Wai-iti Beach Retreat Monitoring Programme Annual Report 2017-2018

Technical Report 2018-04

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Executive summary

Wai-iti Motor Camp Ltd (the Company) operates the Wai-iti Beach Retreat (the Retreat), located in North Taranaki. The Company holds resource consents to discharge septic tank treated sewage to groundwater via soakage trenches and to erect, place and maintain a rock wall along the front of the accommodation on the Wai-iti Beach foreshore. This report for the period July 2017 to June 2018 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess the Company's environmental and consent compliance performance during the period under review. The report also details the results of the monitoring undertaken and assesses the environmental effects of the Company's activities.

The Company holds two resource consents, which include a total of 24 conditions setting out the requirements that they must satisfy. The Company holds one consent to allow them to discharge treated septic tank effluent to groundwater, and one consent for a boulder rip rap toe protection in the coastal marine area.

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

The Council's monitoring programme for the year under review included three routine inspections of the wastewater system, one inspection of the rock wall, and routine bacteriological water sampling of the Wai-iti Stream and Wai-iti Beach on one occasion.

Two additional bacteriological water sampling rounds were also undertaken to monitor any impacts of the unnamed tributary on the Wai-iti Stream, following recommendations made in the 2016-2017 monitoring report.

The monitoring showed that the Retreat was well maintained during the period under review, overall, and that it did not appear to affect the water quality of the Wai-iti Stream. These results were supported by the faecal source tracking analyses carried out in January 2018 in response to elevated results recorded in recent years. One of the three soakage trenches was disconnected prior to Christmas, due to previous issues with the structure. This has raised concerns that the remaining two trenches could become overloaded. The Company is currently investigating options for reinstating the trench and expects to have the issue resolved in the coming months.

By comparison with previous years, the monitoring indicated an improvement in the Retreat's compliance performance. There were no unauthorised incidents recording non-compliance in respect of this consent holder during the period under review.

During the year, the Company demonstrated an overall good level of environmental and a high level of administrative performance in relation to their consents.

For reference, in the 2017-2018 year, consent holders were found to achieve a high level of environmental performance and compliance for 76% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 20% of the consents, a good level of environmental performance and compliance was achieved.

In terms of overall environmental and compliance performance by the Company over the last several years, this report shows that their performance is improving.

This report includes recommendations for the 2018-2019 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 2017 to June 2018 by the Taranaki Regional Council (the Council) describing the monitoring programme associated with resource consents held by the Wai-iti Motor Camp Ltd (the Company) for the Wai-iti Beach Retreat (the Retreat). The Retreat is situated on Beach Road in North Taranaki (Photos 1 & 2).

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consents held by the consent holder that relate to the discharge of sewage effluent to groundwater and a boulder rip rap wall on the foreshore.

One of the intents of the *Resource Management Act 1991* (RMA) is that environmental management should be integrated across all media, so that a consent holder's use of water, air, and land should be considered from a single comprehensive environmental perspective. Accordingly, the Council generally implements integrated environmental monitoring programmes and reports the results of the programmes jointly. This report discusses the environmental effects of the Company's use of water, land and air, and is the 29th combined annual report to be prepared by the Council for the Company.

Photo 1 Wai-iti Beach Retreat

Photo 2 Wai-iti Beach, 22 May 2017

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 the consent holder;
- the nature of the monitoring programme in place for the period under review; and
- a description of the activities and operations conducted in the Company's site/catchment.

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 2018-2019 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 the Company, 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 the Company'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 2017-2018 year, consent holders were found to achieve a high level of environmental performance and compliance for 76% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 20% of the consents, a good level of environmental performance and compliance was achieved.

1.2 Process description

1.2.1 Sewage treatment system

All wastewaters from the camping ground enter a septic tank of 143 m^3 capacity. The effluent is then pumped via a 50 mm alkathene pipe across the Wai-iti Stream and into soakage trenches situated on a wooded hillside approximately 30 m from the stream (Figure 1).

These multiple soakage trenches work on a rotational basis and were first commissioned in 1991 in response to inadequate treatment of the effluent by the previous system.

When previous proprietors took over the property in 1986-1987, the disposal system consisted of a seepage ditch situated near the base of the wooded hillside. Monitoring found that this trench system was an unsuitable means of disposal, resulting in high faecal coliform counts at the mouth of the Wai-iti Stream. This inadequate treatment led to the development of the new multiple soakage trench system.

Figure 1 Locations of sewage treatment system and sampling sites at the Wai-iti Beach Retreat

1.2.2 Rock wall

Over the summer and autumn months of 2004, rough seas combined with high tides reached the beach toe of the coastal banks and sand dunes that front the Retreat. Fresh erosion scarps were cut into these banks for nearly the full beach frontage, where no system of protection existed (Photo 3).

Photo 3 Erosion on Wai-iti foreshore prior to construction of the rock wall

In 2005 an application was received for a resource consent to provide boulder rip rap protection, over a total distance of 293 m, from the stream at the south end of Wai-iti Beach to an area of existing large

boulder protection in the north. This consent was granted in July 2005. To mitigate any possible end effects, the area between the public entrance and the river was also protected using the boulder rip rap method.

