Stratford District Council
Stratford WWTP
Monitoring Programme
Annual Report
2016-2017

Technical Report 2017-106

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Taranaki Regional Council
Private Bag 713
STRATFORD

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Executive summary

The Stratford District Council (SDC) operates a municipal wastewater treatment plant (WWTP) located on Victoria Road at Stratford, in the Patea 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 SDC'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 SDC's activities.

SDC holds one resource consent to discharge treated wastewater to the Patea River, which includes a total of 12 conditions setting out the requirements that the Company must satisfy.

During the monitoring period, SDC demonstrated an overall good level of environmental performance.

The Council's monitoring programme for the year under review included 4 inspections, wastewater analyses, and physicochemical and biological surveys of the receiving waters of the Patea River.

In recent years, improvements in SDC's maintenance programme have generally enhanced the appearance of the plant and effectively controlled 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 no overflows 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 was good at the time of the moderately low flow late summer receiving water physicochemical survey, with a moderate algal component. This algal component had a minor impact on turbidity under low flow conditions, which was non-compliant with aesthetic consent conditions. A late summer biomonitoring survey found no significant impacts on the macroinvertebrate fauna as a result of the discharge of treated wastewater.

During the year, SDC demonstrated a good level of environmental and a high level of administrative performance with the resource consents. Effects from the discharge on the receiving waters continue to be recorded, with minor or no effects noted beyond the boundary of the permitted mixing zone.

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 good 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 Stratford District Council (SDC). SDC operates a municipal wastewater treatment plant (WWTP) situated on Victoria Road at Stratford.

This report covers the results and findings of the monitoring programme implemented by the Taranaki Regional Council (the Council) in respect of the consents held by SDC that relate to the discharge of treated wastewater in the Patea catchment. This is the thirtieth annual report to be prepared by the Council to cover SDC'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 SDC in the Patea catchment;
- the nature of the monitoring programme in place for the period under review; and
- a description of the activities and operations conducted at SDC'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 SDC, 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 SDC'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

Stratford town sewage is treated by an oxidation pond system (Photo 1) and combined successive maturation cell system (2.6 ha and 1.7 ha in area), that was upgraded in 2009. Changes made to the system during the upgrade included:

- flow recorder installation at the inflow structure to the primary pond;
- splitter chamber replaced with an influent chamber (to prevent overflows);
- installation of a step screen system at the influent;
- relocation of the tanker waste disposal area to Esk Road;
- a new trade waste connection from the regional stockyards on Esk Road into the system; and
- improvements to the pond system itself.

A full history of the pond system and upgrade process can be found in the 2014-2015 annual report (TRC, 2015). Some industrial wastes are also discharged into the system, which includes an influent chamber fitted with a permanent flow-recording device.

Photo 1 Stratford WWTP

1.2.1. Inflow and infiltration reduction

SDC reported on progress with the implementation of the inflow and infiltration reduction programme to minimise stormwater inflow in mid 2010. This programme includes visual infiltration surveys in winter and summer, followed by CCTV surveys within the reticulation to determine sections requiring repairs or replacement. This work was intended to be prioritised, although SDC advised that the completion of the work could take several years due to financial constraints.

SDC has relined 1,090 m of sewer pipework over the past five year and this work has seen a noticeable reduction in the wet weather flow in the Achilles, Hathaway, and Lysander Street catchments.

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.

SDC holds water discharge permit **0196-4** to discharge treated wastewater from the Stratford Wastewater Treatment Plant into the Patea River. This permit was issued by the Council on 14 November 2013 under Section 87(e) of the RMA. It expired on 1 June 2016, but SDC continues to operate under the consent as per Section 124 of the RMA.

Condition 1 relates to best practice.

Conditions 2 and 3 relate to limits on wastewater volume and infiltration reduction.

Conditions 4, 5, and 6 detail requirements for management plans, maintenance of the ponds, and trade wastes connections.

Conditions 7 to 11 detail requirements of effects on the receiving waters and provisions for the physicochemical and nutrient monitoring programmes.

Condition 12 provides for review of the consent.

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 Stratford WWTP consisted of four 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. Site inspections

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

1.4.4. Chemical sampling

The Council undertook sampling of the discharge from the site, as well as the water quality either side of the discharge point and mixing zone.

The Stratford WWTP final effluent from the maturation cells was sampled for dissolved oxygen and microfloral component on four occasions; and for pH, conductivity, BOD, SS, turbidity, faecal coliform, nutrient and metal analyses on one occasion in early autumn.

Sampling of the Patea River either side of the discharge was carried out on three occasions, and the sample analysed for BOD, chloride, pH, turbidity, and nutrient analyses. Additional bacteriological (faecal coliform) and metal analyses were included on one sampling occasion under early autumn low flow conditions.

1.4.5. Biomonitoring surveys

A biological survey was performed on one occasion on 22 March 2017 in the Patea River, to determine whether or not the discharge of treated wastewater from the site has had a detrimental effect upon the communities of the stream.

2. Results

2.1. Inspections

2 September 2016

An inspection was conducted in mainly fine weather with a cool, westerly, moderate breeze. The monthly rainfall was 162 mm as recorded at the Stratford TRC weather station.

The step screen was operating and wastes were fully contained. The influent flow rate was recorded as 99 m^3/hr (28 L/s). The pond was operating a normal level, with a slightly turbid, green brown colour and a lightly rippled surface. Three out of four aerators were operating, creating a swift pond circulation. No scum accumulation was noted on the pond surface, and the wavebands and outlet screen were clear of any debris. 12 ducks and five black swans were observed on the pond surface.

All three maturation cells were a slightly turbid, light green brown colour, with a rippled surface. The tops of the cell walls were all exposed, and operating levels were normal. An algal sample was collected for chlorophyll-a analysis. Approximately 100 ducks were observed on the surface of the cells, including a mixture of mallard, teal, and paradise ducks, black swans, Canadian geese, and seagulls.

A slightly noticeable odour was noted downwind from the flume shed and step screen areas. No odour was detected around the pond perimeter.

The treated effluent discharge flow rate into the Patea River was estimated at 25 L/s, and showed no visual environmental impact at the point of discharge. The Patea River flow rate was recorded as 4.395 m^3/s at the Skinner Road site. Receiving water samples were collected upstream and downstream of the WWTP discharge, which was also sampled.

The Esk Road septic wastes unloading facility was also inspected. This area was found to be in a satisfactory condition with no odour or unauthorised waste disposal issues noted.

28 November 2016

An inspection was conducted in overcast, showery weather with a westerly wind. The monthly rainfall was 287 mm rain as recorded at the Stratford TRC weather station.

The step screen was operating and wastes were fully contained. The influent flow rate was measured as 134 m^3/hr (37 L/s). The pond was a slightly turbid, green brown colour, with a rippled surface. All four aerators were operating, creating a swift pond circulation. The fourth aerator had recently been replaced following maintenance. No scum was observed on the pond surface, and the wavebands were clear of any debris. Approximately 120 ducks and 17 black swans were noted on the pond.

All three maturation cells were operating at a normal level, with the tops of the cell walls exposed. The cells were a slightly turbid, green brown colour, with rippled surfaces.

A sample was collected for chlorophyll-a analysis. More than 275 birds including mallard, teal, and paradise ducks, and several black swans, were noted on the surface of the cells.

Minimal odour was encountered downwind from the ponds and step screen area. No odour was detected offsite.

