New Plymouth District Council
Inglewood WWTP
Monitoring Programme
Annual Report
2016-2017

Technical Report 2017-108

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Executive summary

The New Plymouth District Council (NPDC) operates a municipal wastewater treatment plant (WWTP) located on Lincoln Road at Inglewood, in the Kurapete catchment. This report for the period July 2016 to June 2017 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess NPDC's environmental and consent compliance performance during the period under review. The report also details the results of the monitoring undertaken and assesses the environmental effects of NPDC's activities.

NPDC holds one resource consent to intermittently discharge treated wastewater to the Kurapete Stream, which includes a total of nine conditions setting out the requirements that they must satisfy.

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

The Council's monitoring programme for the year under review included three inspections, wastewater effluent analyses, and biological surveys of the receiving waters of the Kurapete Stream.

NPDC's maintenance programme continues to generally enhance the operation and appearance of the plant and effectively control any produced odour. No complaints were received in relation to the operation of the WWTP. Regular inspections indicated no immediate problems with the performance of the plant, with only a single consented overflow recorded during the monitoring year. Seasonal variability in pond microfloral populations (as indicated by chlorophyll-a populations) was also influenced by preceding wet weather stormwater infiltration. Wastewater quality measured during the overflow event was relatively good, and comparable with results from previous monitoring. Biomonitoring surveys in summer and late autumn found no significant impacts on the macroinvertebrate fauna as a result of the discharge of treated wastewater.

During the year, NPDC demonstrated a high level of environmental and administrative performance with the resource consents. No effects from intermittent discharges of treated wastewater continue to be recorded.

For reference, in the 2016-2017 year, consent holders were found to achieve a high level of environmental performance and compliance for 74 % of the consents monitored through the Taranaki tailored monitoring programmes, while for another 21 % of the consents, a good level of environmental performance and compliance was achieved.

In terms of overall environmental and compliance performance by the consent holder over the last several years, this report shows that the consent holder's performance remains at a high level. This report includes recommendations for the 2017-2018 year.

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1. Introduction

1.1. Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1. Introduction

This report is for the period July 2016 to June 2017 and describes the monitoring programme associated with a resource consent held by New Plymouth District Council (NPDC). NPDC operates a municipal wastewater treatment plant (WWTP) situated on Lincoln Road at Inglewood.

This report covers the results and findings of the monitoring programme implemented by the Taranaki Regional Council (the Council) in respect of the consent held by NPDC that relates to the intermittent discharge of treated wastewater in the Kurapete catchment. This is the 30th annual report to be prepared by the Council to cover NPDC's discharge and its effects.

1.1.2. Structure of this report

Section 1 of this report is a background section. It sets out general information about:

- consent compliance monitoring under the Resource Management Act 1991 (RMA) and the Council's obligations;
- the Council's approach to monitoring sites though annual programmes;
- the resource consents held by NPDC in the Kurapete catchment;
- the nature of the monitoring programme in place for the period under review; and
- a description of the activities and operations conducted at NPDC's site.

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

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

Section 4 presents recommendations to be implemented in the 2017-2018 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 RMA primarily addresses environmental 'effects' which are defined as positive or adverse, temporary or permanent, past, present or future, or cumulative. Effects may arise in relation to:

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

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

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

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

e. risks to the neighbourhood or environment.

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

1.1.4. Evaluation of environmental and administrative performance

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

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

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

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

Environmental Performance

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

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

For example:

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

Improvement required: Likely or actual adverse effects of activities on the receiving environment were more than minor, but not substantial. There were some issues noted during monitoring, from self reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent

minor non-compliant activity could elevate a minor issue to this level. Abatement notices and infringement notices may have been issued in respect of effects.

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

Administrative performance

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

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

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

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

For reference, in the 2016-2017 year, consent holders were found to achieve a high level of environmental performance and compliance for 74 % of the consents monitored through the Taranaki tailored monitoring programmes, while for another 21 % of the consents, a good level of environmental performance and compliance was achieved.

1.2. WWTP system

Since late 1999, municipal wastewater from the Inglewood WWTP has been pumped and gravity-fed to the New Plymouth WWTP, for further treatment prior to discharge to the Tasman Sea. Due to the limited capacity of the Moa-Nui pipeline from the Inglewood WWTP, overflows are likely to occur during extreme peak flows, when stormwater and groundwater infiltration are excessive. Overflow facilities are used during peak storm flows to treat pond effluent before discharge to the stream occurs. No continuous discharge occurs from the ponds' system in the long term.

The present population serviced by the Inglewood system is close to 3,000 persons, and industrial waste is a minimal 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 annual reports prepared by the Council (TRC, 2015(b)).

Wet weather in August 2015 and September 2015 raised pond levels but not to overflow levels indicating that work done to reduce stormwater infiltration and inflow has had a marked effect.

No additional trade wastes connections to the sewerage reticulation were recorded during this monitoring period. It should be noted that industrial waste disposal tankers are not encouraged to use the plant for disposal and treatment purposes, but preferably to utilise the New Plymouth WWTP (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.

Photo 1 Inglewood WWTP

1.2.1. Inflow and infiltration reduction

Development and implementation of a stormwater infiltration reduction programme, as required by Special Condition 5 of the consent was instigated by NPDC, and progress has been reported at required intervals.

Considerable work has been reported, including a manhole replacement programme, lateral replacements, ongoing sewer patching, and continued flow monitoring. NPDC have 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 depends to some extent on the existing condition of the reticulation.

1.3. Resource consents

1.3.1. Water discharge permit

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

NPDC holds water discharge permit **1449-5** to intermittently discharge treated municipal wastewater from the Inglewood oxidation ponds system into the Kurapete Stream. This permit was issued by the Council on 28 June 2016 under Section 87(e) of the RMA, and expires on 1 June 2033.

Condition 1 relates to best practice.

Conditions 2 and 3 relate to limits on the timing of overflows and minimum screening of the discharge.

Conditions 4, 5, and 6 detail requirements for management plans, and recording and reporting of overflows.

Condition 7 details requirements for stormwater infiltration reduction.

Condition 8 limits the effects on receiving waters.

Condition 9 provides for review.

The permit is attached to this report in Appendix I.

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

1.4. Monitoring programme

1.4.1. Introduction

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

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

The monitoring programme for the Inglewood WWTP consisted of five primary components.

1.4.2. Programme liaison and management

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

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

1.4.3. Data review

NPDC undertake a significant amount of self-monitoring of the performance of the WWTP. The data gathered is reported to the Council on a monthly basis, and is reviewed by the Council to determine compliance with consent conditions.

1.4.4. Site inspections

The Inglewood WWTP was visited three times during the monitoring period. The main points of interest were plant operation, maintenance, upgrades, and occurrence of any discharges of treated wastewater. These inspections provided for the operation, internal monitoring, and supervision of the plant to be reviewed by the Council.

1.4.5. Chemical sampling

The Council undertook sampling of the secondary pond effluent from the site on each inspection, for the purposes of monitoring algal populations in the system.

1.4.6. Biomonitoring surveys

A biological survey was performed on two occasions on 16 February 2017 and 26 April 2017, in the Kurapete Stream, to document recovery of the biological stream communities following the removal of a continuous discharge to the Stream.

2. Results

2.1. Inspections

21 September 2016

An inspection was conducted in wet weather with a southerly wind. The monthly rainfall was 316 mm rain, as recorded at the Inglewood WWTP TRC weather station.

The step screen was operating and wastes were fully contained. The primary aeration pond was a turbid brown colour, with the aerator operating, and minimal odour detected in the vicinity. The aeration pond was discharging into the main pond, and slight foaming was observed at the discharge point.

The main pond was measured at a normal level of 1.7 m, with a slightly turbid brown colour, and mainly flat surface. The discharge flow rate to the New Plymouth WWTP was measured at 163 m^3/hr, and no odour was detected around the perimeter. An algal sample was collected for chlorophyll-a analysis. Five mallard ducks and two black swans were observed on the pond surface. No overflow had recently discharged to the Kurapete Stream.

The WWTP and facilities were operating satisfactory. The leachate drain was discharging relatively clear leachate, at an estimated rate of 0.5 L/s, into the main pond.

10 January 2017

An inspection was conducted in fine weather with a cool westerly wind. The monthly rainfall was 210 mm of rain as recorded at the Inglewood WWTP TRC weather station.

The step screen was operating and wastes were fully contained. Slight odour was noticeable in the vicinity of the step screen. One aerator was operating on the aeration pond, which was a turbid, light grey brown colour. The pond was discharging into the main pond.

The main pond had a normal level of 0.76 m, with a relatively clear, green grey colour and rippled surface. The discharge flow rate to the New Plymouth WWTP was measured at 124 m^3/hr, and no odour was detected around the perimeter. An algal sample was collected for chlorophyll-a analysis. Over 300 mallard and paradise ducks, and two black swans were observed on the pond surface. No sign of recent pond overflow discharge into the Kurapete Stream was observed.

The WWTP and facilities were operating satisfactory. The leachate drain was not discharging at the time of the inspection.

2 May 2017

An inspection was conducted in fine, calm weather. The monthly rainfall was 354 mm of rain as recorded at the Inglewood WWTP TRC weather station.

The primary screen was operating and wastes were fully contained, and only a slight odour was noticeable in the vicinity. One aerator was operating on the aeration pond, which was a turbid brown colour and discharging into the main pond.

The main pond was operating at a normal level of 1.45 m, with a slightly turbid brown colour and a flat surface. The discharge flow rate to the New Plymouth WWTP was measured at 163 m^3/hr, and no odour was detected around the perimeter. An algal sample was collected for chlorophyll-a analysis. Approximately forty mallard ducks and two black swans were observed on the pond surface. There was no sign of recent overflow discharges from the main pond to the Kurapete Stream.

The WWTP and facilities were operating satisfactory. The leachate drain was discharging a relatively clear discharge into the main pond.

