New Plymouth District Council
Inglewood Oxidation Ponds System
Monitoring Programme
Annual Report
2013-2014

Technical Report 2014-16

ISSN: 0114-8184 (Print)
ISSN: 1178-1467 (Online)
Document: 1373492 (Word)
Document: 1410444 (Pdf)

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October 2014

Executive summary

The New Plymouth District Council operates the Inglewood municipal oxidation ponds treatment system located at Inglewood in the Kurapete catchment.

The New Plymouth District Council holds a renewed resource consent allowing for the discharge of treated wastewater overflows to the Kurapete Stream, a small tributary of the Manganui River in the Waitara catchment. Following the successful diversion of all dry weather wastewater inflows from the ponds' system to the New Plymouth wastewater treatment plant (via the former Moa-Nui dairy pipeline) in late 1999, the renewed consent authorises only intermittent wet weather overflows of treated wastewater to the Kurapete Stream. The previous consent expired in June 2003 and was renewed in September 2004. The renewed resource consent includes a total of 13 special conditions setting out the requirements that the New Plymouth District Council must satisfy.

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

The Council's monitoring programme included three regular inspections, one additional inspection, and two biological receiving water surveys. Two short duration overflows (four to five days) occurred between late September and mid October 2013.

Regular inspections indicated no problems with the ponds' system maintenance or operation, with no unauthorised overflows to the stream of any nature. Two incidents of stormwater/sewage overflows were reported in the Konini Street area of the township due to surcharging of the reticulation under very heavy rainfall conditions. Reactivation of an alarmed and telemetered overflow site has been necessary to alleviate sewage entry to domestic property. Signage requirements have been recognised and provided for should such events re-occur.

Pond microfloral monitoring which had indicated a trend of improved in-pond conditions under the post-diversion operating regime of maintenance of mainly low main pond levels for stormwater infiltration storage purposes, have been superceded by chlorophyll-a monitoring which indicated marked variability correlated with varying dissolved oxygen saturation.

Reduction in stormwater infiltration to the reticulation system had been the subject of completed work, and generally had been successful in reducing the frequency of authorised overflows in recent years. Some overflows have continued to occur, but in compliance with the condition authorised by the consent. However, considerable investigative work has been programmed by the consent holder subsequent to more frequent 2011-2012, 2012-2013, and 2013-2014 overflow events which have indicated more recent direct stormwater inflows to the reticulation. One major source was found and eliminated during the current year and the pumping system was replaced with improvements made to delivery capabilities via the pipeline to the New Plymouth WWTP.

The spring and summer biomonitoring surveys in the Kurapete Stream documented maintenance of the marked recovery in biological communities which had been recorded soon after the diversion of all discharges out of the stream (in late 1999), and the satisfactory sealing of the new outfall.

An extended spring survey also documented no impacts of a very diluted, relatively recent wastewater overflow on the biological communities at three sites downstream of the discharge. Trend evaluation of the eighteen years of biomonitoring data has highlighted a significant statistical temporal improvement in the biological 'health' of the lower reaches of the Kurapete Stream, attributable to the removal of the continuous discharge. The temporal trend has lessened in significance more recently, but stream biological 'health' has been maintained at an improved level relative to pre-diversion 'health'.

Riparian initiatives have been undertaken by most landowners in the Kurapete Stream catchment (twenty-eight plans prepared to date) and the financial contribution provided by the consent holder (as a condition of the previous discharge permit) has been completely utilised.

New Plymouth District Council demonstrated a very good level of environmental performance over the period and a very good level of consent compliance.

Recommendations include continuation of the reduced monitoring programme formulated for the renewed consent, and provision for timely reporting of each overflow event in order that any additional relevant monitoring can be undertaken. This recognises the marked improvement in receiving water conditions documented in recent years and relative infrequency of overflows from the system over the past ten years, although it has been noted that the number of these consented overflows has increased in the last five year period.

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1. Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is the Annual Report for the period July 2013 to June 2014 by the Taranaki Regional Council on the monitoring programme associated with a resource consent held by New Plymouth District Council for the Inglewood municipal oxidation pond system in the Kurapete catchment.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consent held by New Plymouth District Council that relates to the potential discharge of wastes within the Kurapete catchment.

This is the twenty-seventh annual report to be prepared by the Taranaki Regional Council to cover the treatment and disposal of wastewater from the Inglewood municipal plant.

1.1.2 Structure of this report

Section 1 of this report is a background section. It sets out general information about compliance monitoring under the *Resource Management Act 1991* (RMA) and the Council's obligations and general approach to monitoring sites through annual programmes, the resource consents held by New Plymouth District Council, the nature of the monitoring programme in place for the period under review, and a description of the activities and operations conducted in the Inglewood Oxidation Ponds system.

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

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

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

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

1.1.3 The Resource Management Act 1991 and monitoring

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

(a) the neighbourhood or the wider community around a discharger, and may include cultural and socio-economic effects;

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

In drafting and reviewing conditions on discharge permits, and in implementing monitoring programmes, the Taranaki Regional Council is recognising the comprehensive meaning of `effects' inasmuch as is appropriate for each discharge source. 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 performance of resource users against regional plans and consents. Compliance monitoring, including impact monitoring, also enables the Council to continuously assess its own performance in resource management as well as that of resource users particularly consent holders. It further enables the Council to continually re-evaluate its approach and that of consent holders to resource management, and, ultimately, through the refinement of methods, to move closer to achieving sustainable development of the region's resources.

1.1.4 Evaluation of environmental performance

Besides discussing the various details of the performance and extent of compliance by the New Plymouth District Council during the period under review, this report also assigns an overall rating. The categories used by the Council, and their interpretation, are as follows:

- a **high** level of environmental performance and compliance indicates that essentially there were no adverse environmental effects to be concerned about, and no, or inconsequential (such as data supplied after a deadline) non-compliance with conditions.

- a **good** level of environmental performance and compliance indicates that adverse environmental effects of activities during the monitoring period were negligible or minor at most, or, the Council did not record any verified unauthorised incidents involving significant environmental impacts and was not obliged to issue any abatement notices or infringement notices, or, there were perhaps some items noted on inspection notices for attention but these items were not urgent nor critical, and follow-up inspections showed they have been dealt with, and inconsequential non compliances with conditions were resolved positively, co-operatively, and quickly.

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

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

1.2 Treatment plant system

1.2.1 Background

Prior to late 1999 municipal wastewater was discharged to the Kurapete Stream following treatment in an oxidation pond system (2.66 hectares in area) designed for a year 1970 population of 2500 persons, and a year 1990 population of 3100 persons with additional mechanical aeration. The present population is close to 3000 persons and there is a minimal industrial wastes component of the wastewater loading on the system. Historical problems relating to siltation of the treatment ponds and refurbishment measures undertaken by NPDC have been documented in several TRC Annual Reports (see Bibliography) culminating in the consent holder commissioning a number of investigations and reports to assist in determining the preferred treatment and disposal option for Inglewood sewage in the longer term and as a requirement for renewal of the discharge permit (in December 1998).

In summary, the preferred option was to pipe effluent from the Inglewood oxidation pond using the existing Moa-Nui effluent line from Inglewood to Brixton and a new pipeline to Bell Block. Under this option effluent was to be pumped at 44 L/s and gravity fed to the New Plymouth wastewater treatment plant for further treatment prior to discharge to the Tasman Sea. This option utilised the existing ponds at Inglewood for attenuation during peak rainfall events. During extreme peak flows, overflows from the pond were predicted to occur given the limited amount of attenuation available. Accordingly, overflow facilities would be utilised during peak storm flows to treat pond effluent before discharge to the stream occurred. The number and duration of overflows from the pond would be rainfall dependent but estimated to be in the order of 3.3 overflows per year. No continuous discharge would therefore occur from the ponds' system in the long term. It was also recommended that a rock filter be incorporated into the design for use in high flow periods to mitigate the impacts of discharge overflow to the Kurapete Stream.
The provision and maintenance of up-graded screening of the original outlet from the second pond and the rock filter on the new outfall was intended to improve the aesthetic quality of any overflow discharge of treated effluent by reduction of the debris which had accumulated previously in streamside vegetation to the concern of downstream property owners, particularly following stream freshes.

The capacity of the Moa-Nui pipeline was limited to about 44 L/s. It was estimated that when the capacity of the pipeline was exceeded the average duration of each overflow would be between five and seven days per event. Accordingly consent was sought to discharge overflow from the ponds as required during high rainfall events.

To reduce the effect of stormwater and groundwater influent volumes on sewage flows the New Plymouth District Council committed $100,000 per annum to a specialised inspection and maintenance programme including closed circuit video inspection to assess the condition of pipelines, coupled with visual inspection of manholes and smoke or dye testing of household drains. It was proposed that any faults identified would be prioritised and then rectified using insitu repair technologies. New Plymouth District Council is committed to reducing influent volumes to achieve a nil overflow situation. This will achieve the ultimate objective of no wastewater discharges to the Kurapete Stream. Achieving this outcome would depend to some extent on the existing condition of the reticulation.

After three consent pre-hearing meetings were held with submitters and following a formal hearing by the Regional Council, in late 1998, a consent was granted to New Plymouth District Council to provide for the intermittent discharge of screened, oxidation pond treated wastewater to the Kurapete Stream. Discharges were only occurring during periods when the attenuation capacity of the system was exceeded (i.e. when stormwater and groundwater inflows are excessive). This consent was renewed in September 2004 with an expiry date of June 2015.

Diversion of the wastewater discharge to the New Plymouth wastewater treatment system was substantially completed by late 1999 (TRC, 2003), with only minor overflows to the stream subsequently recorded, mainly as a result of operational refurbishment activities.

Although sealing of this original outfall pipe was undertaken by the consent holder in the 1999-2000 period, a steady overflow (1 L/sec) continued to occur from the outfall pipe after very high pond levels in early October 2000. Concrete sealing again was undertaken in early December 2000 and no further discharge occurred from this outfall into the Kurapete Stream.

The alarm system was overhauled in 1999-2000 and an operating manual updated for the system by NPDC. Self-monitoring of the ponds' system by the consent holder was also being undertaken on a regular basis.

No occurrences of anaerobic pond conditions, nor objectionable odours, have been recorded since an incident in mid 1997 (see TRC 1998 and TRC 1999).

Development and implementation of a stormwater infiltration reduction programme, as required by Special Condition 5 of the consent was instigated by the consent holder and progress has been reported at required intervals. Considerable work has been reported by the consent holder and included a manhole replacement programme, lateral replacements, an ongoing sewer patching programme and continued flow monitoring. All new stormwater systems have been constructed at a deeper level than any adjacent sewer in order to reduce groundwater inflow into the sewerage system. Nearly $1.1 million was spent by the consent holder over the 2000-2002 period and a further $0.5 million spent by the end of 2004 for the purposes of sewer mains and laterals refurbishment, replacement of faulty manholes, maintenance work and measurement of this work's effectiveness. Contract work continued until mid 2006 with a further $75,000 spent during the 2005-2006 financial year, a reduction which reflected the success of the extensive infiltration reduction programme. This completed the repairs to all faulty laterals and the consent holder has reported a move to a straight maintenance regime.

The consent holder re-examined the predictive flow model for the system using the existing main pond operation range and maximum pumping capacity (to the NPDC wastewater treatment plant). The secondary pond was deepened during 1999-2000 to increase the storage capacity. The predictive model indicated a much reduced likelihood of pond overflow of 3 occurrences in total over any 10 year period as a result of this increased pond capacity and higher diversion pumping rate than originally proposed.

Previously, NPDC advised that investigations into cross connections between sewer and stormwater systems would be undertaken to identify any inflow point sources which may have caused rapid increases in inflows to the WWTP (such as 300% increase over 30 minutes in early September 2010).

Development and implementation of a stormwater infiltration reduction programme, as required by Special Condition 5 of the consent, has been instigated by the consent holder and progress has been reported at required intervals. Considerable work has been reported by the consent holder and includes a manhole replacement programme, lateral replacements, an ongoing sewer patching programme and continued flow monitoring.

All new stormwater systems have been constructed at a deeper level than any adjacent sewer in order to reduce groundwater inflow into the sewerage system. Most of the sewer patching had been completed by June 2002 with further manhole replacement work continuing through 2002-2003 and maintenance work on the main sewer and laterals and monitoring of its effectiveness performed during the four previous monitoring periods. The consent holder reported that the pump station and screening system operated efficiently throughout the period. New flow metering of the pump outlet had been installed in January 2010. The increased frequency of overflows (above that predicted) has warranted further investigations by the consent holder which have indicated that large initial inflow responses to rainfall are thought to be due to direct stormwater inflow to the reticulation. This has led to the initiation of further smoke-testing (as method of identifying illegal cross-connections of stormwater systems to sewer) in an identified quadrant of the town where the source of the inflow is considered to be greatest. NPDC subsequently identified a number of sources of direct inflows to the sewerage system with follow-up remedial works required of landowners (HPDC. pers comm, August 2012). Work also continued to further identify direct connections(s) between stormwater and sewerage systems. A significant direct washdown and stormwater connection has been subsequently identified and removed in August, 2013. Only minor cross-connections have been found by smoke testing investigations.

Two new pumps with improved delivery capabilities were installed during the 2013-2014 period. These will be more energy efficient and provide an increase in maximum delivery capacity and deliver a small increase in flow during prolonged operation (see Appendix III, TRC 2013) as the pump station will operate to match the incoming flow.

Re-lining and repairs to the trunk sewer were completed by May 2014. Joint seal failures detected during this work were indicative of a high potential for inflow and infiltration to occur. The effectiveness of these repairs will continue to be assessed from inflow data during wet weather events and initial indications (from June 2014) suggest reduced peak inflows and significant reductions in infiltration (see Appendix III).

Wet weather in April 2014, May 2014 and June 2014 raised pond levels but not to overflow levels indicating that work done to reduce stormwater infiltration and inflow has had a marked effect.

No additional trade wastes connections to the sewerage reticulation were recorded during the 2009-2014 monitoring periods. It should be noted that industrial waste disposal tankers are not encouraged to use the Inglewood oxidation pond treatment system for disposal and treatment purposes, but preferably to utilise the New Plymouth City wastewater treatment system (NPDC, pers. comm.). Controlled facilities also exist at the Stratford and Hawera oxidation ponds treatment systems for wastes disposal of this nature from within those districts.

1.3 Resource consents

1.3.1 Water discharge permit

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

New Plymouth District Council holds water discharge permit 1449 to cover the intermittent discharge of treated municipal wastewater into the Kurapete Stream. This permit was issued by the Taranaki Regional Council on 10 December 1998 as a resource consent under Section 87(e) of the RMA. It expired on 1 June 2003 and the renewal was granted on 1 September 2004 until June 2015 with review dates of June 2005 and June 2010.

Discharges are only intended to occur during periods when the attenuation capacity of the refurbished system is exceeded (ie, when stormwater and groundwater inflows to the reticulation are excessive).

A copy of the consent is included as Appendix I. Special conditions attached to the consent require diversion of the normal dry weather wastewater discharges and part of the wet weather component out of the Kurapete Stream to the New Plymouth wastewater treatment plant. The diversion effectively commenced in November 1999. Definition of the discharge periods, requirements for screening the final effluent, record-keeping, operation of the system and appropriate monitoring of both the system and the receiving waters are also provided by special conditions.

Other special conditions require the continued implementation of a stormwater infiltration reduction programme by the consent holder.

1.4 Monitoring programme

1.4.1 Introduction

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

The Taranaki Regional Council may therefore make and record measurements of physical and chemical parameters, take samples for analysis, carry out surveys and inspections, conduct investigations, and seek information from consent holders.
A monitoring programme appropriate to the renewed consent, for the intermittent discharge of treated, screened municipal wastewater was established during the 1999-2000 period. This programme was reduced in intensity in 2007-2008 in relation to inspection frequency and sampling of wastewater quality and physicochemical water quality effects on the Kurapete Stream, as no overflows to the stream had occurred for several years, and the management of the system had been of a very high standard. Subsequently, overflows have increased in frequency and the necessary monitoring has been adjusted accordingly.

The monitoring programme over the 2013-2014 period consisted of the following primary components.

1.4.2 Programme liaison and management

There is generally a significant investment of time and resources by the Taranaki Regional Council in ongoing liaison with resource consent holders over consent conditions and their interpretation and application, in discussion over monitoring requirements, preparation for any reviews, renewals, or new consents, advice on the Council's environmental management strategies and the content of regional plans, and consultation on associated matters. This was particularly relevant during and following the transition phase involving the diversion of the wastewater to the New Plymouth wastewater treatment plant.

1.4.3 Site inspections

The Inglewood wastewater treatment plant site was visited three times as programmed during the monitoring period. The main points of interest were plant operation, maintenance and performance, particularly in relation to the provision of ponds' buffering capacity in order to prevent and reduce the frequency of treated effluent discharges to the Kurapete Stream. One additional inspection was performed during the 2013-2014 monitoring year, coincident with an overflow event in September 2013.

1.4.4 Wastewater and receiving water quality sampling

This component of the monitoring programmes has been removed in recognition of the relatively infrequent nature and minimal effects of overflows to date.