The discharge flow rate into the Patea River was visually estimated at 40 L/s, showing no visual environmental effects at the point of discharge. The flow rate in the Patea River was measured as 4.289 m^3/s at Skinner Road. Samples of the WWTP discharge, and receiving waters upstream and downstream from the discharge were collected for effluent analysis.

The Esk Road septic wastes unloading facility had been recently inspected on 4 November 2016. The area was found to be tidy with no odour issues noted (Photo 2).

Photo 2 Esk Road wastes facility, November 2016

21 March 2017

An inspection was conducted in fine and sunny weather with a light south westerly breeze. The monthly rainfall was 105 mm as recorded at the Stratford TRC weather station. The WWTP and surrounds were found to be in satisfactory condition.

The step screen was operating and wastes were fully contained. The influent flow rate was recorded as 78 m^3/hr (22 L/s), and all four aerators were operating, creating a swift pond circulation. The pond was a turbid, dark green colour, with a normal operating level. Over 250 mallard ducks and several black swans were noted on the pond surface.

The maturation cells were at a normal operating level for the summer period, and each cell was a turbid, dark green brown colour. Approximately 300 paradise and mallard ducks were scattered over Cells 1 and 2. DO and algal samples were collected from the final cell, and effluent grab samples were collected from the downstream discharge (adjacent to the Patea River).

The discharge flow rate into the Patea River was estimated at 15 L/s showing a slightly noticeable environmental effect at the point of discharge and also at sampling site (PAT000350) approximately 130 m downstream from the discharge. This was also apparent in the difference between black disk measurements at the sites upstream and downstream of the discharge. The Patea River flow rate was recorded as 2.0 m^3/s at Skinner Road. Compliance monitoring samples were collected at the four receiving waters sites under low flow river conditions, in conjunction with the inspection and sampling of the WWTP system.

Minimal odour was noted throughout the site during the inspection visit.

The Esk Road waste unloading facility was also inspected. It appeared that this facility had been well maintained with no evidence of any odour nor recent overflow events apparent.

16 May 2017

An inspection was conducted in overcast weather with calm wind conditions. The monthly rainfall was recorded as 215 mm rain at the Stratford TRC weather station. The WWTP and surrounds were found to be satisfactory.

The step screen was operating and wastes were fully contained. The influent flow rate at the flume shed was measured at 357 m^3/hr (99 L/s). Three of the four aerators were operating, as one aerator had been removed from the pond. The pond was operating at a normal level, with a turbid, green colour. Several black swans were noted on the pond surface.

The maturation cells showed slightly high winter levels, with effluent flowing between cells via the dividing cell wall channels. Approximately 45 black swans and mallard ducks were observed on the surface of the cells. An algal sample was collected for chlorophyll-a analysis, along with DO and effluent grab samples from the downstream discharge adjacent to the Patea River.

The treated effluent discharge flow rate into the Patea River was estimated at 50 L/s, showing no significant visual environmental effects at the point of discharge. The Patea River flow rate was recorded as 4.7 m^3/s at the Skinner Road site. Receiving water samples were collected upstream and downstream of the discharge point

Minimal odour was noted onsite, and was found mainly near the step screen flume shed area. Pond DO and saturation readings were found to be low, and this was attributed to only having 3 out of 4 aerators operating.

2.2. Results of effluent monitoring

Effluent analysis for dissolved oxygen (Section 2.2.1) and microfloral component (Section 2.2.2) was carried out at the outlet of the tertiary maturation cell on all four inspection occasions. Samples were also analysed for BOD, chloride, conductivity, faecal coliform bacteria, pH, suspended solids, turbidity, temperature, unionized ammonia (NH_3), ammonia-N (NH_4), nitrate-nitrite nitrogen (NNN), dissolved reactive phosphorus (DRP), and metal analyses on one occasion in early autumn. These results are presented in Table 1.

Table 1 Results of effluent monitoring for the Stratford WWTP

Site		OXP005002	
Date		21 Mar 2017	2009-2016 Range
Time		0845	
Parameter	Unit		
BOD	g/m^3	58	2.2-15.0
BODF	g/m^3	4.5	5.0-19.0
Chloride	g/m^3	23	11.7-35.2
Conductivity	mS/m@20°C	32.1	15.6-42.3
Faecal coliform bacteria	/100ml	7,400	270-14,000
pH	pH	7.6	7.1-8.8
SS	g/m^3	36	5.0-62
Turbidity	NTU	25	5.7-71
Temp	°C	18.4	6.2-21.9

Site		OXP005002	
Date		21 Mar 2017	2009-2016 Range
Time		0845	
Nutrient Analyses			
NH_3	g/m³ N	0.2421	0.04382-0.46990
NH_4	g/m³ N	14.5	0.870-25.4
NNN	g/m³ N	2.83	1.13-4.28
DRP	g/m³ P	2.2	1.02-5.80
Metal Analyses (acid soluble)			
Cadmium	g/m³	<0.005	<0.005-0.005
Chromium	g/m³	<0.03	<0.03-0.03
Zinc	g/m³	0.014	0.008-0.035
Appearance		turbid, green brown	

The tertiary cell effluent quality (Table 1) was typical of a well treated secondary oxidation pond waste with low filtered BOD_5 and moderate suspended solids levels and faecal coliform bacteria number. Nutrient levels were typical of the secondary oxidation pond treated effluent. Exceptions to these trends included total BOD which was four times higher than the previously recorded maximum, and chloride which remained elevated but within the range recorded since the upgrade.

Metal concentrations were less than minimum detectable levels, with the exception of zinc, which has consistently remained at low, but detectable, concentrations after a significant increase resulting from the disposal of galvanising wastes during August 1991 (see TRC 92-17). None of these metals' concentrations measured in the effluent at the time of the survey would be expected to exceed toxic levels for aquatic fauna given the dilution provided in the receiving waters of the Patea River.

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 Stratford WWTP effluent was analysed for DO and temperature, and the results are displayed in Table 2.

Table 2 Dissolved oxygen measurements from the Stratford WWTP

Date	Time (NZST)	Temperature (°C)	Chloride (g/m³)	Dissolved Oxygen	
				Concentration (g/m³)	Saturation (%)
2 Sept 2016	1030	12.4	16.5	3.5	34
28 Nov 2016	0845	14.3	14.3	3.7	38
21 Mar 2017	0845	18.4	23	6	66
17 May 2017	0845	11.8	14.5	0.96	9

Results in Table 2 indicate a moderately narrow range of DO concentrations (between 9 % and 66 % 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 dissolved oxygen variations. Mechanical aeration of the primary pond by up to 4 aerators (Photo 3) was operative on all inspection occasions.

Photo 3 View of Stratford WWTP primary pond with aerators operating

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 tertiary cell 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 maturation cell effluent analyses are provided in Table 3 together with field observations of pond appearance.

Table 3 Chlorophyll-a levels and tertiary cell appearance

Date	Time (NZST)	Appearance	Chlorophyll-a (mg/m^3)	Range for the period 2009-2016	
				Range	Median
2 Sept 2016	1030	Slightly turbid, light green brown	113	4.6-474	89
28 Nov 2016	0845	Slightly turbid, green brown	39		
21 Mar 2017	0845	Turbid, green brown	302		
17 May 2017	0845	Slightly turbid, pale green	70		

Relatively poor microfloral populations were indicated by low chlorophyll-a concentrations in early spring and late autumn, when dissolved oxygen saturation levels of 38 % and 9 % were measured respectively. These results have been attributed to wet weather conditions and stormwater dilution through the WWTP system. Late spring and summer concentrations were noticeably higher, indicating a significant phytoplanktonic component.