2.2. Results of effluent monitoring

In past monitoring periods, samples of the 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 WWTP was completed prior to the summer of 1999-2000, no summer physicochemical effluent or receiving water sampling has been necessary, although regular sampling of the main pond is carried out to assess the performance of the ponds. Any periods of overflow events are monitored by the consent holder (wastewater only), with samples collected and analysed by NPDC at the time of each event. Overflow events and sampling results are further discussed in Section 2.2.3.

Photo 2 The Inglewood WWTP main pond

Measurements of chlorophyll-a, dissolved oxygen and temperature were taken from the surface of the main pond adjacent to the final section on all three inspection occasions. The results from this monitoring are presented in Sections 2.2.1 and 2.2.2.

2.2.1. Dissolved oxygen levels

The dissolved oxygen (DO) concentration in WWTPs varies both seasonally and during the day as a result of a combination of factors. The photosynthetic activity of the pond's microflora together with fluctuations in influent waste loadings on the system are the major influencing factors. Minimum DO concentrations are generally recorded in the early hours of daylight, and therefore pond performance has been evaluated by standardising sampling times toward mid-morning for all regular inspection visits during the monitoring period.

The Inglewood WWTP effluent was analysed for DO and temperature, and the results are displayed in Table 1.

Table 1 Dissolved oxygen measurements from the Inglewood WWTP

Date	Time (NZST)	Temperature (°C)	Dissolved Oxygen	
			Concentration (g/m^3)	Saturation (%)
21 September 2016	0805	13.9	7.8	77
10 January 2017	0915	21.2	8.4	99
2 May 2017	0930	14.1	5.1	50

Results in Table 1 indicate a narrow range of DO concentrations (between 50 % and 99 % saturation) in the surface layer of the tertiary maturation cell near the outlet. This was typical of the results generally recorded at this point (i.e. supersaturation is seldom recorded), and indicates that DO was present at all times in the surface layer of the cell. The lowest DO readings were recorded in the late autumn period, which was attributed to cool, wet weather conditions. The variation in saturation levels measured to date has been typical of a biological treatment system in which the photosynthetic contribution of the microfloral population often causes wide DO variations. Mechanical aeration of the primary pond by one aerator was operative on all inspection occasions.

2.2.2. Microfloral component

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

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

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

The results of the final pond effluent analyses are provided in Table 2 together with field observations of pond appearance.

Table 2 Chlorophyll-a levels and tertiary cell appearance

Date	Time (NZST)	Appearance	Chlorophyll-a (mg/m^3)	Range for the period 2000 -mid 2016	
				Range	Median
21 September 2016	0805	Slightly turbid, brown	7	1.0 - 169	22
10 January 2017	0915	Slightly turbid, grey brown	24		
2 May 2017	0930	Slightly turbid, brown	25		

Relatively poor microfloral populations were indicated by a low chlorophyll-a concentration in late spring, when a dissolved oxygen saturation level of 77 % was measured. This result has been attributed to ingress and flushing of stormwater during wet weather events. Summer and late autumn concentrations were noticeably higher, indicating a significant phytoplanktonic component.

2.2.3. Emergency overflow monitoring

Since the wastewater diversion to the New Plymouth WWTP was completed prior to 2000, only intermittent discharges from the Inglewood WWTP have occurred, related to intense rainfall events and high stormwater inflows. Any periods of overflow events are monitored by NPDC (wastewater only), with samples collected and analysed by them at the time of each event (see Appendix III).

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 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 does not require effluent monitoring by the consent holder. A summary of historical effluent quality from monitoring by the consent holder and the Council is presented in Table 3.

This data is presented for reference purposes as it provides an historical summary of the variability in effluent quality for the Inglewood WWTP, both pre- and post-diversion to the NPDC WWTP.

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.

NPDC had one overflow event during the 2016-2017 period, commencing on the 1 August 2016, for a duration of eight days. During this period, NPDC notified the Council and undertook sampling of the effluent at regular intervals. The results of this monitoring have been included in Table 3.

Table 3 Summary of NPDC and TRC overflow effluent data

Parameter	Unit	NPDC			TRC			
		Pre-diversion	Overflows		Pre-diversion		Overflows	
		(1992-1999)	(2008-mid 2017)		(1986-1999)		(2000-mid 2017)	
		Range	Range	Median	Range	Median	Range	Median
BOD_5*	g/m^3	8.0-57	<1-10	5	11.0-56.0	26	1.1-2.5	1.8
Conductivity*	mS/m	14.7-43.3	13.4-21.9	15.5	11.8-38.6	25	15.0-16.3	15.6
DO	g/m^3	<0.2-15.0	-	-	<0.1-25	5.3	2.2-18.1	7.62
Faecal coliform bacteria	nos/100ml	<1-720,000	1,300-10,300	2380	210-1,000,000	12,000	190-1,100	190
pH		6.8-8.9	6.9-8.8	7.6	6.9-8.9	7.4	7.0-7.2	7.1
SS	g/m^3	<5-178	<5-38	14	10-160	36	3	3
Nutrient analyses								
NH_4	g/m^3 N	1.2-32	0.1-5.5	1.1	0.71-22	9.17	2.74-3.16	2.95
NNN	g/m^3 N	<0.2-13.5	-	-	<0.01-0.46	0.08	0.62-0.92	0.77
DRP	g/m^3 P	-	-	-	1.08-6.55	2.64	0.19-0.22	0.204

(Note: * carbonaceous BOD for NPDC; conductivity for NPDC measured @ 25°C and for TRC @ 20°C)

2.3. Results of receiving environment monitoring

Physicochemical receiving water surveys are no longer required due to the relative infrequency of overflow events and/or absence of measurable effects on receiving water quality.

2.3.1. Biological monitoring surveys

The biological monitoring component of the receiving water monitoring programme was performed in the Kurapete Stream on two occasions (summer and autumn). As neither survey followed a very recent overflow event, the surveys were performed as a reduced, two-site survey in accordance with documented receiving water monitoring requirements. The sites are described in Table 4 and Figure 1 below.

Table 4 Location of sampling sites

Site No.	Location	GPS Location	Site code	Survey
1	Upstream of WWTP discharge	E1705225 N5665510	KRP000300	Spring/Summer
2	Approx. 75 m d/s of WWTP discharge	E1705337 N5665530	KRP000311	N/S*
3	Approx. 300 m d/s of WWTP discharge	E17054814 N5665637	KRP000330	N/S*
4	Approx. 6 km d/s of WWTP discharge	E1709239 N56467481	KRP000660	Spring/Summer

(*N/S = Not Sampled)

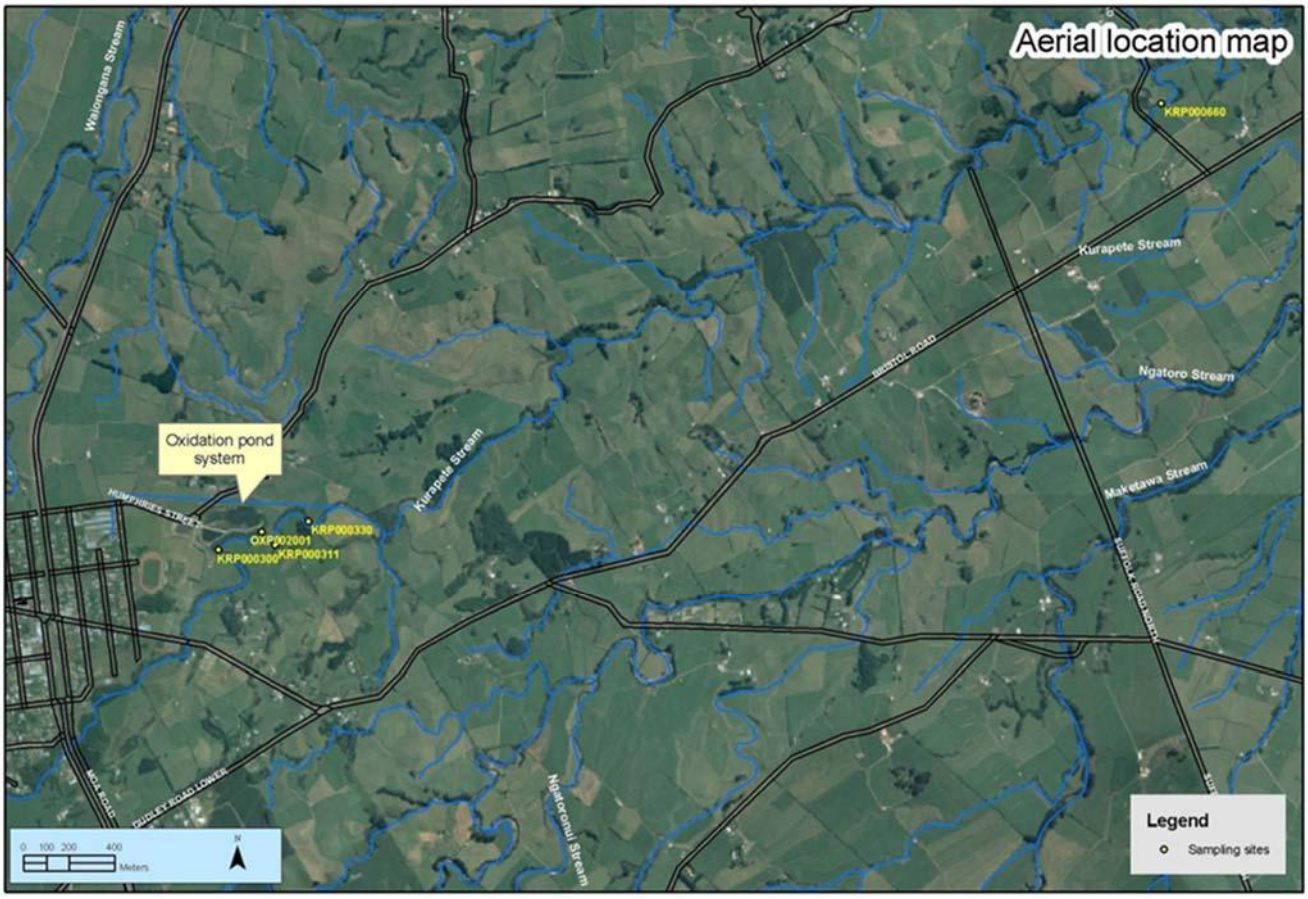

Figure 1 Aerial location map of sampling sites in relation to Inglewood WWTP

2.3.1.1. Summer 2017

The Council's standard 'kick-sampling' technique was used at two established sites 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 WWTP, 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.

