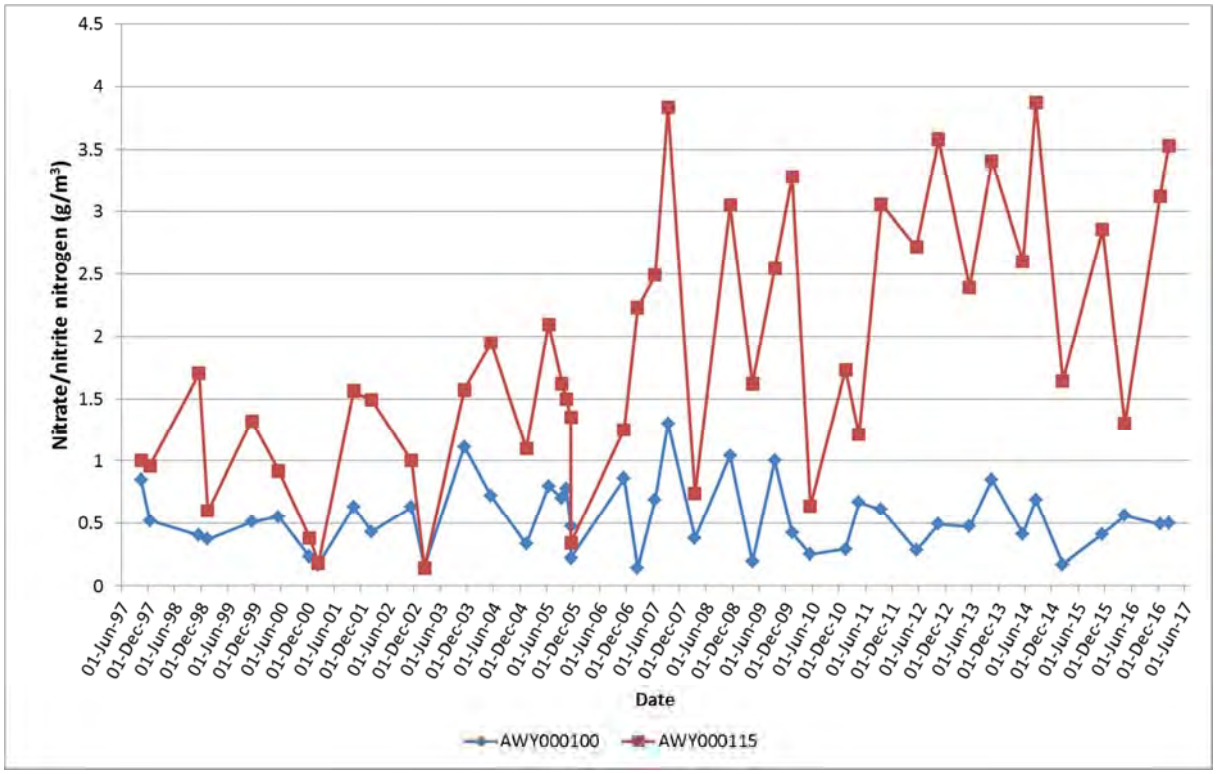

Figure 7 Nitrate/nitrite nitrogen results in the main tributary upstream and downstream of the Inglewood landfill tributary discharge

2.2.3.2. Biomonitoring

Macroinvertebrate sampling was undertaken on 15 February 2017 and 10 May 2017, at four sites in two tributaries of the Awai Stream, using a combination of the 'sweep-net' and 'kick' sampling techniques, both standard sampling techniques used by the Council. This was undertaken to assess whether leachate discharges from Inglewood landfill had had any adverse effects on the macroinvertebrate communities of this stream. 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 with the MCI or the $SQMCI_s$ between sites indicate the degree of adverse effects (if any) of the discharges monitored.

February 2017

This February 2017 survey did not indicate that leachate from the Inglewood landfill had significantly affected the freshwater macroinvertebrate communities in these tributaries. These communities appear to be determined by the physical habitat conditions, particularly the low flow conditions, soft/fine substrate and changes in macrophyte habitats available to the aquatic invertebrates.

The smaller, landfill drainage tributary sites exhibited improvements in taxa richness and $SQMCI_s$ score in a downstream direction. The differences observed between the sites can probably be attributed to the difference in available habitat, with better habitat at site 1b (downstream). This site has progressively become choked with vegetation, but the wetted area is greater, and water speeds swifter.

Significant differences were recorded in the MCI and $SQMCI_s$ scores between sites 2 and 3 in the larger tributary of the Awai Stream which can be attributed to a number of slight changes in taxa abundances, the result of varying habitat condition.

The significant (Stark, 1998) improvement in MCI score recorded at site 3 from the February 2016 survey can be attributed to a slight improvement in habitat during the current survey (greater flow) and also to the improved access at this site, which meant a larger area of habitat could be sampled.

Site 2 had a higher MCI score compared to the two sites in the smaller tributary (1a and 1b) and again, differences in habitat condition were thought to be the main reason for these differences in the macroinvertebrate communities at all sites.

No sites supported any undesirable biological growths.

The results of this survey provide no indication that the discharge of leachate into the unnamed tributary of the Awai Stream was having a significant adverse effect on the macroinvertebrate communities in the tributaries monitored.

May 2017

This May 2017 survey did not indicate that leachate from the Inglewood landfill had significantly affected the freshwater macroinvertebrate communities in these tributaries. These communities appear to be determined by the physical habitat conditions, particularly the flow conditions, soft/fine substrate and changes in macrophyte habitats available to the aquatic invertebrates.

The smaller, landfill drainage tributary sites exhibited an improvement in $SQMCI_s$ score in a downstream direction. The differences observed between the sites can probably be attributed to the difference in available habitat, with better habitat at site 1b (downstream). This site has progressively become choked with vegetation, but the wetted area is greater, and water speeds swifter.

Substantial differences were recorded in the MCI and $SQMCI_s$ scores between sites 2 and 3 in the larger tributary of the Awai Stream which can be attributed to a number of slight changes in taxa abundances, the result of varying habitat condition.

The significant (Stark, 1998) improvement in MCI score recorded at site 3 from the February 2016 survey can be attributed to a slight improvement in habitat during the current survey (greater flow) and also to the improved access at this site, which meant a larger area of habitat could be sampled.

Site 2 had a higher MCI score compared to the two sites in the smaller tributary (1a and 1b) and again, differences in habitat condition were thought to be the main reason for these differences in the macroinvertebrate communities at all sites.

No sites supported any undesirable biological growths.

The results of this survey provide no indication that the discharge of leachate into the unnamed tributary of the Awai Stream was having a significant adverse effect on the macroinvertebrate communities in the tributaries monitored.

2.2.4. Air quality

Methane and hydrogen sulphide readings were taken at the landfill entrance gate, and at the culvert at the toe of the landfill, during routine site inspections.

No methane was detected at either monitoring location during the period under review. No objectionable odours were noted on the site or beyond the site boundary during any of the inspections.

2.2.5. Investigations, interventions, and incidents

In the 2016-2017 period, it was not necessary for the Council to undertake significant additional investigations and interventions, or record incidents, in association with NPDC's conditions in resource consents or provisions in Regional Plans in relation to the consent holder's activities at the Inglewood landfill.

2.3. Discussion

2.3.1. Discussion of site performance

The landfill at Inglewood continues to act as a contingency landfill for NPDC, and is currently actively used for the disposal of cleanfill.

There were no environmental issues raised with regard to site management during the period under review. No unauthorised materials were found in the cleanfill area, the cap and batters were found to be stable and secure, and grazing on the site was well managed.

Air monitoring did not detect any methane or hydrogen sulphide emissions at the site, and no dust or odour issues were found.

There were no complaints received by Council in regard to the landfill during the period under review.

2.3.2. Environmental effects of exercise of consents

Water sampling undertaken during the year shows that the tributary immediately below the landfill continues to experience contamination from the landfill, however the levels of these contaminants (with the exception of nitrate/nitrite nitrogen) are significantly attenuated in the landfill tributary 130 m downstream of the landfill.

Chemical monitoring shows that the larger tributary of the Awai Stream (downstream of the landfill tributary) appears to be impacted to only a minor degree, with the levels of contaminants being at an acceptable level in this tributary. The nitrate/nitrite nitrogen concentration is well below the National Objectives Framework (NOF) bottom line of 9.8 g/ m^3 (annual 95 percentile)[1]. However, it is noted that the ammoniacal nitrogen and unionised ammonia concentrations in the landfill tributary at the culvert appear to be increasing and the difference in the nitrate/nitrogen concentrations between the upstream and downstream sites in the main tributary also appear to be increasing. It was thought possible that the condition of the cap as found in the 2014-2015 year, with its increased permeability, may have contributed to the increasing trends seen in the nitrogen containing species in recent years. At this stage, this does not appear to have resolved with the remediation work undertaken on the cap during the 2014-2015 year.

Although monitoring undertaken in the 2015-2016 year indicated that this trend may have been starting to level off, further monitoring during the period under review indicated that this may not be the case. Council will continue to monitor the situation under the routine compliance monitoring programme, but may require further investigations if necessary. In time, the addition of total nitrogen analysis of the samples to the programme may help with the interpretation of the receiving water results.

Biomonitoring surveys undertaken during the 2016-2017 year indicated that there were no significant effects to aquatic life in either of the unnamed tributaries of the Awai Stream downstream of the landfill as a result of the discharges from the site.

Based on the results of this monitoring period the presence of the landfill has not been found to have had significant adverse effects on the water quality downstream of the site during the period under review.

The results from inspections and air quality monitoring show that the presence of the landfill is unlikely to have any significant effects in terms of emissions to air.

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[1] Appendix 2 of the National Policy Statement for Freshwater Management (Ministry for the Environment 2014)

2.3.3. Evaluation of performance

A tabular summary of NPDC's compliance record for the year under review is set out in Table 6, Table 7 and Table 8.

Table 6 Summary of performance for Inglewood contingency landfill leachate consent 3954-2

Purpose: ***To discharge up to a total of 4,752 m^3/day (55 L/s) of leachate and stormwater from the Inglewood municipal landfill into an unnamed tributary of the Awai Stream, a tributary of the Mangaoraka Stream in the Waiongana Catchment***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Prepare and maintain a site contingency plan	Review of documentation on file in relation to inspection finding. Latest plan dated October 2016	Yes
2. Prepare and maintain a landfill operations and management plan	Plan provided. Latest plan dated May 2017	Agreed that Improvements in contingency disposal leachate management practices to be incorporated
3. Provide a landfill closure management plan by 1 June 2007	Plan previously provided	Yes
4. One months notice required by Council/ NPDC requesting/advising of changes to the operation and management or closure plans	Site inspection and review of plans on file. Latest plan dated May 2017, Council comment on latest plan to be provided to NPDC. No changes had been requested by Council	Yes
5. Monitoring of ground and surface water on and near the site to Council's satisfaction	Surface water monitoring undertaken by the Council at inspection	Yes
6. Maintain all parts of all stormwater and leachate systems	Site inspection	Yes
7. No actual or likely adverse impact on aquatic life or receiving water quality	Biomonitoring and surface water sampling	Some contaminants increasing in landfill tributary and main tributary. However, no unacceptable changes found during the year under review
8. Optional review provision re environmental effects	No further opportunities for review	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**Good**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 7 Summary of performance for Inglewood contingency landfill air discharge consent 4526-3

Purpose: *To discharge contaminants, being landfill gas, and odours associated with a landfill, into the air from the Inglewood municipal landfill*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Adopt the best practicable option to prevent or minimise effects	Inspection and off site observations	Yes
2. Consent to be exercised in accordance with application documentation	Inspection and liaison with consent holder	Yes
3. One months notice required by Council/ NPDC requesting/advising of changes to the operation and management or closure plans	Site inspection and review of plans on file. Latest plan dated May 2017 No changes had been requested by Council	Yes
4. Maintain and adhere to the landfill operations and management plan	Plan provided. Latest plan dated May 2017	Yes
5. The conditions of the consent prevail over any potential contradictions with the management plan	N/A	N/A
6. Offensive, objectionable, dangerous and noxious odours, dust or ambient levels of any other contaminant prohibited	Inspection and off site observations. Ambient air quality monitoring for methane and hydrogen sulphide	Yes
7. Burning prohibited	Site inspection	Yes
8. Significant adverse effects on any ecosystem is prohibited	Site inspection and off site observations	Yes
9. Specifies records to be kept by consent holder in the event of a complaint	Site inspection and liaison with consent holder. No complaints received by NPDC or the Council	Yes
10. Optional review provision re environmental effects	Next opportunity for review June 2020	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 8 Summary of performance for Inglewood cleanfill and contingency landfill discharge to land consent 4527-3

Purpose: ***To discharge cleanfill and inert materials onto and into land at the Inglewood municipal landfill, and to discharge municipal refuse onto and into land at the Inglewood municipal landfill when, and only when, it cannot be discharged at the Colson Road municipal landfill***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Prepare and maintain a site contingency plan	Review of documentation on file in relation to inspection finding. Latest plan dated October 2016	Yes
2. The activity shall be undertaken in accordance with the application documents	Site inspection	Yes
3. Notification of changes to landfill management plan	Inspection and review of plans on file. Updated contingency disposal plan received	Yes
4. Maintain and adhere to management plan	Plan provided. Latest plan dated May 2017	Agreed that improvements in contingency disposal leachate management practices to be incorporated
5. Consent conditions to prevail over management plan	Review of inspection findings in relation to documentation on file	Yes
6. Liquid waste shall not be accepted at the landfill	Site inspection – transfer station and cleanfilling activities only during the year under review	Yes
7. Acceptable cleanfill criteria	Site inspection	Yes
8. Unacceptable cleanfill criteria	Site inspection	Yes
9. Discharge shall not result in contaminants directly entering water	Site inspection and sampling	Yes
10. Install leachate retention structures	Site inspection	Yes
11. Install stormwater systems	Site inspection	Yes
12. Optional review provision re environmental effects	Next opportunity for review June 2020	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**Good**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Overall during the year, NPDC demonstrated a good level of environmental performance and a high level of administrative performance in relation to the Inglewood landfill consents as defined in Section 1.1.5.

Although no significant environmental effects were found due to the operation of the site, the trend of increasing concentrations of nitrogen compounds in the landfill tributary and the main tributary indicate that there may be the potential for environmental effects to emerge in the future.

2.3.4. Recommendation from the 2015-2016 Annual Report

In the 2015-2016 Annual Report, it was recommended:

1. THAT monitoring of discharges from Inglewood landfill in the 2016-2017 year be amended from that undertaken in 2015-2016 by the addition of total nitrogen analysis to the discharge and receiving water sampling.

This recommendation was implemented.

2.3.5. Alterations to monitoring programmes for 2017-2018

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 RMA;
- its obligations to monitor emissions and discharges and their effects under the RMA; and
- to report to the regional community.

The Council also takes into account the scope of assessments required at the time of renewal of permits, and the need to maintain a sound understanding of industrial processes within Taranaki emitting to the atmosphere/discharging to the environment.

