South Taranaki District Council
Hawera Municipal Oxidation Ponds System
Monitoring Programme
Annual Report
2015-2016

Technical Report 2016-46

ISSN: 1178-1467 (Online)
Document: 1735712 (Word)
Document: 1746736 (Pdf)

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November 2016

Executive summary

The South Taranaki District Council (STDC) operates seven municipal oxidation pond systems within the district of South Taranaki. This report, for the period July 2015 to June 2016, focusses on the oxidation ponds system located in Hawera, which comprises an anaerobic pond, two primary/facultative ponds in parallel, and a maturation pond. This report for the period July 2015 to June 2016 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess STDC's environmental performance during the period under review. The report also details the results of the monitoring undertaken and assesses the environmental effects of STDC's activities in relation to the Hawera Wastewater Treatment Plant (HWWTP).

STDC holds two resource consents for the site which include a total of 26 conditions setting out the requirements that STDC must satisfy. STDC holds consent 5079-1 for operation of the Hawera oxidation ponds system, and consent 7520-1 to discharge to an unnamed stream in the event of high rainfall.

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

The Council's monitoring programme for the year under review included five inspections, during which effluent samples were collected from the aerobic ponds and maturation pond. Shellfish and seawater samples were also collected during the year, and two marine ecological surveys were undertaken. STDC provided the Council with continuous dissolved oxygen (DO) and outflow data as well as an annual report.

Monitoring of the HWWTP found that one of the two aerobic ponds failed to maintain the required DO concentration for a sufficient proportion of the year. However, the margin of this non-compliance was small, and this was the only significant issue that was noted during monitoring period. Monitoring did not detect any adverse effects in the receiving environment that could be attributed to the exercise of consent 5079-1. There were no unauthorised incidents reported at the HWWTP site during the period under review.

During the year, STDC demonstrated a good level of environmental performance and a high level of administrative compliance with resource consents held for the HWWTP.

For reference, in the 2015-2016 year, 71% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 24% demonstrated a good level of environmental performance and compliance with their consents.

In terms of overall environmental and compliance performance by the consent holder over the last several years, this report shows that the consent holder's performance remains at a good level.

This report includes recommendations for the 2016-2017 year.

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1. Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is for the period July 2015 to June 2016 by the Council describing the monitoring programme associated with resource consents held by South Taranaki District Council (STDC). STDC operates the Hawera Wastewater Treatment Plant (HWWTP) situated on Beach Road in Hawera.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consents held by STDC that relate to the discharge of wastewater from the HWWTP into the Tasman Sea via the Whareroa outfall (the Outfall). This is the 23rd report to be prepared by the Council to cover the discharge of municipal wastewater from Hawera.

1.1.2 Structure of this report

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

- consent compliance monitoring under the RMA and the Council's obligations;
- the Council's approach to monitoring sites though annual programmes;
- the resource consents held by STDC;
- the nature of the monitoring programme in place for the period under review; and
- a description of the activities and operations conducted at the HWWTP.

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

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

Section 4 presents recommendations to be implemented in the 2016-2017 monitoring year.

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

1.1.3 The Resource Management Act 1991 and monitoring

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

(a) the neighbourhood or the wider community around an activity, and may include cultural and social-economic effects;
(b) physical effects on the locality, including landscape, amenity and visual effects;
(c) ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;

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

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

1.1.4 Evaluation of environmental and administrative performance

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

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

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

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

Environmental Performance

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

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

For example:

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

- **Improvement required**: Likely or actual adverse effects of activities on the receiving environment were more than minor, but not substantial. There were some issues noted during monitoring, from self reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent minor non-compliant activity could elevate a minor issue to this level. Abatement notices and infringement notices may have been issued in respect of effects.

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

Administrative performance

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

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

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

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

For reference, in the 2015-2016 year, 71% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 24% demonstrated a good level of environmental performance and compliance with their consents

1.2 Treatment plant description

Up until February 2001, effluent from the HWWTP was discharged into a small unnamed coastal stream and across the foreshore before entering the Tasman Sea. Consent 1335-3 authorised the discharge of up to 10,000 m^3/day of treated wastewater from the municipal ponds system. That consent lapsed during the 2000-2001 monitoring period. Consent 5079-1 was granted in February 2001, for the discharge of the same volume of wastewater from the refurbished ponds system into the Tasman Sea via the Outfall, located approximately 3 km to the southeast of the plant.

Currently, the oxidation pond system at the HWWTP treats both industrial and domestic wastes from Hawera and Eltham. Partially treated (screened) wastewater from meat processors Silver Fern Farms and Graeme Lowe Protein Limited are treated in an anaerobic lagoon before discharging into the oxidation pond system (Figure 1).

Since 2000, the ponds have been reconfigured several times. Prior to November 2000, the two primary ponds (Pond 1 and Pond 2) operated in parallel. After November 2000, the two ponds were operated in series to increase treatment efficiency, with the treated wastewater from Pond 2 discharging to a pipeline that transferred the final effluent to the Outfall. However, since 2010, the ponds changed back to operate in parallel, with effluent from these two ponds now passing into a tertiary/maturation pond (divided into 4 cells) which is the final pond system (Figure 1).

Since June 2010, primary treated wastewater from the single oxidation pond at Eltham has discharged intermittently to the HWWTP, at approximately 90 m^3/hour. Raw domestic wastewater from Hawera and primary wastewater from Eltham combine on site at the HWWTP with the anaerobic lagoon effluent and are then split 60:40 to enter the two primary ponds (Figure 1). Both Pond 1 and Pond 2 have surface aerators. The hydraulic residence time (HRT) for Pond 1 is approximately 20 days (NIWA 2012).

The effluent from both Ponds 1 and 2 combines at the outlet points from each pond and flows through to the new maturation pond, constructed in 2009 (Photo 1). The maturation pond has three baffles dividing the pond into four cells to increase the residence time within the pond. The total HRT for the ponds is estimated to be approximately 60 days (NIWA 2012). Final treated effluent from the maturation pond is gravity-fed to the pump station from where it is pumped (preferentially at night) via a 2.8 km pipeline, to the mixing chamber on the cliff top and combines with wastewater from the Whareroa dairy factory for discharge via the 1,845 m long Outfall.

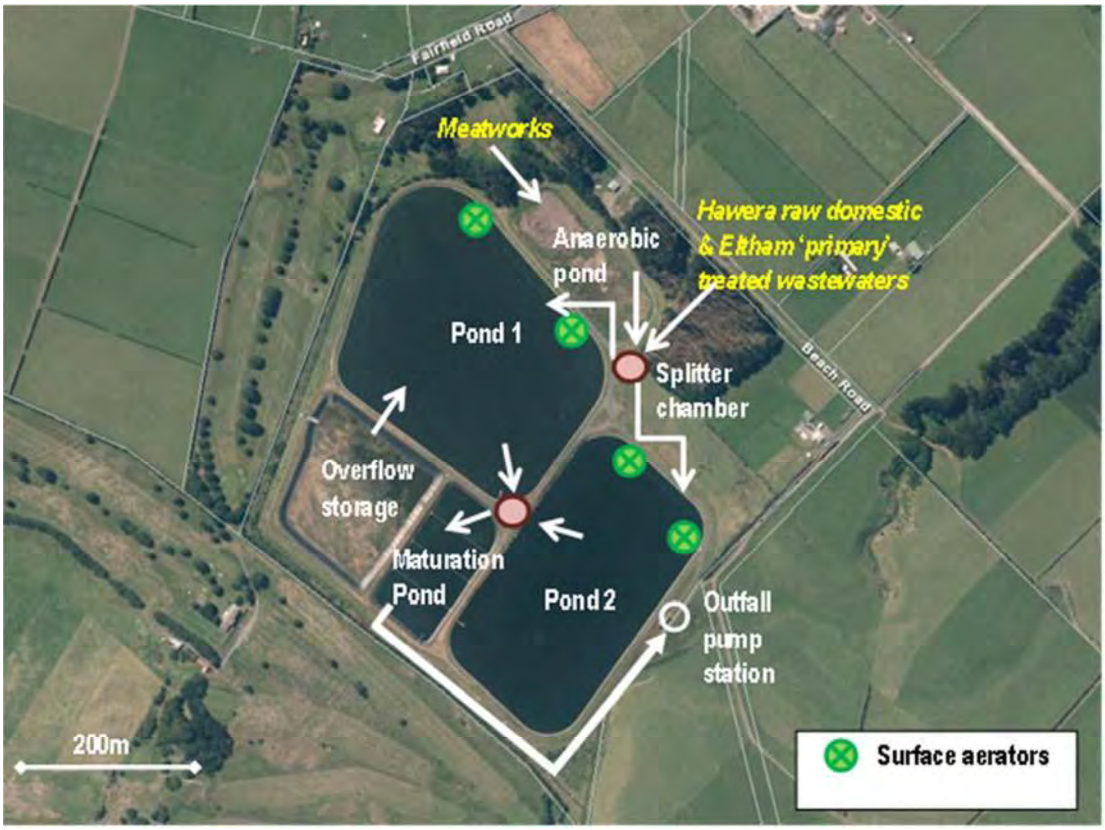

Figure 1 Configuration of the HWWTP (adapted from NIWA 2012)

During high rainfall events, the maturation pond can overflow into the neighbouring emergency overflow/storage detention pond (capacity approximately 65,000 m^3, NIWA 2012) with wastewater then being passed back into Pond 1. Consent 7520-1 has been granted to allow overflow from the detention area into the local stream that borders the HWWTP. Since being granted in 2009, this consent has not yet needed to be exercised.

Photo 1 Aerial photograph of the Hawera pond system, 8 March 2016

STDC's wastewater treatment staff undertake frequent, regular maintenance and operational surveillance surveys of the HWWTP system.

1.3 Resource consents

1.3.1 Water discharge permit

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

STDC holds consent **5079-1** to allow the discharge of up to 12,000 m^3/day (seven day average discharge) of treated municipal wastes generated in the Hawera and Eltham townships, including treated meat processing and dairy industry wastes, through a combined outfall into the Tasman Sea near Hawera (Appendix 1).

The consent was originally granted on 22 March 1998. However, in June 2003 STDC applied to change consent 5079-1 to increase the discharge volume from 10,000 m^3/day to 12,000 m^3/day to allow for the additional treatment and discharge of partially treated industrial and domestic wastewater from Eltham. This wastewater would be treated in the HWWTP, pumped to the Outfall and then discharged to the Tasman Sea.

This consent required pre-hearing meetings, held during 2004-2005 and 2005-2006, due to submissions against the consent. The consent variation was the subject of a formal hearing with the decision to grant the variation subsequently appealed by one submitter early in the 2006-2007 period.

A meeting was held on 16 July 2007 between the Council, STDC and authorised representatives of Inuawai - Okahu and Kanihi - Umutahi hapu. Positive progress was made with agreement that a scheduled mediation meeting on 20 August 2007 would not be required. An agreed deadline for reaching a conclusion on the state of the hapu appeal was 30 August 2007. If an agreement was not reached by this date then it was agreed that a hearing would be requested, otherwise the Hapu's counsel would submit a memorandum to the Court requesting that the Hearing Committee's decision stands.

On 1 August 2007, STDC wrote to iwi and the Council committing to: work on decreasing storm water ingress to the Hawera sewerage system; testing the permeability of the detention storage pond; not exceed the 12,000 m^3/day volume of the consent; and undertaking the necessary work under the consent (condition 10) to review in 2009 the best practicable option for treatment and disposal of wastewater, including the option of disposal to land.

Iwi agreed to withdraw the appeal, and this was lodged with the registrar of the Environment Court on 19 September 2007. The appellants wished to inform the Court that the discharge of treated human waste and industrial pollutants to the sea is, and always will be, culturally abhorrent to both hapu.

On 23 October 2007 the Environment Court recommended to the Minister of Conservation that the decision to grant the changes to consent 5079-1 stand. Approval was sought from the Department of Conservation (Wanganui branch) and the variation to consent 5079-1 was granted on 19 December 2007.Conditions on the consent increased from 14 to 17 to reflect these changes.

On 29 June 2010 amendments were made to Conditions 1 and 2 in order to comply with pond best practice guidelines and bring in line with other wastewater treatment facilities in South Taranaki.

Condition 1 was altered slightly to include the words 'during daylight hours' so that the condition reads:

"The consent holder shall properly and efficiently maintain and operate the oxidation ponds system, with aerobic ponds maintained in an aerobic condition during daylight hours."

Condition 2 was changed to include a time period where the dissolved oxygen (DO) is to be maintained above 2 g/m^3, so that the condition reads:

"For 90% of the time between 1100 and 1400 hours the dissolved oxygen level in the aerobic ponds, and in the waste water immediately prior to discharge, shall be maintained at or above 2g/m^3 and that the consent holder shall monitor the dissolved oxygen levels in the aerobic ponds, on a continuous basis, and supply the results to the Chief Executive, Taranaki Regional Council, upon request."

There are 17 special conditions on coastal permit 5079-1.

Conditions 1 and 2 both deal with maintaining aerobic conditions in the ponds.

Conditions 3, 4, 5 and 7 deal with the discharge including effects on the Tasman Sea beyond the mixing zone, effects on shellfish on the shoreline, volume of the wastewater and management of the discharge.

Condition 6 requires the consent holder to advise and consult with the Council should trade wastes be accepted in to the wastewater system, as it may be necessary to place limits on toxic or hazardous components in the discharge.

Conditions 8, 9 and 10 deal with reporting, including a contingency plan (to be reviewed annually), an annual report outlining the performance of the system and compliance with the consent, and a report on the best practicable option for treatment and disposal of wastewater generated at Hawera and Eltham (to be provided by December 2009).

Condition 11 requires the reduction of stormwater infiltration into the system, and upgrade of the Eltham and Hawera wastewater treatment plants and the construction of a pipeline for the transfer of sewage from Eltham to Hawera.

Condition 12 requires reports on the implementation of condition 11, and condition 13 requires the consent holder and staff of the Council to meet at least once per year, with representatives from iwi, submitters and other interested parties, to discuss any matters relating to the consent.

Conditions 14 and 15 both deal with the establishment of a monitoring programme to analyse effects of the exercise of the consent on the intertidal reefs and coastal water quality adjacent to the discharge.

Condition 16 requires the consent holder to install a screen to prevent the discharge of undisintegrated solids into and from the oxidation pond.

Condition 17 deals with review of the consent.

The consent expired on 1 June 2015, however, in accordance with Section 124 of the RMA, the consent holder applied to renew the consent prior to its expiry, and therefore, continues to operate under the expired consent.

STDC holds consent **7520-1** to discharge, as a consequence of high rainfall, partially treated wastewater from the HWWTP into Unnamed Stream 22. The consent was originally granted on 4 November 2009.

There are nine special conditions on coastal permit 7520-1.

Condition 1 states that the discharge shall only occur as a consequence of high rainfall events.

Conditions 2 and 3 relate to the holding capacity of the pond, and modifications to the plant.

Conditions 4, 5 and 6 address record keeping, adopting the best practicable option and notification of the Council during and after overflow events.

Conditions 7 and 8 outline the requirements for STDC to supply a contingency plan and for the Council to undertake necessary monitoring in response to any discharges.

Condition 9 deals with review of the consent.

The consent is due to expire on 1 June 2027.

These permits are attached to this report in Appendix I.

1.4 Monitoring programme

1.4.1 Introduction

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

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

The monitoring programme for the HWWTP over the 2015-2016 period consisted of five primary components.

1.4.2 Programme liaison and management

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

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

1.4.3 Inspections

The HWWTP was visited five times during the monitoring period. With regard to consents for the abstraction of or discharge to water, the main points of interest were plant processes with potential or actual discharges to receiving watercourses, including contaminated stormwater and process wastewaters. Air inspections focused on plant processes with associated actual and potential emission sources and characteristics, including potential odour, dust, noxious or offensive emissions. Sources of data being collected by STDC were identified and accessed, so that performance in respect of operation, internal monitoring, and supervision could be reviewed by the Council. The neighbourhood was surveyed for environmental effects.

1.4.4 HWWTP monitoring

Physical and chemical properties of wastewater in the HWWTP were measured in order to ascertain plant performance during the 2015-2016 monitoring period. The monitoring was undertaken by the Council and STDC.

The Council collected samples from Ponds 1 and 2 on five occasions during the year. These samples were analysed for temperature, DO and chlorophyll *a*. In order to satisfy Condition 2 of consent 5079-1, STDC also recorded continual DO measurements over the year in Ponds 1 and 2.

The Council collected samples of the ponds' combined effluent (from the maturation cells) on five occasions during the year. These samples were analysed for pH, conductivity, uninhibited biochemical oxygen demand (BOD; total, carbonaceous and filtered), total grease, suspended solids, ammonia, nitrogen, phosphorus, turbidity, faecal coliform, enterococci.

Some additional bacteriological monitoring of the effluent from the maturation cells was undertaken by the Council in relation to the shoreline water quality surveys.

Additional samples were collected from the maturation cells and analysed for metals on two of the sampling occasions.

The volume of wastewater discharged from the plant was also subjected to continuous monitoring by STDC, as required by Condition 5 of consent 5079-1.

1.4.5 Receiving environment monitoring

During the monitoring period the Council conducted two intertidal surveys at four sites to assess the effect of discharges from the Outfall on intertidal communities. The surveys were undertaken near the peak of the dairy season in October/November 2015, and in the post-peak period in March 2016.

The Council carried out two complete microbiological surveys of water quality at five shoreline sites and one river site in relation to discharges of municipal wastewater (also sampled) through the Outfall. One reduced microbiological water quality survey (incorporating three sites) was also undertaken. Faecal coliforms counts were obtained using the most probable number (MPN) method, as is recommended for shellfish gathering waters (Ministry for the Environment and Ministry of Health, 2003).

Microbiological surveys of shellfish (green lipped mussel) tissue quality were carried out on two occasions at four shoreline sites in relation to discharges of municipal wastewater through the Outfall. Shellfish tissue analysis for trace metals was carried out once during this period.

1.4.6 Additional reporting requirements

Consent conditions require STDC to provide various reports during the monitoring period. These reports were reviewed by Council staff.

2. Results

2.1 Inspections

Inspections of Hawera wastewater treatment system were carried out on five occasions at approximately two-monthly intervals from August to April. During these inspections, the condition of the pond system was assessed. Each inspection, field measurements of DO in both oxidation ponds were collected. Samples were also collected from both oxidation ponds and the maturation pond during each inspection.

Odours ranging from noticeable to strong were detected downwind of the anaerobic lagoon during every inspection. No odours were detected beyond the site boundary.

The step screen was found to be operating effectively during each inspection. Odours were often detected emanating from the screening area.

Pond one received doses of 'biobugs' over the monitoring period, as the Parklink desludging programme continued (Photo 2). No dosing took place in pond two (desludging concluded in 2014). Both ponds appeared dark green and turbid during the majority of the inspections. The ponds received varying degrees of aeration over the course of the inspections.

Photo 2 Parklink staff undertaking a sludge index survey in pond 1

The level of effluent in the maturation cells was highest during the winter inspection. The cells appeared dark green during the majority of the inspections.

The retention pond had received and contained an effluent overflow prior to the August inspection. This was pumped back into pond one. The retention pond was otherwise found to be dry during the inspections.

No issues were noted upon inspecting the old coastal outfall and perimeter drains.

2.2 HWWTP monitoring

2.2.1 Dissolved oxygen

Conditions 1 and 2 of consent 5079-1 require that the ponds are maintained in an aerobic condition, with the DO maintained at a level at, or exceeding, 2 g/m^3 for 90% of the time during the hours of 11:00 to 14:00.

The photosynthetic activity of the microalgae within the ponds is a major factor affecting variation in pond DO concentrations. However, fluctuating industrial loadings, operation of the mechanical aeration system and weather conditions can also influence DO concentrations in ponds systems.

Results from the DO field measurements recorded by the Council are presented in Table 1.

The DO saturation from these field measurements ranged from 30 to 120% in Pond 1, and from 22 to 38% in Pond 2. The lowest DO concentration was recorded in Pond 2 in February (1.8 g/m^3). This concentration was recorded at 08:45, so the 2 g/m^3 limit stated in Condition 2 was not applicable. It's important to note that all of these samples were collected in the morning and only one set was collected within the time period specified in condition 2 (11:00-14:00). Lower DO concentrations would be expected earlier in the morning due to shorter hours of daylight and less time for oxygen accumulation due to photosynthesis.

Table 1 Council DO measurements from the surface of HWWTP oxidation ponds (Ponds 1 and 2) for the 2015-2016 monitoring year

Date	Pond 1				Pond 2			
	Time (NZST)	Temp (°C)	Dissolved oxygen		Time (NZST)	Temp (°C)	Dissolved oxygen	
			Concentration (g/m^3)	Saturation (%)			Concentration (g/m^3)	Saturation (%)
10-Aug-15	11:05	8.5	5.2	45	1115	9.6	3.9	34
13-Oct-15	10:40	15.6	5.8	59	1045	15.6	3.8	38
16-Dec-15	09:30	19.5	2.8	30	0945	19	3.5	37
12-Feb-16	08:30	22.1	10.4	120	0845	23	1.8	26
8-Apr-16*	10:30	18	8.5	-	1045	18.2	4.7	-
14-Jun-16	10:00	11.1	5.3	48	1015	11.6	2.4	22

* Measurements recorded using STDC field meter

Condition 2 also requires that STDC monitor the DO concentrations on a continuous basis and supply the results to the Council (Table 2, Figure 2). The condition further requires that the ponds maintain a DO concentration of at least 2 g/m^3 for 90% of the year (between the hours of 11:00 and 14:00). The DO concentration in Pond 1 was at least 2 g/m^3 for 86.6% of the year in Pond 1 and for 90.9% of year in Pond 2 (Table 2). Therefore, Pond 1 was non-compliant and Pond 2 was compliant, in relation to condition 2.