1.4.5 Biological surveys of the receiving waters

Macroinvertebrate biological receiving surveys were performed at four sites in the Kurapete Stream under relatively low flow conditions spring 2013 (an extended survey following a recent overflow event) and at two sites under very low flow conditions in late summer 2014. The surveys had been reduced in intensity (from four to two sites) in spring 2007 in recognition of the documented recovery of the biological stream communities since the removal of the continuous discharge to the stream. However, provision for extended four site surveys remained if necessitated by prolonged overflow events (e.g. September, 2013). These surveys have also been incorporated within the Council's temporal trending State of the Environment Monitoring programme (see TRC, 2009a and TRC, 2014)).

2. Results

2.1 Inspections of treatment system operation

Three regular scheduled inspections of the system were performed during the monitoring period. One additional inspection was made during a notified overflow event in late September 2014.

Physical features of the system were recorded and the surface dissolved oxygen concentration of the final section of the main pond was measured (by Winkler technique) adjacent to the effluent outlet on the three regular inspection occasions (Table 1). A sample was also collected from the same site at the time of inspections, for chlorophyll-a analysis (see Section 2.2.2).

Table 1 Dissolved oxygen measurements from the surface of the second section of the Inglewood oxidation pond system adjacent to the outlet

Date	Pond level (m)	Time (NZST)	Temperature (°C)	Dissolved oxygen	
				Concentration (g/m^3)	Saturation (%)
8 July 2013	1.23	0905	8.8	5.0	44
11 November 2013	1.18	0730	19.7	18.1	201
2 April 2014	0.56	0830	18.1	7.9	83

Aerobic conditions were recorded on all inspection occasions (Table 1), despite the lack of wave action on the surface of the main pond at most times and the low pond levels (on all three occasions) maintained to provide adequate flow buffering capacity since the effluent discharge was diverted away from the stream. The dissolved oxygen saturation levels (44% to 201%) were typical of biological treatment systems with supersaturation in early summer and a typical wide range, possibly a consequence of the maintenance of low operating pond levels and low wastes loadings on this pond. High saturation levels are generally indicative of additional contributions to dissolved oxygen levels from algal photosynthesis. As dissolved oxygen levels vary seasonally and on a daily basis (in response to climatic conditions and biological photosynthetic activity), with minimum concentrations recorded in early daylight hours, pond condition and performance were evaluated by confining sampling times to midmorning (between 0730 hours and 0945 hours in this monitoring period).

Generally, the surrounds to the entire pond system were maintained in a tidy condition due to the metalling which had been performed to enable access to the western perimeter, where refurbishment work had been done in the past on the wavebands. Maintenance was undertaken prior to the April, 2014 inspection.

All of the inspections were performed in calm conditions with minimal surface movement again apparent on either the primary pond aeration cell or the main pond, and no greater than rippling of the surface. Some of the surface movement on the primary cell was caused by mechanical aeration with one aerator operating on each of the three inspection occasions.

Aeration cell appearance varied only from turbid, pale brown to turbid dark brown to turbid, grey, while the main pond's appearance varied from relatively clear, pale brown to turbid, brown to turbid, grey-brown. No noticeable odours around the main pond were recorded on any inspection occasion during the period, with only very slight localised odours noted on two occasions downwind of the primary aeration cell.

Moderate numbers of wildlife [ducks (mallard and teal) and up to six black swan on all occasions] were noted on the main pond, with no wildfowl associated with the aeration cell on two inspection occasions and a few ducks on the other occasion. On all occasions the aeration cell level was relatively high, discharging a small volume into the main oxidation pond. This was due to a small inflow of raw sewage designed to maintain biological activity in the primary treatment cell although higher inflows occurred during and after extremely wet weather conditions.

The principal pond was managed at a low wastewater level (more than 1.0 m below outlet overflow) and an operating depth of about 0.7 to 1 metre, throughout the majority of the monitoring year while diversion of the raw wastewater to the New Plymouth wastewater treatment plant was occurring, with the particular exception of elevated pond levels after wet weather in June 2013, late September 2013, December 2013, January 2014 and May 2014. The concrete sealing of the old outfall pipe undertaken in December 2000 continued to be effective and no seepage discharge occurred from this outfall into the Kurapete Stream throughout the period.

Pond level is continuously monitored by the consent holder and the minimum level is maintained at approximately 1.5 metres below overflow level (which occurs at 2.4 metres (NPDC, pers comm)) as much as possible. Highest pond levels were recorded following heavy rainfall in late September 2013 when an overflow (over 4 days) occurred and in mid October, 2013 when another overflow was recorded. Signage was erected at Everett Park on the latter occasion by the consent holder (see Section 2.4).

Incorporation of the perimeter stormwater and landfill seepage tributary into the primary pond (by diversion drains) operated successfully through the period, although some further investigative work will be undertaken by NPDC in respect of the perimeter stormwater disposal system.

2.2 Results of wastewater treatment plant monitoring

2.2.1 Plant performance

In past monitoring periods, samples of the wastewater treatment plant system's effluent have been analysed as a component of summer assessments of effects surveys in the receiving waters of the Kurapete Stream. Since the wastewater diversion to the New Plymouth treatment plant was completed prior to the summer of 1999-2000, no summer physicochemical effluent or receiving water sampling has been necessary. However, two periods of overflow events were monitored by the consent holder (wastewater only), with samples collected and analysed by NPDC at the time of each event (see Appendix III). No aesthetic impacts were noticeable in the relatively high flow of the Kurapete Stream downstream of the outfall when the pond was overflowing at the time of the September 2013 additional inspection.

Prior to the wastes diversion, the consent holder had been required to monitor effluent quality on a two-monthly basis, as a special condition of discharge permit 1449, and report these results to the Taranaki Regional Council. This monitoring commenced in January 1992, continuing at two monthly intervals, until the diversion of the wastewater from the stream discharge. The renewed consent (1449) does not require effluent monitoring by the consent holder. A summary of historical effluent quality from monitoring by the consent holder and the Regional Council is presented in Table 2 [and includes wastewater quality data from selected overflow events to date including on two occasions in September and October 2013 (see Appendix III)].

Table 2 Inglewood oxidation pond system effluent: summary of analytical data monitored by NPDC and Taranaki Regional Council (1986 to August 1999) and effluent overflows monitored since 1999

Data source		NPDC						TRC				
Parameter	Unit	1992-1999		Overflows (2003-2013)		Overflows (2013-2014)		1986-1999			Overflows (2000 to 2013)	
		N	Range	N	Range	N	Range	N	Range	Median	N	Range
Dissolved oxygen	g/m^3	45	<0.2-15.0	-	-	-	-	74	<0.1-25	5.3	43	2.2-12.8
BOD_5*	g/m^3	45	8-57	19	<1-8	2	7-9	25	11-56	26	2	1.1-2.5
BOD_5 (filtered)*	g/m^3	45	2-24	-	-	-	-	19	4-17	10	-	-
pH		45	6.8-8.9	23	6.9-8.8	2	7.7-7.8	26	6.9-8.9	7.4	2	7.0-7.2
Conductivity @ 20°C	mS/m	-	-	-	-	-	-	25	11.8-38.6	25.0	2	15.0-16.3
Conductivity @ 25°C	mS/m	45	14.7-43.3	23	13.8-21.9	2	15.3-15.9	-	-	-	-	-
Ammonia-N	g/m^3N	45	1.2-32	23	0.1-5.5	2	0.88-1.5	26	0.71-22	9.17	2	2.74-3.16
Nitrite + nitrate-N	g/m^3N	45	<0.2-13.5	-	-		-	6	<0.01-0.46	0.08	2	0.62-0.92
Nitrate-N	g/m^3N	-	-	-	-		-	15	<0.01-0.69	0.06	-	-
Dissolved reactive phosphorus	g/m^3P	-	-	-	-		-	18	1.08-6.55	2.64	2	0.19-0.22
Suspended solids	g/m^3	45	<5-178	23	<5-38	2	<5-15	25	10-160	36	2	3
Faecal coliform bacteria	nos/100ml	45	$1.5x10^2$-$7.2x10^5$	21	$1.3x10^2$-$1.03x10^4$	2	$2.0x10^2$-$5.3x10^3$	26	$2.1x10^2$-$1.0x10^6$	$1.2x10^4$	2	190-1100

[Notes: * carbonaceous BOD_5 for NDPC data; DO since 2000 include regular inspection data; N = number of samples]

These data are presented for reference purposes as they provide a comprehensive historical summary of the variability in effluent quality for the Inglewood wastewater treatment system, both pre and post diversion to the NPDC WWTP.

Seasonal variations in system performance account for the ranges in most parameters. Variability in faecal coliform bacteria counts, suspended solids and dissolved oxygen concentrations generally occurred with the season, with increasing microfloral populations during summer months raising pH and dissolved oxygen levels and resulting in increased BOD (total) and suspended solids concentrations. The fluctuations in conductivity levels reflected the degree of stormwater infiltration (i.e., dilution) within the ponds' system, with lower levels particularly apparent following heavy rainfall events.

Wastewater treatment plant effluent sampled during overflow events to date has had a relatively clear appearance with very good effluent quality due to the extensive dilution provided by the stormwater infiltration. Nearly all parameters' levels have been well below historical median levels, particularly BOD_5, suspended solids, and faecal coliform bacteria numbers which have shown the influence of considerable stormwater dilution. In this regard, concentrations of BOD_5 and suspended solids have been significantly lower than previously recorded on almost every occasion. This continued to be the case during the overflow events of September and October 2013 when BOD_5 was < 10 g/m^3 , suspended solids was 15 g/m^3, and faecal coliform bacteria was less than 1 x 10^4 nos/100 ml.

2.2.2 Microflora of the treatment system

Pond microflora are very important for the stability of the symbiotic relation with aerobic bacteria within the facultative pond. These phytoplankton may be used as a bio-indicator of pond conditions e.g. cyanobacteria are often present in under-loaded conditions and chlorophyceae are present in overloaded conditions. To maintain facultative conditions in a pond system there must be an algal community present in the surface layer.

The principal function of algae is the production of oxygen which maintains aerobic conditions while the main nutrients are reduced by biomass consumption. Elevated pH (due to algal photosynthetic activity) and solar radiation combine to reduce faecal bacteria numbers significantly.

Samples of the secondary pond effluent had been collected at the time of most inspections of the Inglewood oxidation ponds system for semi-quantitative microfloral assessment prior to curtailment of this component of the programme during the 2012-2013 period. The microflora present in the secondary oxidation pond have been summarised and discussed in recent annual reports and historical data have been provided in a previous annual report (TRC, 2009).

Samples of the secondary pond effluent were collected on all three inspection occasions for chlorophyll-a analyses. Chlorophyll-a concentration can be used as a useful indicator of the algal population present in the system. (Note: Pearson (1996) suggested that a minimum in-pond chlorophyll-a concentration of 300mg/m^3 was necessary to maintain stable facultative conditions). However, seasonal changes in algal populations and also dilution by stormwater infiltration might be expected to occur in any wastewater treatment system which together with fluctuations in waste loading would result in chlorophyll-a variability.

The results of secondary pond effluent analyses are provided in Table 3 together with field observations of pond appearance.

Table 3 Chlorophyll-a measurements from the surface of the Inglewood secondary oxidation pond at the perimeter adjacent to the outlet

Date	Time NZST	Appearance	Chlorophyll-a (mg/m^3)
8 July 2013	0905	rel. clear; pale brown	10
11 November 2013	0730	turbid; brown	169
2 April 2014	0830	turbid; grey-brown	17

Chlorophyll-a concentrations were very low in winter and autumn (< 20 mg/m^3) coincident with dissolved oxygen saturation levels of 44% and 83% respectively, whereas a much higher chlorophyll-a concentration in early summer coincided with supersaturation (approximately 200%). These concentrations (10 to 169 mg/m^3) may be anticipated to vary widely, not only seasonally, but in response to the fluctuations in pond levels caused by ingress and flushing of stormwater during wet weather events.

2.3 Results of receiving environment monitoring

Physicochemical receiving water surveys no longer are required due to the infrequency of overflow events and/or absence of measurable effects on receiving water quality. One component of the receiving water monitoring programme (biological monitoring) was scheduled for the period. This biological monitoring of the Kurapete Stream was performed on the usual two (spring and summer) occasions and while it will be retained as an on-going component of the programme, it has been reduced in intensity from a four site to a two site survey. However, the spring survey followed a very recent overflow event and therefore was extended to a four site survey in accordance with documented receiving water monitoring requirements.

2.3.1 Biomonitoring surveys

Two biomonitoring surveys of the receiving waters of the Kurapete Stream were performed at the sites listed in Table 4 and illustrated in Figures 1 and 2.

Table 4 Sampling sites for biological monitoring of the Kurapete Stream

Site No	Site location	GPS reference	Site code	Survey
1	upstream of WWTP outfall	1705225E-5665510N	KRP000300	spring/summer
2	approximately 75m d/s of WWTP outfall	1705337E-5665530N	KRP000311	spring
3	approximately 300m d/s of WWTP outfall	1705481E-5665637N	KRP000330	spring
4	approximately 6 km d/s of WWTP outfall	1709239E-5667481N	KRP000660	spring/summer

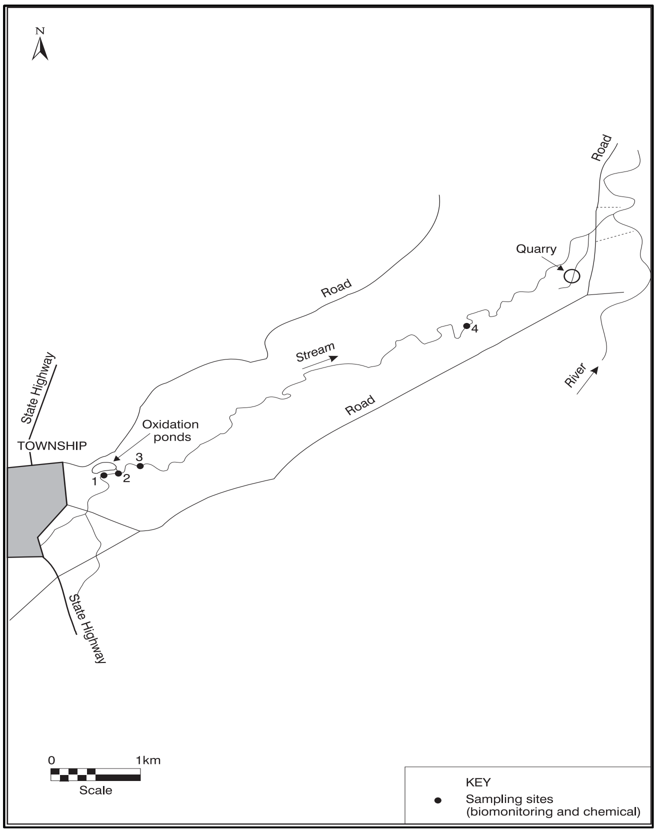

Figure 1 Sampling sites in the Kurapete Stream in relation to Inglewood oxidation ponds

The first survey was performed in spring (10 October 2013) during relatively low recession flow conditions, and the second survey was undertaken in late summer (4 February 2014) under very low flow conditions; with both surveys performed when all wastes discharges were diverted from the stream but ten days after an overflow event in spring, and no further overflow events before the summer survey. These reports are attached as Appendix II and results summarised in Table 5.