Taxa richnesses at both sites were moderate and consistent with post-diversion historic medians. MCI scores indicated that the stream community at both sites was of 'fair' health with no significant differences between the 'control' and 'impact' sites. Furthermore, the $SQMCI_S$ score at the 'impact' site was significantly higher than the 'control' site score and was the highest recorded score to date for the site.

2.3.1.2. Autumn 2017

This autumn survey was the second of two surveys programmed for the 2016-2017 monitoring period. Normally, a spring and summer survey are performed, but due to persistent wet weather in spring the spring survey was completed in autumn.

The Council's standard 'kick-sampling' technique was used at two established sites 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 autumn 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.

Taxa richnesses at both sites were moderate and consistent with post-diversion historic medians. MCI scores indicated that the stream community at the 'control' site was fair while the 'impact' site was 'good' with no significant differences between the 'control' and 'impact' sites. Furthermore, the $SQMCI_S$ scores were also not significantly different from each other and the 'impact' site had a score significantly higher than its historic median.

A summary of the results for the current year and comparison with the post-diversion period from February 2000 to April 2017 is provided in Table 5.

Table 5 Summary of results for 2016-2017, and comparison with post-diversion results

Site No.	No of taxa			MCI value			SQMCIs value		
	Median	Range	Current survey	Median	Range	Current survey	Median	Range	Current survey
1	22	13-32	23	95	86-106	98	4.4	2.8-6.4	5.2
2	24	15-33	N/A	94	80-101	N/A	3.5	2.5-6.4	N/A
3	23	15-28	N/A	92	84-103	N/A	3.7	2.5-6.1	N/A
4	25	21-30	22	97	85-112	103	4.0	1.7-6.1	4.9

Overall, there was no evidence that discharges from the Inglewood WWTP had had any significant detrimental impacts on the macroinvertebrate communities of the Kurapete Stream.

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 NPDC. During the year matters may arise which require additional activity by the Council, for example provision of advice and information, or investigation of potential or actual causes of non-compliance or failure to maintain good practices. A pro-active approach that in the first instance avoids issues occurring is favoured.

The Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The incident register includes events where NPDC 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 2016-2017 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with NPDC's conditions in resource consents or provisions in Regional Plans for the Inglewood WWTP.

3. Discussion

3.1. Discussion of site performance

The Inglewood WWTP system has continued to perform satisfactorily, with aerobic conditions maintained and a generally high standard of treated wastewater measured throughout the monitoring period. There was only one consented overflow event, as a result of extreme wet weather conditions, and monitoring of the discharge showed a good quality effluent that was well within previously measured parameters.

Monitoring of the microfloral component of the main pond (using chlorophyll-a measurements) indicated that the system had a low algal content, particularly following heavy rainfall events. Microfloral populations have not indicated poor performance of the treatment system to date.

The WWTP system and surrounds continue to be maintained in good condition, with no issues with the step screen or odour from the system. Pond level management (for storage purposes) was good during this period as was maintenance of the pond system with continued aeration of the primary cell and regular maintenance of the treatment system. Localised leachate drainage continued to be diverted into the pond system following investigative works and maintenance by the consent holder. Diversion of wastes to NPWWTP continues, with the pumps operating at their maximum speed for 60 % of the year.

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. Over the 2016-2017 period, a total of $30,530 was spent on pipe lining to repair defects in the reticulation system.

A straight maintenance regime will also continue to be followed in the future.

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.

Improvements to reporting commitments are discussed as necessary with NPDC, who continue to provide a comprehensive report for the monitoring year including improvements in relation to alarms and reporting requirements and regular monthly reporting.

3.2. Environmental effects of exercise of consents

Wastewater from the Inglewood WWTP was contained and diverted to the New Plymouth WWTP for the majority of the year, with one exception in August 2016 following high rainfall.

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 summer and late autumn. Neither survey followed a 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 waste discharge being removed from the stream, particularly under low flow conditions.

3.3. Evaluation of performance

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

Table 6 Summary of performance for consent 1449-5

Purpose: ***To intermittently discharge treated municipal wastewater from the Inglewood oxidation ponds system into the Kurapete Stream***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Consent holder to adopt best practicable option	Inspections, liaison with consent holder	Yes
2. Limits on timing of discharges	Inspections, consent holder reporting	Yes
3. Requirements for outlet screening	Inspections	Yes
4. Requirements of Management Plan	Plan received in 2001, inspections	Yes
5. Requirements of overflow recording and reporting	Records provided to Council as required	Yes
6. Notification of overflows to TDHB	Liaison with consent holder, notification received	Yes
7. Implementation of a stormwater reduction programme	Programme implemented, improvements ongoing	Yes
8. Limits on effects in receiving waters	Inspections, physicochemical and biological sampling	Yes
9. Optional review provisions	Next optional review scheduled in June 2019	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

N/A = not applicable

Table 7 Evaluation of environmental performance over time

Year	High	Good	Improvement req	Poor
2003		1		
2004	1			
2005	1			

Year	High	Good	Improvement req	Poor
2006	1			
2007	1			
2008	1			
2009	1			
2010	1			
2011	1			
2012	1			
2013	1			
2014		1		
2015	1			
2016	1			
Totals	12	2		

During the year, NPDC demonstrated a high level of environmental and administrative performance with the resource consents as defined in Section 1.1.4. Work continues to be carried out to reduce stormwater inflow and infiltration from the reticulation system. All consented overflows were notified and reported on as per conditions in consent 1449.

Ratings are as defined in Section 1.1.4

3.4. Recommendations from the 2015-2016 Annual Report

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

1. THAT monitoring of consented activities at Inglewood WWTP in the 2016-2017 year continues at the same level as in 2015-2016.

This recommendation was subsequently implemented and all aspects of the 2016-2017 programme were performed as required.

3.5. Alterations to monitoring programmes for 2017-2018

In designing and implementing the monitoring programmes for air/water discharges in the region, the Council has taken into account:

- the extent of information already made available through monitoring or other means to date;
- its relevance under the RMA;
- the Council's obligations to monitor consented activities and their effects under the RMA;
- the record of administrative and environmental performances of the consent holder; and
- reporting to the regional community.

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

It is proposed that for 2017-2018, monitoring of the Inglewood WWTP continues at the same level as in 2016-2017.

It should be noted that the proposed programme represents a reasonable and risk-based level of monitoring for the site(s) in question. The Council reserves the right to subsequently adjust the programme from that initially prepared, should the need arise if potential or actual non-compliance is determined at any time during 2017-2018.

4. Recommendations

1. THAT in the first instance, monitoring of consented activities at Inglewood WWTP in the 2017-2018 year continue at the same level as in 2016-2017.
2. THAT should there be issues with environmental or administrative performance in 2017-2018, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.

Glossary of common terms and abbreviations

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

Biomonitoring	Assessing the health of the environment using aquatic organisms.
BOD	Biochemical oxygen demand. A measure of the presence of degradable organic matter, taking into account the biological conversion of ammonia to nitrate.
BODF	Biochemical oxygen demand of a filtered sample.
cfu	Colony forming units. A measure of the concentration of bacteria usually expressed as per 100 millilitre sample.
Conductivity	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m.
DO	Dissolved oxygen.
DRP	Dissolved reactive phosphorus.
FC	Faecal coliforms, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
Fresh	Elevated flow in a stream, such as after heavy rainfall.
g/m^3	Grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred.
Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring.
Investigation	Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident.
Incident Register	The Incident Register contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
L/s	Litres per second.
m^2	Square Metres.
MCI	Macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats.
mS/m	Millisiemens per metre.
Mixing zone	The zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point.
NH_4	Ammonium, normally expressed in terms of the mass of nitrogen (N).
NH_3	Unionised ammonia, normally expressed in terms of the mass of nitrogen (N).
NNN	Nitrate-Nitrite nitrogen.

NO_3^-	Nitrate, normally expressed in terms of the mass of nitrogen (N).
NO_2^-	Nitrite, normally expressed in terms of the mass of nitrogen (N).
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water.
pH	A numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
Physicochemical	Measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment.
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
RMA	*Resource Management Act 1991* and including all subsequent amendments.
SS	Suspended solids.
SQMCI	Semi quantitative macroinvertebrate community index.
Temp	Temperature, measured in °C (degrees Celsius).
Turb	Turbidity, expressed in NTU.
WWTP	Wastewater Treatment Plant

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

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Appendix I

Resource consent held by New Plymouth District Council

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

Discharge Permit

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

Name of Consent Holder:	New Plymouth District Council Private Bag 2025 New Plymouth 4342
Decision Date:	28 June 2016
Commencement Date:	28 June 2016

Conditions of Consent

Consent Granted:	To intermittently discharge treated municipal wastewater from the Inglewood oxidation ponds system into the Kurapete Stream
Expiry Date:	1 June 2033
Review Date(s):	June 2019 and 3-yearly intervals thereafter
Site Location:	Lincoln Road, Inglewood
Grid Reference (NZTM)	1705219E-5665557N
Catchment:	Waitara
Tributary:	Manganui Kurapete

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

General condition

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

Special conditions

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

2. The discharge shall only occur at times when inflow to the plant exceeds the rate that effluent can be pumped to the New Plymouth Waste Water Treatment Plant, and there is no available storage.