Table 2 Percentage of time DO was greater than 2.0 g/m^3 (between the hours of 11:00 and 14:00) for the 2015-2016 monitoring year

Month	Pond 1 (DO g/m³)			Pond 2 (DO g/m³)		
	Average	Max	% > 2.0	Average	Max	% > 2.0
Jul-15	6.66	10.98	97.8%	5.54	13.79	100.0%
Aug-15	3.97	7.86	88.3%	6.02	19.99	85.4%
Sep-15	5.19	16.37	83.1%	6.64	19.99	97.7%
Oct-15	7.99	19.98	81.7%	8.07	19.99	98.3%
Nov-15	9.65	19.98	76.6%	5.82	13.97	86.9%
Dec-15	4.98	16.77	69.2%	9.36	19.99	94.4%
Jan-16	8.35	19.97	77.4%	5.66	19.67	85.1%
Feb-16	12.47	19.97	93.8%	5.77	19.97	79.4%
Mar-16	6.32	16.50	95.1%	7.11	19.99	95.4%
Apr-16	6.17	15.51	93.1%	6.27	19.98	86.5%
May-16	5.86	14.36	90.6%	4.05	7.82	83.7%
Jun-16	4.02	10.25	91.5%	3.62	6.83	89.8%
Pond 1 yearly total			86.6%	Pond 2 yearly total		90.9%

Note: Non-compliant results in red

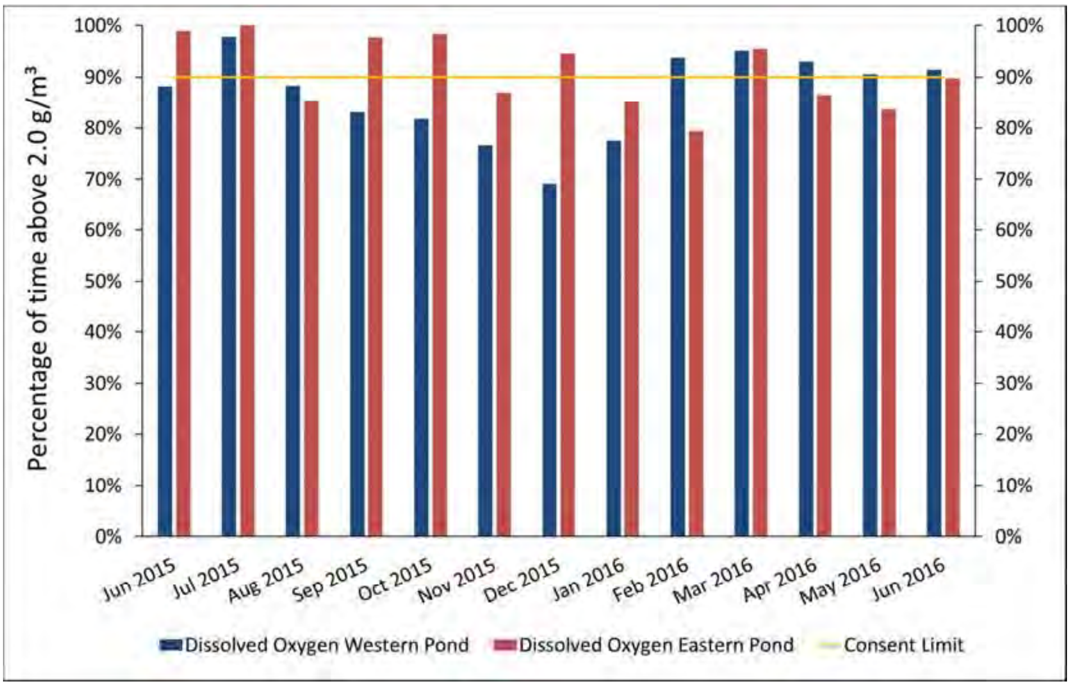

Figure 2 Compliance of DO concentration (g/m^3) with consent conditions in the primary and secondary oxidation ponds 2015-2016 (between hours of 11:00 – 14:00). Data from pond outlet.

2.2.2 Chlorophyll *a*

To maintain facultative conditions in a pond system there must be an algal community present in the surface layer. The principal function of algae in an oxidation pond 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.

Effluent samples from Ponds 1 and 2 were collected during inspections of the HWWTP for semi-quantitative microalgal assessment prior to curtailment of this component of the programme in July 2013. The microalgal taxa present in both ponds has been summarised and discussed in previous annual reports.

During the 2015-2016 inspections, samples were collected from Pond 1 and Pond 2 for chlorophyll *a* analysis. Chlorophyll *a* concentration can be used as a measure of algal biomass in the system. Pearson (1996) recommends that a minimum in-pond chlorophyll *a* concentration of 300 mg/m^3 is necessary to maintain stable facultative conditions. Seasonal changes in algal populations and dilution by stormwater infiltration is expected to occur in wastewater treatment systems. These factors, together with fluctuations in waste loadings, can result in chlorophyll *a* variability.

The results of Pond 1 and 2 effluent chlorophyll *a* analyses are provided in Table 3.

Table 3 Chlorophyll *a* concentrations in Ponds 1 and 2 during the 2015-2016 period

Date	Pond 1		Pond 2	
	Time (NZST)	Chl-*a* (mg/m^3)	Time (NZST)	Chl-*a* (mg/m^3)
10 Aug 2015	11:05	39	11:15	20
13 Oct 2015	10:40	76	10:45	60
16 Dec 2015	09:30	216	09:45	1,800
12 Feb 2016	-	-	-	-
08 Apr 2016	10:30	702	10:45	784
14 Jun 2016	10:00	266	10:15	154
Median		216	Median	154
Summary statistics (2013-2015)				
Median		344	Median	283
Minimum		3.2	Minimum	46
Maximum		2,130	Maximum	1,840
Number of samples		11	Number of samples	11

Note: Chlorophyll *a* samples were not collected during the February inspection

The median chlorophyll *a* concentration for each pond during the 2015-2016 monitoring period was lower than each pond's respective historical median (Table 3).

Higher chlorophyll *a* concentrations were recorded from summer through to autumn. Lower concentrations were recorded in winter/spring – a time of elevated rainfall resulting in the greatest stormwater dilution through the HWWTP system.

2.2.3 Final effluent quality

During the 2015-2016 period, samples of the combined effluent of the ponds' parallel configuration were collected from the maturation cells. These samples provide an indication of the degree of treatment that the wastewater has received. The samples also provide insight into the source of the influent waste.

The results from the physical and chemical effluent analyses are provided separately in Table 4 and discussed below.

Table 4 Physical and chemical parameters of the final effluent collected from the maturation cells during the 2015-2016 period, including the median for that period and a brief historical summary

Parameter		Sample date and time (2015-2016)							2010 - 2015		
		10 Aug 11:40	13 Oct 10:00	16 Dec 10:00	12 Feb 09:00	08 Apr 11:15	14 Jun 10:35	Median	Median	Min	Max
BOD	Total (g/m³)	19	12	170	53	70	29	41	56	11	330
	Total carbonaceous (g/m³)	19	12	55	38	28	18	23.5	24	9.2	86
	Filtered (g/m³)	5.1	10	87	12	28	7.2	11	13	4.2	43
Nutrients	Ammonia (g/m³)	32.8	29.7	19.2	35.5	44.1	58.9	34.15	40.1	4.6	74.8
	Total N (g/m³)	35.2	33.2	46.4	51.9	66.4	59.7	49.15	49.6	29.6	92.2
	Total P (g/m³)	5.45	5.89	10.5	16.2	15.7	12.7	11.6	8.8	5.4	21
Temperature		8.9	15.4	19.4	22.7	17.8	11.5	17.8	16	7.6	23.2
Conductivity @20°C (mS/m)		58.6	61.8	74.9	94.2	104	97.2	74.7	77.5	42.9	127
pH		7.2	7.9	7.4	8	7.7	7.9	7.8	7.7	6.8	8.1
Suspended solids (g/m³)		22	13	81	170	100	39	60	47.5	9	170
Turbidity (NTU)		16	12	44	98	58	28	36	33	12	97
Total grease (g/m³)		-	< 5	7	13	11	< 5	11	7	< 5	33

Median values for the effluent constituents in the 2015-2016 period were comparable with historical medians (Table 4). The greatest exceedances of historical medians were those of suspended solids and total grease concentrations. On separate occasions, Filtered BOD and turbidity results exceeded the associated historical maximums.

Effluent quality demonstrated seasonal variability, with patterns evident for a number of the analysed effluent parameters (Table 4). For example, suspended solids and turbidity were greatest over the summer months; a period of less rainfall and therefore less dilution via infiltration. Lower BOD_5 concentrations were found during late winter and spring.

Previous investigations into the nature of the high total BOD_5 concentrations has indicated that at times there has been a significant non-carbonaceous component (83 to 88% of total BOD_5: March to June 2007) indicative of nitrification contributions, likely to be associated with the high industrial waste loadings.

The results from the faecal indicator bacteria analyses are provided separately in Table 5 and discussed below.

Table 5 Faecal indicator counts in the final effluent from the maturation cells (2015-2016)

Parameter	Sample date and time								
	10/08/15	1/10/15	13/10/15	27/10/15	24/11/15	16/12/15	12/02/16	8/04/16	14/06/16
	11:40	08:10	10:00	13:25	12:20	10:00	09:00	11:15	10:35
Temperature (°C)	8.9	13.6	15.4	20	19.9	19.4	22.7	17.8	11.5
Conductivity @20°C (mS/m)	58.6	62.2	61.8	64	74.7	74.9	94.2	104	97.2
E. coli (cfu/100ml)	-	-	260	-	-	5,500	6,800	-	44,000
Enterococci (cfu/100ml)	3,600	-	30	-	-	80	430	940	3,200
Faecal coliforms (cfu/100ml)	11,000	220	340	79	3,500	6,900	8,300	14,000	47,000

The results from the current monitoring period were comparable with the results from the past seven years, since the maturation pond was installed (Figure 3). Faecal indicator counts demonstrated notable seasonal variability, with the counts much lower in spring/summer than during the autumn/winter months (Table 5, Figure 3).

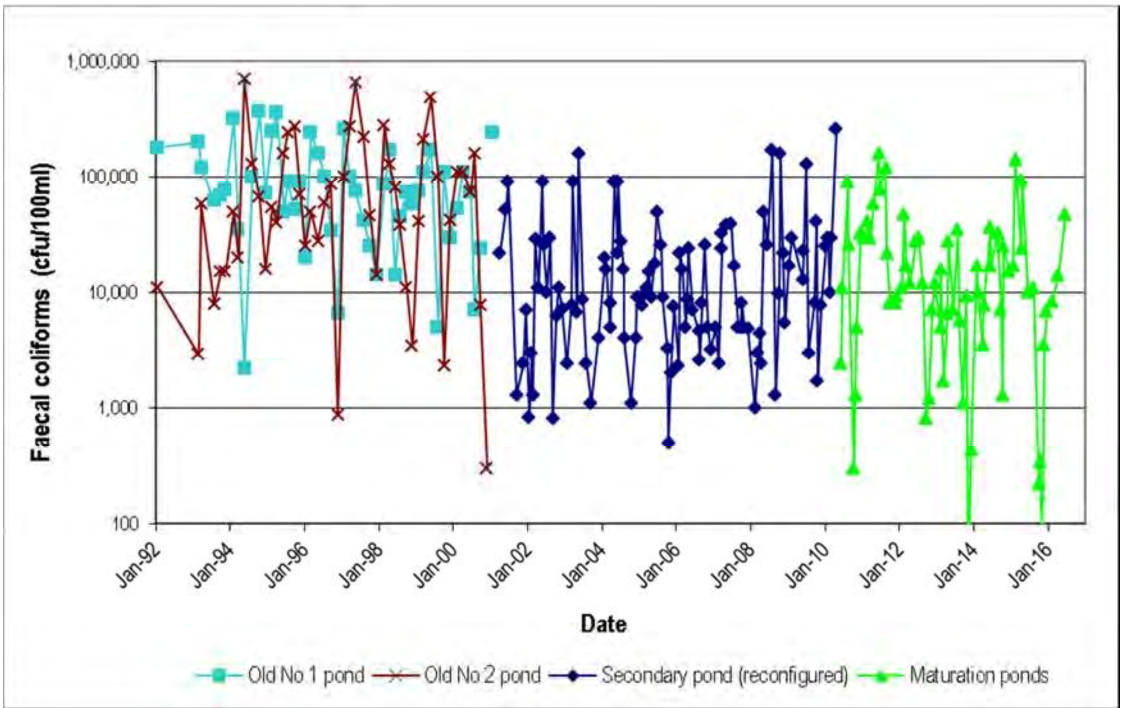

Figure 3 Faecal coliform numbers in the HWWTP effluent, 1992 to 2016

The results from the metals analyses are provided separately in Table 6 and discussed below.

Table 6 Trace metal (g/m³) analyses from the final effluent from the maturation cells (2015-2016)

Parameter	HWTTP Maturation pond			Fonterra WW *	NP WWTP #
	13 Oct 2015	12 Feb 2016	2001-2015	2002-2016	1995-2016
Arsenic	<0.001	<0.001	<0.001 - <0.005	<0.001	-
Cadmium	<0.005	<0.005	<0.005 – 0.006	<0.005 - 0.007	<0.005 , <0.008
Chromium	<0.03	<0.03	<0.03 - 0.04	<0.03	<0.03 , <0.05
Copper	<0.01	<0.01	<0.01 – 0.01	<0.01 - 0.02	<0.01 - 0.05
Lead	<0.05	<0.05	<0.05	<0.05 – 0.07	<0.02 – 0.04
Mercury	<0.0001	<0.0002	<0.0001 - 0.0012	<0.0002	<0.0002 – 0.0003
Nickel	<0.02	<0.02	<0.02 - 0.05	<0.02 - 0.04	<0.02 – 0.07
Zinc	0.02	0.025	<0.005 - 0.035	0.06 - 0.181	<0.02 - 0.15

* = IND001001
# = SWG002002

Concentrations of trace metals in Hawera wastewater (Table 6) have been low, near or below levels of detection for routine analyses of municipal wastewaters for most metals. Traces of chromium, copper, mercury and nickel and low levels of zinc have been found occasionally since reconfiguration of the system in early 2001. Trace metal concentrations were similar to those measured elsewhere in the region.

2.2.4 Discharge volume

Condition 5 of consent 5079-1 requires STDC to provide records of the discharge volumes to the Outfall. The consent holder supplied records for the period from 1 July 2015 to 30 June 2016 (Figure 4).

The purpose of the consent is to discharge no more than 12,000 m³ per day (based on the seven day average) from the HWWTP to the Outfall. There were three separate exceedance events in relation to this limit early in the 2015-2016 monitoring year. The first exceedance in July carried over from the 2014-2015 period and lasted 17 days. The second exceedance occurred later in July and lasted for six days. The final exceedance occurred in mid August and lasted for three days. The total number of days where the seven day average was above the consent limit was 26.

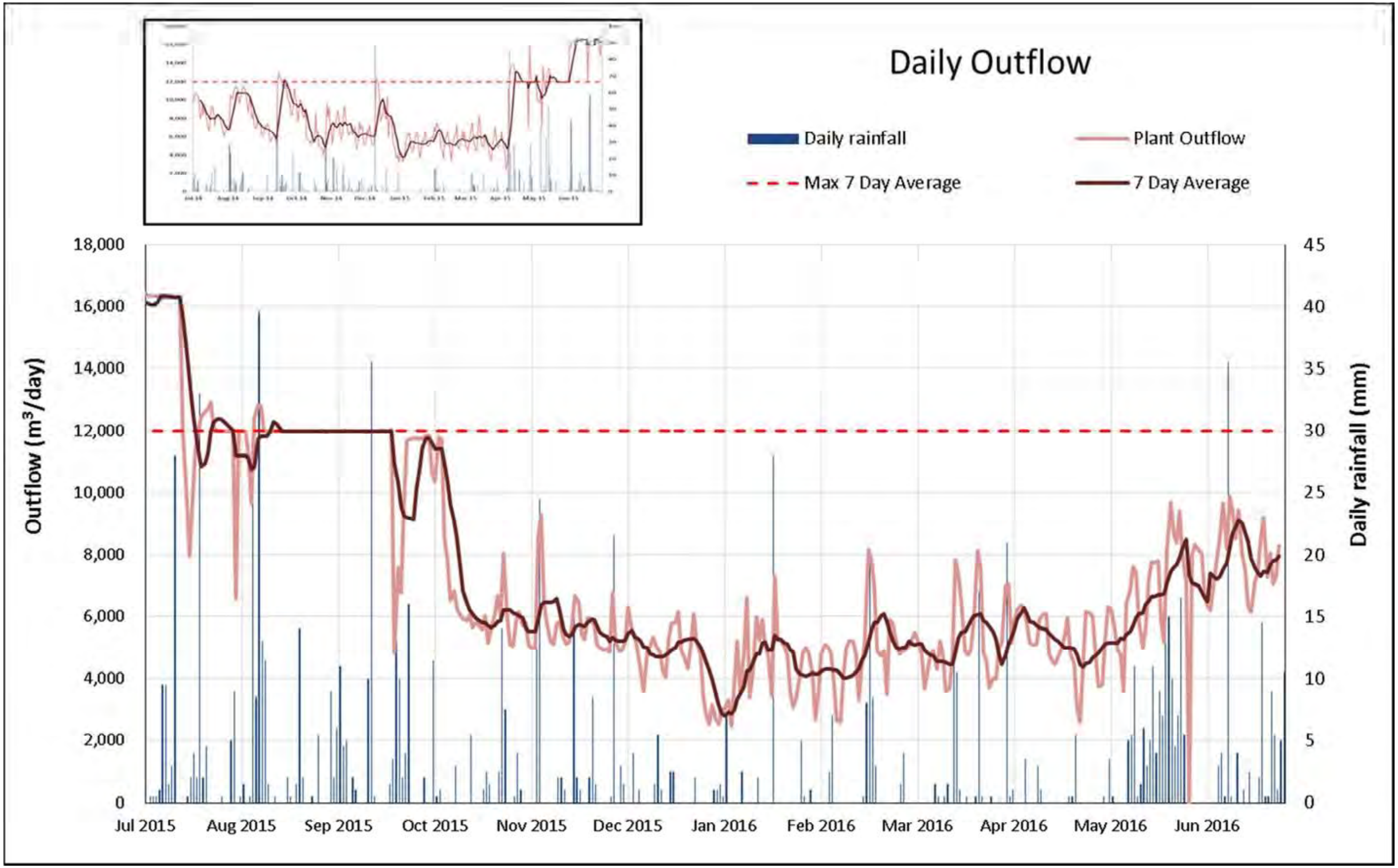

Figure 4 Daily discharge volumes (m^3/day) from the HWWTP and daily rainfall data (mm) from a Council rainfall station approximately 5 km east of the site, 1 July 2015 to 30 June 2016. Inset: Rainfall and outflow data from 2014-2015 monitoring period

2.3 Receiving environment monitoring

Condition 3 of the consent requires that the discharge does not give rise to various effects on the Tasman Sea beyond a mixing zone of 200 m from the centre line of the outfall diffuser. Sub-condition d) requires that there are no significant adverse effects on aquatic life. Condition 14 requires that the consent holder ensure that a monitoring programme is established to record and analyse effects on the intertidal reefs and coastal water quality adjacent to the discharge. Monitoring is by way of marine ecological surveys, shellfish tissue analysis and shoreline water quality.

2.3.1 Marine ecology

In order to assess the effects of the Whareroa dairy factory and HWWTP outfall discharge on the nearby intertidal communities, ecological surveys were conducted over October/November 2015, and March 2016 at four sites (Figure 5, Photo 2). The two survey reports, including statistical analysis of results and further discussion of the findings, are included in Appendix II. This section summarises the main findings of these survey reports.

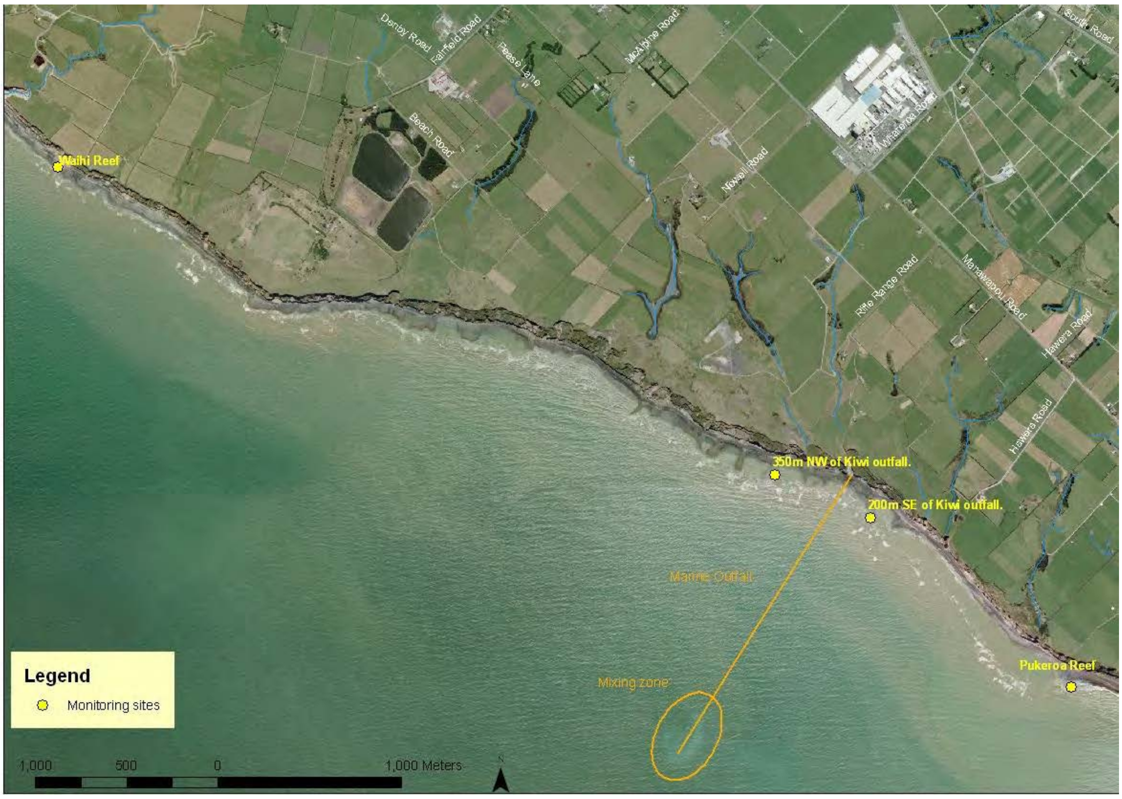

Figure 5 Location of marine ecological monitoring sites

It is expected that adverse effects of the Outfall discharge on the intertidal communities would have been evident as a significant decline in species richness and diversity at the potential impact sites relative to the control sites. No such adverse effects were evident during the 2015-2016 monitoring period.

The spring survey found that the most influential factor affecting the surveyed reef communities was land-based erosion (Photo 3). This was epitomised by the site 200 m SE of the Outfall, which recorded no marine species along the surveyed transect. This section of reef had been completely buried by cliff material spanning from the foot of the cliff down to the low water mark. There was evidence of similar erosion events having an impact at the remaining reef sites, including the partial burial of the site 350 m NW of the Outfall. It was noted in the summer survey that some intertidal species had started to return to the 200 m SE Reef site, with some of the slip material having been washed away. Newly settled barnacles were noted on patches of exposed rock and indicated that the reef was slowly starting to recover. It is possible that the impact of the eroding cliffs may have concealed any adverse effects that the Outfall was having on the nearby reefs; however, the survey results lend no evidence to support this theory.