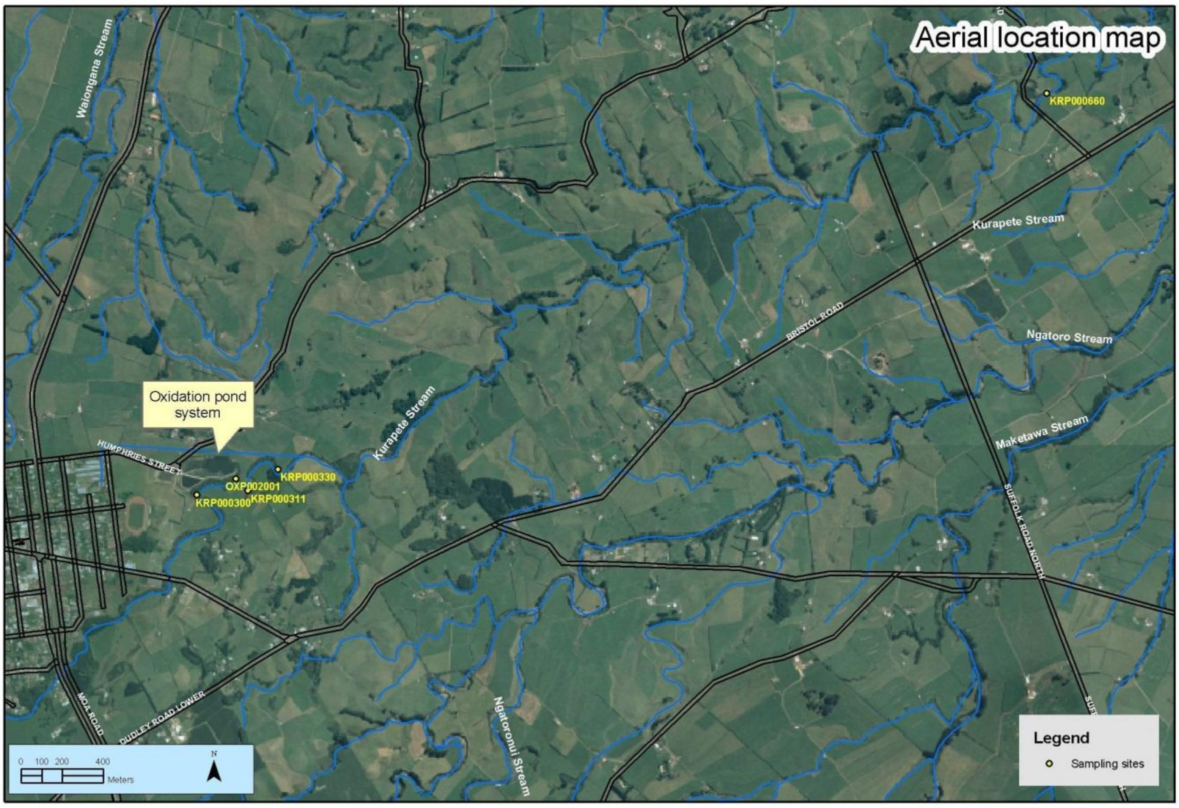

Figure 2 Aerial location map

Table 5 Biomonitoring results from the two surveys of the Kurapete Stream in the 2013-2014 period

Site No	Macroinvertebrate fauna			
	Taxa numbers		MCI values	
	10 Oct 2013	4 Feb 2014	10 Oct 2013	4 Feb 2014
1	25	22	90	102
2	25	-	98	-
3	22	-	93	-
4	23	21	99	98

The spring survey, performed about ten days after the most recent overflow discharge event (late September 2013 following intensive and prolonged heavy rainfall), continued to record the improvement in the biological condition of the stream at all sites downstream of the outfall since the diversion and no impacts of the recent overflow. Macroinvertebrate taxa richness and MCI scores continued to illustrate the post-diversion recovery of the fauna which was relatively similar in composition and characteristics at the three sites in the immediate vicinity of the oxidation ponds system. Subtle community composition changes, associated with some increase in substrate periphyton cover, were recorded at the site nearly 6 km further downstream. A total of 12 taxa (31% of the 39 taxa found over the reach surveyed) was present at all four sites and a further six taxa were present at a minimum of three sites. Taxa richnesses were relatively close to medians and had a relatively narrow range (from 22 to 25 taxa), and MCI scores a narrow range (from 90 to 99 units) over the reach of the Kurapete Stream surveyed. Richnesses and MCI scores generally were consistent with those at 'control' sites in similar seepage-fed ringplain streams elsewhere in the region. The presence of significant proportions of 'sensitive' taxa in the communities at each site and the absence of any 'heterotrophic growths' were indicative of marked improvements in habitat and physicochemical water quality in this reach of the Kurapete Stream subsequent to wastes diversion despite the recent overflow event. The biological community of the site approximately 6 km below the outfall also reflected marked improvements indicative of the significance of wastes removal from this stream.

The late summer survey was performed in summer under low flow conditions more than fourteen years since the diversion of the oxidation pond system effluent discharge from the Kurapete Stream into the New Plymouth District Council Carrousel Treatment Plant, and in the absence of any recent overflow discharge events after heavy rainfall. It continued to record the documented improvement in the biological condition of the stream at the site downstream of the outfall since the diversion to the extent that the biological 'health' at the downstream site was typical (in terms of MCI score) of that recorded post-wastewater diversion. Macroinvertebrate taxa richness and MCI scores continued to illustrate this post-diversion recovery of the fauna downstream of the oxidation ponds system. Several community composition changes, coincident with an increased substrate periphyton cover and the more open nature of the stream, were recorded at the site nearly 6km further downstream as illustrated by only 39% of the 31 taxa found between the two sites being present at both sites. Taxa richnesses were moderate and within a very narrow range. The moderate MCI scores had a narrow range, from 98 to 102 units, over the reach of the Kurapete Stream surveyed. MCI scores were very similar to those predicted for sites of similar altitudes in ringplain streams in the region particularly for a stream with its source downstream of the National Park. The presence of significant proportions of 'sensitive' taxa in the communities at both sites and the absence of any 'heterotrophic growths' continued to illustrate the improvements in habitat and physicochemical water quality in this reach of the Kurapete Stream subsequent to wastes diversion. The biological community at the site approximately 6 km below the outfall particularly reflected these improvements, indicative of the significance of municipal wastes discharges removal from this stream, in the absence of recent wet weather overflows of very dilute oxidation pond wastewater to the stream.

The most recent statistical trend analyses of macroinvertebrate data collected over the ten and eighteen year periods between 1995 and 2013 (Stark and Fowles, 2006 and TRC, 2014) have identified significant temporal trends of increasing MCI scores at sites 1 and 4 which both were ecologically significant. The positive trend was significantly stronger at the downstream site (KRP000660) than at the upstream 'control' site (KRP000300) over the first ten years, but the trend at the downstream site has partly reduced in significance over the longer eighteen year period. The improvement upstream was attributed principally to the diversion of the iron-laden tributary draining the old Inglewood landfill, into the oxidation ponds system, while the major influence downstream has been the removal of the wastewater discharge from the stream (TRC, 2006 and 2014). In recent years the upstream trend has tended to continue while there has been a very strong trend of improvement between 1999 and 2004 at the downstream site, then a decreasing trend between 2004 and 2007, followed by further steady improvement which overall has reduced the significance of the temporal trend. Stream generic 'health' over this reach remains 'fair' (mainly) to 'good' (occasionally), representing an improvement from the 'poor' health consistently recorded at the downstream site when wastewater was discharged into the Kurapete Stream prior to 2000.

Biological monitoring of the stream will continue to be performed on the reduced basis in terms of fewer sites (upstream 'control' site 1 and downstream site 4), in order to document temporal trends in stream 'health', particularly as riparian improvements and dairy wastes disposal to land initiatives are implemented in the catchment. A return to the four site survey (as performed on specific survey occasions in the past e.g. spring 2013) would occur only in order to assess any impacts of consented (1449) extreme rainfall associated discharges, should such events be prolonged.

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

The Taranaki Regional Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The Unauthorised Incident Register (UIR) includes events where the consent holder 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 consent holder is indeed the source of the incident (or that the allegation cannot be proven).

In the 2013-2014 year, there were two incidents recorded by the Council that were associated with the consent holder's exercise of consent 1449 (see Appendix III).In mid-October 2013 NPDC advised that a small sewage overflow incident occurred to stormwater and then an unnamed tributary of the Waiongana Stream which was in fresh at the time. A temporary reinstated overflow point was installed by NPDC after a further overflow incident (under very wet weather conditions in early December 2013), with appropriate telemetry and alarm system, and the incident response plan was updated accordingly. The overflows were due to surcharging in Konini Street and reinstatement of the alarmed wet weather overflow point was necessary to prevent further ingress into domestic property in this street. Appropriate signage has also been proposed for such an event. No further problems occurred after early December 2013.

Although not an incident, the consented oxidation treatment pond overflows in September-October 2013 which were notified to the Taranaki Area Health Board as required by Special Condition 6 of the consent, resulted in a public health risk assessment undertaken by the Board in relation to possible public usage of the Kurapete Stream (TAHB, 2014). Data and various reference reports were supplied by the Regional Council to assist with the Board's interviews with all landowners in the catchment and a stream usage survey. In summary, it was concluded that there was minimal use of the stream for food-gathering or recreational purposes, and that the public health risk was minimal under heavy rain overflow conditions.

The report suggested that:

- monitoring of the Kurapete Stream and Manganui River continues
- riparian planting and dairy shed wastewater diversion initiatives are undertaken in the stream catchment
- WWTP overflow frequencies are minimized
- signage is undertaken at the Everett Road recreational area at the Manganui River on every WWTP overflow occasion.

3. Riparian mitigation in the catchment

Special condition 12 of consent 1449 (prior to its expiry in June 2003) required:

> 'that by agreement of the consent holder, the consent holder shall mitigate the effects of the discharge to the Kurapete Stream, below the discharge point, to the reasonable satisfaction of the General Manager. Mitigation for the purpose of this condition shall include:
>
> a) removing objectionable debris from the stream after 30 June 1999; and
> b) riparian fencing and/or planting;
> c) the total cost to be a minimum of $20,000 [plus GST].'

The consent holder reported that minimal debris required removal from the stream in the vicinity of the original discharge following the diversion of the wastewater. No debris has been deposited in or near the stream on any occasions of intermittent stormwater-related overflow discharges since 1999.

The consent holder made a $20,000 financial contribution to the Taranaki Tree Trust which had been spent by the end of the 2003-2004 financial year. Twenty-seven individual riparian plans and one conservation plan have been prepared for landowners in the Kurapete Stream catchment by July 2013 (Figure 3). The quarry owner had fenced a section of the true right bank of the stream's lower reaches upstream of the Everett Road bridge and riparian planting had been undertaken. This vegetation was well established at the time of the 2013-2014 period.

Streambank length in the Kurapete catchment equates to 86 km. Currently, 60 km of banks are protected by existing and completed fencing with 34 km protected by existing/completed vegetation. Since the preparation of riparian plans, 24 km of fencing and 8 km of planting have been completed in the catchment.

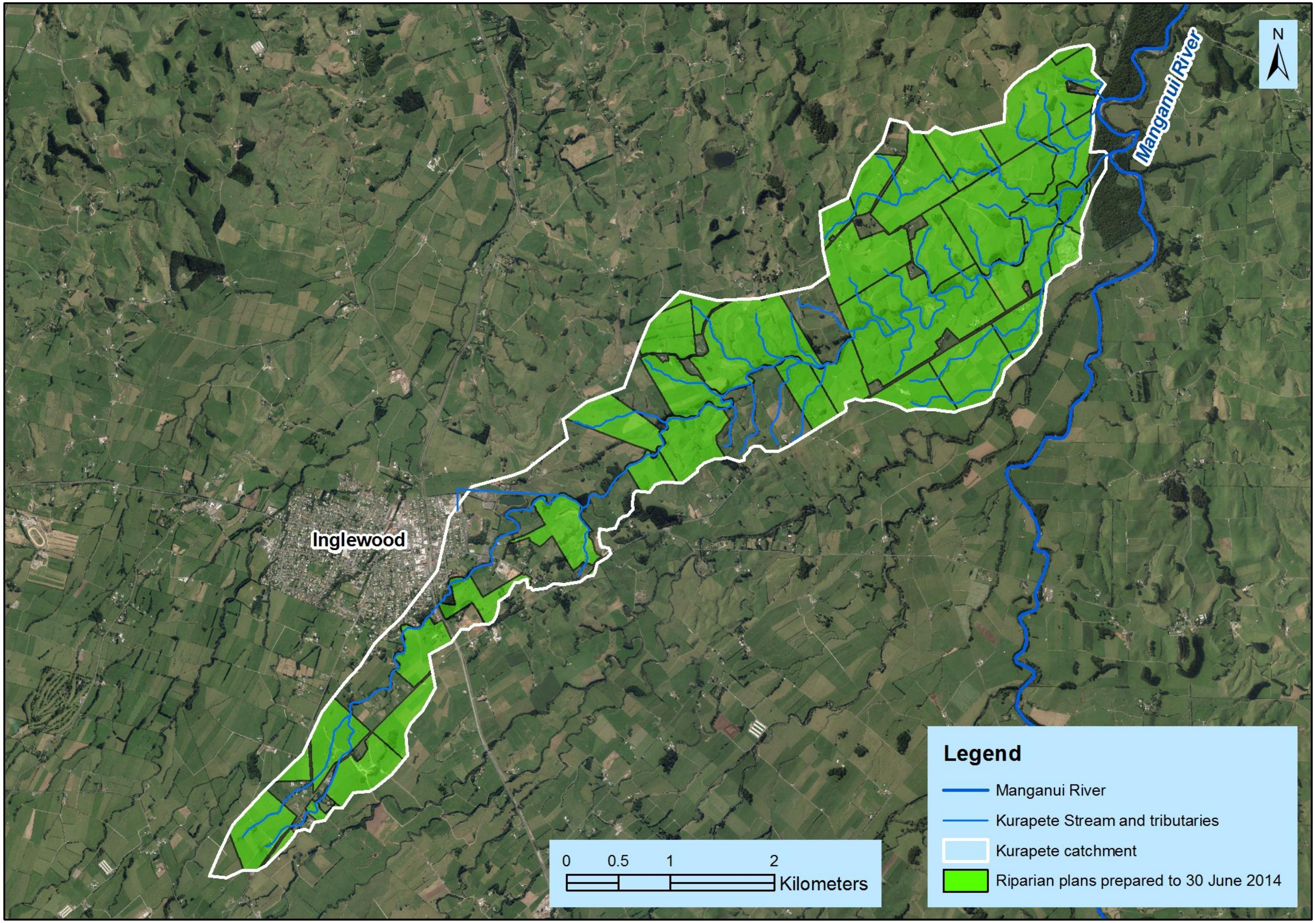

Figure 3 Riparian plans prepared in the Kurapete Stream catchment to date

4. Discussion

4.1 Discussion of plant performance

Diversion of the wastewater from the pond system to the New Plymouth wastewater treatment plant was completed in late 1999 (TRC, 2003). Very dilute oxidation pond treated effluent discharged into the stream on two occasions during the monitoring year, ranging in duration over four to five days, while the stream was either in fresh or in recession from significant freshes. No leakages around the outfall gate structure have occurred since successful resealing in March, 2002. Pond level management (for storage purposes) was good during this period as was maintenance of the pond system with continued aeration of the primary cell and regular maintenance of the treatment system.

Semi-quantitative microfloral biomonitoring of the main pond was discontinued in the previous period as results had illustrated that while the algal diversity had been one of the lowest recorded for Taranaki oxidation pond systems, [possibly due in part to lack of wind action, high grazing rates and occasional high flushing rates through the system], algal taxa and abundances continued to be relatively low in winter and late spring. Chlorophyll-a monitoring showed variable concentrations which were correlated with dissolved oxygen saturation levels.

Effluent quality monitoring by the consent holder is no longer a requirement following the diversion of all dry weather wastewater flows out of the system. Physicochemical receiving water quality assessment surveys are also no longer required. There were two periods of intermittent occurrences of wet weather overflows during the year. To date, alarm system and reporting procedures have ensured that the Council has been informed almost immediately following each overflow discharge event when these have occurred and signage at a nearby recreational area (Everett Park) was instigated following concerns by the Area Health Board in association with possible human health risks.

Overflow events were anticipated to lessen in frequency with greater treatment ponds' storage capacity, an increase in pumping rate to the New Plymouth wastewater treatment plant, and some reduction in stormwater infiltration to the sewerage reticulation. This had been the case between 2002 and 2007 although intermittent overflow events in mid winter 2008, mid winter 2010, and on two other occasions in 2010-2011 had followed prolonged heavy rainfall events. However, more frequent (although relatively short duration) overflows occurred in the 2011-2012 period necessitating increased investigative work by the consent holder to determine the causes of such events, with two further events during the 2012-2013 period, and another two overflow events in 2013-2014.

Work associated with reduction in stormwater infiltration into the Inglewood township sewerage reticulation required by consent conditions has been reported as it has been completed, with the longer term aim of removal of all oxidation pond discharges from the Kurapete Stream.

However, after the several 2011-2012, 2012-2013, and 2013-2014 overflow events, the consent holder reported that further investigations will continue in relation to possible cross connections between stormwater and sanitary sewerage systems. A straight maintenance regime will continue to be followed in future and further investigative work will focus on the perimeter stormwater drainage adjacent to the oxidation pond system to minimise inflows from that source. Smoke testing and additional investigative work are also continuing into possible direct inflows to the reticulation system. One significant area of cross linkage was discovered and removed from the system during 2013-2014 and new pumps were installed at the WWTP with improved delivery capacity via the pipeline to the New Plymouth WWTP.

4.2 Environmental effects of exercise of water permit

The water permit was exercised on two intermittent occasions between July 2013 and June 2014 monitoring year (but for relatively short durations (four to five days) in early spring 2013 as a result of the majority of wastewater being contained and diverted to the New Plymouth Wastewater Treatment Plant). No visual impacts were recorded on the fresh flows of the Kurapete Stream while these discharges of very (stormwater) diluted pond treated wastewater were occurring.

The improved biological communities present in the stream subsequent to the diversion of treated wastewater discharges from the Kurapete Stream were again documented by two surveys performed (in spring and late summer) under low to very low flow conditions. The first survey followed a very recent overflow event and necessitated an extended four-site survey. The biological community of the site nearly 6 km downstream of the original outfall continued to maintain this improvement, with a statistically significant trend of long term improvement in stream 'health' (although less significant in more recent years), an indication of the significance of wastes removal from the stream, particularly under low flow conditions. No significant impacts of preceding overflow events were found on the biological community at the three downstream sites on the spring survey occasion when the 'health' at these sites, as measured by the MCI, was above historical medians recorded over the past 20 years.

4.3 Evaluation of performance

A tabular summary of the consent holder's compliance record for the year under review is set out in Table 6.

Table 6 Summary of performance for Consent 1449 - discharge of treated wastewater

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Requires diversion of majority of discharge away from receiving waters	Inspections of site and supply of records	Yes
2. Restricts timing of discharges	Inspections and perusal of consent holder's records	Yes
3. Provision of outlet screening	Inspections of treatment system	Yes
4. Provision of wastewater management plan	Plan received by Council and approved in 2001	Yes
5. Provision of overflow records	Records provided to Council as required	Yes

Condition requirement	Means of monitoring during period under review	Compliance achieved?
6. Notification of overflows to Taranaki Health	Liaison with consent holder, perusal of records	Yes (signage deemed necessary)
7. Implementation of a stormwater reduction programme	Completed report, but requiring on-going updates	Yes (further investigations)
8. Operation of the system	Inspections of treatment system	Yes
9. Provision of trained operator	Liaison with consent holder	Yes
10. Limits on receiving water effects	Inspections and extended biological survey showed no impacts	Yes
11. Provision for a monitoring programme	Performance of programme	Yes
12. Consultation in respect of additional loadings on system	Liaison with consent holder	N/A (no additions)
13. Optional review provision re environmental effects	No further reviews prior to consent expiry in June 2015	N/A
Overall assessment of consent compliance and environmental performance		Very good

During the year the New Plymouth District Council demonstrated a very good level of environmental performance and very good compliance with the appropriate resource consent. The consent holder has regular reporting requirements imposed by consent conditions and must ensure that alarm and recording systems perform to acceptable standards and are reported and the necessary signage is installed within appropriate time frames.

