Stratford District Council
Municipal oxidation ponds system
Monitoring Programme
Annual Report
2013-2014

Technical Report 2014-14

ISSN: 0114-8184 (Print)
ISSN: 1178-1467 (Online)
Document: 1356186 (Word)
Document: 1367787 (Pdf)

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July 2014

Executive summary

The Stratford District Council operates the Stratford municipal oxidation ponds system located to the east of Stratford in the Patea catchment. The Stratford District Council holds a renewed resource consent to allow it to discharge treated wastewater to the Patea River. This report for the period July 2013 to June 2014 describes the monitoring programme implemented by the Taranaki Regional Council to assess the environmental performance during the period under review, and the results and effects of the content holder's activities.

The resource consent was renewed in June 2013 for a short 3 year duration and included a total of 12 special conditions setting out the requirements that the Stratford District Council must satisfy. The previous short term (5 year) consent was granted in April 2008 and was conditional upon a staged upgrade of the treatment system and subsequent extensive (two year) monitoring of the effectiveness of the upgrade prior to addressing issues and options relating to longer term upgrades to the system. This upgrade involved aeration of the primary pond, division of the second pond into three cells, provision of a sub-surface outlet, and relocation and construction of a new rock riprap outfall, and was completed within the requisite time frame. More intensive monitoring commenced in September 2009 to assess the performance of the significant WWTP upgrade and this contractual monthly programme was completed in August, 2011. However, further receiving water investigations, specifically in relation to riverbed periphyton impacts, were recognised as fundamental to a more complete assessment of upgrade requirements. This resulted in a further short-term consent renewal (three years) to allow for this contractual work to be completed and evaluated. The reduction of stormwater infiltration entering the reticulation, remains an issue to be minimised, with some overflow issues occurring during the monitoring period, due mainly to excessive inflows at the inlet of the plant. Remedial work undertaken to improve the hydraulic capacity of the new outlet and outfall design together with additional sealing of the second pond's cells' walls has been successful in preventing seepage to adjacent pasture land.

The Council's monitoring programme included four regular inspections, wastewater analyses, and physicochemical and biological surveys of the receiving waters of the Patea River.

In recent years improvements in the consent holder's maintenance programme have generally enhanced the appearance of, and controlled odour from, the system. For the sixth year in succession, no odour complaints were received from neighbouring property owners during the monitoring period coincident with the plant upgrade. Neither were any problems of surface scum accumulation and associated nuisance odours recorded during the period.

Stricter control of industrial waste tanker disposal was instigated by the District Council more than sixteen years ago, and a more appropriate relocation of the tanker disposal area to provide better control of this activity and fewer operational problems for the treatment system was initiated and completed toward the end of the 2008-2009 period. However, some remedial measures and upgrades to this facility were required to alleviate localised problems at this site. No problems were experienced with this site during the 2013-2014 period. Liaison with the Regional Council has continued whenever uncertainties have existed with respect to proposed additional industrial loadings.

Regular inspections indicated no immediate problems with the oxidation ponds system's performance, with no overflows to land or adjacent stormwater drains, following very wet weather as a direct consequence of re-engineered bunding and cell wall upgrades. Seasonal variability in secondary pond microfloral populations (as indicated by chlorophyll-concentrations) was also influenced by preceding wet-weather stormwater infiltration. Wastewater quality was good at the time of the low flow late summer receiving water physicochemical monitoring survey with a moderate algal wastewater component. The survey found some impacts of the discharge via the newly located outfall on water quality at sites downstream of the permitted mixing zone in the Patea River, mainly related to increases in nutrient loadings and turbidity under low receiving water flow conditions, the latter non-compliant with aesthetic consent conditions. A late summer biomonitoring survey found localised impacts upon the macroinvertebrate fauna despite improvements in aspects of the quality of the treated wastewater.

Overall, operational performance of the upgraded system and the environmental performance showed improvements with the additional remedial works successful in coping with hydraulic overloads resulting in good environmental compliance during the monitoring year. Issues of high hydraulic loadings will continue to need addressing in the longer term by appropriate stormwater infiltration measures. These improvements were addressed by conditions of the previously renewed consent, in particular the upgrade of the wastewater treatment system which was completed by mid 2009. Performance of the plant was also the subject of a more intensive two-year monitoring programme (required by specific consent conditions and completed in August, 2011) to ascertain the effectiveness of the upgrade and further assess impacts upon the receiving waters of the Patea River. Additional contractual receiving water periphyton work was identified as essential for consideration of WWTP upgrade options and this work has now been completed.

Late in the 2011-2012 period, the consent holder had presented a report in partial fulfilment of the previous consent requirement to detail issues and options relating to the effects of the upgraded plant's discharge on the receiving environment and the options for further upgrades to the treatment system. The latter was required to give particular emphasis to nutrient reduction in the wastewater discharge which necessitated that the additional periphyton receiving environment work was performed in order for the report to be finalised. This report is now required by 1 June 2015 as a condition of the recently renewed consent which will now expire at 1 June 2016.

Recommendations include continuation of a similar basic monitoring programme over the 2014-2015 period and requirements relating to operation and maintenance of the treatment ponds system and liaison with the Taranaki Regional Council.

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1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is the Annual Report for the period July 2013 to June 2014 by the Taranaki Regional Council describing the monitoring programme associated with the recently renewed resource consent held by Stratford District Council for the Stratford municipal oxidation ponds' system (see Appendix I), which expires on 1 June 2016.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consent held by Stratford District Council relating to the discharge of treated wastes into the Patea River. This is the twenty-seventh annual report to be prepared by the Taranaki Regional Council to cover this 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 compliance monitoring under the Resource Management Act and the Council's obligations and general approach to monitoring sites through annual programmes, the resource consents held by Stratford District Council 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 in the Patea catchment.

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

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

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

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

1.1.3 The Resource Management Act (1991) and monitoring

The Resource Management Act primarily addresses environment 'effects' which are defined as positive or adverse, temporary or permanent, past, present or future, or cumulative. Effects may arise in relation to:

- the neighbourhood or the wider community around a discharger and may include cultural and socio-economic effects;
- physical effects on the locality, including landscape, amenity and visual effects;
- ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;

- natural and physical resources having special significance (e.g. recreational, cultural, or aesthetic);
- risks to the neighbourhood or environment.

In drafting and reviewing conditions on discharge permits, and in implementing monitoring programmes, the Taranaki Regional Council is recognizing the comprehensive meaning of 'effects' inasmuch as is appropriate for each discharge source. Monitoring programmes are not only based on existing permit conditions, but also on the obligations of the Resource Management Act to asses the effects of the exercise of consents. In accordance with section 35 of the Resource Management Act 1991, the Council undertakes compliance monitoring for consents and rules in regional plans; and maintains an overview of performance of resource users against regional plans and consents. Compliance monitoring, including impact monitoring, also enables the Council to continuously assess its own performance in resource management as well as that of resource users particularly consent holders. It further enables the Council to continually re-evaluate its approach and that of consent holders to resource management, and, ultimately, through the refinement of methods, to move closer to achieving sustainable development of the region's resources.

1.1.4 Evaluation of environmental performance

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

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

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

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

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

1.2 Treatment plant system

Stratford town sewage was treated by a twin oxidation ponds system (2.6 ha and 1.7 ha in area), designed and constructed in 1965 for a population of 6300 persons and operative in that format until upgraded in 2009. Some industrial wastes are also discharged into the system, which included an influent splitter chamber at the end of the main town trunk sewer.

This chamber provided for splitting of the raw sewage influent to flow into either, or both ponds, but this provision was only intended for utilisation when excessive stormwater infiltration may have caused an overflow directly to the second pond. The final outfall (from the second pond) was to the Patea River. However, the connection between the two ponds and the outlet to the river were originally positioned directly opposite each other, thereby having the potential to short-circuit and reduce retention time in the second pond. The consent holder re-sited the final outlet to the south of the original outlet during 1998-1999 to provide improved retention in the secondary pond. Prior to the 2000-2001 monitoring period no significant sludge accumulation had been detected in the pond's system, although only one intensive survey had been performed, fifteen years after commissioning of the treatment system. However, following significant primary pond surface scum problems recorded late in 2000, the consent holder obtained a consultant's report which indicated that considerable sludge accumulation had occurred in the primary pond in particular. Temporary work was necessary to alleviate the immediate surface scum problem, with local burial covering of the sludge. Longer term de-sludging of the pond system required detailed planning by the consent holder with the Taranaki Regional Council and was programmed for the latter part of the 2003-2004 period in accordance with an air emission consent (6262) granted specifically for this purpose. The de-sludging operation was performed during the 2004-2005 period (TRC, 2005 and TRC, 2006), after which the consent was surrendered.

In the 2000-2001 period the consent holder installed influent flow recording at the entrance to the system as the first stage of an assessment of pond loadings and performance, including stormwater infiltration to the system. This information, together with more frequent monitoring of effluent quality (which commenced under contract to the consent holder in the 2001-2002 period) provided the consent holder with data relating to the optimisation of the existing ponds' system and determination of further tertiary treatment options. Further reconstruction of the influent chamber was undertaken during the 1999-2000 period with the longer-term intention of elimination of the influent splitting facility. A building to house the area was constructed during the 2000-2001 period.

Renewal of the grating system on the original outlet from the second pond was undertaken in late 1999. This outlet was then sealed but was raised and re-opened in 2004 and was utilised whenever stormwater infiltration volumes increase effluent rates beyond the capacity of the re-positioned outlet.

Connection of the new saleyards' partially treated wastes into the sewerage reticulation was approved during the 2002-2003 period and has operated without problems since the saleyards were commissioned.

Construction of a new step screen on the influent line to the ponds system was completed in 2005, as a component of the upgrade, but was de-commissioned for a period in 2006-2007 due to blockage problems thought to be linked with industrial waste tanker usage of the system. Waterblasting of the main reticulation upstream of the step-screen was only partially successful in alleviating this problem, necessitating relocation of the waste tanker disposal facility closer to the ponds system. A further relocation of this facility was discussed and implemented in mid 2009. The more suitable location at the Esk Road saleyards provides better facilities and an improved monitoring capability together with a suitable disposal site for campervan wastes, although regular monitoring and maintenance is required by SDC.

The consent holder advised in 2001 that $600,000 had been allocated for improvements to the ponds' system. A pond's influent waste loadings assessment was a component of an upgraded programme. Any further upgrade of ponds' wavebands was to be addressed in the upgrade. An initial meeting between the consent holder, consultant and the Taranaki Regional Council was held in February 2003 to address issues in relation to the 2004 renewal of the consent. This meeting outlined issues of upgrading options for improvements to the treatment system, which formed a component of the assessment of effects accompanying an application for consent renewal received in November 2003. Provision of additional information occurred and the final assessment of effects report was lodged with the Regional Council late in 2007. The renewal of the consent was granted in April 2008 following a further pre-hearing meeting with several submitters.

1.2.1 Upgrading of the system

During the consent renewal process, the consent holder proposed various upgrades to address various issues which had arisen in the operation and performance of the treatment system. These short, medium and long-term measures included:

- mitigation of the risk to the secondary pond embankment by reducing the pond level by means of the recommissioned original outlet with an overflow riser to take diluted flows in excess of the capability of the newer outlet;
- identification and removal of illegal stormwater connections from properties in the town (30% of properties inspected to date have not fully complied with regulations);
- a step-screen fitted to the inlet to the ponds system;
- investigation and strengthening of the areas of faulty embankment;
- longer term replacement of old pipework to reduce stormwater infiltration into the reticulation (proceeding).