Photo 3 Significant erosion over the reef site 200 m SE of the outfall, October 2015 (A), Relatively intact cliffs covered in vegetation above the Pukeroa Reef site, October 2015 (B), A large slip above Waihi Reef, November 2015 (C)

The following summary of survey results does not include the potential impact site 200 m SE of the Outfall, due to the erosion event. In the spring survey, differences in species richness and diversity at the potential impact sites relative to the control site were non-significant. In the summer survey, species richness and diversity was significantly higher at the potential impact site 350 m NW of the Outfall, when compared to the control site. There was no significant difference in these values between the Pukeroa Reef site and the control site during the same survey. Furthermore, neither survey provided evidence of species richness or diversity at the potential impact sites declining over time, relative to the control site (Figures 6-9).

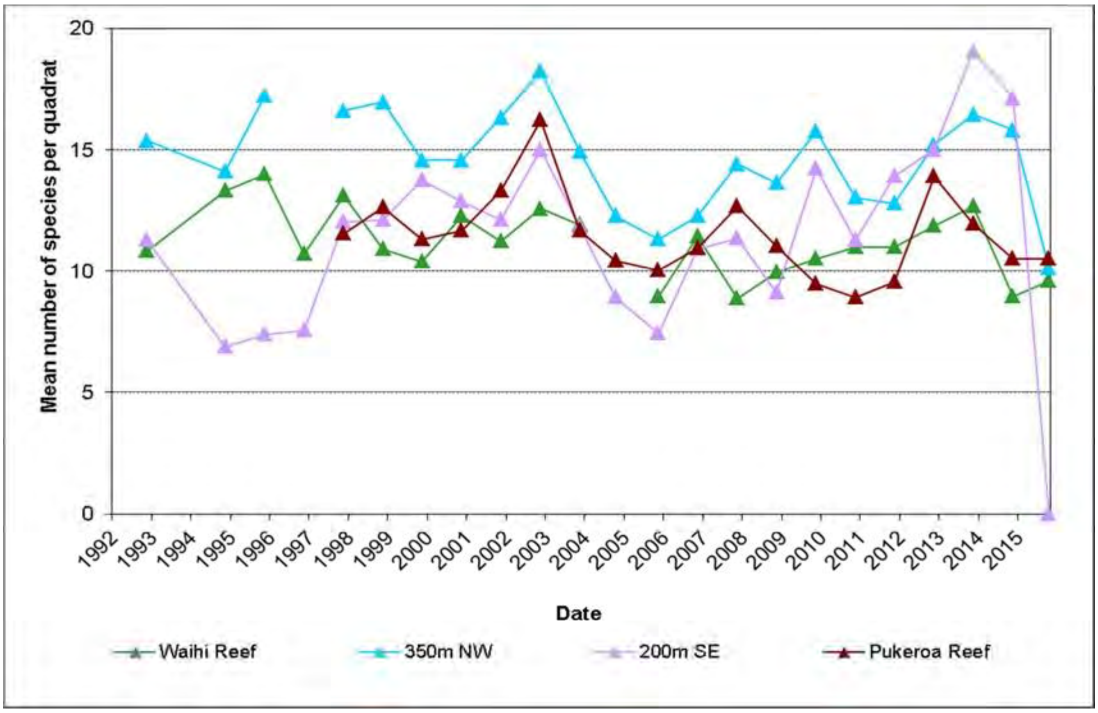

Figure 6 Mean number of species per quadrat for spring surveys 1992-2016

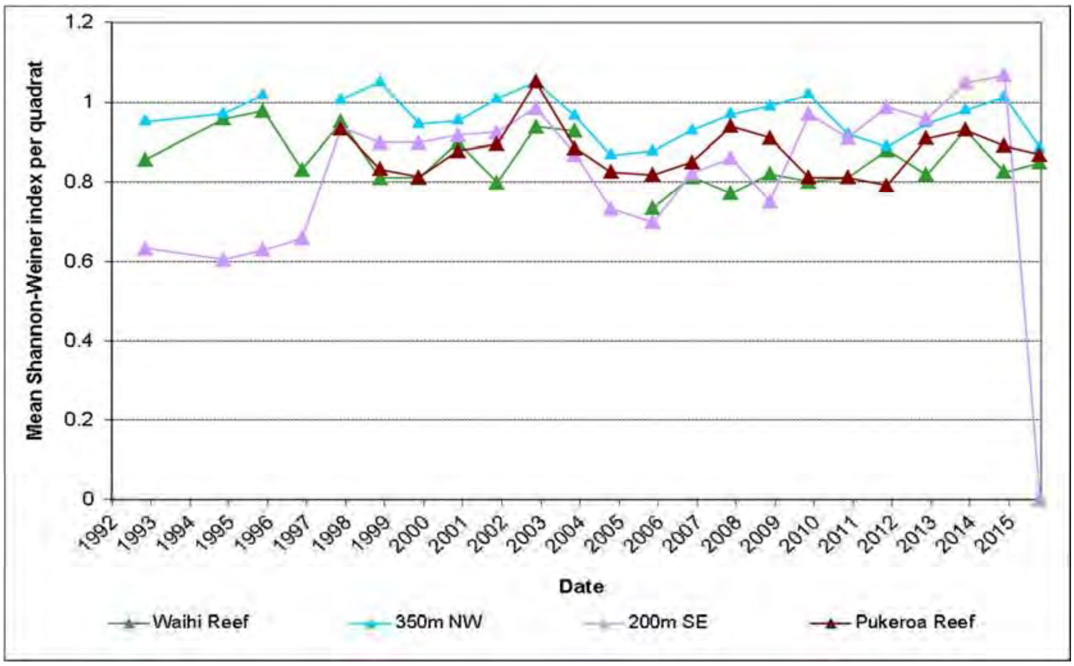

Figure 7 Mean Shannon-Weiner indices per quadrat for spring surveys 1992-2016

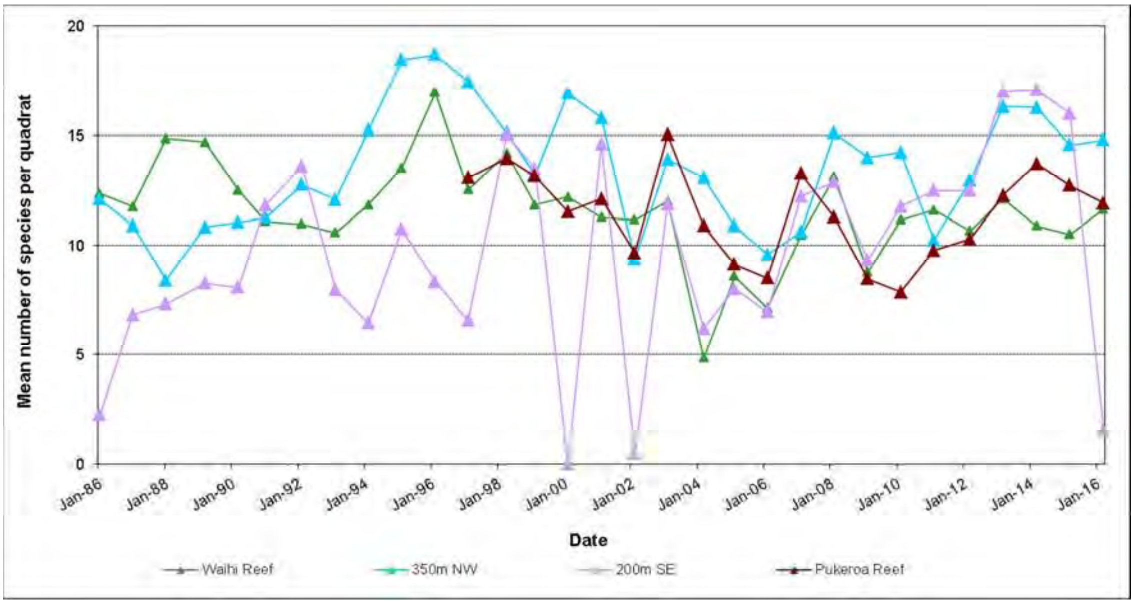

Figure 8 Mean number of species per quadrat for summer surveys 1986-2016

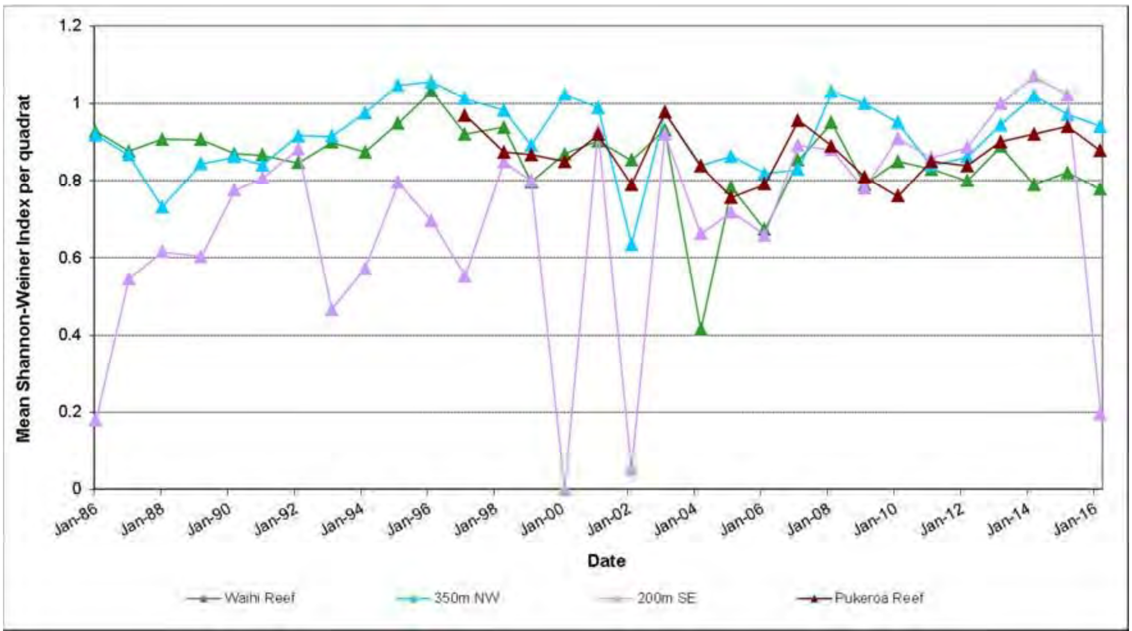

Figure 9 Mean Shannon-Weiner Indices per quadrat for summer surveys 1986-2016

2.3.2 Shellfish tissue

Condition 4 of the consent states that the discharge shall not result in the guidelines for shellfish-gathering waters, as specified in the *'Provisional Microbiological Water Quality Guidelines for Recreational and Shellfish-Gathering Waters in New Zealand'* being exceeded at the shoreline.

Figure 10 Shoreline water sampling and shellfish collection sites

Samples of the green lipped mussel, *Perna canaliculus*, were gathered from scattered natural populations at four sites (Figure 10, Table 7, and Photo 4).

Table 7 Location of shellfish (mussel) monitoring sites

Site Code	Location	Grid reference
SEA906049	350 m NW of outfall	1710960 - 5612942
SEA906062	1,000 m SE of outfall	1712138 - 5612117
SEA906067	1,650 m SE of outfall	1712574 - 5611784
SEA906072	3,200 m SE of outfall	1713874 - 5610803

2.3.2.1 Faecal coliforms

Faecal coliform counts in shellfish tissue provide information relating to the bioaccumulation of faecal indicator bacteria which may originate from non-point source runoff (particularly into nearby rivers and streams) and/or point source discharges (e.g. sewage treatment systems).

Mussel samples collected at shoreline sites in the vicinity of the outfall discharge were analysed for faecal coliform concentration by the most probable number (MPN) method.

There are microbiological standards for a lot/consignment of bivalve molluscs under the Australia New Zealand Food Standards Code (2002): The acceptable concentration of *Escherichia coli* (230 MPN/100g), should not be exceeded in more than one in five samples of food, and no sample of food shall exceed a concentration of 700 MPN/100g. *E. coli* belong to the faecal coliform group and in some environmental samples, *E. coli* can account for the majority of faecal coliforms present. When assessing the results from the Council's monitoring against these guidelines, all mussels sampled at an individual site during the monitoring period were considered to be from the same "lot of food".

Photo 4 Green lipped mussels, *Perna canaliculus*, at Pukeroa Reef

Since 2002, shellfish sampling in the vicinity of the Outfall has occurred six times each year (at approximately two-month intervals). However, following the 2015 June floods, large sections of the coastal cliffs north and south of the Outfall became unstable, leading to increased erosion (see Section 2.3.1). There were a number of subsequent slips which buried vast expanses of reef as far as the low water mark. For obvious safety reasons, the remaining shellfish sampling that was scheduled for the 2015-2016 monitoring period was cancelled. Two sampling surveys had been undertaken prior to the slip events which triggered the safety concerns.

The results for the 2015-2016 period are presented in Table 8 with a summary of the historical data. All monitoring data since early 1997 is presented in Figure 11.

Table 8 Mussel tissue faecal coliform counts (MPN/100g) from coastal sites adjacent to the Outfall 2015-2016

Date	Sites			
	SEA906049	SEA906062	SEA906067	SEA906072
30 Sep 2015	45	230	78	45
27 Oct 2015	130	130	20	20
Median	87.5	180	49	32.5
Historical data (2001 - 2015)				
Min	9	9	9	9
Max	9,000	3,000	3,000	3,000
Median	80	80	80	110
No. of samples	84	84	87	83

These shellfish faecal coliform concentrations were comparable to the results from recent years. Of the eight samples, five were below their site's historical median. The mussel with the highest faecal coliform concentration (230 MPN/100g) was collected at SEA906062.

No samples exceeded the acceptable concentration limit for faecal coliforms (>230 MPN/100g). It should be noted that there was an insufficient number of samples to access compliance with this limit (only two samples were collected when the limit requires at least five; assuming all mussels sampled at an individual site were considered to be from the same "lot of food").

No samples exceeded the maximum concentration limit for faecal coliforms (>700 MPN/100g).

The annual median counts at all four sites have been within the guideline limit (230 MPN/100g) since 2001, however since 2001, six samples exceeded the maximum 700 MPN/100g E. coli limit at SEA906049 (7%), three at SEA906062 (3%), seven at SEA906067 (8%), and ten at SEA906072 (12%). Usually these exceedances have followed wet weather when faecal coliform numbers in the coastal seawater have increased due to the run-off from many small coastal streams and the nearby Tangahoe River catchment (see TRC, 2004).

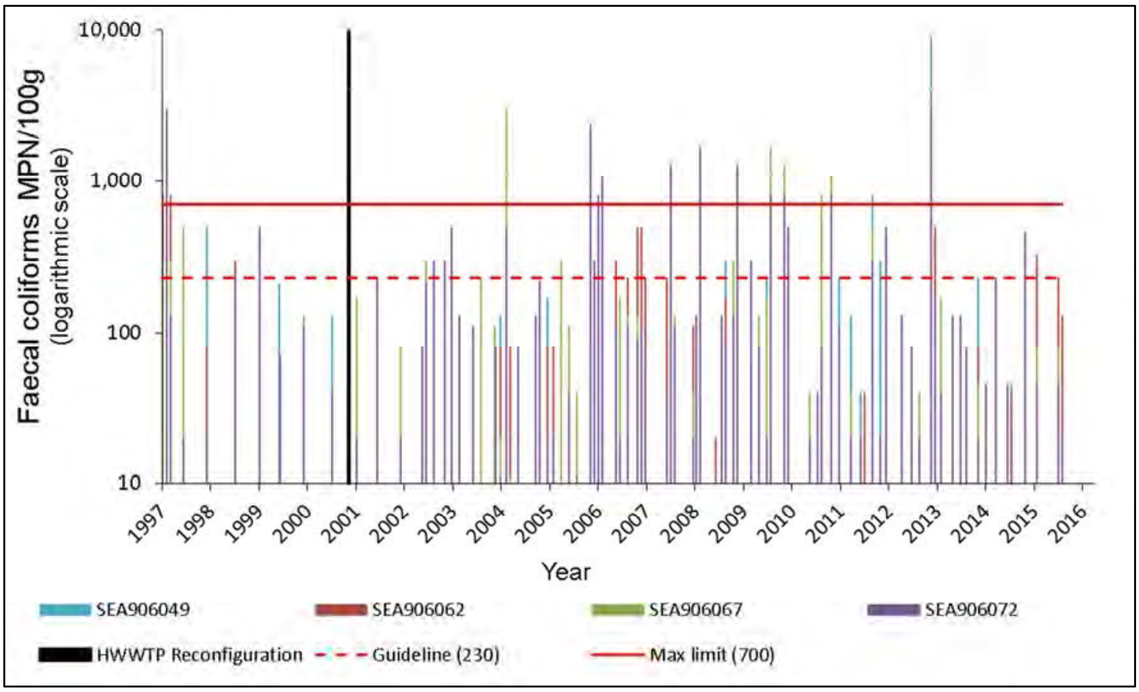

Figure 11 Shellfish (mussel) tissue faecal coliform bacteria numbers (MPN/100g) from surveys of coastal sites (since 1997) adjacent to the Outfall[1].

2.3.2.2 Trace metals

Shellfish tissue trace metal concentrations can provide evidence of longer term bio-accumulation of metals which may originate from non-point source run-off and/or point source discharges e.g. sewage treatment systems.

Trace metal concentrations in shellfish tissue are monitored in relation to discharges from the Hawera oxidation pond system and Fonterra Co-operative Group Limited dairy factory at Whareroa biennially. Each sample is depurated (mussels are placed in seawater for a period of time to allow the elimination of waste products from the gut) prior to analysis of a number of trace metals. During the period under review, one set of mussel samples were collected from four coastal sites and analysed for trace metal content. The results from this survey are presented in Table 9. A summary of the historical survey results can be found in Appendix III.

Table 9 Results of mussel trace metal concentrations (mg/kg wet weight) from samples collected during the 2015-2016 monitoring year

Metal	Unit	Site				Australia NZ Food Standards Code 2016
		350 m NW SEA906049	1,000 m SE SEA906062	Pukeroa Reef SEA906067	3,200 m SE SEA906072	
Arsenic	mg/kg	-	-	-	-	**1.0**
Cadmium	mg/kg	0.035	0.029	0.022	0.022	**2.0**
Chromium	mg/kg	0.09	0.05	0.03	0.04	**-**

1 The long outfall was commissioned in August 1997 and Hawera wastewater was redirected through this in February 2001.

Metal	Unit	Site				Australia NZ Food Standards Code 2016
		350 m NW SEA906049	1,000 m SE SEA906062	Pukeroa Reef SEA906067	3,200 m SE SEA906072	
Copper	mg/kg	0.81	0.6	0.42	0.71	-
Iron	mg/kg	28	17.1	11.6	17.2	-
Lead	mg/kg	0.054	0.032	0.02	0.054	**2.0**
Mercury	mg/kg	<0.01	<0.01	<0.01	<0.01	**0.5**
Nickel	mg/kg	0.31	0.5	0.27	0.34	-
Zinc	mg/kg	6.1	4.5	2.8	4.2	-

The results from this monitoring period found that concentrations of cadmium, lead and mercury were well below their respective limits in the Australia New Zealand Food Standards Code 2016 guidelines.

Although not analysed in this year's survey, levels of arsenic typically remain well below the associated guideline limit. It should be noted that the Council results are for total arsenic and that the Australia New Zealand Food Standards Code guideline is for inorganic arsenic which is estimated to be 10% of total arsenic.

Although no guidelines exist for the remaining metals, these trace metal levels are consistent with ranges of concentrations found in shellfish elsewhere on the Taranaki coastline.

2.3.3 Shoreline water quality

Special Condition 4 of consent 5079-1, which provides for the discharge of Hawera municipal effluent from the Outfall, states:

> *'That the discharge shall not result in the guideline for shellfish-gathering waters, as specified in the document 'Provisional Microbiological Water Quality Guidelines for Recreational and Shellfish-Gathering Waters in New Zealand[2]' (Department of Health 1992), being exceeded at the shoreline.'*

That is, the median faecal coliform content of samples taken over a shellfish gathering season shall not exceed 14 MPN/100 ml, and not more than ten percent of the samples should exceed 43 MPN/100 ml (five-tube decimal dilution test).

To determine compliance with this condition, the Council has monitored bacteriological water quality at five sites along the coastline and one site at the Tangahoe River mouth (Table 11, Figure 12).

Background monitoring started in April 1997, with three surveys conducted prior to the commissioning of the long Outfall. Seventeen surveys were undertaken during the period when only the dairy factory wastewater was discharged. A further 86 surveys have been undertaken since the introduction of the HWWTP discharge to the Outfall in

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[2] These have been replaced by Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas, 2003.

February 2001 until the end of the reporting period in June 2016. Due to the safety concerns outlined in Section 2.3.2, there were only two complete surveys and one partial survey undertaken in the 2015-2016 monitoring period.

Table 10 Location of bacteriological receiving water quality monitoring sites

Site code	Location	Grid reference
SEA906020 (control site)	Tasman Sea; NW Waihi S, 5.7 km NW of outfall	E1706404 – N5615244
SEA906047	Tasman Sea; 1.05 km NW of outfall	E1710960 – N5612942
SEA906062	Tasman Sea; Pukeroa reef (north end), 1 km SE of outfall	E1712138 – N5612117
SEA906067	Tasman Sea; Pukeroa reef (south end), 1.65 km SE of outfall	E1712574 – N5611784
SEA906072	Tasman Sea; 3.2 km SE of outfall	E1713874 – N5610803
TNH000998	Tangahoe River; at mouth, 5 km SE of outfall	E1715337 – N5609999

The samples were analysed for faecal coliforms by the MPN method. Conductivity was analysed to provide an indication of the influence of freshwater inflows from coastal streams and/or the Tangahoe River. Results for the 2015-2016 monitoring period are presented in Table 10.

Table 11 Receiving water faecal coliform (FC) counts and conductivity values (mS/m @20°C) from the maturation pond and sites adjacent to the Outfall during the 2015-2016 period

Date	Site													
	OXP008002		SEA906020		SEA906047		SEA906062		SEA906067		SEA906072		TNH000998	
	FC cfu/100 ml	Conductivity	FC MPN/100 ml	Conductivity	FC MPN/100 ml	Conductivity	FC MPN/100 ml	Conductivity	FC MPN/100 ml	Conductivity	FC MPN/100 ml	Conductivity	FC MPN/100 ml	Conductivity
30 Sep 15	220 *	62.2 *	<1.8 *	4,540 *	170	4,540	2	4,600	2	4,580	<1.8	4,600	240	129
27 Oct 15	79	64	7.8	4,590	22	4,610	<1.8	4,620	6.8	4,610	17	4,670	220	168
24 Nov 15	3,500	74.7	2	4,680	-		-		-		63	4,700	540	314
Median FC count			2		96		1.5		4.4		17		240	
Historical FC data (2001 - 2015)														
Min			< 2		< 1.8		< 2		< 2		< 2		80	
Max			900		300		500		300		300		9,000	
Median			7.8		4		4		4		7.8		500	
No. of samples			83		82		81		83		83		83	

Note: Where necessary, values of <1.8 have been transformed to 1 to calculate a median.
* = Sample collected on 1 October 2015

The 10% guideline requirement could not be adequately assessed as the highest number of samples that was collected at a single site was three. However, it should still be noted that mussels were collected from two seawater sites, SEA906047 and SEA906072, where the faecal coliform concentrations exceeded 43 MPN/100 ml (170 and 63 MPN/100 ml, respectively; Table 11).