It is proposed that for 2017-2018, monitoring of the Inglewood landfill be amended from that undertaken in 2016-2017 by the addition of site AWY000107 to the physicochemical receiving water sampling surveys.

2.4. Recommendation

1. THAT monitoring of consented activities at the Inglewood landfill in the 2017-2018 year be amended from that undertaken in 2016-2017 by the addition of site AWY000107 to the physicochemical receiving water sampling surveys.

3. Marfell Park landfill

3.1. Introduction

3.1.1. Site description

The landfill at Marfell closed in 1982. Due to effects caused by leachate discharging into the Mangaotuku Stream, NPDC applied for consent to discharge leachate in 1996. In 1998 NPDC captured the main leachate flow and directed it to the trade waste system. Various investigations have taken place at the site during previous monitoring periods, some undertaken by Council and others by consultants. The findings of these investigations are in earlier Council Annual Reports and other documents listed in the bibliography.

The discharge from the site now is predominantly stormwater. Presently the site is a park with sports field, playground and a BMX track.

Figure 8 An aerial view showing former landfill at Marfell Park and associated sampling sites

3.1.2. Water discharge permit

NPDC holds resource consent **4902-2** to cover the discharge leachate from the Marfell former landfill site via groundwater into the Mangaotuku Stream. This permit was originally issued by the Council on 26 January 1996 under Section 87(e) of the RMA and was renewed on 21 October 2014. It is due to expire on 1 June 2032.

It has six conditions:

Condition 1 requires the adoption of the best practicable option to prevent or minimise any adverse effect on the environment associated with the discharge of leachate from the site.

Condition 2 requires that the cap and stormwater structures be maintained to prevent ponding, to minimise stormwater infiltration, ensure effective stormwater diversion and drainage, and prevent iron oxide deposits at the outfall structure from entering the stream.

Condition 3 requires the provision of a management plan within three months of the granting of the consent (by 21 January 2015) that is to be certified by the Council. This is to cover general site management practices to ensure consent compliance and specifically addresses the way in which compliance with the matters contained in condition 2 will be achieved.

Condition 4 places limits on the concentration of ammoniacal nitrogen (0.9 g/m^3), unionised ammonia (0.025 g/m^3), pH range (6-9) and dissolved zinc (0.05 g/m^3) in the stream downstream of the discharge.

Condition 5 prohibits a range of specific effects in the stream downstream of the discharge.

Condition 6 provides for a review of the conditions of the consent in June 2020 and/or in June 2026.

This summary of consent conditions may not reflect the full requirements of each condition. The consent conditions in full can be found in the resource consent(s) which is/are appended to this report.

3.2. Results

3.2.1. Inspection

18 August 2016

The inspection was conducted in cloudy weather with light wind conditions. The cap was walked and was found to be secure and relatively intact. Following recent wet weather, it was damp and soft underfoot. Vehicle tracks were noted on the middle section of the fill area, causing wide spread but only minor damage to the grass cover. No ponding, slumping or exposed refuse was noted on the cap or batters.

The stormwater drains were clear and tidy with a minor amount of leaf litter present. They were free flowing at a trickle flow. The stormwater collection system was discharging at an estimated rate of 1.5 L/s into the Mangaotuku Stream. Abundant oxides had built up around the discharge point. There were no signs of leaks or overflows from the system.

Appropriate signage was in place at the site, and there was evidence of vehicle access to the site. Overall the site was tidy, with no odour or dust issues. Samples were collected for analysis upstream and downstream of the landfill and from the stormwater discharge point.

NPDC was asked to ensure that the integrity of the cap is maintained.

3.2.2. Receiving water and discharge sampling

Samples were taken on one occasion during the 2016-2017 monitoring year. The results are presented below in (Table 9).

The discharge is a mixture of stormwater and spring water that drains from the area surrounding the landfill. The bulk of the leachate from the filled area is captured and piped to trade waste. The results of the discharge monitoring indicate that low level contamination is occurring from the landfill.

Table 9 Results of sampling undertaken a Marfell Park landfill on 18 August 2016

Parameter	Unit	MGK000176	STW001123	MGK000178	*Consent limit*
		10m u/s discharge	discharge	20 m d/s discharge	
Alkalinity	g/m^3 $CaCO_3$	30	230	42	-
Conductivity	mS/m	13.9	47.5	16.0	-
Acid soluble iron	g/m^3	0.39	24.3	1.6	-
Unionised ammonia	g/m^3-N	0.00007	0.02105	0.00198	***0.025***
Ammoniacal nitrogen	g/m^3-N	0.026	9.97	0.602	***0.9***
pH	pH	7.0	6.8	7.1	***6.0-9.0***
Temperature	Deg C	11.6	15.2	11.9	
Dissolved zinc	g/m^3	<0.005	0.012	<0.005	***0.05***
Semi volatile organic compounds					
Acenaphthene	g/m^3	-	0.0004	-	-
Naphthalene	g/m^3	-	0.0004	-	-
2-Chlorophenol	g/m^3	-	0.0005	-	-
1,2-Dichlorobenzene	g/m^3	-	0.0011	-	-

Of the full range of semi-volatile organic compounds determined, only the four contaminants listed above were found at concentrations above the detection limit. Two of these contaminants were most likely to be associated with run off from roadway deposition and/or vehicles, and two that may have been associated with the historical landfilling activities. However, given that the discharge results were well below Canadian and ANZECC guidelines for freshwater, with the available dilution, there would be no significant adverse effect anticipated in the Mangaotuku Stream.

With the exception of ammoniacal nitrogen, the receiving water shows very little change in water quality between the upstream and downstream sites. Although the ammoniacal nitrogen of the stream was found to have increased by more than a factor of ten, the ammoniacal concentration of the stream remained at an acceptable level, and the unionised ammonia concentration in the stream remained relatively low. This has been a consistent finding over the last several years of monitoring.

Based on these results and those gathered in previous monitoring periods the discharges from the closed Marfell landfill are having only a minor effect on the receiving water.

3.2.3. Investigations, interventions, and incidents

In the 2016-2017 period, it was not necessary for the Council to undertake significant additional investigations and interventions, or record incidents, in association with NPDC's conditions in resource consents or provisions in Regional Plans in relation to the consent holder's activities at the Marfell landfill.

3.3. Discussion

3.3.1. Discussion of site performance

At inspection it was found that there had been one or more vehicles accessing the site and had caused minor damage to the grass cover, but no significant damage to the cap itself. It was found that the cap and stormwater drains were adequately maintained.

3.3.2. Environmental effects of exercise of consents

The site was found to be adequately maintained and no odour issues were noted. There were no issues found at inspection that required urgent attention.

Sampling found that although there was an increase in the ammoniacal nitrogen concentration in the stream, this was within the limits of the consent and constituted only a minor effect at most.

3.3.3. Evaluation of performance

A tabular summary of NPDC's compliance record for the year under review is set out in Table 10.

Table 10 Summary of performance for Marfell Park closed landfill leachate consent 4902 -2

Purpose: ***To discharge up to 2 L/s of leachate from the Marfell Park former landfill site via groundwater into the Mangaotuku Stream in the Huatoki Catchment***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Adopt best practice to prevent or minimise any adverse effects on the environment	Site inspection	Yes
2. Maintain cap and drains on site to minimise ponding, stormwater infiltration, ensure stormwater diversion and drainage, and prevent iron oxide on outlet structure entering the stream	Site inspection	Yes
3. Site to be operated in accordance with management plan that details how the site will be managed to ensure consent compliance. Plan required by 21 January 2014	Review of Council records. Plan received 11 March 2015	Yes
4. The discharge shall not cause specified parameter concentrations to be outside prescribed limits in the Mangaotuku Stream	Sampling	Yes
5. Prohibits certain effects in the stream beyond reasonable mixing	Sampling	Yes
6. Provision of review of consent conditions	Next opportunity of review June 2020	N/A

Purpose: *To discharge up to 2 L/s of leachate from the Marfell Park former landfill site via groundwater into the Mangaotuku Stream in the Huatoki Catchment*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

During the year, NPDC demonstrated an overall high level of environmental performance and a high level of administrative performance with their Marfell landfill resource consent as defined in Section 1.1.5.

3.3.4. Recommendation from the 2015-2016 Annual Report

In the 2015-2016 Annual Report, it was recommended:

1. THAT the biennial monitoring of discharges at the Marfell landfill continue unchanged and that the programme next be implemented in the 2016-2017 period.

This recommendation was implemented.

3.3.5. Alterations to monitoring programmes for 2017-2018

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 RMA;
- its obligations to monitor emissions and discharges and their effects under the RMA; and
- to report to the regional community.

The Council also takes into account the scope of assessments required at the time of renewal of permits, and the need to maintain a sound understanding of industrial processes within Taranaki emitting to the atmosphere and discharging to the environment.

It is proposed that the biennial monitoring of discharges at the Marfell landfill continues unchanged with the programme next being implemented in 2018-2019.

3.4. Recommendation

1. THAT the biennial monitoring of discharges at the Marfell landfill continues unchanged and that the programme next be implemented in the 2018-2019 period.

4. Okato landfill

4.1. Introduction

4.1.1. Site description

The Okato landfill stopped accepting general waste for discharge to land in 2005. The landfill was capped and the site became a transfer station. The NPDC also continued to exercise consent 4529-3 (discharge of contaminants to land) for the purpose of accepting and discharging green waste and cleanfill. All other refuse accepted at the site is transferred to New Plymouth for disposal or recycling. The site is also designated as a contingency landfill in the event that Colson Road landfill and/or Inglewood landfill became unusable or inaccessible.

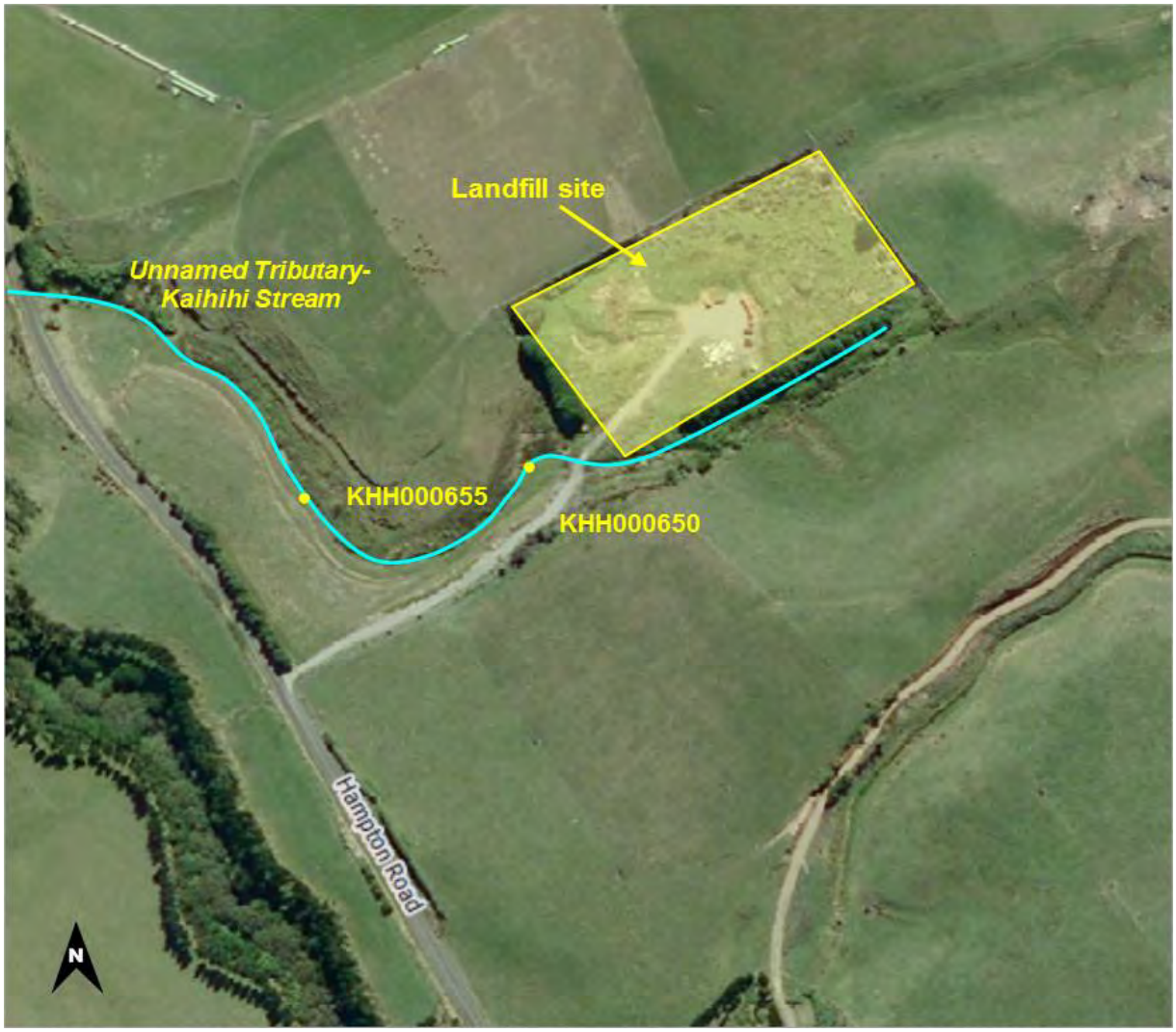

Figure 9 Okato landfill and sampling sites

4.1.2. Resource consents

4.1.2.1. Water discharge permit

NPDC holds resource consent **3860-3** to discharge stormwater and leachate from the Okato municipal landfill into an unnamed tributary of the Kaihihi Stream. This permit was issued by the Council on 13 September 2013 under Section 87(e) of the RMA. It expires on 1 June 2031.

It has seven conditions:

Condition 1 requires the consent holder to adopt the best practicable option.

Condition 2 requires the consent holder to adhere to the landfill management plan as supplied with the application.

Conditions 3 and 4 deal with the management of stormwater and leachate from the closed filling areas.

Condition 5 requires that leachate from any contingency filling be directed to a lined holding pond for removal from the site.

Condition 6 is a lapse condition.

Condition 7 is a review condition.

A copy of this consent is included in Appendix I of this report.

This summary of consent conditions may not reflect the full requirements of each condition. The consent conditions in full can be found in the resource consent(s) which is/are appended to this report.

4.1.2.2. Air discharge permit

The NPDC holds air discharge permit **4528-3** to discharge emissions into the air from the contingency discharge of solid contaminants at the Okato municipal landfill. This permit was issued by the Council on 13 September 2013 under Section 87(e) of the RMA. It is due to expire on 1 June 2031. It has six conditions:

Condition 1 specifies that discharge of refuse only occur on a contingency basis as set out in the management plan supplied with the application.

Condition 2 requires the consent holder to adopt the best practicable option.

Condition 3 prohibits objectionable and offensive odours beyond the boundary.

Condition 4 sets out limits for PM_{10} and dust deposition.

Condition 5 is a lapse condition.

Condition 6 contains provisions for review of the conditions of the consent.

A copy of this consent is included in Appendix I.

This summary of consent conditions may not reflect the full requirements of each condition. The consent conditions in full can be found in the resource consent(s) which is/are appended to this report.