3. The discharge shall pass through a screen with a maximum aperture of 6 mm.

4. The site shall be operated in accordance with a 'Management Plan' prepared by the consent holder and approved by the Chief Executive, Taranaki Regional Council, acting in a certification capacity. The plan shall detail how the site will be managed to achieve compliance with the conditions of this consent.

5. The consent holder shall record the time 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 six monthly intervals.

6. The consent holder shall immediately notify the Taranaki District Health Board of any discharge.

7. The consent holder shall continue to implement a stormwater infiltration reduction investigation for the township of Inglewood and report annually on progress to the Chief Executive, Taranaki Regional Council for the period up to 30 June.

8. 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.

9. 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 or review during the month of June 2019 and at 3-yearly intervals thereafter, for the purpose of for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 28 June 2016

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Appendix II

Biomonitoring reports

To	Rae West, Job Manager
From	Darin Sutherland, Scientific Officer
Document	1898445
Report No	DS069
Date	13 July 2017

Biomonitoring of the Kurapete Stream in relation to the New Plymouth District Council's Inglewood oxidation ponds' system, February 2017

Introduction

This summer survey was the first of two surveys programmed for the 2016-2017 monitoring period. Normally, a spring and summer survey are performed but due to persistent wet weather in spring the spring survey has been re-scheduled for autumn (April or May). Since spring 2007, biomonitoring surveys have been reduced from four sites to two sites in recognition of the minimal usage of the WWTP overflow facility to the Kurapete Stream in recent years. However, a wet winter and very wet early spring to mid summer (2011-2012) period, caused a series of overflows of very dilute, treated wastewater to the Kurapete Stream over several periods until approximately two weeks prior to the mid-summer survey (see CRF541). In response to additional receiving water monitoring requirements associated with significant overflow events, an extended four site mid-summer biomonitoring survey was undertaken at all four established sites at that time. Two brief overflow events occurred between early and mid March 2012 and another in July 2012. At the time of the October 2012 survey, more than ten weeks since any overflow, the storage pond wastewater had been reduced (by pumping to the New Plymouth treatment plant) to a level approximately 1.5 m below the overflow level. No subsequent overflows occurred prior to the February 2013 (summer) biomonitoring survey. However, a wet winter and early spring period caused a series of overflows of very dilute, treated wastewater to the Kurapete Stream over several periods with an overflow event ceasing only two weeks prior to the spring 2013 survey. At the time of that survey (in October 2013), the storage pond wastewater had been reduced (by pumping to the New Plymouth treatment plant) to a level approximately 1m below the overflow level. In response to additional receiving water monitoring requirements associated with significant overflow events, an extended four site spring biomonitoring survey was undertaken at all four established sites [which had been last fully surveyed in January, 2012 (CF541, 2012)]. No extended four site surveys have been required since that spring 2013 survey. The most recent overflow event followed an intensive wet weather period in late June 2015.

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 16 February 2017.

Table 1 Biomonitoring sites in the tributary of the Mangaone Stream that receives stormwater discharges from MASL

Site No	Site code	Grid reference	Location
1	KRP000300	1705087E 5665510N	Upstream of oxidation ponds' discharge
4	KRP000660	1709239E 5667481N	Approximately 6km downstream of oxidation ponds' discharge

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

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using protocol P1 of NZMWG protocols for sampling macroinvertebrates in wadeable streams (Stark et al, 2001). Macroinvertebrate taxa abundances scored based on the categories presented in (Table 2).

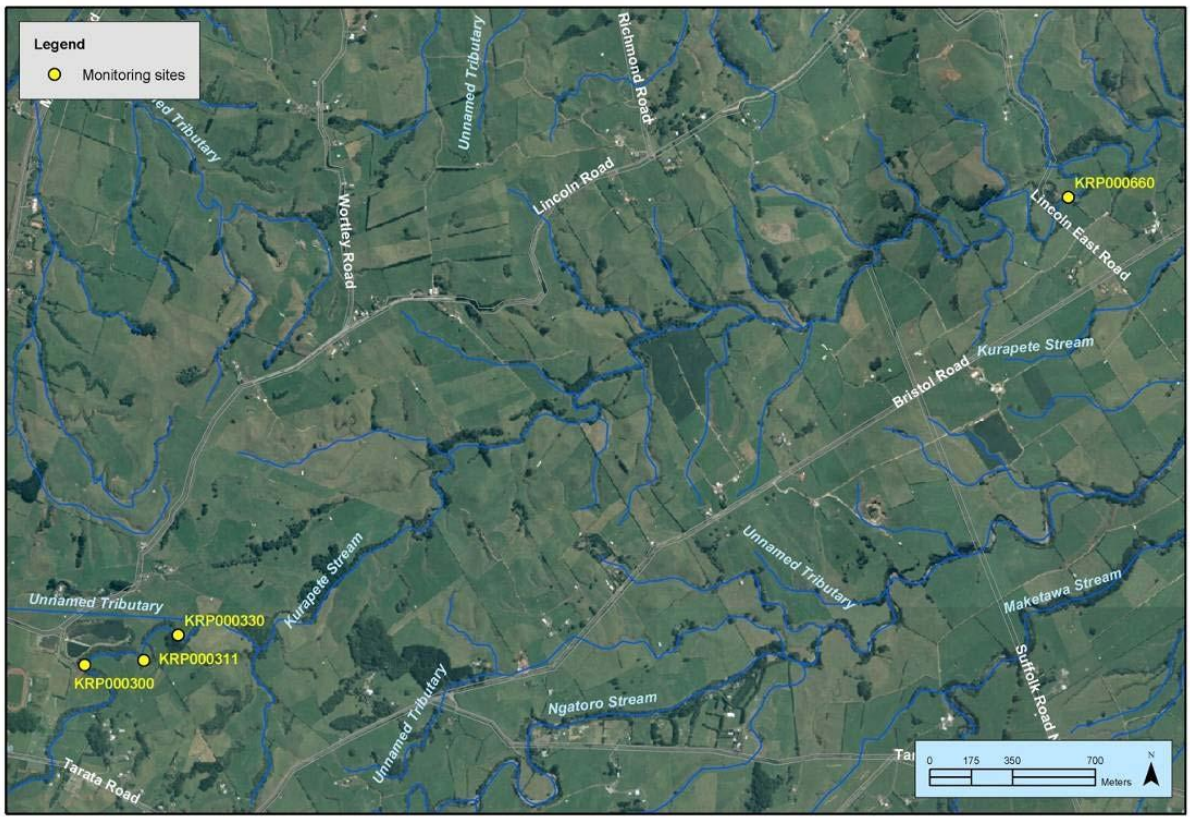

Figure 1 Sampling sites in the Kurapete Stream in relation to Inglewood oxidation ponds

Table 2 Macroinvertebrate abundance categories

Abundance category	Number of individuals
R (rare)	1-4
C (common)	5-19
A (abundant)	20-99
VA (very abundant)	100-499
XA (extremely abundant)	500+

Stark (1985) developed a scoring system for macroinvertebrate taxa according to their sensitivity to organic pollution in stony New Zealand streams. Highly `sensitive' taxa were assigned the highest scores of 9 or 10, while the most `tolerant' forms scored 1. Sensitivity scores for certain taxa have been modified in accordance with Taranaki experience. By averaging the scores obtained from a list of taxa collected from one site and multiplying by a scaling factor of 20, a Macroinvertebrate Community Index (MCI) value was obtained. The MCI is a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. A gradation of biological water quality conditions based upon MCI ranges which has been adapted for Taranaki streams and rivers (TRC, 2013) from Stark's classification (Stark, 1985 and Boothroyd and Stark, 2000) (Table 2). More 'sensitive' communities inhabit less polluted waterways. A difference of 10.83 units or more in MCI values is considered significantly different (Stark 1998).

Table 3 Macroinvertebrate health based on MCI ranges which has been adapted for Taranaki streams and rivers (TRC, 2015) from Stark's classification (Stark, 1985, Boothroyd and Stark, 2000, and Stark and Maxted, 2007)

Grading	MCI
Excellent	>140
Very Good	120-140
Good	100-119
Fair	80-99
Poor	60-79
Very Poor	<60

A semi-quantitative MCI value, $SQMCI_S$ (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). A difference of 0.83 units or more in $SQMCI_s$ values is considered significantly different (Stark 1998).

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

Site habitat characteristics and hydrology

This summer survey was performed under moderate flow conditions (approximately median flow), 11 days after a fresh in excess of 3 times median flow and 13 days after a fresh of 7 times median flow (flow gauge at the Mangaoraka Stream at Corbett Rd). The survey followed a relatively wet summer period with several significant river freshes recorded over the preceding month. The water temperature was 14.9°C at site 1 and 15.6°C at site 4. At sites 1 and 4 the water speed was swift, water grey and cloudy.

The stream at site 1 had slippery periphyton mats and no filamentous algae. Moss, leaves and wood were patchy on the streambed. There was partial bed shading from overhanging vegetation. The substrate was predominately cobbles. Site 4 had patchy mats and widespread filamentous algae. Moss and leaves were patchy on the streambed. There was partial bed shading from overhanging vegetation. The substrate was also predominately cobbles.

Macroinvertebrate communities

The results of the 32 surveys performed following cessation of the permanent discharge to the Kurapete Stream and prior to the current survey are summarised for comparative purposes in Table 4. 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 5 and discussed on a site-by-site basis.

