New Plymouth District Council
Inglewood Oxidation Ponds System
Monitoring Programme
Annual Report
2012-2013

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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 2012 to June 2013 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, three additional inspections and two biological receiving water surveys. Although four separate overflow events had occurred in the 2003-04 monitoring year, none had been recorded over the four annual periods to mid 2008. A prolonged period of very wet weather from mid July to early August 2008 resulted in further intermittent overflows of very dilute, treated wastewater to the stream until mid August 2008. Similar intermittent overflows were recorded after very wet weather late in the 2009-2010 period, over a four week period in September 2010 and again, more briefly late in the 2010-2011 period. Seven intermittent overflows, each of one to four days duration, occurred following heavy rainfall events in the 2011-2012 period. One overflow event, intermittently over eight days duration, occurred in July 2012 and another of two days duration occurred very late in the current 2012-2013 monitoring period.

Regular inspections indicated no problems with the ponds' system maintenance or operation, with no unauthorised overflows to the stream of any nature.

Pond microfloral monitoring continued to indicate 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, although microfloral populations were of low richnesses and generally relatively low abundances during the first half of the period, and particularly after elevations in pond levels due to increased flushing by stormwater inflows.

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 continued to occur, but in compliance with the condition authorised by the consent. However, some further investigative work has been programmed by the consent holder subsequent to more frequent 2011-2012 and 2012-2013 overflow events which have indicated more recent direct stormwater inflows to the reticulation.

The spring and summer biomonitoring surveys 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.

The spring survey also documented no impacts of a very diluted, relatively recent wastewater overflow on the biological community at the site downstream of the discharge. Trend evaluation of the seventeen 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 high 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 relatively infrequent overflows from the system over the past nine years.

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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 2012 to June 2013 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-sixth 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 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 2013-2014 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 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 (eg, 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 Resource Management Act to assess the effects of the exercise of consents. In accordance with section 35 of the Resource Management Act 1991, 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 desirable** indicates that the Council may have been obliged to record a verified unauthorised incident involving measurable environmental impacts, 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 abatement notices may have been issued.

- **poor performance** indicates that the Council may have been obliged to record a verified unauthorised incident involving significant environmental impacts, or, there were adverse environmental effects arising from activities and 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 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.

No additional trade wastes connections to the sewerage reticulation were recorded during the 2009-2012 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 Resource Management Act 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 Resource Management Act. 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 Resource Management Act 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.

The monitoring programme 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. Two additional inspections were performed during the 2012-2013 monitoring year, coincident with the potential for an overflow event in September 2012 and an actual overflow event in late June 2013.

1.4.4 Wastewater and receiving water quality sampling

This component of the monitoring programmes has been removed in recognition of the 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 two sites in the Kurapete Stream under relatively low flow conditions spring 2012 and under very low flow conditions in late summer 2013. Both 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. These surveys have also been incorporated within the Council's temporal trending State of the Environment Monitoring programme (see TRC, 2006a, TRC, 2009a, TRC, 2009b, TRC, 2012, and TRC 2013).

1.5 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 causes of non-compliance or failure to maintain good practices. A pro-active approach that in the first instance avoids issues occurring is favoured.

The 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 company concerned has itself notified the Council. The register contains details of any investigation and corrective action taken.

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

In the 2012-2013 period, it was necessary for the Council to undertake one additional investigation and intervention, and record an incident, in association with New Plymouth District Council Inglewood oxidation ponds system conditions in resource consents or provisions in Regional Plans in relation to the consent holder's activities during the monitoring period.

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 followed a overflow event in late June 2013 and one other coincided with the potential for an overflow event in September 2012 following a pump shutdown/pipeline reticulation discharge event into the Mangaoraka catchment.

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 microfloral sample was also collected from the same site at the time of inspections, for semi-quantitative assessment.

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 (%)
4 July 2012	1.07	0920	7.4	11.2	95
6 November 2012	0.76	0810	17.8	8.9	94
2 April 2013	0.65	0730	18.8	7.7	84

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 (84% to 95%) were typical of biological treatment systems although they were high and within an atypical narrow 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 0920 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 spraying of weedy surrounds was undertaken prior to the April, 2013 inspection.

The inspections were performed in conditions ranging from calm to light winds, 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 slightly turbid pale brown to turbid dark brown, while the main pond's appearance varied from turbid brown to slightly turbid pale green. No noticeable odours around the main pond were recorded on any inspection occasion during the period, with only very slight localised odours noted on occasions downwind of the primary aeration cell.

Moderate to high numbers of wildlife [ducks (mallard and paradise) and up to six black swan on all occasions, and a few teal and scaup (on one occasion)] were noted on the main pond, with no wildfowl associated with the aeration cell on any inspection occasion. On all occasions this pond 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 at the time of the additional June, 2013 inspection.

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 July 2012 and June 2013. 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 (2.4 metres (NPDC, pers comm)) as much as possible. Highest pond levels were recorded following heavy rainfall in mid and late July 2012 when an intermittent overflow (over 8 days) occurred. Further major rises in pond level followed heavy rainfall in late August 2012, but this did not result in overflows, but another (two-day) overflow in late June 2013 followed heavy rainfall (Appendix III).

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.

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 a 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 (NPDC. pers comm, August 2012). Work has also continued to identify direct connection(s) between stormwater and sewerage systems (Appendix III).

Two new pumps with improved delivery capabilities were ordered and have been received with installation intended for July 2013. 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).

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.

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 July 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 July 2012 and June 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 (2003-2012)		Overflows (2012-2013)		1986-1999			Overflows (2000 to 2012)	
		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	17	<1-8	2	3	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	21	7.0-8.8	2	6.9-7.2	26	6.9-8.9	7.4	2	7.0-7.2
Conductivity @ 20^{o}C	mS/m	-	-	-	-	-	-	25	11.8-38.6	25.0	2	15.0-16.3
Conductivity @ 25^{o}C	mS/m	45	14.7-43.3	21	13.8-21.9	2	13.9-15.5	-	-	-	-	-
Ammonia-N	g/m^{3}N	45	1.2-32	21	0.1-5.5	2	1.8-2.0	26	0.71-22	9.17	2	2.74-3.16
Nitrite + nitrate-N	g/m^{3}N	45	<0.2-13.5	-	-		-	6	<0.01-0.46	0.08	2	0.62-0.92
Nitrate-N	g/m^{3}N	-	-	-	-		-	15	<0.01-0.69	0.06	-	-
Dissolved reactive phosphorus	g/m^{3}P	-	-	-	-		-	18	1.08-6.55	2.64	2	0.19-0.22
Suspended solids	g/m^3	45	<5-178	21	<5-38	2	<5-9	25	10-160	36	2	3
Faecal coliform bacteria	nos/100ml	45	$1.5x10^2$-$7.2x10^5$	19	$1.3x10^2$-$7.8x10^3$	2	$5.3x10^3$-$1.03x10^4$	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 July 2012 and June 2013 when BOD_5 was 3 g/m^3 and suspended solids less than 10 g/m^3.

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 eg cyanobacteria are often present in under-loaded conditions and chlorophyceae are present in overloaded conditions.

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.

The main Inglewood oxidation pond was sampled on three occasions during the 2012-2013 monitoring year in conjunction with routine inspections of the pond system. Composition of algal communities and MfCI values are shown in Table 3 and referenced in full in TRC, 2009. Since November 1999, wastewater has been diverted to the New Plymouth District Council wastewater treatment plant and no longer enters the Inglewood oxidation ponds unless the volume of stormwater and wastewater exceed the pumping capacity to the NPDC wastewater treatment plant. Any changes in the algal community after this upgrade (i.e. reduced diversity and abundance of algae) are likely to be due to operational changes, particularly lowered pond levels designed to increase stormwater retention capabilities in the system. Over this period the pond has been managed predominantly at about 1 metre in depth although on a few occasions the pond filled after heavy rainfall events (eg at the time of the July 2012 inspection).

Samples of effluent were collected from adjacent to the outlet of the oxidation pond and analysed under binocular microscope to identify phytoplankton present including algal and non-algal groups. The presence and estimated abundance (present (P), abundant (A) or very abundant (VA)) of these are recorded and the dominant taxa are highlighted (in bold). Taxa richness (number of taxa) and the Microfloral Community Index (MfCI) were calculated. The MfCI was designed by Taranaki Regional Council biologists as a measure of sewage pond performance using phytoplankton and some heterotrophic groups. This MfCI uses 'sensitivity' scores of 1 to 10 assigned to each taxon, depending on their occurrence in poorly-performing (overloaded) or well-performing ponds. Higher MfCI values are indicative of better pond performance.

2.2.2.1 Main oxidation pond

In the past the Inglewood pond has supported one of the least diverse algal communities of Taranaki sewage treatment systems. Algal richnesses in the monitoring year under review before curtailment of this component, were slightly below average on the two sampling occasions (4 and 5 taxa), (Table 3 and Figure 1), these numbers reflecting the flushing effects of several high rainfall ingress events during the period prior to sampling.

An indicator of poorly performing ponds, the motile *Euglena* has been present in the Inglewood Pond system on a majority of survey occasions to date (being the dominant species on 32 occasions). However, following the diversion of the wastewater to the New Plymouth District Council wastewater treatment plant,

Euglena has usually been absent from the pond or in very low numbers. It was absent from the pond on the two occasions (winter and late spring) during the current monitoring year.