4.1.2.3. Discharge of wastes to land

NPDC holds discharge permit **4529-3** to discharge cleanfill and green waste to land and to discharge general refuse on a contingency basis to land at the Okato landfill. This permit was issued by the Council on 9 September 2013 under Section 87(e) of the RMA. It will expire on 1 June 2031.

It has 15 conditions:

Condition 1 specifies that contaminants may only be discharged within the footprint of the existing landfill.

Condition 2 requires the consent holder adopt the best practicable option.

Condition 3 requires the consent holder to maintain stormwater and diversion drains.

Condition 4 requires that the existing landfill cap not be disturbed.

Condition 5 requires any areas used for the discharge of cleanfill and green waste be re-vegetated and reinstated prior to expiry or surrender of the consent.

Condition 6 requires that cleanfill be discharged as set out in the landfill management plan as supplied with the application.

Conditions 7, 8 and 9 deal with what materials are acceptable as cleanfill.

Condition 10 requires that green waste be discharged as set out in the landfill management plan as supplied with the application.

Condition 11 states that general refuse shall only be discharged as set out in the landfill management plan as supplied with the application.

Condition 12 deals with notification requirements.

Condition 13 deals with site reinstatement.

Condition 14 is a lapse condition.

Condition 15 is a review condition.

A copy of this consent is included in Appendix I.

This summary of consent conditions may not reflect the full requirements of each condition. The consent conditions in full can be found in the resource consent(s) which is/are appended to this report.

4.2. Results

4.2.1. Inspections

18 August 2016

The inspection was conducted in cloudy weather with light wind conditions. The cap was well vegetated and intact, with no sign of slumping, cracking or erosion. There was no ponding on the cap, and the batters were in good condition with no slumping or exposed refuse.

The stormwater drains were clear of obstructions. There was some ponded water in the lower reaches, which was discharging to the wetland at a trickle flow.

Well maintained signage and security were in place at the site. The fencing was permanent and intact. The site was unoccupied at the time of inspection. The cleanfill and green waste areas were tidy and no unauthorised material was noted. The cleanfill area had been recently levelled and there were no odour or dust issues.

Samples were collected downstream of the landfill. The tributary was found to be dry upstream of the landfill.

19 April 2017

The inspection was conducted in calm overcast conditions. The cap was well vegetated and intact, with no sign of erosion or slumping. There was no sign of ponded water on the cap following very heavy rain in the preceding few days. The batters were tidy and had been recently sprayed for gorse and weeds. No slumping, cracking or exposed refuse were noted on the batters.

The stormwater drains were tidy and had been recently sprayed for weeds. This had resulted in vegetation die back, allowing for clear free flowing drainage. Minor ponded stormwater was apparent in some places, however the drains were still discharging at a trickle flow.

The site was secure and well fenced with permanent fencing in place. No sign of cattle access was noted, and the site was unoccupied at the time of inspection.

The waste transfer station was tidy, with no windblown refuse. The cleanfill and green waste areas were found to be well managed, with no unauthorised material noted. There were no odour or dust issues.

Samples were collected immediately downstream from the landfill only. The upstream and furthermost downstream sites were dry and therefore no samples were taken at these locations. The wetland at the furthermost downstream site appeared to have expanded out, covering over the existing sample site. This has been reported to the relieving job manager, and photographs were taken.

4.2.2. Results of surface water sampling

Samples were collected from the tributary of the Kaihihi Stream below the landfill on two occasions, 18 August 2016 and 19 April 2017.

Table 11 Chemical analysis of a tributary of the Kaihihi Stream, sampled on 18 August 2016

Parameter	Unit	KHH000650	KHH000655
		30 m d/s of landfill	200m d/s of landfill
Alkalinity	g/m^3 $CaCO_3$	80	76
Conductivity	mS/m	31.4	29.8
Dissolved reactive phosphorus	g/m^3-P	<0.003	<0.003
Acid soluble iron	g/m^3	0.42	0.15
Unionised ammonia	g/m^3-N	0.00033	<0.00001
Ammoniacal nitrogen	g/m^3-N	0.146	<0.003
Nitrate/nitrite nitrogen	g/m^3-N	3.13	2.54
pH	pH	6.9	7.3
Temperature	Deg C	13.1	13.7
Dissolved zinc	g/m^3	0.007	<0.005

Table 12 Chemical analysis of a tributary of the Kaihihi Stream, sampled on 19 April 2017

Parameter	Unit	KHH000650	KHH000655[a]
		30 m d/s of landfill	200m d/s of landfill
Alkalinity	g/m^3 $CaCO_3$	78	-
Conductivity	mS/m	30.3	-
Dissolved reactive phosphorus	g/m^3-P	<0.003	-
Acid soluble iron	g/m^3	0.82	-
Unionised ammonia	g/m^3-N	0.00066	-
Ammoniacal nitrogen	g/m^3-N	0.214	-
Nitrate/nitrite nitrogen	g/m^3-N	2.32	-
pH	pH	7.0	-
Temperature	Deg C	14.2	-
Dissolved zinc	g/m^3	<0.005	-

a Sampling site too overgrown with raupo to allow access waterbody

As with previous monitoring results there is no indication that the presence of the landfill is having any significant adverse effects on the environment. The levels of ammonia and other indicator contaminants immediately below the landfilled area are low, indicating only low levels of leachate contamination.

4.2.3. Air quality

Objectionable odour and dust nuisance were checked for during each inspection during the monitoring period. There were no problems in regard to dust or odour during any of the inspections for the period under review.

4.2.4. Investigations, interventions, and incidents

In the 2016-2017 period, it was not necessary for the Council to undertake significant additional investigations and interventions, or record incidents, in association with NPDC's conditions in resource consents or provisions in Regional Plans in relation to the consent holder's activities at the Okato landfill.

4.3. Discussion

4.3.1. Discussion of site performance

Overall, the site was well managed during the 2016-2017 period. There were no issues in regards to cap condition, stormwater or leachate control. It was considered that there was generally good control over the site and its operation during the monitoring period.

4.3.2. Environmental effects of exercise of consents

The landfill will carry on generating leachate, some of which will continue to enter the stream below the site via ground and spring water.

Physicochemical analysis of the unnamed tributary indicates that the landfill is having no significant adverse effect on water quality at this site.

There were no issues of concern during the 2016-2017 monitoring period. No odour or dust problems were observed at or beyond the boundary of the site.

4.3.3. Evaluation of performance

A tabular summary of NPDC's compliance record for the year under review is set out in Table 13, Table 14, and Table 15.

Table 13 Summary of performance for Okato contingency landfill leachate consent 3860-3

Purpose: ***To discharge stormwater and leachate from the Okato municipal landfill into an unnamed tributary of the Kaihihi Stream***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Best practicable option	Site inspection	Yes
2. Discharges in accordance with management plan	Site inspection	Yes
3. Install and maintain stormwater diversion drains	Site inspection	Yes
4. Surface runoff and leachate directed to leachate stormwater/collection drain	Site inspection	Yes

Purpose: *To discharge stormwater and leachate from the Okato municipal landfill into an unnamed tributary of the Kaihihi Stream*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
5. All leachate generated from a contingency discharge to be directed to a lined pit and removed from site	No contingency discharge during monitoring period	N/A
6. Consent lapse September 2018 if not exercised	N/A	N/A
7. Optional review provision re environmental effects	Next review opportunity June 2019	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 14 Summary of performance for Okato contingency landfill air discharge consent 4528-3

Purpose: *To discharge emissions into the air from the contingency discharge of solid contaminants at the Okato municipal landfill*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Discharge to occur on contingency basis only	Consent not exercised	N/A
2. Optional review provision re environmental effects	Consent not exercised	N/A
3. Discharge not to result in offensive or objectionable odours at or beyond the boundary	Consent not exercised	N/A
4. Limits on deposited and suspended dust	Consent not exercised	N/A
5. Lapse of consent	N/A	N/A
6. Optional review provision re environmental effects	Next review opportunity June 2019	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**N/A**
Overall assessment of administrative performance in respect of this consent		**N/A**

N/A = not applicable

Table 15 Summary of performance for Okato contingency landfill discharge to land consent 4529-3

Purpose: *To discharge cleanfill and green waste to land and to discharge general refuse on a contingency basis to land*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Discharges to occur within existing landfill footprint	Site inspection and review of records	Yes
2. Best practicable option to prevent or minimise environmental effects	Site inspection	Yes
3. Consent holder to install stormwater diversion drains	Site inspection	Yes
4. Existing landfill cap to remain undisturbed	Site inspection	Yes
5. Areas used for discharge of cleanfill and green waste to be stabilised and revegetated prior to surrender or expiry	Consent still being exercised	N/A
6. Cleanfill may be discharged at any time in accordance with Management Plan	Site inspection and review of records	Yes
7. Allowable cleanfill materials	Site inspection	Yes
8. Materials not to be discharged	Site inspection	Yes
9. Written approval required where uncertainty of acceptability of waste	Site inspection	Yes
10. Green waste may be discharged at any time in accordance with Management Plan	Site inspection	Yes
11. Discharge of general refuse on a contingency basis only	No discharge to landfill during the monitoring period	N/A
12. Notification of contingency discharge	No discharge to landfill during the monitoring period	N/A
13. Contingency discharge to be capped and revegetated	No discharge to landfill during the monitoring period	N/A
14. Consent lapse September 2018	N/A	N/A
15. Optional review of consent	Next optional review scheduled in June 2019	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

During the year, NPDC demonstrated a high level of environmental performance and a high level of administrative performance in relation to the Okato landfill resource consents as defined in Section 1.1.5.

4.3.4. Recommendation from the 2015-2016 Annual Report

In the 2015-2016 Annual Report, it was recommended:

1. THAT monitoring of discharges from the Okato landfill in the 2016-2017 year continues at the same level as in 2015-2016.

This recommendation was implemented.

4.3.5. Alterations to monitoring programmes for 2017-2018

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 RMA;
- its obligations to monitor emissions and discharges and their effects under the RMA; and
- to report to the regional community.

The Council also takes into account the scope of assessments required at the time of renewal of permits, and the need to maintain a sound understanding of industrial processes within Taranaki emitting to the atmosphere/discharging to the environment.

It is proposed that the monitoring of discharges at the Okato landfill continue unchanged.

4.4. Recommendation

1. THAT monitoring of consented activities at Okato landfill in the 2017-2018 year continue at the same level as in 2016-2017.

5. Summary of recommendations

The following is a summary of the recommendations for each landfill as presented in the individual sections of this report.

1. THAT monitoring of consented activities at the Inglewood landfill in the 2017-2018 year be amended from that undertaken in 2016-2017 by the addition of site AWY000107 to the physicochemical receiving water sampling surveys.
2. THAT the biennial monitoring of discharges at the Marfell landfill continues unchanged and that the programme next be implemented in the 2018-2019 period.
3. THAT monitoring of consented activities at the Okato landfill in the 2017-2018 year continue at the same level as in 2016-2017.

Glossary of common terms and abbreviations

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

Biomonitoring	Assessing the health of the environment using aquatic organisms.
BOD	Biochemical oxygen demand. A measure of the presence of degradable organic matter, taking into account the biological conversion of ammonia to nitrate.
BODF	Biochemical oxygen demand of a filtered sample.
Bund	A wall around a tank to contain its contents in the case of a leak.
Conductivity	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m.
DO	Dissolved oxygen.
DRP	Dissolved reactive phosphorus.
g/m^3	Grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred.
Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring.
Investigation	Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident.
Incident Register	The Incident Register contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
L/s	Litres per second.
m^2	Square Metres.
MCI	Macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats.
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).
NNN	Nitrate and nitrite nitrogen, normally expressed in terms of the mass of nitrogen (N).
TN	Total nitrogen, 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).

pH	A numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
Physicochemical	Measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment.
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
RMA	*Resource Management Act 1991* and including all subsequent amendments.
SS	Suspended solids.
SQMCI	Semi quantitative macroinvertebrate community index.
Temp	Temperature, measured in °C (degrees Celsius).
Turb	Turbidity, expressed in NTU.
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 NPDC

(For a copy of the signed resource consent
please contact the TRC Consents department)

Inglewood

Discharge Permit

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

Name of Consent Holder:	New Plymouth District Council Private Bag 2025 NEW PLYMOUTH
Consent Granted Date:	18 February 2002

Conditions of Consent

Consent Granted:	To discharge up to a total of 4,752 cubic metres/day (55 litres/second) of leachate and stormwater from the Inglewood Municipal Landfill into an unnamed tributary of the Awai Stream, a tributary of the Mangaoraka Stream in the Waiongana Catchment at or about GR: Q19:124-296
Expiry Date:	1 June 2020
Review Date(s):	June 2008, June 2014
Site Location:	Inglewood Municipal Landfill, 277 King Road, Inglewood
Legal Description:	Lot 1 DP 16116 Blk XI Paritutu SD
Catchment:	Waiongana
Tributary:	Mangaoraka Awai

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

General conditions

a) That on receipt of a requirement from the Chief Executive, Taranaki Regional Council (hereinafter the Chief Executive), 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. Within three months of granting of this consent the consent holder shall prepare and maintain a site contingency plan to the satisfaction of the Chief Executive, Taranaki Regional Council, outlining measures and procedures undertaken to prevent spillage or accidental discharge of contaminants and procedures carried out should such a spillage or discharge occur. This shall be reviewed by the Council on an annual basis.

2. Within three months of granting of this consent the consent holder shall prepare and maintain a landfill operations and management plan to the satisfaction of the Chief Executive, Taranaki Regional Council, and shall adhere to such a plan in so far as they concern the exercise of this consent at all times.

3. The consent holder shall provide a landfill closure management plan to the satisfaction of the Chief Executive, Taranaki Regional Council, by 1 June 2007 or 3 months prior to the closure of the landfill should this occur before 1 June 2007; such plan to address site security, litter control, vegetation cover, stormwater diversion, leachate control, site contouring, and cover placement and compaction, in addition to any other matters relevant to the exercise of this consent.

4. The consent holder shall advise the Taranaki Regional Council one month prior to any changes being made to the operation and management plan or landfill closure management plan. Should the Taranaki Regional Council wish to review either of these plans, one month’s notice shall be provided to the consent holder.

5. The monitoring of the site and adjacent surface and groundwaters shall be to the satisfaction of the Chief Executive, Taranaki Regional Council

6. The leachate and stormwater diversion, collection, treatment and discharge systems shall be maintained to the satisfaction of the Chief Executive, Taranaki Regional Council

7. Any discharge shall not, in the opinion of the Chief Executive, Taranaki Regional Council, cause nor be likely to cause any significant adverse effects on aquatic life or receiving water quality.

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 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.