Table 4 Summary of macroinvertebrate taxa numbers and MCI values for post effluent diversion surveys performed between February 2000 and February 2017 and for the current survey

Site No.	N	No of taxa			MCI value			$SQMCI_s$ value		
		Median	Range	Current survey	Median	Range	Current survey	Median	Range	Current survey
1	33	23	13-32	22	95	82-106	98	4.5	2.8-6.4	4.4
2	18	24	15-33	NA	94	80-101	NA	3.5	2.5-6.4	NA
3	18	23	15-28	NA	92	84-103	NA	3.7	2.5-6.1	NA
4	33	26	21-30	21	97	85-112	96	4.0	1.7-5.6	6.1

Table 5 Macroinvertebrate fauna of the Kurapete Stream in relation to the Inglewood oxidation ponds system sampled on 16 February 2017

Taxa List	Site Number	MCI score	1	4
	Site Code		KRP000300	KRP000660
	Sample Number		FWB17106	FWB17107
ANNELIDA (WORMS)	Oligochaeta	1	VA	C
MOLLUSCA	*Potamopyrgus*	4	A	C
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	A	A
	Coloburiscus	7	C	C
	Deleatidium	8	-	VA
	Zephlebia group	7	VA	C
PLECOPTERA (STONEFLIES)	*Zelandoperla*	8	R	-
COLEOPTERA (BEETLES)	Elmidae	6	A	A
	Ptilodactylidae	8	R	-
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	C	C
TRICHOPTERA (CADDISFLIES)	*Hydropsyche (Aoteapsyche)*	4	A	A
	Costachorema	7	-	C
	Hydrobiosis	5	R	C
	Neurochorema	6	R	R
	Pycnocentrodes	5	R	R
	Triplectides	5	R	-
DIPTERA (TRUE FLIES)	*Aphrophila*	5	-	A
	Eriopterini	5	R	-
	Hexatomini	5	R	R
	Chironomus	1	R	-
	Maoridiamesa	3	-	R
	Orthocladiinae	2	R	A
	Polypedilum	3	R	R
	Empididae	3	-	R
	Muscidae	3	-	R
	Austrosimulium	3	C	C
	Tanyderidae	4	R	-
ACARINA (MITES)	Acarina	5	R	-
		No of taxa	22	21
		MCI	98	96
		SQMCIs	4.4	6.1
		EPT (taxa)	9	9
		%EPT (taxa)	41	43
'Tolerant' taxa	'Moderately sensitive' taxa		'Highly sensitive' taxa	

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

Site 1 (upstream of the oxidation ponds' discharge)

A moderate macroinvertebrate community richness of 22 taxa was found at site 1 ('control' site) at the time of the summer survey. This was one taxa lower than the historical median for this site and the same as the previous survey on March 2016 (Figure 2 and Table 4).

The MCI score of 98 units indicated a community of 'fair' biological health which was significantly higher (Stark, 1998) than the historical median MCI score of 95 units. The MCI score was also not significantly different (Stark, 1998) to the preceding survey (106 units) which had the highest MCI score recorded at the site in 33 post discharge surveys.

The $SQMCI_S$ score of 4.4 units was not significantly different to the historic median MCI score of 4.4 units and significantly lower than the preceding survey score (6.3 units) (Stark, 1998) (Table 4).

The community was characterised by three 'tolerant' taxa [oligochaete worms, snails (*Potamopyrgus*), and caddisfly (*Hydropsyche/Aoteapsyche*)] and three 'moderately sensitive' taxa [mayflies (*Austroclima*, and *Zephlebia* group) and beetle (Elmidae)] (Table 5).

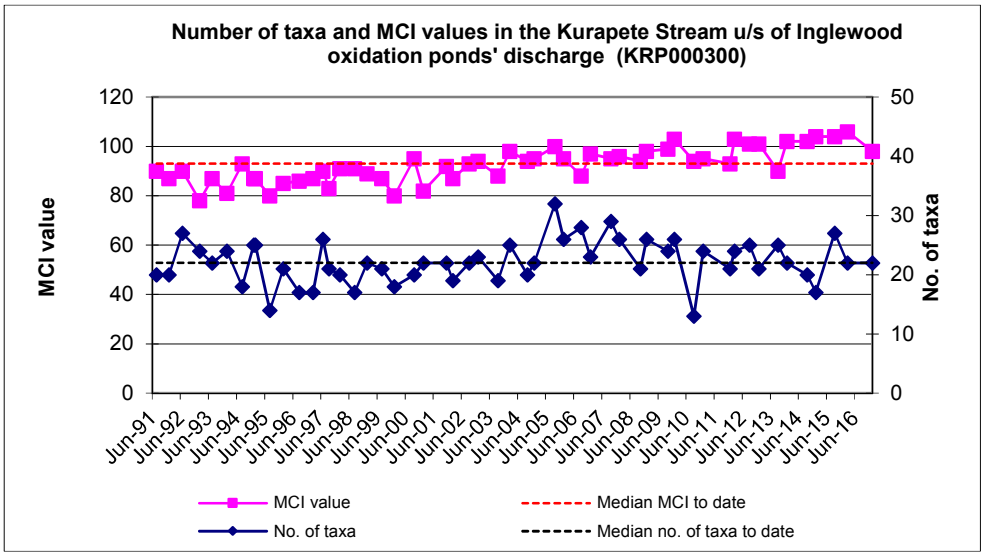

Figure 2 Taxa richness and MCI scores recorded to date for site 1 in the Kurapete Stream

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

A moderate macroinvertebrate community richness of 21 taxa was found at site 4 ('impact' site) at the time of the summer survey. This was five less than the historical median for this site and four less than the previous survey (25 taxa) (Figure 3, Table 4).

The MCI score of 96 units indicated a community of 'fair' biological health which was not significantly different (Stark, 1998) to the historical median MCI score of 97 units. The MCI score was also not significantly different (Stark, 1998) to the preceding survey (99 units).

The $SQMCI_S$ score of 6.1 units was the highest score recorded for post effluent diversion surveys and significantly higher than the median MCI score of 4.0 units and the preceding survey (4.0 units) (Stark, 1998) (Table 4).

The community was characterised by two 'tolerant' taxa [caddisfly (*Hydropsyche/Aoteapsyche*) and orthoclads midges] and three 'moderately sensitive' taxa [mayfly (*Austroclima*), beetle (Elmidae) and cranefly (*Aphrophila*)], and one 'highly sensitive' taxon [mayfly (*Deleatidium*)] (Table 5).

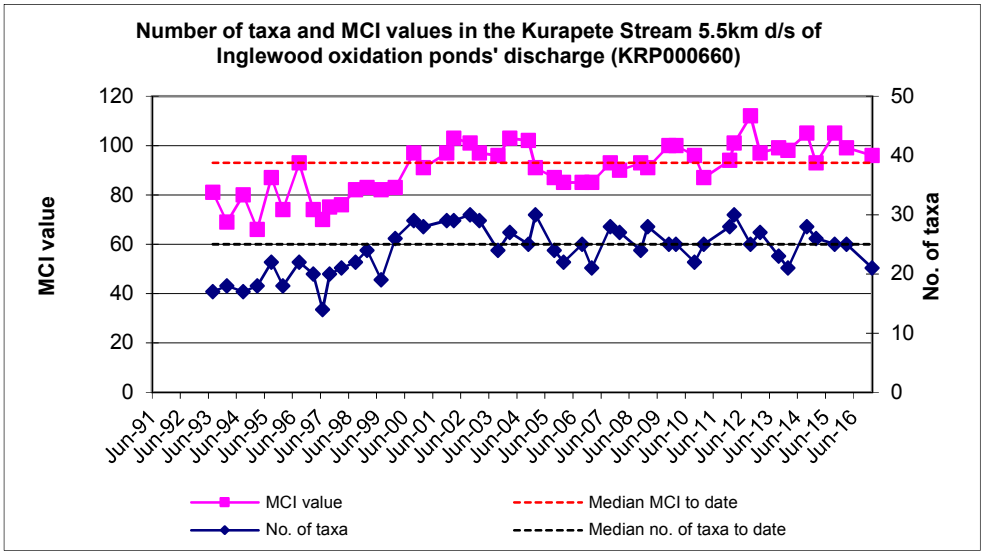

Figure 3 Taxa richness and MCI scores recorded to date for site 4 in the Kurapete Stream

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.

Discussion and conclusions

Refurbishment of the pond system had been performed in late 1999 and completed by the consent holder early in 2000 with all wastes diverted to the New Plymouth Carrousel Treatment Plant. Subsequently, several consented overflows have occurred following very heavy rainfall periods. More recently several overflows occurred in the late winter-spring of 2011, early January 2012, two further short duration overflows in early to mid March 2012, in July 2012, and in October 2013 after a series of wet weather events. No subsequent overflows to the stream had occurred until April 2015 with the most recent overflow following wet weather in late June 2015.

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 although subsequent reticulation work in the vicinity of this diversion had altered the drainage pattern.

This survey was performed in summer under relatively moderate flow conditions more than 17 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.

Macroinvertebrate richnesses at both sites were moderate and very similar to each other (within one taxon). There was a slight decline in taxa richness at the 'impact' site compared with the historical median (by five taxa) but this was not significant suggesting no effects of any toxic discharges.

The MCI scores at both sites indicated 'fair' health and were not significantly different from each other (by two units), and were also very similar to their historical medians (by 1-3 units). This indicates typical, post-effluent discharge communities present at the time of the survey with no evidence of any negative effect from discharges from the Inglewood WWTP. Furthermore, the 'impact' site had a significantly higher $SQMCI_S$ score than the 'control' site and it was the highest score recorded to date indicating better than normal macroinvertebrate health at the site. The presence of 'highly sensitive' *Deleatidium* mayflies in large

numbers at the 'impact' site was the major reason for the difference in $SQMCI_S$ scores between the 'control' and 'impact' sites.

The absence of any 'heterotrophic growths' provides further evidence that water quality in this reach of the Kurapete Stream subsequent to wastes diversion was not being impacted by discharges from the Inglewood WWTP.

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

Summary

The Council's standard 'kick-sampling' technique was used at two established sites 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.

Taxa richnesses at both sites were moderate and consistent with post-diversion historic medians. MCI scores indicated that the stream community at both sites was of 'fair' health with no significant differences between the 'control' and 'impact' sites. Furthermore, the $SQMCI_S$ score at the 'impact' site was significantly higher than the 'control' site score and was the highest recorded score to date for the site.