NPDC has noted its commitments for monitoring and reporting of overflow events including:

- continuous measurements of the inflow and outflow at the ponds' system, and the level of the pond system;
- operating manual procedures requiring immediate notification to the Council of the activation of the secondary pond overflow;
- twice weekly visual inspections to supplement the automated supervisory control of the oxidation ponds system; and
- development of a Management Information System to allow automatic collection, archiving and reporting of data including flow data and overflow timing and duration.

Two periods of intermittent overflow events occurred between July 2013 and June 2014 in the period; the fourteenth and fifteenth times such events have occurred in nine years resulting in discharges to the Kurapete Stream. Most of these events have been reported immediately to the Taranaki Regional Council. Improvements to reporting commitments have been discussed with the consent holder who has provided a comprehensive report for the monitoring year including improvements in relation to alarms and reporting requirements and regular monthly reporting.

4.4 Recommendations from the 2012-2013 Annual Report

The previous Annual Report (TRC 2013-29) made the following recommendations:

1. THAT the monitoring of the Inglewood oxidation ponds system be performed in 2013-2014 by continuation of a programme similar in format to the programme undertaken in 2012-2013 with a minor change to the microfloral component of the inspectorial requirement.
2. THAT regular maintenance of the oxidation pond system is performed by the consent holder (i.e. screen clearance, waveband maintenance, floating debris and weed removal);
3. THAT the consent holder advises the Council whenever industrial waste connections are made to the sewerage reticulation system; and
4. THAT the consent holder continues to liaise with and advise Council immediately of the occurrence of each overflow event to the Kurapete Stream.

Compliance with the recommendations 1 to 4 was achieved during the monitoring period. Monitoring included two biomonitoring surveys and the requisite and occasional additional inspections. Reporting procedures by the consent holder have generally been appropriate (with regular monthly reporting).

4.5 Alterations to monitoring programme for 2014-2015

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

As a result of the absence of overflow events over the 2005 to 2008 period and excellent maintenance of the treatment system, a reduction in the intensity of the monitoring programme was made. However, the consent holder was advised that reinstatement of a full biomonitoring survey would need to be considered, should overflows occur to the Kurapete Stream and that this would be considered on a case-by-case basis (such as that which occurred in September 2013).

For the 2014-2015 programme, it is proposed that monitoring continue at the same level as that in the 2013-2014 period.

A recommendation to this effect is attached in section 5 of this report.

4.6 Exercise of optional review of consent

Resource consent 1449 provided for an optional review of the consent in June 2010. Special condition 13 allowed the Council to review the consent in June 2010 but it was considered that there were no grounds requiring a review to be pursued. There are no further reviews provided for prior to the expiry date in June 2015.

5. Recommendations

As a consequence of the results of the 2013-2014 monitoring programme for Discharge Permit 1449 the following recommendations are made:

1. THAT the monitoring of the Inglewood oxidation ponds system be performed in 2014-2015 by continuation of a programme identical in format to the programme undertaken in 2013-2014.
2. THAT regular maintenance of the oxidation pond system is performed by the consent holder (ie, screen clearance, waveband maintenance, floating debris and weed removal);
3. THAT the consent holder advises the Council whenever industrial waste connections are made to the sewerage reticulation system;
4. THAT the consent holder continues to liaise with and advise Council immediately of the occurrence of each overflow event to the Kurapete Stream.
5. THAT costs of $1020 incurred in relation to the additional spring biomonitoring monitoring necessitated by the recent, consented overflow event, be charged to the consent holder.

6. Acknowledgements

The Job Manager for the programme was Chris Fowles (Scientific Officer) who was the author of this Annual Report and also performed the two macroinvertebrate surveys. Field inspections were undertaken by Ray Harris (Technical Officer) with physicochemical wastewater analyses performed by the Taranaki Regional Council ISO-9000 accredited laboratory.

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 structure to contain its contents in the case of leakage.
Condy	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.
E.coli	*Escherichia coli,* an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as the number of colonies per 100 ml.
Ent	Enterococci, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as the number of colonies per 100 ml.
FC	Faecal coliforms, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as the number of colonies per 100 ml.
Fresh	Elevated flow in a stream, such as after heavy rainfall.
g/m^3	Grammes per cubic metre, and equivalent to milligrammes per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
l/s	Litres per second.
MCI	Macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats.
MfCI	Microflora community index; a numerical indication of the state of treatment pond biological life which takes into account the sensitivity of floral taxa to wastewater quality.
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	Ammoniacal nitrogen, normally expressed in terms of the mass of nitrogen (N).
NO_3	Nitrate, normally expressed in terms of the mass of nitrogen (N).
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water.

O&G	Oil and grease, defined as anything that will dissolve into a particular organic solvent (e.g. hexane). May include both animal material (fats) and mineral matter (hydrocarbons).
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 subsequent amendments.
SS	Suspended solids.
Temp	Temperature, measured in °C.
Turb	Turbidity, expressed in NTU.
UI	Unauthorised Incident.
UIR	Unauthorised Incident Register – contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.

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Appendix I

Resource consent held by New Plymouth District Council

Consent 1449-4

TARANAKI
REGIONAL
COUNCIL

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

Please quote our file number on all correspondence

Discharge Permit

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

Name of Consent Holder:	New Plymouth District Council Private Bag 2025 NEW PLYMOUTH
Consent Granted Date:	1 September 2004

Conditions of Consent

Consent Granted:	To intermittently discharge up to 5600 cubic metres per day of treated municipal wastewater from the Inglewood oxidation ponds system into the Kurapete Stream a tributary of the Manganui River in the Waitara catchment at or about GR: Q19:153-273
Expiry Date:	1 June 2015
Review Date(s):	June 2005, June 2010
Site Location:	Lincoln Road, Inglewood
Legal Description:	Lot 1 DP 9892 Blk IV Egmont SD
Catchment:	Waitara
Tributary:	Manganui Kurapete

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 undertake to continue to divert the normal dry weather effluent discharge and a proportion of the wet weather effluent discharge from the Kurapete Stream catchment, substantially in accordance with recommended Option A4 contained in the supporting document entitled 'Inglewood Sewage Disposal Options Study' [Beca, Carter, Hollings and Ferner Limited], April 1998.

2. The intermittent discharge of treated, screened wastewater shall only occur when the stormwater and groundwater inflows to the oxidation ponds system are at such a volume that the attenuation capacity of the oxidation ponds system is exceeded.

3. The consent holder shall provide screening of the outlet to the Kurapete Stream, capturing all solids greater than 6 mm.

4. The consent holder shall implement and maintain a management plan which shall include operating procedures to avoid, remedy or mitigate against potential adverse effects arising from:

   i) operation of the wastewater treatment plant operation, including intermittent discharge via rock filter and screens; and
   ii) plant failure.

5. The consent holder shall record the timing and duration of each overflow to the Kurapete Stream, as authorised by special condition 2, and report these records to the Chief Executive, Taranaki Regional Council, at 6 monthly intervals.

6. The consent holder shall immediately notify Taranaki Health following each discharge authorised by this permit, in order to enable any measures necessary for the protection of public health to be undertaken.

7. The consent holder shall continue to implement a stormwater infiltration reduction investigation for the township of Inglewood and report on progress to the Chief Executive, annually.

8. The oxidation pond system shall be maintained in an aerobic condition at all times for the purposes of maintaining the system in efficient working order, and avoiding production of offensive or objectionable odour beyond the boundary of the site

9. The consent holder shall provide a suitably trained operator to ensure proper and efficient operation and maintenance of the wastewater treatment system.

10. The overflow discharges shall not give rise to all or any of the following effects in the receiving waters of the Kurapete Stream 100 metres downstream of the discharge:

    (a) the production of 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 effect on aquatic life.

11. Appropriate monitoring, including physicochemical, bacteriological and ecological monitoring of the wastewater treatment system and receiving waters shall be undertaken through the term of the consent, as deemed necessary by the Chief Executive, Taranaki Regional Council, subject to section 35(2)(d) and section 36 of the Resource Management Act 1991.

12. The consent holder shall undertake to advise and consult with the Taranaki Regional Council prior to accepting new trade wastes, which may contain toxic or hazardous wastes, into the consent holder's wastewater system.

13. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2005 and/or June 2010, for the purpose of:

    (a) ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time, and/or
    (b) assessing the effectiveness of the stormwater infiltration programme.

Signed at Stratford on 1 September 2004

For and on behalf of
Taranaki Regional Council

Director-Resource Management

Appendix II

Biomonitoring surveys of spring 2013 and summer 2014

To K Brodie, Monitoring Manager—Environment Quality
From C R Fowles, Scientific Officer
Document 1317106
Report No CF602
Date February 2014

Biomonitoring of the Kurapete Stream in relation to the New Plymouth District Council's Inglewood oxidation ponds' system, February 2014

Introduction

This summer survey was the second of two surveys programmed for the 2013-2014 monitoring period. Since spring 2007, biomonitoring surveys have been reduced from four sites to two sites in recognition of the minimal usage of the WWTP overflow facility to the Kurapete Stream in recent years. However, a wet winter and very wet early spring to mid summer (2011-2012) period, caused a series of overflows of very dilute, treated wastewater to the Kurapete Stream over several periods until approximately two weeks prior to the mid-summer survey (see CRF541). In response to additional receiving water monitoring requirements associated with significant overflow events, an extended four site mid-summer biomonitoring survey was undertaken at all four established sites at that time. Two brief overflow events occurred between early and mid March 2012 and another in July 2012. At the time of the October 2012 survey, more than ten weeks since any overflow, the storage pond wastewater had been reduced (by pumping to the New Plymouth treatment plant) to a level approximately 1.5 m below the overflow level. No subsequent overflows occurred prior to the February 2013 (summer) biomonitoring survey. However, a wet winter and early spring period caused a series of overflows of very dilute, treated wastewater to the Kurapete Stream over several periods with an overflow event ceasing only two weeks prior to the spring 2013 survey. At the time of that survey (in October 2013), the storage pond wastewater had been reduced (by pumping to the New Plymouth treatment plant) to a level approximately 1m below the overflow level. In response to additional receiving water monitoring requirements associated with significant overflow events, an extended four site spring biomonitoring survey was undertaken at all four established sites [which had been last fully surveyed in January, 2012 (CF541, 2012)]. No overflows have occurred subsequent to October 2013.

Methods

The standard '400 ml kick sampling' technique was used to collect streambed (benthic) macroinvertebrates from two established sampling sites in the Kurapete Stream (illustrated in Figure 1) on 4 February 2014.

These sites were:

Site No	Site Code	GPS reference	Location
1	KRP000300	1705087E 5665510N	Upstream of oxidation ponds' discharge
4	KRP000660	1709239E 5667481N	Approx 6km downstream of oxidation ponds' discharge

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

Samples were preserved with Kahle’s Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using protocol P1 of NZMWG protocols for sampling macroinvertebrates in wadeable streams (Stark et al, 2001).

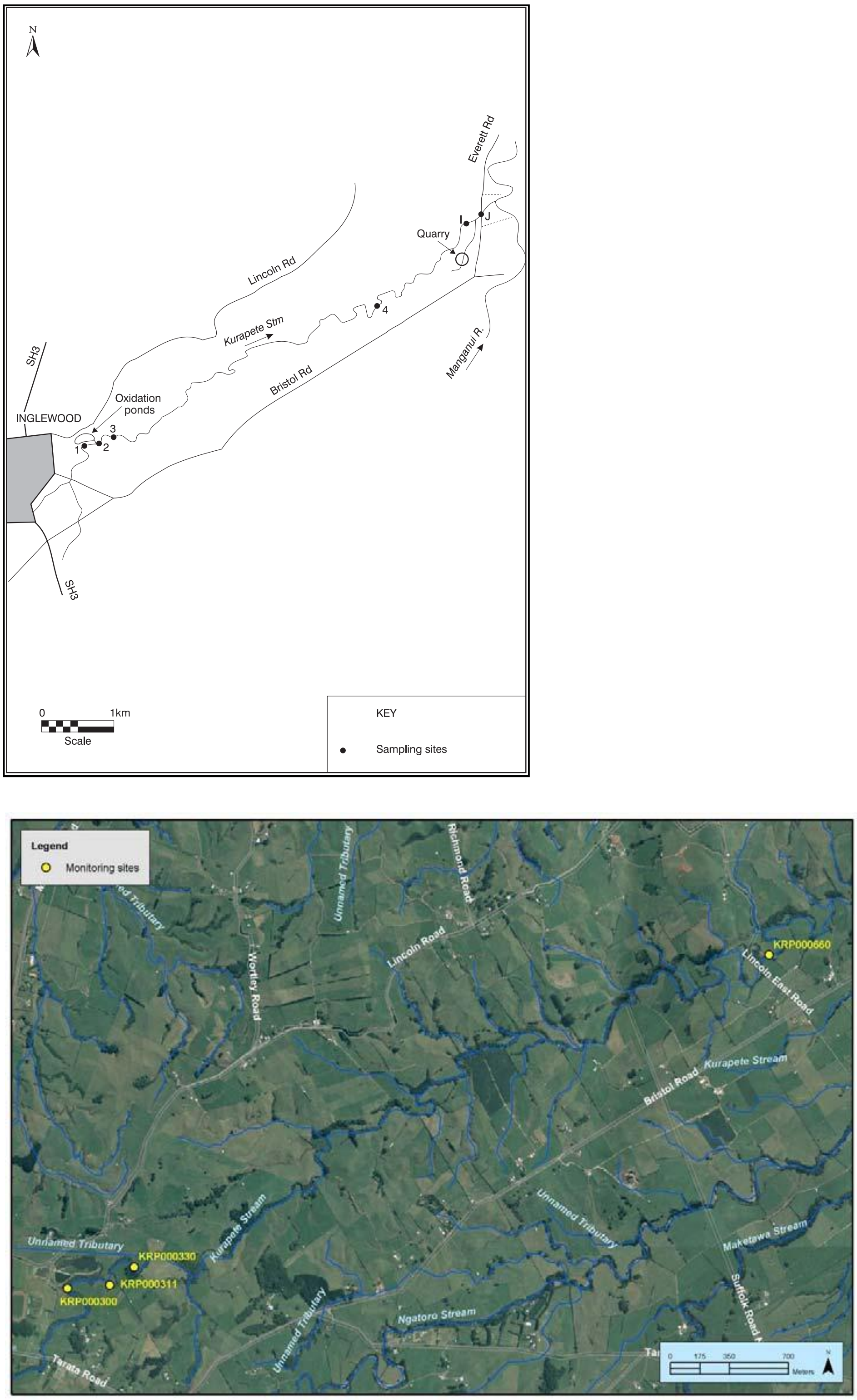


Figure 1 Sampling sites in the Kurapete Stream in relation to Inglewood oxidation ponds

Macroinvertebrate taxa found in each sample were recorded as:

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

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

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

Sub-samples of algal and detrital material taken from the macroinvertebrate samples where necessary, were scanned under 40-400x magnification to determine the presence or absence of any mats, plumes or dense growths of bacteria, fungi or protozoa (‘undesirable biological growths’) at a microscopic level. The presence of masses of these organisms is an indicator of organic enrichment within a stream.

Results and discussion

This summer survey was performed during low (recession) flow conditions, 27 days after a fresh greater than 3x median flow and 30 days after a fresh in excess of 7x median flow. Water temperatures ranged from 14.2°C to 14.4°C during this early morning survey.

Refurbishment of the pond system had been performed in late 1999 and completed by the consent holder early in 2000 with all wastes diverted to the New Plymouth Carrousel Treatment Plant. Subsequently, several consented overflows have occurred following very heavy rainfall periods. More recently several overflows occurred in the late winter-spring of 2011, early January 2012, two further short duration overflows in early to mid March 2012, in July 2012, and in October 2013 after a series of wet weather events.

The diversion of the small left bank tributary draining the old landfill area, by a cut-off drain into the primary oxidation pond, had significantly reduced the extent of orange-brown iron-oxide deposits on the bed of the Kurapete Stream at site 1 upstream of the effluent discharge. The predominantly gravel-cobble-boulder substrate at this site had some silt and minor sand deposition. Very thin mats of periphyton and patchy moss, but no filamentous algal growth, were recorded at site 1, in the riffles at this completely shaded site. The low flow was clear and uncoloured in appearance at the time of the survey.

The low flow at site 4, approximately 6 km downstream of the discharge, was also clear and uncoloured in appearance in the absence of any overflow from the WWTP at the time of the survey. Thin periphyton mats and patchy filamentous algae, and patchy moss were recorded at this partly shaded site where the substrate was mainly gravel, cobble, and boulders, with some sand and silt components.