Signed at Stratford on 18 February 2002

For and on behalf of
Taranaki Regional Council

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Director-Resource Management

Discharge Permit

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

Name of Consent Holder:	New Plymouth District Council Private Bag 2025 NEW PLYMOUTH 4600
Consent Granted Date:	20 March 2007

Conditions of Consent

Consent Granted:	To discharge contaminants, being landfill gas, and odours associated with a landfill, into the air from the Inglewood Municipal Landfill at or about GR: Q19:120-295
Expiry Date:	1 June 2026
Review Date(s):	June 2014, June 2020
Site Location:	Inglewood Municipal Landfill, 277 King Road, Inglewood
Legal Description:	Lot 1 DP 16116 Blk XI Paritutu SD

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

General conditions

a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

   i) the administration, monitoring and supervision of this consent; and
   ii) charges authorised by regulations.

Special conditions

1. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects on the environment from the exercise of this consent.

2. The exercise of this consent shall be undertaken generally in accordance with the documentation submitted in support of applications 4475, 1611 and 94/118. In the case of any contradiction between the documentation submitted in support of applications 4475, 1611 and 94/118 and the conditions of this consent, the conditions of this consent shall prevail.

3. The consent holder shall advise the Taranaki Regional Council one month prior to any changes being made to the landfill management plan, and/or landfill closure management plan. Should the Taranaki Regional Council wish to review any of these plans, one month's notice shall be provided to the consent holder.

4. The consent holder shall maintain the landfill management plan to the satisfaction of the Chief Executive, Taranaki Regional Council, and shall adhere to such a plan in so far as it concerns the exercise of this consent at all times.

5. In case of any contradiction between the landfill management plan and the conditions of this consent, the conditions of this consent shall prevail.

6. The discharge of contaminants into the air from the landfill operation shall not result in any of the following - offensive or objectionable odours; offensive or objectionable dust; or dangerous or noxious ambient concentrations of any airborne contaminant - as determined by at least one enforcement officer of the Taranaki Regional Council, at or beyond the boundary of the site.

7. No material is to be burnt at the landfill site.

8. The discharges authorised by this consent shall not give rise to any significant adverse ecological effects on any ecosystem, including but not limited to, habitats, plants, animals, microflora and microfauna.

9. The consent holder shall keep a record of any complaints received relating to discharges to air with respect to the landfill activity. The complaints record shall include the following where possible:

   a) name and address of complainant;
   b) nature of complaint;
   c) date and time of the complaint and alleged event;
   d) weather conditions at the time of the event; and
   e) any action taken in response to the complaint.

10. 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 2014 and/or June 2020, 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 20 March 2007

For and on behalf of
Taranaki Regional Council

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Director-Resource Management

Discharge Permit

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

Name of Consent Holder:	New Plymouth District Council Private Bag 2025 NEW PLYMOUTH 4600
Consent Granted Date:	20 March 2007

Conditions of Consent

Consent Granted:	To discharge cleanfill and inert materials onto and into land at the Inglewood Municipal Landfill at or about GR: Q19:120-295, and to discharge municipal refuse onto and into land at the Inglewood Municipal Landfill when, and only when, it cannot be discharged at the Colson Road Municipal Landfill
Expiry Date:	1 June 2026
Review Date(s):	June 2014, June 2020
Site Location:	Inglewood Municipal Landfill, 277 King Road, Inglewood
Legal Description:	Lot 1 DP 16116 Blk XI Paritutu SD
Catchment:	Waiongana
Tributary:	Awai Mangaoraka

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

General conditions

a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

   i) the administration, monitoring and supervision of this consent; and
   ii) charges authorised by regulations.

Special conditions

1. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects on the environment from the exercise of this consent.

2. The exercise of this consent shall be undertaken generally in accordance with the documentation submitted in support of applications 4476, 1613 and 94/119. In the case of any contradiction between the documentation submitted in support of applications 4476, 1613 and 94/119 and the conditions of this consent, the conditions of this consent shall prevail.

3. The consent holder shall advise the Taranaki Regional Council one month prior to any changes being made to the landfill management plan, and/or landfill closure management plan. Should the Taranaki Regional Council wish to review any of these plans, one month's notice shall be provided to the consent holder.

4. The consent holder shall maintain the landfill management plan to the satisfaction of the Chief Executive, Taranaki Regional Council, and shall adhere to such a plan in so far as it concerns the exercise of this consent at all times.

5. In case of any contradiction between the landfill management plan and the conditions of this consent, the conditions of this consent shall prevail.

6. Waste, including liquid and sludges, with a solids content of 20% or less, shall not be accepted at the landfill.

7. For the purposes of this consent, "clean fill and inert materials" are defined as materials consisting of any solid concrete, cement or cement wastes, bricks, mortar, tiles (clay, ceramic or concrete), non-tanalised timber, porcelain, glass, gravels, boulders, shingles, fibreglass, plastics, sand, soils and clays, and/or tree stumps and roots, whether singly or in combination or mixture, or any other material that when placed onto and into land will not render that land or any vegetation grown on that land toxic to vegetation or animals consuming vegetation.

8. For the purposes of this consent, "clean fill and inert materials" excludes: food wastes, paper and cardboard, grass clippings, vegetative wastes other than tree stumps and roots, textiles, steel, galvanised metals, construction materials containing paint or fillers or sealers or their containers, oils or greases or any liquids or sludges or their containers, any industrial process by-products other than as permitted under condition 7, any poisons or solvents or their containers, batteries, general domestic refuse not otherwise described, or any wastes with the potential to render land or any vegetation grown on the land toxic to vegetation or to animals consuming such vegetation.

9. The discharge to land shall not result in any contaminant entering surface water.

10. Silt and leachate retention structures shall be installed and maintained to the satisfaction of the Chief Executive, Taranaki Regional Council.

11. The consent holder shall install and maintain stormwater diversion drains to minimise stormwater movement across, or ponding on the site, to the satisfaction of the Chief Executive, Taranaki Regional Council.

12. 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 2014 and/or June 2020, 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 20 March 2007

For and on behalf of
Taranaki Regional Council

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Director-Resource Management

Marfell Park

Discharge Permit

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

Name of Consent Holder:	New Plymouth District Council Private Bag 2025 New Plymouth 4342
Decision Date:	21 October 2014
Commencement Date:	21 October 2014

Conditions of Consent

Consent Granted:	To discharge leachate from the Marfell Park former landfill site via groundwater into the Mangaotuku Stream
Expiry Date:	01 June 2032
Review Date(s):	June 2020, June 2026
Site Location:	Marfell Park, Grenville Street, New Plymouth
Legal Description:	Lot 4 DP 9485 (Discharge point) Lot 1 DP 9295 Lot 1 DP 15742 (Discharge source)
Grid Reference (NZTM)	1690275E-5674646N
Catchment:	Huatoki
Tributary:	Mangaotuku

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

General condition

a. The consent holder shall pay to the Taranaki Regional Council all the administration, monitoring and supervision costs of this consent, fixed in accordance with section 36 of the Resource Management Act 1991.

Special conditions

1. The consent holder shall 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 landfill cap and associated stormwater structures shall be maintained in a manner that;

    a) Minimises ponding to prevent stormwater infiltration into the filled area;
    b) Ensures stormwater is adequately diverted and/or drained away from the land fill cap; and
    c) Ensures iron oxide deposits on the outfall structure do not directly enter the Mangaotuku Stream.

3. The site shall be operated in accordance with a 'Management Plan' prepared by the consent holder within 3 months of granting of this consent, and approved by the Chief Executive, Taranaki Regional Council, acting in a certification capacity. The plan shall detail how the site will be managed to achieve compliance with the conditions of this consent and shall include but not be limited to:

    a) maintenance of the landfill cap to minimise ponding and stormwater infiltration;
    b) maintenance and management of the stormwater drains on and around the landfill to ensure stormwater is adequately diverted and/or drained away from the land fill cap; and
    c) monitoring and management of iron oxide deposits on the outfall structure to ensure iron oxide deposits do not enter the water way.

4. After reasonable mixing the receiving waters downstream of the discharge shall meet the following standards;

    a) unionised ammonia concentration less than 0.025 g/m^3;
    b) ammoniacal nitrogen level concentration less than 0.9 g/m^3;
    c) pH within the range of 6.0 and 9.0; and
    d) dissolved zinc concentration less than or equal to 0.05 g/m^3.

5. The discharge shall not cause the following effects in the receiving waters after reasonable mixing;

    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.

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 2020 and/or June 2026 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 21 October 2014

For and on behalf of
Taranaki Regional Council

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B G Chamberlain
Chief Executive

Okato

Discharge Permit

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

Name of Consent Holder:	New Plymouth District Council Private Bag 2025 NEW PLYMOUTH 4342
Decision Date:	13 September 2013
Commencement Date:	13 September 2013

Conditions of Consent

Consent Granted:	To discharge stormwater and leachate from the Okato Municipal Landfill into an unnamed tributary of the Kaihihi Stream
Expiry Date:	1 June 2031
Review Date(s):	June 2019, June 2025
Site Location:	Okato Municipal Landfill, Hampton Road, Okato
Legal Description:	Lot 1 DP 13150 Blk I Cape SD (Discharge site)
Grid Reference (NZTM)	1674817E-5663981N
Catchment:	Kaihihi

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

General condition

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

Special conditions

1. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects on the environment from the exercise of this consent.

2. All discharges permitted under this consent shall be undertaken in accordance with the "Okato Landfill Contingency Disposal Management Plan" as supplied with the application (5831).

3. The consent holder shall install and maintain all stormwater diversion drains to minimise stormwater entering or flowing across the discharge area.

4. During routine operations all surface runoff and leachate from the previously filled area of the landfill shall be directed to the leachate stormwater/ collection drain.

5. During and after any contingency discharge of general refuse (as permitted under consent 4529-2), all leachate generated from the new fill shall be directed to a lined pond and removed from the site.

6. This consent shall lapse on 30 September 2018, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

7. 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 2019 and/or June 2025 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 13 September 2013

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

Discharge Permit

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

Name of Consent Holder:	New Plymouth District Council Private Bag 2025 NEW PLYMOUTH 4342
Decision Date:	13 September 2013
Commencement Date:	13 September 2013

Conditions of Consent

Consent Granted:	To discharge cleanfill and greenwaste to land and to discharge general refuse on a contingency basis to land
Expiry Date:	1 June 2031
Review Date(s):	June 2019, June 2025
Site Location:	Okato Municipal Landfill, Hampton Road, Okato
Legal Description:	Lot 1 DP 13150 Blk I Wairau SD (Discharge source & site)
Grid Reference (NZTM)	1674817E-5663981N
Catchment:	Kaihihi

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

General condition

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

Special conditions

1. All discharges permitted by this consent shall occur within the existing landfill footprint as shown by the red dotted line on the attached plan (appendix 1).

2. The consent holder shall at all times adopt the best practicable option or options [as defined in section 2 of the Resource Management Act 1991] to prevent or minimise any actual or potential effect on the environment arising from any discharge at the site.

3. The consent holder shall install and maintain stormwater diversion drains to minimise stormwater entering or flowing across the discharge area.

4. The existing landfill cap shall at all times be maintained in its existing condition and shall not be disturbed during any activities permitted by this consent.

5. Prior to the expiry or surrender of this consent all areas used to discharge greenwaste and/or cleanfill shall be stabilised and re-vegetated to minimise erosion, sedimentation and stormwater infiltration.

Cleanfill

6. Cleanfill as defined by special conditions seven and eight may be discharged at any time and shall be undertaken in accordance with the Okato Landfill Contingency Disposal Management Plan as submitted with application 5833.

7. The contaminants to be discharged shall be limited to cleanfill and/or inert materials. For the purposes of this condition, "clean fill and inert materials" are defined as materials consisting of any concrete, cement or cement wastes, bricks, mortar, tiles [clay, ceramic or concrete], non-tanalised timber, porcelain, glass, gravels, boulders, shingles, fibreglass, plastics, sand, soils and clays, and/or tree stumps and roots, whether singly or in combination or mixture, or any other material [subject to condition 8] that when placed onto and into land will not render that land or any vegetation grown on that land toxic to vegetation or animals consuming vegetation.

8. The discharge of the following contaminants shall not occur: food wastes, paper and cardboard, grass clippings, garden wastes including but not limited to wastes containing foliage or other vegetation [other than tree stumps and roots as permitted under condition 7], textiles, steel, galvanised metals, construction materials containing paint or fillers or sealers or their containers, oils or greases or any liquids or sludges or their containers, any industrial process by-products other than as permitted under condition 7, any poisons or solvents or their containers, batteries, general domestic refuse not otherwise described, or any wastes with the potential to render land or any vegetation grown on the land toxic to vegetation or to animals consuming such vegetation.

9. If the consent holder is uncertain as to the acceptability or not of a certain material the consent holder shall obtain written approval from the Consents Manager, Taranaki Regional Council, prior to its discharge.

Greenwaste

10. Green waste may be discharged at any time and shall be undertaken in accordance with the Okato Landfill Contingency Disposal Management Plan as submitted with application 5833.

Contingency Landfilling

11. The discharge of general refuse at the site shall only occur on a contingency basis and in accordance with the Okato Landfill Contingency Disposal Management Plan as submitted with application 5833.

12. In the event that contingency filling is required, the consent holder shall notify Council within 48 hours via email at worksnotification@trc.govt.nz . The notification shall include, reasons for using the site, likely volume of material to be discharged and likely duration of the contingency discharge.
13. Upon completion of any contingency discharge, the discharged refuse shall be capped and re-vegetated to the specifications set out in section 4.10.3 of the Okato Landfill Contingency Disposal Management plan as submitted with application 5833.