2.3. Results of receiving environment monitoring

Monitoring of the impacts of the Stratford WWTP on the receiving waters was measured using both chemical analyses of the receiving waters of the Patea River beyond the boundary of the mixing zone, and a biological monitoring survey at the same locations. Chemical sampling was carried out on four occasions during the 2016-2017 period (Section 2.3.1). One biomonitoring survey was conducted during autumn 2017 (Section 2.3.2). The locations of sampling sites are listed in Table 4 and displayed in Figure 1 below.

Table 4 Location of sampling sites

Site	Location	GPS Location	Site code
Patea River	At Swansea Road bridge (u/s of landfill and WWTP discharges)	E1711801 N5644382	PAT000315
Patea River	Approx. 250 m d/s of the WWTP original discharge (and 350 m u/s of the new outfall)	E1712748 N5644549	PAT000345
Tertiary cell effluent	At discharge point from rock riprap outfall	E1712834 N5644344	OXP005002

Site	Location	GPS Location	Site code
Patea River	Approx. 130 m d/s of the WWTP new outfall	E1713033 N5644266	PAT000350
Patea River	Approx. 1 km u/s of the Kahouri Stream confluence	E1714497 N5645112	PAT000356

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

2.3.1. Receiving water surveys of September 2016, November 2016, and May 2017

Receiving water samples were collected on the 2 September 2016, 28 November 2016, and 16 May 2017 at two sites in the Patea River, upstream and downstream of the Stratford WWTP discharge point. The results of these surveys are displayed in Table 5.

Table 5 Receiving water results September 2016, November 2016, and May 2017

Site		PAT000345				PAT000350			
Date		2 Sept 2016	28 Nov 2016	16 May 2017	2009-2016 Range	2 Sept 2016	28 Nov 2016	16 May 2017	2009-2016 Range
Time		1120	0925	0920		1150	0945	0950	
Parameter	Unit								
BODF	g/m³	<0.5	<0.5	<0.5	<0.5-0.6	<0.5	<0.5	<0.5	<0.5-0.8
Chloride	g/m³	9	7.5	9	7.5-11.8	9.2	7.6	10	7.6-10.0
pH	pH	7.6	7.3	7.5	7.3-8.2	7.5	7.3	7.5	7.3-7.8
Turbidity	NTU	0.84	0.9	0.72	0.5-4.1	1.3	1.2	1.2	0.7-4.8

Temp	°C	10.7	10.5	10.7	7.7-18.6	10.8	10.4	10.8	8.0-17.5
NH_3	g/m³ N	0.0005	0.0002	0.0006	0.0002-0.0019	0.0031	0.0011	0.0035	0.0006-0.0150
NH_4	g/m³ N	0.053	0.041	0.075	0.037-0.867	0.407	0.234	0.464	0.038-1.070

These results show that there were no significant effects noted in the Patea River as a result of the WWTP discharge. Filtered BOD_5 concentration was well within the 2.0 gm^2 limit imposed by Special Condition 11, as was unionised ammonia (NH3). There was one minor exceedance of the limit on turbidity (an increase of 67 %) between the two sites on the March 2017 sampling occasion. This result was indicative of the high organic wastes' loadings from the pond, which coincided with the lowest measured DO levels and only three of the four aerators operating.

2.3.2. Low flow receiving water survey of March 2017

A late summer low flow assessment of the impact of the WWTP's effluent discharge on the receiving waters of the Patea River was performed on 21 March 2017. River flow (at the Skinner Road recorder) was 1.973 m^3/s during a low recession flow period, nine days after a significant river fresh twenty two times over the median flow. The flow was above the average March mean monthly flow (0.40 m^3/s) but below the mean monthly flow (2.88 m^3/s) for the period 1978 to 2017. There was a moderate rate of discharge from the ponds system (estimated at approximately 15 L/s) at the time of the survey. The results of the survey are displayed in Table 6.

Table 6 Low flow receiving water results March 2017

	Site	PAT000315		PAT000345		PAT000350		PAT000356	
	Date	21 Mar 2017	2009-2016 Range	21 Mar 2017	2009-2016 Range	21 Mar 2017	2009-2016 Range	21 Mar 2017	2009-2016 Range
	Time	0810		0910		0955		1040	
Parameter	**Unit**								
Black disc	m	3.13	1.79-4.80	3.7	0.90-3.92	2.81	1.10-3.02	2.46	1.21-3.25
BOD	g/m³	<0.5	<0.5-0.5	<0.5	<0.5-3.8	3.6	0.6-3.6	2.7	0.6-3.5
BODF	g/m³	<0.5	<0.5-0.5	<0.5	<0.5-0.6	0.6	<0.5-0.8	<0.5	<0.5-0.8
Chloride	g/m³	8.6	8.0-10.5	8.9	7.50-11.8	9.1	7.60-10.0	9.4	8.8-12.3
Conductivity	mS/m @20°C	9.3	6.8-10.7	9.4	7.2-12.1	10.1	7.7-11.8	9.9	6.4-12.6
DO (concentration)	g/m³	10.2	8.70-10.8	10.2	8.40-10.6	10.2	9.20-10.3	10.7	8.3-11.4
DO (saturation)	%	101	91-102	101	86-108	102	96-104	108	87-119
Faecal coliform bacteria	/100ml	200	66-800	820	84-3,900	650	80-800	240	140-760
pH	pH	7.7	7.2-7.9	7.8	7.3-8.2	7.8	7.3-7.8	8.1	7.0-9.1
SS	g/m³	<2	2.0-13	<2	<2.0-7.0	<2	<2-5	2	1.0-15
Turbidity	NTU	0.74	0.58-3.60	0.9	0.54-4.10	1.4	0.74-4.80	1.4	0.88-10.0
Temp	°C	13.1	10.2-17.9	13.3	7.7-18.6	13.9	8.0-17.5	14.7	6.7-20.7
Nutrient Analyses									

Site		PAT000315		PAT000345		PAT000350		PAT000356	
Date		21 Mar 2017	2009-2016 Range	21 Mar 2017	2009-2016 Range	21 Mar 2017	2009-2016 Range	21 Mar 2017	2009-2016 Range
Time		0810		0910		0955		1040	
NH_3	g/m³ N	0.00009	<0.0005-0.00064	0.00067	0.0002-0.0019	0.00813	0.00055-0.01498	0.00484	0.00041-0.00630
NH_4	g/m³ N	0.006	<0.003-0.035	0.037	0.037-0.867	0.43	0.038-1.070	0.123	<0.003-0.324
NNN	g/m³ N	0.78	0.18-0.78	0.8	0.31-0.80	0.9	0.58-0.91	1.02	0.74-1.34
DRP	g/m³ P	0.033	0.007-0.057	0.03	0.018-0.200	0.103	0.031-0.243	0.082	0.024-0.310
Metal Analyses (dissolved)									
Cadmium	g/m³	<0.005	<0.005-0.005	<0.005	<0.005-0.005	<0.005	<0.005-0.005	<0.005	<0.005-0.005
Chromium	g/m³	<0.03	<0.003-0.003	<0.03	<0.03-0.03	<0.03	<0.03-0.03	<0.03	<0.03-0.03
Zinc	g/m³	<0.005	<0.005-0.010	<0.005	<0.005-0.007	<0.005	<0.005-0.007	<0.005	<0.005-0.006
Appearance		clear, uncoloured		clear, uncoloured		slightly turbid, light green brown		slightly turbid, green brown	

A dilution ratio of approximately twenty nine parts river flow to one part effluent discharge at the time of the sampling survey was indicated by reference to selected analytical results assuming complete mixing at the sampling site (PAT000350).