Table 3 Planktonic microflora found in the Inglewood secondary sewage treatment pond over the 2012-2013 period

Algal Taxa	4 July 2012	6 Nov 2012
GREEN ALGAE		
Ankistrodesmus		P
Closterium	P	
Chlorella	**A**	P
Coelastrum	P	
Dictyosphaerium		P
Scenedesmus	P	P
Oocystis		P
Unidentified (unicells)		P
CRYPTOPHYTES		
Cryptomonas		
NUMBER OF TAXA	**4**	**5**
MfCI	**80**	**60**

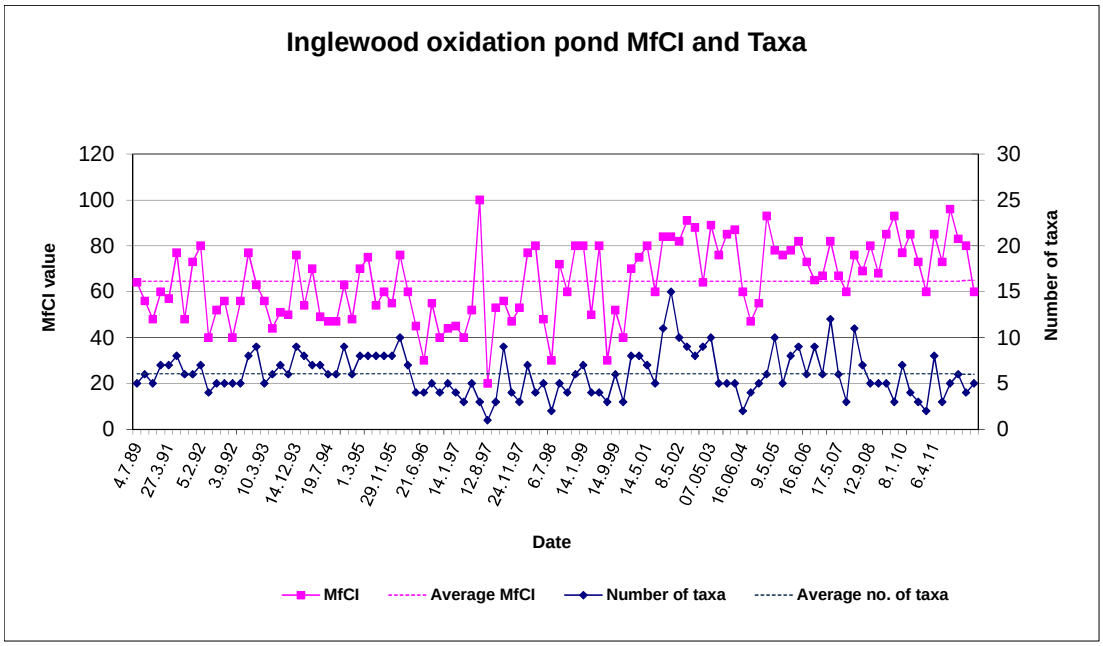

Figure 1 Numbers of taxa and MfCI values for phytoplankton communities in the Inglewood oxidation (main) pond since 1989

During the 2012-2013 monitoring year, the predominant taxon was identical on both the sampling occasions (Table 3), the former when this green algal taxon (*Chlorella*) was also abundant.

In the past the 'Pond MfCI' used by the TRC has tended to produce low results for the Inglewood pond. Prior to the current consent monitoring period, the low MfCI average (63 units) and median (63 units) were due to low diversities and past high flushing rates. These conditions may have prevented the establishment of some of

the 'higher-scoring' taxa which are less common in overloaded ponds. The cooler months of 1993 produced a series of low MfCI values (Figure 1).

The cool temperatures and high flushing rates during these periods combined with the grazing by zooplankton such as copepods and cladocera (usually *Daphnia*), reduced the algae to low diversities and abundance. The MfCI score of 100 recorded in July 1997 was an anomaly which reflected the rare occurrence of two relatively high scoring algae. In August 1997 a pond MfCI of 20 units was recorded when the 'low scoring' bacteria was the only taxon present on this occasion. Since the upgrade of the pond system and diversion to the New Plymouth wastewater treatment plant, the average MfCI has been steadily increasing. During the current monitoring year the MfCI values were well above the average of 64 units in winter (80 units) and slightly lower (60 units) in late spring. The average MfCI value subsequent to wastewater diversion (in late 1999) has now increased to 78 units, an indication that the condition of the pond (operating at low levels as a storage system) has improved under the different operating regime.

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 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.

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 2 and 3.

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

The first survey was performed in spring (5 October 2012) during relatively low recession flow conditions, and the second survey was undertaken in late summer (1 February 2013) under very low flow conditions; with both surveys performed when all wastes discharges were diverted from the stream and no overflow events had occurred within ten weeks of either survey. These reports are attached as Appendix II and results summarised in Table 5.

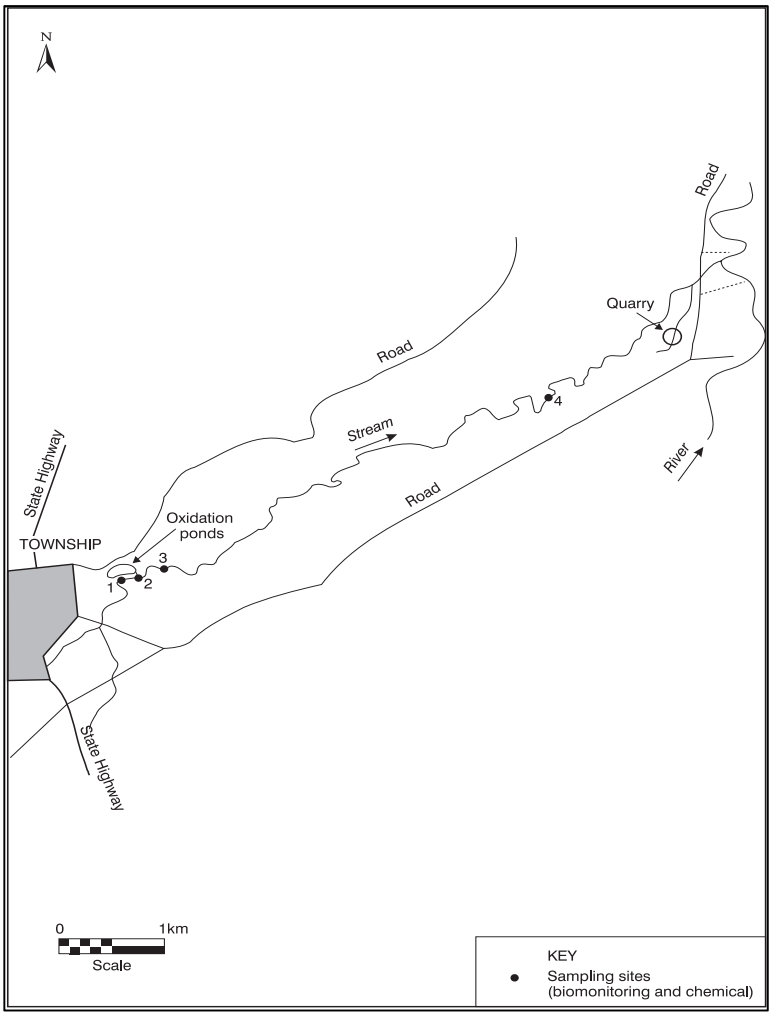

Figure 2 Sampling sites in the Kurapete Stream in relation to Inglewood oxidation ponds

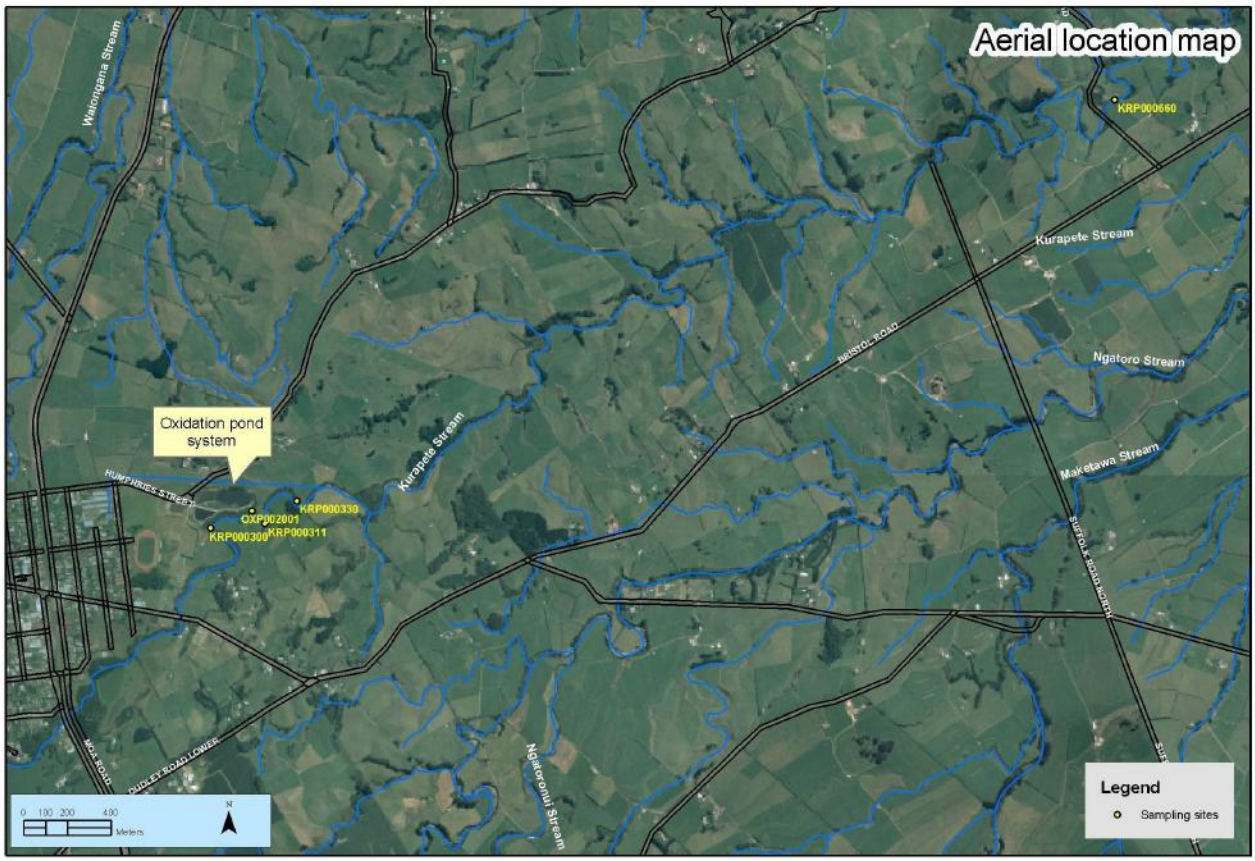

Figure 3 Aerial location map

Table 5 Biomonitoring results from the two surveys of the Kurapete Stream in the 2012-2013 period

Site No	Macroinvertebrate fauna			
	Taxa numbers		MCI values	
	5 Oct 2012	1 Feb 2013	5 Oct 2012	1 Feb 2013
1	25	21	101	101
4	25	27	112	97

The spring survey, performed about ten weeks after the most recent overflow discharge event (mid July 2011 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 of the wastewater discharge from the stream). It also found no impacts of recent overflows, to the extent that the biological 'health' of the downstream site was better than recorded previously. Macroinvertebrate taxa richness and MCI scores continued to illustrate this post-diversion recovery of the fauna downstream of the oxidation ponds system. Some community composition changes, coincident with a moderate increase in substrate periphyton cover and the more open nature of the stream, were recorded at the site nearly 6 km further downstream. Taxa numbers were relatively high and within a narrower range than usual. MCI scores had a wider range (from 101 to 112 units) than often found over the reach of the Kurapete Stream surveyed. MCI scores were similar or above those predicted for sites in similar ringplain streams at similar altitudes. 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 of the site approximately 6 km below the outfall particularly reflected these improvements indicative of the significance of wastes removal from this stream despite an earlier overflow of very dilute oxidation pond treated wastewater to the stream under wet weather conditions.