The median guideline requirement could not be assessed either, due to the insufficient number of samples collected in the monitoring year (ranging from two to three at each site). However, it should be noted that there were two sites, SEA906047 and SEA906072, where the median faecal coliform concentrations exceeded 14 MPN/100 ml (Table 11).

A typical, much higher, median level was recorded for the Tangahoe River (Table 11). This is likely due to runoff from the extensively farmed land in the catchment and indicates that the main source of faecal contamination is likely from the river and not the Outfall.

There has been a tendency for the higher faecal coliform results at the shoreline to coincide with elevated counts in the nearby Tangahoe River, particularly following floods. Conductivity data support this, as lower conductivities (indicative of increased freshwater influence) have often coincided with increased bacterial counts. However, such a pattern is not evident in the 2015-2016 monitoring results.

A comparison of all monitoring data for pre and post HWWTP discharge connection to the Outfall is provided in Figure 12.

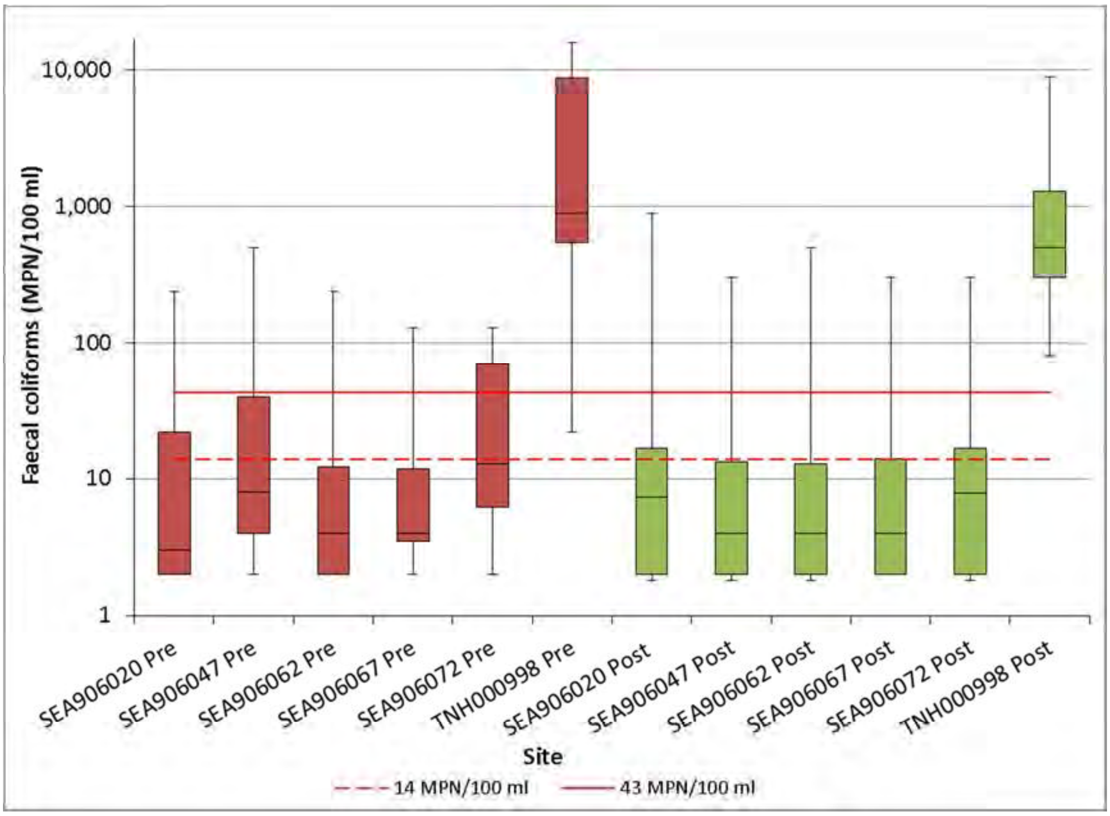

Figure 12 Box and whisker plot of faecal coliform counts (MPN/100ml) at shoreline sites and in the Tangahoe River before and after connection of the HWWTP discharge to the Outfall

2.4 Additional reporting requirements

Consent 5079-1 contains six special conditions relating to reporting and approval requirements.

Condition 6 required that STDC advises and consults with the Council if trade wastes are accepted into the wastewater system for which it may be appropriate or necessary to place limits on concentrations of any toxic or hazardous contaminants. In March 2016, 630 litres of Lecithin was accepted into the plant for treatment. It had no adverse effect on the environment and the Council were notified of this at the time.

Condition 8 required STDC to provide, within three months of granting of the consent (i.e. by 20 March 2008), a contingency plan outlining measures and procedures to be undertaken to prevent spillage or accidental discharge of contaminants in the event of a breakdown, including measures to avoid, remedy or mitigate the environmental effects of such a discharge. The consent condition requires that this plan is updated annually. A management and contingency plan for the site was produced in May 2008, and this was up-to-date as of August 2016.

Condition 9 required STDC to supply an annual report on its waste treatment system, including the performance of the Outfall and compliance with the consent, by 31 August each year. This report was received on 5 August 2016. Its contents are discussed further in Section 3.1.

Condition 10 required that STDC supply a report reviewing the best practicable option for treatment and disposal of wastewater generated at Hawera and Eltham, due by 31 December 2009. This was carried out by consultants, and after initial discussions with iwi and Council in October 2008, was presented to iwi in December 2008. A further presentation was made in March 2009, and no feed-back from iwi was received. The report was submitted to the Council in December 2009.

Condition 11 outlined the four main actions required to complete the project. Condition 12 required that reports on the implementation of condition 11 are provided to the Council by 31 March, 30 June, 30 September and 15 December of each year until implementation is complete. Implementation was complete by 30 June 2011; therefore reports are no longer required to be submitted.

Condition 13 requires that the consent holder and staff of the Council meet with representatives various iwi, other submitters to the consent and any other interested party to discuss any matters relating to the consent and facilitate ongoing consultation. In addition, condition 15 requires that the scope and detail of the monitoring programme (as required by condition 14) is developed in consultation with submitters. Although no meetings were held for the purpose of satisfying condition 13 during the 2015-2016 period, meetings were held with all stakeholder groups as a part of the discharge consent renewal process. The next stakeholder meeting will be scheduled following the release of this monitoring report in order to discuss its findings.

2.5 Investigations, interventions, and incidents

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

The Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The incident register includes events where 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 2015-2016 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with the Company's conditions in resource consents or provisions in Regional Plans. Although there were a number of non compliances associated with DO concentrations (Section 2.2.1) and exceedance of discharge volumes (Section 2.2.4) none of there resulted in adverse environmental effects.

3. Discussion

3.1 Plant performance

During the 2015-2016 reporting period, the HWWTP was in its sixth monitoring year since the upgrade and reconfiguration of the treatment system.

Regular inspections of the HWWTP found that odours, ranging from noticeable to strong, were often detected downwind of the anaerobic lagoon. Odours were never detected beyond the site boundary. STDC worked with Silver Fern Farms and Parklink during the monitoring period to review issues with the lagoon. Parklink's sludge removal methods are currently being assessed for future application in the lagoon to reduce the resident solids content. It is anticipated that an outcome from this assessment will be reached in 2016.

Pond 1 failed to achieve compliance with condition 2 of consent 5079-1. Over the year, this pond maintained a DO concentration of at least 2 g/m^3 for 86.6% of the time. DO concentrations were better maintained in the latter half of the monitoring period. Pond 2 was compliant with this condition. This pond maintained a DO concentration of at least 2 g/m^3 for 90.9% of the year. There were no objectionable odours noted by the Council or STDC in the vicinity of the aerobic ponds during the 2015-2016 year. STDC is currently reviewing the aeration system in these ponds due to the sub-optimal performance of the current system and its associated costs.

The de-sludging trial in Pond 1 was ongoing during the monitoring period. The de-sludging trial that was carried out in Pond 2 concluded in December 2014. A survey undertaken in January 2016 in this pond indicated a 9% increase in sludge build up.

The consent limit (12,000 m^3) on the volume of discharge from the HWWTP was exceeded on three occasions consisting of 26 days in July and early August. These exceedances coincided with the prolonged and heavy rainfall of June and July 2015 (Figure 4). Taking into consideration the dilute nature of the discharge, any environmental effects resulting from these exceedances would likely have been minor.

There were no overflows from the retention basin to the environment during the monitoring period. The capacity of the retention basin was adequate to contain the overflow from the oxidation ponds during and following the heavy rainfall in June and July 2015. Therefore, consent 7520-1 to discharge to the stream in the event of high rainfall was not exercised in the 2015-2016 monitoring period.

3.2 Environmental effects of exercise of consents

During the 2015-2016 period, STDC discharged effluent from HWWTP to the Tasman Sea via the Outfall.

The Council monitored the environmental effects of discharges by assessment of hard substrate communities in the intertidal zone, along with shoreline water and shellfish monitoring for microbiological quality and metals.

Impacts of the Outfall discharge on local intertidal communities were not evident in the two surveys undertaken during the monitoring period (Appendix II). An insufficient number of samples were collected to provide a robust representation of the microbiological quality of the receiving shoreline waters and shellfish during the year under review. This was the result of the unstable state of the cliffs following an extreme weather event in June 2015, making sampling unsafe for much of the year. Disregarding the impaired sampling effort, this year's shoreline water and shellfish sampling results were comparable with those from previous years in terms of both microbiological quality and also metals concentration. The results provided no indication of any environmental degradation attributable to the Outfall.

For health and safety reasons explained above, insufficient samples were collected over the monitoring period to assess the microbiological quality of seawater and shellfish against the Ministry of Health guidelines. The results obtained from this period were comparable with historical results, however.

All possible sources of water quality degradation must be considered when interpreting the shoreline results with respect to special condition 4 of resource consent 5079-1. Water quality at the Tangahoe River site (TNH000998) is consistently poor, relative to the shoreline sites (Table 11, Figure 12), and this years results were no exception. Therefore, it is likely that this river has a notable influence on the water quality at adjacent coastal sites. The influence of pastoral agriculture and subsequent runoff to rivers and streams is an important factor affecting coastal water quality along most of the Taranaki coastline, and elsewhere in New Zealand.

3.3 Evaluation of performance

A tabular summary of the consent holder's compliance record for the year under review is set out in Tables 12 and 13.

Table 12 Summary of performance for consent 5079-1

Purpose: ***To discharge treated municipal wastes through a marine outfall***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Maintenance and operation of system	Inspections and sampling	Yes
2. Maintenance of DO level in ponds ≥ 2 gm^{-3} for 90% time between hours of 11:00 and 14:00	Consent holder continuous recording; supply of data; and sampling	**Pond 1 – No** Pond 2 - Yes
3. Limits on receiving water effects in Tasman Sea	Inspections and ecological surveys	Yes
4. Discharge not result in exceedance of shellfish-gathering microbiological guidelines	Bacteriological sampling	Yes
5. Provision of discharge volume records	Records supplied by consent holder	Yes
6. Consultation with Council re trade wastes	Liasion with consent holder	Yes
7. Management of system	Inspections and self monitoring data from STDC	Yes
8. Provision of contingency plan (annual review)	Up-to-date as of August 2016	Yes
9. Supply of annual report by 31 August	Supplied by consent holder	Yes

Purpose: ***To discharge treated municipal wastes through a marine outfall***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
10. Supply of report reviewing options for treatment of wastewater	Previously supplied by consent holder	Yes
11. Schedule of works and upgrades to be completed	Works complete	N/A
12. Supply of reports on implementation of condition 11	Works complete	N/A
13. Annual meeting with interested parties	Various meetings held over the year in relation to consent renewal	Yes
14. Establishment of coastal and ecological monitoring programmes	Implementation of tailored monitoring programmes	Yes
15. Monitoring programme to be developed in consultation with submitters	Liaison with consent holder and parties	Yes
16. Installation of screening	Inspections	Yes
17. Optional review provision re environmental effects		N/A
Overall assessment of environmental performance and compliance in respect of this consent Overall assessment of administrative performance in respect of this consent		**Good** **High**

N/A = Not applicable

Table 13 Summary of performance for consent 7520-1

Purpose: ***To discharge partially treated wastewater to an unnamed stream as a consequence of high rainfall***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Discharge shall only occur as a consequence of high rainfall events	Notification and inspections	N/A
2. Temporary holding pond capacity shall be no less than 55,000 cubic metres	Inspections	Yes
3. No modifications to the treatment plant that may result in an increase in the frequency of the discharge.	Inspections	Yes
4. Provision of discharge timing and volume records	Records supplied by consent holder	N/A
5. Adopt the best practicable option	Inspections	Yes
6. Notification of Council immediately after a discharge.	Records supplied by consent holder	N/A no discharges
7. Provision of contingency plan	Up-to-date as of August 2016	Yes

Purpose: ***To discharge partially treated wastewater to an unnamed stream as a consequence of high rainfall***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
8. Monitoring programme including physicochemical, bacteriological and ecological monitoring of the wastewater treatment system and receiving waters	Inspection and sampling	N/A no discharges
9. Optional review provision re environmental effects	Next due June 2015, recommendation in section 3.6	N/A
Overall assessment of environmental performance and compliance in respect of this consent Overall assessment of administrative performance in respect of this consent		**High** **High**

N/A = Not applicable

During the year, STDC demonstrated a good level of environmental performance and a high level of administrative compliance with resource consents at the HWWTP. While Pond 1 did not meet the necessary DO concentration limit, it was only marginally under. There were three exceedances in discharge volume during high rainfall events. The monitoring did not detect any adverse environmental effects that could be attributed directly to the exercise of consent 5079-1. During the period under review there were no unauthorised incidents reported at the HWWTP site.

3.4 Recommendations from the 2014-2015 Annual Report

In the 2014-2015 Annual Report, it was recommended:

1. THAT monitoring of the HWWTP, comprising inspection and effluent analysis in relation to the treatment system, and water quality and shellfish tissue analysis in relation to the receiving waters, be continued for the 2015-2016 monitoring period.

2. THAT the 2015-2016 monitoring programme continues to be integrated with and complementary to that for Fonterra’s discharge through the same ocean outfall.

3. THAT regular maintenance of the waste treatment system is performed by the consent holder who shall maintain adequate records of the operation of the system.

4. THAT the consent holder liaises with the Council with respect to any proposed additional industrial waste discharge to the system in order that potential impacts may be addressed and if necessary, additional monitoring requirements formulated.

5. THAT the consent holder liaises with the Council with respect to any modifications to the ponds system, and its performance.

6. THAT the consent holder continues a bi-monthly schedule for reporting volumes discharged and continuous ponds’ DO levels to the Council.

7. THAT the consent holder supply Council with an annual report on its waste treatment system, including the performance of the outfall and compliance with the consent by 31 August 2015, as required by condition 9 of consent 5079-1.

8. THAT a liaison meeting is held with iwi, submitters and other interested parties as per condition 13 of consent 5079-1.

3.5 Alterations to monitoring programmes for 2016-2017

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

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

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

It is proposed that the HWWTP monitoring programme for the 2016-2017 period remains unchanged from that of the 2015-2016 period.

4. Recommendations

1. THAT monitoring of the HWWTP, comprising inspection and effluent analysis in relation to the treatment system, and water quality and shellfish tissue analysis in relation to the receiving waters, be continued for the 2016-2017 monitoring period.

2. THAT the 2016-2017 monitoring programme continues to be integrated with and complementary to that for Fonterra's discharge through the same ocean outfall.

3. THAT regular maintenance of the waste treatment system is performed by the consent holder who shall maintain adequate records of the operation of the system.

4. THAT the consent holder liaises with the Council with respect to any proposed additional industrial waste discharge to the system in order that potential impacts may be addressed and if necessary, additional monitoring requirements formulated.

5. THAT the consent holder liaises with the Council with respect to any modifications to the ponds system, and its performance.

6. THAT the consent holder continues a bi-monthly schedule for reporting volumes discharged and continuous ponds' DO levels to the Council.

7. THAT the consent holder supply Council with an annual report on its waste treatment system, including the performance of the outfall and compliance with the consent by 31 August 2015, as required by condition 9 of consent 5079-1.

8. THAT a liaison meeting is held with iwi, submitters and other interested parties as per condition 13 of consent 5079-1.

Glossary of common terms and abbreviations

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

As*	Arsenic.
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.
CBOD	Carbonaceous biochemical oxygen demand. A measure of the presence of degradable organic matter, excluding the biological conversion of ammonia to nitrate.
Cr*	Chromium
Cd*	Cadmium
cfu	Colony forming units. A measure of the concentration of bacteria usually expressed as per 100 millilitre sample.
COD	Chemical oxygen demand. A measure of the oxygen required to oxidise all matter in a sample by chemical reaction.
Conductivity	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m.
Cu*	Copper.
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 colony forming units per 100 millilitre sample.
Ent	Enterococci, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre of sample.
F	Fluoride.
FC	Faecal coliforms, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
Fresh	Elevated flow in a stream, such as after heavy rainfall.
g/m^3	Grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred.
Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring.

Investigation	Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident.
Incident Register	The Incident Register contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
L/s	Litres per second.
m^2	Square Metres.
mS/m	Millisiemens per metre.
Mixing zone	The zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point.
NH_4	Ammonium, normally expressed in terms of the mass of nitrogen (N).
NH_3	Unionised ammonia, normally expressed in terms of the mass of nitrogen (N).
Ni*	Nickel
NO_3	Nitrate, normally expressed in terms of the mass of nitrogen (N).
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water.
O&G	Oil and grease, defined as anything that will dissolve into a particular organic solvent (e.g. hexane). May include both animal material (fats) and mineral matter (hydrocarbons).
Pb*	Lead.
pH	A numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
Physicochemical	Measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment.
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
RMA	*Resource Management Act 1991* and including all subsequent amendments.
SS	Suspended solids.
SQMCI	Semi quantitative macroinvertebrate community index.
Temp	Temperature, measured in °C (degrees Celsius).
Turb	Turbidity, expressed in NTU.
UI	Unauthorised Incident.
Zn*	Zinc.

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

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

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Appendix I

Resource consents held by STDC for the HWWTP

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

Coastal Permit

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

Name of Consent Holder:	South Taranaki District Council Private Bag 902 HAWERA 4640
Change To Conditions Date:	29 June 2010 [Granted: 22 March 1998]

Conditions of Consent

Consent Granted:	To discharge up to 12,000 cubic metres/day [seven day average discharge] of treated municipal wastes generated in the Hawera and Eltham townships, including treated meat processing and dairy industry wastes, through a combined marine outfall into the Tasman Sea near Hawera at or about (NZTM) 1710652E-5611568N
Expiry Date:	1 June 2015
Review Date(s):	June 2010
Site Location:	Rifle Range Road, Hawera
Legal Description:	Pt Lot 13 DP 2625 and Foreshore Blks IX & X Hawera SD
Catchment:	Tasman Sea

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

General conditions

a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

   i) the administration, monitoring and supervision of this consent; and
   ii) charges authorised by regulations.

Special conditions

1. The consent holder shall properly and efficiently maintain and operate the oxidation ponds system, with aerobic ponds maintained in an aerobic condition during daylight hours.

2. For 90% of the time between the hours of 1100-1400 the dissolved oxygen level in the aerobic ponds, and in the wastewater immediately prior to discharge, shall be maintained at a level at or exceeding 2 gm^{-3} and that the consent holder shall monitor the dissolved oxygen levels in the aerobic ponds, on a continuous basis, and supply the results to the Chief Executive, Taranaki Regional Council, upon request.

3. The discharge authorised by this consent shall not give rise to any of the following effects in the Tasman Sea beyond a mixing zone of 200 metres from the centre line of the outfall diffuser:

   a) the production of conspicuous oil or grease films, scums or foams or floatable or suspended materials;
   b) any conspicuous change in the colour or visual clarity;
   c) any emission of objectionable odour;
   d) any significant effects on aquatic life.

4. The discharge shall not result in the guideline for shellfish-gathering waters, as specified in the document 'Provisional Microbiological Water Quality Guidelines for Recreational and Shellfish-Gathering Waters in New Zealand' [Department of Health 1992], being exceeded at the shoreline.

5. The consent holder shall monitor the volume of wastewater discharged on a continuous basis and shall supply this information to the Chief Executive, Taranaki Regional Council, upon request.

6. The consent holder shall undertake to advise and consult with the Taranaki Regional Council if trade wastes are accepted into the consent holder's wastewater system, for which it may be appropriate or necessary to place limits on the concentrations in the final discharge of any toxic or hazardous contaminants which may be contained in that trade waste. If such limits are considered necessary, the Chief Executive, Taranaki Regional Council, shall require a review of the consent conditions in accordance with s128 of the Resource Management Act 1991.

7. The consent holder shall manage the discharge so as to ensure compliance with special condition 3.

8. Within three months of the granting of this consent, the consent holder shall provide to the Chief Executive, Taranaki Regional Council, a contingency plan outlining measures and procedures undertaken to prevent spillage or accidental discharge of contaminants in the event of plant, including the wastewater pipeline and pumping system, breakdown or maintenance and measures to avoid, remedy or mitigate the environmental effects of such a spillage or discharge. The consent holder shall annually review and maintain the plan.

9. The consent holder shall supply to the Chief Executive, Taranaki Regional Council, an annual report on its waste treatment system, including the performance of the outfall and compliance with the consent; such report to be provided by 31 August each year.

10. The consent holder shall supply to the Chief Executive, Taranaki Regional Council, a report reviewing the best practicable option for treatment and disposal of wastewater generated at Hawera and Eltham, including the option of disposal to land, such report to be provided by 31 December 2009.

11. The consent holder shall, substantially in accordance with information submitted in support of application 2541, including the Eltham Sewage Disposal Project Schedule:

    a) Reduce stormwater infiltration to the Hawera wastewater system;
    b) Upgrade the Eltham wastewater treatment plant;
    c) Upgrade the Hawera wastewater treatment plant; and
    d) Construct a pipeline for the transfer of municipal sewage waste from Eltham to Hawera.

    Once the above works are complete, the consent holder shall discharge all Eltham wastewater, via the pipeline, to the Hawera wastewater treatment plant. The works shall be completed, and the discharge shall commence, by 31 July 2009.

12. The consent holder shall provide reports on implementation of condition 11 [including progress on the Eltham Sewage Disposal Project Schedule, and detailing changes to the schedule] to the Chief Executive, Taranaki Regional Council, by 31 March, 30 June, 30 September, and 15 December of each year until implementation is complete.