As a result of the large dilution afforded to the discharge, there was only a small decrease in clarity of the stream downstream of the discharge point as emphasised by the 24 % decrease in black disc clarity and a 36 % (0.5 NTU) increase in turbidity between sites. Nutrient concentrations increased between 11 % and 92 % for each parameter. No significant impacts on the river were recorded for the other parameters measured (Table 5) with minimal or no increases in measured levels of pH, conductivity, suspended solids, bacteria, and filtered BOD_5. These results were indicative of compliance with Special Conditions 8, 10, and 11 of the consent.

The river appearance was clear and uncoloured at the upstream sites, with only a slight noticeable visual impact downstream of the WWTP discharge. Dissolved oxygen concentrations exceeded 100 % saturation at all sites upstream and downstream of the discharge.

2.3.3. Biological monitoring survey

The biomonitoring survey associated with the receiving waters of the Patea River was performed on 22 March 2017 under moderately low flow conditions (approximately half median flow), nine days after a fresh in excess of three times median flow and 10 days after a fresh in excess of seven times median flow in the Patea River. Results of the biomonitoring survey are summarised in Table 7 and compared to data obtained from previous biomonitoring surveys between March 1987 and February 2016. The full report is presented in Appendix II.

Table 7 Results for March 2017 survey and comparison with data from February 1985 and December 2016

Site No.	No of taxa			MCI value			$SQMCI_s$ value		
	Median	Range	Current survey	Median	Range	Current survey	Median	Range	Current survey
1	26	20-33	20	110	98-130	120	6.1	3.2-7.6	7.1
2	24	11-36	25	106	96-119	116	5.8	3.6-7.8	7.1
3a	24	21-29	25	101	95-113	99	5.7	3.4-7.1	6.2
4	23	17-31	22	99	82-116	99	4.1	2.3-7.2	6.2

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

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

The MCI scores categorised site 1 as being in 'very good' health, site 2 as having 'good' health, and the two 'impact' sites (sites 3a and 4) as being of 'fair' health. There was only a minor decrease of four units between sites 1 and 2 indicating the old landfill site was not having an affect on stream macroinvertebrate communities. However, there was a significant decrease in MCI and $SQMCI_s$ scores between sites 2 and 3 coincident with the SDC WWTP discharge point. As both 'control' sites for the WWTP had similar MCI and $SQMCI_s$ scores and were both significantly higher than the two 'impact' sites this gives further certainty that water quality, as opposed to habitat differences, was the main cause of the changes. However, there were no undesirable heterotrophic growths or abundant periphyton found on the substrate at the two downstream sites' indicating that water quality was not of poor quality.

Overall, the results indicate that there was a significant drop in macroinvertebrate health, towards the lower end of significance, between sites 2 and 3a, coincident with discharges from the Stratford WWTP. There was no evidence that leachate from the closed Stratford landfill site had negatively affected macroinvertebrate communities.

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 SDC. 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 SDC 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 SDC's conditions in resource consents or provisions in Regional Plans for the Stratford WWTP.

3. Discussion

3.1. Discussion of site performance

The Stratford WWTP system has continued to perform satisfactorily, with aerobic conditions maintained and a generally high standard of treated wastewater discharged throughout the monitoring period. Effluent quality was of a good standard, particularly when diluted during wet weather conditions. Monitoring of the microfloral component of the tertiary cell of the secondary 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 and generally indicate an improvement in conditions in the tertiary cell since the last WWTP upgrade.

Screening of the outlet from the secondary oxidation pond was well maintained. The inlet system functioned as designed during the monitoring period, and any overflows from the inlet following heavy rainfall were contained and directed into the primary pond. Longer term remedial work to the reticulation system will provide additional capacity and be necessary to markedly reduce stormwater reticulation infiltration. These measures have been identified and planned by the consent holder in conjunction with the system upgrades required by the renewed consent.

Trade wastes controls placed by SDC on the usage of the system by industrial tanker wastes continue to require monitoring by the consent holder, due to the nature and/or source of wastes being discharged to the system. No major problems with this aspect of the waste disposal to the WWTP occurred during the monitoring year. Disposal of treated wastes from the regional stockyard through the pond system had no apparent impact on the system's performance. Capacity remains for additional waste loadings to the system, provided that hydraulic issues associated with the inflow volumes and outflow reticulation can be resolved.

3.2. Environmental effects of exercise of consents

No impacts of the discharge were recorded on the physical and chemical quality of the Patea River during the late summer low flow survey. Localised and moderate increases in nutrients were recorded downstream of the rock riprap outfall, mitigated to a certain extent by the effluent quality which was of a good standard at the time of the survey. Some discolouration of the receiving water occurred downstream of the discharge, but this did not extend beyond the permitted mixing zone.

The late summer macroinvertebrate fauna survey showed some impacts of the discharge beyond the permitted mixing zone under moderately low flow conditions. No significant heterotrophic growths were found on the substrate of the riverbed and all effluent metal concentrations were low with levels unlikely to cause problems to the biota. Increases in benthic periphyton cover continue to be recorded at two sites in the Patea River downstream of the discharge over spring to late summer/autumn in recent receiving water surveys. This data will contribute to the evaluation of options for future upgrades to the WWTP.

Three additional seasonal receiving water monitoring surveys found compliance with most special conditions of the consent in each occasion. Some increases in turbidity in the Patea River were recorded during the late autumn survey, when very low dissolved oxygen conditions indicated high organic wastes' loadings on the system. This contributed to elevated turbidity levels above the compliance limit on one occasion, under moderate dilution conditions in the relatively low flow of the river.

3.3. Evaluation of performance

A tabular summary of SDC's compliance record for the year under review is set out in Table 8.

Table 8 Summary of performance for consent 0196-4

Purpose: ***To discharge treated wastewater from the Stratford Wastewater Treatment Plant into the Patea River***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Adopt best practicable option	Inspection and chemical sampling	Yes
2. Limits on the discharge volume	Inspection, records	Yes
3. Requirements of Inflow and Infiltration Reduction programme	Inspection, liaison with consent holder	Yes
4. Requirements of Management Plan	Inspection, liaison with consent holder	Yes
5. Aerobic conditions to be maintained in ponds	Inspection and chemical sampling	Yes
6. Trade wastes connections	Liaison with consent holder	Yes
7. Limits on receiving water effects	Inspection and chemical sampling	Yes
8. Limits on turbidity	Chemical sampling	No – 3 of 4 surveys compliant
9. Monitoring provisions	Performance of tailored monitoring programme	Yes
10. Requirements for nutrient monitoring	Performance of tailored monitoring programme	Yes
11. Limits on unionised ammonia and filtered BOD in receiving waters	Chemical sampling	Yes
12. Issues and Options report provided to Council before 30 June 2015	Report provided	Yes
Overall assessment of consent compliance and environmental performance in respect of this consent Overall assessment of administrative performance in respect of this consent		**Good** **High**

N/A = not applicable

Table 9 Evaluation of environmental performance over time

Year	High	Good	Improvement req	Poor
2000	1			
2001	1			
2002	1			
2003	1			
2004			1	
2005	1			
2006		1		
2007		1		
2008			1	
2009		1		
2010		1		
2011		1		
2012		1		
2013		1		
2014		1		
2015		1		
2016		1		
Totals	5	10	2	

During the year, SDC demonstrated a good level of environmental and high level of administrative performance with the resource consents as defined in Section 1.1.4. Improvement was recorded with aspects of the WWTP operation, and requirements for improvements to wastewater treatment had been addressed by considering upgrades of the system to meet RMA requirements coincident with the short-term renewed consent for the current period. No complaints relating to odour from any of the facilities were received.