Further, the consent holder undertook (as required by conditions of the renewed consent) to upgrade the wastewater treatment system by:

- provision of mechanical aeration of the first pond (which was installed in June 2008);
- refurbishment of ponds' wavebunds;
- partitioning of the second pond into three cells (Photo 1) and installation of a subsurface outlet to minimise the microfloral component of the treated effluent;
- relocation and redesign of the piped discharge (further downstream) with passage of the treated effluent through a rock riprap structure prior to river discharge.

These upgrades were required to be completed by 30 June 2009 after which more intensive treated wastewater monitoring (contracted to the TRC) was to be instigated to asses both the effectiveness of the upgrade and options for further improvements to the wastewater treatment system necessary to address the environmental effects of the discharge on the water quality and the aquatic biota of the Patea River.

The short-term renewed consent had an expiry date of June 2013 and various performance reporting timeframes within this period.

All components of the upgrade were completed and operative by the end of the 2008-2009 period, necessitating certain alterations to the spatial components of the receiving water monitoring programme (see Section 2.5).

An updated report on progress with implementation of the inflow and infiltration reduction programme to minimise stormwater inflow was received in mid 2010 advising that the consent holder would undertake visual infiltration surveys in winter and summer followed by CCTV surveys within the reticulation to determine sections of the mains requiring repairs or replacement. This work was intended to be priority programmed based on the severity of problems, although the consent holder anticipated that completion of the work could take several years due to financial restraints.

After completion of the winter 2010 infiltration survey, smoke testing of sewer mains and laterals was identified as required to ascertain the reasons for further significant infiltration found in specific urban areas. On completion of these investigations, SDC was to programme further repair work. Further advice has been received from the consent holder that as several areas have severe infiltration, one particular catchment has been identified for intensive work by contract prior to remedial work in other catchments.

A problem with the original outlet from the second pond had remained unresolved at the end of the 2008-2009 monitoring period. This outlet in the newly created first cell of this pond had overflowed intermittently to the new diversion pipeline prior to joining the final effluent discharge, thereby partially short-circuiting the full treatment design provided by the upgraded three cell division of the second pond. Rectification of the situation had been discussed with the consent holder (and consultant), and the pipe was sealed later in 2009, prior to the implementation of the increased contractual monitoring to assess the upgrade's effectiveness (as required by Special Conditions 12 and 13 of the renewed consent).

This additional monitoring was subsequently commenced in late September 2009 and continued at monthly intervals with completion in August 2011 after two years' duration. Data was reported to the consent holder and consultant at yearly intervals. Further assessment of the impacts of the upgraded wastewater treatment plant's discharge upon nuisance periphyton growth on the river substrate, has been initiated (over a period of two spring/summer seasons) and was completed in early 2014. This has delayed the full appraisal of the long term upgrade options which necessitated a further, acceptable, short-term renewal of the consent.

Urgent remedial work was also required on the rock riprap component of the outfall where the manhole upstream of the riprap surcharged severely following a very wet-weather period in mid 2009, August 2009, September 2009 and June 2010 (see TRC, 2010) with wastewater flooding the surrounding pastures.

Engineering extensions were undertaken to the rock riprap and the modified outfall structure performed effectively as required although the manhole surcharged from time to time under high, wet weather flow conditions. A major re-engineering of the outfall was undertaken subsequently to improve hydraulic capacity of the structure.

The secondary pond wall was raised and the pond perimeter bunded in July 2010 while the outlet was re-engineered to provide improved hydraulic capacity in the discharge pipeline. This was completed in August 2010 and the cell dividing walls were also provided with contoured shallow spillways (between the cells) to alleviate overtopping.

1.3 Resource consent

1.3.1 Water discharge permit

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

Stratford District Council holds water discharge permit 0196 which authorised the discharge of 4,800 cubic metres/day of treated wastewater from the municipal oxidation ponds system into the Patea River.

This consent was renewed in late April 2008 and again in June 2013, and expires on 1 June 2016 with no review dates. A copy of the renewed consent is attached as Appendix I and was the subject of the monitoring programme. Conditions limit the volume to be discharged, consultation on trade waste connections, reporting progress on the upgrade, proper operation of the system, implementation of an infiltration reduction programme, maintenance of a management plan, and limit effects in the receiving waters. Other conditions require monitoring which will provide information contributing to a report detailing options and issues for reduction in nutrient discharge loadings when considering further upgrading of the WWTP.

1.4 Monitoring programme

1.4.1 Introduction

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

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

An appropriate monitoring programme was established for the system in 1987 and upgraded annual programmes have continued since this date. The 2013-2014 monitoring programme consisted of four primary components.

1.4.2 Programme liaison and management

There is generally a significant investment of time and resources by the Taranaki Regional Council in ongoing liaison with resource consent holders over consent conditions and their interpretation and application, in discussion over monitoring requirements, preparation for any reviews, renewals, or new consents, advice on the Council's environmental management strategies and the content of regional plans, and consultation on associated matters.

1.4.3 Site inspections

The Stratford oxidations ponds system was visited four times (as programmed) 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 Wastewater and receiving water quality sampling

The Taranaki Regional Council undertook sampling of wastewater quality and receiving river water physicochemical quality for plant performance and impact assessment purposes. Frequency of sampling and analytical parameters measured varied according to the purpose of monitoring. An additional site had been added into the receiving waters sampling programme since the 2008-2009 period, due to the relocation of the upgraded outfall.

1.4.5 Biological survey

The programmed summer macroinvertebrate biological receiving water survey was undertaken on 18 February 2014 at four sites in the Patea River under late summer very low flow conditions, one day prior to the physicochemical survey of the receiving waters. The additional site, added to the survey in March 2009 as necessitated by the relocation of the outfall (a component of the WWTP upgrade), was used in place of one of the original sites, which was no longer appropriate for biomonitoring purposes.

2. Results

2.1 Inspections of treatment system operation

The four regular scheduled inspections were performed during the monitoring period. During regular inspections, physical features of the components of the system were recorded, and dissolved oxygen concentrations were measured in the surface wastes adjacent to the repositioned oxidation pond outlet. Results of the dissolved oxygen measurements from scheduled inspections are summarized in Table 1. Chlorophyll-a samples were also collected from the final cell of the second pond on each scheduled inspection visit (see Section 4.6) for on-going assessments of system performance.

Table 1 Dissolved oxygen measurements from the surface of the third cell of the upgraded Stratford secondary oxidation pond at the perimeter adjacent to the outlet

Date	Time (NZST)	Temperature (˚C)	Dissolved oxygen	
			Concentration (g/m³)	Saturation (%)
7 August 2013	0900	11.5	9.4	88
29 October 2013	0745	14.7	1.7	17
19 February 2014	0800	21.8	4.2	48
22 May 2014	0910	12.0	2.1	20

As dissolved oxygen concentrations vary both seasonally and on a daily basis (with minimum concentrations recorded in the early hours of daylight), pond performance has been monitored by standardising sampling times toward mid-morning (0745 to 0910 hrs in the 2013-2014 period). Sampling was standardised in this manner for all regular inspection visits. The results in Table 1 indicate dissolved oxygen was present at all times in the surface layer of the third cell of the upgraded secondary pond near the outlet, over a moderately wide range of concentrations, with some seasonal variation (between 17% and 88% saturation) recorded during the period, although not as variable as in past period when supersaturation has been recorded. 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 and may lead to supersaturation at times during daylight hours (particularly later in the day). Mechanical aeration of the primary pond (4 aerators) was installed as a component of the system upgrade (required by the renewed consent), late in the 2007-2008 monitoring period (see Section 2.3) and these aerators were operative on all inspection occasions.

The primary pond varied from pale brown to turbid, green-brown while the final cell of the secondary pond system varied from relatively clear, pale green to turbid, green to turbid, dark green in appearance on inspection occasions. No surface accumulations of floating scum were noted in the corners or at the edges of the primary pond on any inspection occasions coincident with the continual operation of the mechanical aerators which maintained noticeable circulation through this pond.

Localised odours were recorded in the vicinity of the ponds on all inspection times, but these were slight and no odour complaints were received from nearby residents during the period. Past complaints had been related to scum build-up on the surface of the primary pond necessitating remedial clearance. Occasional slight odours in the area around the flume shed and step screen were noted but improved management of the solid wastes screening and disposal system minimised these issues. The stepscreen was dismantled for maintenance purposes near the end of the period. This area had been tidied and re-grassed during the 2011-2012 period. Tanker wastes disposal had been transferred to a better disposal site (at the Esk Road saleyards) by the consent holder near the end of the 2009-2010 period.

No sediment was observed rising to the surface in either the primary pond or cells of the secondary pond on any inspection occasion, which might be expected after the relatively recent de-sludging operation. The primary pond and secondary cells' surfaces were relatively flat on all occasions as inspections coincided with calm to relatively light wind conditions. Wildlife were present during all inspection visits with ducks (mallard, teal, and paradise) common on both ponds at all times and black swans (up to 18 swan) also present on both ponds on several occasions. Scaup and gulls were present in low numbers on the secondary pond cells on one occasion where pied stilt were noted from time to time. There was a repeat of the large populations (>1000) of paradise ducks present on these cells in late summer. These wildlife species are common to the avifauna associated with such treatment ponds (Don, 2004).

The ponds' surrounds were generally tidy due to grazing throughout the monitoring period. The waveband repairs of the mid 1990s which used gabion baskets, continue to be monitored by the consent holder with respect to weed growth, debris entrapment and/or odour problems. Further waveband replacement and repairs had been undertaken by the consent holder as a component of the consented upgrade. Some localised subsidence behind the original waveband repairs had previously required remedial backfilling (TRC, 2004). The secondary pond cells' walls were re-contoured and sealed early in the 2011-2012 monitoring period.

Debris was cleared regularly from the original second pond outlet grids. New access jetties to the outlet grids had been constructed by the consent holder relatively recently for cleaning and maintenance purposes.

The new outlet from the final pond was clear of debris on all of the inspection occasions. The provision for influent splitting at the entrance to the ponds' system had been designed for use only under high (stormwater infiltration) flows. The influent splitter is checked after heavy rainfall and on a regular weekly basis by the consent holder's contractor but in September 2009 a direct inflow of raw wastewater short-circuiting to the final cell of the secondary pond was noted and required immediate remedial action to be undertaken by the consent holder to plug the connection. At that time, a new influent design to prevent inflow directly entering the secondary pond during heavy rainfall events (which had been constructed during the 2000-2001 monitoring period) was ineffective as it had been by-passed by a faulty bung. This was remedied soon after discovery of the problem.

Effluent discharge estimates ranged from 12 to 40 L/sec, depending upon preceding climatic conditions although these could have been underestimates due to the nature of the rock riprap structure which reduced visibility of the total flow at the outfall. Appearance varied from slightly turbid (winter) to turbid, dark green through the period.

These discharges were from the new re-relocated outfall from the system upgrade, 600 metres further downstream of the original outfall, where filtration of the wastewater through rock riprap occurs on the true right bank of the river prior to discharge. This outfall was fully operative during the period after the overflow outlet in the first cell of the secondary pond was re-routed into the outlet pipeline in 2008-2009. The rock rip-rap required some maintenance by way of debris clearance later in the period as the aesthetic appearance in close proximity to the extended river walkway was unacceptable. Hydraulic problems with this new outfall structure, in mid 2009 (see TRC, 2010) required redesign of the rock riprap section early in the 2009-2010 period and further re-engineering to improve the hydraulic capacity of the structure in the 2011-2012 period. There were no particularly noticeable visual impacts of the effluent discharge under moderate winter, spring, and late autumn river flow conditions. However, there was visual discolouration beyond the mixing zone under very low river flow conditions in late summer.