1.3 Resource consents

The Company holds two resource consents, the details of which are summarised in the table below and outlined in sections 1.3.1 and 1.3.2.

Table 1 Resource consents held by Wai-iti Motor Camp Ltd

Consent number	Purpose	Granted	Review	Expires
1971-3	To discharge up to 27 m^3 per day of septic tank treated sewage effluent via soakage trenches to groundwater in the vicinity of the Wai-iti Stream	21 August 1991	June 2015	1 June 2021
6462-1	To erect, place and maintain a boulder rip rap toe protection in the coastal marine area on the Wai-iti Beach foreshore	12 July 2005	June 2015	1 June 2021

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.

The Company holds water discharge permit 1971-3 to cover the discharge of up to 27 m^3 per day of septic tank treated sewage effluent via soakage trenches to groundwater in the vicinity of the Wai-iti Stream.

This permit was first issued by the Council on 21 August 1991 and was renewed in 28 March 2003 under Section 87(c) of the RMA. It is due to expire on 1 June 2021.

There are five special conditions attached to the consent.

Condition 1 requires bacteriological monitoring of the coastal waters of the foreshore and Wai-iti Stream.

Condition 2 requires the consent holder to ensure proper maintenance of the septic tank, pumping station and soakage trenches.

Condition 3 requires the consent holder to provide records of daily effluent volumes discharged.

Condition 4 requires the consent holder to provide a contingency plan for the site.

Condition 5 deals with review of the consent.

1.3.2 Coastal structure

Section 12(b) of the RMA stipulates that no person may erect, reconstruct, place, alter, extend, remove, or demolish any structure or any part of a structure that is fixed in, on, under, or over any foreshore or seabed, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or by national regulations.

The Company holds coastal permit 6462-1 to erect, place and maintain a boulder rip rap toe protection in the coastal marine area on the Wai-iti Beach foreshore. This permit was issued in July 2005 under Section 87(c) of the RMA. It is due to expire on 1 June 2021.

There are nineteen special conditions attached to the consent.

Conditions 1 to 16 deal with various aspects of the construction of the seawall.

Condition 17 deals with monitoring of the wall.

Condition 18 requires the structure to be removed if it is no longer required.

Condition 19 deals with review of consent conditions.

Copies of both permits are attached to this report in Appendix I.

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

1.4 Monitoring programme

1.4.1 Introduction

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

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

The monitoring programme for the Retreat consisted of three primary components.

1.4.2 Programme liaison and management

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

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

1.4.3 Site inspections

The Retreat was visited three times during the monitoring period. With regard to consents for the 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. The neighbourhood was surveyed for environmental effects.

In addition, the rock wall was checked for any end effects, or further erosion of the banks behind and in front of the wall.

1.4.4 Bacteriological sampling

Samples were collected at six sites during the second site inspection. Three samples were collected from the Wai-iti Stream, one from the tributary at the base of the slope and two from coastal sites either side of the stream mouth (Table 2; Figure 1; Photo 4). Two additional, reduced sampling rounds were conducted during the first and third inspections, as recommended in the 2016-2017 annual report. In these surveys, two samples were collected from the Wai-iti Stream and a third was collected from the unnamed tributary. Bacteriological samples were also collected from the tributary, the upstream site and the downstream site during a follow-up sampling round in January 2018, for faecal source tracking (FST). These analyses were

only carried out on the upstream and downstream sites, as the bacteriological count of the sample from the tributary was too low for accurate FST analysis. A report of the FST analyses performed on these samples is presented in Appendix II.

Sites 1, 3, 4 and 5 have been monitored since 1994. Site 2, located approximately 50 m downstream of the tributary, was selected during the 1999-2000 monitoring period to assess the influence of the tributary on water quality in the Wai-iti Stream. Site 6 was proposed in the 2015-2016 annual report to determine whether there are any other sources of contamination in the tributary and is included for the second time in this the 2017-2018 annual report (TRC, 2016).

Table 2 Locations of bacteriological sampling sites at the Wai-iti Beach Retreat

Site	Location	Site code	GPS
1*	Wai-iti Stream upstream of beach camp	WIT000420	1727999-5690544
2*	Wai-iti Stream approx. 10 m d/s of tributary	WIT000460	1727896-5690572
3	Wai-iti Stream adjacent beach entrance	WIT000490	1727686-5690533
4	Sea coast approx. 75 m north of stream mouth	SEA900060	1727667-5690609
5	Sea coast approx. 30 m south of stream mouth	SEA900063	1727555-5690516
6*	Tributary at base of slope	WIT000446	1727911-5690562

* Sites also sampled in the two reduced sampling rounds

Samples were analysed for temperature, conductivity and the faecal indicator bacteria (FIB), enterococci and *Escherichia coli*. The FIB were monitored to provide an indication of potential contamination of the water by animal and/or human excreta.