Macroinvertebrate communities

Survey results for the period prior to the February 2000 survey are summarised in Table 1, including those from site 2 which was established in July 1997. This period coincided with the duration of discharges of treated effluent to the Kurapete Stream.

Table 1 Summary of macroinvertebrate taxa numbers and MCI values for previous surveys performed between June 1986 and August 1999 (pre effluent diversion)

Site	Site code	No of surveys	Taxa numbers		MCI values	
			Range	Median	Range	Median
1	KRP000300	28	10-29	20	78-94	87
2	KRP000311	5	12-18	15	53-78	72
3	KRP000330	27	8-19	14	52-86	64
4	KRP000660	14	14-24	20	66-93	78

The results of the twenty-eight surveys performed following cessation of the permanent discharge to the stream and prior to the current survey are summarised for comparative purposes in Table 2.

Table 2 Summary of macroinvertebrate taxa numbers and MCI values for post effluent diversion surveys performed between February 2000 and October 2013

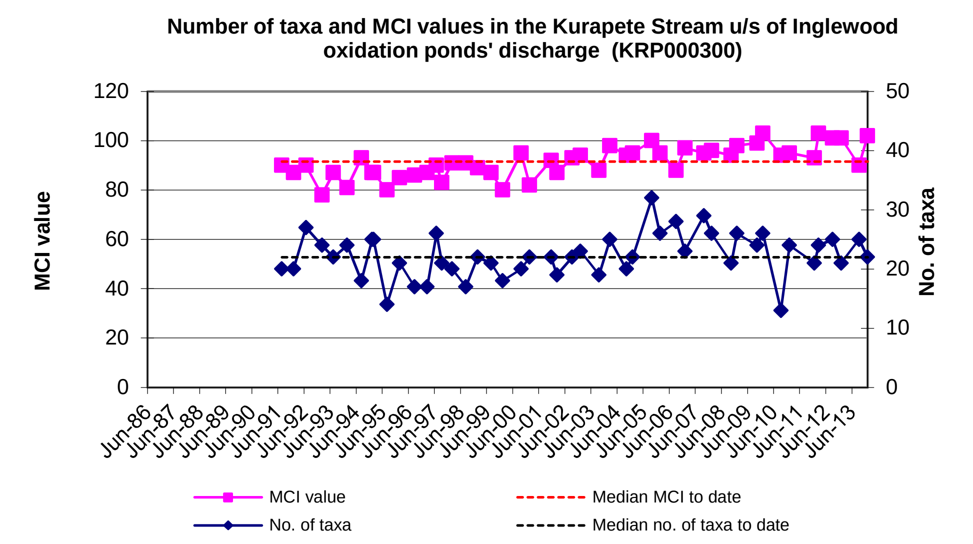
Site	Site code	No of surveys	Taxa numbers		MCI values	
			Range	Median	Range	Median
1	KRP000300	28	13-32	23	80-103	95
2	KRP000311	18	15-33	24	80-101	94
3	KRP000330	18	15-28	23	84-103	92
4	KRP000660	28	21-30	27	83-112	96

The results of the current survey are summarised for comparative purposes in Table 3.

Table 3 Summary of macroinvertebrate results from the February 2014 survey

Site	Site code	Macroinvertebrate fauna	
		Taxa number	MCI
1	KRP000300	22	102
4	KRP000660	21	98

Survey results from June 1986 to date for each site are illustrated in Figure 2. This current survey's faunal results are presented in Table 4 and discussed on a site-by-site basis.



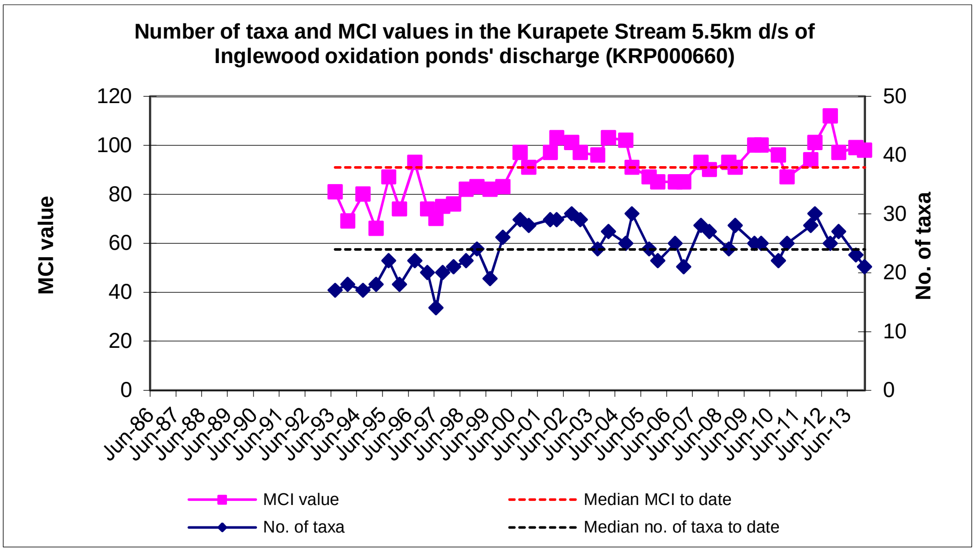


Figure 2 Taxa richness and MCI scores recorded to date at each of the sites in the Kurapete Stream

Site 1 – upstream of the oxidation ponds' discharge

An equivalent long term median (22 taxa) macroinvertebrate community richness of 22 taxa was recorded at this site, which was also in the mid range of richnesses recorded by the more recent surveys since 2004 (Tables 1 and 2 and Figure 2). Three 'highly sensitive' taxa were found (although none in abundance) with the site characterised by two 'moderately sensitive' taxa [extremely abundant mayfly (*Zephlebia* group); and elmid beetles]; and three 'tolerant' taxa [oligochaete worms, snail (*Potamopyrgus*), and net-building caddisfly (*Aoteapsyche*)]. This was lower than the number of characteristic taxa recorded by the previous summer survey. The relatively high proportion of higher scoring 'sensitive' taxa (64% of the fauna) comprising this community was reflected in the MCI score of 102 units which was only one unit less than the historical maximum score and significantly higher than the long-term median recorded (56 surveys) for this site (90 units) and seven units higher than the median score for surveys since February 2000 (Table 2 and Figure 2). Generally, the faunal composition was similar to those found at the time of the majority of previous summer and spring surveys but with relatively fewer numbers of dominant taxa (TRC, 2014). The MCI score was within one unit of the predicted MCI score for a ringplain seepage stream site at an altitude of 180 m asl (Stark and Fowles, 2009) and was indicative of 'good' generic health and 'expected' predictive health for the mid reaches of a ringplain seepage stream (TRC, 2014).

Table 4 Macroinvertebrate fauna of the Kurapete Stream in relation to the Inglewood oxidation ponds system sampled on 4 February 2014

Taxa List	Site Number	MCI score	1	4
	Site Code		KRP000300	KRP000660
	Sample Number		FWB14034	FWB14035
PLATYHELMINTHES (FLATWORMS)	*Cura*	3	R	-
NEMERTEA	Nemertea	3	R	-
ANNELIDA (WORMS)	Oligochaeta	1	A	C
MOLLUSCA	*Potamopyrgus*	4	VA	C
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	C	C
	Coloburiscus	7	-	C
	Deleatidium	8	C	VA
	Nesameletus	9	-	R
	Zephlebia group	7	XA	C
COLEOPTERA (BEETLES)	Elmidae	6	VA	VA
	Hydraenidae	8	R	-
	Ptilodactylidae	8	R	-
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	C	A
TRICHOPTERA (CADDISFLIES)	*Aoteapsyche*	4	A	VA
	Costachorema	7	-	C
	Hydrobiosis	5	-	A
	Neurochorema	6	-	C
	Pycnocentria	7	R	-
	Triplectides	5	R	-
DIPTERA (TRUE FLIES)	*Aphrophila*	5	R	A
	Eriopterini	5	R	-
	Harrisius	6	R	-
	Maoridiamesa	3	-	A
	Orthocladiinae	2	R	A
	Polypedilum	3	R	R
	Tanypodinae	5	R	-
	Tanytarsini	3	-	C
	Empididae	3	-	C
	Muscidae	3	-	C
	Austrosimulium	3	C	R
ACARINA (MITES)	Acarina	5	R	-
		No of taxa	22	21
		MCI	102	98
		SQMCIs	6.2	5.5
		EPT (taxa)	6	9
		%EPT (taxa)	27	43
'Tolerant' taxa	'Moderately sensitive' taxa	'Highly sensitive' taxa		

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

Site 4 – approximately 6 km downstream of the oxidation ponds' discharge

A moderate taxa richness (21 taxa) was recorded at this site, one taxon more than the median of taxa numbers previously recorded from fourteen surveys prior to wastes diversion (Table 1), and equal with the minimum richness found since this diversion (Table 2 and Figure 2). This was coincident with the presence of patchy moss and filamentous algae and thin periphyton mats on this site's substrate. Two 'highly sensitive' taxa were found at this site (one of which was very abundant), one fewer than the number of 'highly sensitive' taxa found upstream at site 1. The community was characterised by one 'highly sensitive' taxon [mayfly (*Deleatidium*)]; four 'moderately sensitive' taxa [elmid beetles, dobsonfly (*Archichauliodes*), free-living caddisfly (*Hydrobiosis*), and cranefly (*Aphrophila*)]; and three 'tolerant' taxa [net-building caddisfly (*Aoteapsyche*), and midges (orthoclads and *Maoridiamesa*]. Most of the 'tolerant' taxa are generally associated with periphyton substrate cover which was patchy at this site under low flow conditions at the time of this survey.

Significant individual taxon differences in downstream abundances included increases within one 'highly sensitive', five 'tolerant', and five 'moderately sensitive' taxa and decreases within one 'moderately sensitive' and two 'tolerant' taxa. Despite these differences, there was only a relatively small decrease in $SQMCI_s$ scores of 0.7 unit between sites 1 and 4, mainly as a result of numerical dominance being balanced between 'tolerant' and 'sensitive' taxa at both sites.

The relatively even balance between 'tolerant' (48%) and 'sensitive' (52%) taxa was reflected in the MCI score of 98 units. This score was significantly (Stark, 1998) 20 units above the median of all surveys prior to wastes diversion (Table 1 and Figure 2), and only 4 units less than the score at the upstream 'control' site. This decline in scores between sites 1 and 4 was typical of that expected through the mid reaches of a Taranaki stream sourced outside the National Park (TRC, 2014) but lower than the median rate of decline (1.5 units/km) found prior to wastewater diversion (Table 1). The score at site 4 was 2 units above the median of scores found since wastes diversion from the stream (Figure 3). This was indicative of much improved water quality conditions following wastes diversion throughout this reach of the Kurapete Stream (Figure 2) and also of minor downstream deterioration in stream 'health' under spring low flow conditions in the absence of recent overflows of very dilute wastewater to the stream. The MCI score was one unit above the predicted score for a ringplain seepage stream site at an altitude of 120 m asl (Stark and Fowles, 2009) and was indicative of 'fair' generic health and 'expected' predictive health for the lower mid-reaches of such a stream (TRC, 2014).

Microscopic heterotrophic assessment

Microscopic examination of subsamples from the two sites found no evidence of significant heterotrophic growths at any site confirming visual field observations. These results were consistent with the diversion of the oxidation pond system discharges out of the Kurapete Stream coincident with recovery of the faunal communities of the receiving waters subsequent to this diversion and the absence of any diluted wastewater overflow events over the four month period since the previous survey.

Conclusions

This survey was performed in summer under low flow conditions more than fourteen years since the diversion of the oxidation pond system effluent discharge from the Kurapete Stream into the New Plymouth District Council Carrousel Treatment Plant, and in the absence of any recent overflow discharge events after heavy rainfall. It continued to record the documented improvement in the biological condition of the stream at the site downstream of the outfall since the diversion to the extent that the biological 'health' at the downstream site was typical (in terms of MCI score) of that recorded post-wastewater diversion. Macroinvertebrate taxa richness and MCI scores continued to illustrate this post-diversion recovery of the fauna downstream of the oxidation ponds system. Several community composition changes, coincident with an increased substrate periphyton cover and the more open nature of the stream, were recorded at the site nearly 6km further downstream as illustrated by only 39% of the 31 taxa found between the two sites being present at both sites. Taxa richnesses were moderate and within a very narrow range. The moderate MCI scores had a narrow range, from 98 to 102 units, over the reach of the Kurapete Stream surveyed. MCI scores were very similar to those predicted for sites of similar altitudes in ringplain streams in the region particularly for a stream with its source downstream of the National Park. The presence of significant proportions of 'sensitive' taxa in the communities at both sites and the absence of any 'heterotrophic growths' continued to illustrate the improvements in habitat and physicochemical water quality in this reach of the Kurapete Stream subsequent to wastes diversion. The biological community at the site approximately 6 km below the outfall particularly reflected these improvements, indicative of the significance of municipal wastes discharges removal from this stream, in the absence of recent wet weather overflows of very dilute oxidation pond wastewater to the stream.

The most recent statistical trend analyses of macroinvertebrate data collected over the ten and eighteen year periods between 1995 and 2013 (Stark and Fowles, 2006 and TRC, 2014) have identified significant temporal trends of increasing MCI scores at sites 1 and 4 which both were ecologically significant. The positive trend was significantly stronger at the downstream site (KRP000660) than at the upstream 'control' site (KRP000300) over the first ten years, but the trend at the downstream site has partly reduced in significance over the longer eighteen year period. The improvement upstream was attributed principally to the diversion of the iron-laden tributary draining the old Inglewood landfill, into the oxidation ponds system, while the major influence downstream has been the removal of the wastewater discharge from the stream (TRC, 2006 and 2014). In recent years the upstream trend has tended to continue while there has been a very strong trend of improvement between 1999 and 2004 at the downstream site, then a decreasing trend between 2004 and 2007, followed by further steady improvement which overall has reduced the significance of the temporal trend. Stream generic 'health' over this reach remains 'fair' (mainly) to 'good' (occasionally), representing an improvement from the 'poor' health consistently recorded at the downstream site when wastewater was discharged into the Kurapete Stream prior to 2000.

Biological monitoring of the stream will continue to be performed on the reduced basis in terms of fewer sites (upstream 'control' site 1 and downstream site 4), in order to document temporal trends in stream 'health', particularly as riparian improvements and dairy wastes disposal to land initiatives are implemented in the catchment. A return to the four site survey (as performed on specific survey occasions in the past e.g. spring 2013) would occur only in order to assess any impacts of consented (1449) extreme rainfall associated discharges, should such events be prolonged.

Summary

The Council's standard 'kick-sampling' technique was used at two established site to collect streambed macroinvertebrates from the Kurapete Stream. Samples were processed to provide the number of taxa (richness), MCI score, $SQMCI_S$ score, and %EPT taxa for each site.

The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. The $SQMCI_S$ takes into account taxa abundance as well as sensitivity to pollution, and may reveal more subtle changes in communities. It may provide more relevant information in relation to non-organic impacts. Differences in either the MCI or the $SQMCI_S$ between sites indicate the degree of adverse effects (if any) of the discharges being monitored.

This summer macroinvertebrate survey indicated that, in the absence of any recent (consented) discharges of treated oxidation ponds' wastes from the Inglewood Wastewater Treatment Plant, the macroinvertebrate community of the Kurapete Stream at the site some 6 km downstream of the original discharge point had maintained the improvement in condition ('health') consistent with that documented since wastes diversion from the stream.

The macroinvertebrate communities of the stream contained moderate (predominant) proportions of 'sensitive' taxa at both sites and the communities were dominated by a combination of 'sensitive' and 'tolerant' taxa with a slightly lower percentage of 'sensitive' taxa at the more open downstream site where periphyton substrate cover was more extensive and more typical of that found previously (particularly in summer). Taxonomic richnesses (numbers of taxa) and MCI scores indicated that this post-wastes diversion improvement had been maintained at the time of this summer survey when compared with the surveys conducted prior to wastes diversion from the stream.

MCI scores indicated that the stream communities at both sites were of 'fair' to ' good' health, and generally equivalent with typical conditions recorded in similar reaches of Taranaki seepage-sourced ringplain streams.

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To	K Brodie, Monitoring Manager—Environment Quality
From	C R Fowles, Scientific Officer
Document	1301010
Report No	CF592
Date	January 2014

Biomonitoring of the Kurapete Stream in relation to the New Plymouth District Council's Inglewood oxidation ponds' system, October 2013

Introduction

This spring survey was the first of two surveys programmed for the 2013-2014 monitoring period. Since spring 2007, biomonitoring surveys have been reduced from four sites to two sites in recognition of the minimal usage of the WWTP overflow facility to the Kurapete Stream in recent years. However, a wet winter and very wet early spring to mid summer (2011-2012) period, caused a series of overflows of very dilute, treated wastewater to the Kurapete Stream over several periods until approximately two weeks prior to the mid-summer survey (see CRF541). In response to additional receiving water monitoring requirements associated with significant overflow events, an extended four site mid-summer biomonitoring survey was undertaken at all four established sites at that time. Two brief overflow events occurred between early and mid March 2012 and another in July 2012. At the time of the October 2012 survey, more than ten weeks since any overflow, the storage pond wastewater had been reduced (by pumping to the New Plymouth treatment plant) to a level approximately 1.5 m below the overflow level. No subsequent overflows occurred prior to the February 2013 (summer) biomonitoring survey. However, a wet winter and early spring period caused a series of overflows of very dilute, treated wastewater to the Kurapete Stream over several periods with an overflow event ceasing only two weeks prior to the current survey. At the time of the survey, the storage pond wastewater had been reduced (by pumping to the New Plymouth treatment plant) to a level approximately 1m below the overflow level. In response to additional receiving water monitoring requirements associated with significant overflow events, an extended four site spring biomonitoring survey was undertaken at all four established sites [which had been last fully surveyed in January, 2012 (CF541, 2012)].