14. This consent shall lapse on 30 September 2018, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991

15. 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 2019 and or June 2025, 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 13 September 2013

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

Appendix 1

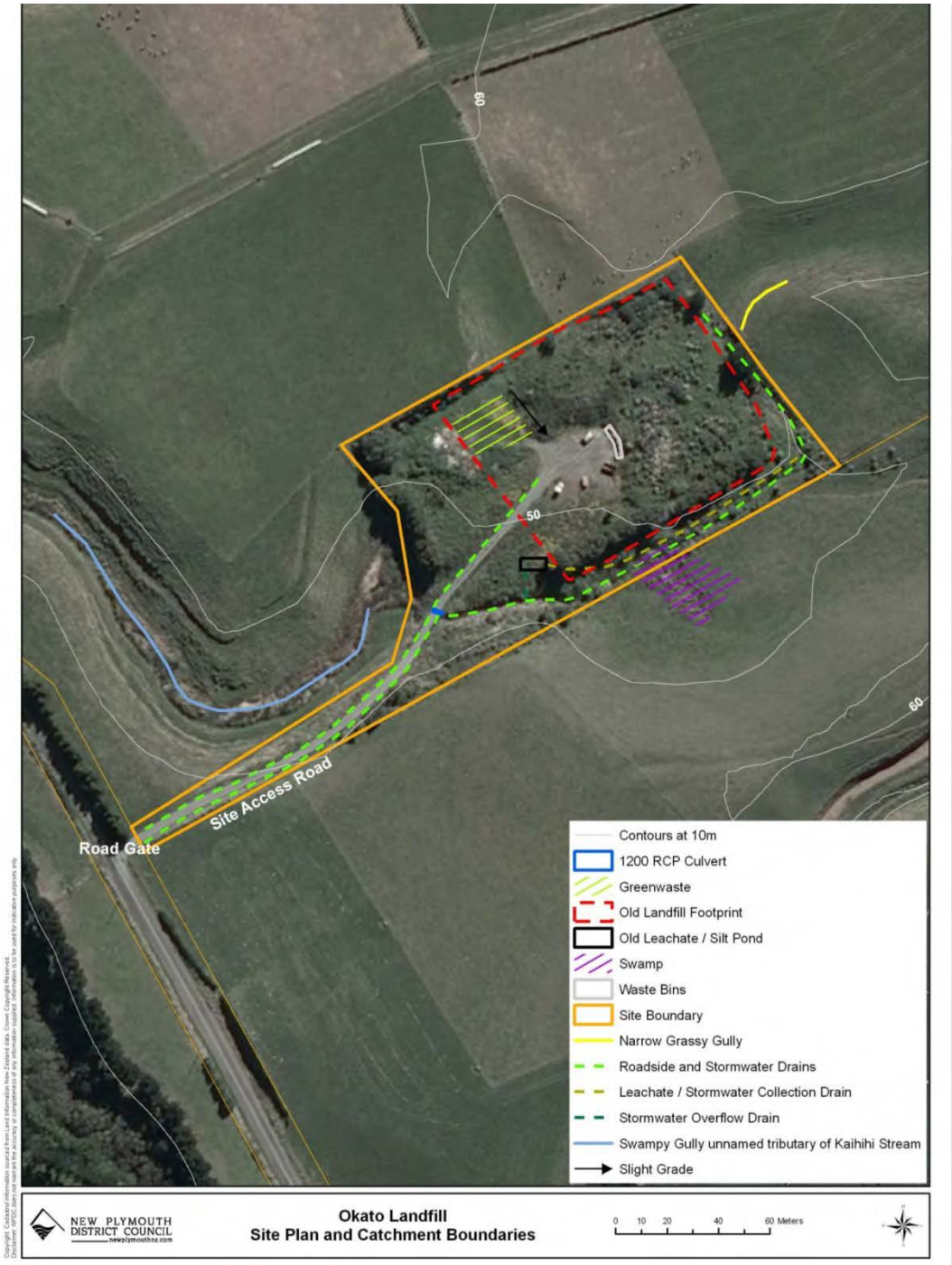

Figure 1 Aerial plan of Okato landfill site

Appendix II

Biomonitoring reports

5To Job Manager, Lorraine Smith

From Scientific Officer, Brooke Thomas

Document 1869004

Date 30 May 2017

Biomonitoring of two unnamed tributaries of the Awai Stream, below the Inglewood landfill, February 2017

Introduction

This was the first biological survey undertaken of the two surveys scheduled for the 2016-2017 monitoring year in two tributaries of the Awai Stream in relation to the Inglewood landfill. Leachate from the landfill discharges to a small tributary, which then joins a larger tributary approximately 450m below the face of the landfill. Results of biological surveys performed in the tributaries since the 2001-2002 monitoring year are discussed in the series of reports referenced at the end of this report.

Methods

This survey was undertaken on 15 February 2017 at four sites on the two tributaries of the Awai Stream; sites 1(a) and 1 (b) were located in the smaller tributary and sites 2 and 3 on the larger tributary (Table 1 and Figure 1).

A combination of the standard 400 ml 'kick-sampling' and 'sweep-net' sampling techniques was used to collect streambed macroinvertebrates. The 'kick-sampling' technique is very similar to Protocol C1 (hard-bottomed, semi-quantitative) protocol for macroinvertebrate samples in wadeable streams (Stark *et al*, 2001). The 'sweep-net' sampling technique was very similar to Protocol C2 (soft-bottomed, semi-quantitative) protocol of the New Zealand Macroinvertebrate Working Group (NZMWG).

Table 1 Biomonitoring sites in tributaries of the Awai Stream

Site number	Site code	Location
1a	AWY000105	Smaller tributary, 100 metres below tip face
1b	AWY000107	Smaller tributary, 400 metres below tip face
2	AWY000100	Larger tributary, above confluence with small tributary
3	AWY000115	Larger tributary, 80 metres below confluence with small tributary

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope 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). 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. After extensive use of the MCI, categories were assigned to the sensitivity scores, to clarify their 'relative' sensitivity e.g. taxa that scored between 1 and 4 inclusive are considered tolerant (see Table 3).

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	HBMCI	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.

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 these organisms is an indicator of organic enrichment within a stream.

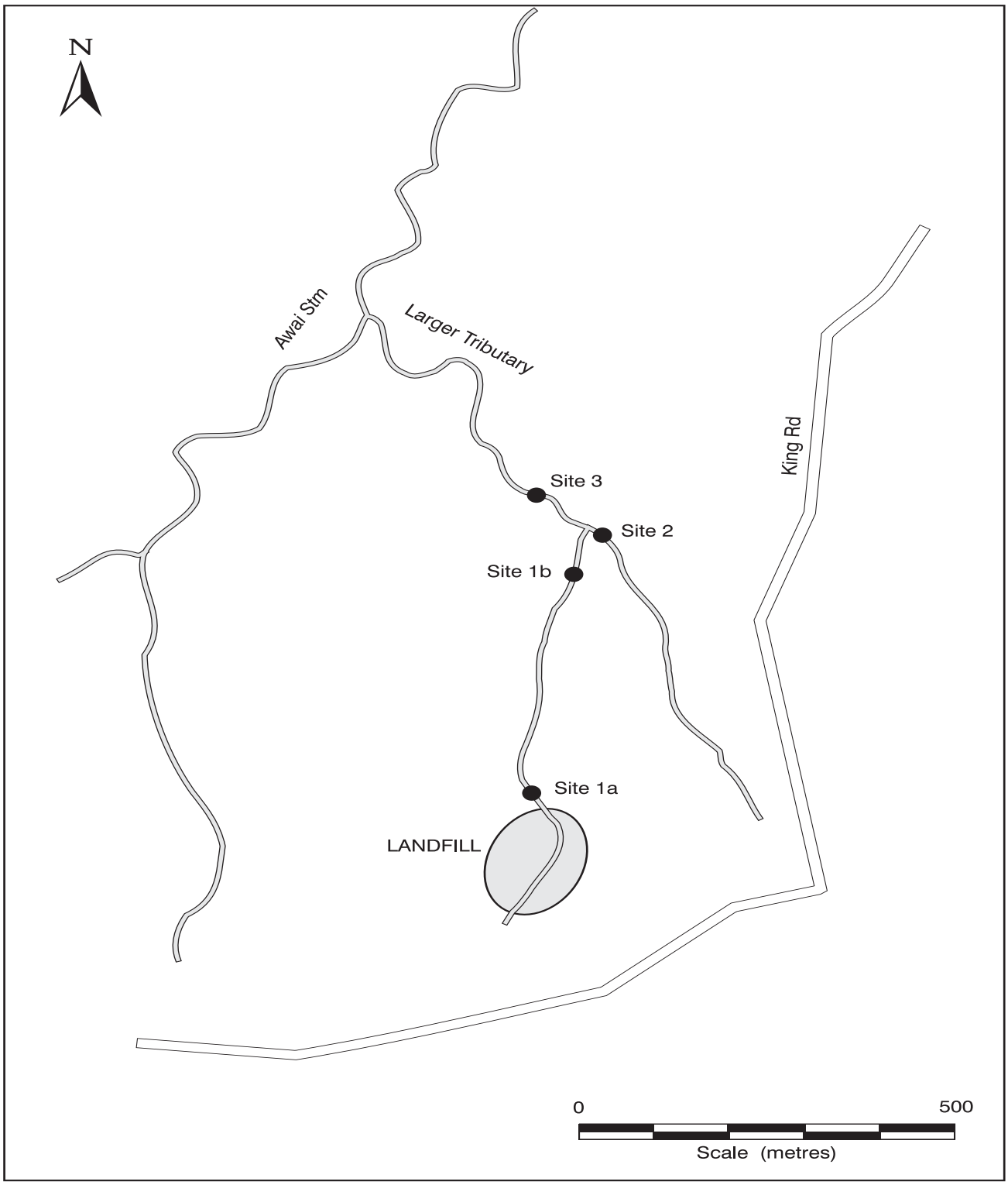

Figure 1 Biomonitoring sites in tributaries of the Awai Stream related to the Inglewood landfill

Results

This February 2017 survey was carried out under low flow conditions. The water at all sites was clear and uncoloured. It had been 10 days since the nearby Mangaoraka Stream flowed at more than three times its median flow and 12 days since flows exceeded seven times median.

The substrate comprised predominantly of silt at site 1a, silt and hard clay at site 1b and a combination of silt, sand, gravels and woody debris at sites 2 and 3. Macrophytes were recorded on the bed and banks of the stream at site 1a and site 1b. No macrophytes were recorded at site 2 or site 3. The widespread iron oxide coating noted at site 1a, was not recorded at any other site during this survey. At the time of this survey the water temperatures recorded ranged between 15.3 and 17.3°C. There was no shading at site 1a, partial shading at site 1b and complete shading at site 3 and site 2.There were patchy mats of periphyton growing at site 1a but no periphyton recorded at any of the other sites. No site supported any undesirable biological growths.

Macroinvertebrate communities

A summary of results from previous surveys performed in the tributaries of the Awai Stream in relation to the Inglewood landfill are presented together with current results in Table 2. The full results of the present survey are provided in Table 3.

Table 2 Numbers of taxa and MCI values recorded in previous surveys related to the Inglewood landfill, together with current results

Site No	No. Taxa				MCI values				$SQMCI_s$ values			
	No. samples	Range	Median	Current result	No. Samples	Range	Median	Current result	No. samples	Range	Median	Current result
1a	44	4-23	15	9	44	60-92	72	64	34	1.2-3.6	2.6	2.3
1b	47	11-29	19	22	47	69-88	77	71	34	2.1-4.5	3.3	4.0
2	48	8-29	18	14	48	79-108	90	101	34	1.4-6.1	3.9	5.2
3	48	9-27	19	17	48	69-111	91	82	34	1.3-5.8	3.3	3.3

Table 3 Macroinvertebrate fauna of unnamed tributaries of the Awai Stream sampled in relation to the Inglewood landfill on 15 February 2017

Taxa List	Site Number	MCI score	1a	1b	2	3
	Site Code		AWY000105	AWY000107	AWY000100	AWY000115
	Sample Number		FWB17067	FWB17068	FWB17069	FWB17070
COELENTERATA	Coelenterata	3	-	R	-	-
PLATYHELMINTHES (FLATWORMS)	*Cura*	3	-	R	R	-
ANNELIDA (WORMS)	Oligochaeta	1	-	C	C	A
	Lumbricidae	5	-	C	-	-
MOLLUSCA	Lymnaeidae	3	-	C	-	-
	Potamopyrgus	4	-	VA	-	C
	Sphaeriidae	3	-	-	-	C
CRUSTACEA	Ostracoda	1	VA	C	-	C
	Isopoda	5	-	-	R	R
	Paracalliope	5	-	R	-	-
	Paraleptamphopidae	5	-	-	A	C
	Paranephrops	5	-	-	R	R
EPHEMEROPTERA (MAYFLIES)	*Zephlebia group*	7	-	-	A	R
ODONATA (DRAGONFLIES)	*Xanthocnemis*	4	C	R	-	-
HEMIPTERA (BUGS)	*Microvelia*	3	-	C	-	R
COLEOPTERA (BEETLES)	Hydrophilidae	5	-	R	-	-
	Ptilodactylidae	8	-	-	R	-
TRICHOPTERA (CADDISFLIES)	*Hydropsyche (Orthopsyche)*	9	-	-	R	-
	Polyplectropus	6	-	A	-	-
	Psilochorema	6	-	R	-	-
	Oeconesidae	5	-	-	R	R
	Oxyethira	2	C	R	-	-
	Triplectides	5	-	-	C	R
DIPTERA (TRUE FLIES)	*Paralimnophila*	6	-	-	R	R
	Chironomus	1	A	R	-	-
	Corynoneura	3	-	C	-	-
	Orthocladiinae	2	-	C	-	-
	Polypedilum	3	VA	A	C	A
	Tanypodinae	5	A	C	-	R
	Paradixa	4	-	-	R	R
	Austrosimulium	3	A	R	-	R
	Stratiomyidae	5	C	R	-	-
ACARINA (MITES)	Acarina	5	R	A	C	A
		No of taxa	9	22	14	17
		MCI	64	71	101	82
		SQMCIs	2.3	4.0	5.2	3.3
		EPT (taxa)	0	2	4	3
		%EPT (taxa)	0	9	29	18

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

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

Site 1a

A total of nine taxa was recorded at site 1a, 100 metres downstream of the landfill face. This result was six taxa less than the median richness recorded at this site. The majority of taxa (67%) recorded at the site were 'tolerant' taxa which was reflected by the poor MCI score of 64 units. This MCI score was lower than the median but within the range of MCI scores recorded to date. There was a slight decrease of four units in the MCI score at this site from the previous February 2016 survey, a reflection of the low flow recorded at the time of sampling (Figure 2).

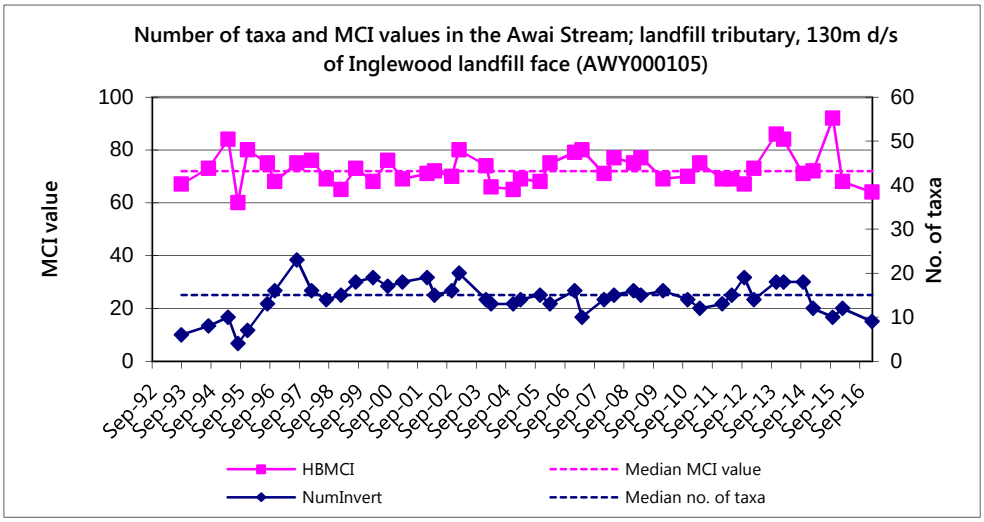

Figure 2 Number of taxa and MCI values at site 1a in a tributary of the Awai Stream

The macroinvertebrate community at this site was characterised by four 'tolerant' taxa; [ostracod seed shrimp, black sandfly larvae (*Austrosimulium*) and chironomid midges (*Chironomus*) and (*Polypedilum*)], and one 'moderately sensitive' taxon; [chironomid midge (Tanypodinae)] (Table 3). The numerical dominance by 'tolerant' taxa resulted in the $SQMCI_s$ score of 2.3 units which was slightly lower than the median $SQMCI_s$ by 0.3 unit (Table 2).