Problems that had been experienced with the hydraulic loadings on the system during previous periods were adequately managed by SDC during the period. Reduction in secondary pond algal blooms and subsequent discharge impacts have been partially addressed by the most recent upgrade. Issues with aspects of trade wastes disposal to the sewerage reticulation at the Esk Road facility which had been the subject of public complaint were maintained adequately during the period with no further issues.

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 Stratford 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 made available by previous authorities;
- its relevance under the RMA;
- its obligations to monitor emissions/discharges and effects under the RMA; and
- to report to the regional community.

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

It is proposed that for 2017-2018, monitoring of the Stratford 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 Stratford 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.
COD	Chemical oxygen demand. A measure of the oxygen required to oxidise all matter in a sample by chemical reaction.
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
Zn*	Zinc.

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

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

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Appendix I

Resource consent held by Stratford 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:	Stratford District Council P O Box 320 STRATFORD 4352
Decision Date:	23 October 2013
Commencement Date:	14 November 2013

Conditions of Consent

Consent Granted:	To discharge treated wastewater from the Stratford Wastewater Treatment Plant into the Patea River
Expiry Date:	1 June 2016
Site Location:	Victoria Road, Stratford
Legal Description:	Lot 1 DP 9529 Lots 7, 8, 9 & 10 DP 1942 Blk II Ngaere SD (Discharge source & site)
Grid Reference (NZTM)	1712836E-5644349N
Catchment:	Patea

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

General condition

a. The consent holder shall pay to the Taranaki Regional Council 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 of the discharge on the environment.

2. The volume of treated wastewater discharge shall not exceed 4,800 cubic metres per day, unless there has been a total of more than 10 mm of rain over the previous three days (as measured by the Taranaki Regional Council rain gauge at Stratford).

3. The consent holder shall implement an inflow and infiltration reduction programme to minimise the stormwater inflow to the ponds. The programme shall include taking all practicable actions to ensure that all unauthorised stormwater connections to the sewage reticulation system are removed and remain disconnected. The consent holder shall report on progress under this condition to the Chief Executive, Taranaki Regional Council, by 30 June each year.

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

   a) the operation of the wastewater treatment plant;

   b) the build up of sludge in the ponds; and

   c) stormwater and groundwater infiltration into the sewerage system.

5. The oxidation ponds shall be maintained in aerobic conditions at all times during daylight hours.

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

7. After allowing for reasonable mixing, being a mixing zone extending from the discharge point, to a point 50 metres downstream of the discharge point, the discharge shall not give rise to any of the following effects in the receiving waters of the Patea River:

   a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;

   b) any conspicuous change in the colour or visual clarity;

   c) any emission of objectionable odour;

   d) any significant adverse effect on aquatic ecosystems.

8. After allowing for reasonable mixing within a mixing zone extending 50 metres downstream of the discharge point, the discharge shall not give rise to an increase in turbidity of more than 50% (as determined using NTU (nephelometric turbidity units)) in the Patea River.

9. The consent holder shall, in conjunction with the Taranaki Regional Council, undertake chemical, bacteriological and ecological monitoring of the oxidation pond system and Patea River as deemed reasonably necessary by the Chief Executive, Taranaki Regional Council subject to Section 36 of the Resource Management Act 1991. That monitoring shall include wastewater quality monitoring to provide for an assessment of possible further upgrade requirements in relation to potential impacts on the biological communities of the receiving water.

10. The monitoring, evaluation and assessment required by condition 9 shall specifically include monitoring, evaluation and assessment of dissolved reactive phosphorus (DRP) and other nutrient-species.

11. After allowing for reasonable mixing, being a mixing zone extending from the discharge point, to a point 50 metres downstream of the discharge point, the discharge shall not cause the receiving waters of the Patea River to exceed the following concentrations:

Contaminant	**Concentration**
Unionised ammonia	0.025 gm^{-3}
Filtered carbonaceous BOD_5	2.0 gm^{-3}

12. Before 30 June 2015 the consent holder shall provide to the Chief Executive, Taranaki Regional Council a report detailing issues and options for the Stratford Wastewater Treatment Plant.

    The report shall document the environmental effects of the discharge from the Stratford Wastewater Treatment Plant, and set out the options available to address the effects on the receiving environment resulting from the discharge.

    The report shall be to the reasonable satisfaction of the Chief Executive, Taranaki Regional Council and shall, as a minimum, address the following:

    a) the environmental effects of discharge on the Patea River, including water quality, periphyton growth and aquatic biota;

    b) options available for further treatment of wastewater from Stratford, giving particular emphasis to the reduction of nutrients in the discharge; and

    c) detail the: costs; expected levels of reduction in adverse effects; and practical implications of introducing each option to the Stratford wastewater treatment system.

Signed at Stratford on 23 October 2013

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

Appendix II

Biomonitoring report

To	Technical Officer, Rae West
From	Scientific Officer, Darin Sutherland
Doc No	1901402
Report No	DS071
Date	19 July 2017

Summer biomonitoring of the Patea River in relation to the Stratford District Council's upgraded Wastewater Treatment Plant, March 2017

Introduction

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

Methods

The standard '400 ml kick sampling' technique was used to collect streambed (benthic) macroinvertebrates from three established sites and one more recently established site (listed in Table 1 and illustrated in Figure 1 and Figure 2) in the Patea River, on 22 March 2017.

Table 1 Location of sampling sites in the Patea River

Site No	Site code	Grid reference	Location
1	PAT000315	E1711801 N5644382	Swansea Road bridge (upstream of landfill and oxidation ponds' discharge)
2	PAT000330	E1712403 N5644580	Upstream of WWTP discharge (and downstream of landfill)
3a	PAT000350	E1712956 N5644292	Approximately 130 m downstream of the WWTP new outfall
4	PAT000356	E1714497 N5645112	Approximately 1 km upstream of the Kahouri Stream confluence