Methods

The standard '400 ml kick sampling' technique was used to collect streambed (benthic) macroinvertebrates from four established sampling sites in the Kurapete Stream (illustrated in Figure 1) on 10 October 2013.

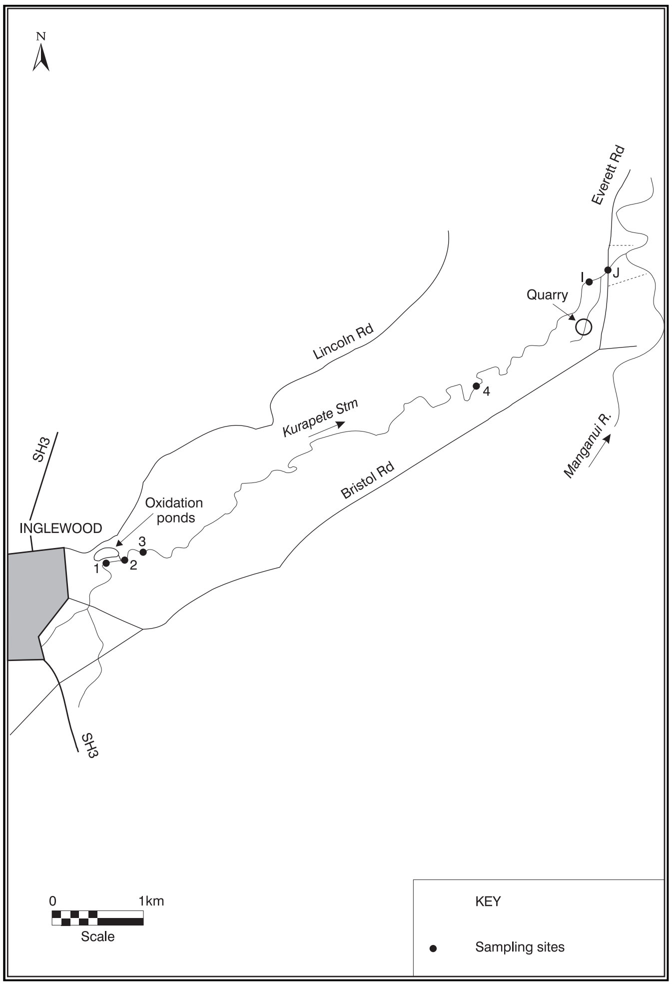
These sites were:

Site No	Site Code	GPS reference	Location
1	KRP000300	1705087E 5665510N	Upstream of oxidation ponds' discharge
2	KRP000311	1705337E 5665530N	Approx 75m downstream of oxidation ponds' discharge
3	KRP000330	1705471E 5665658N	Approx 300m downstream of oxidation ponds' discharge
4	KRP000660	1709239E 5667481N	Approx 6km downstream of oxidation ponds' discharge

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

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using protocol P1 of NZMWG protocols for sampling macroinvertebrates in wadeable streams (Stark et al, 2001). Macroinvertebrate taxa found in each sample were recorded as:

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



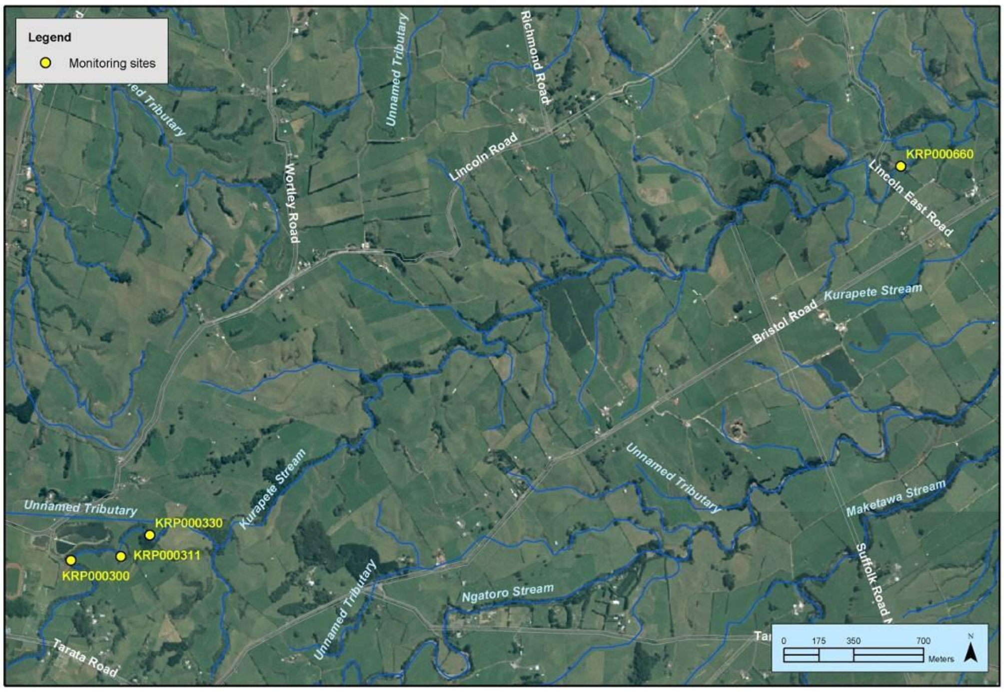


Figure 1 Sampling sites in the Kurapete Stream in relation to Inglewood oxidation ponds

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

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

Sub-samples of algal and detrital material taken from the macroinvertebrate samples where necessary, were scanned under 40-400x magnification to determine the presence or absence of any mats, plumes or dense growths of bacteria, fungi or protozoa ('undesirable biological growths') at a microscopic level. The presence of masses of these organisms is an indicator of organic enrichment within a stream.

Results and discussion

This spring survey was performed during low (recession) flow conditions nine days after a fresh greater than 3x median flow and ten days after a fresh in excess of 7x median flow. Water temperatures ranged from 11.8°C to 12.1°C during this early afternoon survey.

Refurbishment of the pond system had been performed in late 1999 and completed by the consent holder early in 2000 with all wastes diverted to the New Plymouth Carrousel Treatment Plant. Subsequently, several consented overflows occurred following very heavy rainfall periods. More recently several overflows occurred in the late winter-spring of 2011, early January 2012, two further short-duration overflows in early to mid March 2012, and in July 2012 after a series of wet weather events. Two overflow events of short duration occurred between July 2012 and June 2013 (TRC, 2013) prior to a five day duration overflow in late September, 2013.

The diversion of the small left bank tributary draining the old landfill area, by a cut-off drain into the primary oxidation pond, had significantly reduced the extent of orange-brown iron-oxide deposits on the bed of the Kurapete Stream at site 1 upstream of the effluent discharge. The predominantly gravel-cobble-boulder substrate at this site had a small amount of silt and sand deposition. Patchy mats of periphyton and moss, but no filamentous algal growth, were recorded at site 1, in the riffles at this shaded site. The low flow was clear and uncoloured in appearance at the time of the survey.

The flow at site 2, approximately 75 m downstream of the discharge, was also uncoloured and clear in appearance in the absence of any overflow from the WWTP at the time of the survey. Patchy periphyton mats and moss, but no filamentous algae, were recorded at this partly shaded site where the substrate was mainly gravel, cobble, and boulders, with some sand and silt.

The shallow, low flow conditions at the partially shaded site 3 appeared clear and uncoloured. Patchy periphyton mats, moss, and filamentous algae, were noted on the mainly gravel-cobble-boulder substrate at this site, where some silt and sand deposition was noted, following the relatively recent removal of some vegetation to provide a stream vehicle crossing some 20 m upstream.

A clear, uncoloured, low flow characterised site 4 approximately 6 km downstream of the (overflow) outfall discharge. This mainly open site’s gravel-cobble-boulder substrate had a patchy cover of periphyton mats and filamentous green algae. Patchy moss was also recorded. Some silt and sand deposition was also apparent at this site which had a relatively widespread periphyton substrate cover despite the many and frequent stream freshes (13 in excess of three times median flow and seven in excess of seven times median flow) experienced over the preceding two months.

Macroinvertebrate communities

Survey results for the period prior to the February 2000 survey are summarised in Table 1, including those from the more recently established site 2. This period coincided with the duration of discharges of treated effluent to the Kurapete Stream.

Table 1 Summary of macroinvertebrate taxa numbers and MCI values for previous surveys performed between June 1986 and August 1999 (pre effluent diversion)

Site	Site code	No of surveys	Taxa numbers		MCI values	
			Range	Median	Range	Median
1	KRP000300	28	10-29	20	78-94	87
2	KRP000311	5	12-18	15	53-78	72
3	KRP000330	27	8-19	14	52-86	64
4	KRP000660	14	14-24	20	66-93	78

The results of the twenty-seven surveys performed following cessation of the permanent discharge to the stream and prior to the current survey are summarised for comparative purposes in Table 2.

Table 2 Summary of macroinvertebrate taxa numbers and MCI values for post effluent diversion surveys performed between February 2000 and February 2013

Site	Site code	No of surveys	Taxa numbers		MCI values	
			Range	Median	Range	Median
1	KRP000300	27	13-32	23	80-103	95
2	KRP000311	17	15-33	23	80-101	93
3	KRP000330	17	15-28	23	84-103	92
4	KRP000660	27	21-30	27	83-112	96

The results of the current survey are summarised for comparative purposes in Table 3.

Table 3 Summary of macroinvertebrate results from the October 2013 survey

Site	Site code	Macroinvertebrate fauna	
		Taxa number	MCI
1	KRP000300	25	90
2	KRP000311	25	98
3	KRP000330	22	93
4	KRP000660	23	99

Survey results from June 1986 to date for each site are illustrated in Figure 2. This current survey's faunal results are presented in Table 4 and discussed on a site-by-site basis.

Site 1 – upstream of the oxidation ponds' discharge

A slightly above median macroinvertebrate community richness (25 taxa) was recorded at this site, but similar to richnesses recorded by most of the more recent surveys (Tables 1 and 2 and Figure 2). Only two 'highly sensitive' taxa were found (neither in abundance) with the site characterised by three 'moderately sensitive' taxa [mayfly (*Zephlebia* group), elmid beetles, and dobsonfly (*Archichauliodes*)] and four 'tolerant' taxa [oligochaete worms, snail (*Potamopyrgus*), orthoclad midges, and sandfly (*Austrosimulium*)]. This was slightly fewer than the number of characteristic taxa recorded by the previous summer survey. The even balance between the higher scoring 'sensitive' taxa (52% of the fauna) and 'tolerant' taxa comprising this community was reflected in the MCI score of 90 units which was equivalent with the long-term median previously recorded (55 surveys) for this site (90 units) but an insignificant five units below the median score for surveys since February 2000 (Table 2 and Figure 2). Generally, the faunal composition was typical to that found at the time of the majority of previous summer and spring surveys. The MCI score was significantly 13 units below the predicted MCI score for a ringplain seepage stream site at an altitude of 180 m asl (Stark and Fowles, 2009) and was indicative of 'fair' generic health and slightly below 'expected' predictive health for the mid reaches of a ringplain seepage stream (TRC, 2013a).

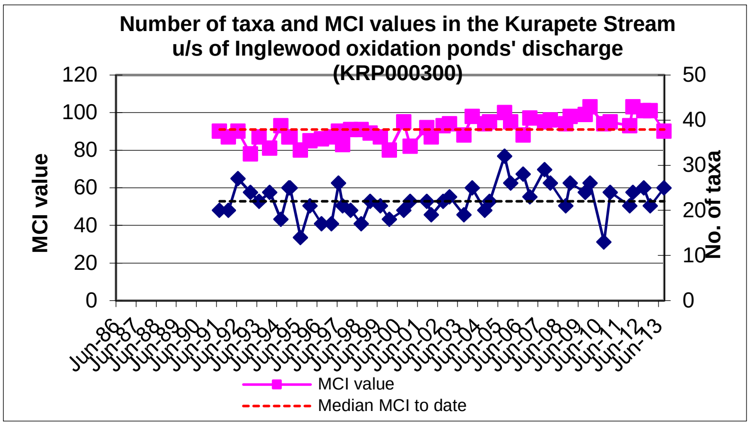
Site 2 – 75 m downstream of the oxidation ponds' discharge

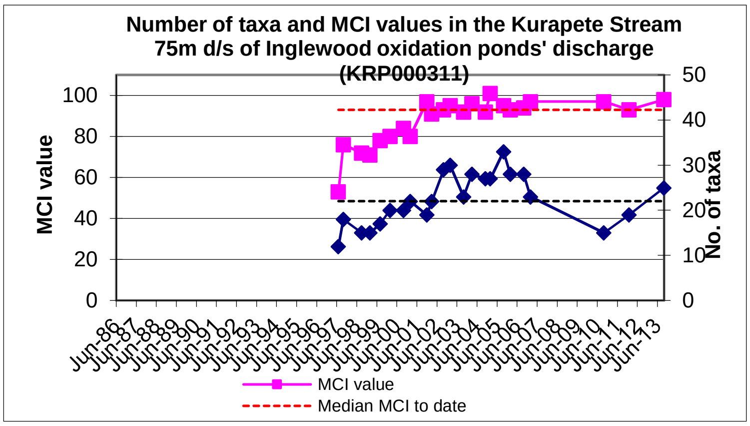
Community richness (25 taxa) was also slightly above the historical median at this site, two taxa more than the median post-wastes diversion richness (Table 2), and equal with the number of taxa recorded by the current survey at the upstream site. This taxa richness was ten more than the median of richnesses recorded prior to discharge diversion (Table 1 and Figure 2). It reflected a community (in terms of principal taxa composition) relatively similar (20 shared taxa) to that found at site 1 upstream of the oxidation ponds system. 'Highly' and 'moderately sensitive' taxa comprised 60% of the total taxa in the community which was characterised by no 'highly sensitive' taxa; four 'moderately sensitive' taxa [(mayfly (*Zephlebia* group), elmid beetles, dobsonfly (*Archichauliodes*), and cranefly (*Aphrophila*)], and four 'tolerant' taxa [oligochaete worms (less dominant numerically than in pre-diversion surveys), snail (*Potamopyrgus*), and midges (orthoclads and *Maoridiamesa*)].

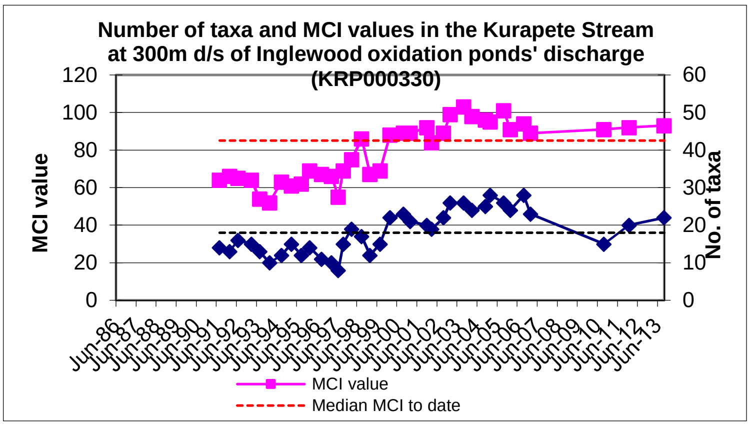
Table 4 Macroinvertebrate fauna of the Kurapete Stream in relation to the Inglewood oxidation ponds system sampled on 8 October 2013

Taxa List	Site Number	MCI score	1	2	3	4
	Site Code		KRP000300	KRP000311	KRP000330	KRP000660
	Sample Number		FWB13266	FWB13267	FWB13268	FWB13269
PLATYHELMINTHES (FLATWORMS)	*Cura*	3	R	R	-	-
NEMERTEA	Nemertea	3	-	-	-	R
NEMATODA	Nematoda	3	R	-	R	-
ANNELIDA (WORMS)	Oligochaeta	1	A	VA	A	VA
	Lumbricidae	5	R	C	-	-
MOLLUSCA	*Latia*	5	R	-	-	-
	Potamopyrgus	4	XA	VA	VA	A
	Sphaeriidae	3	R	-	-	-
CRUSTACEA	Isopoda	5	-	-	R	-
	Paraleptamphopidae	5	-	R	R	-
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	-	R	R	C
	Coloburiscus	7	-	R	C	A
	Deleatidium	8	C	C	A	VA
	Zephlebia group	7	VA	A	A	C
PLECOPTERA (STONEFLIES)	*Acroperla*	5	R	C	R	-
	Zelandobius	5	-	-	-	C
	Zelandoperla	8	-	-	-	R
COLEOPTERA (BEETLES)	Elmidae	6	A	A	A	VA
	Ptilodactylidae	8	R	R	-	-
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	A	A	C	A
TRICHOPTERA (CADDISFLIES)	*Aoteapsyche*	4	C	C	R	VA
	Costachorema	7	R	C	-	C
	Hydrobiosis	5	C	C	C	C
	Neurochorema	6	-	-	-	R
	Oeconesidae	5	R	-	-	-
	Oxyethira	2	R	-	-	-
	Pycnocentria	7	-	-	-	R
	Pycnocentrodes	5	-	-	-	A
DIPTERA (TRUE FLIES)	*Aphrophila*	5	C	A	C	R
	Hexatomini	5	-	R	-	-
	Maoridiamesa	3	R	A	C	A
	Orthocladiinae	2	A	VA	VA	VA
	Polypedilum	3	-	C	C	-
	Tanypodinae	5	R	R	R	-
	Tanytarsini	3	-	-	-	C
	Empididae	3	R	R	R	C
	Psychodidae	1	-	-	-	R
	Austrosimulium	3	A	C	C	-
	Tanyderidae	4	R	C	R	-
		No of taxa	25	25	22	23
		MCI	90	98	93	99
		SQMCIs	4.4	3.4	3.8	4.4
		EPT (taxa)	7	8	7	12
		%EPT (taxa)	28	32	32	52
'Tolerant' taxa	'Moderately sensitive' taxa		'Highly sensitive' taxa			