Overall, there was no evidence that discharges from the Inglewood waste water treatment plant had had any significant detrimental impacts on the macroinvertebrate communities of the Kurapete Stream.

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To	Rae West, Job Manager
From	Darin Sutherland, Scientific Officer
Document	1903347
Report No	DS076
Date	24 July 2017

Biomonitoring of the Kurapete Stream in relation to the New Plymouth District Council's Inglewood oxidation ponds' system, April 2017

Introduction

This autumn survey was the second of two surveys programmed for the 2016-2017 monitoring period. Normally, a spring and summer survey are performed but due to persistent wet weather in spring the spring survey was completed in autumn. Since spring 2007, biomonitoring surveys have been reduced from four sites to two sites in recognition of the minimal usage of the WWTP overflow facility to the Kurapete Stream in recent years. However, a wet winter and very wet early spring to mid summer (2011-2012) period, caused a series of overflows of very dilute, treated wastewater to the Kurapete Stream over several periods until approximately two weeks prior to the mid-summer survey (see CRF541). In response to additional receiving water monitoring requirements associated with significant overflow events, an extended four site mid-summer biomonitoring survey was undertaken at all four established sites at that time. Two brief overflow events occurred between early and mid March 2012 and another in July 2012. At the time of the October 2012 survey, more than ten weeks since any overflow, the storage pond wastewater had been reduced (by pumping to the New Plymouth treatment plant) to a level approximately 1.5 m below the overflow level. No subsequent overflows occurred prior to the February 2013 (summer) biomonitoring survey. However, a wet winter and early spring period caused a series of overflows of very dilute, treated wastewater to the Kurapete Stream over several periods with an overflow event ceasing only two weeks prior to the spring 2013 survey. At the time of that survey in October 2013, the storage pond wastewater had been reduced (by pumping to the New Plymouth treatment plant) to a level approximately 1m below the overflow level. In response to additional receiving water monitoring requirements associated with significant overflow events, an extended four site spring biomonitoring survey was undertaken at all four established sites [which had been last fully surveyed in January, 2012 (CF541, 2012)]. No extended four site surveys have been required since that spring 2013 survey. The most recent overflow event followed an intensive wet weather period in late June 2015.

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 26 April 2017.

Table 1 Biomonitoring sites in the Kurapete Stream

Site No	Site code	Grid reference	Location
1	KRP000300	1705087E 5665510N	Upstream of oxidation ponds' discharge
4	KRP000660	1709239E 5667481N	Approximately 6km downstream of oxidation ponds' discharge

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

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using protocol P1 of NZMWG protocols for sampling macroinvertebrates in wadeable streams (Stark et al, 2001). Macroinvertebrate taxa abundances scored based on the categories presented in (Table 2).

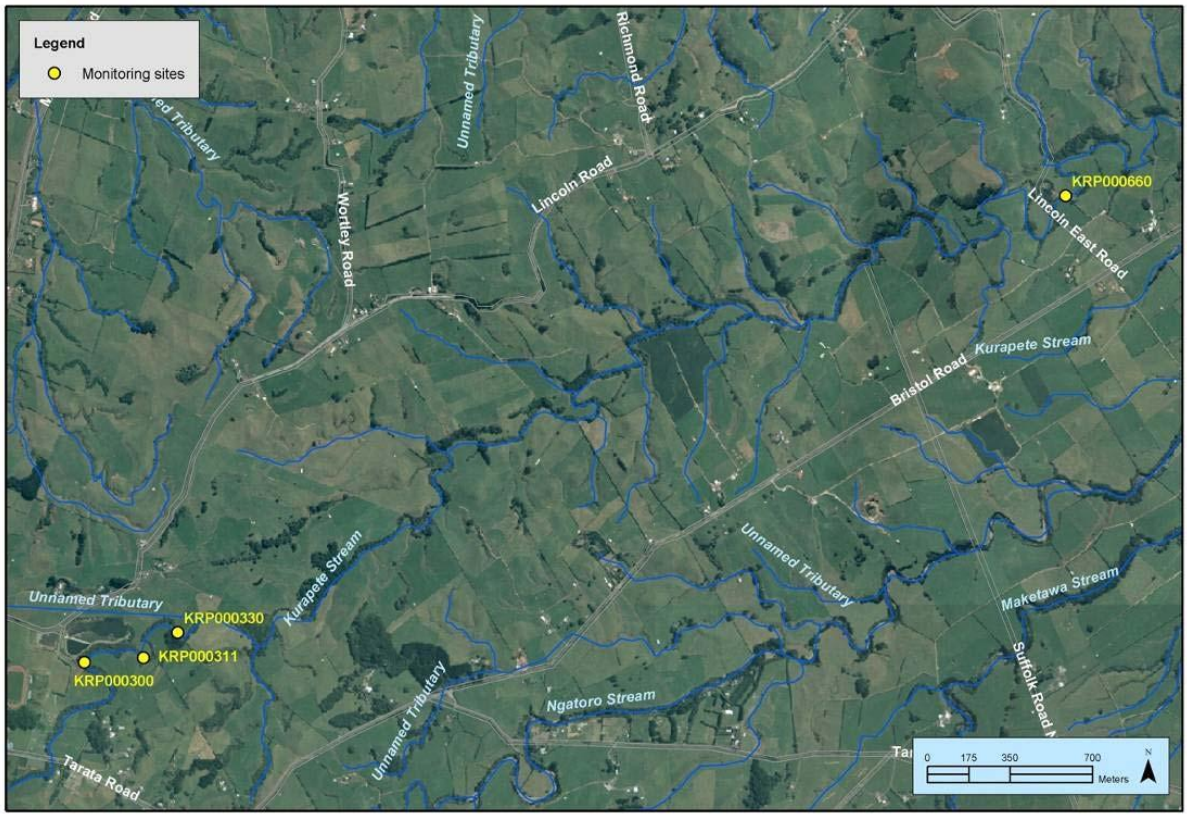

Figure 1 Sampling sites in the Kurapete Stream in relation to Inglewood oxidation ponds

Table 2 Macroinvertebrate abundance categories

Abundance category	Number of individuals
R (rare)	1-4
C (common)	5-19
A (abundant)	20-99
VA (very abundant)	100-499
XA (extremely abundant)	500+

Stark (1985) developed a scoring system for macroinvertebrate taxa according to their sensitivity to organic pollution in stony New Zealand streams. Highly `sensitive' taxa were assigned the highest scores of 9 or 10, while the most `tolerant' forms scored 1. Sensitivity scores for certain taxa have been modified in accordance with Taranaki experience. By averaging the scores obtained from a list of taxa collected from one site and multiplying by a scaling factor of 20, a Macroinvertebrate Community Index (MCI) value was obtained. The MCI is a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. A gradation of biological water quality conditions based upon MCI ranges which has been adapted for Taranaki streams and rivers (TRC, 2013) from Stark's classification (Stark, 1985 and Boothroyd and Stark, 2000) (Table 2). More 'sensitive' communities inhabit less polluted waterways. A difference of 10.83 units or more in MCI values is considered significantly different (Stark 1998).

Table 3 Macroinvertebrate health based on MCI ranges which has been adapted for Taranaki streams and rivers (TRC, 2015) from Stark's classification (Stark, 1985, Boothroyd and Stark, 2000, and Stark and Maxted, 2007)

Grading	MCI
Excellent	>140
Very Good	120-140
Good	100-119
Fair	80-99
Poor	60-79
Very Poor	<60

A semi-quantitative MCI value, $SQMCI_S$ (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). A difference of 0.83 units or more in $SQMCI_s$ values is considered significantly different (Stark 1998).

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

Site habitat characteristics and hydrology

This autumn survey was performed under moderate flow conditions (approximately median flow), 10 days after a fresh in excess of 3 times median flow and 12 days after a fresh in excess of 7 times median flow (flow gauge at the Mangaoraka River at Corbett Rd). The survey followed a relatively wet summer period with several freshes recorded over the preceding month. The water temperature was 12.6°C at site 1 and 12.5°C at site 4. At site 1 the water speed was swift, the water was grey in colour and cloudy while at site 4 the water speed was swift, water uncoloured and clear.

The stream at site 1 had no periphyton mats and filamentous algae. Leaves and wood were widespread on the streambed. There was partial bed shading from overhanging vegetation. The substrate was predominately cobble and gravels. Site 4 had patchy mats and widespread filamentous algae. Moss and leaves were patchy on the streambed. There was partial bed shading from overhanging vegetation. The substrate was also predominately cobbles with some boulders.

Macroinvertebrate communities

The results of the 33 surveys performed following cessation of the permanent discharge to the Kurapete Stream and prior to the current survey are summarised for comparative purposes in Table 4. 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 5 and discussed on a site-by-site basis.