Water quality is of significant interest at this site as Wai-iti Beach receives moderate recreational use over the bathing season. In 2003, the Ministry for the Environment (MfE) developed the *Guidelines for Recreational Water Quality* to assess the safety of water for contact recreation. The coastal guidelines focus on enterococci as these bacteria have the ability to survive in marine water, providing the closest correlation with health effects in New Zealand coastal waters (MfE, 2003). For freshwater the MfE 2003 guidelines use *E. coli* as the preferred indicator. 'Alert' and 'Action' guideline levels are summarised in Table 3 and are based on keeping illness risk associated with recreational use to less than 2% of users.

Table 3 Marine recreational bathing guidelines (MfE, 2003)

	Indicator	Mode		
		Surveillance	Alert	Action
Marine	Enterococci (cfu/100 ml)	No single sample >140	Single sample >140	Two consecutive single samples >280
Freshwater	*E. coli* (cfu/100 ml)	No single sample >260	Single sample >260	Single sample >550

Photo 4 Coastal Site 4 at Wai-iti Beach, looking towards Site 5, with the Wai-iti Stream entering from center-left

2 Results

2.1 Inspections

21 December 2017

Conditions were fine, with a light breeze. The camp manager was not present at the time of the inspection. The Wai-iti Beach Retreat (the Retreat) appeared to be empty during the inspection; it was likely to become busier after Christmas.

There were no odours or visual issues at the pump station or at the old drain during the inspection. Mild sewage odours were noted at and up to 10 m downwind of the soakage trenches, and in the immediate vicinity of the septic tank.

Three water samples were collected during this "reduced" sampling round, one each from Sites 1, 2 and 6.

The sea wall was not inspected on this occasion.

Overall, the Retreat appeared to be operating in compliance with its resource consent at the time of the inspection. The Company was notified in the inspection notice that a record of daily effluent volumes would be requested at the end of the monitoring period.

11 January 2018

Conditions were overcast at the time of the inspection. The camp manager was present and reported that approximately 30 campers were on site. Up to 50 campers were expected over the coming weekend. The camp manager reported that the site had been full over Christmas and New Year's, and would continue to fill up over upcoming summer weekends.

No visual issues were observed at the pump station. However, mild sewage odours were detected at the pump station, which was pumping to the soakage trenches at the time of the inspection. Moderate-strong sewage odours were also noted within 5 m of the soakage trenches.

Six water samples were collected and analysed for *Escherichia coli* during this full sampling round; one each from Sites 1, 2, 3 and 6. Additionally, coastal water samples were collected from Sites 4 and 5 and analysed for enterococci.

The sea wall was not inspected on this occasion.

Overall, the Retreat appeared to be operating in compliance with its resource consent at the time of the inspection.

9 February 2018

Conditions were overcast during the inspection. The camp manager was present at the time, and reported that approximately 80 people were booked into the Retreat. In recent weeks, the Retreat had been quieter during the week, with wedding functions booked in during weekends. During the inspection, CityCare erected a warning sign for beach bathing water quality, in response to the recent, elevated faecal indicator bacteria counts recorded at site SEA900060 during the beach bathing programme.

The flow meter and log book were visually assessed during the inspection, and appeared to be consistent. Flow readings had been recorded daily since 22 January 2018. Prior to this, flow readings were recorded weekly. The camp manager reported that only two of the trenches had been operational since before Christmas, with the third trench having been disconnected in response to previous issues with the structure. The Council indicated that they were concerned that the two trenches which were in operation at the time could become overloaded. No visual issues or odours were observed at the pump station. The Company was asked to please ensure that all three trenches were fully operational.

Three water samples were collected, during this "reduced" sampling round, one each from Sites 1, 2 and 6.

The sea wall was inspected on this occasion. Neither the wall nor the land behind it appeared to be suffering from any obvious erosion or degradation.

Overall, the Retreat appeared to be operating in compliance with its resource consents at the time of the inspection.

2.2 Results of bacteriological monitoring

A summary of historical bacteriological results from January 1993 to January 2017 is presented in Table 4. Median *E. coli* counts are historically higher at the sites monitored downstream of the camp, particularly at the site located 10 m downstream of the unnamed tributary. These higher FIB counts are typically not reflected at the coastal sites, where a high degree of mixing and dilution occurs where the stream meets the Tasman Sea.

Table 4 Summary of previous bacteriological results, measured in cfu/100 ml (1993-2017)

	Upstream WIT000420		10 m downstream tributary WIT000460		Stream at beach WIT000490		Coast 75 m N SEA900060		Coast 30 m S SEA900063	
	E. coli	**Ent**	***E. coli***	**Ent**	***E. coli***	**Ent**	***E. coli***	**Ent**	***E. coli***	**Ent**
Number of samples	24	26	18	19	23	25	22	25	22	24
Minimum	150	130	230	100	210	130	1	0.5	0.5	0.5
Maximum	2,700	3,100	3,100	3,200	2,700	2,900	260	210	120	140
Median	550	635	720	900	695	610	8	9	8	6

The results of the routine bacteriological monitoring undertaken during the 2017-2018 summer monitoring period, as well as the results of the reduced sampling rounds undertaken in December 2017 and February 2018, are presented in Table 5.