The late summer survey was performed under very low flow conditions more than thirteen 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 following heavy rainfall. It continued to record the improved biological condition of the stream at the site downstream of the outfall in the lower reaches since the diversion, with no significant downstream deterioration in stream 'health'. Macroinvertebrate taxa richness and the MCI score illustrated the earlier documented post-diversion recovery of the fauna downstream of the oxidation ponds system. Several community composition changes, coincident with a marked increase in substrate periphyton cover and the more open nature of the stream, were recorded at the site nearly 6 km further downstream as illustrated by only 56% of the 32 taxa found between the two sites being present at both sites. Taxa richnesses were relatively high and within a moderate range (six taxa between sites). The moderate MCI scores had a narrow range, from 97 to 101 units, over the reach of the Kurapete Stream surveyed. MCI scores were very similar to those predicted for sites at 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 of 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 overflows of very dilute municipal oxidation pond treated wastewater to the stream under wet weather conditions.

Recent statistical trend analysis of macroinvertebrate data collected over ten and seventeen year periods between 1995 to 2012 (Stark and Fowles, 2006 and TRC 2013) has 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 reduced in significance over the longer seventeen year period. The improvement upstream has been 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 2013). In recent years, the upstream site's trend has tended to plateau while there has been a very strong trend of improvement at the downstream site between 1999 and 2004, then a decreasing trend between 2004 and 2007, followed by further 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 are implemented in the catchment. A return to the four site survey would occur only in order to assess any impacts of consented (1449) extreme rainfall associated discharges, should such events be prolonged or frequent (as was the situation in mid summer, 2012).

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 2012-2013 year, there was one incident recorded by the Council that was associated with the consent holder's exercise of consent 1449.

In mid-September 2012 NPDC advised that a small sewage leak had been found in the rising sewerage main (due to a failure of a glued pvc flange where piping material changed to stainless steel) at the crossing point over the Mangaoraka Stream bridge at Corbett Road. In order to effect the repairs, which were performed the following day, the transfer pumps from the Inglewood WWTP to New Plymouth were switched off. The second oxidation pond rose in level slightly (less than 0.1 m) before the pumps were re-operational late the following day, prior to predicted weekend wet weather which might have resulted in an overflow discharge (permitted by Consent 1449). No overflow eventuated, however and the system was inspected by TRC after the incident was responded to according to TRC protocols. No further action was deemed necessary and no problems have recurred at the pipeline stream crossing site.

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 2012 (Figure 4). 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 2012-2013 period.

Streambank length in the Kurapete catchment equates to 81 km. Currently, 58 km of banks is protected by existing and completed fencing with 33 km protected by existing/completed vegetation. Since the preparation of riparian plans, 23 km of fencing and 7 km of planting have been completed in the catchment.

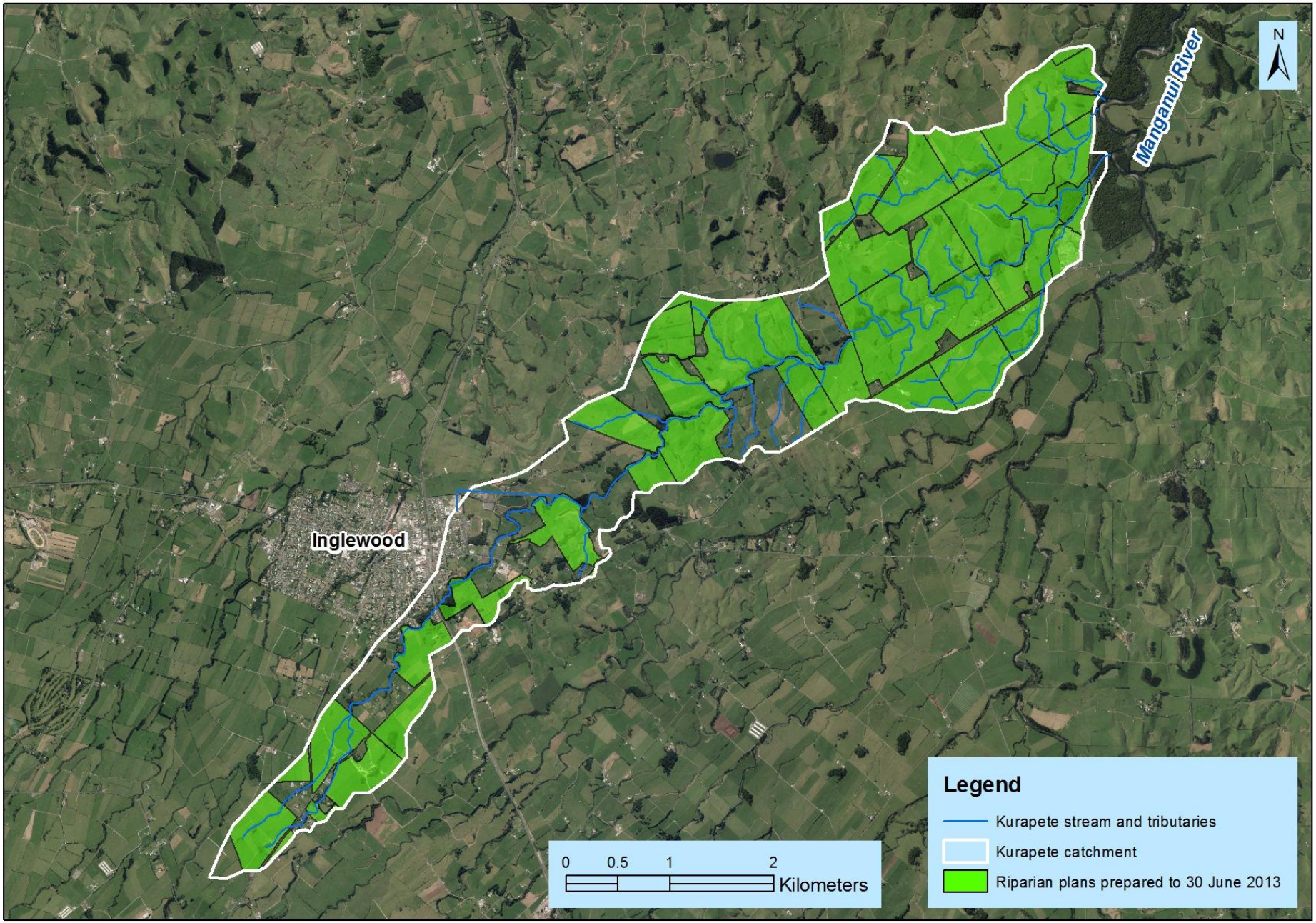

Figure 4 Riparian plans prepared in the Kurapete Stream catchment to date

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 one to eight 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 satisfactory 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 continued until mid-period coincident with variability in pond levels which generally were low when possible for storage purposes over the majority of the period. Results 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. The MfCI scores varied coincidental with fluctuations in pond levels (due to the heavy rainfall events) but maintained the higher average value since wastewater discharges were diverted out of the stream.

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.

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.

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 and 2012-2013 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.

4.2 Environmental effects of exercise of water permit

The water permit was exercised on two intermittent occasions between July 2012 and June 2013 monitoring year (but for relatively short durations (one to four days) 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 relatively recent overflow event. 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 downstream site on the spring survey occasion when the 'health' at this site, as measured by the MCI was the highest recorded over the past 19 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
6. Notification of overflows to Taranaki Health	Liaison with consent holder, perusal of records	Yes

Condition requirement	Means of monitoring during period under review	Compliance achieved?
7. Implementation of a stormwater reduction programme	Completed report and 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 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 high 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 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 2012 and June 2013 in the period; the twelfth and thirteenth times such events have occurred in eight years resulting in discharges to the Kurapete Stream. Most of these events were 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 2011-2012 Annual Report

The previous Annual Report (TRC 2012-21) made the following recommendations:

1. THAT the monitoring of the Inglewood oxidation ponds system be performed in 2012-2013 by formulation of an amended programme similar in format to the programme undertaken in 2011-2012;
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;
4. THAT the consent holder continues to liaise with and advise Council immediately of the occurrence of each overflow event to the Kurapete Stream; and
5. THAT costs of $1,158, incurred in relation to additional biological monitoring associated with the several consented overflow events, be charged to the consent holder.

Compliance with the recommendations 1 to 3 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) although there was a delay with notification of the duration of the two overflow events. Recommendation 5 was implemented by Council.

4.5 Alterations to monitoring programme for 2013-2014

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 Resource Management Act, 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 those which occurred in September 2010 and January 2012).

For the 2013-2014 programme, it is proposed that monitoring continue at the same level as that in the 2012-2013 period, with a minor change to the microfloral monitoring of the pond system where chlorophyll-a analyses will replace the requirement for detailed phytoplankton evaluation at the time of each inspection.

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 2012-2013 monitoring programme for Discharge Permit 1449 the following recommendations are made:

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 requirements (see 4.5 above).
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; 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.