Table 4 Summary of macroinvertebrate taxa numbers and MCI values for post effluent diversion surveys performed between February 2000 and April 2017 and for the current survey

Site No.	N	No of taxa			MCI value			$SQMCI_s$ value		
		Median	Range	Current survey	Median	Range	Current survey	Median	Range	Current survey
1	33	22	13-32	23	95	86-106	98	4.4	2.8-6.4	5.2
2	18	24	15-33	NA	94	80-101	NA	3.5	2.5-6.4	NA
3	18	23	15-28	NA	92	84-103	NA	3.7	2.5-6.1	NA
4	33	25	21-30	22	97	85-112	103	4.0	1.7-6.1	4.9

Table 5 Macroinvertebrate fauna of the Kurapete Stream in relation to the Inglewood oxidation ponds system sampled on 26 April 2017

Taxa List	Site Number	MCI score	1	4
	Site Code		KRP000300	KRP000660
	Sample Number		FWB17221	FWB17222
PLATYHELMINTHES (FLATWORMS)	*Cura*	3	R	-
NEMERTEA	Nemertea	3	-	C
ANNELIDA (WORMS)	Oligochaeta	1	VA	A
	Lumbricidae	5	R	-
MOLLUSCA	*Potamopyrgus*	4	XA	C
CRUSTACEA	Paraleptamphopidae	5	VA	-
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	A	A
	Coloburiscus	7	A	A
	Deleatidium	8	-	A
	Zephlebia group	7	XA	C
PLECOPTERA (STONEFLIES)	*Acroperla*	5	-	R
	Zelandobius	5	R	-
COLEOPTERA (BEETLES)	Elmidae	6	A	A
	Ptilodactylidae	8	R	-
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	A	C
TRICHOPTERA (CADDISFLIES)	*Hydropsyche (Aoteapsyche)*	4	A	VA
	Costachorema	7	-	R
	Hydrobiosis	5	C	C
	Neurochorema	6	-	C
	Beraeoptera	8	-	R
	Oeconesidae	5	R	-
	Pycnocentria	7	A	C
	Pycnocentrodes	5	-	C
	Triplectides	5	R	-
DIPTERA (TRUE FLIES)	*Aphrophila*	5	-	C
	Hexatomini	5	R	-
	Maoridiamesa	3	-	C
	Orthocladiinae	2	R	C
	Polypedilum	3	R	-
	Muscidae	3	-	R
	Austrosimulium	3	C	C
	Tanyderidae	4	R	-
ACARINA (MITES)	Acarina	5	R	-
		No of taxa	23	22
		MCI	98	103
		SQMCIs	5.2	4.9
		EPT (taxa)	9	12
		%EPT (taxa)	39	55

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

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

Site 1 (upstream of the oxidation ponds' discharge)

A moderate macroinvertebrate community richness of 23 taxa was found at site 1 ('control' site) at the time of the autumn survey. This was one higher than the historical median for this site and the previous survey on February 2017 (22 taxa) (Figure 2, Table 4).

The MCI score of 98 units indicated a community of 'fair' biological health which was not significantly higher (Stark, 1998) than the historical median MCI score of 95 units. The MCI score was also not significantly different (Stark, 1998) to the preceding survey (98 units).

The $SQMCI_S$ score of 5.2 units was not significantly different (Stark, 1998) to median MCI score of 4.4 units and to the preceding survey score (4.4 units) (Stark, 1998) (Table 4).

The community was characterised by three 'tolerant' taxa [oligochaete worms, snails (*Potamopyrgus*), and caddisfly (*Hydropsyche/Aoteapsyche*)] and three 'moderately sensitive' taxa [mayflies (*Austroclima*, *Coloburiscus* and *Zephlebia* group) and beetle (Elmidae)] (Table 5).

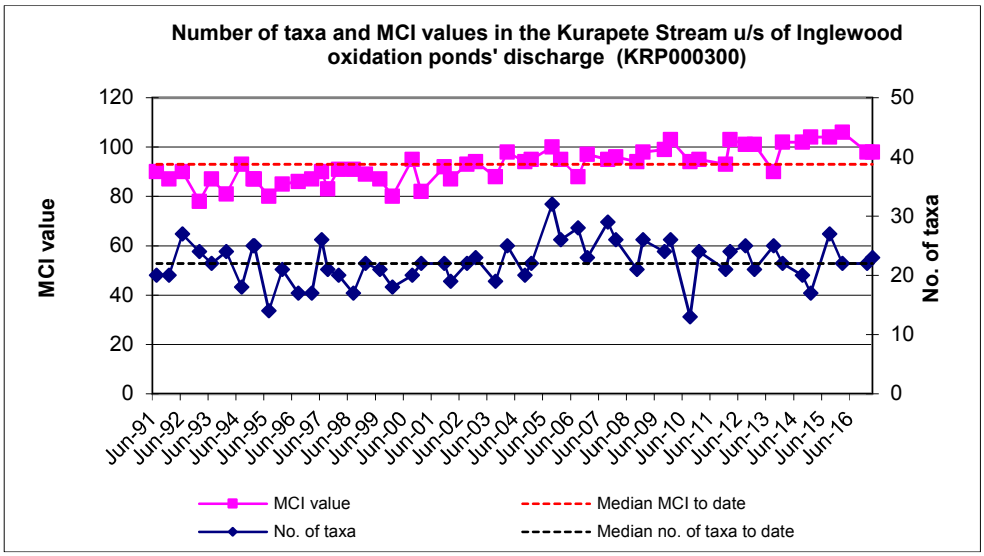

Figure 2 Taxa richness and MCI scores recorded to date for site 1 in the Kurapete Stream

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

A moderate macroinvertebrate community richness of 22 taxa was found at site 4 ('impact' site) at the time of the autumn survey. This was three less than the historical median (25 taxa) for this site and one taxon more than the previous survey (21 taxa) (Figure 3,Table 4).

The MCI score of 103 units indicated a community of 'good' biological health which was not significantly different (Stark, 1998) to the historical median MCI score of 97 units. The MCI score was also not significantly different (Stark, 1998) to the preceding survey (96 units).

The $SQMCI_S$ score of 4.9 units was significantly higher (Stark, 1998) than the median MCI score of 4.0 units but significantly lower (Stark, 1998) than the preceding survey (6.1 units) which had the highest score to date (Table 4).

The community was characterised by two 'tolerant' taxa [caddisfly (oligochaete worms and *Hydropsyche/Aoteapsyche*)], three 'moderately sensitive' taxa [mayflies (*Austroclim* and *Coloburiscus*), and beetle (Elmidae), and one 'highly sensitive' taxon [mayfly (*Deleatidium*)] (Table 5).

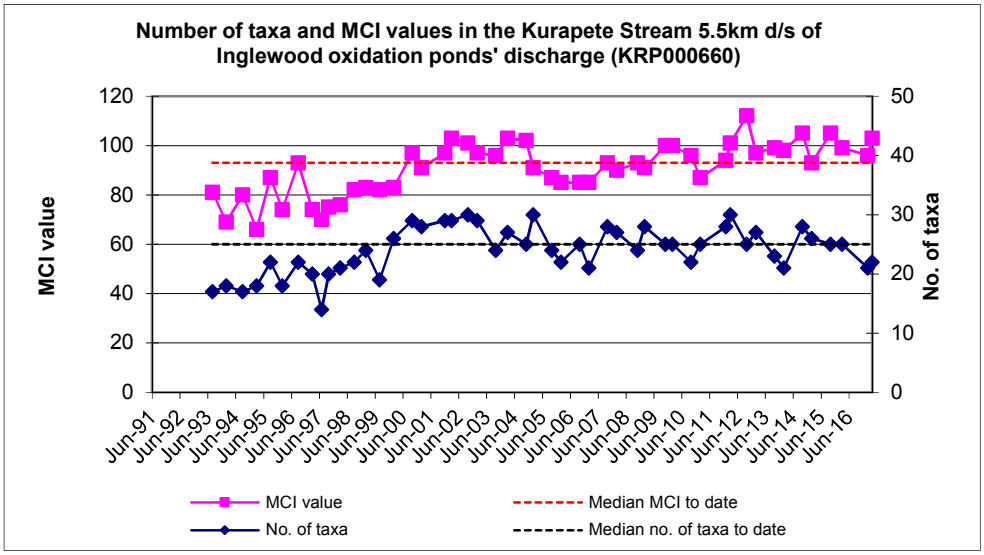

Figure 3 Taxa richness and MCI scores recorded to date for site 4 in the Kurapete Stream

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.

Discussion and conclusions

Refurbishment of the pond system had been performed in late 1999 and completed by the consent holder early in 2000 with all wastes diverted to the New Plymouth Carrousel Treatment Plant. Subsequently, several consented overflows have occurred following very heavy rainfall periods. More recently several overflows occurred in the late winter-spring of 2011, early January 2012, two further short duration overflows in early to mid March 2012, in July 2012, and in October 2013 after a series of wet weather events. No subsequent overflows to the stream had occurred until April 2015 with the most recent overflow following wet weather in late June 2015.

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 although subsequent reticulation work in the vicinity of this diversion had altered the drainage pattern.

This survey was performed in autumn under relatively moderate flow conditions more than 17 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.

Macroinvertebrate richnesses at both sites were moderate and very similar to each other (within one taxon). There was a slight decline in taxa richness at the 'impact' site compared with the historical median (by three taxa) but this was not significant suggesting no effects of any toxic discharges.

The MCI scores at the 'control' site indicated 'fair' health while the 'impact' site indicated 'good' health with a non-significant difference from each other of five units. Currents scores were also very similar to their historical medians (by 3-6 units). This indicates typical, post-effluent discharge communities present at the time of the survey with no evidence of any negative effect from discharges from the Inglewood WWTP.

The $SQMCI_S$ scores showed similar results to the MCI scores. There was no significance difference between the 'control' and impact' sites, the 'control' site had a typical score not significantly different from the historic

median while the 'impact' site had a significantly' higher score than the historic median which was at the same time significantly lower than the preceding survey, possibly indicating that the 'impact' site is continuing to show general improvement.

The absence of any 'heterotrophic growths' provides further evidence that water quality in this reach of the Kurapete Stream subsequent to wastes diversion was not being impacted by discharges from the Inglewood WWTP.

Biological monitoring of the stream will continue to be performed with two sites (upstream 'control' site 1 and downstream 'impact' site 4), in order to document temporal trends in stream 'health', particularly as riparian improvements and dairy wastes disposal to land initiatives are implemented in the catchment. A return to the four site survey (as performed on specific survey occasions in the past e.g. spring 2013) would occur only in order to assess any impacts of consented (resource consent 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 autumn 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.

Taxa richnesses at both sites were moderate and consistent with post-diversion historic medians. MCI scores indicated that the stream community at the 'control' site was fair while the 'impact' site was 'good' with no significant differences between the 'control' and 'impact' sites. Furthermore, the $SQMCI_S$ scores were also not significantly different from each other and the 'impact' site had a score significantly higher than its historic median.