13. The consent holder and staff of the Taranaki Regional Council shall meet as appropriate and at least once per year, with representatives of Ngati Ruanui Iwi Authority, Inuawai/Okahu hapu and Kanihi/Umutahi hapu, other submitters to the consent, and any other interested party, at the discretion of the Chief Executive, Taranaki Regional Council, to discuss any matter relating to the exercise of this resource consent, in order to facilitate ongoing consultation.

14. The consent holder shall ensure that a monitoring programme is established to record and analyse effects of the exercise of this consent on the intertidal reefs and coastal water quality adjacent to the discharge to the satisfaction of the Chief Executive, Taranaki Regional Council.

15. The scope and detail of the monitoring programme established in special condition 14 shall be developed in consultation with submitters to applications 96/302 and 2541 in relation to this consent.

16. The consent holder shall install a screen prior to the influent reaching the southern aerobic oxidation pond for the purpose of preventing the discharge of undisintegrated solids into and from the oxidation pond.

17. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent within six months of receiving a report prepared by the consent holder pursuant to condition 10 of this consent, or by giving notice of review during the month of June 2010, for the purposes of:

    a) dealing with any significant adverse effect on the environment arising from the exercise of the consent which was not foreseen at the time the application was considered or which it was not appropriate to deal with at the time; and/or
    b) requiring the consent holder to adopt the best practicable option for treatment and disposal of wastewater generated in Hawera and Eltham.

    In determining, whether such a review is undertaken, the Regional Council will take into account the views expressed by Ngati Ruanui Tahua Iwi Authority Inc., Inuawai/Okahu Hapu and Kanihi/Umutahi Hapu, and the consent holder.

Signed at Stratford on 29 June 2010

For and on behalf of
Taranaki Regional Council

Director-Resource Management

Discharge Permit

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

Name of Consent Holder:	South Taranaki District Council Private Bag 902 HAWERA 4640
Consent Granted Date:	4 November 2009

Conditions of Consent

Consent Granted:	To discharge, as a consequence of high rainfall, partially treated wastewater from the Hawera Wastewater Treatment Plant into Unnamed Stream 22 at or about (NZTM) 1708616E-5614555N
Expiry Date:	1 June 2027
Review Date(s):	June 2015, June 2017, June 2021
Site Location:	Beach Road, Hawera
Legal Description:	Lot 1 DP 382332 Lot 1 DP 16178 Blk IX Hawera SD
Catchment:	Unnamed Stream 22

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

General conditions

a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

   i) the administration, monitoring and supervision of this consent; and
   ii) charges authorised by regulations.

Special conditions

1. The discharge shall only occur as a consequence of high rainfall events when the inflows to the wastewater treatment plant are such that the holding capacity of the treatment plant is exceeded.

2. The temporary holding pond capacity shall be no less than 55,000 cubic metres.

3. The consent holder shall not undertake any modifications to the treatment plant that may result in an increase in the frequency of the discharge.

4. The consent holder shall record the timing and duration of the overflow to the Unnamed Stream, and report these records to the Chief Executive, Taranaki Regional Council, on request.

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

6. The consent holder shall phone the Taranaki Regional Council immediately after becoming aware of each discharge authorised by this permit, in order to enable the undertaking monitoring of the discharge in accordance with special condition 8.

7. Within three months of the granting of this consent, the consent holder shall prepare and maintain a contingency plan. The contingency plan shall be adhered to in the event of a discharge and shall, to the satisfaction of the Chief Executive, Taranaki Regional Council, detail measures and procedures to be undertaken to avoid, remedy or mitigate the environmental effects of the discharge.

8. Subject to Section 36 of the Resource Management Act [1991], monitoring, including physicochemical, bacteriological and ecological monitoring of the wastewater treatment system and receiving waters shall be undertaken, as deemed reasonably necessary by the Chief Executive, Taranaki Regional Council, to understand the effects of the discharge.

9. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2015 and/or June 2017 and/or June 2021, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 4 November 2009

For and on behalf of
Taranaki Regional Council

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Director-Resource Management

Appendix II

Intertidal Survey Memorandums

Spring 2015 and Summer 2016

Memorandum

To: Science Manager – Hydrology/Biology, Regan Phipps
From: Scientific Officer, Emily Roberts and Technical Officer Thomas McElroy
File: 1616097
Date: 11 January 2016

Fonterra Whareroa/Hawera Municipal Combined Outfall – Marine Ecological Survey October/November 2015

Introduction

Consent 1450 allows the discharge of dairy factory wastewater from the Fonterra Whareroa factory via a marine outfall. The consent allowing this discharge was renewed in September 1995, requiring the Company to install a long outfall by 31 August 1997. Prior to the renewal of this consent, the wastewater was discharged via a short marine outfall at approximately mean low water spring (MLWS) level which caused significant adverse effects on marine intertidal ecology to at least 1000 m southeast of the outfall.

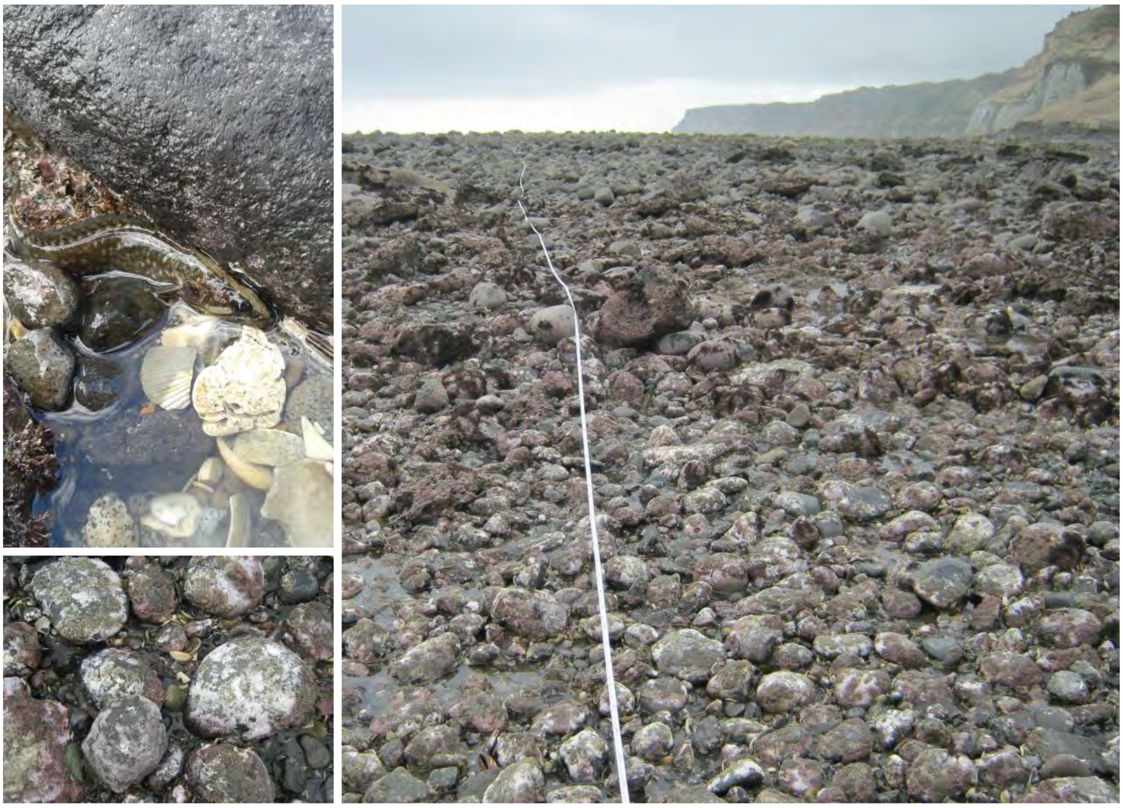
In February 2001, wastewater from the Hawera Oxidation Ponds was connected to the long outfall by consent 5079, allowing a municipal wastewater discharge of 10,000 m^3/day. By comparison, the Fonterra Whareroa wastewater discharge limit was 26,000 m^3/day. As of 19 September 2006, the permitted volume of wastewater discharge increased to 40,000 m^3/day. The oxidation pond discharge was also increased to 12,000 m^3/day in December 2007.

Special condition 6 of consent 1450 and special condition 3 of consent 5079 requires there to be no significant visual, chemical or ecological impacts outside of a 200 m mixing zone or within the intertidal zone. Specifically, consent 5079 requires the consent holder to ensure that a monitoring programme is established to record and analyse the effects on the intertidal reefs and water quality adjacent to the discharge. Accordingly, two surveys of the intertidal zone were scheduled for the 2015-2016 monitoring programme for the combined marine outfall. The first survey for the 2015-2016 monitoring period was conducted at four sites between 27 October and 24 November 2015.

Methods

Field Work

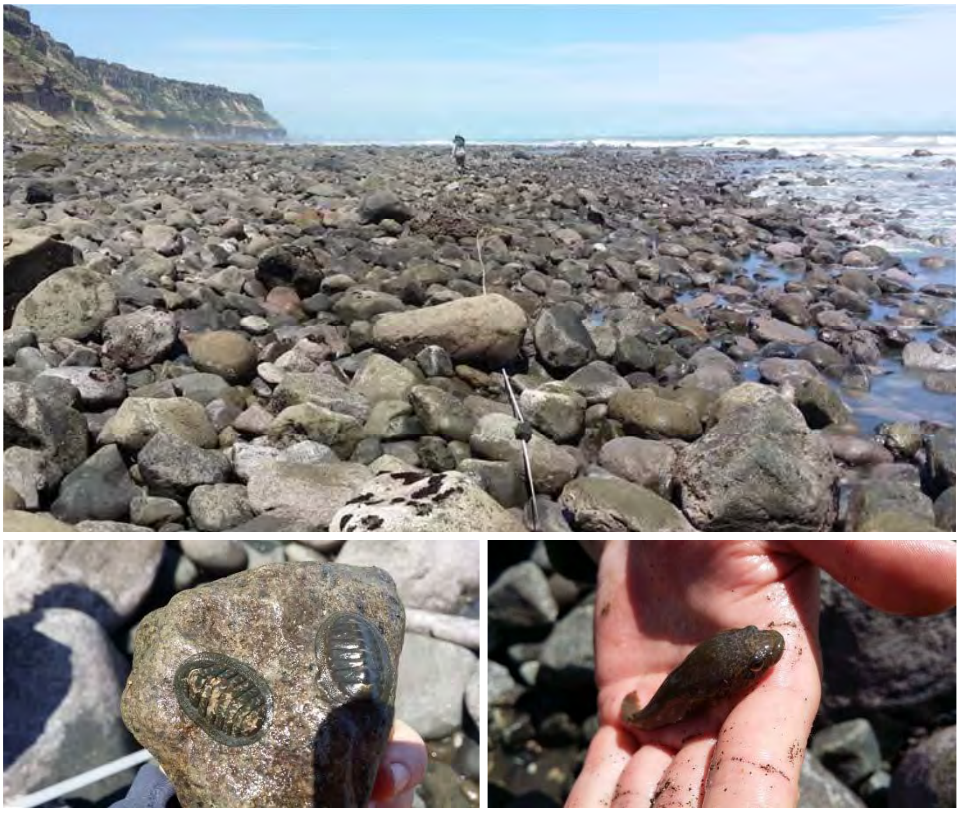
Of the four sites surveyed, three have been identified by NIWA as having shoreline contact with the wastewater discharged from the outfall (Palliser *et al*., 2013): 350 m northwest of the outfall (SEA906049), 200 m southeast of the outfall (SEA906057) and 1.55 km southeast of the outfall on Pukeroa Reef (SEA906067) (Photographs 1-3, Figure 1). The control site at Waihi Reef (Photograph 4, Figure 1), approximately 4.5 km northwest of the outfall (SEA906025), has been identified by NIWA as unlikely to be impacted by the discharged wastewater (Palliser *et al*., 2013).



Photograph 1 Surveying the potential impact site 350 m northwest of the outfall (October 2015)

Photograph 2 Surveying the potential impact site 200 m southeast of the outfall (October 2015)

Photograph 3 Surveying Pukeroa Reef; a potential impact site (October 2015)



Photograph 4 Survey control site Waihi Reef (November 2015)

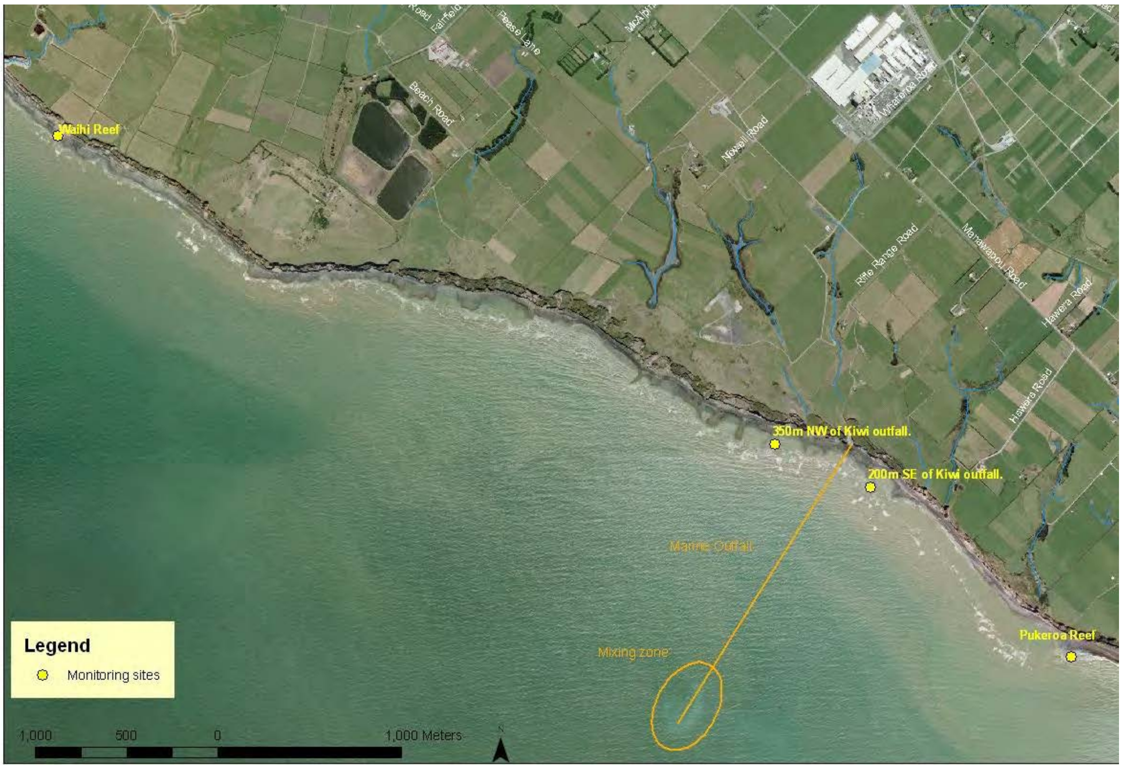


Figure 1 Survey sites in relation to the outfall

At each site, a 50 m transect was used to establish five 5 m x 3 m blocks. Within each block, five random 0.25 m^2 quadrats were laid giving a total of 25 random quadrats (Photograph 5). For each quadrat the percentage cover of algae and encrusting animal species was estimated using a grid. For all other animal species, individuals larger than 3 mm were counted. Under boulder biota was counted where rocks and cobbles were easily overturned.

Photograph 5 Past survey 200 m southeast of the outfall showing the transect used

Results

Summary statistics, including the mean number of species per quadrat and the mean Shannon-Weiner indices, are shown in Table 1. The Pukeroa Reef site had the highest mean number of species, followed by 350 m NW, then Waihi Reef and finally 200 m SE. The site 350 m NW of the outfall had the highest mean diversity (Shannon-Wiener Index), followed by Pukeroa Reef, then Waihi Reef and finally 200 m SE.

Table 1 Mean results for the October/November 2015 survey

Site	No. of quadrats	Mean number of species per quadrat			Mean Shannon-Weiner indices per quadrat		
		Algae	Animals	Total Species	Algae	Animals	Total Species
Waihi Reef	25	2.52	7.08	9.60	0.316	0.715	0.848
350 m NW	25	3.60	6.52	10.12	0.504	0.673	0.884
200 m SE	25	0.00	0.00	0.00	0.000	0.000	0.000
Pukeroa Reef	25	2.68	7.84	10.52	0.386	0.743	0.868

Number of Species per Quadrat

Figure 2 shows the total number of species per quadrat as a box and whisker plot. The notched area of the box represents the median plus and minus a 95% confidence interval for the median. This form of graphical representation allows a quick comparison to be made between sites. Generally, if the notched areas of the boxes for the different sites do not overlap, one would expect to obtain a significantly different result with ANOVA.

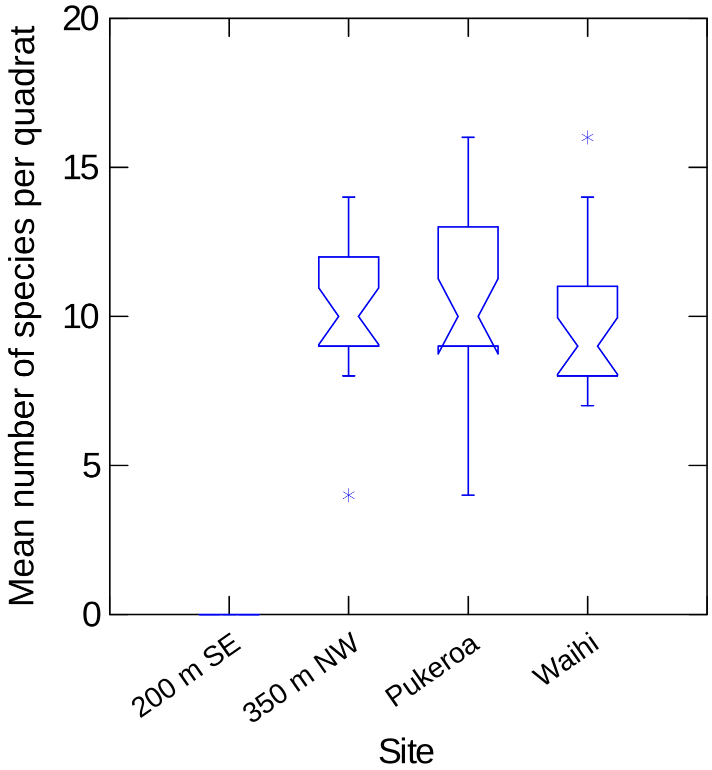


Figure 2 Box and whisker plots of mean number of species per quadrat

The Lilliefors test of normal distribution was not conducted as the data already deviated from the ANOVA assumptions due to the uneven data variance between 200 m SE and the remaining sites. Accordingly, a non-parametric approach was adopted.

There was a significant difference in the mean number of species per quadrat between sites (Kruskal-Wallis, H = 56.604, degrees of freedom (df) = 3, $P < 0.001$). Significant differences between sites were determined using the Wilcoxon signed-ranks test (Table 2). There were significantly less species found at the site 200 m SE of the outfall when compared to the other three sites. There was no significant difference in the mean number of species between these remaining three sites.

Table 2 Wilcoxon signed ranks test of number of species per quadrat

Site	Waihi	350 m NW	200 m SE
350 m NW	NS		
200 m SE	SIG	SIG	
Pukeroa Reef	NS	NS	SIG

Key: SIG = significant difference at 95% confidence level
NS = no significant difference

The anomalous data from the site 200 m SE of the outfall appeared to skew the comparison between sites. So, in order to maximise the power to detect differences between the remaining three sites, the analyses were intended to be repeated using ANOVA without the

200 m SE site. However, using both raw and transformed data (with natural logarithm), the data deviated from the normal distribution for at least one site during each test (Lilliefors test, n=25, P ≤ 0.05).

Shannon-Weiner Diversity Index

Figure 3 shows the mean Shannon-Weiner index data at each site as a box and whisker plot.

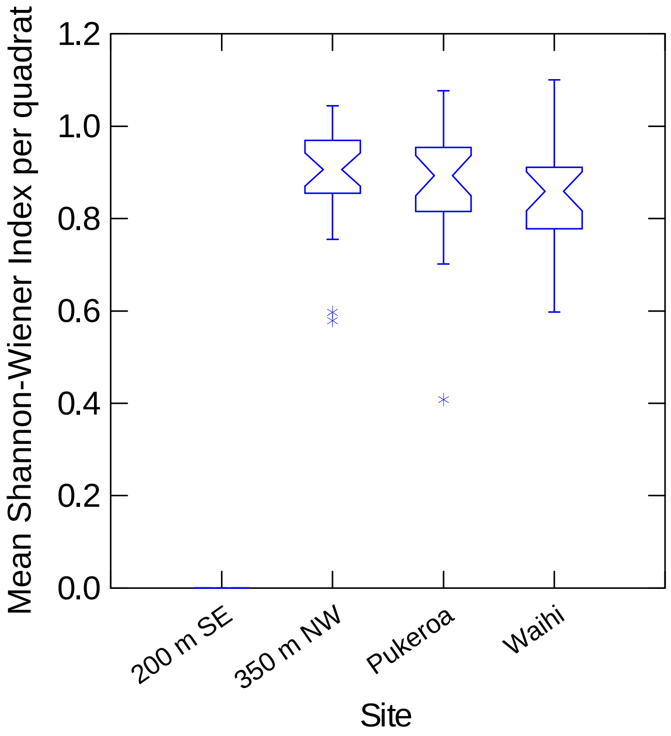


Figure 3 Box and whisker plots of mean Shannon-Weiner indices per quadrat

The Lilliefors test of normal distribution was not conducted as the data already deviated from the ANOVA assumptions due to the uneven data variance between 200 m SE and the remaining sites. Accordingly, a non-parametric approach was adopted.

There was a significant difference in the mean Shannon-Wiener Index per quadrat between sites (Kruskal-Wallis, H = 56.231, df = 3, P < 0.001). Significant differences between sites were determined using the Wilcoxon signed-ranks test (Table 3). The mean Shannon-Wiener index was significantly lower at the site 200 m SE of the outfall when compared to the other three sites. There was no significant difference in the mean Shannon-Wiener index between these remaining three sites.

Table 3 Tukey multiple comparison test of Shannon-Weiner index per quadrat

Site	Waihi	350 m NW	200 m SE
350 m NW	NS		

200 m SE	SIG	SIG	
Pukeroa Reef	NS	NS	SIG

SIG = Significant difference
NS = No significant difference

The anomalous data from the site 200 m SE of the outfall appeared to skew the comparison between sites. So, in order to maximise the power to detect differences between the remaining three sites, the analyses were intended to be repeated using ANOVA without the 200 m SE site. However, using both raw and transformed data (with natural logarithm), the data deviated from the normal distribution for at least one site during each test (Lilliefors test, n=25, $P \leq 0.05$).

Sand, silt and mud coverage

The level of sand cover was low (<2%) at the Pukeroa and Waihi Reef sites (Table 4, Figure 4). Sand cover was moderate at the site 350 m NW of the outfall, and high at the site 200 m SE of the outfall. Abundance and diversity of intertidal species/communities can be significantly impacted by sand cover of 30% and higher.