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 are 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 2012 and summer 2013

To K Brodie, Monitoring Manager—Environment Quality
From C R Fowles, Scientific Officer
Document 1129255
Report No CF560
Date November 2012

Biomonitoring of the Kurapete Stream in relation to the New Plymouth District Council's Inglewood oxidation ponds' system, October 2012

Introduction

This spring survey was the first of two surveys programmed for the 2012-2013 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. These four sites had been last fully surveyed in October, 2010 (CF512, 2010). Two further brief overflow events occurred between early and mid March 2012 and another in July 2012. At the time of the current 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.

Methods

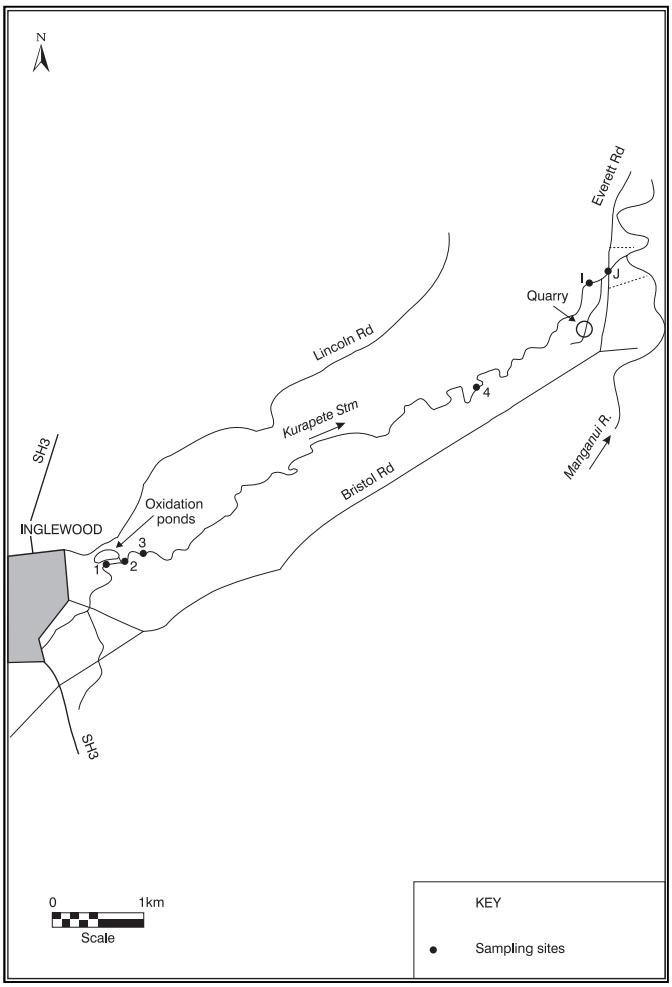
The standard '400 ml kick sampling' technique was used to collect streambed (benthic) macroinvertebrates from two established sampling sites in the Kurapete Stream (illustrated in Figure 1) on 5 October 2012.

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).



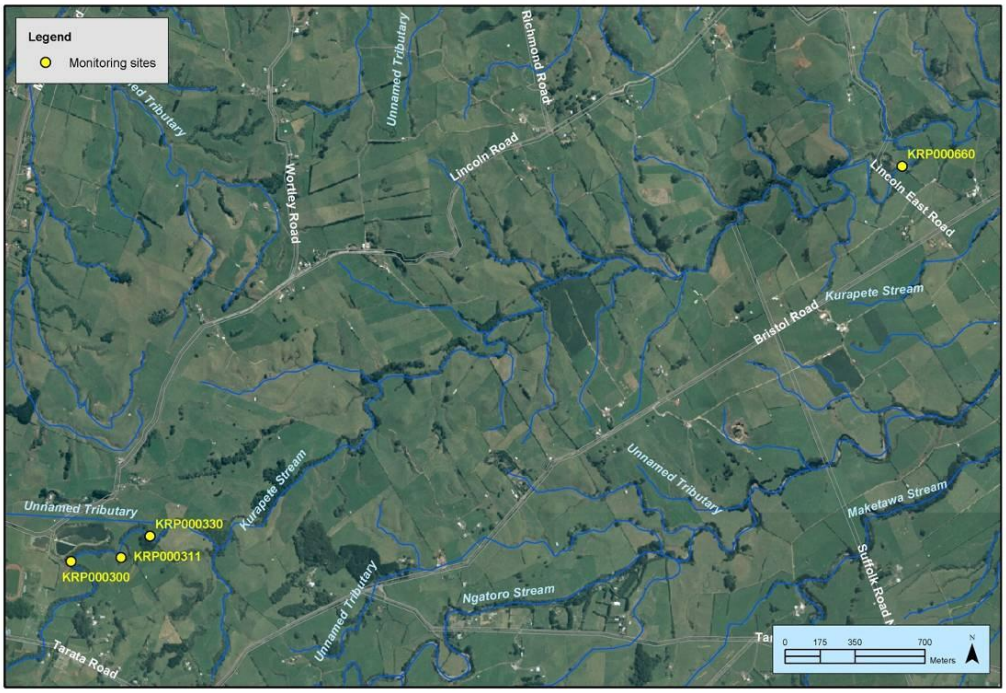


Figure 1 Sampling sites in the Kurapete Stream in relation to Inglewood oxidation ponds

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 spring survey was performed during relatively low (recession) flow conditions 18 days after a fresh greater than 3x median flow and 27 days after a fresh in excess of 7x median flow. Water temperatures ranged from 10.6°C to 11.2°C during this mid 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, and in July 2012 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. Patchy mats of periphyton and moss, but no filamentous algal growth, were recorded at site 1, in the riffles at this mainly 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, filamentous algae, and moss were recorded at this partly shaded site where the substrate was mainly gravel, cobble, and boulders, with a minor sand and silt component.

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-five 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 March 2012

Site	Site code	No of surveys	Taxa numbers		MCI values	
			Range	Median	Range	Median
1	KRP000300	25	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	25	21-30	27	83-103	94

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

Table 3 Summary of macroinvertebrate results from the October 2012 survey

Site	Site code	Macroinvertebrate fauna	
		Taxa number	MCI
1	KRP000300	25	101
4	KRP000660	25	112

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.

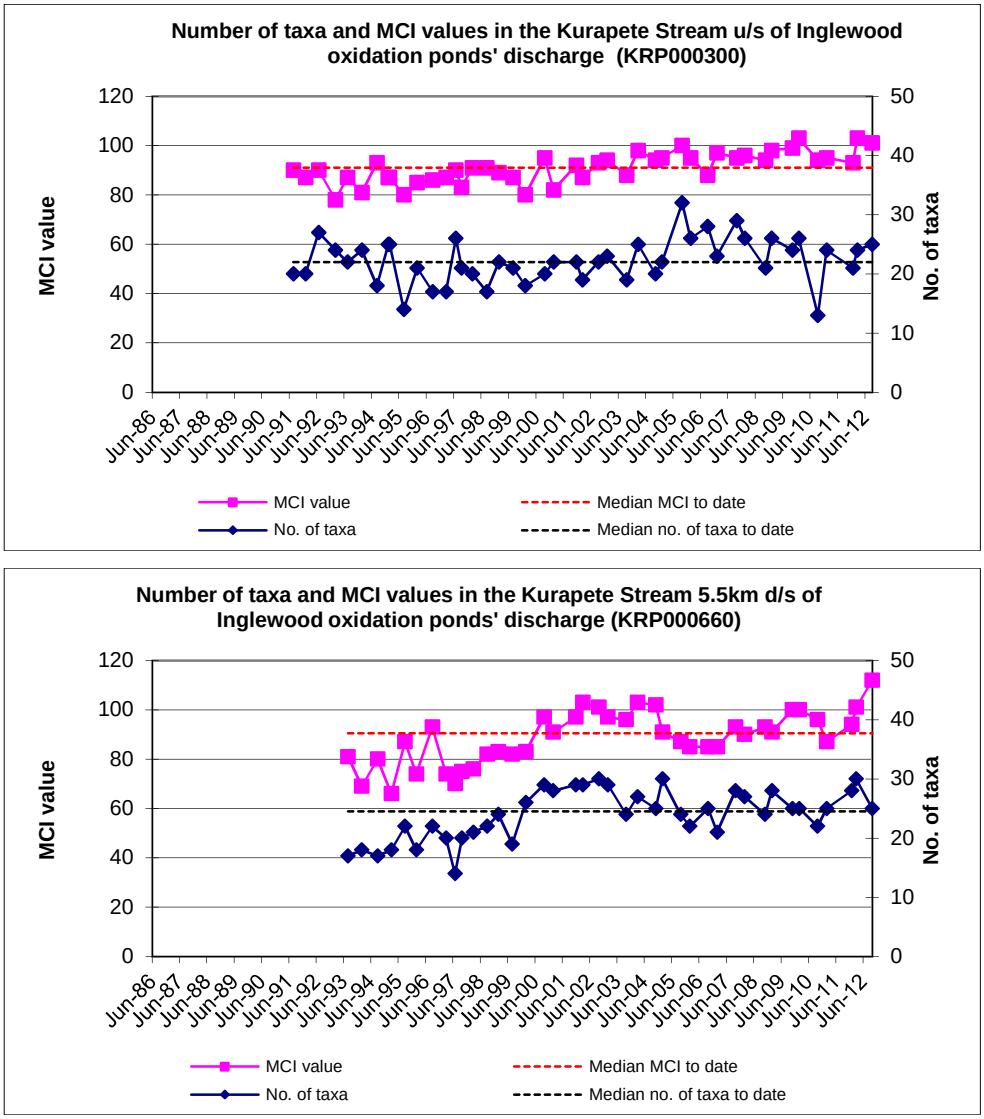


Figure 2 Taxa richness and MCI scores recorded to date at each of the sites in the Kurapete Stream

Site 1 – upstream of the oxidation ponds' discharge

A slightly above median macroinvertebrate community richness (25 taxa) was recorded at this site, in the mid range of than richnesses recorded by the more recent surveys since 2004 (Tables 1 and 2 and Figure 2). Four 'highly sensitive' taxa were found (but only one in abundance) with the site characterised by the one 'highly sensitive' taxon [mayfly (*Deleatidium*)]; three 'moderately sensitive' taxa [mayfly (*Zephlebia* group), elmid beetles, and cranefly (*Aphrophila*)]; and four 'tolerant' taxa [oligochaete worms, snail (*Potamopyrgus*), orthoclad midges, and sandfly (*Austrosimulium*)]. This was very similar to the number of characteristic taxa recorded by the previous late summer survey and the composition was only slightly different. The relatively high proportion of higher scoring 'sensitive' taxa (60% of the fauna) comprising this community was reflected in the MCI score of 101 units. This was only two units less than the historical maximum score and significantly higher than the long-term median recorded (53 surveys) for this site (90 units) and six 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 with a similar number and composition of dominant taxa (TRC, 2012). The MCI score was within 2 units 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 'better than expected' predictive health for the mid reaches of a ringplain seepage stream (TRC, 2012).