Table 5 Bacteriological monitoring results (2017-2018)

Site	Date	Conductivity (mS/m @ 20°C)	*E. coli* (cfu/100 ml)	Enterococci (cfu/100 ml)
Upstream WIT000420	Dec-17	18.9	1,120	1,600
	Jan-18	18.8	1,270	612
	Feb-18	18.9	663	3,300
50 m downstream tributary WIT000460	Dec-17	18.9	727	1,300
	Jan-18	18.8	1,330	717
	Feb-18	19.0	670	3,500
Tributary WIT000446	Dec-17	31.9	225	37,600
	Jan-18	34.5	86	146
	Feb-18	33.2	172	N/D

Site	Date	Conductivity (mS/m @ 20ºC)	*E. coli* (cfu/100 ml)	Enterococci (cfu/100 ml)
Stream at beach WIT000490	Jan-18	19.8	1,200	465
Coast 75 m N SEA900060	Jan-18	4,660.0	30	9
Coast 30 m S SEA900063	Jan-18	4,640.0	41	11

FIB counts were typically lower in the tributary than at the upstream and downstream sites located in the Wai-iti Stream, in 2017-2018. Additionally, FIB counts were either lower or only slightly higher at the downstream site, relative to the upstream site. The highest *E. coli* counts were recorded in January 2018. Historically, median counts of *E. coli* and enterococci are both greater at the two sites located downstream of the confluence than at the upstream site (Table 4).

E. coli counts exceeded the MfE 'Action' guideline level in all freshwater samples collected from the stream.

The enterococci count recorded in the tributary in December 2017 was considerably higher than the counts recorded for the sites located in the Wai-iti Stream. This trend was not detected in subsequent sampling rounds however and could be due to naturally-occurring bacteria. Both of the coastal sites recorded enterococci counts below the MfE 'Alert' guideline level during the monitoring year. The comparatively low enterococci counts at the coastal sites are likely due to the high degree of mixing and dilution where the stream meets the Tasman Sea.

2.3 Provision of consent holder data

The Council recommended in the 2016-2017 annual report that a flow meter be installed within the wastewater treatment system, in order to comply with condition 3 of consent 1971-3 (TRC, 2017). The Company complied with this data request and provided records of average daily effluent volumes discharged to the soakage trenches between 10 November 2017 and 30 June 2018 (Appendix III). Volumes were initially recorded weekly, and were subsequently recorded daily, as requested in the January 2018 inspection notice. None of the average daily effluent volumes exceeded the consent limit of 27 m^3 per day. On average, 4.19 m^3 of effluent was discharged per day.

2.4 Investigations, interventions, and incidents

The monitoring programme for the year was based on what was considered to be an appropriate level of monitoring, review of data, and liaison with the consent holder. During the year, matters may arise which require additional activity by the Council, 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 2017-2018 period, the Council was required to undertake significant additional investigation in association with resource consent 1971-3.

Elevated FIB counts recorded in the Wai-iti Steam during the 2014-2015 summer survey led to an investigation into potential sources of faecal contamination, in the following monitoring period (TRC, 2016). During the 2015-2016 period, human faecal contamination was confirmed in the tributary which drains the area directly below the soakage trenches and a ruptured disposal field was identified as the likely cause of this contamination (TRC, 2016). A ruptured disposal field was again reported by the Company in the 2016-2017 period, during an additional inspection in July 2017. Monitoring of the tributary and two additional sampling rounds were carried out in the 2016-2017 and 2017-2018 monitoring periods, to ensure that faecal contamination was no longer occurring at the Retreat.

Monitoring results from the 2017-2018 period indicated that faecal contamination was no longer occurring in the tributary. *E. coli* counts in the tributary had considerably decreased since the leaking soakage trench was resolved. Any elevated *E. coli* results recorded in the stream during the 2017-2018 monitoring period appeared to be caused by contamination from further upstream; *E. coli* levels at the upstream site were found to be either higher than or similar to the levels recorded at the downstream site. Upstream tributaries of the Wai-iti Stream drain an agricultural catchment, making agricultural influence a potential contributor to the *E. coli* levels recorded in the stream.

Faecal source tracking (FST) was carried out during the Retreat's busy summer season, in order to follow up on the elevated results recorded in recent years. The report on FST analysis provided by ESR is included in Appendix II of this report. Analyses identified one of two human markers, and detected a weak ruminant faecal source, for both stream samples. The elevated *E. coli* levels were most likely due to an aged or partially treated faecal source, or a naturalised source of *E. coli* in the stream (pers. comm., Paula Scholes, ESR, 2018). The FST provided no evidence for the wastewater treatment system at the Retreat influencing the water quality of the Wai-iti Stream.

3 Discussion

3.1 Discussion of site performance

The pump station at the Wai-iti Beach Retreat (the Retreat) was inspected three times during the 2017-2018 monitoring period. The camp manager's regular monitoring and maintenance of the pump station appeared to have prevented any significant issues from arising. However, one of the soakage trenches was disconnected before Christmas, in response to previous issues with the structure. There was concern that the two trenches which remained in operation could become overloaded. The Company is currently investigating options for reinstating the trench and expects to have the issue resolved in the coming months.