Overall, there was no evidence that discharges from the Inglewood waste water treatment plant had had any significant detrimental impacts on the macroinvertebrate communities of the Kurapete Stream.

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Appendix III

New Plymouth District Council Inglewood WWTP 2016-2017 Annual Report

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 2016

TO 30 JUNE 2017

Prepared by:
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PRINCIPAL OPERATIONS ENGINEER

Version 1
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CONTENTS

1. INTRODUCTION

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

2. INGLEWOOD OXIDATION POND OPERATION

2.1 Screens

Routine maintenance has been carried out on the screens.

2.2 Pump Station

Pump maintenance has been undertaken during the year with both pumps receiving routine six month and 12 month checks. The pumps have worked well with few periods of low flow where pump speed is reduced. The pumps have operated at maximum speed for 60% of the year pumping at a flow in excess 160m^3/hr to New Plymouth

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. The pond has a minimum level of 0.6m and the pond level was recorded at less than 0.75m for more than 140 days during the reporting period. A number of periods of significant rainfall occurred throughout the year which caused the secondary pond level to rise. In general the ponds served well to buffer the flows but the capacity was exceeded once between 1st and 10 August. The overflow was notified to TRC and the volume of water discharged was estimated as 37,000m^3.

2.5 Outfall Screen

The system was called to operate once during this reporting period. Routine inspections and maintenance have been completed.

3. MONITORING

3.1 Monitoring of Data

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

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

3.2 Unauthorised Discharges

Inglewood oxidation pond

There was one overflow from the oxidation ponds between 31 July 2016 and 12 August 2016 due to high rainfall.

Reticulation overflows

There were no overflows from the Inglewood reticulation between 1 July 2016 and 30 June 2017.

3.3 Inflow and Infiltration

Graphs of annual rainfall compared to inflow, outflow and secondary pond levels are shown in Figure 2 and Figure 3. More detailed monthly graphs have been issued to TRC at the end of each month throughout the year.

A total of 3,019mm of rain was received in Inglewood during the year compared to 2,212mm last year.

The oxidation pond received a total volume of 1,062,166m^3 over the 12 month period compared to 630,000 m^3 in 2015/16. The average daily inflow was 2,910m^3 with a maximum flow of 10,677m^3 on 3 February 2017 and minimum flow of 1,145m^3 on 6 March 2017. The theoretical average daily inflow based on 250 litres per person per day and assuming an estimated 3,750 resident population is 937m^3/day.

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

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

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

Figure 2 shows the daily summary of flow to the Inglewood oxidation ponds. Figure 3 shows the daily rainfall measured by the TRC rain gauge at Inglewood.

When comparing these charts with previous reports it is relevant to consider the axis scales particularly for rainfall, with the Y axis reading to 140mm in 2016/17 compared to only 70mm in last year's report. In 2015-16 the rainfall depth exceeded 59mm on three separate occasions with a maximum 24 hour value of 65.5mm. In 2016-17 the rainfall depth exceeded 59mm on two occasions with a maximum 24 hour value of 118mm on 2 February 2017.

The KPI results for the 2016/17 year have not been analysed as there was so much rain throughout the year that it has been difficult to isolate individual rain events and the corresponding inflow and infiltration profiles. It does remain clear that there is significant inflow and infiltration in Inglewood that requires attention not least because the total volume received in 2016/17 was 400,000m^3 greater than during 2015/16. Further investigation has been undertaken to determine alternate methods of identifying the sources of I&I.

A methodology called distributed temperature sensing has been assessed as a suitable alternative to smoke testing and will be undertaken in Inglewood during 2017/18.

Distributed temperature sensing involves measurement of the temperature of sewage flowing within the reticulation. Sewage has a very constant temperature regardless of the environmental conditions and seasonality. Inflow and infiltration from rain and ground water is at a lower temperature than sewage and so by measuring temperature throughout the sewer system individual points of inflow or infiltration can be identified.

The temperature measurement is undertaken by pulling a fibre optic through the pipe network. The fibre is installed in a loop fashion to each individual pipe being monitored which results in the fibre passing through each pipe twice. The fibre is used to measure temperature at 1 metre intervals along the length. Inflow and infiltration shows up as a drop in temperature at the point of entry. Because the measurements are made at 1 metre intervals and each point of entry shows up twice due to the looped installation, it should be possible to identify entry of water with a high degree of accuracy. The maximum length of fibre that can be installed is 6km. This is insufficient to cover the whole of Inglewood in a single installation and so initial flow monitoring will be used to establish the areas with the highest levels of inflow and infiltration. The cost of this exercise is expected to amount to $60,000 plus any additional costs for cleaning sewers to install the fibre, however if successful the same methodology will be utilised elsewhere within New Plymouth District.

Work has continued on smoke testing within Inglewood through the reporting period. During the 2016/17 year $30,530 spent on pipe lining to rehabilitate sewer mains with defects which were identified through previous CCTV surveys.

The map below (Figure 1) shows the locations of pipes which were lined during the period.

Figure 1 Location of pipe lining

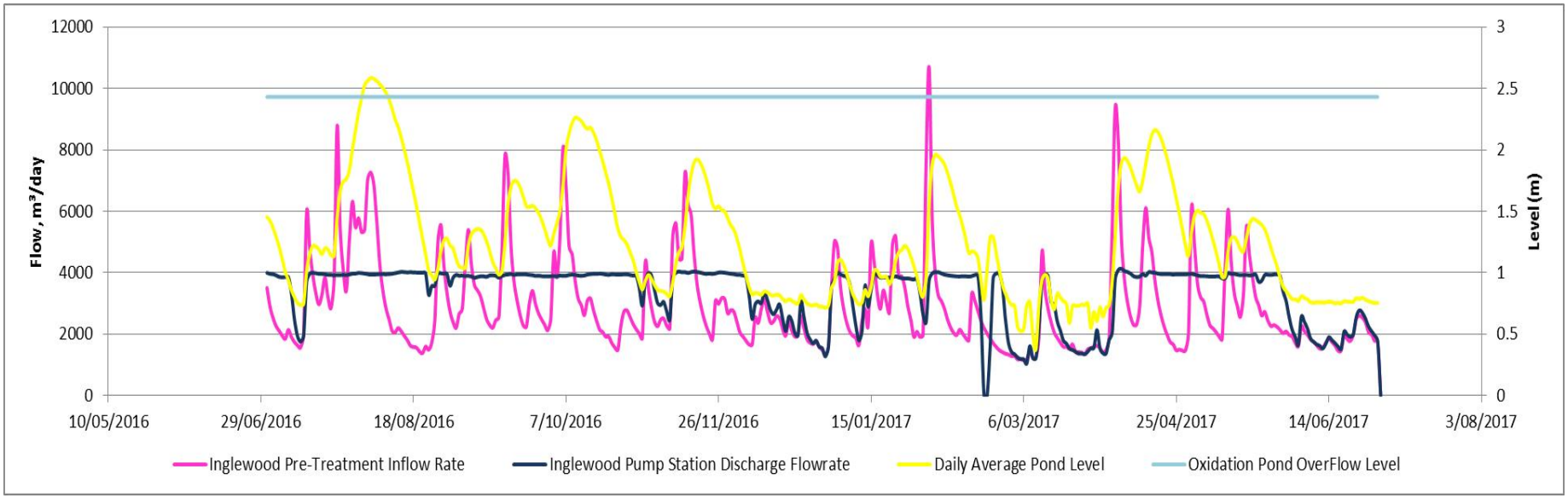

Figure 2 Inglewood Oxidation Pond from 01/07/2016 to 30/06/2017 (daily summaries)

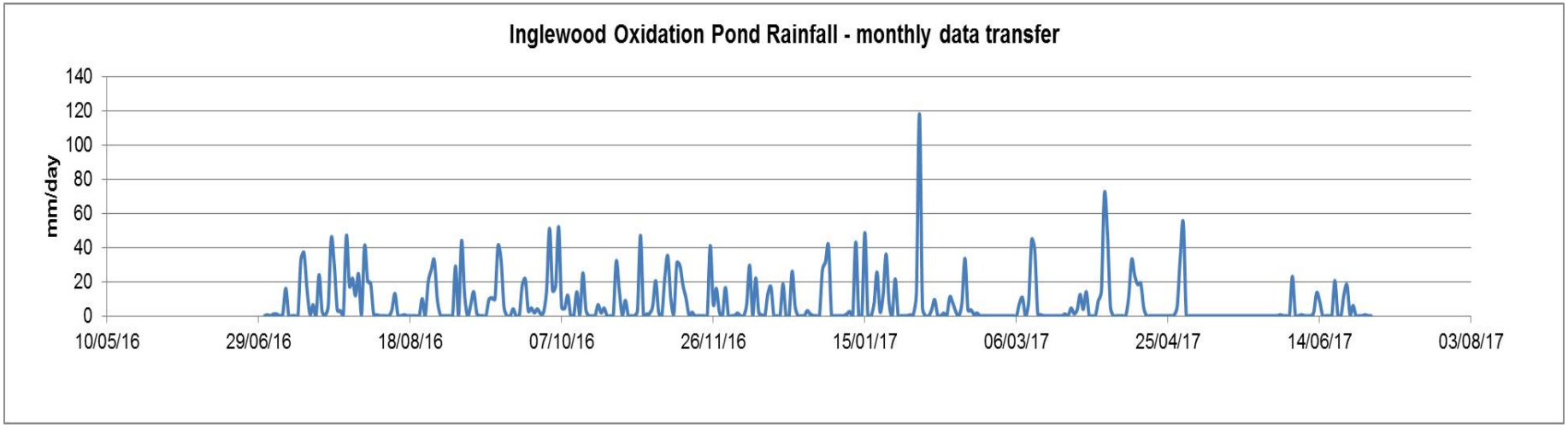

Figure 3 Daily Rainfall from 01/07/2016 to 30/06/2017