Photo 2 Dye-tracing from the WWTP outfall into the Patea River, March 2014

Photo 2 Dye tracing in the Patea River at the boundary of the mixing zone, March 2014

The adequacy of the mixing characteristics within the consented 100 metres mixing zone of the river was confirmed by a fluorescein dye-tracing exercise undertaken on 28 March 2014 under relatively low river flow conditions (Skinner Road recorder flow: 0.495 m^3/s). The dye tracer (Photo 1) indicated complete mixing across the river at the boundary of the mixing zone, 100 m downstream of the rock riprap outfall (Photo 2).

2.2 Comments and incidents

Matters relating to wavebands maintenance, scum formation, primary pond de-sludging (TRC, 2006) and ponds' overflows have been extensively documented in past reports (see references) particularly the report for the 2003-2004 period (TRC, 2004). No overflow incidents were recorded during the 2008-2009 period, but higher than normal levels noted in the first cell of the second pond had been addressed by the consent holder. However, overflow events re-occurred in the 2009-2010 period (TRC, 2010). The secondary pond cells' walls were subsequently raised and re-metalled, spillways were constructed in the cell dividing walls, and a major re-engineering of the outlet structure was performed to improve its hydraulic capacity. The secondary cells' walls were re-contoured and sealed early in the 2011-2012 period.

Despite expectations that scum formation would be less prevalent following completion of the primary pond de-sludging programme and installation of an inlet pre-screening mechanism, monitoring prior to the 2008-2009 period found that the problem remained. However, subsequent to introduction of mechanical aeration of the primary pond (a component of the system upgrade), no scum formation or accumulation problems occurred and this continued to be the situation over the current monitoring period.

2.2.1 Step-screen at the inlet

A step-screen and associated overflow by-pass were constructed at the inlet to the ponds' system early in the 2005-2006 monitoring period.

Following a complaint in early August 2005 of raw sewage flowing down Victoria Road from the entrance gateway to the ponds' system, it was found that screens in both channels had blocked causing the channels to overflow to the adjacent roadside and drain. Following notification by Regional Council staff, the consent holder immediately manually cleaned both screens which lowered inflow levels and stopped the overflow, and then temporarily removed the step-screen to prevent further blockages.

The problem was linked to significant gravel build-up in the main sewerage reticulation upstream of the inlet. The secondary screen on the bypass line was permanently removed and temporary barriers were installed to contain the spillage. The overflow area was limed for disinfection and tidied. Permanent bunding was constructed, planting and earthworks undertaken, and the system alarmed to provide for immediate contractual response. Monitoring of the system by the consent holder found that gravel build-up in the sewer line continued to cause problems upstream of the step-screen which was removed and re-installed when the blockage was removed. Additional inspections during 2005-2006, particularly following heavy rainfalls, found that no further overflows had occurred and none occurred during the 2006 to 2009 monitoring periods. However, smaller localised spillages were noted in the 2008-2009 period with these directed through an open channel into the primary pond. With the relocation of the septic tanker wastes disposal facility to the Esk Road saleyards this area was tidied up. Reports that unauthorised tanker usage of the system had occurred during the 2012-2013 period were conveyed to the consent holder for resolution at that time. No such reports occurred during the 2013-2014 period.

Several odour complaints during 2006-2007 and 2007-2008 from neighbouring properties suggested that surface scum build-up (responsible for the odours) had worsened since the de-commissioning of the step-screen. This facility was made operational by March 2007 and, apart from electrical maintenance, remained operative through the remainder of the 2006-2007 period. However operating problems occurred at times in the latter half of 2007, particularly in relation to the solids wastes bin disposal system. This was rectified with the provision of fully enclosed plastic bin liners. All debris removed by the screen is pressed on site prior to transfer for disposal at the Colson Road, New Plymouth landfill. The step screen was removed for maintenance late in the 2013-2014 period. In recognition of the potential for debris build-up in the reticulation (between the tanker discharge site and the step-screen) to affect the step-screen performance, a new tanker wastes disposal facility was constructed adjacent to the entrance to the ponds system. Although this was completed for use during the 2007-2008 monitoring period, various problems at the site required that SDC relocate this facility to a more suitable site (at the Esk Road saleyards) and also that improved quality control measures regulating its usage were instigated. This system generally operated successfully during the 2009-2010,2010-2011, 2011-2012, and current period.

2.2.2 Esk Road trade waste facility

In early 2012 a complaint was received from a resident adjacent to the Esk Road wastewater disposal facilities in relation to the maintenance and operation of these facilities; particularly the septic tanker wastes disposal area and the potential for overflows from the sewerage reticulation manhole (toward an unnamed tributary of the Patea River). Following an onsite inspection in March 2012 with the complainant and a subsequent meeting with Stratford District Council staff it was noted that:

- general maintenance of the septic tanker wastes could be improved by sealing of the surrounds to the disposal area, together with the proposed construction of a 'solids trap' in order to prevent debris being washed by road stormwater in the direction of the complainant's property.
- debris from a recent manhole overflow would be removed from the pasture in the nearby farmer's paddock and, should any further overflows occur, these events would be notified immediately to the TRC. Such overflows are to be contained (with no discharges to natural water), disinfected, and debris removed from the area adjacent to the manhole.
- a contingency/management plan would be prepared by Stratford District Council for the operation and maintenance of the several wastes disposal facilities (to the sewerage reticulation) at Esk Road.

It was acknowledged that at the time of the complaint and subsequent inspection, no discharges of wastewater were occurring to natural water; rather there were operational/maintenance issues of concern to the complainant. The implementation and monitoring of a dual alarm system by Stratford District Council in the wastewater pumping chamber would ensure that future overflow events would be minimised and/or eliminated, but should such an overflow re-occur, it must be contained with no subsequent discharge to natural surface water.

The Esk Road facility was included in subsequent TRC inspections of the overall wastewater treatment system compliance monitoring programme. Some localised odours were noted during tanker disposal activities but provided that washdown and debris removal was undertaken satisfactorily by the operators at the time of disposal, no overflow problems were likely to occur. The debris from the referenced overflow incident was removed from the manhole surrounds in the adjacent farmland and the disposal area bund wall was sealed The District Council enlarged the receiving inlet to the reticulation to improve the system's operation and reduce the likelihood of overflow.

A subsequent inspection noted no operational issues with the system and no complaints were received in 2012 since the upgrade was completed, although it was noted that the District Council needed to maintain regular appropriate monitoring of the usage of the facility to ensure that the system operated without causing a nuisance and within the trade wastes agreements pertinent to the users.

Some limitations were placed upon the use of this facility by wastes tanker operators (in mid period) due to concerns by the District Council that unlawful industrial dumping was occurring of wastes generated outside of the district.

A complaint was received in mid-February 2013 that wastewater was discharging from the Esk Road pump station manhole over an adjacent paddock to the nearby stream. This occurred during a power outage, but a blockage in the storage chamber reduced the planned storage capacity and an electronic failure within the alarm system resulted in a short-term overflow. Repair and disinfection of the area were undertaken in a timely manner and provisions were made for remedial work in relation to alarms and regular inspectorial monitoring of the system by the District Council.

A further overflow from the Esk Road pump station facility occurred in late May 2013 when the alarm system float switches became obstructed in the wet well and therefore did not activate the pumps. A brief overflow of wastewater from the manhole occurred to the nearby stream, which was subsequently rectified. A permanent engineering solution has been installed and tested by the District Council. All debris was removed from the adjacent land.

Letters of explanation for both events were received from the District Council and accepted with no further action recommended by the Regional Council following costs recovery. A temporary protective fence was installed around the manhole.

No complaints concerning this facility were received in the 2013-2014 period during which inspections indicated that maintenance was adequate, no overflows occurred, and there were no odours in the vicinity of the pump station.

2.2.3 Treatment system overflows

In early October, 2011 following a very heavy rainfall event, the consent holder reported that very high levels of raw influent were causing spillage from the flume shed over the track toward a stormwater drain adjacent to Victoria Road rather than being channelled back into the primary oxidation pond. The step screen was operational at the time. The primary pond level was high and all three cells in the secondary pond had very high levels with the new spillways between cells fully operative and adequate freeboard in the ponds' cells. The re-engineered outlet appeared to have coped effectively with the high pond levels and the discharge via the rock rip-rap structure was flowing at a high rate into the river which was in flood. The flume shed overflow was sand-bagged and the overflow re-directed into the primary pond via the (recently) re-contoured area.

This incident was entered as an unauthorised, non-compliance event within the Unauthorised Incident Register and a written explanation sought and received from the consent holder. The remedial works undertaken and proposed by the consent holder were noted. These were completed in November 2011.

No further overflows occurred over the remainder of the 2011-2012 monitoring period and no overflows occurred in the 2012-2013 period. Very wet weather in July 2012 and late May 2013 caused high inflows to the system which were contained and directed into the primary pond by the re-contoured area around the flume shed. The primary pond level was very high in May 2013, in part due to a partially blocked outlet screen, which was cleaned after discussions with the consent holder. On both occasions the recently re-contoured eastern cell perimeter wavebands operated as designed to contain all wastes without overflows. No overflows occurred during the 2013-2014 period during which all pond levels were normal and the dividing walls between the secondary pond cells remained exposed at the time of inspections.

3. Results of oxidation ponds' system monitoring

3.1 Plant performance

A sample of the oxidation ponds' system effluent discharge was collected for analysis on 19 February 2014 as a component of the late summer assessment of effects on the physicochemical quality of the receiving waters of the Patea River under very low flow conditions. In recognition of the industrial trade wastes component of the sewage inflow to the oxidation ponds' system (e.g. galvanising industry, tanker wastes disposal and saleyards wastes), the ponds' effluent was also analysed for selected metals' components. These metals have the potential to impact on biological aquatic life in the receiving waters if concentrations exceed certain levels of toxicity.

The results of this effluent analysis are provided in Table 2 and compared with past surveys' data, which includes the additional monthly contractual tertiary cell analyses (performed between September 2010 and August 2011).

Table 2 Results of the effluent analysis from the final cell of the Stratford oxidation ponds' system, 19 February 2014 and past records of secondary pond data (for the period 1987 to mid 2009) and final tertiary cell data (for the period mid 2009-2013)

Parameter	Unit	Survey of 19 February 2014	Secondary pond			Final (tertiary) cell		
			No. of samples	Range	Median	No. of samples	Range	Median
Time	NZST	0800	-	-	-	-		
Temperature	°C	21.8	105	7.4-24.1	14.0	33	6.2-21.5	15.1
Dissolved oxygen	g/m^3	4.2	98	0.2-15.9	4.6	33	0.7-15.1	3.4
Dissolved oxygen saturation	%	48	95	2-177	43	33	8-141	34
BOD_5	g/m^3	24	32	9-56	20	31	5-36	12
BOD_5 filtered	g/m^3	2.9	17	2.0-11	4.6	4	2-15	4
pH		7.6	24	6.9-8.8	7.5	27	7.1-8.8	7.5
Conductivity @ 20°C	mS/m	36.4	32	18.0-61.6	31.5	28	15.6-41.6	24.8
Chloride	g/m^3	25.5	19	22-92	27.2	29	11.7-30.9	17.9
Dissolved reactive phosphorus	g/m^3P	2.82	25	1.44-11.1	4.08	28	0.70-4.97	1.76
Total phosphorus	g/m^3P	-	9	1.7-5.8	4.8	25	1.02-5.80	2.18
Ammonia-N	g/m^3N	18.2	37	0.59-24.9	13.1	28	0.87-25.4	9.3
Nitrate + nitrite-N	g/m^3N	2.28	14	<0.01-0.60	0.10	4	1.13-4.28	2.6
Total nitrogen	g/m^3N	-	-	-	-	25	7.2-30.8	13.8
Turbidity	NTU	31	29	5.6-89	15	28	5.7-71	16
Suspended solids	g/m^3	41	35	4-120	37	28	5-62	22
Faecal coliform bacteria	nos/100/ml	5500	32	70-160000	3400	28	270-14,000	2200
Metals (acid soluble)								
Cadmium	g/m^3	<0.005	17	<0.005<0.01	<0.005	4	<0.005-<0.005	<0.005
Chromium	g/m^3	<0.03	15	<0.03-0.04	<0.03	4	<0.03-<0.03	<0.03
Zinc	g/m^3	0.037	18	0.009-0.118	0.036	4	0.021-0.035	0.030
Appearance		turbid, dark green						

Note: with the exception of DO results, secondary pond data have been recorded mainly from summer surveys]

This tertiary cell effluent quality (Table 2) was typical of a well treated secondary oxidation pond waste with relatively low total BOD_5 and suspended solids levels and moderate faecal coliform bacteria number. Nutrient levels were typical of the secondary oxidation pond treated effluent prior to the plant upgrade with the exception of nitrate N which remained elevated but within the range recorded since the upgrade. Turbidity and appearance were indicative of a well treated wastewater effluent quality with only a moderate algal component compared to that often recorded in the past in the secondary pond treated wastes (e.g. blooms of cyanobacteria, *Microcystis*), particularly as recorded by the summer 2008 survey (TRC, 2008).