The rock wall was found to be in good repair, with no obvious end effects or erosion occurring.

3.2 Environmental effects of exercise of consents

The exercise of resource consent 1971-3 did not appear to have notable effects on the environment in the year under review. Although high levels of *E. coli* were detected in the stream, the Retreat's effluent treatment system did not appear to be the source of contamination. Rather, it appeared that upstream contaminants, potentially from the agricultural catchment drained by the stream, influenced the high FIB levels recorded during the 2017-2018 monitoring period.

Ongoing maintenance and monitoring of the effluent system is particularly important as additional baches have increased the pressure on the system in recent years. The 1991 effluent system report also forecast that the soakage trenches would eventually reach a saturation level, which would ultimately contaminate the Wai-iti Stream. Further, the area in which the soakage trenches are located is heavily vegetated; the passage of tree roots and subsidence associated with windfall can create preferential flow paths for effluent migration. These flow paths allow effluent to bypass the soil structure rapidly, reducing effluent residence time and the level of treatment provided by percolation systems. The steep gradient of the hillside to which effluent is discharged, and the proximity of the unnamed tributary, can further exacerbate these issues.

The pathogens that occur in human faecal matter present a significant health risk. Although the stream is not thought to be commonly bathed in, the presence of eels attracts people to the stream banks, and it is often crossed where it runs out over the beach. These considerations highlight the importance of maintaining the effluent treatment and disposal systems in the vicinity of the waterbodies. It is essential that all three trenches remain in operation, in order to prevent any operational trenches from becoming overloaded and potentially contaminating the stream. It is also essential that any damages to the trenches are dealt with appropriately.

No significant environmental effects resulting from the exercise of resource consent 6462-1 were recorded in the year under review. Inspections of the rock wall found no notable end effects, and neither the wall nor the land behind it appeared to be suffering from any obvious erosion or degradation.

3.3 Evaluation of performance

A tabular summary of the Company's compliance record for the year under review is set out in Tables 6 and 7.

Table 6 Summary of performance for consent 1971-3

Purpose: ***To discharge up to 27 cubic metres/day of septic tank treated sewage effluent via soakage trenches to groundwater in the vicinity of the Wai-iti Stream***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Bacteriological sampling to be undertaken in the Wai-iti Stream and the coastal waters	Council's bacteriological sampling at five sites	Yes
2. Consent holder to ensure maintenance of septic tanks, pumps and soakage trenches is undertaken	Site inspections	**No – only two of the three soakage trenches are currently operational**
3. Consent holder to provide records of daily effluent volumes discharged to the soakage trenches	Records were requested from the consent holder	Yes – records provided
4. Contingency plan to be provided	An updated contingency plan received June 2009	Yes
5. Optional review provision re environmental effects	Not required	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent Overall assessment of administrative performance in respect of this consent		**Good** **High**

N/A = not applicable

Table 7 Summary of performance for consent 6462-1

Purpose: ***To erect, place and maintain a boulder rip rap toe protection in the coastal marine area on the Wai-iti Beach foreshore***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Notification period before construction or maintenance begins		N/A
2. Structure to be constructed and maintained in accordance with the engineering plans	Site inspections	Yes
3. Landward position of seawall is to be determined by survey to satisfaction of Council		N/A
4. Crest of structure to be no higher than reduced level plus 7.5 m	Site inspections	Yes

Purpose: *To erect, place and maintain a boulder rip rap toe protection in the coastal marine area on the Wai-iti Beach foreshore*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
5. Maximum size of boulders to be used	Site inspections	Yes
6. Structure to have minimum slope of 2 to 1	Site inspections	Yes
7. No refuelling of machinery within coastal marine area		N/A
8. Construction to comply with noise standards as defined in the coastal plan		N/A
9. No work to be undertaken during weekends and holiday periods		N/A
10. No maintenance to be undertaken during weekends or the summer holiday period	No maintenance work has had to be undertaken as yet	N/A
11. Sufficient signage to be in place during construction		N/A
12. In situ beach materials only to be used for foreshore reinstatement purposes		N/A
13. Area and volume of disturbance to be minimised and reinstated	Site inspections	Yes
14. Works to cease if any archaeological remains are found		N/A
15. Structure to be constructed within 12 months of issuing of consent	Construction complete	Yes
16. Area behind rock wall to be planted in sand binding plants	Grasses planted	Yes
17. Annual monitoring programme to be developed for integrity of the wall	An annual inspection is incorporated with the monitoring for the wastewater treatment system at the Wai-iti Beach Retreat. Further monitoring (structure survey) may be required in future	Yes
18. Structure to be removed and reinstated if no longer required		N/A
19. Optional review provision re. environmental effects	Not required	N/A

Purpose: *To erect, place and maintain a boulder rip rap toe protection in the coastal marine area on the Wai-iti Beach foreshore*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
Overall assessment of consent compliance and environmental performance in respect of this consent Overall assessment of administrative performance in respect of this consent		**High** **High**

N/A = not applicable

During the year, the Company demonstrated a good level of environmental and high level of administrative performance in relation to the exercise of resource consent 1971-3. During the year under review, there was no evidence from routine or additional bacteriological sampling that the Retreat's effluent system was contaminating the Wai-iti Stream. However, there is concern that the disconnected soakage trench may cause the remaining two trenches to become overloaded in the busy summer season.