Table 4 Mean percentage sand cover per quadrat observed during 2015 spring survey

Site	Sand	Silt and mud	Total
Waihi Reef	1.44	0.00	1.44
350 m NW	9.28	1.36	10.64
200 m SE	32.84	8.48	41.32
Pukeroa Reef	0.40	0.4	0.8

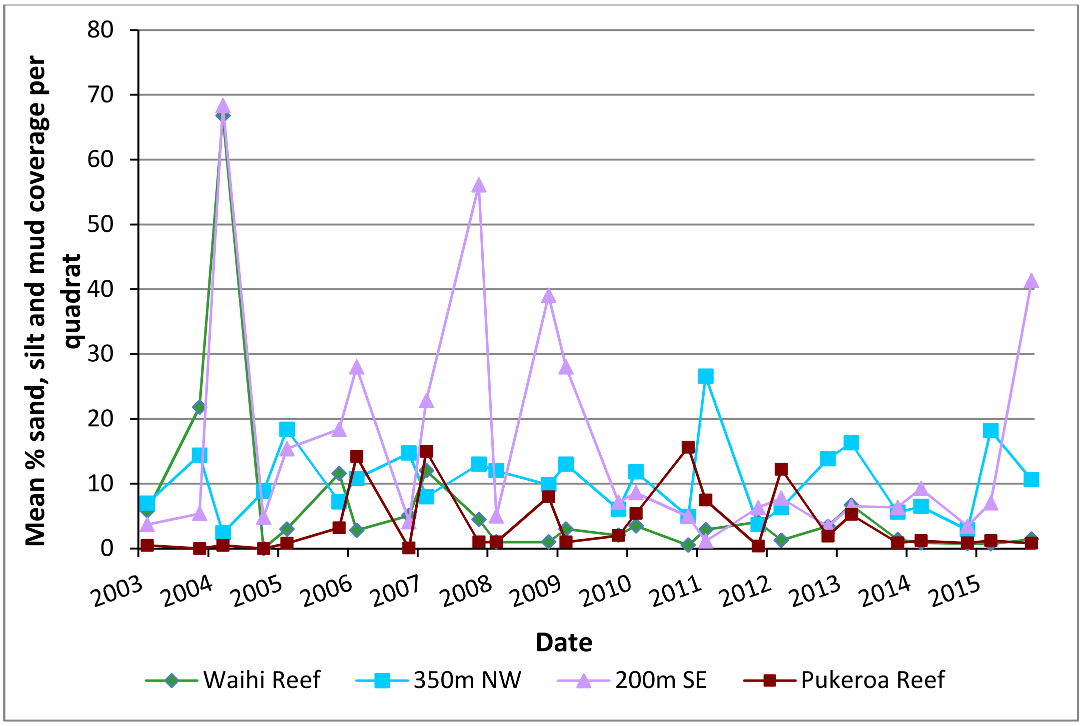


Figure 4 Mean percentage of sand, silt and mud cover per quadrat from summer 2003 to spring 2015

Trends over time

Species number and diversity

Comparisons of the mean number of species per quadrat (Figure 5) and mean Shannon-Weiner diversity index per quadrat (Figure 6) for all spring surveys undertaken since November 1992 are shown below.

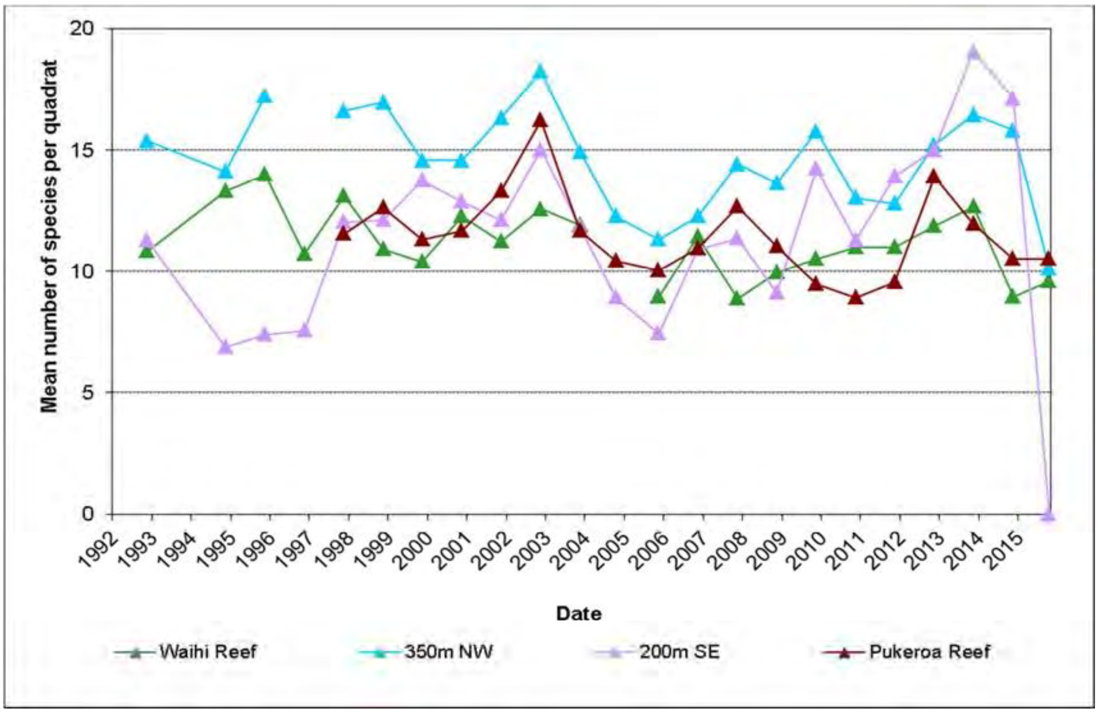


Figure 5 Mean number of species per quadrat for spring surveys 1992-2015

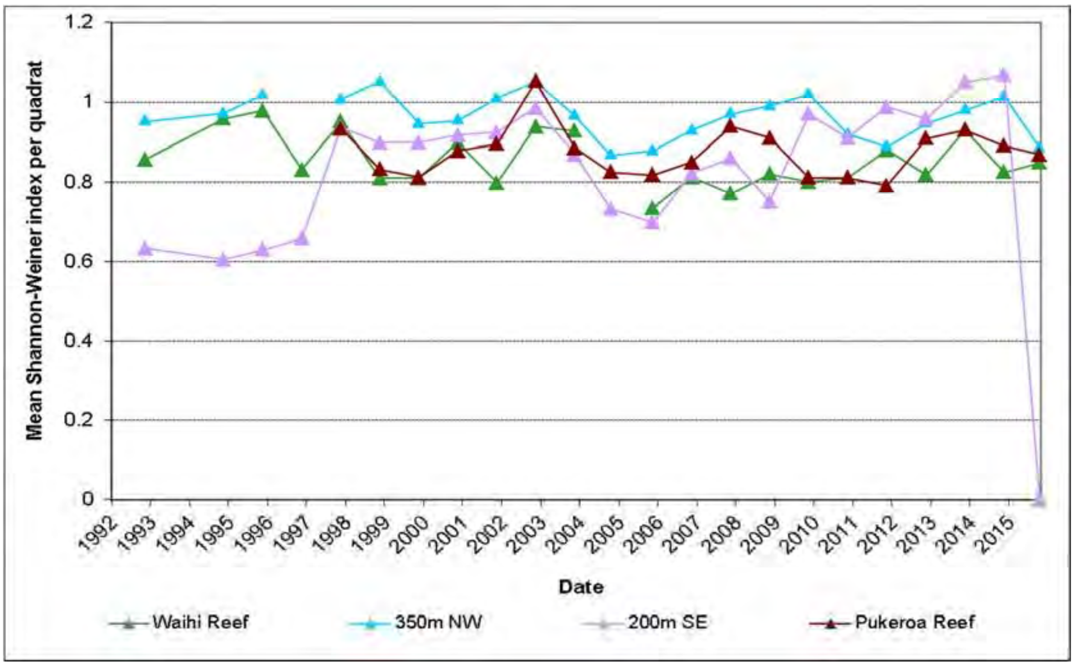


Figure 6 Mean Shannon-Weiner indices per quadrat for spring surveys 1992-2015

Prior to the installation of the long marine outfall in August 1997, both number of species and Shannon-Weiner Index per quadrat at the impact site 200 m SE were generally lower than at the control site at Waihi Reef (Figures 5 and 6). Since then (1997), sites have shown interannual variability in both number of species and Shannon-Weiner Index, but there has been no noticeable difference in trends between the impact site and the control sites over this period, with the exception of years with heavy sand inundation (e.g. 2000 and 2002 at 200 m SE, Figures 5 and 6).

The results of the 2015 spring survey show large decreases in the mean number of species at the two impact sites closest to the outfall (200 m SE and 350 m NW, Figure 5). A slight increase in the mean number of species was observed at Waihi Reef, while there was no change at Pukeroa Reef (Figure 5). At nearly every site, the change in Shannon-Wiener index from the previous year followed the same direction as the change in mean number of species (Figure 6). Pukeroa Reef was the only exception as there was a slight decrease in Shannon-Wiener index from the previous year, whereas the mean number of species had not changed.

Discussion

Previous surveys have shown that the dairy factory wastewater discharged through the near-shore outfall prior to 1997 (Photograph 1) was having significant adverse effects on the local intertidal community. The adverse effects recorded included the coating of rocks and tidal pools with fats, significant coverage by filamentous bacterial growths and a significant decrease in ecological diversity. The nature and magnitude of adverse effects varied with distance from the outfall, and were most apparent at the sites 30 m and 200 m southeast of the outfall (note that the former site is no longer surveyed as of 2007). In 1997 the dairy company installed a long outfall to discharge the wastewater nearly 2 km offshore in order to mitigate the adverse effects occurring along the coastline. Numerous spring and summer intertidal surveys have now been undertaken along the Hawera coastline subsequent to installation of the long outfall. Results show a general improvement in the health of intertidal communities following installation of the outfall. In February 2001 the Hawera Oxidation Ponds municipal wastewater was also connected to the long outfall.

Photograph 6 Discharge from the dairy factory near-shore outfall prior to 1997

Of all four sites, the two sites closest to the outfall showed the greatest decreases in species richness and diversity when compared to the previous survey. However, these decreases can not be attributed to the marine outfall. Indeed, impacts of the marine outfall discharge on the local intertidal communities were not evident from the 2015 spring survey results.

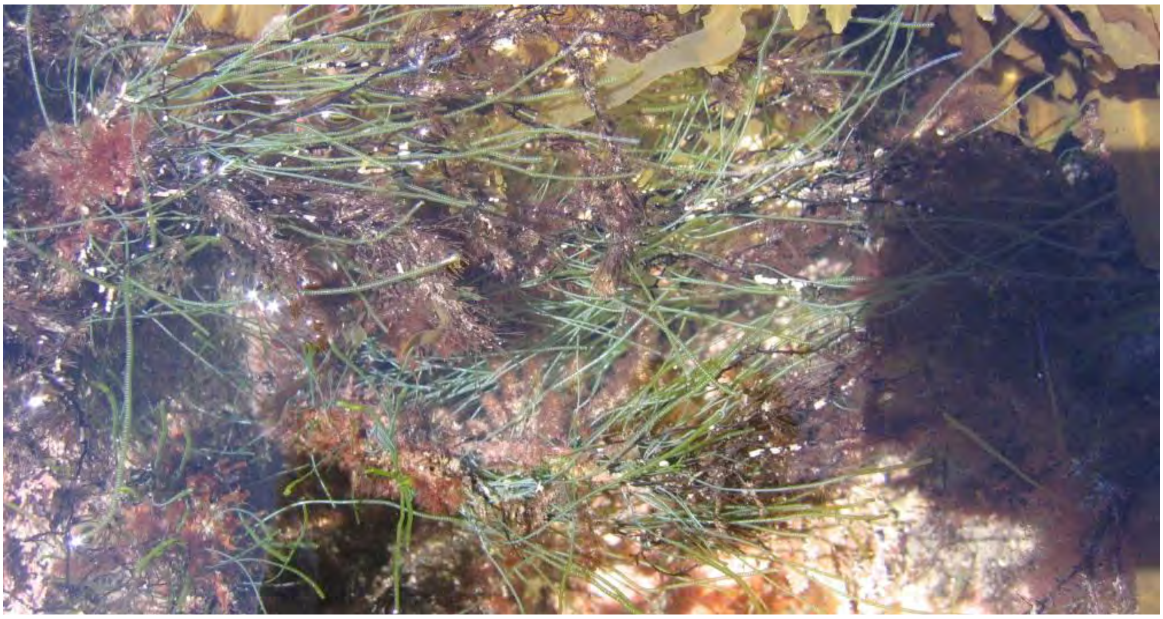
The most influential factor affecting the surveyed reef communities was land-based erosion. This was epitomised by the site 200 m SE of the outfall, which recorded no marine species along the surveyed transect. This section of reef had been completely buried by cliff material spanning from the foot of the cliff down to the low water mark. Similarly, when surveying the site 350 m NW of the outfall, it appeared that some sections of the transect appeared to have been recently buried; presumably by eroded cliff material. The extent of the erosion at the other two survey sites was far less (although still notable). It is possible that the impact of the eroding cliffs may have concealed any adverse effect that the outfall was having on the nearby reefs. However, not including the site 200 m SE of the outfall, there were no significant differences in species richness and diversity between the remaining two impact sites and the control site.

The historical record of survey results (Figures 5 and 6) showed no obvious impact of the marine outfall discharge on the local intertidal communities since installation of the long outfall in 1997. Both control and potential impact sites showed interannual variability and there were no obvious declining trends at the impact sites closest to the outfall relative to the control site. It must be noted that the high energy receiving environment combined with the effects of suspended sediments from nearby rivers/streams and eroding cliffs prevent the development of stable biological communities along the South Taranaki coastline (Clark *et al*., 2012). Such communities could potentially mask any subtle ecological effects from the outfall wastewater discharge. However, in spite of these limitations, the long term record indicates that the intertidal surveys are useful for detecting more noticeable effects from the wastewater, as the impact on intertidal communities prior to installation of the outfall is clearly evident (Figures 5 and 6, Clark *et al*., 2012).

The most notable change in species composition since the commissioning of the long outfall is the decline of *Chaetomorpha* sp. (Photograph 8) and the absence of filamentous bacterial growths at 200 m SE (Figures 7 and 8). The adverse effects recorded prior to the long outfall also included the coating of rocks and tidal pools with fats and a significant decrease in ecological diversity.

As mentioned earlier, the inundation of earth, sand and silt resulting from cliff face erosion (Photograph 9) can be an important factor affecting species composition and diversity along the South Taranaki coastline. The coast is in a constant state of erosion with layers of sand and silt often smothering marine life at some sites. Not only does fallen cliff material cripple marine communities through disturbance and burial, observations indicate that freshly fallen boulders provide a poor habitat for intertidal organisms. This factor could limit the resilience of reef communities encountering erosion events by deterring organisms from settling and ultimately prolonging the recovery timeframe. Another consequence of erosion is an increased turbidity of the seawater which can affect light availability and ultimately impact on macroalgae. In the current survey, many of the intertidal pools within the transect at the Pukeroa Reef site were highly turbid (Photograph 7). The most likely cause of the turbidity was the eroding cliff face further up the coast, as the appearance of the silt was consistent with the fallen debris found at the survey sites near the outfall. It is possible that this turbidity may have lead to the survey under-representing the number of species at this site as it was difficult to examine the pools to the same degree as when the water was clear.

Photograph 7 Turbid intertidal pools at Pukeroa Reef



Photograph 8 Green filaments of *Chaetamorpha*, an algal genus often associated with high nutrient concentrations (North Taranaki)

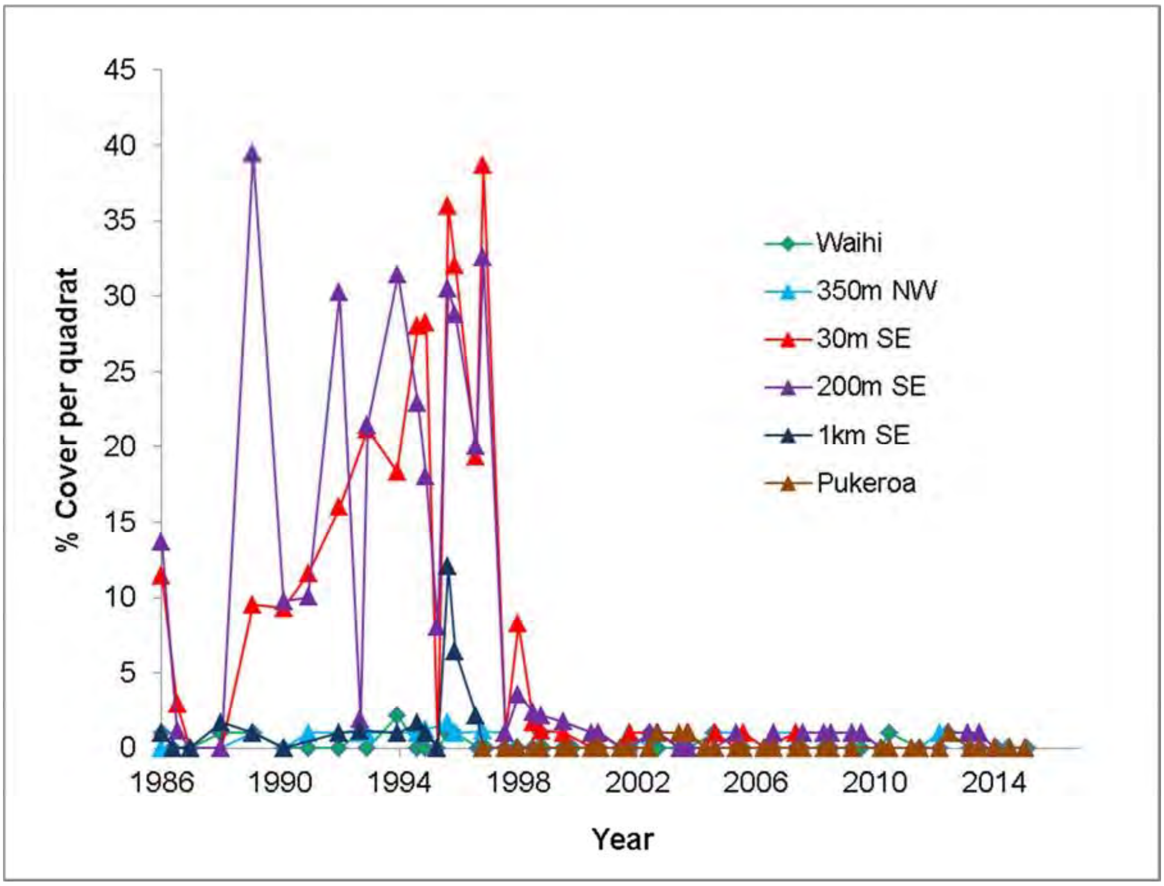


Figure 7 Percentage cover per quadrat of *Chaetomorpha* since 1986

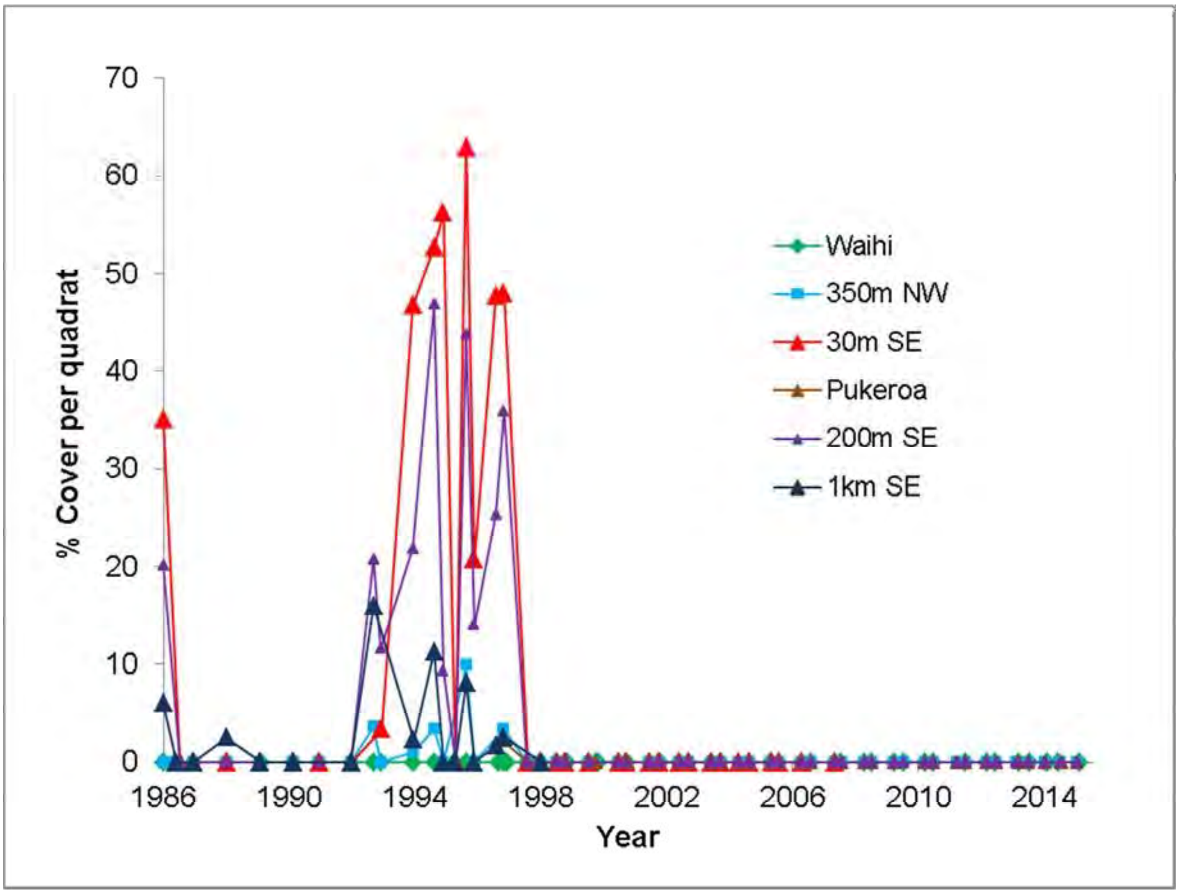


Figure 8 Percentage cover per quadrat of filamentous bacteria since 1986

N.B. Since 2007, the sites 30 m SE and 1 km SE are no longer monitored as part of the Fonterra Whareroa intertidal survey.