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.

Comparatively, tertiary cell effluent parameters were within ranges recorded from previous surveys of the pre-upgrade secondary pond effluent (Table 2), with the exception of nitrate N, and in most instances were similar to, or above, median values. Effluent quality was good in terms of BOD_5 concentration and faecal coliform bacteria number, with a moderate suspended solids concentration coincident with a moderate late summer microfloral population abundance as also illustrated by an above median turbidity.

The partitioning of the second pond cell into a three cell system with aeration of the primary pond appears to have resulted in a treated wastewater with narrower ranges for most parameters to date (Table 2), particularly total BOD_5, conductivity, dissolved reactive phosphorus, suspended solids, and faecal coliform bacteria; and improved quality for most parameters (in terms of median levels). However, the period of operation of the refurbished system has only included five summers to date whereas the majority of the secondary pond data collected over a period of 22 years was strongly biased toward summer-autumn conditions.

3.1.1 Microflora of the Stratford ponds' system

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

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

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

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

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

Table 3 Chlorophyll-a measurements from the surface of the third cell of the upgraded Stratford secondary oxidation pond at the perimeter adjacent to the outlet

Date	Time (NZST)	Appearance	Chlorophyll-a (mg/m^3)
7 August 2013	0900	pale green-brown	450
29 October 2013	0745	pale green	4.6
19 February 2014	0800	dark green	361
22 May 2014	0845	green	

Good microfloral populations were indicated by higher chlorophyll-a concentrations in late winter and late summer when dissolved oxygen saturation levels of 88% and 48% were measured respectively. A very low concentration (coincident with the lowest saturation (17%)) followed very wet early spring weather conditions and greatest stormwater dilution through the WWTP system.

3.2 Results of receiving environment monitoring

Two components of the receiving water monitoring programme were operative during the period. These assessed the impacts of treated wastes disposal from the upgraded system specifically upon the physicochemical quality and biological communities of the receiving waters of the Patea River. These surveys were also designed to assess any impacts of the adjacent and recently closed Stratford municipal landfill on the receiving waters of the river and are also discussed in this respect in the appropriate Annual Report (TRC 2014).

Three additional receiving water physicochemical compliance surveys were also undertaken in conjunction with inspections, as required for consent compliance assessment.

3.2.1 Late summer physicochemical receiving water survey

A late summer assessment of the impact of the upgraded oxidation ponds' system effluent discharge on the receiving waters of the Patea River was performed on 19 February 2014 when flow in the river (at the Skinner Road recorder) was 0.87 m^3/sec, during a low recession flow period (but not as extreme as the very low, lengthy recession flow surveyed in the summer of 2008). Sites were located (Figure 2) as summarised in Table 4.

Table 4 Location of sampling sites

Site	Location	GPS location	Site code
Patea River	at Swansea Road bridge (upstream of landfill and WWTP discharges)	E1711801 N5644382	PAT000315
Patea River	approximately 250 m downstream of the WWTP original discharge (and 350m upstream of the new outfall)	E1712748 N5644549	PAT000345
Secondary oxidation pond tertiary cell effluent	at manhole upstream of rock riprap outfall	E1712834 N5644344	OXP005002
Patea River	approximately 130 m downstream of the WWTP new outfall	E1713033 N5644266	PAT000350
Patea River	approximately 1 km upstream of the Kahouri Stream confluence	E1714497 N5645112	PAT000356

Figure 1 Aerial photo of site and location of sampling sites since the upgrade of the WWTP

This survey was performed 28 days after a river fresh. The river flow was above the minimum mean monthly flow recorded for February (0.64 m³/s) at the Skinner Road recorder site [4.5 km downstream of the new outfall (and the Kahouri Stream confluence)], and well below the monthly mean of 2.78 m³/s. This receiving water flow was approximately one and a half-times the river flow recorded at the time of the autumn, 2008 survey and about 80% of the flow at the time of the late summer 2013 survey. An estimated river flow in the vicinity of the oxidation ponds discharge was 0.60 m³/s.

The results of the survey are summarised in Table 5. All analyses were performed in the Taranaki Regional Council IANZ-registered laboratory using documented standard methods.

Table 5 Patea River physicochemical sampling survey results of 19 February 2014

Site		PAT000315	PAT000345	OXP005002	PAT000350	PAT000356
Site Location		Upstream of landfill and WWTP	Downstream of landfill and 350m upstream of new WWTP outfall	Effluent discharge at new outfall	130m downstream of WWTP new outfall	1km upstream of Kahouri Stream
Parameter	**Unit**					
Time	NZST	0730	0820	0835	0855	0940
Temperature	^oC	16.5	17.0	21.8	17.5	17.8
Dissolved oxygen	g/m^3	9.2	9.2	4.2	9.3	10.5
DO Saturation	%	97	98	48	101	113
BOD_5 (total)	g/m^3	0.8	0.6	24	1.7	N/A
BOD_5 (filtered)	g/m^3	<0.5	<0.5	2.9	0.7	N/A
pH		7.7	7.7	7.6	7.7	8.1
Conductivity @ 20^{o}C	mS/m	9.6	9.7	36.4	10.6	10.1
Chloride	g/m^3	8.5	8.5	25.5	9.1	8.8
Zinc (dissolved)	g/m^3	<0.005	<0.005	0.037	<0.005	N/A
Cadmium (dissolved)	g/m^3	<0.005	<0.005	<0.005	<0.005	N/A
Chromium (dissolved)	g/m^3	<0.03	<0.03	<0.03	<0.03	N/A
Dissolved reactive phosphorus	g/m^3P	0.026	0.024	2.82	0.122	0.095
Ammonia-N	g/m^3N	0.035	0.070	18.2	0.589	0.037
Un-ionized ammonia-N	g/m^3N	0.006	0.0013	0.390	0.0116	0.0018
Nitrate & nitrite-N	g/m^3N	0.55	0.56	2.28	0.74	1.10
Turbidity	NTU	3.6	0.9	31	1.9	2.8
Black disc	m	2.88	2.79	-	1.20	1.21
Suspended solids	g/m^3	9	<2	41	2	3
Faecal coliform bacteria	nos/100ml	150	290	5500	330	N/A
Appearance		clear, pale-green	clear, pale-green	turbid, dark green	slightly turbid, green-brown	slightly turbid, brown

[Note: N/A = not analysed]

A dilution ratio of approximately twenty-five 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).

The effluent discharge had minimal impacts on the receiving waters of the Patea River in terms of temperature, dissolved oxygen, pH, dissolved metals, and suspended solids. This was consistent with moderate dilution of the effluent by river flow and a good effluent quality in terms of these parameters. There was a 57% decrease in black disc clarity coincidental with an increase in turbidity of 1.0 NTU (representing a 110% increase) but minimal rise in suspended solids levels in the receiving waters. This decrease in black disc clarity measured at the periphery of the new mixing zone, represented a noticeable change in visual clarity and slight change in colour mainly due to the fine algal component in the oxidation ponds treated effluent. The increased turbidity in the receiving waters was in non-compliance with the relevant consent condition (Special Condition 11) under these very low flow conditions and river turbidity showed no improvement further downstream. Bacterial numbers showed a small increase at the site 130 m downstream of the mixing zone.

Increases in total BOD_5 (0.6 to 1.7 g/m^3) recorded at the site downstream of the discharge had no impact on dissolved oxygen level at this site below the mixing zone. Dissolved reactive phosphorus was elevated at sites 3 and 4 below the discharge, while there was a significant increase in ammonia N downstream of the discharge followed by a reduction at the furthest downstream site 4 which was consistent with results in most previous summer-autumn periods under low flow conditions. This was due in part to uptake by riverbed periphyton (mats and filamentous algae) which was widespread at the time of this survey, and nitrification of ammoniacal nitrogen in the receiving waters. Un-ionized ammonia concentrations downstream of the permitted mixing zone were well within the limit required by Special Condition 14 of the consent.

In general terms, Patea River water quality upstream of the oxidation ponds' outfall (and downstream of the municipal landfill) was relatively high (97% to 98% dissolved oxygen saturation, slightly alkaline pH, very low total and dissolved BOD_5, and good water clarity) with moderate faecal coliform numbers. Although nutrient levels were also relatively low, an increase in ammonia-N level (and significant increase in bacteria number) continued to be recorded between the two sites upstream of the WWTP discharge, possibly due to landfill leachate seepage into the river from the true right bank (TRC, 2014).

3.2.2 Receiving water compliance surveys

Receiving water physicochemical monitoring surveys were required to further assess compliance with Special Conditions 11 and 14 of the consent relating to specific limits set on the Patea River at the boundary of the mixing zone, 100m downstream of the new outfall. These sampling surveys were performed on 7 August 2013, 29 October 2013, and 22 May 2014 with results discussed beneath. The sampling sites were OXP005002, PAT000345, and PAT000350 as described in Table 4.

3.2.2.1 Survey of 7 August 2013

The wastewater discharge from the new outfall was slightly turbid and green in appearance (following a wet winter period) with a moderate flow rate. Results are presented in Table 6.

Table 6 Results of the receiving water compliance survey of 7 August 2013

Site		PAT000345	OXP005002	PAT000350
Location		Upstream	Discharge	Downstream
Parameter	Unit			
Time	NZST	0930	0900	1000
Temperature	˚C	9.8	11.5	10.0
BOD_5 (carbonaceous filtered)	g/m^3	<0.5	-	<0.5
pH	pH	7.7	-	7.7
Chloride	g/m^3	9.1	22.4	9.6
Ammonia-N	g/m^3N	0.080	-	0.648
Unionised ammonia	g/m^3N	0.0009	-	0.0073
Turbidity	NTU	1.7	-	2.4
Black disc	m	1.79	-	1.55
Appearance		sl. turbid, brown	sl. turbid, pale green-brown	sl. turbid, brown

Some visual impact of the wastewater discharge was apparent on the Patea River beyond the mixing zone. The river was slightly turbid with a relatively low flow of

1.87 m^3/sec (at the Skinner Road hydrological site) during a gradual recession from a small fresh (6 m^3/sec) fourteen days previously.