The Company demonstrated a high level of environmental and administrative performance in relation to the exercise of resource consent 6462-1. No adverse environmental effects were observed as a result of the rock wall structure.

Resource consents and ratings are as defined in Section 1.1.4.

3.4 Recommendations from the 2016-2017 Annual Report

In the 2016-2017 Annual Report, it was recommended:

1. THAT monitoring of consented activities at the Retreat in the 2017-2018 year continues at the same level as in 2016-2017.
2. THAT inspections of the entire effluent treatment and disposal system, including the pipework, pumps and soakage trenches, be conducted.
3. THAT the Company initiates investigations of treatment system improvement options, including alternative system designs, in the event that monitoring indicates that system performance does not improve following the reinstatement of the ruptured soakage trench.
4. That a flow meter is installed within the wastewater treatment system, in order to comply with Condition 3 of Consent 1971-3.

These recommendations were implemented in full.

3.5 Alterations to monitoring programmes for 2018-2019

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

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

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

It is proposed that for 2018-2019, the two additional, reduced sampling rounds included in the past two monitoring periods be discontinued.

It should be noted that the proposed programme represents a reasonable and risk-based level of monitoring for the site in question. The Council reserves the right to subsequently adjust the programme from that initially prepared, should the need arise if potential or actual non-compliance is determined at any time during 2018-2019.

4 Recommendations

1. THAT monitoring of consented activities at the Retreat in the 2018-2019 year be amended from that undertaken in 2017-2018 by discontinuing the two additional, reduced sampling rounds that have been carried out in the past two monitoring periods.
2. THAT should there be issues with environmental or administrative performance in 2018-2019, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.

Glossary of common terms and abbreviations

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

'Action' mode	Marine: two consecutive single samples >280 enterococci/100 ml. Freshwater: single sample >550 *E. coli*/100 ml.
'Alert' mode	Marine: single sample 141-280 enterococci/100 ml. Freshwater: single sample 261-550 *E. coli*/100 ml.
Bathers	Those who enter the water, and either partially or fully immerse themselves.
Bathing season	Generally, the bathing season extends between 1 November and 31 March.
Beach	The shore or any access point to the sea.
BODCF	Biochemical oxygen demand of a filtered sample.
cfu	Colony forming units. A measure of the concentration of bacteria usually expressed as per 100 ml sample.
Conductivity	An indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m.
Contact recreation	Recreational activities that bring people physically in to contact with water, involving a risk of involuntary ingestion or inhalation of water.
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 ml of sample.
Ent	Enterococci, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 ml of sample.
FC	Faecal coliforms, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 ml of sample.
FIB	Faecal Indicator Bacteria – in this report it refers collectively to *E. coli*, enterococci and faecal coliforms.
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.
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.
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 the circumstances/events surrounding an incident, including any allegations of an incident.
Median	Central value when values are arranged in order of magnitude.
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* including all subsequent amendments.
Temperature	Measured in °C (degrees Celsius).
Water quality	The bacteriological condition of a water body as it relates to human health, measured using indicator bacteria.

For further information on analytical methods, contact a Science Services Manager.

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Taranaki Regional Council 2017. Wai-iti Motor Camp Monitoring Programme Annual Report for 2016-2017. TRC Technical Report 17-38.

Appendix I

Resource consents held by the consent holder

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

Discharge Permit

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

Name of Consent Holder:	Wai-iti Motor Camp Limited C/- 538 Carrington Road R D 1 NEW PLYMOUTH
Consent Granted Date:	28 March 2003

Conditions of Consent

Consent Granted:	To discharge up to 27 cubic metres/day of septic tank treated sewage effluent via soakage trenches to groundwater in the vicinity of the Waiiti Stream at or about GR: Q18:379-523
Expiry Date:	1 June 2021
Review Date(s):	June 2009, June 2015
Site Location:	Beach Road, Waiiti
Legal Description:	Pt Lot 2 DP 13368 Waiiti 54B3 54B2 Blk X Mimi SD
Catchment:	Waiiti

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, in conjunction with the Taranaki Regional Council, undertake such bacteriological monitoring of the Waiiti Stream and coastal waters of the foreshore as deemed necessary by the Chief Executive, Taranaki Regional Council.

2. The consent holder shall ensure proper maintenance of the septic tanks, pumping station and soakage trenches as required.

3. The consent holder shall provide records of daily effluent volumes discharged to the soakage trenches at the request of the Chief Executive, Taranaki Regional Council.

4. The consent holder shall provide a contingency plan to the satisfaction of the Chief Executive, Taranaki Regional Council, outlining measures to be undertaken in the event of power failure, pump breakdown, pipe blockage and failure of soakage trenches, within three months of granting this consent.