Table 4 Macroinvertebrate fauna of the Kurapete Stream in relation to the Inglewood oxidation ponds system sampled on 5 October 2012

Taxa List	Site Number	MCI score	1	4
	Site Code		KRP000300	KRP000660
	Sample Number		FWB12364	FWB12365
NEMATODA	Nematoda	3	R	-
ANNELIDA (WORMS)	Oligochaeta	1	A	A
	Lumbricidae	5	R	-
MOLLUSCA	*Potamopyrgus*	4	VA	A
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	R	A
	Coloburiscus	7	-	VA
	Deleatidium	8	VA	VA
	Nesameletus	9	-	R
	Zephlebia group	7	VA	A
PLECOPTERA (STONEFLIES)	*Acroperla*	5	R	C
	Zelandobius	5	-	VA
	Zelandoperla	8	-	R
COLEOPTERA (BEETLES)	Elmidae	6	A	A
	Ptilodactylidae	8	R	-
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	C	A
TRICHOPTERA (CADDISFLIES)	*Aoteapsyche*	4	C	VA
	Costachorema	7	R	C
	Hydrobiosis	5	C	C
	Hydrobiosella	9	-	C
	Neurochorema	6	-	C
	Orthopsyche	9	R	-
	Beraeoptera	8	R	-
	Oxyethira	2	R	-
	Pycnocentria	7	-	R
	Pycnocentrodes	5	-	A
	Triplectides	5	-	R
DIPTERA (TRUE FLIES)	*Aphrophila*	5	A	VA
	Eriopterini	5	R	R
	Maoridiamesa	3	R	C
	Orthocladiinae	2	A	A
	Polypedilum	3	R	-
	Tanypodinae	5	C	-
	Austrosimulium	3	A	R
	Tanyderidae	4	R	-
		No of taxa	25	25
		MCI	101	112
		SQMCIs	5.6	5.6
		EPT (taxa)	9	16
		%EPT (taxa)	36	64

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

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

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

A relatively good taxa richness (25 taxa) was recorded at this site, one taxa more than the maximum of taxa numbers previously recorded from fourteen surveys prior to wastes diversion (Table 1), and two taxa fewer than the median richness found since this diversion (Table 2 and Figure 2). This was coincident with the presence of patchy moss, filamentous algae, and periphyton mats on this site's substrate. Four 'highly sensitive' taxa were found at this site (one of which was very abundant), the same number of 'highly sensitive' taxa as found upstream at site 1. The community was characterised by one 'highly sensitive' taxon [mayfly (*Deleatidium*)]; eight 'moderately sensitive' taxa [mayflies (*Coloburiscus, Austroclima,* and *Zephlebia* group), stonefly (*Zelandobius*), elmid beetles, dobsonfly (*Archichauliodes*), stony-cased caddisfly (*Pycnocentrodes*), and cranefly (*Aphrophila*)]; and four 'tolerant' taxa [oligochaete worms, snail (*Potamopyrgus*), net-building caddisfly (*Aoteapsyche*), and orthoclad midges]. Most of these 'tolerant' taxa are generally associated with periphyton and algal substrate cover, which was patchy at this site under relatively low flow conditions at the time of this survey but there was a significant increase in the number of dominant 'sensitive' taxa.

The 'tolerant' caddisfly and up to six 'sensitive' taxa showed increases in abundances coincident with less substrate periphyton cover than often present and there was a marked decrease in abundance of the 'tolerant' sandfly. Despite the downstream increases in mayfly abundances in particular, there was no change in the $SQMCI_s$ scores between sites 1 and 4 mainly as a result of the numerical dominance by one 'highly sensitive' and one 'tolerant' taxon at both sites. The predominance of 'sensitive' taxa (76% of richness) was reflected in the MCI score of 112 units. This score was very significantly (Stark, 1998) 34 units above the median of all surveys prior to wastes diversion (Table 1 and Figure 2), and 11 units above the score at the upstream 'control' site. This improvement between sites 1 and 4 was atypical of the rate of decline expected through the mid reaches of a Taranaki stream sourced outside the National Park (TRC, 2012) and also the median rate of decline (1.5 units/km) found prior to wastewater diversion (Table 1). The score at site 4 was 9 units above the maximum and a significant 18 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 no downstream deterioration in stream 'health' under spring relatively low flow, some 10 weeks since the recent overflow of very dilute wastewater to the stream. The MCI score was 15 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 'good' generic health and 'better than expected' predictive health for the lower mid-reaches of such a stream (TRC, 2012).

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 for the majority of the preceding period, and coincident with recovery of the faunal communities of the receiving waters subsequent to this diversion, despite a relatively recent diluted wastewater overflow event ten weeks prior to this survey.

Conclusions

This survey was performed in spring under relatively low flow conditions more than twelve 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 relatively recent overflow discharge event after intensive heavy rainfall earlier in July 2012. It continued to record the improvement in the biological condition of the stream at the site downstream of the outfall since the diversion and no impacts of the recent overflow to the extent that the biological 'health' at the downstream site was better (in terms of MCI score) than recorded previously. Macroinvertebrate taxa richness and MCI scores continued to illustrate this post-diversion recovery of the fauna downstream of the oxidation ponds system. Some community composition changes, coincident with a moderate increase in substrate periphyton cover and the more open nature of the stream, were recorded at the site nearly 6km further downstream as illustrated by only 47% of the 34 taxa found between the two sites being present at both sites. Taxa richnesses were relatively high and within a narrower range (no change in number between sites) than usual. The moderate MCI scores had a wider range, from 101 to 112 units, than often found over the reach of the Kurapete Stream surveyed. MCI scores were similar or above 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, despite an earlier overflow of very dilute oxidation pond wastewater to the stream under wet weather conditions.

The most recent statistical trend analyses of macroinvertebrate data collected over the ten and sixteen year periods between 1995 and 2011 (Stark and Fowles, 2006 and TRC, 2012) 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 reduced in significance over the longer sixteen 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 2012). In recent years the upstream trend has plateaued 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 improvement which has reduced the significance of the overall temporal trend. Stream '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 are implemented in the catchment. A return to the four site survey (as performed on the previous survey 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 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 spring macroinvertebrate survey indicated that, despite a relatively recent (consented) discharge 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 and further improved 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 an atypical higher number of 'sensitive' taxa at the more open downstream site where periphyton substrate cover was more extensive but not as prolific as has often been found previously Taxonomic richnesses (numbers of taxa) and MCI scores indicated that this post-wastes diversion improvement had been maintained or enhanced at the time of this spring 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 ' good' health, and generally equivalent with, or better than, typical conditions recorded in similar reaches of Taranaki seepage-sourced ringplain streams.

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<u>Pre-diversion of wastes</u>

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Post-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 pond's system, February 2001 (CF232).

Fowles CR: Biomonitoring of the Kurapete Stream in relation to the New Plymouth District Council's Inglewood oxidation pond's system, December 2001 (CF243).

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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, October 2002 (CF258).

Fowles CR: Biomonitoring of the Kurapete Stream in relation to the New Plymouth District Council's Inglewood oxidation pond's system, February 2003 (CF268).

Fowles CR: Biomonitoring of the Kurapete Stream in relation to the New Plymouth District Council's Inglewood oxidation pond's system, October 2003 (CF290).

Fowles CR: Biomonitoring of the Kurapete Stream in relation to the New Plymouth District Council's Inglewood oxidation pond's system, March 2004 (CF310).

Fowles CR: Biomonitoring of the Kurapete Stream in relation to the New Plymouth District Council's Inglewood oxidation pond's system, November 2004 (CF346).

Fowles CR: Biomonitoring of the Kurapete Stream in relation to the New Plymouth District Council's Inglewood oxidation pond's system, February 2005 (CF358).

Fowles CR: Biomonitoring of the Kurapete Stream in relation to the New Plymouth District Council's Inglewood oxidation pond's system, October 2005 (CF389).

Fowles CR: Biomonitoring of the Kurapete Stream in relation to the New Plymouth District Council's Inglewood oxidation pond's system, February 2006 (CF402).

Fowles CR: Biomonitoring of the Kurapete Stream in relation to the New Plymouth District Council's Inglewood oxidation pond's system, October 2006 (CF407).

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To K Brodie, Monitoring Manager—Environment Quality
From C R Fowles, Scientific Officer
Document 1182692
Report No CF567
Date April 2013

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

Introduction

This summer survey was the second of two surveys programmed for the 2012-2013 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. These four sites had been last fully surveyed in October, 2010 (CF512, 2010). 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 have occurred since July 2012.