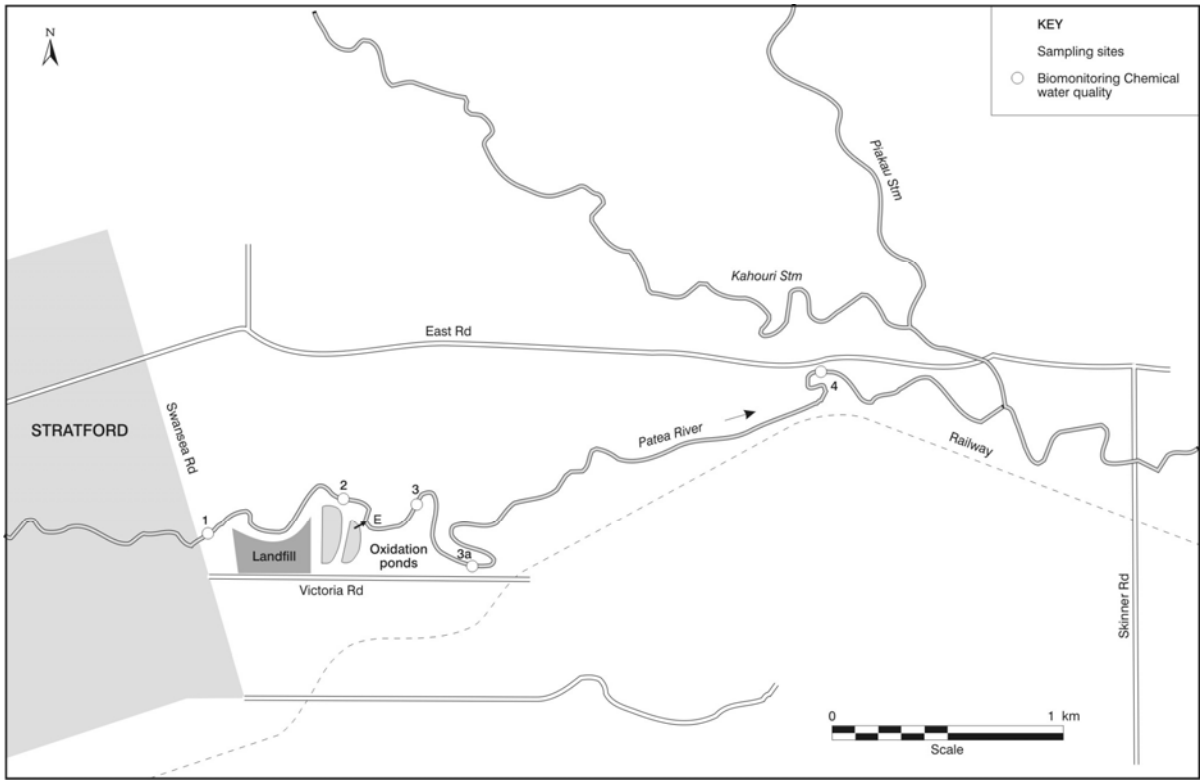


Figure 1 Biomonitoring sites in the Patea River in relation to Stratford landfill and oxidation ponds discharge

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

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

Samples were preserved with Kahle's Fluid for later stereomicroscopic sorting and identification according to documented Taranaki Regional Council methodology and macroinvertebrate taxa abundances scored based on the categories in Table 2.

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+

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

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 (Table 3). More 'sensitive' communities inhabit less polluted waterways. A difference of 11 units or more in MCI values is considered significantly different (Stark 1998).

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

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

Results

Site habitat characteristics and hydrology

This summer survey was performed under moderately low flow conditions (approximately half median flow), 9 days after a fresh in excess of 3 times median flow and 10 days after a fresh in excess of 7 times median flow in the Patea River (flow gauging site at the Patea River at Skinner Road). The survey followed a relatively wet spring period but during the last month was relatively dry with only one significant fresh recorded over the preceding month.

The water temperatures during the survey were in the range 14.5-15.9 °C. Water levels were low and water speed was swift. The water was uncoloured and clear. The substrate at all four sites comprised gravel/cobble/boulder.

Sites 1 and 3a had patchy algal mats, moss, and leaves. Sites 2 and 4 had slippery algal mats and patchy moss and leaves.

Macroinvertebrate communities

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

Table 4 Summary of macroinvertebrate taxa numbers and MCI values for previous surveys performed between February 1985 and December 2016 and 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	48	26	20-33	20	110	98-130	120	6.1	3.2-7.6	7.1
2	34	24	11-36	25	106	96-119	116	5.8	3.6-7.8	7.1
3a	10	24	21-29	25	101	95-113	99	5.7	3.4-7.1	6.2
4	44	23	17-31	22	99	82-116	99	4.1	2.3-7.2	6.2

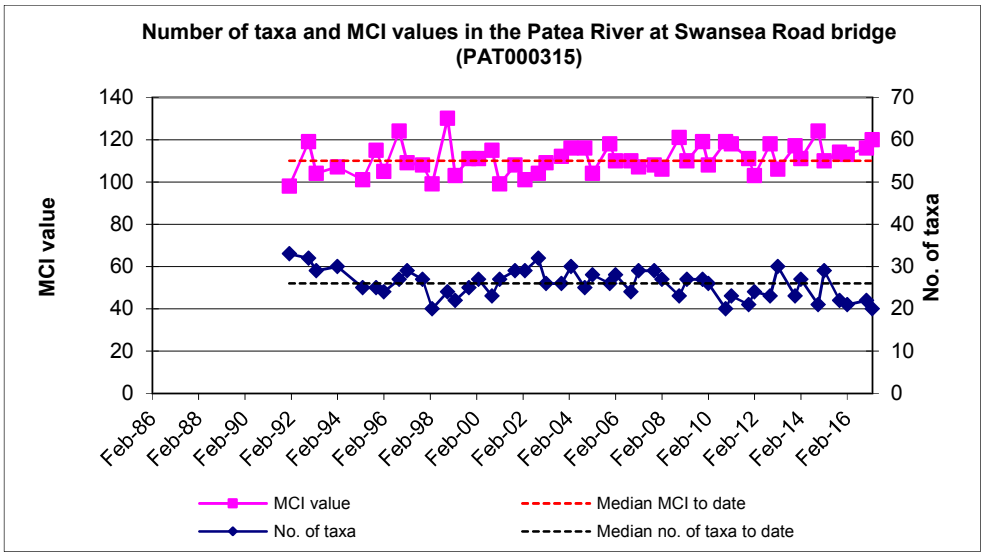
Survey results since February 1986 are illustrated in Figure 2, while the results of the current survey are presented in Table 2 and discussed beneath.

Table 5 Macroinvertebrate fauna of the Patea River in relation to SDC WWTP discharge on the 22 March 2017

Taxa List	Site Number	MCI score	1	2	3a	4
	Site Code		PAT000315	PAT000330	PAT000350	PAT000356
	Sample Number		FWB17202	FWB17203	FWB17204	FWB17205
ANNELIDA (WORMS)	Oligochaeta	1	R	R	C	R
HIRUDINEA (LEECHES)	Hirudinea	3	-	-	R	-
MOLLUSCA	*Potamopyrgus*	4	R	-	-	-
CRUSTACEA	Cladocera	5	-	-	C	-
	Talitridae	5	-	-	R	-
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	C	-	C	R
	Coloburiscus	7	VA	VA	A	C
	Deleatidium	8	VA	XA	VA	VA
	Nesameletus	9	VA	VA	A	-
	Zephlebia group	7	R	-	-	R
PLECOPTERA (STONEFLIES)	*Zelandoperla*	8	R	R	-	R
COLEOPTERA (BEETLES)	Elmidae	6	A	A	A	C
	Hydraenidae	8	C	A	C	R
	Ptilodactylidae	8	-	R	-	-
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	A	A	C	C
TRICHOPTERA (CADDISFLIES)	*Hydropsyche (Aoteapsyche)*	4	VA	VA	A	A
	Costachorema	7	C	C	C	C
	Hydrobiosis	5	R	C	C	R
	Neurochorema	6	C	R	-	-
	Beraeoptera	8	VA	A	C	-
	Confluens	5	-	C	R	C
	Helicopsyche	10	-	R	-	-
	Olinga	9	-	C	-	-
	Oxyethira	2	-	-	-	R
	Pycnocentrodes	5	C	A	A	C
	Triplectides	5	R	-	-	-
DIPTERA (TRUE FLIES)	*Aphrophila*	5	C	VA	C	R
	Eriopterini	5	-	R	-	-
	Chironomus	1	-	-	R	-
	Maoridiamesa	3	-	-	C	A
	Orthocladiinae	2	-	C	A	C
	Tanytarsini	3	-	R	C	C
	Empididae	3	-	R	-	R
	Ephydridae	4	-	-	R	-
	Muscidae	3	R	R	C	R
	Austrosimulium	3	-	R	C	C
	No of taxa		20	25	25	22
	MCI		120	116	99	99
	SQMCIs		7.1	7.1	6.2	6.2
	EPT (taxa)		13	13	10	10
	%EPT (taxa)		65	52	40	45