Site 1b

Twenty-two taxa were recorded at site 1b, approximately 400 metres downstream of the landfill face, three taxa more than the median recorded at this site and 13 taxa higher than that recorded at site 1a in this same survey. At the time of this survey a high proportion of 'tolerant' taxa was recorded (67%), resulting in the low MCI score of 71 units. This MCI score was reflective of 'poor' macroinvertebrate health and was 6 units lower than the median score for the site (Figure 3) but 7 units higher than the MCI score recorded at site 1a in this survey.

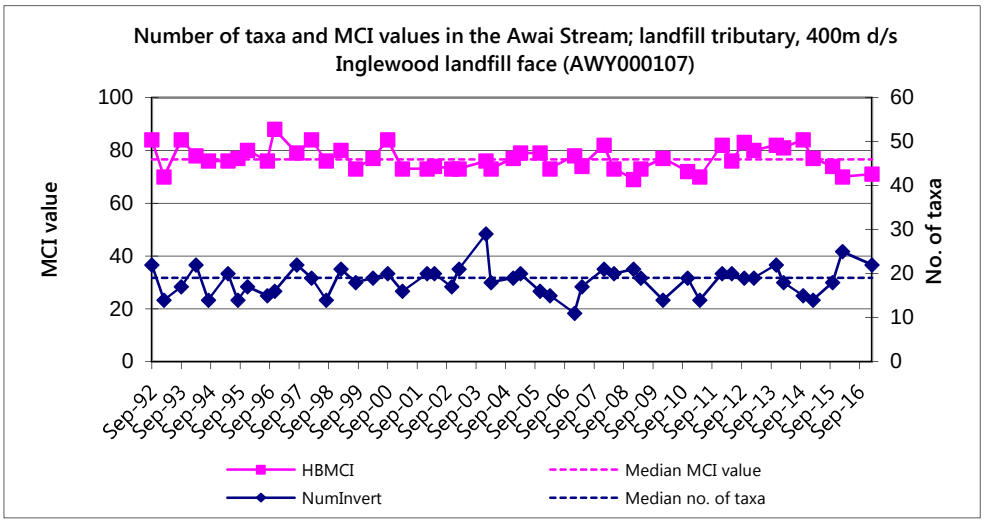

Figure 3 Number of taxa and MCI values at site 1b in a tributary of the Awai Stream

The macroinvertebrate community at this site was characterised by two 'tolerant' taxa; [snail (*Potamopyrgus*) and chironomid midge (*Polypedilum*)], and two 'moderately sensitive' taxa; [free-living caddis (*Polyplectropus*) and mites (Acarina)] (Table 3). The $SQMCI_s$ score of 4.0 units recorded at site 1b was 0.7 unit higher than the median score for the site and a substantial 1.7 units higher than that recorded at site 1a.

Site 2

The 'control' site 2, upstream of the confluence with the landfill tributary had a community richness of 14 taxa, four taxa lower than the median number found by previous surveys (Table 2, Figure 4). A high proportion of the community recorded at this site in the current survey were 'sensitive' taxa (71%) which resulted in the 'good' MCI score of 101 units (Table 3). This MCI score was a significant (Stark, 1998) 11 units higher than the median score recorded by the site previously and was significantly (Stark, 1998) higher than the MCI scores recorded at the two sites in the small unnamed tributary (1a and 1b) (by 37 and 30 units respectively).

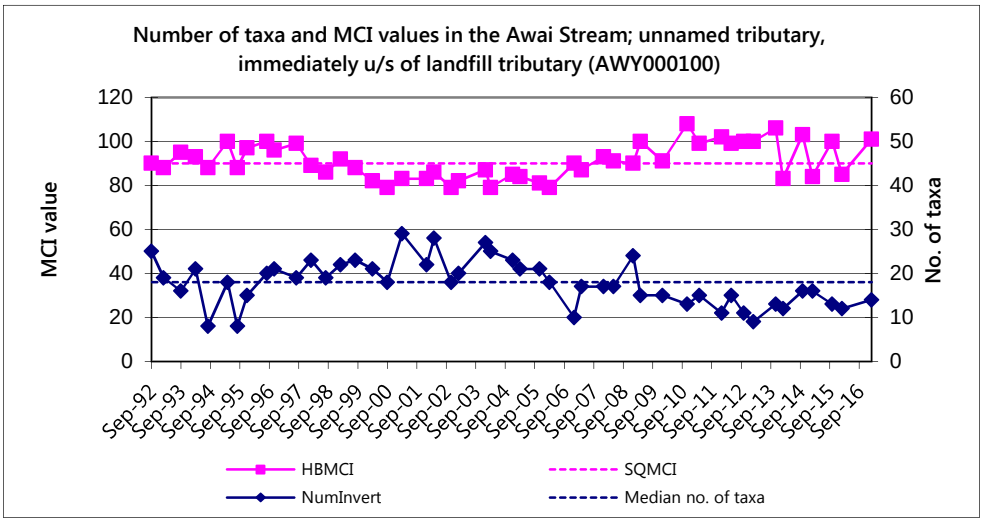

Figure 4 Number of taxa and MCI values at site 2 in a tributary of the Awai Stream

The community was characterised by two 'sensitive' taxa; [mayfly (*Zephlebia group*) and amphipod (Paraleptamphopidae)](Table 3). The $SQMCI_s$ score of 5.2 units (Table 2) was substantially higher than the

median score recorded at the site previously (by 1.3 units) and was higher than the score recorded at site 1a and 1b in the small unnamed tributary (by 2.9 units and 1.2 units respectively).

Site 3

A total of 17 taxa was found at site 3 below the confluence with the landfill drainage tributary, which was two taxa less than the median richness recorded by previous surveys. The MCI score of 82 units was lower (by 9 units) than the median for this site but a significant (Stark, 1998) 13 units higher than that recorded in the previous survey (Figure 5).

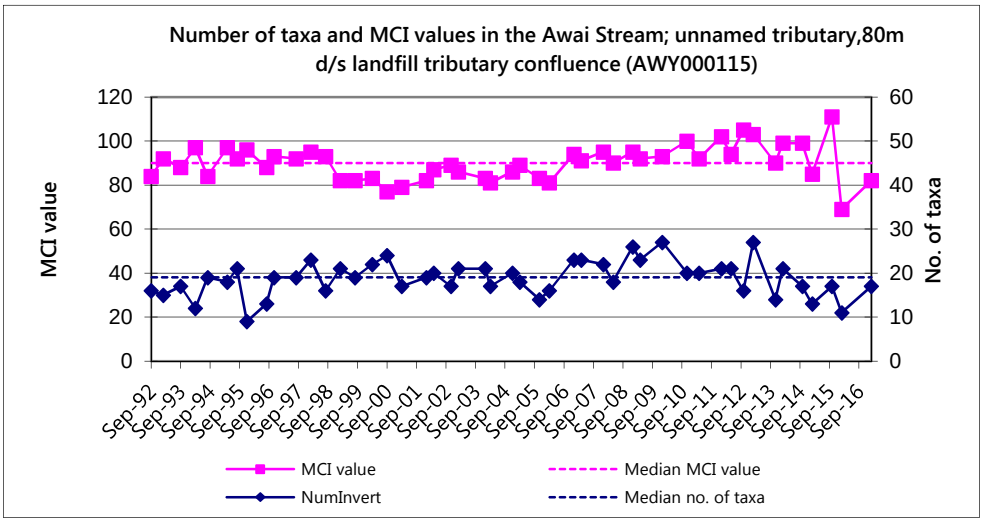

Figure 5 Number of taxa and MCI values at site 3 in a tributary of the Awai Stream

The macroinvertebrate community at this site was characterised by two 'tolerant' taxa; [oligochaete worms, and chironomid midge (*Polypedilum*)], and one 'moderately sensitive' taxon; [mites (Acarina)] (Table 3). A similar numerical dominance of both 'tolerant' and 'sensitive' taxa in the community resulted in the $SQMCI_s$ score of 3.3 units, which was the same as the median score recorded at this site by previous surveys.

Discussion and conclusions

Wetland and grassy stream habitats such as at sites 1a and 1b often support abundances of molluscs, crustacea, true flies (dipterans), and certain caddisflies, and this was reflected by the current survey.

At the time of this February survey, there was a low flow of slow water recorded at site 1a which was indicative of a seepage feed stream. This was reflected in the macroinvertebrate community recorded at the site which was numerically dominated by low scoring 'tolerant' taxa. This resulted in a low MCI of 64 units and a low $SQMCI_s$ score of 2.3 units. The MCI and $SQMCI_s$ scores were both within the range of scores recorded at the site in previous surveys.

Previous surveys typically recorded a poorer community at site 1a than at site 1b.The results of this survey were consistent with this. There was a 13 taxa increase in taxa richness between the sites, and the $SQMCI_s$ score increased substantially by 1.7 units. The MCI scores were not significantly different between sites (Stark, 1998).

In the current survey, the macroinvertebrate community recorded at the upstream 'control' site (2) consisted of a high proportion of 'sensitive' taxa which was reflected by the 'good' MCI score of 101 units. The MCI score at site 2 was significantly (Stark, 1998) higher than that recorded at sites 1a and 1b in the

smaller tributary if the Awai Stream. In addition, the $SQMCI_s$ score recorded at site 2 was substantially higher than that recorded at sites 1a and site 1b. This is most likely the result of differences in the habitat quality at site 2 compared to sites 1a and 1b and a change in sampling technique used between the sites.

The MCI and $SQMCI_s$ scores recorded at site 3 downstream of the confluence with the small tributary were significantly less (Stark, 1998) than those recorded at site 2 in this survey although the taxa richness was slightly higher, and community composition was relatively similar, with only four significant differences in taxa abundance. The significant differences in MCI and $SQMCI_s$ scores are equated to differences in habitat quality. The MCI score recorded at site 3 had improved significantly (Stark, 1998) from the previous February 2016 survey, likely due to a slight habitat improvement at this site (greater flow) and also reflective of the improvements made to site access prior to the current survey which enabled sampling to be carried out more effectively.

Overall, the results suggest that differences in the macroinvertebrate communities between the four sites relate to differences in habitat rather than the effects of any discharge from the landfill site.

Summary

Macroinvertebrate sampling was undertaken on 15 February 2017, at four sites in two tributaries of the Awai Streams, using a combination of the 'sweep-net' and 'kick' sampling techniques, both standard sampling techniques used by the Council. This was undertaken to assess whether leachate discharges from Inglewood landfill had had any adverse effects on the macroinvertebrate communities of this stream. 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 with the MCI or the $SQMCI_s$ between sites indicate the degree of adverse effects (if any) of the discharges monitored.

This February 2017 survey did not indicate that leachate from the Inglewood landfill had significantly affected the freshwater macroinvertebrate communities in these tributaries. These communities appear to be determined by the physical habitat conditions, particularly the low flow conditions, soft/fine substrate and changes in macrophyte habitats available to the aquatic invertebrates.

The smaller, landfill drainage tributary sites exhibited improvements in taxa richness and $SQMCI_s$ score in a downstream direction. The differences observed between the sites can probably be attributed to the difference in available habitat, with better habitat at site 1b (downstream). This site has progressively become choked with vegetation, but the wetted area is greater, and water speeds swifter.

Significant differences were recorded in the MCI and $SQMCI_s$ scores between sites 2 and 3 in the larger tributary of the Awai Stream which can be attributed to a number of slight changes in taxa abundances, the result of varying habitat condition.

The significant (Stark, 1998) improvement in MCI score recorded at site 3 from the February 2016 survey can be attributed to a slight improvement in habitat during the current survey (greater flow) and also to the improved access at this site, which meant a larger area of habitat could be sampled.

Site 2 had a higher MCI score compared to the two sites in the smaller tributary (1a and 1b) and again, differences in habitat condition were thought to be the main reason for these differences in the macroinvertebrate communities at all sites.

No sites supported any undesirable biological growths.

The results of this survey provide no indication that the discharge of leachate into the unnamed tributary of the Awai Stream was having a significant adverse effect on the macroinvertebrate communities in the tributaries monitored.

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To Job Manager, Lorraine Smith

From Scientific Officer, Brooke Thomas

Document 1904520

Date 31 July 2017

Biomonitoring of two unnamed tributaries of the Awai Stream, below the Inglewood landfill, May 2017

Introduction

This was the second biological survey undertaken of the two surveys scheduled for the 2016-2017 monitoring year in two tributaries of the Awai Stream in relation to the Inglewood landfill. Leachate from the landfill discharges to a small tributary, which then joins a larger tributary approximately 450m below the face of the landfill. Results of biological surveys performed in the tributaries since the 2001-2002 monitoring year are discussed in the series of reports referenced at the end of this report.

Methods

This survey was undertaken on 10 May 2017 at four sites in two tributaries of the Awai Stream; sites 1(a) and 1 (b) were located in the smaller tributary and sites 2 and 3 in the larger tributary (Table 1 and Figure 1).

The 'sweep-net' technique and a combination of the standard 400 ml 'kick-sampling' and 'sweep-net' sampling techniques were used to collect streambed macroinvertebrates. The 'kick-sampling' technique is very similar to Protocol C1 (hard-bottomed, semi-quantitative) protocol for macroinvertebrate samples in wadeable streams (Stark *et al*, 2001). The 'sweep-net' sampling technique was very similar to Protocol C2 (soft-bottomed, semi-quantitative) protocol of the New Zealand Macroinvertebrate Working Group (NZMWG).

Table 1 Biomonitoring sites in tributaries of the Awai Stream

Site number	Site code	Location
1a	AWY000105	Smaller tributary, 100 metres below tip face
1b	AWY000107	Smaller tributary, 400 metres below tip face
2	AWY000100	Larger tributary, above confluence with small tributary
3	AWY000115	Larger tributary, 80 metres below confluence with small tributary

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope 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). 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. After extensive use of the MCI, categories were assigned to the sensitivity scores, to clarify their 'relative' sensitivity e.g. taxa that scored between 1 and 4 inclusive are considered tolerant (see Table 3).

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	HBMCI	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.

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 these organisms is an indicator of organic enrichment within a stream.