5. 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 2009 and/or June 2015, 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.

Transferred at Stratford on 5 December 2003

For and on behalf of
Taranaki Regional Council

_____

Chief Executive

Coastal Permit

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

Name of Consent Holder:	Wai-iti Motor Camp Limited 538 Carrington Road R D 1 NEW PLYMOUTH
Consent Granted Date:	12 July 2005

Conditions of Consent

Consent Granted:	To erect, place and maintain a boulder rip rap toe protection in the coastal marine area on the Wai-iti Beach foreshore at or about GR: Q18:379-523
Expiry Date:	1 June 2021
Review Date(s):	June 2009, June 2015
Site Location:	Beach Road, Urenui
Legal Description:	Pt Lot 2 DP 13368 Blk X Mimi 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 notify the Chief Executive, Taranaki Regional Council, in writing at least 48 hours prior to commencement, and upon completion of initial construction, and again at least 48 hours prior to, and upon completion of, any subsequent maintenance works.

2. The structure authorised by this consent shall be constructed and subsequently maintained in accordance with the engineering plans submitted in support of application 3319 and to ensure the conditions of this consent are met. Any variation to these plans will be subject to the approval of the Chief Executive, Taranaki Regional Council. In the case of any contradiction between the documentation submitted in support of application 3319 and the conditions of this consent, the conditions of this consent shall prevail.

3. The landward position of the seawall is determined by survey to the satisfaction of the Chief Executive, Taranaki Regional Council prior to the commencement of works.

4. The crest of the structure shall not exceed a maximum height of reduced level plus 7.5 metres.

5. The maximum diameter of boulders utilised within the structure shall be no more than 0.8 metres.

6. The structure shall have a minimum seaward slope of 2 horizontal to 1 vertical.

7. There shall be no refuelling of construction machinery within the coastal marine area.

8. The construction, use, maintenance and removal of the structure authorised by this consent shall comply with the noise standards as outlined within section 4.4.3 of the Regional Coastal Plan for Taranaki.

9. During construction of the structure no work shall be undertaken during school holidays, public holidays and weekends without the approval of the Chief Executive, Taranaki Regional Council.

10. All practicable measures shall be undertaken to ensure maintenance of the structure shall not occur on weekends, public holidays or between 1 December and 31 January.

11. During construction and maintenance periods the area subject to works shall have sufficient signage to ensure public safety of any potential safety hazards.

12. In situ beach material shall be used only for foreshore reinstatement purposes seaward of the structure, and shall not be used for construction purposes.

13. The consent holder shall ensure that the area and volume of foreshore disturbance shall, so far as practicable, be minimised and any areas which are disturbed shall, so far as practicable, be reinstated.

14. In the event that any archaeological remains are discovered as a result of the exercise of this consent, the works shall cease immediately at the affected site. The Ngati Mutunga Iwi Authority and the Chief Executive of the Taranaki Regional Council shall be notified immediately, and be invited to inspect the site.

15. The structure authorised by this consent shall be constructed within twelve months of the granting of this consent. Upon completion of construction the consent holder shall submit as built plans of the structure if different to those submitted in support of application 3319.

16. The consent holder shall undertake all practicable measures to ensure the development of healthy functioning flax, spinefex and other native sand binding plants immediately behind the rock revetment wall to the satisfaction of the Chief Executive, Taranaki Regional Council.

17. An annual monitoring programme will be developed for the integrity of the rock wall , erosion of the beach and for any end effects of the surrounding environment. All costs associated with the monitoring will be met by the consent holder.

18. The structure authorised by this consent shall be removed and the area reinstated, if and when the structure is no longer required. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing at least 48 hours prior to the structures removal and reinstatement.

19. 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 2009 and/or June 2015, 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.

Footnote:

i. The structure is proposed to be constructed on New Plymouth District Council esplanade reserve. The New Plymouth District Council takes no responsibility for the maintenance of the structure or effects it might have on the beach or neighbouring properties.

Signed at Stratford on 12 July 2005

For and on behalf of
Taranaki Regional Council

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Director-Resource Management

Appendix II

Faecal source tracking analysis report (30 January 2018)

Science for Communities

30 January 2018

To: Angela Smith
Taranaki Regional Council
Private Bag 713
STRATFORD 4352

Email: angela.smith@trc.govt.nz

From: ESR Christchurch Science Centre
PO Box 29181
CHRISTCHURCH 8540

Email: faecalsource@esr.cri.nz

REPORT ON FAECAL SOURCE TRACKING ANALYSIS

The following samples were received on 18th January 2018 and were analysed for faecal source PCR markers.