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

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



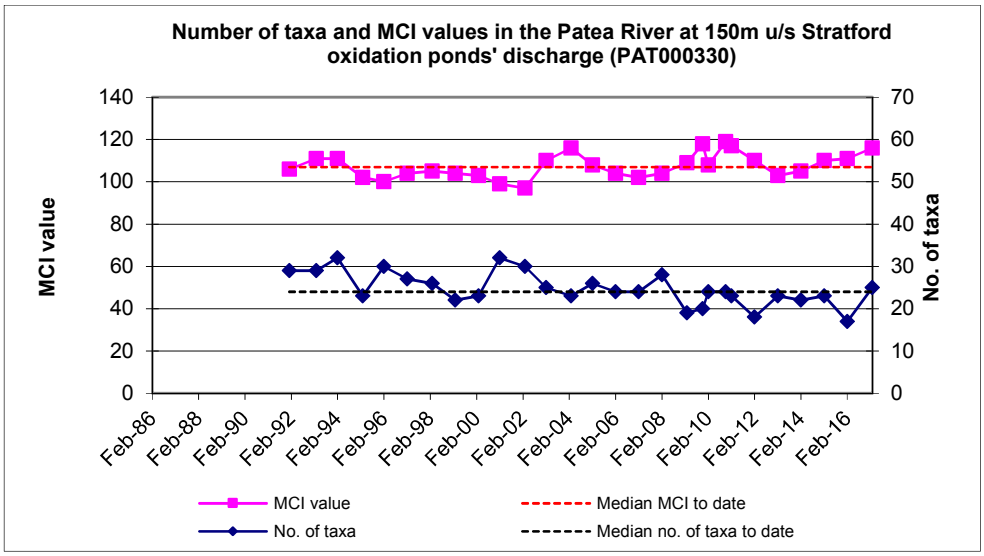
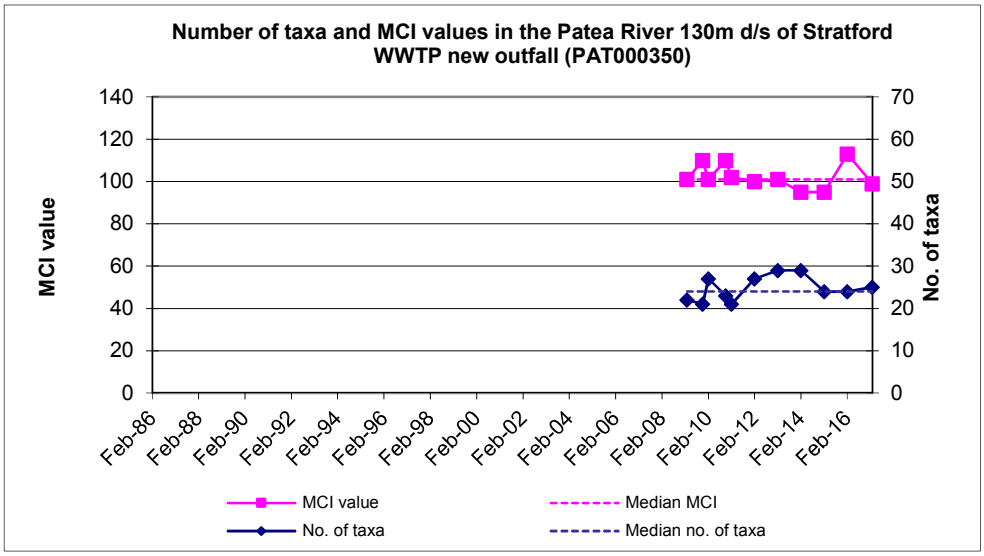


Figure 2 Taxa richness and MCI scores recorded to date at the Patea River sites upstream of the WWTP discharge



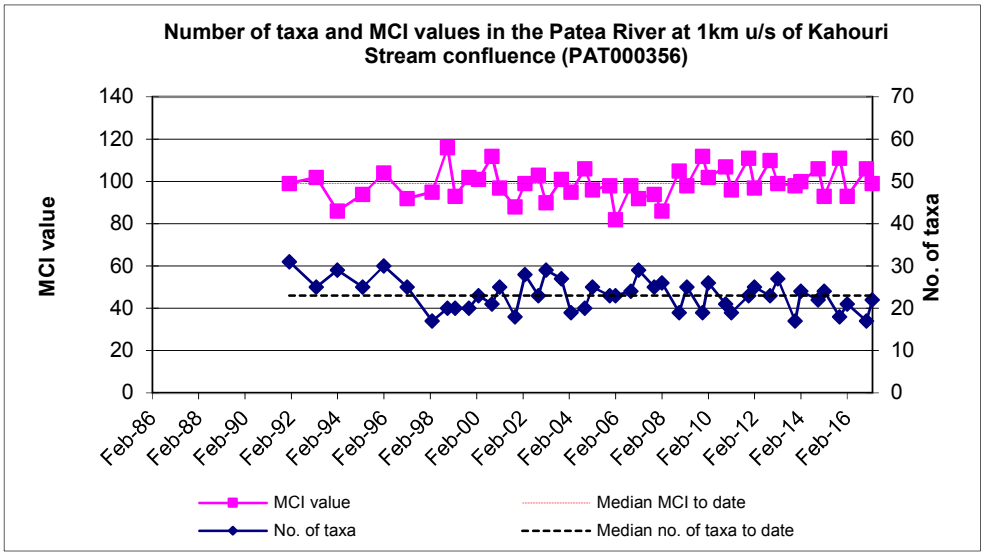


Figure 3 Taxa richness and MCI scores recorded to date at the Patea River sites downstream of the WWTP discharge

Site 1 (Swansea Road)

A moderate macroinvertebrate community richness of 20 taxa was found at site 1 ('primary control' site) at the time of this summer survey (Table 1). This was five taxa more than the previous survey on December 2016 (22 taxa) and six taxa less than the historic median (26 taxa).

The MCI score of 120 units indicated a community of 'very good' biological health which was not significantly different (Stark, 1998) to the median MCI score of 110 units and to the preceding survey on December 2016 (116 units).

The $SQMCI_S$ score of 7.1 units was significantly higher than the median $SQMCI_S$ score of 6.1 units (Table 1) but not significantly different to the preceding survey (7.6 units).

The community was dominated by one 'tolerant' taxon [caddisfly (*Hydropsyche/Aoteapsyche*)], three moderately sensitive taxa [mayfly (*Coloburiscus*), elmid beetles and dobsonfly (*Archichauliodes*)] and three 'highly sensitive' taxa [mayflies (*Deleatidium*) and (*Nesameletus*), and caddisfly (*Beraeoptera*)] (Table 5).