Methods

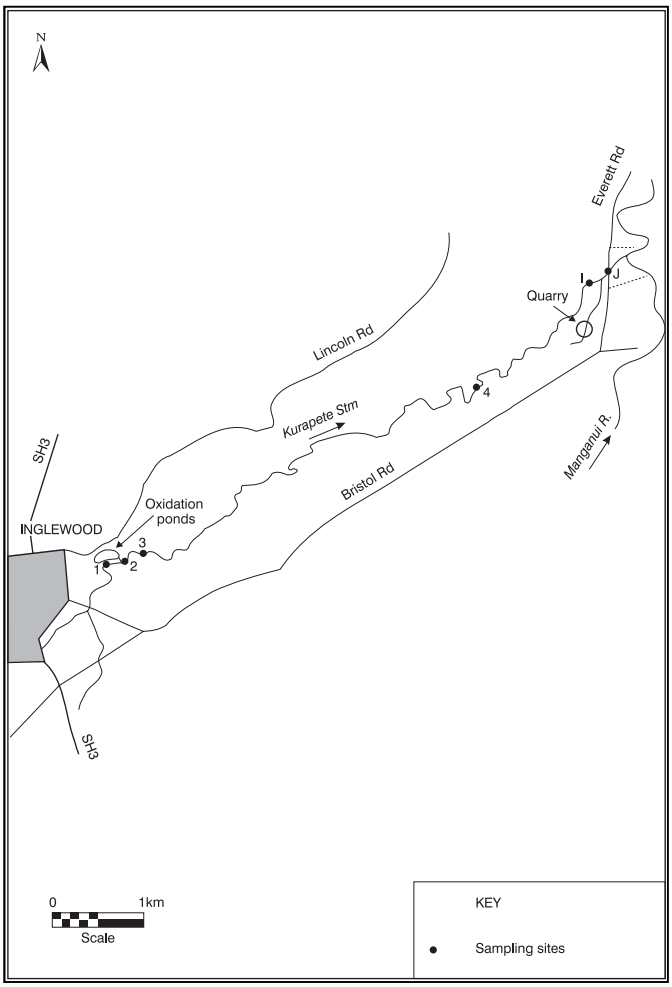
The standard '400 ml kick sampling' technique was used to collect streambed (benthic) macroinvertebrates from two established sampling sites in the Kurapete Stream (illustrated in Figure 1) on 1 February 2013.

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).



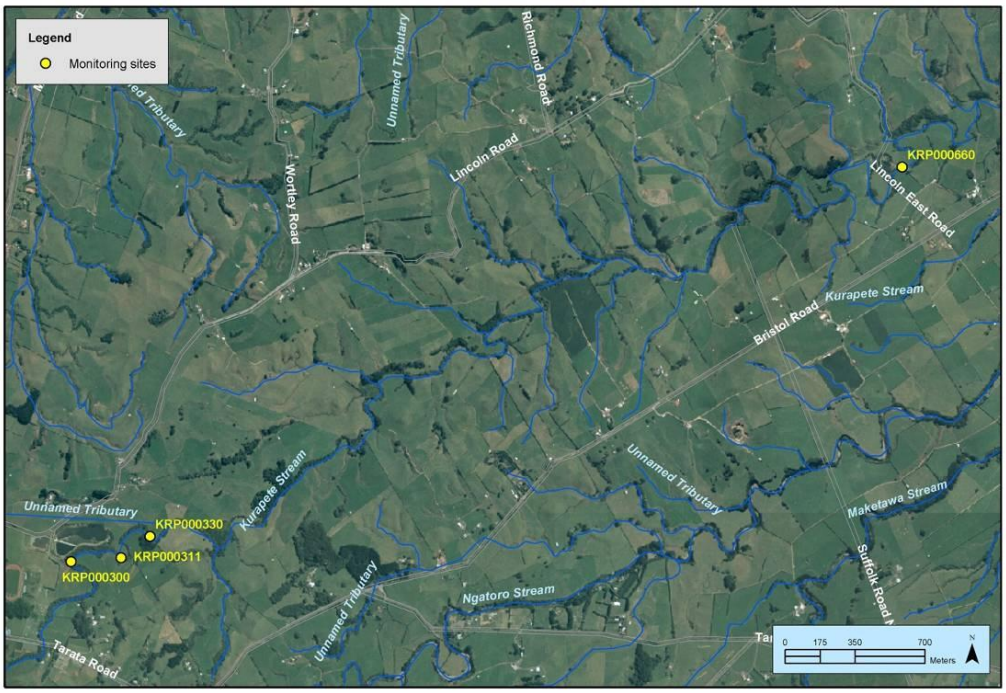


Figure 1 Sampling sites in the Kurapete Stream in relation to Inglewood oxidation ponds

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 very low (recession) flow conditions, 18 days after a fresh greater than 3x median flow and 75 days after a fresh in excess of 7x median flow. Water temperatures ranged from 16.2°C to 17.0°C during this mid 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, and in July 2012 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. Thin mats of periphyton and patchy moss, but no filamentous algal growth, were recorded at site 1, in the riffles at this mainly shaded site. The very low flow was slightly cloudy and uncoloured in appearance at the time of the survey.

The very low flow at site 2, approximately 75 m downstream of the discharge, was also uncoloured and slightly cloudy in appearance in the absence of any overflow from the WWTP at the time of the survey. Widespread periphyton mats and 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 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-six 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 2012

Site	Site code	No of surveys	Taxa numbers		MCI values	
			Range	Median	Range	Median
1	KRP000300	26	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	26	21-30	27	83-112	95

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

Table 3 Summary of macroinvertebrate results from the February 2013 survey

Site	Site code	Macroinvertebrate fauna	
		Taxa number	MCI
1	KRP000300	21	101
4	KRP000660	27	97

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.

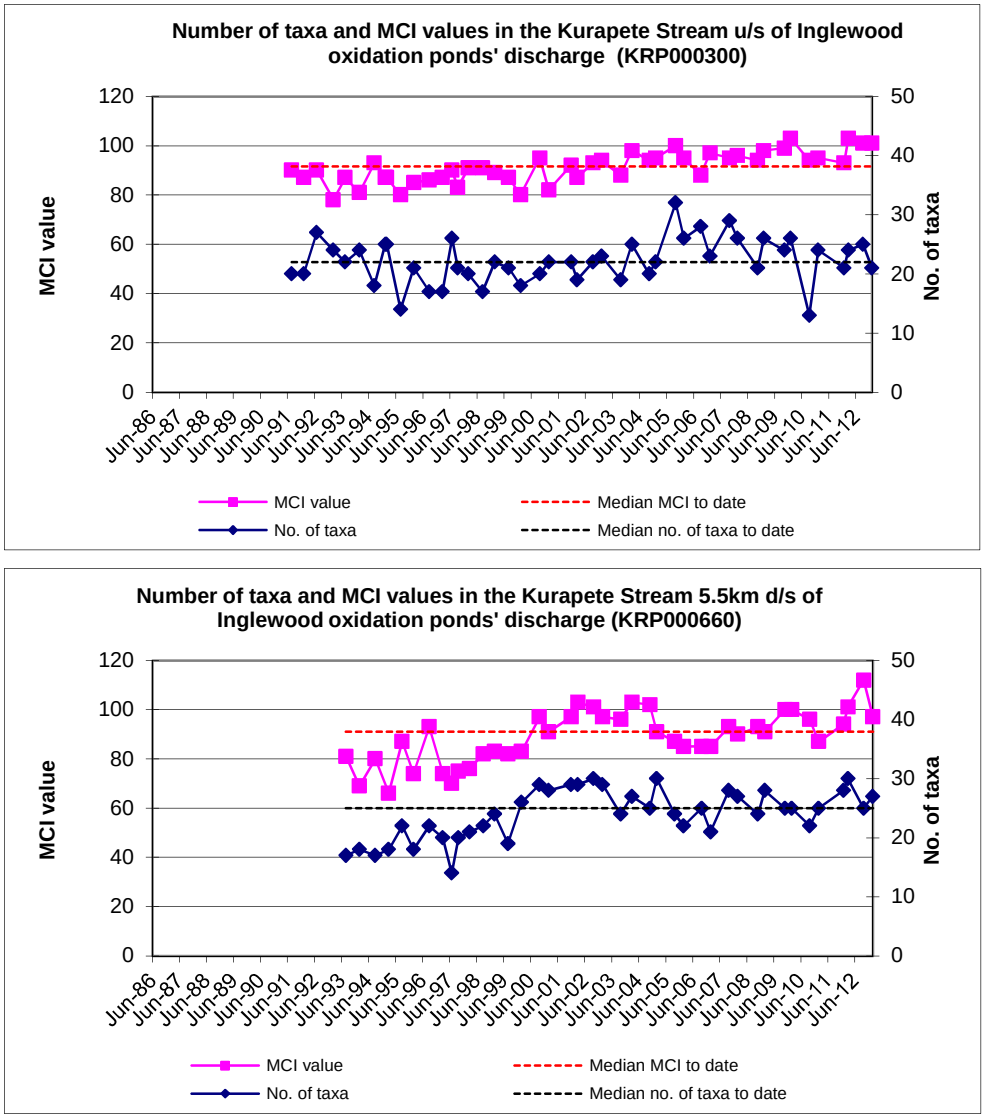


Figure 2 Taxa richness and MCI scores recorded to date at each of the sites in the Kurapete Stream

Site 1 – upstream of the oxidation ponds' discharge

A slightly below long term median (22 taxa) macroinvertebrate community richness of 21 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 (but only one in abundance) with the site characterised by the one 'highly sensitive' taxon [mayfly (*Deleatidium*)]; five 'moderately sensitive' taxa [mayflies (*Austroclima* and *Zephlebia* group), elmid beetles, dobsonfly (*Archichauliodes),* and tanypod midges]; and three 'tolerant' taxa [oligochaete worms, snail (*Potamopyrgus*), and net-building caddisfly (*Aoteapsyche*)]. This was similar to the number of characteristic taxa recorded by the previous spring survey but the composition was slightly different. The relatively high proportion of higher scoring 'sensitive' taxa (62% of the fauna) comprising this community was reflected in the MCI score of 101 units. This was only two units less than the historical maximum score and significantly higher than the long-term median recorded (54 surveys) for this site (90 units) and six 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 with a relatively similar number and composition of dominant taxa (TRC, 2013). The MCI score was within 2 units 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 'better than expected' predictive health for the mid reaches of a ringplain seepage stream (TRC, 2013).