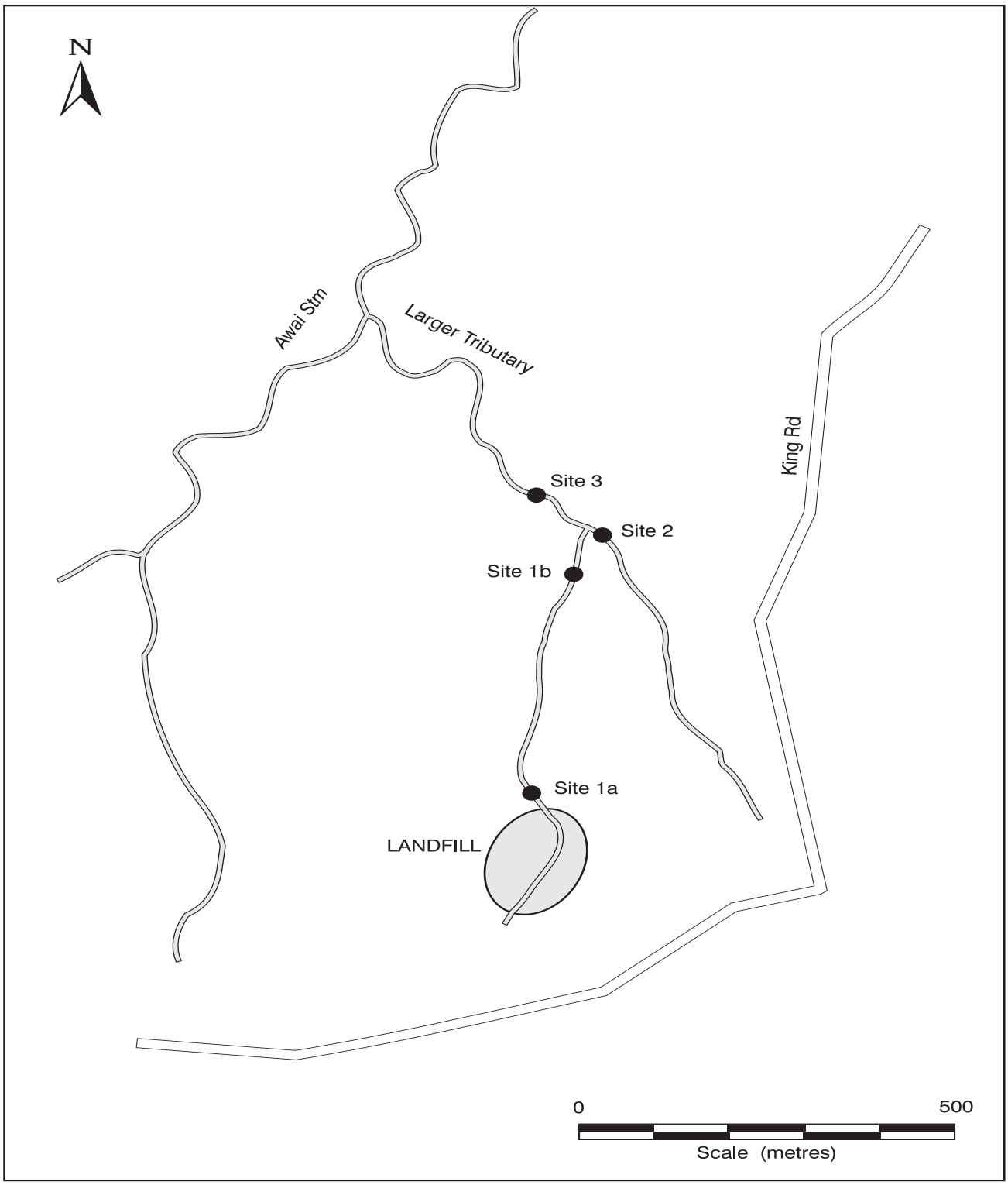

Figure 1 Biomonitoring sites in tributaries of the Awai Stream related to the Inglewood landfill

Results

This May 2017 survey was carried out under moderate to low flow conditions. The water at all sites was clear and uncoloured. It had been eight days since the nearby Mangaoraka Stream flowed at more than three times its median flow and ten days since flows exceeded seven times median.

The substrate comprised predominantly of silt at site 1a, silt, hard clay and wood/root at site 1b and a combination of silt, sand, gravels and woody debris at sites 2 and 3. There was a higher proportion of fine substrate (silt and sand) recorded at site 3 compared with site 2. Macrophytes were recorded on the bed and banks of the stream at site 1a and site 1b. No macrophytes were recorded at site 2 or site 3. The widespread iron oxide coating noted at site 1a, was recorded to a lesser extent at site 1b but not at sites 2 or 3. At the time of this survey, the water temperatures recorded ranged between 13.3 and 14.2°C. There was no shading at site 1a, partial shading at site 1b and complete shading at site 3 and site 2.There was no periphyton growing at any of the four sites. No site supported any undesirable biological growths.

Macroinvertebrate communities

A summary of results from previous surveys performed in the tributaries of the Awai Stream in relation to the Inglewood landfill are presented together with current results in Table 2. The full results of the present survey are provided in Table 3.

Table 2 Numbers of taxa and MCI values recorded in previous surveys related to the Inglewood landfill, together with current results

Site No	No. Taxa				MCI values				$SQMCI_s$ values			
	No. samples	Range	Median	Current result	No. Samples	Range	Median	Current result	No. samples	Range	Median	Current result
1a	45	4-23	15	20	45	60-92	72	82	35	1.2-3.6	2.6	1.6
1b	48	11-29	19	19	48	69-88	77	79	35	2.1-4.5	3.3	3.9
2	49	8-29	18	18	49	79-108	90	89	35	1.4-6.1	3.9	5.5
3	49	9-27	19	18	49	69-111	90	80	35	1.3-5.8	3.3	1.9

Table 3 Macroinvertebrate fauna of unnamed tributaries of the Awai Stream sampled in relation to the Inglewood landfill on 10 May 2017

Taxa List	Site Number	MCI score	1a	1b	2	3
	Site Code		AWY000105	AWY000107	AWY000100	AWY000115
	Sample Number		FWB17252	FWB17253	FWB17254	FWB17255
PLATYHELMINTHES (FLATWORMS)	*Cura*	3	-	R	R	-
NEMERTEA	Nemertea	3	R	R	R	C
NEMATODA	Nematoda	3	-	-	-	R
ANNELIDA (WORMS)	Oligochaeta	1	C	A	A	VA
MOLLUSCA	Lymnaeidae	3	R	R	-	-
	Potamopyrgus	4	A	XA	R	R
	Sphaeriidae	3	-	-	-	R
CRUSTACEA	Ostracoda	1	XA	C	C	C
	Isopoda	5	-	R	R	-
	Paracalliope	5	R	-	-	-
	Paraleptamphopidae	5	-	-	VA	C
	Paranephrops	5	-	-	R	R
EPHEMEROPTERA (MAYFLIES)	*Zephlebia group*	7	-	-	VA	R
ODONATA (DRAGONFLIES)	*Xanthocnemis*	4	A	R	-	-
	Hemicordulia	5	R	-	-	-
HEMIPTERA (BUGS)	*Microvelia*	3	-	C	-	-
TRICHOPTERA (CADDISFLIES)	Ecnomidae/Psychomyiidae	6	R	-	-	-
	Hydrobiosis	5	R	-	-	-
	Hydropsyche (Orthopsyche)	9	-	-	A	-
	Polyplectropus	6	R	C	-	R
	Psilochorema	6	R	R	R	-
	Oeconesidae	5	-	R	R	R
	Oxyethira	2	R	-	-	-
	Triplectides	5	-	-	C	C
DIPTERA (TRUE FLIES)	Hexatomini	5	-	-	R	-
	Paralimnophila	6	R	-	-	R
	Zelandotipula	6	R	R	-	-
	Orthocladiinae	2	-	-	-	R
	Polypedilum	3	VA	R	A	A
	Tanypodinae	5	R	R	R	R
	Paradixa	4	-	R	-	-
	Muscidae	3	R	-	-	-
	Austrosimulium	3	A	C	R	R
	Stratiomyidae	5	-	R	-	-
ACARINA (MITES)	Acarina	5	C	C	C	C
		No of taxa	20	19	18	18
		MCI	82	79	89	80
		SQMCIs	1.6	3.9	5.5	1.9
		EPT (taxa)	4	3	5	4
		%EPT (taxa)	20	16	28	22

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

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

Site 1a

A total of 20 taxa was recorded at site 1a, 100 metres downstream of the landfill face. This result was five taxa more than the median richness recorded at this site and 11 taxa more than that recorded by the previous survey (Table 2 and Figure 2). 'Tolerant' and 'sensitive' taxa made up equal proportions of the macroinvertebrate community, which was reflected by the 'fair' MCI score of 82 units. This MCI score was substantially higher than the median but within the range of MCI scores recorded to date. There was a significant (Stark, 1998) increase of 18 units in the MCI score at this site from the previous February 2017 survey, a reflection of the higher flow recorded at the time of sampling (Figure 2).

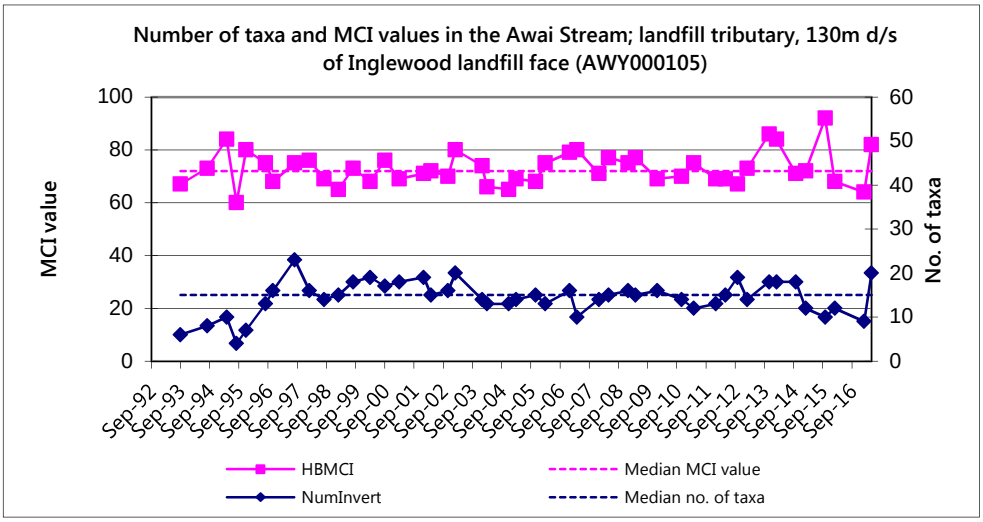

Figure 2 Number of taxa and MCI values at site 1a in a tributary of the Awai Stream

The macroinvertebrate community at this site was characterised by five 'tolerant' taxa [snail (*Potamopyrgus*), ostracod seed shrimp, damselfly larvae (*Xanthocnemis*), black sandfly larvae (*Austrosimulium*) and chironomid midge (*Polypedilum*)] (Table 3). The numerical dominance by 'tolerant' taxa resulted in the $SQMCI_s$ score of 1.6 units, which was substantially lower than the median $SQMCI_s$ by 1.0 unit (Table 2).

Site 1b

A total of 19 taxa was recorded at site 1b, approximately 400 metres downstream of the landfill face. This was the same as the median recorded at this site, three taxa less than that recorded by the previous survey and one taxon lower than that recorded at site 1a in this same survey. At the time of this survey 58% of the macroinvertebrate taxa recorded were 'tolerant' taxa, resulting in the low MCI score of 79 units. This MCI score was reflective of 'poor' macroinvertebrate health and was two units higher than the median score for the site (Figure 3) and 3 units lower than the MCI score recorded at site 1a.

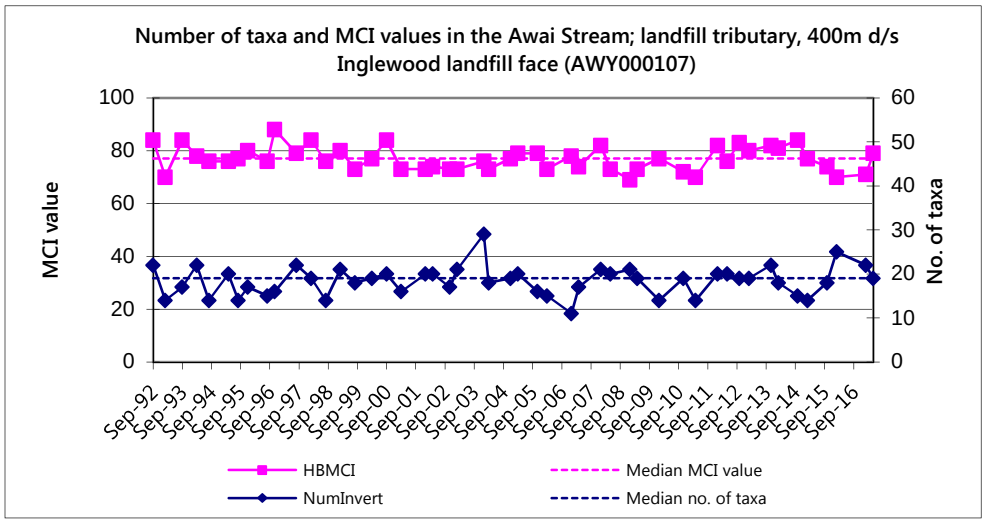

Figure 3 Number of taxa and MCI values at site 1b in a tributary of the Awai Stream

The macroinvertebrate community at this site was characterised by two 'tolerant' taxa [snail (*Potamopyrgus*) and oligochaete worms] (Table 3). The $SQMCI_s$ score of 3.9 units recorded at site 1b was 0.6 unit higher than the median score for the site and a substantial 2.3 units higher than that recorded at site 1a (Table 2).

Site 2

The 'control' site 2, upstream of the confluence with the landfill tributary had a community richness of 18 taxa, the same as the median number found by previous surveys (Table 2, Figure 4). A moderately high proportion of the community recorded at this site were 'sensitive' taxa (61%) which resulted in the 'fair' MCI score of 89 units (Table 3). This MCI score was similar to the median score recorded by the site previously and was not significantly (Stark, 1998) different to the MCI scores recorded at the two sites in the small unnamed tributary (sites 1a and 1b).

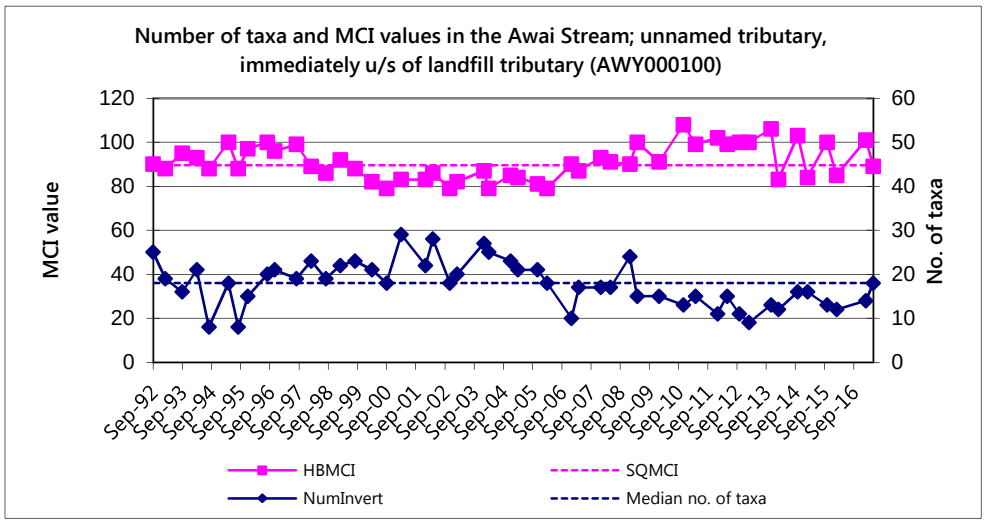

Figure 4 Number of taxa and MCI values at site 2 in a tributary of the Awai Stream

The community was characterised by two 'tolerant' taxa [oligochaete worms and chironomid midge (*Polypedilum*)], two 'moderately sensitive' taxa [mayfly (*Zephlebia group*) and amphipod (Paraleptamphopidae)] and one 'highly sensitive' taxon [caddisfly *(Hydropsyche-Orthopsyche*)] (Table 3). The

SQMCI$_s$ score of 5.5 units (Table 2) was substantially higher than the median score recorded at the site previously (by 1.6 units) and was substantially higher than the score recorded at site 1a and 1b in the small unnamed tributary (by 3.9 units and 1.6 units respectively).