Site 2 (upstream of original oxidation ponds outfall)

A moderately low macroinvertebrate community richness of 25 taxa was found at site 2 ('secondary control' site) at the time of the survey (Table 1). This was eight taxa more than the previous survey on December 2016 (17 taxa) and one taxon more than the historic median (24 taxa).

The MCI score of 116 units indicated a community of 'good' biological health which was not significantly different (Stark, 1998) to the median MCI score of 106 units. The MCI score was very similar to the preceding survey on February 2016 (111 units).

The SQMCIS score of 7.1 units was significantly higher than the median SQMCIS score of 5.8 units (Table 1) but not significantly different to the preceding survey (6.9 units).

The community was dominated by one 'tolerant' taxon [caddisfly (*Hydropsyche/Aoteapsyche*)], five moderately sensitive taxa [mayfly (*Coloburiscus*), elmid beetles, dobsonfly (*Archichauliodes*), caddisfly (*Pycnocentrodes*) and cranefly (*Aphrophila*)] and four 'highly sensitive' taxa [mayflies (*Deleatidium*) and (*Nesameletus*), beetle (Hyraenidae), and caddisfly (*Beraeoptera*)] (Table 5).

Site 3a (130m downstream of new WWTP riprap outfall)

A moderate macroinvertebrate community richness of 25 taxa was found at site 3a ('primary impact' site) at the time of the survey (Table 1). This was one taxon more than the previous survey on February 2016 (24 taxa) and the historic median (24 taxa).

The MCI score of 99 units indicated a community of 'fair' biological health which was not significantly lower (Stark, 1998) than the median MCI score of 101 units. The MCI score was significantly lower than the preceding survey on February 2016 (113 units).

The $SQMCI_S$ score of 5.0 units was not significantly lower than the median $SQMCI_S$ score of 5.7 units (Table 1).

The community was dominated by two 'tolerant' taxa [caddisfly (*Hydropsyche/Aoteapsyche*) and midge (*Maoridiamesa*)], three moderately sensitive taxa [mayfly (*Coloburiscus*), elmid beetles, and caddisfly (*Pycnocentrodes*)] and two 'highly sensitive' taxa [mayflies (*Deleatidium*) and (*Nesameletus*)] (Table 5).

Site 4 (upstream of discharge at East Road)

A moderate macroinvertebrate community richness of 22 taxa was found at site 4 ('secondary impact' site) at the time of the survey (Table 4). This was five taxa more than the previous survey on December 2016 (17 taxa) and one taxon less than the historic median (23 taxa).

The MCI score of 99 units indicated a community of 'fair' biological health which was the same as the historic median MCI score of 99 units. The MCI score was not significantly lower than the preceding survey (106 units).

The $SQMCI_S$ score of 6.2 units was significantly higher than the median $SQMCI_S$ score of 4.1 units (Table 4) but not significantly different to the preceding survey (6.9 units).

The community was dominated by two 'tolerant' taxa [caddisfly (*Hydropsyche – Aoteapsyche*) and midge (*Maoridiamesa*)] and one 'highly sensitive' taxon [mayfly (*Deleatidium*)] (Table 5).

Riverbed heterotrophic growth assessment

Microscopic assessment of material from the riverbed at the four sampling sites indicated that there were no unusual heterotrophic growths present in the river at the two upstream and two downstream sites. This was consistent with the visual absence of such growths noted at all sites at the time of the survey.

Discussion and conclusions

Macroinvertebrate richnesses were moderate and similar to historical medians for all sites. Differences among sites were not particularly large (0-5 taxa). Often, nutrient enrichment can raise taxa numbers in rivers with relatively good water quality but there was no evidence of that for the current survey.

The MCI scores categorised site 1 as being in 'very good' health, site 2 as having 'good' health, and the two 'impact' sites (sites 3a and 4) as being of 'fair' health. MCI were either similar to or not significantly higher than historic medians for all sites. There was only a minor decrease of four units between sites 1 and 2 indicating the old landfill site was not having an affect on stream macroinvertebrate communities. However, there was a significant decrease in MCI score between sites 2 and 3 of 17 units coincident with the SDC WWTP discharge point. As both 'control' sites for the WWTP had similar MCI scores and were both significantly higher than the two 'impact' sites (sites 3a and 4) this gives further certainty that water quality as opposed to habitat differences was the main cause of the changes. It should be noted that Site 4, as mentioned in a previous report (DS059), is a considerable distance downstream of the discharge point and therefore is not located in a particularly useful site to detect minor or moderate effects of WWTP discharges.

$SQMCI_S$ scores were higher than historical medians for sites 1, 2 and 4 but not site 3a which had a slight, non-significant rise. Congruent with the MCI scores, there was a significant decrease in $SQMCI_S$ scores between sites 2 and 3a further indicating that there was a decrease in water quality between the two sites.

Microscopic assessment of material from the riverbed at the four sampling sites indicated that there were no unusual heterotrophic growths present in the river at the two upstream and two downstream 'impact' sites. This was consistent with the visual absence of such growths noted at all sites at the time of the survey. This indicates that there was no highly significant, persistent nutrient enrichment from the WWTP discharges. This is further emphasised by the lack of widespread periphyton at both 'impact' sites though recent freshes would also potentially reduce periphyton levels. Also, site 3a had high numbers of two 'highly sensitive' mayfly species. *Deleatidium* can sometimes be a poor indicator of water quality as some species within the genus have lower water quality preferences, *Nesameletus*, however, with a tolerance value of 9, is a more reliable indicator, and its abundance at site 3a suggests reasonable preceding water quality at the site.

Overall, the results indicate that preceding water quality in the upper Patea River was higher than average leading to healthier than normal macroinvertebrate communities at sites 1 and 2. However, there was a significant drop in macroinvertebrate health indicative of mild nutrient enrichment and towards the lower end of significance, between sites 2 and 3a, coincident with discharges from the Stratford WWTP. There was no evidence that leachate from the closed Stratford landfill site had negatively affected macroinvertebrate communities.

Recommendations that could improve the monitoring programme to allow stronger conclusions about potential affects include shifting site 4 or adding an additional site closer to the discharge point and given the size of the point source discharge spring monitoring would also be beneficial.

Summary

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

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

The MCI scores categorised site 1 as being in 'very good' health, site 2 as having 'good' health, and the two 'impact' sites (sites 3a and 4) as being of 'fair' health. There was only a minor decrease of four units between sites 1 and 2 indicating the old landfill site was not having an affect on stream macroinvertebrate communities. However, there was a significant decrease in MCI and $SQMCI_s$ scores between sites 2 and 3 coincident with the SDC WWTP discharge point. As both 'control' sites for the WWTP had similar MCI and $SQMCI_s$ scores and were both significantly higher than the two 'impact' sites this gives further certainty that water quality, as opposed to habitat differences, was the main cause of the changes. However, there were no undesirable heterotrophic growths or abundant periphyton found on the substrate at the two downstream sites' indicating that water quality was not of poor quality.

Overall, the results indicate that there was a significant drop in macroinvertebrate health, towards the lower end of significance, between sites 2 and 3a, coincident with discharges from the Stratford WWTP. There was no evidence that leachate from the closed Stratford landfill site had negatively affected macroinvertebrate communities.

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