This slightly turbid wastewater was calculated as having a dilution ratio of about 25:1 in the receiving waters at the time of the survey. Un-ionised ammonia and carbonaceous filtered BOD_5 concentrations in the river at the boundary of the mixing zone were both well within the limits imposed by Special Condition 14 of the consent while the downstream increase in turbidity (41%) was in compliance with Special Condition 11. Compliance with Special Conditions 10 (a), (b), and (c) was assessed and confirmed by visual inspection at the time of the survey.

3.2.2.2 Survey of 29 October 2013

The wastewater was slightly turbid and dark greenish in appearance with an estimated flow rate of 40 L/s, causing only a slight visual impact on the relatively clear and uncoloured flow of the Patea River which had a moderate flow of 4.20 m^3/sec (at the Skinner Road recorder), under steady recession four days after the previous fresh (43 m^3/sec). Results of the survey are presented in Table 7.

Table 7 Results of the receiving water compliance survey of 29 October 2013

Site		PAT000345	OXP005002	PAT000350
Location		Upstream	Discharge	Downstream
Parameter	Unit			
Time	NZST	0820	0745	0845
Temperature	˚C	9.6	14.7	10.3
BOD_5 (carbonaceous filtered)	g/m^3	<0.5	-	<0.5
pH	pH	7.6	-	7.5
Chloride	g/m^3	9.0	16.2	9.2
Ammonia-N	g/m^3N	0.078	-	0.422
Unionised ammonia	g/m^3N	0.007	-	0.0031
Turbidity	NTU	0.5	-	0.7
Black disc	m	3.04	-	2.51
Appearance		clear, uncoloured	rel. clear, pale green-grey	sl. turbid, uncoloured

This treated wastewater was calculated to have been diluted at a ratio of about 35:1 by the receiving waters at the time of the survey. Both carbonaceous filtered BOD_5 and un-ionised ammonia concentrations in the river at the mixing zone boundary were in compliance with Special Condition 14 of the consent while visual compliance with Special Conditions 10 (a), (b), and (c) was assessed by inspection. The turbidity values in the river were indicative of relatively clear appearance (<1NTU), with a downstream reduction in black disc clarity of 0.53m, coincident with an increase in turbidity of 40% which was in compliance with Special Condition 11.

3.2.2.3 Survey of 22 May 2014

Relatively turbid green wastewater was discharging at a moderate rate (estimated at 15 L/s) into the relatively clear, uncoloured river which was in recession (2.5 m^3/sec at the Skinner Road recorder) two weeks after the most recent fresh (8 m^3/sec).

There had been four freshes in the river over the preceding three weeks. Minimal visual impact of the discharge was noticeable in the river at the mixing zone boundary. The results of the survey are presented in Table 8.

Table 8 Results of the receiving water compliance survey of 22 May 2014

Site		PAT000345	OXP005002	PAT000350
Location		**Upstream**	**Discharge**	**Downstream**
Parameter	**Unit**			
Time	NZST	0920	0845	1010
Temperature	˚C	10.5	12.0	10.7
BOD_5 (carbonaceous filtered)	g/m^3	<0.5	-	<0.5
pH	pH	7.5	-	7.5
Chloride	g/m^3	8.8	16.9	9.2
Ammonia-N	g/m^3N	0.043	-	0.458
Unionised ammonia	g/m^3N	0.0003	-	0.0028
Turbidity	NTU	0.9	-	1.2
Black disc	m	2.55	-	2.46
Appearance		rel. clear, uncoloured	turbid, green	rel. clear, very pale green

The wastewater was calculated to be diluted by about 20:1 by the receiving waters at the time of this survey.

The effects of the discharge were compliant with Special Condition 14 of the consent (carbonaceous filtered BOD_5 and un-ionised ammonia), Special Condition 10 (a), (b), and (c) (visual assessment), and were compliant with Special Condition 11 (with an increase in turbidity of 33%).

3.2.3 Biomonitoring survey

One late-summer biomonitoring survey was performed under very low flow conditions at the four sites listed in Table 9 and illustrated in Figure 2 with the resultant report attached as Appendix II.

Table 9 Location of biomonitoring surveys' sites

Site	Site code	Location
1	PAT 000315	Swansea Road bridge (upstream of landfill and oxidation ponds' discharge
2	PAT 000330	Upstream of WWTP discharge (and downstream of landfill
3a	PAT 000350	Approximately 130m downstream of the WWTP new outfall
4	PAT 000356	Approximately 1 km upstream of the Kahouri Stream confluence

This late summer biological survey of four sites in the receiving waters of the Patea River was performed on 18 February 2014, one day prior to the physicochemical survey and during a low recession flow period, 28 days after the most recent river fresh. Results of this biomonitoring survey are summarised in Table 10.

Table 10 Biomonitoring results summary from the survey of 18 February, 2014

Site	Macroinvertebrate fauna	
	Taxa numbers	MCI value
1	27	111
2	22	105
3a	29	95
4	24	100

Typical macroinvertebrate communities' richnesses were surveyed at the four Patea River sites during a low flow recession period in the latter part of summer and under conditions of patchy to widespread mats of periphyton river substrate cover and patchy filamentous algae. Minor discolouration of the river's reach below the WWTP's newly located discharge was apparent and there was no wastewater treatment plant ponds' algal deposition on the river bed, as a result of lower algal concentration in the effluent from the upgraded partitioned second oxidation pond cells. Faunal communities upstream of the WWTP discharge had higher percentages of 'sensitive' taxa whereas communities at downstream sites had slightly increased percentages of 'tolerant' taxa. However, there were subtle differences in dominant (characteristic) taxa between these four sites' communities with a tendency toward proportionately slightly more 'tolerant' dominant taxa in a downstream direction.

MCI scores were similar to scores generally typical of mid-catchment ringplain rivers in Taranaki, particularly those found during summer low flow conditions, and showed a moderate range (16 units) along the four sites through the 4.5 km reach of the Patea River. No impacts of seepage from the Stratford landfill (situated between sites 1 and 2) were indicated by the faunal composition at these sites. An increase in number of 'tolerant' taxa, together with slightly fewer 'sensitive' taxa downstream of the WWTP's recently relocated discharge, resulted in lower MCI scores at these sites, which were insignificant considering the distance of the furthest site downstream but more significant in the immediate vicinity of the discharge, before some downstream recovery. There were several significant changes in individual taxon abundances but fewer amongst dominant taxa as reflected in a reduction in $SQMCI_s$ value between sites 2 and 3a of 3.5 units and sites 2 and 4 of 2.6 units. These lower $SQMCI_s$ scores at sites 3s and 4 (up to 2.4 km downstream of the wastewater discharge), reflected lower abundances in certain 'highly sensitive' taxa and increased numbers of 'tolerant' oligochaete worms and midges in particular.

No undesirable heterotrophic growths were found on the substrate of the river at the sites surveyed downstream of the discharge under these summer low recession flow conditions and there was no apparent deposition of oxidation ponds' algae on the river bed.

Effects of discharges on the macroinvertebrate communities of the Patea River vary in relation to the treatment provided by the WWTP, dilution available in the receiving waters, preceding climatic conditions, and the microfloral component of the wastewaters. Such variations in effects have been documented by previous summer biomonitoring surveys with this summer survey illustrating some effects (bordering on statistically significant at the boundary of the mixing zone), during a low recession flow period, below the discharge from the relocated rock riprap outfall following the WWTP upgrade.

3.2.4 River periphyton investigations

Contractual receiving water nuisance periphyton monitoring of the Patea River was undertaken at four specific sites in the vicinity of the WWTP discharge over the spring, summer, late summer (2012-2013) period and was repeated over a similar 2013-2014 period. This programme assessed algal mats and long filamentous periphyton percentage substrate cover, chlorophyll-a concentrations, and periphyton index scores and provides comparisons with a reference (state of the environment) site in the Patea River near the National Park boundary.

These two years of nuisance periphyton data will contribute to the consent holder's assessment of WWTP effects, a necessary requisite for WWTP upgrade considerations at the time of consent renewal.

An example of chlorophyll-a (indicator of algal biomass) results is summarised in Table 11 for the five sites from near the National Park boundary (PAT000200) to Skinner Road, about 4.5km downstream of the WWTP outfall (PAT000360).

Table 11 Chlorophyll-a (mg/m^2) results for Patea River sites over the spring to late summer periods of 2012-2013 and 2013-2014

Period	2012-2013		2013-2014		2012-2014	
Site	Range	Median	Range	Median	Median	Median
PAT000200	5.4-9.0	6.8	3.6-26	4.6	3.6-26	6.1
PAT000345	6.1-34	10	6.6-90	34	6.1-90	22
PAT000350	64-276	64	97-130	100	64-276	99
PAT000356	42-92	55	72-140	90	42-140	81
PAT000360	11-151	94	67-150	88	11-151	91

This illustrates (Figure 3) the impact of the WWTP discharge (between sites PAT000345 and PAT000350) upon the streambed periphyton cover in the mid reaches of the Patea River in each of the two periods.

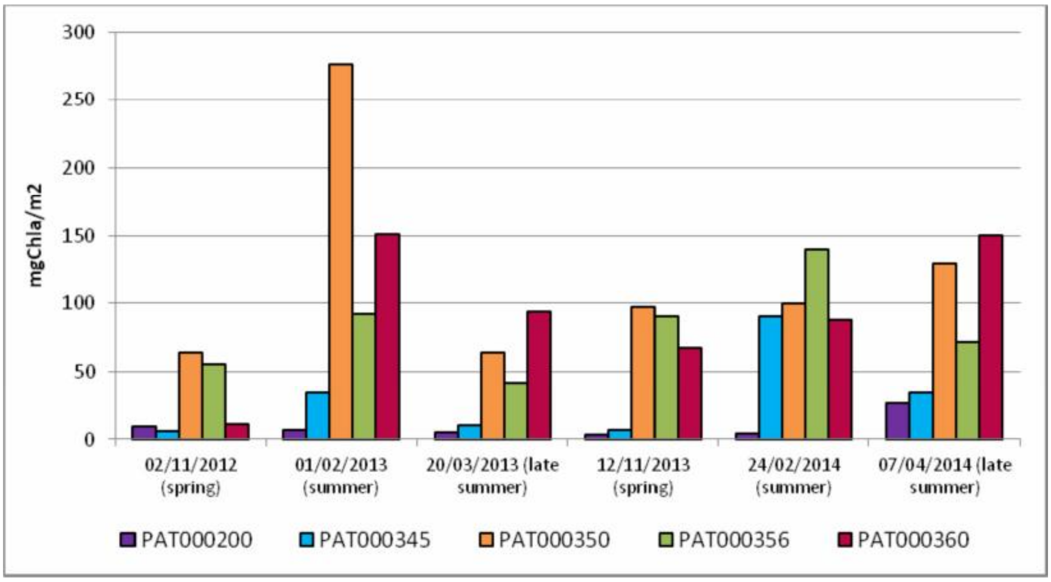

Figure 2 Chlorophyll-a concentrations in the Patea River for the spring 2012 to late summer 2013 and spring 2013 to autumn 2014 periods

3.3 Investigations, interventions, and incidents

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

The Taranaki Regional Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The Unauthorised Incident Register (UIR) includes events where the company concerned has itself notified the Council. The register contains details of any investigation and corrective action taken.

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

In the 2013-2014 year, there were no incidents recorded by the Council that were associated with the consent holder in relation to the exercise of consent 0196, nor were there any incidents (not directly related to the WWTP consent) associated with the Esk Road wastewater trade waste facility (a component of the sewerage reticulation network) reported to Council. For the sixth annual monitoring period in succession no odour complaints associated with the WWTP site were reported to the Council. This absence of odour incidents was coincident with the major upgrade of the WWTP which was completed during the 2008-2009 period and in particular, the introduction of mechanical aeration in the primary pond.