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







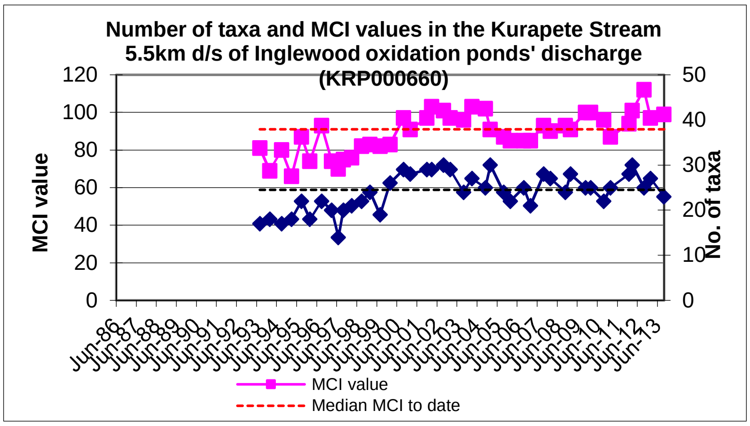


Figure 2 Taxa richness and MCI scores recorded to date at each o f the sites in the Kurapete Stream

This change in dominant taxa composition from very 'tolerant' taxa (e.g. extremely abundant oligochaete worms, snail (*Physa*), and 'bloodworm' chironomid midges) prior to wastes diversion, together with the reappearance of more 'sensitive' taxa such as mayflies, some stoneflies, beetles, dobsonflies, craneflies, and caddisflies, was indicative of the improvement in physicochemical water quality conditions and habitat subsequent to diversion of the oxidation pond system discharge out of the Kurapete Stream despite the recent period of overflow of stormwater–diluted wastewater to this stream. The associated post-diversion improvement in the macroinvertebrate community composition was reflected in the MCI score of 98 units, eight units higher than the score at the upstream control site (site 1), and well above the median score (72) and 20 units above the maximum score from surveys prior to wastes diversion (Table 1 and Figure 2). It was also five units higher than the median of scores recorded by seventeen surveys since the wastes diversion (Table 2). The decrease in $SQMCI_s$ values between sites 1 and 2 (1.0 unit) was mainly the result of increased abundances downstream of 'tolerant' orthoclad midges and oligochaete worms, rather than any major changes in community composition.

Site 3 – 300 m downstream of oxidation ponds' discharge

A similar community richness to that found at the nearest upstream site (site 2) was recorded at this site where 22 taxa were found. This number of taxa was well above the median previously recorded by 27 surveys prior to wastes diversion (Table 1), but very similar to the median number of taxa found by the seventeen surveys since wastes diversion (Table 2). Proportionately fewer 'tolerant' taxa (45% of the community) were present in comparison with earlier surveys prior to wastes diversion, eg 75% of the community was comprised of 'tolerant' taxa at the time of the 1998-99 summer survey. The current survey's characteristic taxa at the site included three 'tolerant' taxa [oligochaete worms, snail (*Potamopyrgus*), and orthoclad midges)]; two 'moderately sensitive' taxa [mayfly (*Zephlebia* group) and elmid beetles], and one 'highly sensitive' taxon [mayfly (*Deleatidium*)] with community composition relatively similar to those at both upstream sites. The presence of increased numbers of 'sensitive' taxa such as beetles, mayflies, dobsonflies, and some caddisflies was indicative of improvement in habitat and physicochemical water quality conditions since the diversion of the oxidation pond system discharge from the Kurapete Stream despite the recent period when the dilute wastewater overflow discharged to the stream. This improvement in the macroinvertebrate fauna was also reflected in the moderately high MCI score (93 units), very similar to the scores found at the two upstream sites, but a very significant (Stark 1998) 29 units higher than the median previously recorded by 27 surveys prior to wastes diversion (Table 1 and Figure 2), and maintaining the high scores since this diversion (Table 2 and Figure 2). The small decrease in $SQMCI_S$ value (0.6 unit) compared to that at the upstream 'control' site, was due mainly to a small downstream decrease in the numeral abundance of one 'moderately sensitive' taxon (mayfly) and increase in the abundance of 'tolerant' orthoclad midges.

Site 4 – approximately 5 km downstream of the oxidation ponds' discharge

A moderately good taxa richness (23 taxa) was recorded at this site, within one taxon of the maximum of taxa numbers recorded from fourteen surveys prior to wastes diversion (Table 1), but four taxa less than the median richness found since this diversion (Table 2 and Figure 2). This was coincident with the presence of patchy filamentous algae, periphyton mats, and moss on this site's substrate. Only two 'highly sensitive' taxa were found at this site (one in abundance), including one of the two 'highly sensitive' taxa found upstream at site 1. The community was characterised by one 'highly sensitive' taxon [mayfly (*Deleatidium*)]; four 'moderately sensitive' taxa [mayfly (*Coloburiscus*), elmid beetles, dobsonfly (*Archichauliodes*), and stony-cased caddisfly (*Pycnocentrodes*)]; and five 'tolerant' taxa [oligochaete worms, snail (*Potamopyrgus*), net-building caddisfly (*Aoteapsyche*), and midges (orthoclads and *Maoridiamesa*)]. Most of these 'tolerant' taxa are generally associated with periphyton and algal substrate cover, which was more widespread at this site under moderately low flow conditions at the time of this survey.

The 'tolerant' caddisfly and oligochaete worms showed increases in abundances coincident with increased substrate periphyton cover but increased abundances of two 'sensitive' taxa resulted in an overall small increase of 0.6 unit in the $SQMCI_s$ score between sites 3 and 4 and no change in $SQMCI_s$ scores between the upstream ('control') site and site 4. The predominance of 'sensitive' taxa (61% of richness) resulted in the MCI score of 99 units, which was significantly (Stark, 1998) 21 units above the median of all surveys prior to wastes diversion (Table 1 and Figure 2), and nine units higher than the score at the upstream 'control' site. It was within the range and three units above the median of scores found since wastes diversion from the stream (Figure 3). It was indicative of improved water quality conditions following wastes diversion throughout this reach of the Kurapete Stream (Figure 2) and also of no downstream deterioration in stream 'health' under spring moderately low flow conditions despite a recent overflow of very dilute wastewater to the stream. The MCI score was two units above the predicted score for a ringplain seepage stream site at an altitude of 120 m asl (Stark and Fowles, 2009) and was indicative of 'fair' (bordering on 'good') generic health and 'expected' predictive health for the lower mid-reaches of such a stream (TRC, 2013a).

Microscopic heterotrophic assessment

Microscopic examination of subsamples from all four sites found no evidence of significant heterotrophic growths at any site and confirmed visual field observations. These results were consistent with the diversion of the oxidation pond system discharges out of the Kurapete Stream for the majority of the preceding period, and coincident with recovery of the faunal communities of the receiving waters subsequent to this diversion, despite the recent diluted wastewater overflow event some two weeks prior to this survey.

Conclusions

This survey was performed in spring under moderately low flow conditions more than fourteen years since the diversion of the oxidation pond system effluent discharge from the Kurapete Stream into the New Plymouth District Council Carrousel Treatment Plant, but following a recent overflow discharge event after intensive and prolonged heavy rainfall in mid September 2013. It continued to record the improvement in the biological condition of the stream at all sites downstream of the outfall since the diversion and no impacts of the recent overflow. Macroinvertebrate taxa richness and MCI scores continued to illustrate the post-diversion recovery of the fauna which was relatively similar in composition and characteristics at the three sites in the immediate vicinity of the oxidation ponds system. Subtle community composition changes, associated with some increase in substrate periphyton cover, were recorded at the site nearly 6 km further downstream. A total of 12 taxa (31% of the 39 taxa found over the reach surveyed) was present at all four sites and a further six taxa were present at a minimum of three sites. Taxa richnesses were relatively close to medians and had a relatively narrow range (from 22 to 25 taxa), and MCI scores a narrow range (from 90 to 99 units) over the reach of the Kurapete Stream surveyed. Richnesses and MCI scores generally were consistent with those at 'control' sites in similar seepage-fed ringplain streams elsewhere in the region. The presence of significant proportions of 'sensitive' taxa in the communities at each site and the absence of any 'heterotrophic growths' were indicative of marked improvements in habitat and physicochemical water quality in this reach of the Kurapete Stream subsequent to wastes diversion despite the recent overflow event. The biological community of the site approximately 6 km below the outfall also reflected marked improvements indicative of the significance of wastes removal from this stream.

The most recent statistical trend analyses of macroinvertebrate data collected over the ten and eighteen year periods between 1995 and 2013 (Stark and Fowles, 2006 and TRC, 2013a) have identified significant temporal trends of increasing MCI scores at sites 1 and 4 which both were ecologically significant. The positive trend was significantly stronger at the downstream site (KRP000660) than at the upstream 'control' site (KRP000300) over the first ten years, but the trend at the downstream site has gradually reduced in significance over the longer eighteen year period. The improvement upstream was attributed principally to the diversion of the iron-laden tributary draining the old Inglewood landfill, into the oxidation ponds system, while the major influence downstream has been the removal of the wastewater discharge from the stream (TRC, 2006, 2013, and 2013a). In recent years the upstream trend has tended to plateau while there has been a very strong trend of improvement between 1999 and 2004 downstream, then a decreasing trend between 2004 and 2007, followed by further steady improvement which overall has reduced the significance of the temporal trend. Stream generic 'health' over this reach remains 'fair' (mainly) to 'good' (occasionally), representing an improvement from the 'poor' health consistently recorded at the downstream site when wastewater was discharged into the Kurapete Stream prior to 2000.

Biological monitoring of the stream will continue to be performed on the reduced basis in terms of fewer sites (upstream 'control' site 1 and downstream site 4), in order to document temporal trends in stream 'health', particularly as riparian improvements and dairy wastes disposal to land initiatives are implemented in the catchment. A return to the four site survey (as performed on specific survey occasions in the past and on this occasion) would occur only in order to assess any impacts of consented (1449) extreme rainfall associated discharges, should such events be prolonged.

Summary

The Council's standard 'kick-sampling' technique was used at four established sites to collect streambed macroinvertebrates from the Kurapete Stream, which was an extended survey to assess any impacts of a recent overflow of stormwater-diluted wastewater following prolonged heavy rainfall. Samples were processed to provide the number of taxa (richness), MCI score, $SQMCI_S$ score, and EPT taxa for each site.

The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. The $SQMCI_S$ takes into account taxa abundance as well as sensitivity to pollution, and may reveal more subtle changes in communities. It may provide more relevant information in relation to non-organic impacts. Differences in either the MCI or the $SQMCI_S$ between sites indicate the degree of adverse effects (if any) of the discharges being monitored.

This spring macroinvertebrate survey indicated that, despite the recent discharge of very dilute, treated oxidation ponds' wastes from the Inglewood site, the macroinvertebrate communities of the Kurapete Stream maintained the improvement demonstrated at the four sites upstream and downstream of the original discharge point since wastes diversion from the stream, with no significant decrease in taxa richnesses recorded through the stream despite several preceding catchment freshes.

The macroinvertebrate communities of the stream contained moderately high proportions of 'sensitive' taxa at all sites and the communities were generally dominated by relatively similar numbers of 'sensitive' and 'tolerant' taxa. Similarity in taxonomic richnesses (numbers of taxa) and MCI scores at sites adjacent to the outfall indicated that this improvement in biological health had been maintained at the time of this spring survey compared to the surveys conducted prior to wastes diversion from the stream and that there was no indication of impacts of the (consented) recent wastewater overflow to the stream.

MCI scores indicated that the stream communities were of 'fair' (bordering on 'good') health, and generally equivalent with typical conditions recorded elsewhere in similar reaches of Taranaki seepage-sourced ringplain streams.

References

Internal Taranaki Regional Council reports

Pre-diversion of wastes

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Fowles CR: Biomonitoring of the Kurapete Stream in relation to the New Plymouth District Council's Inglewood oxidation ponds' discharge, August 1999 (CF192).

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

Post-diversion of wastes

Fowles CR: Biomonitoring of the Kurapete Stream in relation to the New Plymouth District Council's Inglewood oxidation pond's system, February 2000 (CF206).

Fowles CR: Biomonitoring of the Kurapete Stream in relation to the New Plymouth District Council's Inglewood oxidation pond's system, October 2000 (CF222).

Fowles CR: Biomonitoring of the Kurapete Stream in relation to the New Plymouth District Council's Inglewood oxidation pond's system, February 2001 (CF232).

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Fowles CR: Biomonitoring of the Kurapete Stream in relation to the New Plymouth District Council's Inglewood oxidation pond's system, March 2002 (CF249).

Fowles CR: Biomonitoring of the Kurapete Stream in relation to the New Plymouth District Council's Inglewood oxidation pond's system, October 2002 (CF258).

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Appendix III

NPDC report relating to oxidation pond levels and overflows during the 2013-2014 period

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INGLEWOOD OXIDATION POND DISCHARGE CONSENT 1449-4

ANNUAL REPORT

FOR THE PERIOD 1 JULY 2013 TO 30 JUNE 2014

Prepared by:
Graeme Pool
MANAGER OPERATIONS WATER & WASTES

File: WW 08-04-05-06

CONTENTS

1. INTRODUCTION

This report is submitted to satisfy the requirements of Discharge Consent 1449-4 which allows the discharge of treated municipal wastewater from the Inglewood oxidation ponds system into the Kurapete Stream.

2. INGLEWOOD OXIDATION POND OPERATION

2.1 Screens

Routine maintenance has been carried out on the screens.

2.2 Pump Station

Both pumps were renewed during the year. Changes were made to the operating control philosophy for the pumping station. More details are provided below.

2.3 Lagoon No. 1 (Primary Lagoon)

The lagoon has run well during the year.

2.4 Lagoon No. 2 (Secondary Lagoon)

The lagoon has run well during the year.

2.5 Outfall Screen

The system has run well when called on start up during the year for the overflow events caused by high rainfall infiltration.

2.6 Oxidation ponds pump improvements

During 2012 – 13 and as discussed in the annual report, a review of pump selection was undertaken and new pumps were ordered for Inglewood. The pumps had a smaller motor size compared to the previously installed pumps but modelling had shown that the pumps should achieve at least the same discharge rate. The pumps were scheduled to be installed in July 2013.

For a number of reasons including high rainfall and high inflows the operations staff and maintenance contractors were unable to enter the wet well to measure up the required pipe work for transition pipe pieces until December 2013. Once the transitions were made up the new pumps were installed in January 2014 and the second pump installed in April 2014. The flow rate from the pumps while the pumps are running at full speed has been checked and confirmed as delivering 168m^3/hr compared to 161m^3/hr for the older pumps. The current draw for the new pumps is 25 amps compared to 37 amps for the old pumps and so a significant efficiency gain and a slight increase in pump flow has been achieved.

During December 2013 changes were made to pump station operating control philosophy. This change was intended to take advantage of the installed Variable Frequency Drives and hence to control the pumps to match the incoming sewage flow by maintaining a fixed level in the wet well. Initially the control level was set to 60% full. The pump station operated as expected and the pump speed varied to match incoming flow. However in wet weather the secondary pond appeared to fill prematurely. Shortly after this observation, the dry summer period started and the inflows to the Oxidation ponds dropped to low levels. At the first rain it was again observed that the pump control did not maintain a high pump speed when there was water in the Secondary pond. Further investigation was undertaken which resulted in the wet well control level being lowered to 40%. Recent observation, since the end of April has shown that the pump station maintains a high speed of operation until the Secondary pond has drained down and then the pumps match the inflow rate of sewage.

3. MONITORING

3.1 Monitoring of Data

Monitoring of the Oxidation Ponds operating data continues to be collected by automated SCADA systems. The SCADA system monitors the operating parameters and initiates alarms to pager / mobile phone in the event of a fault condition arising. The operations staff have responded to urgent alarms as required.

The operating data collected includes inflow to the Oxidation Ponds, and flow pumped by the oxidation ponds pumping station as well as secondary pond water level and overflow status. Monthly reports including this key operational data and daily rainfall data, which are obtained from TRC, have been provided throughout the year.

3.2 Unauthorised Discharges

There were two periods of overflow from the oxidation ponds between 1st July 2013 and 30th June 2014. The overflows were caused by high rainfall infiltration to the site.

The total duration of the overflows was 8.29 days (11,941 minutes) which represents 2.28% of the time. In 2012-13 this time was 12.55 days (18,069 minutes) or 3.44% of the time.