Site 3

A total of 18 taxa was found at site 3 below the confluence with the landfill drainage tributary, which was one taxon less than the median richness recorded by previous surveys. The MCI score of 80 units was lower (by 10 units) than the median for this site but similar to that recorded by the previous survey (Figure 5). This MCI was again an improvement from the February 2016 survey which recorded the lowest MCI for the site to date (69 MCI units) (Figure 5).

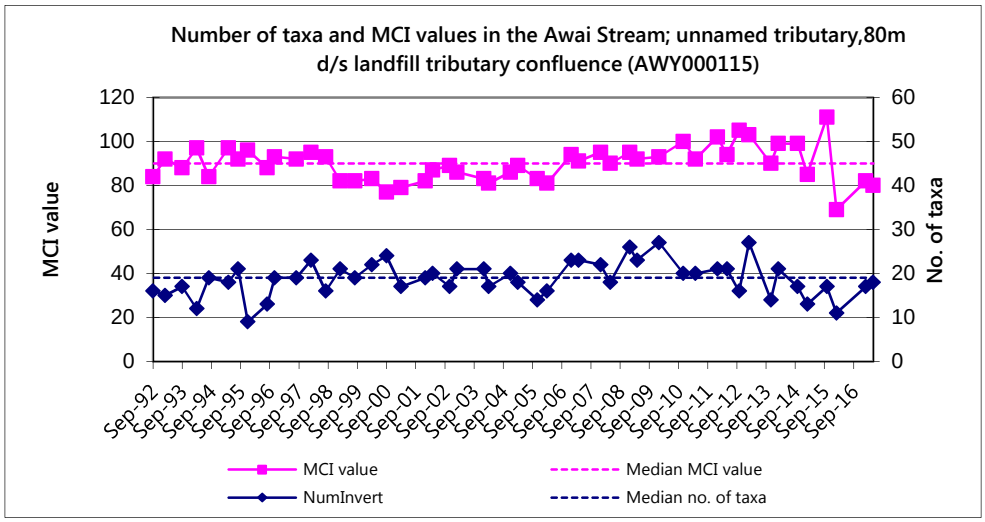

Figure 5 Number of taxa and MCI values at site 3 in a tributary of the Awai Stream

The macroinvertebrate community at this site was characterised by two 'tolerant' taxa [oligochaete worms, and chironomid midge (*Polypedilum*)] (Table 3). The numerical dominance of 'tolerant' taxa in the community resulted in the SQMCI$_s$ score of 1.9 units, which was substantially lower than the median score recorded at this site by previous surveys (Table 2).

Discussion and conclusions

Wetland and grassy stream habitats such as at sites 1a and 1b often support abundances of molluscs, crustacea, true flies (dipterans), and certain caddisflies, and this was reflected by the current survey.

At the time of this May survey, there was a low flow of steady water recorded at site 1a which was indicative of a seepage feed stream. This was reflected in the macroinvertebrate community recorded at the site which was numerically dominated by low scoring 'tolerant' taxa. This resulted in a low MCI of 82 units and a low SQMCI$_s$ score of 1.6 units. The MCI and SQMCI$_s$ scores were both within the range of scores recorded by the site in previous surveys.

Previous surveys typically recorded a poorer community at site 1a than at site 1b. However the results of this survey showed no substantial differences in taxa richness and MCI score between the two sites; although the SQMCI$_s$ score increased substantially by 2.3 units from site 1a and 1b.

In the current survey, the macroinvertebrate community recorded at the upstream 'control' site (2) consisted of a moderately high proportion of 'sensitive' taxa, which was reflected by the 'fair' MCI score of 89 units. The MCI score at site 2 was higher than that recorded at sites 1a and 1b in the smaller tributary of the Awai Stream. In addition, the $SQMCI_s$ score recorded at site 2 was substantially higher than that recorded at sites 1a and site 1b. This is most likely the result of differences in the habitat quality at site 2 compared to sites 1a and 1b and a change in sampling technique used between the sites.

The MCI and $SQMCI_s$ scores recorded at site 3 downstream of the confluence with the small tributary were substantially lower than those recorded at site 2, although the taxa richness was the same at both sites. The community composition was relatively similar, with only three significant differences in taxa abundance between sites. The differences in MCI and $SQMCI_s$ scores are equated to differences in habitat quality. The MCI score recorded at site 3 showed a continued improvement from the very low MCI score recorded by the February 2016 survey. Again, this is likely due to a slight habitat improvement at this site (greater flow) and is also reflective of the improvements made to access at this site, which enabled sampling to be carried out more effectively.

Overall, the results suggest that differences in the macroinvertebrate communities between the four sites relate to differences in habitat rather than the effects of any discharge from the landfill site.

Summary

Macroinvertebrate sampling was undertaken on 10 May 2017, at four sites in two tributaries of the Awai Stream, using a combination of the 'sweep-net' and 'kick-sampling' techniques, both standard sampling techniques used by the Council. This was undertaken to assess whether leachate discharges from Inglewood landfill had had any adverse effects on the macroinvertebrate communities of this stream. 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 with the MCI or the $SQMCI_s$ between sites indicate the degree of adverse effects (if any) of the discharges monitored.

This May 2017 survey did not indicate that leachate from the Inglewood landfill had significantly affected the freshwater macroinvertebrate communities in these tributaries. These communities appear to be determined by the physical habitat conditions, particularly the flow conditions, soft/fine substrate and changes in macrophyte habitats available to the aquatic invertebrates.

The smaller, landfill drainage tributary sites exhibited an improvement in $SQMCI_s$ score in a downstream direction. The differences observed between the sites can probably be attributed to the difference in available habitat, with better habitat at site 1b (downstream). This site has progressively become choked with vegetation, but the wetted area is greater, and water speeds swifter.

Substantial differences were recorded in the MCI and $SQMCI_s$ scores between sites 2 and 3 in the larger tributary of the Awai Stream which can be attributed to a number of slight changes in taxa abundances, the result of varying habitat condition.

The significant (Stark, 1998) improvement in MCI score recorded at site 3 from the February 2016 survey can be attributed to a slight improvement in habitat during the current survey (greater flow) and also to the improved access at this site, which meant a larger area of habitat could be sampled.

Site 2 had a higher MCI score compared to the two sites in the smaller tributary (1a and 1b) and again, differences in habitat condition were thought to be the main reason for these differences in the macroinvertebrate communities at all sites.

No sites supported any undesirable biological growths.

The results of this survey provide no indication that the discharge of leachate into the unnamed tributary of the Awai Stream was having a significant adverse effect on the macroinvertebrate communities in the tributaries monitored.

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Appendix III

Marfell – Laboratory analytical report semi volatile organic compounds

Hill Laboratories
BETTER TESTING BETTER RESULTS

R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	Taranaki Regional Council	**Lab No:**	1633626	SPv1
Contact:	L Smith	**Date Received:**	19-Aug-2016	
	C/- Taranaki Regional Council	**Date Reported:**	30-Aug-2016	
	Private Bag 713	**Quote No:**	79895	
	Stratford 4352	**Order No:**		
		Client Reference:	Marfell Park Landfill Discharge	
		Submitted By:	Rae West	

Sample Type: Aqueous

Sample Name:		STW001123 18-Aug-2016 10:40 am				
Lab Number:		1633626.1				
Haloethers Trace in SVOC Water Samples by GC-MS						
Bis(2-chloroethoxy) methane	g/m³	< 0.0005	-	-	-	-
Bis(2-chloroethyl)ether	g/m³	< 0.0005	-	-	-	-
Bis(2-chloroisopropyl)ether	g/m³	< 0.0005	-	-	-	-
4-Bromophenyl phenyl ether	g/m³	< 0.0003	-	-	-	-
4-Chlorophenyl phenyl ether	g/m³	< 0.0005	-	-	-	-
Nitrogen containing compounds Trace in SVOC Water Samples, GC-MS						
2,4-Dinitrotoluene	g/m³	< 0.0010	-	-	-	-
2,6-Dinitrotoluene	g/m³	< 0.0010	-	-	-	-
Nitrobenzene	g/m³	< 0.0005	-	-	-	-
N-Nitrosodi-n-propylamine	g/m³	< 0.0010	-	-	-	-
N-Nitrosodiphenylamine + Diphenylamine	g/m3	< 0.0010	-	-	-	-
Organochlorine Pesticides Trace in SVOC Water Samples by GC-MS						
Aldrin	g/m³	< 0.0005	-	-	-	-
alpha-BHC	g/m³	< 0.0005	-	-	-	-
beta-BHC	g/m³	< 0.0005	-	-	-	-
delta-BHC	g/m³	< 0.0005	-	-	-	-
gamma-BHC (Lindane)	g/m³	< 0.0005	-	-	-	-
4,4'-DDD	g/m³	< 0.0005	-	-	-	-
4,4'-DDE	g/m³	< 0.0005	-	-	-	-
4,4'-DDT	g/m³	< 0.0010	-	-	-	-
Dieldrin	g/m³	< 0.0005	-	-	-	-
Endosulfan I	g/m³	< 0.0010	-	-	-	-
Endosulfan II	g/m³	< 0.0010	-	-	-	-
Endosulfan sulfate	g/m³	< 0.0010	-	-	-	-
Endrin	g/m³	< 0.0005	-	-	-	-
Endrin ketone	g/m³	< 0.0010	-	-	-	-
Heptachlor	g/m³	< 0.0005	-	-	-	-
Heptachlor epoxide	g/m³	< 0.0005	-	-	-	-
Hexachlorobenzene	g/m³	< 0.0005	-	-	-	-
Polycyclic Aromatic Hydrocarbons Trace in SVOC Water Samples						
Acenaphthene	g/m³	0.0004	-	-	-	-
Acenaphthylene	g/m³	< 0.0003	-	-	-	-
Anthracene	g/m³	< 0.0003	-	-	-	-
Benzo[a]anthracene	g/m³	< 0.0003	-	-	-	-
Benzo[a]pyrene (BAP)	g/m³	< 0.0003	-	-	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	g/m³	< 0.0003	-	-	-	-

Sample Type: Aqueous						
Sample Name:		STW001123 18-Aug-2016 10:40 am				
Lab Number:		1633626.1				
Polycyclic Aromatic Hydrocarbons Trace in SVOC Water Samples						
Benzo[g,h,i]perylene	g/m³	< 0.0003	-	-	-	-
Benzo[k]fluoranthene	g/m³	< 0.0003	-	-	-	-
1&2-Chloronaphthalene	g/m³	< 0.0003	-	-	-	-
Chrysene	g/m³	< 0.0003	-	-	-	-
Dibenzo[a,h]anthracene	g/m³	< 0.0003	-	-	-	-
Fluoranthene	g/m³	< 0.0003	-	-	-	-
Fluorene	g/m³	< 0.0003	-	-	-	-
Indeno(1,2,3-c,d)pyrene	g/m³	< 0.0003	-	-	-	-
2-Methylnaphthalene	g/m³	< 0.0003	-	-	-	-
Naphthalene	g/m³	0.0004	-	-	-	-
Phenanthrene	g/m³	< 0.0003	-	-	-	-
Pyrene	g/m³	< 0.0003	-	-	-	-
Phenols Trace (drinkingwater) in SVOC Water Samples by GC-MS						
2-Chlorophenol	g/m³	0.0005	-	-	-	-
2,4-Dichlorophenol	g/m³	< 0.0005	-	-	-	-
2,4,6-Trichlorophenol	g/m³	< 0.0010	-	-	-	-
Phenols Trace (non-drinkingwater) in SVOC Water Samples by GC-MS						
4-Chloro-3-methylphenol	g/m³	< 0.0010	-	-	-	-
2,4-Dimethylphenol	g/m³	< 0.0005	-	-	-	-
3 & 4-Methylphenol (m- + p-cresol)	g/m³	< 0.0010	-	-	-	-
2-Methylphenol (o-Cresol)	g/m³	< 0.0005	-	-	-	-
2-Nitrophenol	g/m³	< 0.0010	-	-	-	-
Pentachlorophenol (PCP)	g/m³	< 0.010	-	-	-	-
Phenol	g/m³	< 0.0010	-	-	-	-
2,4,5-Trichlorophenol	g/m³	< 0.0010	-	-	-	-
Plasticisers Trace (non-drinkingwater) in SVOC Water by GCMS						
Butylbenzylphthalate	g/m³	< 0.0010	-	-	-	-
Diethylphthalate	g/m³	< 0.0010	-	-	-	-
Dimethylphthalate	g/m³	< 0.0010	-	-	-	-
Di-n-butylphthalate	g/m³	< 0.0010	-	-	-	-
Di-n-octylphthalate	g/m³	< 0.0010	-	-	-	-
Plasticisers Trace (drinkingwater) in SVOC Water Samples by GCMS						
Bis(2-ethylhexyl)phthalate	g/m³	< 0.003	-	-	-	-
Di(2-ethylhexyl)adipate	g/m³	< 0.0010	-	-	-	-
Other Halogenated compounds Trace (drinkingwater) in SVOC Water						
1,2-Dichlorobenzene	g/m³	< 0.0005	-	-	-	-
1,3-Dichlorobenzene	g/m³	< 0.0005	-	-	-	-
1,4-Dichlorobenzene	g/m³	0.0011	-	-	-	-
Other Halogenated compounds Trace (non-drinkingwater) in SVOC						
Hexachlorobutadiene	g/m³	< 0.0005	-	-	-	-
Hexachloroethane	g/m³	< 0.0005	-	-	-	-
1,2,4-Trichlorobenzene	g/m³	< 0.0005	-	-	-	-
Other SVOC Trace in SVOC Water Samples by GC-MS						
Benzyl alcohol	g/m³	< 0.005	-	-	-	-
Carbazole	g/m³	< 0.0005	-	-	-	-
Dibenzofuran	g/m³	< 0.0005	-	-	-	-
Isophorone	g/m³	< 0.0005	-	-	-	-

Analyst's Comments

It was noted that Security Seals were applied and intact on receipt at the laboratory.

SUMMARY OF METHODS

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

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Semivolatile Organic Compounds Trace in Water by GC-MS	Liquid/Liquid extraction, GPC cleanup (if required), GC-MS FS analysis	-	1

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

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

Peter Robinson MSc (Hons), PhD, FNZIC
Client Services Manager - Environmental