4. Discussion

4.1 Discussion of plant performance

The Stratford oxidation ponds' sewage treatment system has continued to perform satisfactorily with aerobic conditions maintained and a generally high standard of treated wastewater discharged, throughout the twelve month monitoring period. Effluent quality was of a good standard, particularly when excessively diluted following wet weather conditions, with low to moderate microfloral densities (as indicated by chlorophyll-a levels) on the four sampling occasions during the period. In the past, prior to the upgrade in 2009, management had attempted to regularly maintain the ponds' system, but surface debris and scum accumulation occurred, accentuated by certain prevailing wind conditions, despite the completion of the primary pond de-sludging operation in autumn 2005. However, almost continuous usage of the influent step-screen system, mechanical aeration of the primary pond, and appropriate relocation of the tanker disposal site appear to have alleviated this problem during recent years including the 2013-2014 period when no odour complaints were received and no odour incidents reported for the fifth consecutive year.

Screening of the new outlet from the secondary oxidation pond, which was constructed to provide for increased retention time, was well maintained. The inlet system, reconstructed in order to direct all raw wastes to the primary oxidation pond, functioned as designed for the majority of the monitoring period and any overflows following heavy rainfall were contained by the 2011-2012 re-contouring of the area which ensured that all raw influent was directed into the primary pond.

The ponds system did not experience any further hydraulic problems following intensive rainfall events, after re-engineering of the tertiary cell outlet reticulation in order to overcome flow discharge restrictions in the pipe prior to the final river outfall. Additional remedial secondary pond wall recontouring and sealing was successful in containing high pond wastewater levels after heavy rainfall events and prevented seepage to surrounding land. Longer term remedial work to the reticulation will provide additional capacity and will 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. The contracted two year programme of monitoring of the upgrade's effectiveness, which was completed in August 2011, has been augmented by two years of additional nuisance periphyton receiving water assessment work for utilisation in the consideration of effects and options for further WWTP upgrade required by conditions of the consent which was renewed for a further three years for this purpose.

Trade wastes controls placed on the usage of the system by industrial tanker wastes by the Stratford District Council (during 1991-92), although resulting in no major problems with this aspect of waste disposal to the ponds' system performance during the monitoring period, continues to require monitoring (by the consent-holder) particularly the nature and/or source of wastes being discharged to the system. The more recent relocation of the facility to the saleyards site has provided a more appropriate positioning of this facility in the reticulation system. However, further issues arose over the operation and design of this facility which required remedial measures to be undertaken by the District Council and emphasised the need for regular management and frequent monitoring of this facility by the operator. No problems with this facility eventuated during the most recent period. Disposal of treated wastes from the regional stockyards through the pond system, actioned eleven years previously, had no apparent impact on the system's performance.

Capacity for additional wastes loadings to be connected to the system continues to exist (given the upgrade of the treatment plant), provided that the hydraulic issues associated with the inflow volumes and outflow reticulation can be resolved.

Monitoring of the microfloral component of the tertiary cell of the secondary pond (by means of chlorophyll-a measurements) indicated that the system had a low algal content following heavy rainfall flushing events. However, although there was a marked autumn increase in microflora, there was no apparent bloom of blue-green algae, and therefore no repeat of significant aesthetic impacts on the receiving waters of the Patea River, unlike those which had occurred on number of occasions in past summer–autumn low flow, warm periods. Microfloral populations have given no indication of poor performance of the treatment system to date and generally have indicated an improvement in microfloral conditions in the tertiary cell of the secondary pond subsequent to the WWTP upgrade. This component of the programme was replaced with chlorophyll-a monitoring for the 2013-2014 period.

4.2 Environment effects of exercise of water permits

Some impacts of the discharge were recorded on the physical and chemical quality of the Patea River, during the more intensive late summer survey, when very low recession flow conditions provided an approximate twenty-five-fold dilution of the effluent in the receiving waters. Localised and moderate increases in nutrients and small increases in bacteria levels were recorded downstream of the recently re-located rock riprap outfall, mitigated to a certain extent by the effluent quality which was of a good standard at the time of this survey. Some discolouration of the receiving waters occurred downstream of the discharge (beyond the permitted mixing zone) in non-compliance with the relevant Special Condition due mainly to the algal component of the effluent under very low river flow conditions. The late summer macroinvertebrate fauna survey showed some impacts of the discharge beyond the permitted mixing zone under these low recession flow conditions, bordering on statistically significant at the boundary of the mixing zone.

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, under the low receiving waters flow conditions experienced in late summer.

Significant increases in benthic periphyton cover have been recorded at three sites in the Patea River downstream of the discharge over two spring to late summer/autumn receiving water survey periods. This data will contribute to the evaluation of options for upgrading the WWTP in terms of nutrient reductions as required by renewed consent conditions.

Additional seasonal receiving water monitoring (on three occasions) found compliance with all Special Conditions of the consent on each occasion. Some, increases in turbidity in the Patea River were recorded coincident with the fine algal component of the wastewater in particular elevating turbidity (but within the compliance limit) under moderate dilution conditions in the relatively low flows of the Patea River.

4.3 Evaluation of performance

A tabular summary of the Stratford District Council's compliance record for the year under review is set out in Table 12 (in terms of renewed consent 0196).

Table 12 Summary of performance for consent 0196: discharge of oxidation ponds treated wastes to surface water

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Best practicable option	Inspections	Yes
2. Limits on wastewater volume	Inspections	Yes
3. Implementation of infiltration reduction programme	Reporting by consent-holder	Yes (continuing)
4. Implementation of management plan	Provision by consent holder	Yes
5. Maintenance of aerobic ponds conditions	Inspections & sampling	Yes
6. Trade wastes connections	Liaison with consent holder	Yes
7. Narrative limits on receiving water effects	Inspections, physicochemical sampling and biomonitoring	Yes (almost entirely compliant)
8. Limit on receiving water turbidity effect	Physicochemical sampling	Majority of monitoring occasions
9. Monitoring provisions	Performance of tailored programme and additional contract work	Yes (completed additional work)
10. Nutrient monitoring provisions	Performance of tailored programme and additional contract work	Yes (completed after additional work identified)
11. Numerical limits on receiving water effects (after upgrade)	Physicochemical sampling	Yes
12. Reporting issues & options	Provision by consent holder prior to June 2015	N/A (due by June 2015)
Overall assessment of Consent compliance performance in respect of this consent Overall assessment of Environmental performance in respect of this consent		**High** **Good**

During the year, the Stratford District Council demonstrated a good environmental performance and high level of compliance with the resource consent.

Improvement was recorded with aspects of the operation of the WWTP mainly in respect of overflow events. 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 granted late in the 2007-2008 period and subsequently renewed in the current period for a short 3-year term. Problems that had been experienced with hydraulic loadings on the system during previous periods were adequately managed by the consent holder during the 2013-2014 period. Past odour complaints resulted in the reappraisal of methods to control surface scum and its disposal including relocation of the tanker wastes disposal facility and improved pond circulation as components of the upgrade. These facets of the upgrade appear to have alleviated odour problems/scum formation over the 2010-2013 and 2013-2014 periods for the sixth year in succession. Reduction in secondary pond algal blooms and subsequent discharge impacts in part have been addressed by components of the WWTP upgrade relating to the partitioning of the secondary pond and outfall re-design. Issues with aspects of trade wastes disposal to the sewerage reticulation at the Esk Road facility which had been the subject of public complaint and subsequent remedial action by the District Council in the 2012-2013 period, were maintained adequately during the latest period with no further issues.

4.4 Provision of Issues and Options Report

Special Condition 15 of the previous consent (see Appendix I, TRC, 2013) required that a report be provided by the consent holder detailing issues and options for the WWTP, specifically addressing environmental effects on aspects of receiving water quality and options for further treatment of Stratford wastewater.

This consultant's report was provided in June 2012 after provision of various wastewater and receiving water quality data (by TRC) and consultation with the consent holder. It was recognised that additional periphyton monitoring data for the Patea River over two spring-summer periods would be beneficial to provide more appropriate receiving water information relating to the potential wastewater treatment plant upgrade options which were the subject of further reporting required prior to the consent expiry date of June 2013. Such a programme was formulated, contracted, and performed by TRC over the spring 2012 to autumn 2013 period and over a similar 2013-2014 period following which the completed report is required. A short-term (three-year) consent was granted to enable this work to be completed and evaluated for the purpose of assessment of appropriate WWTP upgrade options.

4.5 Recommendations from the 2012-2013 Annual Report

The previous Annual Report (TRC 2013-32) contained the following recommendations in relation to consents monitoring of the operation of the municipal oxidation ponds' system:

1. THAT the monitoring be continued for the 2013-2014 period by formulation of a suitable monitoring programme, similar in format to the 2012-2013 programme including the additional inspection component of the Esk Road industrial wastewater connection facility, with a minor change to the microfloral component of the pond inspectorial requirements;

2. That the consent holder advise the Taranaki Regional Council whenever additional industrial waste connections are made to the sewerage reticulation system;

3. That regular maintenance of the oxidation ponds' system continue to be performed by the consent holder, with particular emphasis given to appropriate monitoring and operation of the system immediately following high intensity rainfall events. Suitable records are to be kept and made available to the Regional Council as required.

4. That the consent holder liaise with the Taranaki Regional Council with respect to matters relating to the WWTP staged upgrade and additional monitoring assessment investigations as required by conditions of the renewed consent.

Recommendations 1, 2, 3, and 4 have been achieved. Monitoring was performed as scheduled with the necessary adjustments. The consent holder had agreed to a more intensive monitoring programme to assess the effectiveness of the completed WWTP upgrade and this work which commenced in September 2009 and was completed in August 2011, has subsequently been extended to include nuisance riverbed periphyton investigations. Thiswas completed in autumn 2014.

4.6 Alterations to the monitoring programme for 2014-2015

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

In the case of the monitoring programme for the Stratford oxidation system it is proposed that for the 2014-2015 period monitoring continue at the same level as that in the 2013-2014 period (including the extended inspection component of the Esk Road industrial connection facility).

4.7 Exercise of optional review of consent

Resource consent 0196 provided for an optional review of the consent in June 2011 but additional investigations since the completion of the upgrade suggested that it was not considered necessary to review the consent at that stage. The renewal of the consent (granted in October 2013) provides for no further reviews prior to the consent expiry date of 1 June 2016.

5. Recommendations

As a result of the 2013-2014 Monitoring Programme for consent 0196, the following recommendations are made:

1. THAT monitoring be continued for the 2014-2015 period by formulation of a suitable monitoring programme, similar in format to the 2013-2014 programme including the additional inspection of the Esk Road industrial wastewater connection facility;

2. THAT the consent holder advise the Taranaki Regional Council whenever additional industrial waste connections are made to the sewerage reticulation system;

3. THAT regular maintenance of the oxidation ponds' system continue to be performed by the consent holder with particular emphasis given to appropriate monitoring and operation of the system immediately following high intensity rainfall events. Suitable records are to be kept and made available to the Regional Council as required;

4. THAT the consent holder liaise with the Taranaki Regional Council with respect to matters relating to the staged WWTP upgrade and additional monitoring required by conditions of the renewed consent.