Date	Comments
23/9/13 – 27/9/13	Overflow from secondary pond to Kurapete Stream
15/10/13 – 20/10/13	Overflow from secondary pond to Kurapete Stream

All overflows were dealt with in accordance with the Incident Response Plan and reported to TRC and Taranaki District Health Board.

A sample was collected for each overflow and analysed by NPDC laboratory at New Plymouth Wastewater Treatment Plant.

Two samples were taken during the reporting period and analysed for Alkalinity, Conductivity, Suspended Solids, Ammonia as Nitrogen, Faecal Coliforms and CBOD5

The results are presented in Table 1.

Table 1 Monitoring during overflows from Inglewood ponds to the Kurapete Stream

Date	pH	Alkalinity (g/m3)	Conductivity (mS/M)	Suspended solids (g/m3)	Ammonia as N (g/m3)	Faecal coliforms (No./100mL)	CBOD5 (g/M3)
12/9/13	7.7	50	15.9	15	1.5	5250	9
15/10/13	7.8	48	15.3	15	0.88	200	7

The overflow performance for the Inglewood catchment remains significantly worse than other sewer catchments within the New Plymouth District.

All other sewer catchments in the New Plymouth District overflowed for a total of 1.53 days (2,206 minutes) which represents 0.01% of the total pump station run time.

Two unauthorised incidents in the reticulation occurred during the year from high inflow events (Table 2). The first event in October 2013 affected a private property and discharge to the stormwater system. As a result of this incident, an old blocked overflow point from the sewer to the stormwater system was re-opened to ensure further effects on private property did not reoccur. The Medical Officer of Health issued a public health advisory and requested further action to protect the health of residents affected by overflows on private property. A reply detailing completed actions and planned work was accepted by TDHB, with no further action required.

The second event utilised the re-instated overflow point from sewer to stormwater and was effective in protecting private property. Ongoing work to reduce I&I is detailed in section 3.3.

Table 2 Unauthorised incidents in the Inglewood reticulation

Date	Incident type	Location	Description	Corrective Action	TRC Action
15/10/2013	Unauthorised incident	Konini St	Excessive stormwater in the sewer reticulation caused an overflow from the sewer into stormwater and property	Smoke testing investigations to identify infiltration sources. Blocked overflow to stormwater at 39 Konini was reinstated to eliminate overflow to property. A level monitor and alarm was installed. Trunk main under Waiongana-iti Stream re-lined.	No further action
13/11/2013	Complaint	Konini St	The Medical Officer of health issued a Public Health Advisory to NPDC for a recurrent Statutory Nuisance at Konini Street	Actions as above. Reply to TDHB outlining actions and basis for best practice design of sewer system.	No further action
5/12/2013	Unauthorised incident	Konini St	Excessive stormwater in the sewer reticulation caused an overflow from the sewer into stormwater and then to the stream	As above; ongoing investigations, smoke testing and pipe lining to be completed.	No further action

3.3 Inflow and Infiltration

An annual graph of rainfall compared to inflow, outflow and secondary pond levels are shown in Figure 1 and Figure 2. More detailed monthly graphs have been issued to TRC at the end of each month throughout the year.

A total of 2,265mm of rain was received in Inglewood during the year.

The oxidation pond received a total of 646,732m^3 over the 12 month period. The average daily inflow was 1,772m^3 with a maximum flow of 10,364m3 on 5 January 2014 and minimum flow of 500m^3 on 4 April 2014. The theoretical average daily inflow based on 250 litres per person per day and assuming an estimated 3,750 resident population is 937m^3/day.

During the first half of 2012 NPDC developed a hydraulic model of the Inglewood reticulation. The model suggested that there was a significant inflow issue in the north east of Inglewood. The smoke testing which commenced during the 2012 – 13 year was continued into the 2013 – 14 year and further defects were identified. However the defects located were all relatively minor and considered unlikely to be the main source of Inflow which was observed during heavy rain events. A CCTV inspection of the Trunk sewer crossing under the Waiongana-iti Stream showed some defects to be present but the video inspection did not show indication of Infiltration. Notwithstanding these observations, NPDC committed to line this section of trunk sewer to remedy the defects. The work took some time to achieve as it was necessary to cut out a protruding piece of reinforcing steel prior to undertaking the lining. Special tooling had to be obtained from overseas. The reinforcing steel was cut out and the pipe lined by end of March 2014.

During early 2012 NPDC also established a set of Key Performance Indicators (KPIs) in order to be able to measure and quantify the performance of individual sewer catchments. The KPI's are based on Water Services Association Australia (WSAA) document on Management of Inflow and Infiltration published in November 2011. This work was reported in more detail in the 2011/12 Annual Report.

In the 2012 – 13 Annual Report NPDC stated that the targets for I & I were

- To reduce the peaking factor to eight or lower during a rain event of less than 20%AEP.
- to reduce the percentage of rainfall derived inflow and infiltration to 6.5% or less.

Figure 1 shows the daily summary of flow to the Inglewood Oxidation Ponds. Figure 2 shows the daily rainfall measured by the TRC rain gauge at Inglewood.

These charts show that there is a significant reduction in response to rain events in the latter part of the year and notably after April 2014. At the end of June two individual days of rainfall over 60mm generated inflow to the oxidation ponds of around 6,000 – 6,500m^3/day whereas earlier in the year similar rainfall generated flows to the ponds in excess of 10,000m^3.

There were a number of specific rain events which generated high inflows during the 2013 – 14 reporting year. Rainfall exceeded 59mm in 24 hours on five occasions with two consecutive days exceeding this value on 4 and 5 January. Maximum rainfall intensity on these days was between 20 to 25mm/hr.

Comparing the I&I KPI's for the seven days ending 11 December 2013 and 29 June 2014 provide an indication as to the performance of the reticulation and the improvements made during the year. Both of these weeks had very similar rainfall totals and antecedent wetness conditions. Also included in the comparison are seven day periods ending 16 September and 10 October 2013. Both of these periods coincide with times of overflow from the ponds. The rainfall data shows these periods were less wet than December 2013 and June 2014.

KPI and rainfall data are shown in Table 3 to provide a comparison of reticulation performance and the improvements made during the year.

The seven day periods ending 29 September and 20 October 2013 coincide with the periods of overflow to the Kurapete Stream. The KPI values and rainfall conditions are similar for both periods.

The seven day periods ending 11 December 2013 and 29 June 2014 by comparison are similar to each other but wetter than the previous September and October 2013 periods. December shows a slightly higher peaking factor but similar total RDII than the previous two periods. The data for June shows a reduced peaking factor and significant reduction in RDII percentage and total RDII volume. This confirms that the remedial works undertaken to address defects identified through smoke testing has been effective.

Table 3 Inflow and Infiltration KPI data

7 days ending	Total rainfall (mm)	Peak intensity (mm/hr)	Antecedent wetness (mm)	Peak factor	%RDII	Volume RDII (m^3)
26/9/13	115	16	57.3	12.4	11.2	29,858
20/10/13	95	15	51.4	13.1	11.9	26,020
11/12/13	97.5	25	97.5	16.15	12.4	27,860
29/6/14	98	20	98	12.3	8.1	18,317

While the targets set in the annual report have not been fully achieved, the amount of rainfall derived inflow and infiltration has been reduced significantly. Monitoring of the performance of the reticulation will continue and any defects which contribute to Inflow and Infiltration will be assessed and rectified if deemed appropriate.

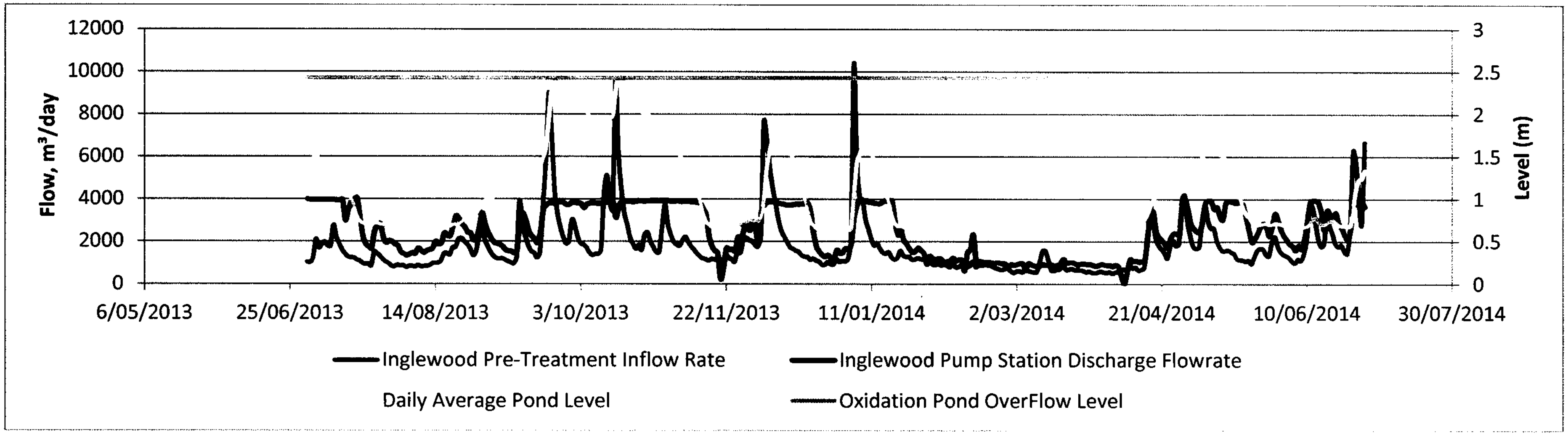

Figure 1 Inglewood Oxidation Pond from 01/07/2013 to 30/06/2014 (daily summaries)

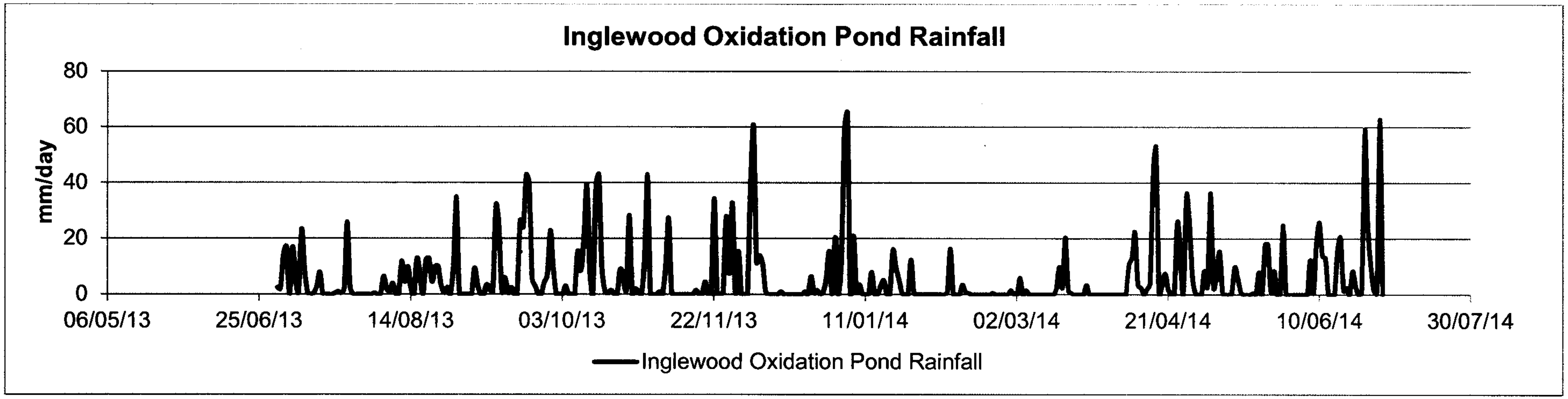

Figure 2 Daily Rainfall from 01/07/2013 to 30/06/2014

lab

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NEW PLYMOUTH DISTRICT COUNCIL
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Laboratory Analytical Report

Sample/Report Number: NPDC-4674
Report Status: Certified

Client: WaterOutlook NPDC

Sample Type: Grab Sample
Sample Date: 15/10/13 1:49 PM By: Simon Haupapa

Sample Received: 15/10/13 2:54 PM By Sue Walton
Results Checked: 22/10/13 3:43 PM By Catherine Yateman
Results KTP Certified 22/10/13 3:50 PM By Catherine Yateman
Client Sample ID: 0

Contact:
Phone:

Sample Description:	Sample Comments:
INGLEWOOD POND OVERFLOW	

Test Date	Analysis	Result:	Units:	Analyst:	Analytical Method:	Test Category
15/10/13	pH	7.8	pH Units	SW	4500-H⁺ B	IANZ RegisteredTest
15/10/13	BOD_5(Carbonaceous)	7	g/m³ $CBOD_5$	CA	5210A, B	IANZ RegisteredTest
16/10/13	Suspended Solids	15	g/m³	MB	2540 D	IANZ RegisteredTest
16/10/13	Ammonia as ' N '	0.88	g/m³	MB	4500-NH_3 D	IANZ RegisteredTest
15/10/13	Alkalinity to pH 4.8	48	g/m³	SW	2320 B	IANZ RegisteredTest
16/10/13	Conductivity	15.3	mS/M	MB	2510A, B	IANZ RegisteredTest
15/10/13	Faecal Coliforms (Liquid Sample)	200	No / 100ml	SW	9222 D	Non Registered Test

1	Analytical Method Number stated refers to 'APHA Standard Methods for the Examination of Water & Waste Water (22nd Edition)' unless stated otherwise
2	This Report may not be reproduced in full or part, without the permission from the New Plymouth District Council Laboratory Manager
4	Results apply only to sample as received

Opinions and interpretations of test results expressed in this Report are outside the scope of the Laboratory's Terms of Registration

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lab

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REGISTRATION IS HELD BY THE LABORATORY SERVICES SECTION
OF THE NEW PLYMOUTH DISTRICT COUNCIL AS FOLLOWS:

Classes of Test: 2.41 Water
Sewage
Effluents
Trade Wastes

a) Potable Waters
b) Non-potable Waters
c) Sewage
d) Effluents
e) Trade Wastes

The following tests in accordance with APHA "Standard Methods for the Examination of Water and Wastewater", 22nd Edition, 2012.

Analysis	[illegible]
Alkalinity	2320, B
Nitrogen (Ammonia)	4500 – NH_3, D
Nitrogen (Nitrite)	4110 A,B
Nitrogen (Nitrate)	4110 A,B
Chloride	4110 A, B
Sulphate	4110 A, B
Sulphate	4500 - SO_4^{2-}, D
Cyanide	4500-CN, F
Oxygen (Dissolved)	4500 –0, C
Fluoride	4500 – F, C
Total Suspended Matter	2540-D
Grease and Oil	5520-D
pH Value	4500 –H^+, B
Phenols	5530, B, D
Phosphorus	4110 A,B
Phosphorus	4500-P, A, B, E
Oxygen Demand (Biochemical)	5210, A, B
Cd, Cu, Cr, Fe, Mn, Pb, Ni, Zn	3030 E, 3111 B
Conductivity	2510, A, B
Temperature	2550 A, B
Chemical Oxygen Demand	5220 D (Hach Apparatus)

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Nitrogen (Nitrate)	4110 A,B
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Sulphate	4110 A, B
Sulphate	4500 - SO_4^{2-}, D
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Oxygen (Dissolved)	4500 –0, C
Fluoride	4500 – F, C
Total Suspended Matter	2540-D
Grease and Oil	5520-D
pH Value	4500 –H^+, B
Phenols	5530, B, D
Phosphorus	4110 A,B
Phosphorus	4500-P, A, B, E
Oxygen Demand (Biochemical)	5210, A, B
Cd, Cu, Cr, Fe, Mn, Pb, Ni, Zn	3030 E, 3111 B
Conductivity	2510, A, B
Temperature	2550 A, B
Chemical Oxygen Demand	5220 D (Hach Apparatus)

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Laboratory Analytical Report

Client: WaterOutlook NPDC

Sample/Report Number:				NPDC-4299
Report Status:				Certified
Sample Type:				Grab Sample
Sample Date:	24/09/13	9:15 AM	By:	Bryan Mullin
Sample Received:	24/09/13	10:07 AM	By	Catherine Yateman
Results Checked:	30/09/13	8:43 AM	By	Catherine Yateman
Results KTP Certified	30/09/13	8:46 AM	By	Catherine Yateman
Client Sample ID:				0

Contact:
Phone:

Sample Description:	Sample Comments:
Inglewood Oxidation Pond	

Test Date	Analysis	Result:	Units:	Analyst:	Analytical Method:	Test Category
24/09/13	pH	7.7	pH Units	SW	4500-H^+ B	IANZ RegisteredTest
24/09/13	BOD_5(Carbonaceous)	9	g/m^3 $CBOD_5$	CA	5210A, B	IANZ RegisteredTest
24/09/13	Suspended Solids	15	g/m^3	MB	2540D	IANZ RegisteredTest
24/09/13	Ammonia as ' N '	1.5	g/m^3	SW	4500-NH_3 D	IANZ RegisteredTest
24/09/13	Alkalinity to pH 4.8	50	g/m^3	SW	2320B	IANZ RegisteredTest
24/09/13	Conductivity	15.9	mS/M	SW	2510A, B	IANZ RegisteredTest
24/09/13	Faecal Coliforms (Liquid Sample)	5250	No / 100ml	SW	9222D	Non Registered Test

Key	
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