Photograph 9 Significant erosion over the reef site 200 m SE of the outfall October 2015 (A), Relatively intact cliffs covered in vegetation above the Pukeroa Reef site October 2015 (B), A large slip above Waihi Reef November 2015 (C)

Conclusions

In order to assess the effects of the Fonterra Whareroa and Hawera Waste Water Treatment Plant outfall discharge on the nearby intertidal communities, surveys were conducted between 27 October and 24 November 2015 at four sites. These surveys included three potential impact sites either side of the outfall (two southeast and one west) and one control site to the northwest. It is expected that adverse effects of the marine outfall discharge on the intertidal communities would have been evident as a significant decline in species richness and diversity at the potential impact sites relative to the control site.

Although the two impact sites closest to the outfall had the greatest declines in diversity and richness of all the sites when compared with the previous survey, these sites were also the worst affected from the cliff face erosion. Aside from this survey, results from the impact sites have not declined notably in relation to the control site in recent years. Accordingly, the results of this survey provide no evidence to suggest that the outfall is having any adverse effect on the intertidal reef communities of South Taranaki. Natural environmental factors, including coastal erosion, exposure and substrate mobility, appeared to be dominant drivers of species richness and diversity at the sites surveyed.

Emily Roberts
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Thomas McElroy
Technical Officer

References

Palliser, C., McBride, G., Goodhune, N., Bell, R., Stott, R. (2013) Fonterra Whareroa Dairy Factory and Hawera WWTP, Stage 2 QMRA based on the combines discharge. NIWA Client Report No. HAM2013-050

Clark, D., Barter, P., Clement, D., Tremblay, L., Forrest, R. (2013) Whareroa Marine Outfall ecological investigation 2012. Cawthron Report No. 2348

Memorandum

To: Science Manager – Hydrology/Biology, Regan Phipps
From: Scientific Officer, Emily Roberts and Technical Officer Thomas McElroy
File: #1671273
Date: 2 May 2016

Fonterra Whareroa/Hawera Municipal Combined Outfall – Marine Ecological Survey Summer 2016

Introduction

Consent 1450 allows the discharge of dairy factory wastewater from the Fonterra Whareroa factory via a marine outfall. The consent allowing this discharge was renewed in September 1995, requiring the Company to install a long outfall by 31 August 1997. Prior to the renewal of this consent, the wastewater was discharged via a short marine outfall at approximately mean low water spring (MLWS) level which caused significant adverse effects on marine intertidal ecology to at least 1000 m southeast of the outfall.

In February 2001, wastewater from the Hawera Oxidation Ponds was connected to the long outfall by consent 5079, allowing a municipal wastewater discharge of 10,000 m^3/day. By comparison, the Fonterra Whareroa wastewater discharge limit was 26,000 m^3/day. As of 19 September 2006, the permitted volume of wastewater discharge increased to 40,000 m^3/day. The oxidation pond discharge was also increased to 12,000 m^3/day in December 2007.

Special condition 6 of consent 1450 and special condition 3 of consent 5079 requires there to be no significant visual, chemical or ecological impacts outside of a 200 m mixing zone or within the intertidal zone. Specifically, consent 5079 requires the consent holder to ensure that a monitoring programme is established to record and analyse the effects on the intertidal reefs and water quality adjacent to the discharge. By conducting two surveys a year (one in spring and one in summer) it is possible to capture information on the seasonal variation of the intertidal communities and any possible effects from the outfall. Accordingly, two surveys of the intertidal zone were carried out as part of the 2015-2016 monitoring programme for the combined marine outfall. The 2015-2016 summer survey was conducted at four sites between the 8th and the 11th of March 2016; the results are covered in this memo.

Methods

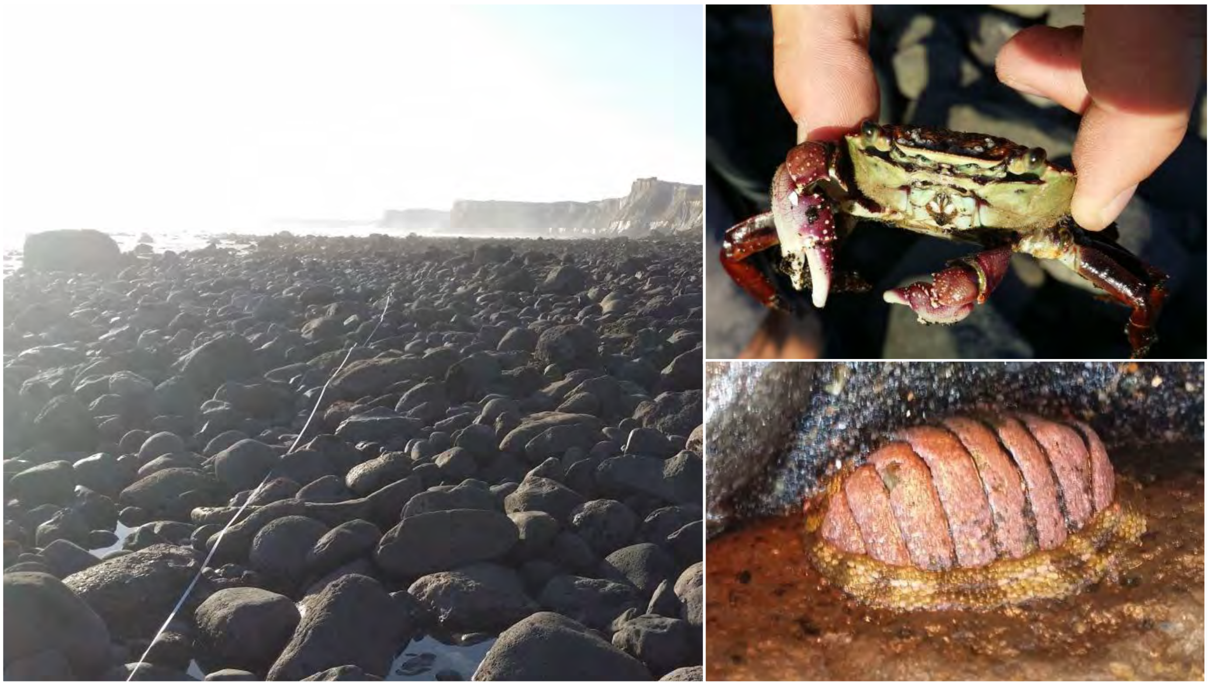
Field Work

Of the four sites surveyed, three have been identified by NIWA as having shoreline contact with the wastewater discharged from the outfall (Palliser *et al.*, 2013): 350 m northwest of the outfall (SEA906049), 200 m southeast of the outfall (SEA906057) and 1.55 km southeast of the outfall on Pukeroa Reef (SEA906067) (Photographs 1-3, Figure 1). The control site at Waihi Reef (Photograph 4, Figure 1), approximately 4.5 km northwest of the outfall (SEA906025), has been identified by NIWA as unlikely to be impacted by the discharged wastewater (Palliser *et al.*, 2013).

Photograph 1 Surveying the potential impact site 350 m northwest of the outfall (11 March 2016)

Photograph 2 Surveying the potential impact site 200 m southeast of the outfall (11 March 2016)

Photograph 3 Surveying Pukeroa Reef; a potential impact site (8 March 2016)



Photograph 4 Survey control site Waihi Reef (9 March 2016)

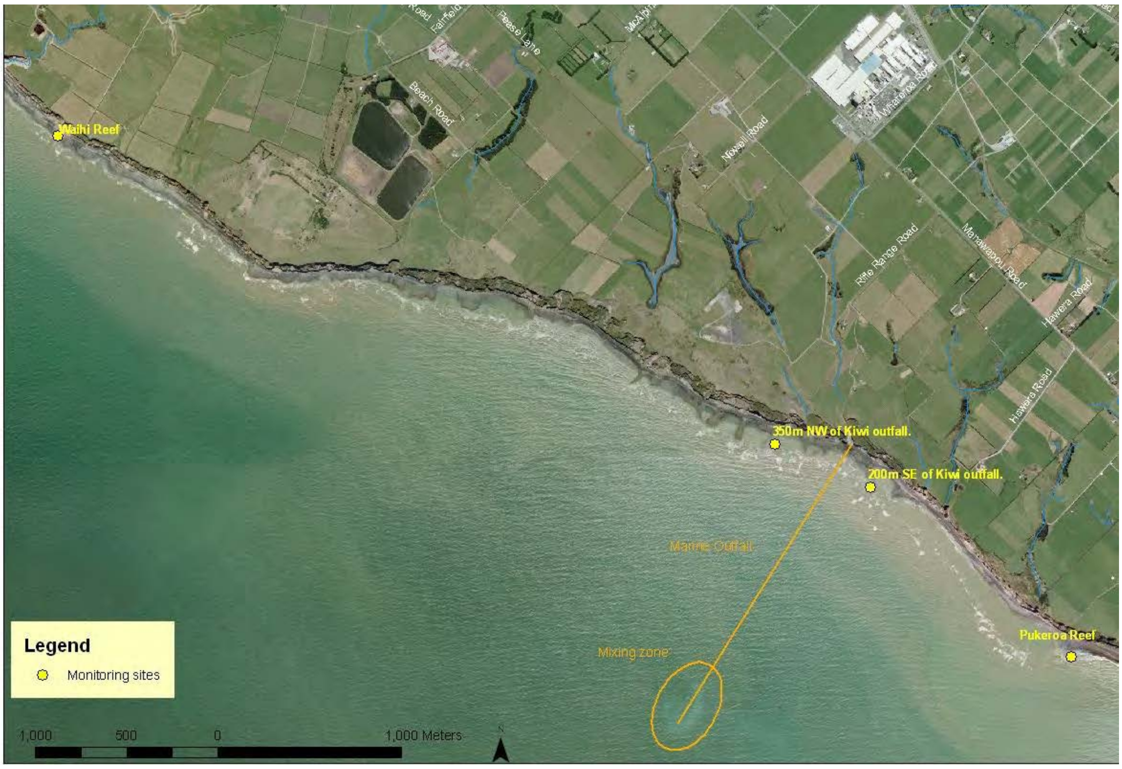


Figure 1 Survey sites in relation to the outfall

At each site, a 50 m transect was used to establish five 5 m x 3 m blocks. Within each block, five random 0.25 m^2 quadrats were laid giving a total of 25 random quadrats (Photograph 5). For each quadrat the percentage cover of algae and encrusting animal species was estimated using a grid. For all other animal species, individuals larger than 3 mm were counted. Under boulder biota was counted where rocks and cobbles were easily overturned.

Photograph 5 Survey at 200 m southeast of the outfall showing the transect used

Results

Summary statistics, including the mean number of species per quadrat and the mean Shannon-Weiner indices, are shown in Table 1. Both the mean number of species and Shannon-Wiener index were highest at the site 350 m NW of the outfall, followed by Pukeroa Reef, Waihi Reef and then the site 200 m SE of the outfall.

Table 1 Mean results for the 2016 summer survey

Site	No. of quadrats	Mean number of species per quadrat			Mean Shannon-Weiner indices per quadrat		
		Algae	Animals	Total Species	Algae	Animals	Total Species
Waihi Reef	25	2.60	9.04	11.64	0.312	0.660	0.777
350 m NW	25	4.08	10.72	14.80	0.513	0.810	0.941
200 m SE	25	0.00	1.56	1.56	0.000	0.196	0.196
Pukeroa Reef	25	3.16	8.76	11.92	0.404	0.760	0.877

Number of Species per Quadrat

Figure 2 shows the total number of species per quadrat as a box and whisker plot. The notched area of the box represents the median plus and minus a 95% confidence interval for the median. This form of graphical representation allows a quick comparison to be made between sites. Generally, if the notched areas of the boxes for the different sites do not overlap, one would expect to obtain a significantly different result with ANOVA.

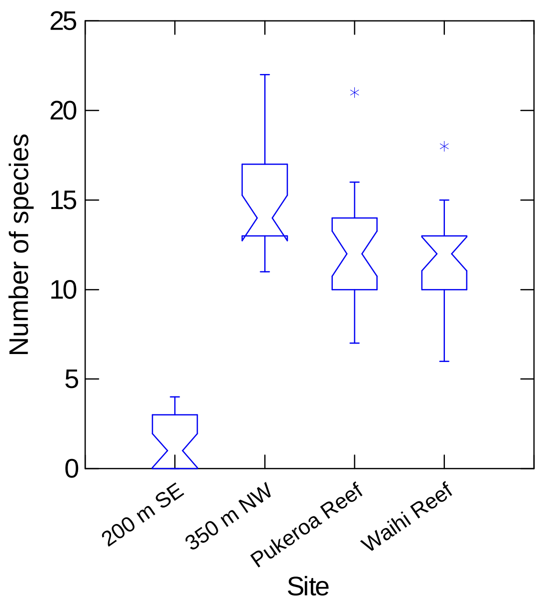


Figure 2 Box and whisker plots of the number of species per quadrat at the four sites

Only the data obtained from the Waihi Reef site conformed to the assumption of normal distribution. The data from the remaining three sites significantly deviated from the normal distribution at the 95% confidence level (Lilliefors test, n = 25, P < 0.05). A natural logarithmic transformation of the data was subsequently conducted. Only the data obtained from the Pukeroa Reef site conformed to the assumption of normal distribution following this transformation. The data from the remaining three sites significantly deviated from the normal distribution at the 95% confidence level (Lilliefors test, n = 25, P < 0.05). As this ANOVA assumption could not be met the remaining analyses were conducted using the raw data with non-parametric tests.

There was a significant difference in the number of species per quadrat between sites[1] (Kruskal-Wallis, H = 64.65, degrees of freedom (df) = 3, P < 0.001). Significant differences between sites were determined using the Wilcoxon signed-ranks test (Table 2). There was no significant difference in the number of species between the Pukeroa and Waihi Reef sites. Both of these sites had a significantly greater number of species than at the site 200 m SE of the outfall and a significantly lower number of species than at the site 350 m NW of the outfall.

Table 2 Wilcoxon signed ranks test of number of species per quadrat

Site	Waihi	350 m NW	200 m SE
350 m NW	SIG		
200 m SE	SIG	SIG	
Pukeroa Reef	NS	SIG	SIG

Key: SIG = significant difference at 95% confidence level
NS = no significant difference

Shannon-Weiner Diversity Index

Figure 3 shows the distribution of Shannon-Weiner Indices recorded at each site as box and whisker plots.

[1]The Kruskal-Wallis and Wilcoxon signed ranks tests are both non-parametric tests. This means they are not testing for differences in sample means (or medians) but rather they are testing for differences in the locations of sample distributions.

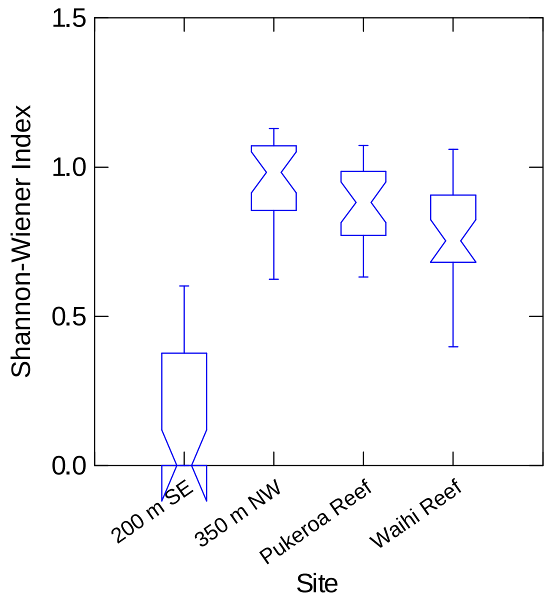


Figure 3 Box and whisker plots of Shannon-Weiner Indices at each site

The site 200 m SE of the outfall showed a significant deviation from normal distribution at the 95% confidence level (Lilliefors test, n = 25, P < 0.001). Additionally, the data variance at this site was not homogeneous with the other sites (Figure 3). As these ANOVA assumptions could not be met the remaining analyses were conducted using the raw data with non-parametric tests.

There was a significant difference in the Shannon-Weiner Indices between sites (Kruskal-Wallis, H = 61.55, degrees of freedom (df) = 3, P < 0.001). Significant differences between sites were determined using the Wilcoxon signed-ranks test (Table 2). There was no significant difference in Shannon-Wiener Indices between the Pukeroa Reef site and the site 350 m NW of the outfall. These two sites had a significantly greater Shannon-Wiener Indices than the remaining two sites. Waihi Reef had a significantly greater Shannon-Wiener Index than the site 200 m SE of the outfall.

Table 3 Wilcoxon signed ranks test with Shannon-Weiner index between sites

Site	Waihi Reef	350 m NW	200 m SE
350 m NW	SIG		
200 m SE	SIG	SIG	
Pukeroa Reef	SIG	NS	SIG

Key: SIG = significant difference at 95% confidence level
NS = no significant difference

Note: Shannon Wiener Index analyses were also performed following the removal of the '200 m SE' from the dataset. The data from this site was negatively skewed (for reasons covered in the discussion), and so was causing the dataset to fail the ANOVA assumptions even though the remaining sites were conforming. The analysis is as follows:

No sites showed a significant deviation from normal distribution at the 95% confidence level (Lilliefors test, n = 25, P > 0.05). Homogenous data variance was also observed across all sites (excluding 200 m SE, Figure 3). As the data conformed to the ANOVA assumptions the remaining analyses were conducted using ANOVA with the raw data.

There was a significant difference in the mean Shannon-Wiener Index between sites ($F_{2,72}$ = 7.629, P = 0.001). Significant differences between sites were determined using the Tukey test (Table 4). The mean Shannon-Wiener Index was significantly higher at the site 350 m NW of the outfall than at the Waihi Reef site (Figure 3, Table 4). There were no other significant differences between sites.

Table 4 Tukey test with mean Shannon-Wiener Index between sites

Site	Waihi Reef	350 m NW
350 m NW	SIG	
Pukeroa Reef	NS	NS

Key: SIG = significant difference at 95% confidence level
NS = no significant difference

Sand coverage

The level of sand cover was low at the Pukeroa and Waihi Reef sites (Table 5, Figure 4). Sand cover was moderate at the two sites nearest the outfall. Abundance and diversity of intertidal species/communities can be significantly impacted by sand cover of 30% and higher.

Table 5 Mean percentage sand cover per quadrat observed during 2016 summer survey

Site	Mean sand coverage (%)	Mean silt coverage (%)	Total sand, silt and mud coverage (%)
Waihi Reef	4.00	0.00	4.00
350 m NW	9.80	1.28	11.08
200 m SE	8.00	5.36	13.36
Pukeroa Reef	1.00	0.84	1.84

Trends over time

Species number and diversity

Comparisons of the mean number of species per quadrat (Figure 4) and mean Shannon-Weiner diversity index per quadrat (Figure 5) for all summer surveys undertaken since January 1986 are shown below.

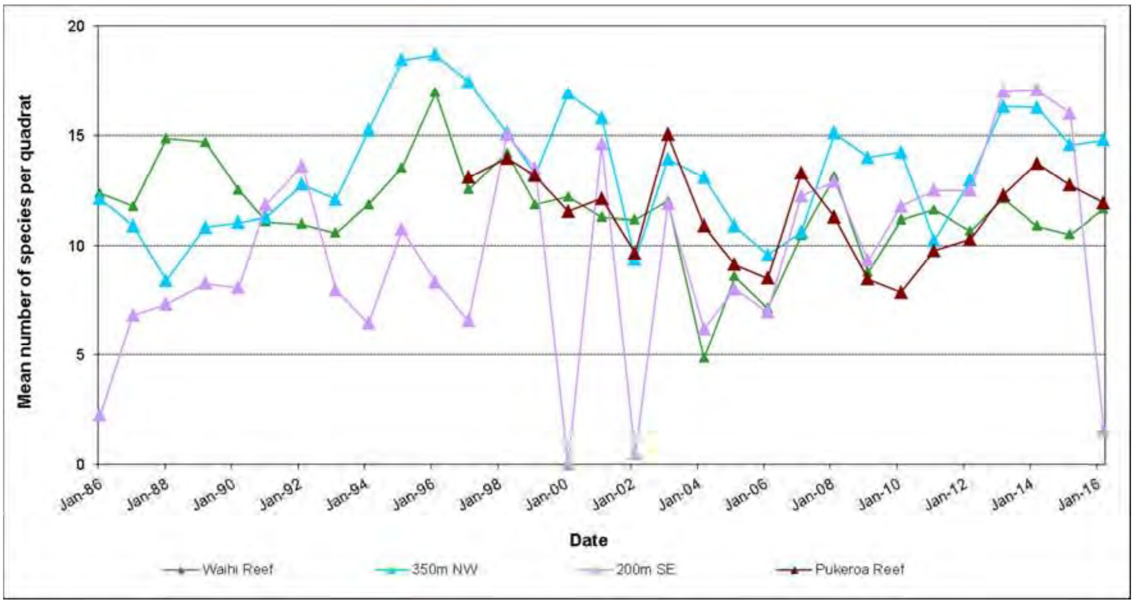


Figure 4 Mean number of species per quadrat for summer surveys 1986-2016

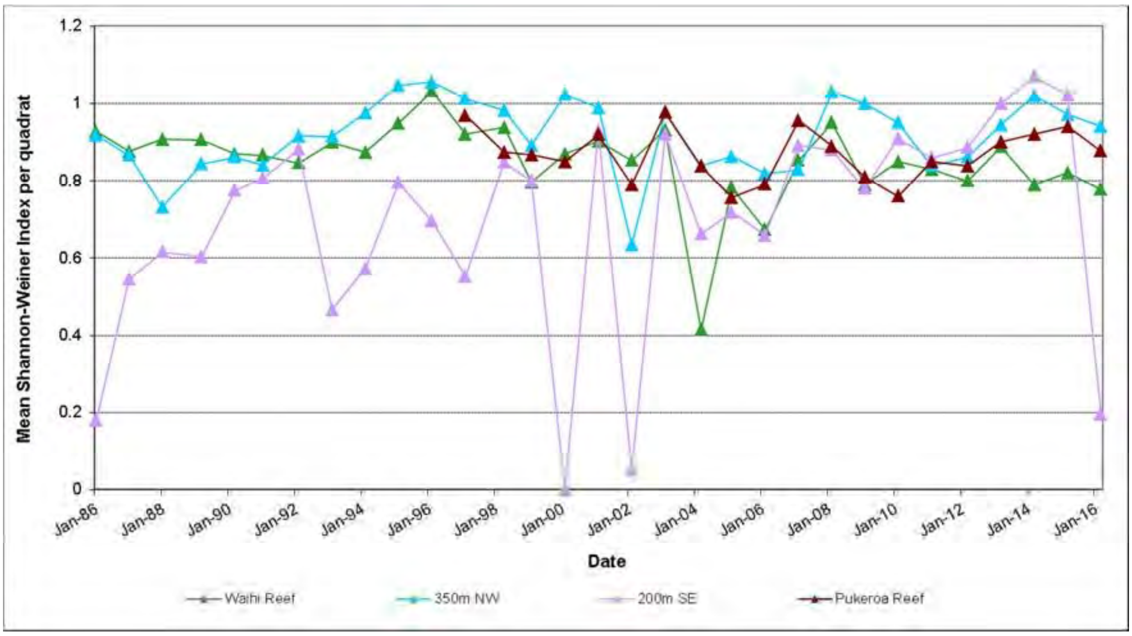


Figure 5 Mean Shannon-Weiner Indices per quadrat for summer surveys 1986-2016

Prior to the installation of the long marine outfall in August 1997, both number of species and Shannon-Weiner Index per quadrat at the impact site 200 m SE were generally lower than at the control site at Waihi Reef (Figures 6 and 7). Since then (1997), sites have shown interannual variability in both number of species and Shannon-Weiner Index, but there has been no noticeable difference in trends between the impact site and the control sites over this period, with the exception of years with heavy sand inundation or slips (e.g. 2000, 2002 and 2016 at 200 m SE, Figures 6 and 7).