Glossary of common terms and abbreviations

The following abbreviations and terms are used within this report:

biomonitoring	assessing the health of the environment using aquatic organisms
BOD	biochemical oxygen demand. A measure of the presence of degradable organic matter, taking into account the biological conversion of ammonia to nitrate
BODF	biochemical oxygen demand of a filtered sample
bund	a wall around a tank to contain its contents in the case of a leak
condy	Conductivity, an indication of the level of dissolved salts in a sample, usually measure at 20˚C and expressed in mS/m
DO	dissolved oxygen
DRP	dissolved reactive phosphorus
E.coli	*Escherichia coli,* an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as the number of colonies per 100 ml
Ent	Enterococci, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as the number of colonies per 100 ml
FC	Faecal coliforms, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as the number of colonies per 100 ml
fresh	elevated flow in a stream such as after heavy rainfall
g/m^3	grammes per cubic metre, and equivalent to milligrammes per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures
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
l/s	litres per second
MCI	macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats
MfCI	microfloral community index: a numerical indication of the state of treatment pond biological life which takes into account the sensitivity of floral taxa to wastewater quality
mS/m	millisiemens per metre
mixing zone	the zone below is a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point
NH_4	ammoniacal nitrogen, normally expressed in terms of the mass of nitrogen (N)
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 subsequent amendments
$SQMCI_S$	semiquantitative macroinvertebrate community index (see MCI) but taking into account each taxon's abundance
SS	suspended solids
taxa richness	number of taxa found in the macroinvertebrate community at a site
temp	temperature, measured in °C
turb	turbidity, expressed in NTU
UI	Unauthorised Incident
UIR	Unauthorised Incident Register – contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan

* an abbreviation for a metal or other analyte may be followed by the letter '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

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 Monitoring Manager - Environmental Quality, K Brodie
From Scientific Officer, C R Fowles
Doc No 1321172
Report No CF604
Date March 2014

Summer biomonitoring of the Patea River in relation to the Stratford District Council's upgraded Wastewater Treatment Plant, February 2014

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 in the Patea River (illustrated in Figures 1 and 2), on 18 February 2014.

These sites were:

Site No	Site code	GPS reference	Location
1	PAT 000315	E1711801 N5644382	Swansea Road bridge (upstream of landfill and oxidation ponds' discharge)
2	PAT 000330	E1712403 N5644580	Upstream of WWTP discharge (and downstream of landfall)
3a	PAT 000350	E1712956 N5644292	Approximately 130 m downstream of the WWTP new outfall
4	PAT 000356	E1714497 N5645112	Approximately 1 km upstream of the Kahouri Stream confluence

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 sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using protocol P1 of

NZMWG protocols for sampling macroinvertebrates in wadeable streams (Stark et al, 2001). Macroinvertebrate taxa found in each sample were recorded as:

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

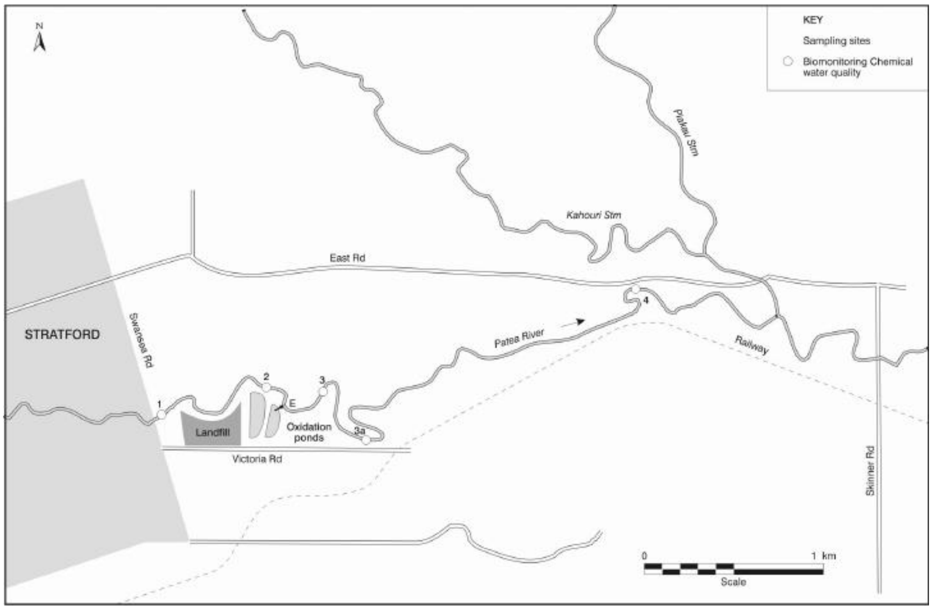

Figure 1 Biomonitoring sites in the Patea River in relation to Stratford landfill and oxidation ponds discharge

Figure 2 Aerial photo of site and location of sampling sites

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

A semi-quantitative MCI value, 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 and discussion

This survey was performed on 18 February, 2014 during a low recession flow, 28 days after a fresh in excess of 3x median flow and 44 days after a fresh in excess of 7x median flow during a dry late summer period. River flow at Skinner Road was 0.94 m^3/sec representing a flow well below the average monthly mean February flow (2.78 m^3/sec) but above the minimum mean monthly flow for February (0.64 m^3/sec) recorded for the period 1978-2013. This flow was slightly higher (by about 0.07 m^3/sec) than the flow at the time of the previous biomonitoring survey in late summer, 2013.

Periphyton mats were patchy at sites 1 and 2 and widespread at sites 3a and 4, while filamentous algal growth was patchy at sites 3a and 4 with none recorded at sites 1 and 2. Patchy moss was recorded on the stony substrate at all sites except site 4. The algal component of the oxidation ponds discharge appeared moderate with rapid dispersion in the river downstream of the outfall and no algae were trapped or deposited amongst the river substrates at either of the downstream sites. Only site 3a did not have partial shading. Water temperatures ranged from 15.6°C to 16.9°C over the four sites at the time of this early to mid morning survey. The discharge via the rock rip-rap at the new outfall was slightly turbid and pale green in appearance and caused a slight visual increase in turbidity in the river at sites 3a and 4 downstream of the outfall.

Macroinvertebrate communities

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

Table 1 Summary of macroinvertebrate taxa numbers and MCI values for previous surveys performed between February 1985 and November 2013

Site	No of surveys	Taxa numbers		MCI Values	
		Range	Median	Range	Median
1	43	20-33	26	98-130	110
2	31	11-36	24	96-119	105
3a	7	21-29	23	100-110	101
4	38	17-31	24	82-116	98

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 2 Macroinvertebrate fauna of the Patea River in relation to Stratford District Council WWTP discharge and closed landfill leachate discharges sampled on 18 February, 2014

Taxa List	Site Number	MCI score	1	2	3a	4
	Site Code		PAT000315	PAT000330	PAT000350	PAT000356
	Sample Number		FWB14128	FWB14129	FWB14130	FWB14131
PLATYHELMINTHES (FLATWORMS)	*Cura*	3	-	-	R	-
ANNELIDA (WORMS)	Oligochaeta	1	C	R	VA	A
MOLLUSCA	*Potamopyrgus*	4	R	R	-	R
CRUSTACEA	Cladocera	5	-	-	C	-
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	R	C	R	R
	Coloburiscus	7	VA	A	A	A
	Deleatidium	8	XA	XA	VA	VA
	Nesameletus	9	A	A	A	C
	Zephlebia group	7	R	R	-	-
PLECOPTERA (STONEFLIES)	*Stenoperla*	10	R	-	-	-
	Zelandoperla	8	C	R	R	R
HEMIPTERA (BUGS)	*Saldula*	5	-	-	R	-
COLEOPTERA (BEETLES)	Elmidae	6	A	A	A	C
	Hydraenidae	8	A	R	C	C
MEGALOPTERA (DOBSONFLIES)	*Archichauliodes*	7	A	C	A	A
TRICHOPTERA (CADDISFLIES)	*Aoteapsyche*	4	VA	VA	VA	XA
	Costachorema	7	A	A	A	A
	Hydrobiosis	5	C	C	C	A
	Neurochorema	6	R	-	R	-
	Psilochorema	6	R	-	-	-
	Olinga	9	R	-	-	-
	Oxyethira	2	R	-	C	R
	Pycnocentrodes	5	R	-	C	R
	Triplectides	5	-	R	-	-
DIPTERA (TRUE FLIES)	*Aphrophila*	5	VA	A	A	A
	Chironomus	1	-	-	C	-
	Maoridiamesa	3	A	A	VA	VA
	Orthocladiinae	2	A	A	XA	VA
	Polypedilum	3	-	R	R	-
	Tanypodinae	5	R	-	R	R
	Tanytarsini	3	R	R	C	C
	Empididae	3	-	R	R	C
	Muscidae	3	R	-	C	A
	Austrosimulium	3	C	A	R	C
	Tanyderidae	4	-	-	R	-
ACARINA (MITES)	Acarina	5	-	-	-	R
		No of taxa	27	22	29	24
		MCI	111	105	95	100
		SQMCIs	6.8	6.9	3.4	4.3
		EPT (taxa)	14	10	10	9
		%EPT (taxa)	52	45	34	38
'Tolerant' taxa	'Moderately sensitive' taxa		'Highly sensitive' taxa			

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

The results from the current survey (Table 2) indicated faunal richnesses ranging from two taxa below (site 2) to 6 taxa above (site 3a) median richnesses (ranging from 22 to 29 taxa) present at the four river sites. These taxa numbers were well within ranges previously recorded (Table 1) at the three longer established sites (1, 2 and 4). The richness at the most recently established site (site 3a) was equal with the maximum richness recorded by the few surveys at this site to date.

The range of taxa richnesses was generally typical of richnesses recorded by previous surveys which have been recorded under summer, more widespread periphyton cover and tending toward low flow conditions.

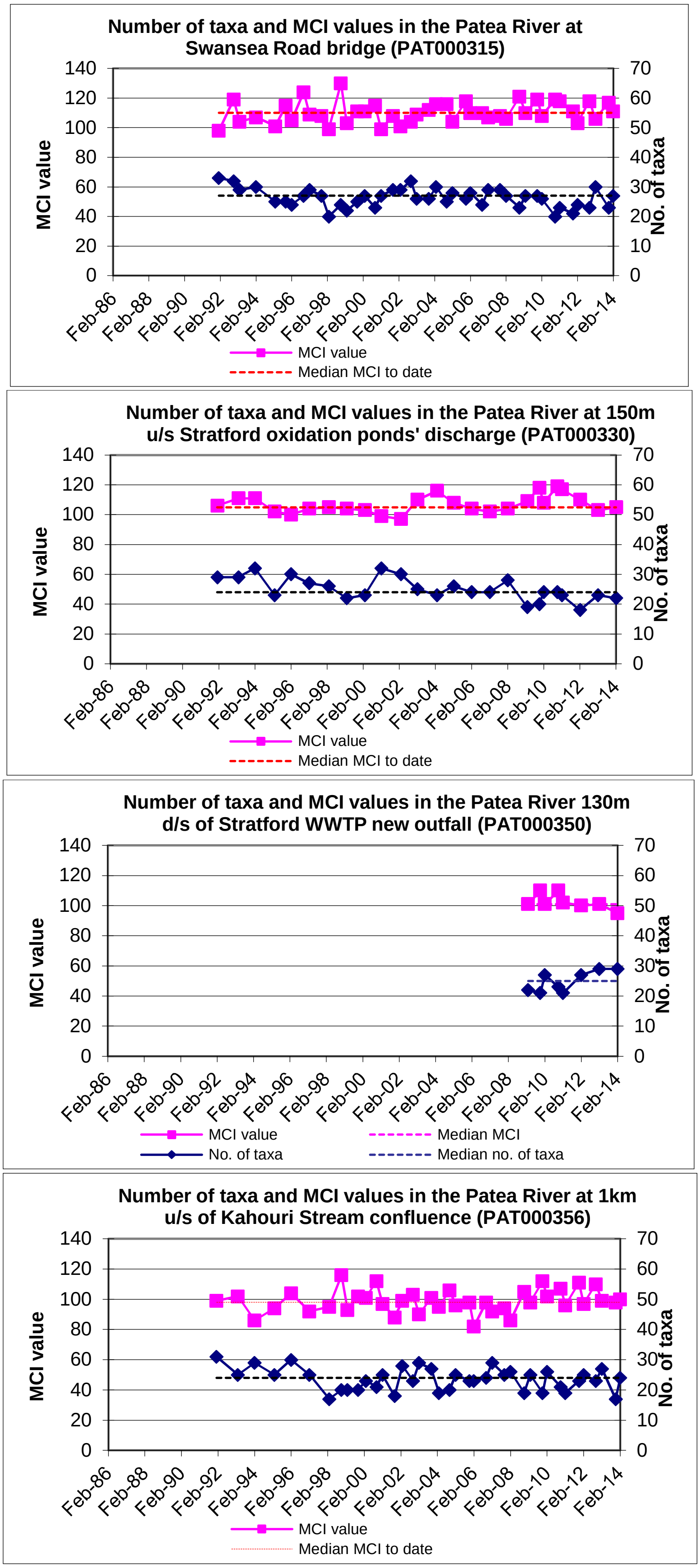

Figure 3 Taxa richness and MCI scores recorded to date at the Patea River sites

Sites upstream of the WWTP discharge (sites 1 and 2)