Table 4 Macroinvertebrate fauna of the Kurapete Stream in relation to the Inglewood oxidation ponds system sampled on 1 February 2013

Taxa List	Site Number	MCI score	1	4
	Site Code		KRP000300	KRP000660
	Sample Number		FWB13028	FWB13029
PLATYHELMINTHES (FLATWORMS)	*Cura*	3	R	R
ANNELIDA (WORMS)	Oligochaeta	1	A	A
	Lumbricidae	5	R	-
MOLLUSCA	*Potamopyrgus*	4	VA	C
CRUSTACEA	Paraleptamphopidae	5	R	-
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	A	C
	Coloburiscus	7	-	A
	Deleatidium	8	VA	VA
	Nesameletus	9	-	R
	Rallidens	9	-	R
	Zephlebia group	7	VA	C
COLEOPTERA (BEETLES)	Elmidae	6	VA	VA
	Hydraenidae	8	R	-
	Ptilodactylidae	8	R	-
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	A	A
TRICHOPTERA (CADDISFLIES)	*Aoteapsyche*	4	VA	VA
	Costachorema	7	-	C
	Hydrobiosis	5	C	A
	Neurochorema	6	-	C
	Psilochorema	6	R	-
	Oxyethira	2	-	C
	Pycnocentrodes	5	-	C
DIPTERA (TRUE FLIES)	*Aphrophila*	5	R	A
	Maoridiamesa	3	-	R
	Orthocladiinae	2	R	A
	Polypedilum	3	-	R
	Tanypodinae	5	A	C
	Tanytarsini	3	-	C
	Empididae	3	R	C
	Muscidae	3	-	C
	Austrosimulium	3	R	C
	Tanyderidae	4	C	R
		No of taxa	21	27
		MCI	101	97
		SQMCIs	5.7	5.4
		EPT (taxa)	6	11
		%EPT (taxa)	29	41

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

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

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

A relatively good taxa richness (27 taxa) was recorded at this site, three taxa more than the maximum of taxa numbers previously recorded from fourteen surveys prior to wastes diversion (Table 1), and equal with the median richness found since this diversion (Table 2 and Figure 2). This was coincident with the presence of patchy moss, and widespread filamentous algae and periphyton mats on this site's substrate. Three 'highly sensitive' taxa were found at this site (one of which was very abundant), the same number of 'highly sensitive' taxa as found upstream at site 1. The community was characterised by one 'highly sensitive' taxon [mayfly (*Deleatidium*)]; five 'moderately sensitive' taxa [mayfly (*Coloburiscus*), elmid beetles, dobsonfly (*Archichauliodes*), free-living caddisfly (*Hydrobiosis*),and cranefly (*Aphrophila*)]; and three 'tolerant' taxa [oligochaete worms, net-building caddisfly (*Aoteapsyche*), and orthoclad midges]. Most of these 'tolerant' taxa are generally associated with periphyton and algal substrate cover, which was widespread at this site under very low flow conditions at the time of this survey when there also was a significant decrease in the number of dominant 'sensitive' taxa in comparison with the previous (spring) survey.

Significant individual taxon differences in downstream abundances included increases within four 'tolerant' and four 'moderately sensitive' taxa and decreases within one 'moderately sensitive' and one 'tolerant' taxon. Despite these differences, there was only a small decrease in $SQMCI_s$ scores of 0.3 unit between sites 1 and 4, mainly as a result of numerical dominance being balanced between 'tolerant' and 'sensitive' taxa at both sites.

The relative balance between 'tolerant' and 'sensitive' taxa was reflected in the MCI score of 97 units. This score was significantly (Stark, 1998) 19 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 deterioration between sites 1 and 4 was typical of the decline expected through the mid reaches of a Taranaki stream sourced outside the National Park (TRC, 2013) 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 summer very low flow conditions in the absence of recent overflows of very dilute wastewater to the stream. The MCI score was equal with 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, 2013).

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 very low flow conditions more than thirteen 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 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) to 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 a marked increase in substrate periphyton cover and the more open nature of the stream, were recorded at the site nearly 6km further downstream as illustrated by only 56% of the 32 taxa found between the two sites being present at both sites. Taxa richnesses were relatively high and within a moderate range (six taxa between sites). The moderate MCI scores had a narrower range, from 97 to 101 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 overflows of very dilute oxidation pond wastewater to the stream under wet weather conditions.

The most recent statistical trend analyses of macroinvertebrate data collected over the ten and seventeen year periods between 1995 and 2012 (Stark and Fowles, 2006 and TRC, 2013) 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 reduced in significance over the longer seventeen 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 2013). 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) 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 slightly lower percentage of 'sensitive' taxa at the more open downstream site where periphyton substrate cover was significantly more extensive and typical of that often found previously. 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, or slightly better than, typical conditions recorded in similar reaches of Taranaki seepage-sourced ringplain streams.

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Appendix III

NPDC report relating to oxidation pond levels and overflows during the 2012-2013 period

Te Kaunihera-ā-Rohe o Ngāmotu
NEW PLYMOUTH DISTRICT COUNCIL
newplymouthnz.com

INGLEWOOD OXIDATION POND DISCHARGE CONSENT 1449-4

ANNUAL REPORT

FOR THE PERIOD 1 JULY 2012

TO 30 JUNE 2013

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 – Screen press no 2 was repaired March 2013.

2.2 Pump Station – Routine maintenance is scheduled on a six monthly basis. This activity was completed by City Care Ltd under their maintenance contract. The routine inspection of the pumps highlighted that both pumps had suffered failure of the shaft seals allowing water in to the oil and in one case water had also entered the motor. The spare pump was installed to replace the worse affected pump and the oil replaced in the remaining pump. The pumps had operated satisfactorily despite the faulty seals. Replacement pumps have been ordered and arrived late in June as discussed further 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.

During 2011 / 12 the delivery of mechanical maintenance services was reviewed and a procurement process followed which resulted in reticulation, mechanical maintenance, pipelining and rehabilitation, and water meter reading being awarded as a combined contract to City Care Ltd. The new contract became effective on 1 July 2012. The intent of this contract was to promote an improved level of preventative and reactive maintenance, and to improve the data capture associated with maintenance activities. The faulty seals on the transfer pumps and the subsequent replacement of these pumps could be cited as example of the expected improvements.

OXIDATION PONDS PUMP IMPROVEMENTS

As a result of routine maintenance identifying issues with the pumps a review of the pump selection was undertaken. Previous work had identified that the installed pumps were not the most efficient selection and by reference to the original Operations and Maintenance (O & M) manual it was apparent that the pumps were incapable for delivering the flow set out in the operation design information. However it was also noted that a modification had been necessary during commissioning as a result of the manhole at the intersection of Humphries St and Rimu St surcharging and overflowing. This manhole is located at the highest point on the delivery main.

Review of the pump selection included modelling of the reticulation, pump operation and the entire delivery main to the Mangati trunk sewer in Bell Block. A two month simulation was carried out using actual recorded rainfall patterns. The simulation confirmed that during low flow condition, while the pumps were operating on a stop / start basis, there were no issues with the delivery and the pumps delivered to the rising main which was pressurised only as far as the Humphries/Rata intersection

approximately 700m from the pump station. From this point the delivery main behaved substantially as a gravity main except for areas where there was a reverse grade preventing the main from draining fully.

During wet weather inflow exceeded the pump capacity and flow was modelled diverting to the storage. Under these conditions the pumps run continuously and a different system curve develops where the gravity main gradually fills until approximately 12km of the delivery main is pressurised. This scenario generates a substantial friction head requirement on the pump and also showed surcharging and overflows at Humphries / Rata St. This modelling confirmed the anecdotal information of overflows in this area.

An extensive discussion took place between NPDC and Xylem (formerly ITT Flygt) to identify the optimum replacement pump. The intention was to select a pump which was able to deliver a greater flow under all conditions and better able to meet the design statement in the O & M manual. After numerous iterations it was concluded that it is impossible to select a pump which can meet the duty point on both system curves.

The best selection was able to produce a minor improvement in pump flow during the high flow condition. This flow is met at a more efficient point on the pump curve and requires a smaller 18kW pump in lieu of the existing 22kW pump installed. A smaller 15kW pump was also capable of matching the existing flow but it was felt that the marginal increase in flow should be taken. The pumps were ordered and received on site during the last week of June and are to be installed early in July.

During the installation of the new pumps, a modification is also to be made to the control philosophy for the pump station. This modification will seek to conserve energy by typically running the pumps at less than full speed. The pumps will no longer operate under a stop / start routine as at present but the speed will vary to maintain a constant wet well level as is the control philosophy of the other pump stations with variable speed drives in New Plymouth District. As a result of this change the flow delivery should match the incoming flow during low flow times, but the pumps will ramp up to full speed as the flow increases and the pumps will run at full speed at all times that inflow is being diverted to the storage ponds.

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 has 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 is obtained from TRC, have been provided throughout the year.

3.2 Non-Complying Discharges

There were three periods of overflow between 1st July 2012 and 30th June 2013. The overflows were caused by high rainfall infiltration to the site. The first two overflows were separated by one day and are related to the same period of rainfall.

The total duration of the overflows was 12.54 days which represents 3.4% of the time.

Date	Comments
18/7/12 – 21/7/12	Overflow to Kurapete Stream
23/7/12 – 28/7/12	Overflow to Kurapete Stream
20/6/13 – 22/6/13	Overflow to Kurapete Stream

All overflows were dealt with in accordance with the NPDC Sewer System Emergency Discharge Contingency Plan (contained within 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 $CBOD_5$ The results are presented in Table 1.

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

Date	pH	Alkalinity (g/m^3)	Conductivity (mS/M)	Suspended solids (g/m^3)	Ammonia as N (g/m^3)	Faecal coliforms (No./100 mL)	$CBOD_5$ (g/M^3)
18/07/ 2012	7.2	43	13.9	9	2.0	10300	3
21/06/ 2013	6.9	48	15.5	<5	1.8	5300	3

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 2,436mm of rain was received in Inglewood during the year. The maximum daily rainfall of 103mm was recorded on 15 July 2012 with a further 82.5mm on the following day. 101mm fell on 17 June 2013.

The oxidation pond received a total of 674,522m^3 over the 12 month period. The average daily inflow was 1,848m^3 with a maximum flow of 12,144m^3 on 16 July 2012 and minimum flow of 649m^3 on 16 March 2013. 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. Comparison of this value to the maximum recorded inflow clearly demonstrates that there are significant Inflow and Infiltration (I&I) issues in Inglewood

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. In July 2012 smoke testing was conducted in the blocks enclosed by Rimu St. Cutfield Street, Rata St and Humphies St. The smoke testing resulted in the identification of a number of defects in private drainage as well as defects in the public drainage. Most notable was the apparent direct connection of a double sump to the sewer system. Further investigation using CCTV revealed that both the sewer and storm water pipes were holed and a tomo had formed allowing storm water to enter the sewer system. Letters were written to each of the private property owners requiring the defects to be fixed. Follow up was conducted to ensure that the work was completed in September / October 2012. The defects in the public drainage were addressed by City Care Ltd in October 2012

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.