The results of the 2016 summer survey show a decrease in the mean number of species at 200 m SE and Pukeroa Reef when compared with the previous summer (Figures 6 and 7). The remaining two sites have shown a slight increase in the mean number of species from the previous summer. Shannon-Weiner Index decreased at all four sites when compared with the previous summer (Figures 6 and 7).

Sand coverage

Over time, sand cover has generally remained low across the sites (Figure 7). Occasionally, however, the reefs experience events of sand inundation, where coverage increases substantially. Over the past ten years, the sites worst effected by inundation events have been those 200 m SE and 350 m NW of the outfall.

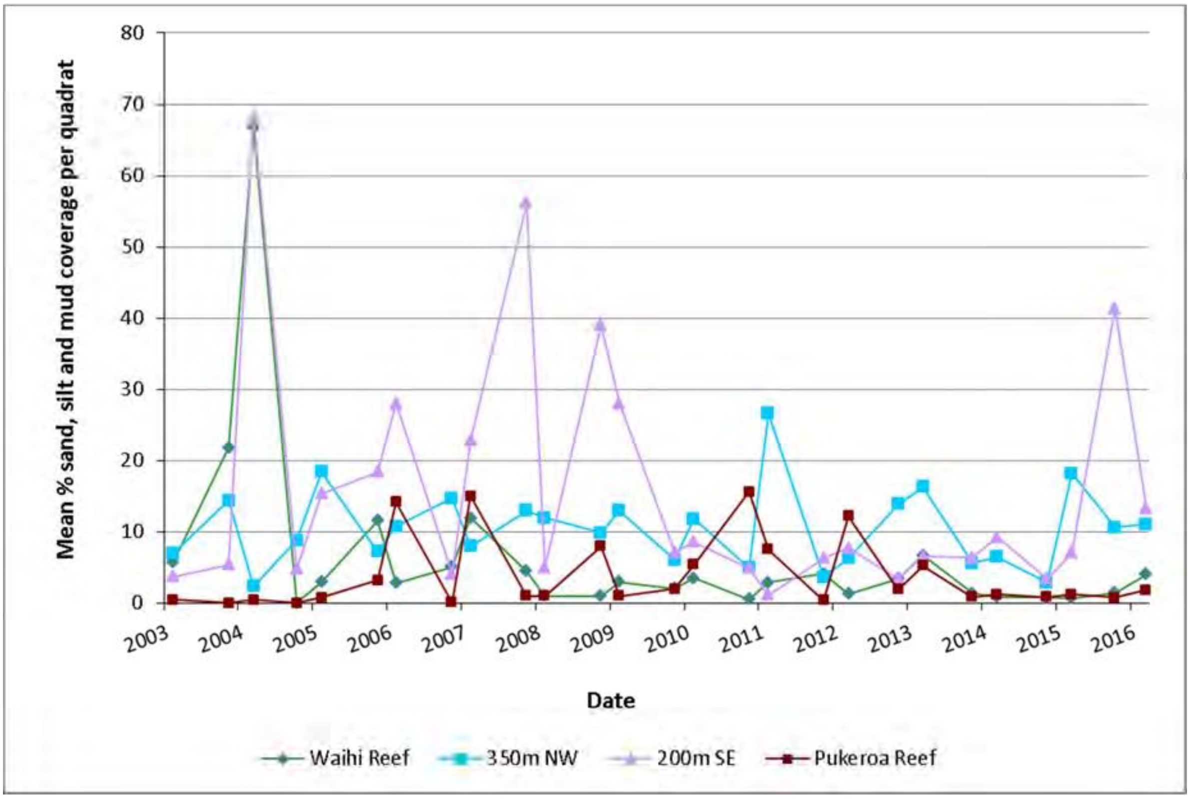


Figure 6 Mean percentage sand cover from 2003 to summer 2016 (including spring and summer surveys)

Discussion

Previous surveys have shown that the dairy factory wastewater discharged through the near-shore outfall prior to 1997 (Photograph 1) was having significant adverse effects on the local intertidal community. The adverse effects recorded included the coating of rocks and tidal pools with fats, significant coverage by filamentous bacterial growths and a significant decrease in ecological diversity. The nature and magnitude of adverse effects varied with distance from the outfall, and were most apparent at the sites 30 m and 200 m southeast of the outfall (note that the former site is no longer surveyed as of 2007). In 1997 the dairy company installed a long outfall to discharge the wastewater nearly 2 km offshore in order to mitigate the adverse effects occurring along the coastline. Numerous spring and summer intertidal surveys have now been undertaken along the Hawera coastline subsequent to installation of the long outfall. Results show a general improvement in the health of intertidal communities following installation of the outfall. In February 2001 the Hawera Oxidation Ponds municipal wastewater was also connected to the long outfall.

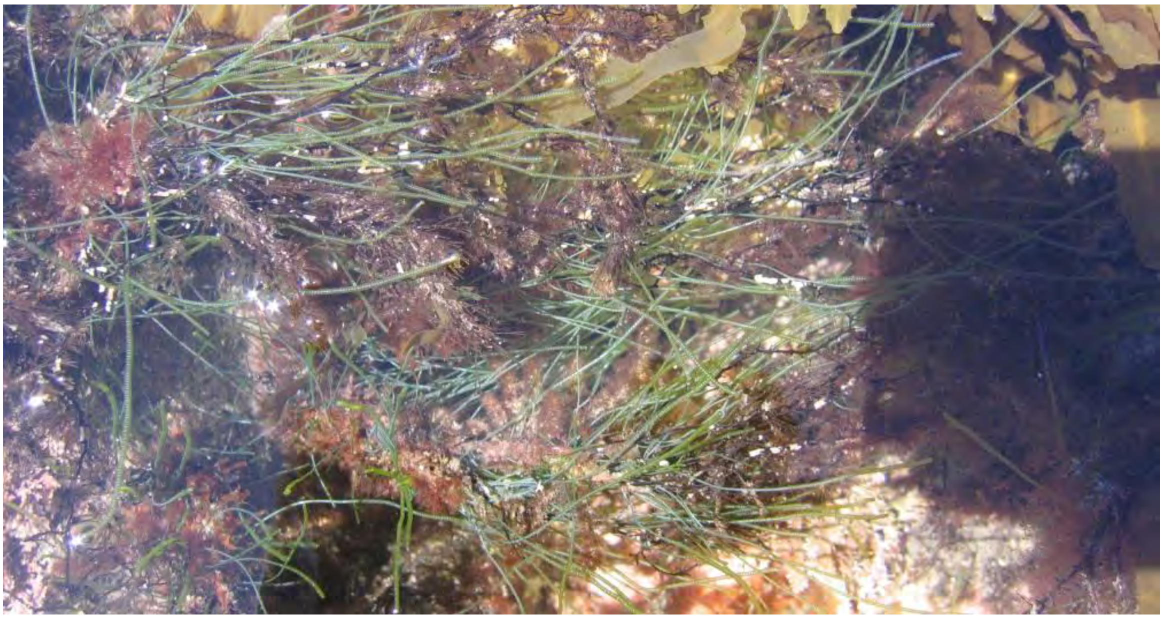
Photograph 6 Discharge from the dairy factory near-shore outfall prior to 1997

Impacts of the marine outfall discharge on the local intertidal communities were not evident from the 2016 summer survey results (Figures 4 and 5). Impact site 200 m SE decreased substantially from the previous summer in terms of mean number of species (species richness) and Shannon-Wiener Index (diversity). The results from this site were also significantly lower than those at the remaining sites. However, the decreases in species richness and diversity can be attributed to a large erosion event on the adjacent cliff-face, which consequently smothered the reef. Aside from this event, there were no considerable decreases in species richness or diversity at the impact sites in relation to the control site. Notably, impact site 350 m NW had significantly higher species richness and diversity scores than what was found at the control site, Waihi Reef.

Sand cover was low (<5%) at Pukeroa and Waihi Reefs during the 2016 summer survey. The sites 200 m SE and 350 m NW of the outfall had moderate sand cover (13.36 % and11.08 %, respectively). This elevated sand cover may have contributed to the slight decrease in mean diversity observed at 350 m NW when compared with the previous summer, whereas the coverage of slip material has likely had the greatest effect at 200 m SE as opposed to sand. Long term monitoring of intertidal rocky reefs around the Taranaki coastline have shown the abundance and diversity of these communities can be adversely affected when sand levels exceed 30% cover. High percentage sand cover (>30%) has previously been recorded at the site 200 m SE (Figure 6).

The historical record of survey results (Figures 4 and 5) show no obvious impact of the marine outfall discharge on the local intertidal communities since installation of the long outfall in 1997. Both control and potential impact sites show interannual variability and with no obvious declining trends at the impact sites closest to the outfall relative to the control site. It must be noted that the high energy receiving environment combined with the effects of suspended sediments from nearby rivers/streams and eroding cliffs prevent the development of stable biological communities along the South Taranaki coastline (Clark *et al*., 2012). Such communities could potentially mask any subtle ecological effects from the outfall wastewater discharge. However, in spite of these limitations, the long term record indicates that the intertidal surveys are useful for detecting more noticeable effects from the wastewater, as the impact on intertidal communities prior to installation of the outfall is clearly evident (Figures 5 and 6, Clark *et al.*, 2012).

The most notable change in species composition since the commissioning of the long outfall is the decline of *Chaetomorpha* sp. (Photograph 7) and the absence of filamentous bacterial growths at 200 m SE (Figures 7 and 8). The adverse effects recorded prior to the long outfall also included the coating of rocks and tidal pools with fats and a significant decrease in ecological diversity.



Photograph 7 Green filaments of *Chaetamorpha*, an algal genus often associated with high nutrient concentrations (North Taranaki)

The inundation of earth, sand and silt resulting from cliff face erosion (Photograph 9) can be an important factor affecting species composition and diversity along the South Taranaki coastline. Indeed, the results from this survey and the spring 2015 survey have found land based erosion to be the single most influential factor affecting these intertidal communities; following the burial of the 200 m SE Reef site (Photograph 8). The coast is in a constant state of erosion with layers of earth, sand and silt often deposited in the intertidal zone. Not only does fallen cliff material cripple marine communities through disturbance and burial, observations indicate that freshly fallen boulders provide a poor habitat for intertidal organisms. This factor could limit the resilience of reef communities encountering erosion events by deterring organisms from settling and ultimately prolonging the recovery timeframe. In the current survey, it was noted that some species are starting to return to the 200 m SE Reef site, with some of the slip material slowly getting washed away. Newly settled barnacles were noted on patches of exposed rock (Photograph 8). Another consequence of erosion is increased suspended sediment in the seawater which can impact on filter feeding organisms and also algal growth through affecting light availability.

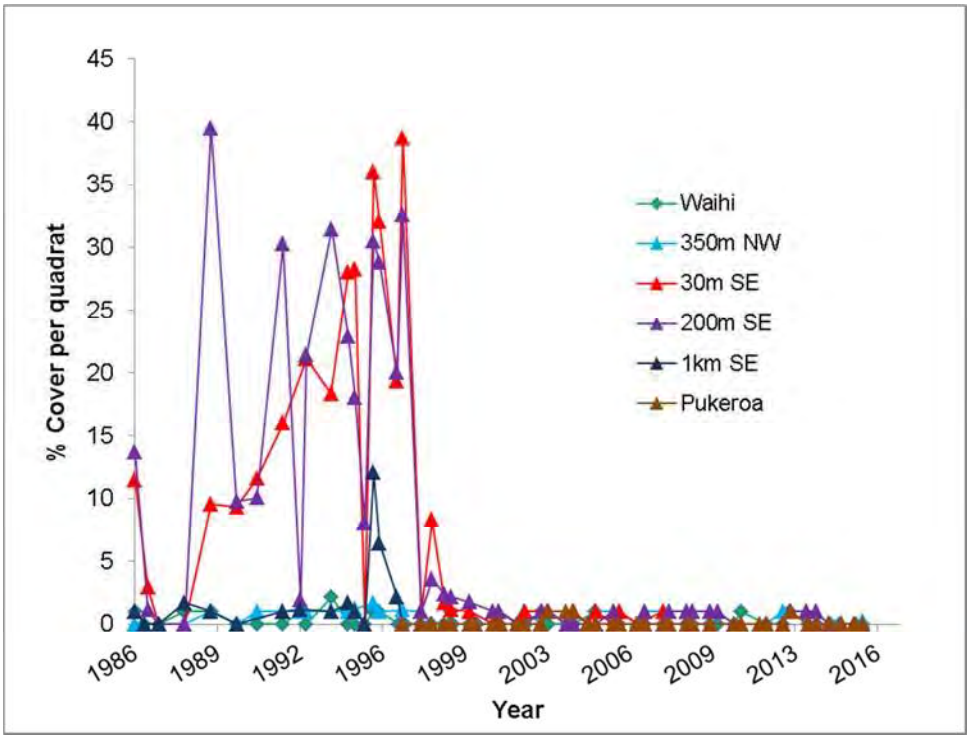


Figure 7 Percentage cover per quadrat of *Chaetomorpha,* 1986 – 2016

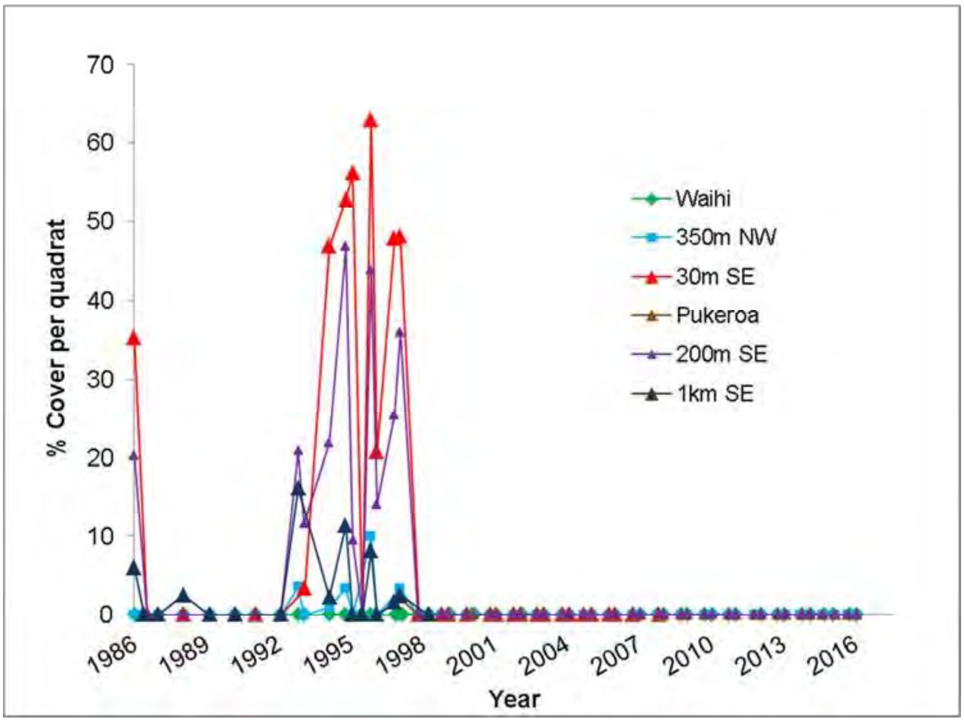
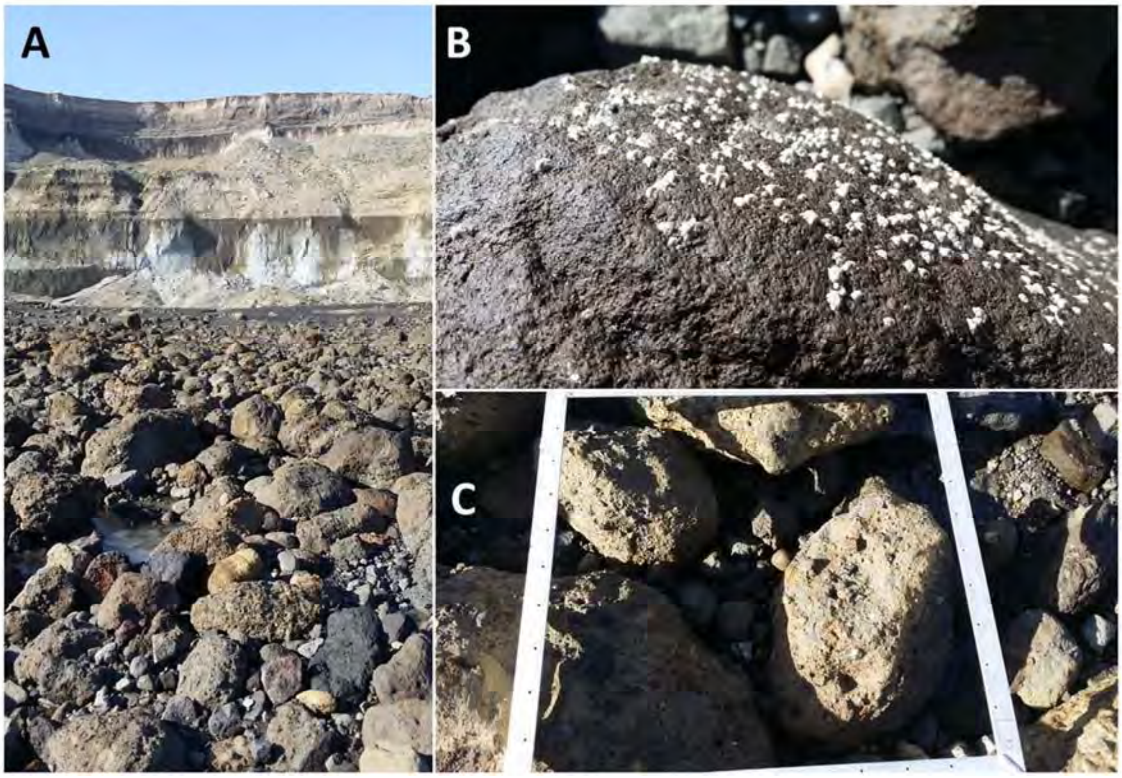


Figure 8 Percentage cover per quadrat of filamentous bacteria, 1986 - 2016

N.B. Since 2007, the sites 30 m SE and 1 km SE are no longer monitored as part of the Fonterra Whareroa intertidal survey.



Photograph 8 Reef site 200 m SE of the outfall. (A) Eroded cliffs with slip material covering reef. (B) New settlement of banacles (*Austrominius modestus*) on a patch of exposed reef. (C) Close up view of slip material on the reef.

Conclusions

In order to assess the effects of the Fonterra Whareroa and Hawera Waste Water Treatment Plant outfall discharge on the nearby intertidal communities, surveys were conducted between the 8th and 11th of March 2016 at four sites. These surveys included three potential impact sites either side of the outfall (two southeast and one west) and one control site to the northwest. It is expected that adverse effects of the marine outfall discharge on the intertidal communities would have been evident as a significant decline in species richness and diversity at the potential impact sites relative to the control site.

With the exception of the reef site 200 m SE of the outfall, which was adversely impacted by natural processes unrelated to the wastewater outfall, none of the potential impact sites showed significant declines in species richness or diversity in relation to the control site. Instead, the reef site 350 m NW of the outfall had significantly greater species richness and diversity than Waihi Reef (the control site), and there was no significant difference between the control site and Pukeroa Reef. Furthermore, there is no evidence of the potential impact sites declining in species richness or diversity over time, relative to the control site. These results indicate that the marine outfall discharge was not having detectable adverse effects on the intertidal reef communities of South Taranaki. Natural environmental factors, including coastal erosion, exposure and substrate mobility, appear to remain the dominant drivers of species richness and diversity at the sites surveyed.

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References

Palliser, C., McBride, G., Goodhune, N., Bell, R., Stott, R. (2013) Fonterra Whareroa Dairy Factory and Hawera WWTP, Stage 2 QMRA based on the combines discharge. NIWA Client Report No. HAM2013-050

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Appendix III

Shellfish trace metal results

(1998 - 2015)

Shellfish trace metal results 1998 - 2015										
Site	Statistic	Cadmium	Chromium	Copper	Iron	Mercury	Nickel	Lead	Zinc	Arsenic
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
SEA906049	Minimum	0.015	0.06	0.56		0.0096	0.28	0.025	5.6	0.92
	Maximum	0.048	0.26	1.39		0.012	1.6	0.12	8.06	1.12
	Median	0.0415	0.11	1.16		0.01045	0.555	0.0565	6.2	0.96
	Mean	0.0372	0.1267	1.1133		0.0106	0.6650	0.0588	6.5567	1.0000
	Count	6	6	6	0	6	6	6	6	3
SEA906062	Minimum	0.024	0.03	0.73		0.0081	0.33	0.025	4.2	0.84
	Maximum	0.046	0.21	1.35		0.014	0.77	0.1	7.5	1.02
	Median	0.031	0.06	0.77		0.011	0.41	0.025	6.7	1
	Mean	0.0330	0.0829	0.8529		0.0110	0.4643	0.0500	6.3214	0.9533
	Count	7	7	7	0	7	7	7	7	3
SEA906067	Minimum	0.008	0.03	0.63		0.009	0.34	0.025	4.2	0.82
	Maximum	0.05	0.22	1.82		0.014	1.1	0.07	6.7	1.2
	Median	0.034	0.1	0.98		0.01	0.51	0.025	5.9	0.98
	Mean	0.0353	0.1144	1.0044		0.0109	0.5456	0.0383	5.8711	1.0000
	Count	9	9	9	0	9	9	9	9	3
SEA906072	Minimum	0.014	0.03	0.64		0.0096	0.31	0.025	4.3	0.85
	Maximum	0.048	0.19	1.96		0.016	1.6	0.26	8.1	1.1
	Median	0.031	0.07	0.92		0.012	0.51	0.05	6.5	0.97
	Mean	0.0319	0.0857	0.9900		0.0124	0.6650	0.0727	6.4100	0.9733
	Count	7	7	7	0	7	6	7	7	3
Detection limit		<0.005				<0.010		<0.050 – 0.100		
ANZFSC 2016		2.0				0.5		2.0		1.0