The macroinvertebrate communities of this reach of the river upstream of the WWTP discharge (and adjacent to the landfill) were of moderately high richness (22 to 37 taxa) and characterised by up to three 'highly sensitive' taxa [mayflies (extremely abundant *Deleatidium*; and *Nesameletus*) and hydraenid beetles]; up to five 'moderately sensitive' taxa [mayfly (*Coloburiscus*), elmid beetles, dobsonfly (*Archichauliodes*), free-living caddisfly (*Costachorema*), and cranefly (*Aphrophila*)]; and up to four 'tolerant' taxa [net-building caddisfly (*Aoteapsyche*), midges (orthoclads and *Maoridiamesa*), and sandfly (*Austrosimulium*)]. These dominant taxa were very similar to those dominant at the time of the previous summer survey (CF575) but one more in number of 'moderately sensitive' and two more in number of 'tolerant' taxa. In comparison with spring surveys at the times of past summer surveys, a lower ratio of 'sensitive' to 'tolerant' taxa generally has characterised these communities associated with the extensive periphyton assemblages typical of the mid and lower reaches of Taranaki rivers and streams during periods of low recession flows. The presence of up to six 'highly sensitive' taxa at these two sites within this surveyed reach of the river was indicative of relatively good preceding physicochemical water quality upstream and adjacent to the Stratford landfill and WWTP under summer, low recession flow conditions. MCI scores (111 and 105 units) reflected the significant proportions of 'sensitive taxa (67% and 59%) comprising the fauna at these sites, with these scores within one unit of medians of previously recorded scores (Table 1). These scores were 4 units (site 1) and a 10 units (site 2) lower than scores predicted for sites at these altitudes (280 to 300 m asl) but 3 to 8 units higher than predicted for sites this distance from the National Park (12.9 to 13.6 km) in ringplain rivers (Stark & Fowles, 2009). These scores categorised these sites as having 'good' generic river health (TRC, 2014) at the time of this summer survey, and not different to that expected under summer low flow conditions at these two sites (Figure 2). The single significant difference in individual taxon abundance between sites (very similar $SQMCI_s$ scores), together with a typical relatively small downstream decrease in MCI score, were indicative of no recent impacts of the adjacent closed landfill on the macroinvertebrate communities of this reach of the river.

Sites downstream of the WWTP new discharge outfall (sites 3a and 4)

These sites' macroinvertebrate communities differed in taxa richnesses by five taxa and were within the range and/or higher than richnesses at the two sites upstream of the outfall. The communities were characterised by up to two 'highly sensitive' taxa [very abundant mayfly (*Deleatidium*); and another mayfly (*Nesameletus*)]; up to six 'moderately sensitive' taxa [mayfly (*Coloburiscus*), elmid beetles, dobsonfly (*Archichauliodes*), free-living caddisflies (*Costachorema* and *Hydrobiosis*), and cranefly (*Aphrophila*)]; and up to five 'tolerant' taxa [oligochaete worms, net-building caddisfly (*Aoteapsyche*), muscid flies, and midges (orthoclads and *Maoridiamesa*)]. There were few significant differences between sites in characteristic taxa with two 'tolerant' taxa (cladocerans and *Chironomus* midges) decreasing in abundance at site 4. However, there were several significant differences in individual taxon abundances between the two sites (2 and 3a) nearest to the WWTP discharge. These included increase abundances in two 'moderately sensitive' taxa (cladocerans and stony-cased caddisfly) and five 'tolerant' taxa (oligochaete worms, algal-piercing caddisfly, *Chironomus* and orthoclad midges, and muscid flies); some of which are wastewater pond fauna with others associated with the increased periphyton streambed cover. Decreases in the proportion of 'sensitive' taxa (55% and 58% of faunal numbers) resulted in decreases (of 10 and 5 units) in the MCI scores between site 2 (upstream of the WWTP discharge) and sites 3a and 4 (95 and 100 units). At site 3a this score was close to significantly lower than the scores obtained in the river reach immediately upstream of the discharge from the WWTP but not at site 4 particularly taking into account the distance of this site further downstream. These differences in scores were indicative of some recent impacts of the upgraded WWTP wastes discharge on the macroinvertebrate fauna in the surveyed reach of the Patea River, although downstream sites' scores were within 6 units of the relevant medians of past scores. The score at site 3a was 5 MCI units lower than recorded previously (by seven surveys) at this site although it was only one unit lower than the historical minimum recorded at the site (2) upstream of the discharge. There was a minimal difference in MCI scores (an increase of 5 units) between the two adjacent downstream sites (3a and 4) and the overall fall in MCI scores (11 units) over a distance of 4.3 km between the 'control' site (1) and furthest downstream site (4) was insignificant given the distance between these two sites. Several more subtle changes in community compositions resulted in a significant decrease in $SQMCI_s$ score of 3.5 units immediately downstream of the new outfall (site 3a) but some recovery in $SQMCI_s$ score (increase of 0.9 unit) at site 4 predominantly was due to increased abundances within three 'tolerant' (dominant) taxa and decreased abundance within one dominant 'highly sensitive' mayfly taxon.

The MCI scores categorised sites 3a and 4 as having 'fair' and 'good' generic river health (TRC, 2014) at the time of this summer survey, which was consistent with river health often recorded by previous surveys. These scores (95 and 100 units) were a significant 17 units and 10 units lower than predicted for sites at these altitudes (265 and 250 m asl) in ringplain rivers but insignificantly 6 units below to equal with predicted scores for these sites 14.8 km and 17.2 km downstream of the National Park boundary (Stark and Fowles, 2009).

The 11 unit difference in MCI scores between sites 1 ('control') and site 4 over a river distance of 4.3km represented an insignificant 8 unit larger difference than predicted for this reach of the Patea River some 13 to 17 km below the National Park boundary (Stark and Fowles, 2009), but the 10 units difference between sites (2 and 3a) adjacent to the discharge was indicative of some recent impacts of the WWTP point source discharge under summer, low flow conditions.

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 during a period of summer low recession flow conditions. This was consistent with the visual absence of such growths noted at all sites at the time of the survey. Also there was no increase in algal deposition at the site downstream of the new relocated outfall and benthic algal substrate cover was mainly patchy over most of the reach surveyed.

Conclusions

Typical macroinvertebrate communities' richnesses were surveyed at the four Patea River sites during a low flow recession period in the latter part of summer and under conditions of patchy to widespread mats of periphyton river substrate cover and patchy filamentous algae. This summer survey was performed as a component of the scheduled monitoring programme in relation to the assessment of compliance of the relatively recently upgraded WWTP with consent conditions. Minor discolouration of the river's reach below the WWTP's newly located discharge was apparent and there was no algal deposition on the river bed, as a result of the lower algal concentration in the upgraded partitioned second oxidation pond cells. Faunal communities upstream of the WWTP discharge had higher percentages of 'sensitive' taxa whereas communities at downstream sites had slightly increased percentages of 'tolerant' taxa. However, there were subtle differences in dominant (characteristic) taxa between these four sites' communities with a tendency toward proportionately slightly more 'tolerant' dominant taxa in a downstream direction.

MCI scores were similar to scores generally typical of mid-catchment ringplain rivers in Taranaki, particularly those found during summer low flow conditions and showed a moderate range (16 units) along the four sites through the 4.5 km reach of the Patea River. No impacts of seepage from the Stratford landfill (situated between sites 1 and 2) were indicated by the faunal composition at these sites. An increase in number of 'tolerant' taxa, together with slightly fewer 'sensitive' taxa downstream of the WWTP's recently relocated discharge, resulted in lower MCI scores at these sites, which were insignificant over the distance of the furthest site downstream but more significant in the immediate vicinity of the discharge before some recovery further downstream. There were several significant changes in individual taxon abundances but fewer amongst dominant taxa as reflected in a reduction in $SQMCI_s$ value between sites 2 and 3a of 3.5 units and sites 2 and 4 of 2.6 units. These lower $SQMCI_s$ scores at sites 3a and 4 (up to 2.4 km downstream of the wastewater discharge) reflected lower abundances in certain 'highly sensitive' taxa and increased numbers of 'tolerant' oligochaete worms and midges in particular.

No 'undesirable heterotrophic growths were found on the substrate of the river at the sites surveyed downstream of the discharge under these summer low recession flow conditions and there was no apparent deposition of oxidation ponds' algae on the river bed.

Effects of discharges on the macroinvertebrate communities of the Patea River vary in relation to the treatment provided by the WWTP, dilution available in the receiving waters, preceding climatic conditions and the microfloral component of the wastewaters. Such variations in effects have been documented by previous summer biomonitoring surveys with this summer survey illustrating some effects (bordering on significant at the boundary of the mixing zone), during a low recession flow period, below the discharge from the relocated rock riprap outfall following the WWTP upgrade.

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.

This scheduled summer, 2014 macroinvertebrate survey (which has complemented previous additional assessments of the upgraded system performance) indicated that the discharge of treated oxidation ponds wastes from the upgraded Stratford WWTP system had had localised effects on the macroinvertebrate communities of the Patea River under summer low river flow conditions prior to recovery at the site 2.4 km downstream of the discharge. Some subtle changes in macroinvertebrate communities' compositions were recorded between the upstream 'control' site and sites downstream of the newly relocated outfall from the WWTP

but no major changes in community structures. However, there were no significant effects associated with seepages from the closed landfill site.

The macroinvertebrate communities of the Patea River contained slightly higher proportions of 'sensitive' taxa at the two upstream sites. 'Tolerant' taxa were more predominant proportionately at the two sites downstream of the relocated WWTP discharge. Dominant taxa composition was relatively similar at all four sites although proportionately tending toward more 'moderately sensitive' and 'tolerant' taxa in a downstream direction, through the surveyed reach of the river, however. Taxonomic richnesses (numbers of taxa) varied by 7 taxa at the four sites in this summer survey and were slightly lower at all but one of these sites than those found by the previous summer (2013) survey. However, similar proportions of 'tolerant' taxa were present at sites downstream of the WWTP discharge compared to the previous summer survey under slightly more widespread periphyton cover of the river bed at the time of this latest survey.

MCI and $SQMCI_S$ scores indicated that the upstream stream communities were of 'good' health (TRC, 2014) and typical of conditions recorded in summer in the mid reaches of similar Taranaki ringplain rivers. Stream communities downstream of the WWTP discharges were of 'fair' to 'good' generic health and were similar to those documented in this reach by most previous surveys during summer recession low flow conditions.

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