Analysis of the I&I KPI's demonstrated that there has been a reduction in the quantity of I&I observed in the Inglewood reticulation for comparable rainfall events. There were few overflows during the reporting year however a substantial rainfall event on 17 June 2013 created an overflow at Konini St via gully traps on private property and the oxidation ponds overflowed on 19 June 2013. The rainfall on 17 June was particularly heavy and analysis of the one minute rain record provided by TRC revealed that the rainfall depth for this event exceeded the 10% annual exceedence probability (AEP). NPDC storm water systems are designed to convey the 20%AEP event so overland flow with a resulting higher probability of direct inflow to the sewer would have resulted. The analysis also demonstrated that there is approx 15 minutes response time between the onset of the rain and the dramatic increase in flow at the oxidation ponds. While obtaining the rainfall data from TRC anecdotal information

was provided suggesting that some residents defeated the smoke testing by blocking up open drainage points when we initiated the pre notification of the works. Further smoke testing has been identified as a result of the 17 June event and is expected to be undertaken during July and August 2013.

For the seven days commencing 14 July 2012 a total of 203mm rain fell. The total depth of rainfall alone does not adequately compare the rainfall pattern. 203mm of rain in one day produces a different impact to 29mm of rain on each of seven days. To account for this, a calculation considers the previous 14 days rainfall to generate a value called "antecedent wetness". This calculation gives more weight to recent rainfall, which has a greater effect on I&I, and less weight to earlier rainfall. The average antecedent wetness for the seven days commencing 14 July was 85mm.
Detailed analysis of the sewage inflows at Inglewood Oxidation ponds indicates a peaking factor of 16.95. i.e. the flow was 16.95 times greater than the flow observed on a dry day.
Seven percent of the rainfall falling within the sewer catchment entered the sewer system

By comparison for the seven days commencing 16 June 2013 a total of 209mm of rain fell. The average antecedent wetness was 86mm.
Detailed analysis of the sewage inflows at Inglewood Oxidation ponds indicates a peaking factor of 14.33.
Seven and a half percent of the rainfall falling within the sewer catchment entered the sewer system

In both cases the peaking factor significantly exceeds that generally indicated as acceptable under the WSAA Guidelines. However, there is a reduction in peaking value in the second of these events indicating a reduction in inflow. The maximum inflow for the week has been reduced from a maximum of 629m^3/hr to 532m^3/hr following the improvements resulting from smoke testing.

The percentage of rainfall entering the sewer system is similar for both data sets and while both values are below the threshold indicated by WSAA Guidelines, in both cases the volume of Inflow and Infiltration exceeded 30,000m^3 during the seven day period. This volume has been pumped at Inglewood and again at Mangati Pump Station in Bell Block en route to treatment at NP WWTP and has incurred significant energy consumption. If this volume is reduced there will be a saving in operational costs, as well as a reduced likelihood of future overflows.

The focus for the coming year will be to continue work to identify and eliminate the sources of direct inflow to the sewer system. This will be managed through detailed analysis and modelling to identify the most likely areas where inflow occurs, and to undertake more targeted smoke testing and CCTV work. The KPI's will be used to demonstrate the success of this work.

The target will be to reduce the peaking factor to eight or lower during a rain event of less than 20%AEP.

The target for percentage rainfall derived inflow and infiltration will be to reduce the percentage to 6.5% or less.

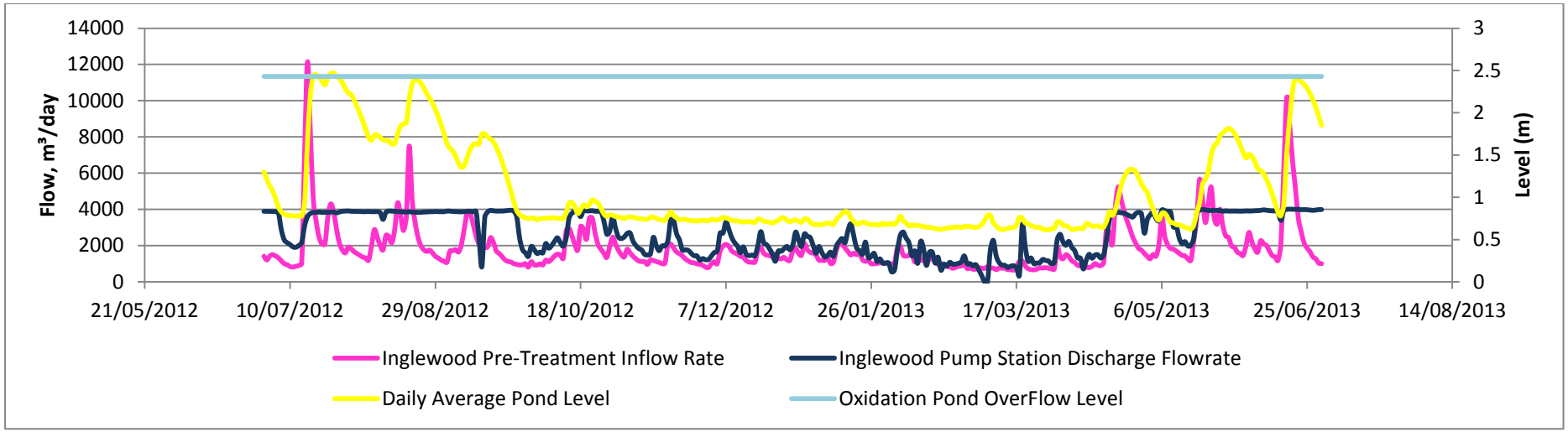

Figure 1 Inglewood Oxidation Pond from 01/07/2012 to 30/06/2013 (daily summaries)

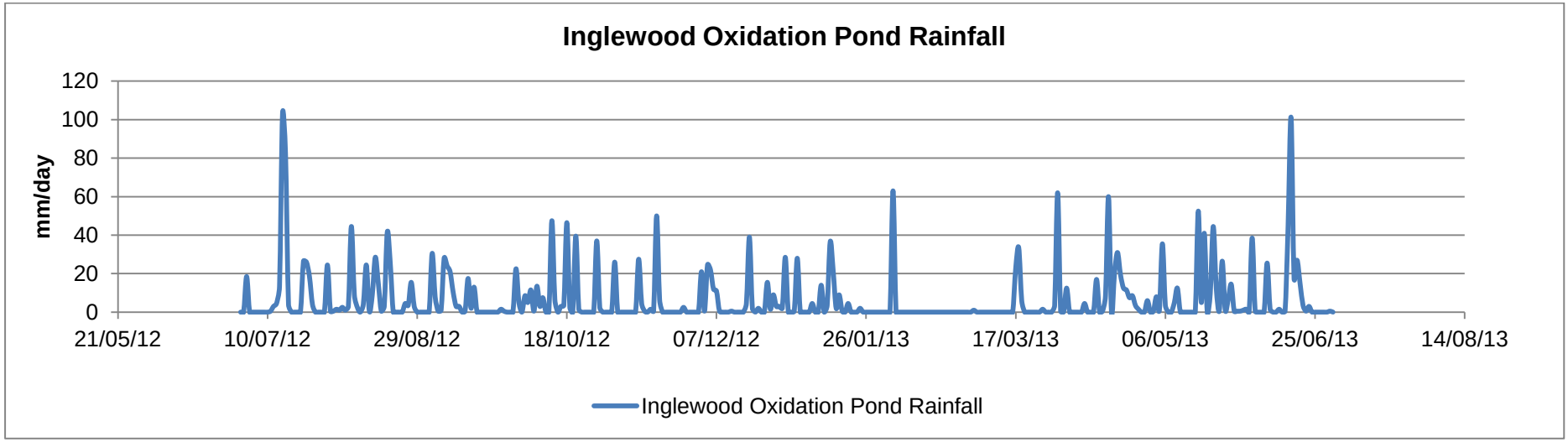

Figure 2 Daily Rainfall from 01/07/2012 to 30/06/2013

Laboratory Analytical Report

Client: Cath Yateman LOL

Sample/Report Number: NPDC-2920
Report Status: Certified

Sample Type: Grab Sample
Sample Date: 21/06/13 12:00 PM **By:** WWTP Operators

New Zealand

Sample Received: 21/06/13 12:45 PM By Cecilia Ashwin
Results Checked: 26/06/13 5:09 PM By Cecilia Ashwin
Results KTP Certified 27/06/13 3:23 PM By Cecilia Ashwin

Contact: Cath Yateman
Phone:
Client Sample ID: N/A

Sample Description:	Sample Comments:
INGLEWOOD OXIDATION POND OVERFLOW	

Test Date	Analysis	Result:	Units:	Analyst:	Analytical Method:	Test Category
21/06/13	pH	6.9	pH Units	MF	4500-H+ B	IANZ RegisteredTest
21/06/13	BOD_5(Carbonaceous)	3	g/m^3 $CBOD_5$	SW	5210 A, B	IANZ RegisteredTest
22/06/13	Suspended Solids	<5	g/m^3	CA	2540 D	IANZ RegisteredTest
21/06/13	Ammonia as ' N '	1.8	g/m^3	MB	4500-NH_3 D	IANZ RegisteredTest
21/06/13	Alkalinity to pH 4.8	48	g/m^3	MF	2320 B	IANZ RegisteredTest
21/06/13	Conductivity	15.5	mS/M	CA	2510 A, B	IANZ RegisteredTest
21/06/13	Faecal Coliforms (Liquid Sample)	5300	No / 100ml	MB	9222 D	Non Registered Test

Notes:	
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

Disclaimer:
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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Waste Water Treatment Plant
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Tests indicated as not accredited are outside the scope of the laboratory's accreditation

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INTERNATIONAL ACCREDITATION NZ
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	Analytical Method
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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