ESR Number	Client Reference	Date Sampled	Site Description	*E.coli* MPN/100mL
CMB180049	WIT000420	16/1/18	Wai-iti Stream	921
CMB180050	WIT000460	16/1/18	Wai-iti Stream, downstream of campsite	1,200

Results of faecal source PCR Marker Analysis:

Please refer to the appendix for guidance on interpretation of these results

ESR Number	Client Reference	Description / Site ID	*E. coli* MPN / 100mL	General GenBac / 100 mls	Human BacH / 100 mls	Human BiADO / 100 mls	Ruminant BacR / 100 mls	Proportion Ruminant	Ruminant Cow / 100 mls	Avian GFD / 100 mls	Conclusion
CMB180049	WIT000420	Wai-iti Stream	921	240,000	210	<43	190	1% or less	<5	<29	Faecal Sources – weak ruminant, 1% or less
CMB180050	WIT000460	Wai-iti St, downstream of campsite	1,200	250,000	300	<43	110	1% or less	<5	<29	Faecal Sources – weak ruminant, 1% or less

Abbreviations: NA = sample was not analysed for this marker.
NC = not calculated

Comment:
With the levels of E.coli and GenBac detected in these samples we would expect to detect a species specific faecal source if tested for.

Notes:
Brief details of the methods of analysis are available on request.
These results relate to samples as received.
This report may not be reproduced except in full.

Paula Scholes
Laboratory Operations Coordinator

Beth Robson
Principal Technician

APPENDIX: Assay Interpretation Guidance Notes

PCR Marker interpretation notes

- Each marker is strongly associated with, but not exclusive to the source tested for. They each have some degree of non-specificity.
- Each marker is a separate test and the levels of the various markers within the same sample cannot be compared. For example, if sample A has a BacH result of 1,000 and a BacR of 100 it is not valid to say there is more human contamination than ruminant in sample A.
- Levels of the same marker in different samples can be compared. For example;
    - If sample A has a BacH result of 1,000 and sample B has a BacH of 10,000 it is valid to conclude there is more human faecal contamination in sample B than in sample A; or
    - If site H sampled in January has a GFD result of 500 and when sampled in February has a GFD result of 10,000, it is valid to conclude the level of avian faecal contamination in February is greater.
    - To be classified as a significantly greater or lesser result the level of marker should vary by a factor of 10.
- Both Human markers are required to be present for a positive human result.
- Ruminant specific markers are reported using a percentage value based on levels of this marker relative to the general marker in fresh ruminant faeces.
    - Samples reported as 50-100% ruminant are consistent with all of the general faecal marker having come from a ruminant source.
    - The lower levels reported (10-50%) may be a consequence of the presence of other sources of pollution, or in fact ruminant sources may still account for all the pollution, but this may include aged faecal material where relative levels of the ruminant marker decline more rapidly than the general marker.
    - Levels less than 10% ruminant suggest a very minor contribution from ruminant sources.

The detection limits of these methods vary depending on the volume of water filtered for analysis. We recommend a minimum volume of 200 mls and a maximum of 1000 mls, this range gives the following detection limits:

mls sample filtered	General GenBac / 100 mls	Human BacH / 100 mls	Human BiADO / 100 mls	Human HumM3 / 100 mls	Ruminant BacR / 100 mls	Ruminant Sheep / 100 mls	Ruminant Cow / 100 mls
< 400 mls	<110	<83	<110	<8	<91	<100	<11
400-700mls	<42	<33	<43	<3	<36	<41	<5
700-1000mls	<21	<17	<21	<2	<18	<21	<2

mls sample filtered	Dog DogBac / 100 mls	Avian GFD / 100 mls	Avian E2 / 100 mls	Gull- 2
> 400 mls	<79	<72	<99	presence / absence test
400-700mls	<31	<29	<40	
700-1000mls	<16	<14	<20	

FWA interpretation notes

The analysis of FWAs in septic tank and community wastewater consistently identifies levels between 10 and 70 µg/L. In previous analysis of water samples levels of FWA greater than 0.1 µg/L suggest human sewage, with levels greater than 0.2 µg/L strongly indicative of human sewage. Levels greater than 0.1 µg/L correlate well with other indicators of human pollution and indicate a local or recent source of pollution. FWAs degrade under sunlight exposure and will undergo dilution. Levels lower than 0.1 µg/L may be indicative of dilute or distant sources of human pollution.

Reference: Devane M., Saunders D. and Gilpin B. (2006). Faecal sterols and fluorescent whiteners as indicators of the source of faecal contamination. Chemistry in New Zealand 70(3), 74-7. http://www.nzic.org.nz/CiNZ/articles/Devane_70_3.pdf

Faecal sterol Intepretation Notes:

Faecal sterol ratios must be interpreted with consideration to the levels of sterols, and relative to one another. For example H1 is typically also above 5-6% in ruminant faeces. Human and ruminant sources generally require at least two of three ratios to reach thresholds.
Plant sterols and mixed sources also have differing effects on sterol interpretations which must be considered.

Conclusions are the best interpretation of sterols in our opinion. Conclusions in **bold** are highly supported by the sterol data, conclusions in brackets are supported by sterol data with some variation from a pure source, or with a lower degree of certainty.

Ratio Key:

Ratios indicative of faecal pollution (either human or animal)		
F1	coprostanol/cholestanol..	>0.5 indicative of faecal source of sterols
F2	24ethylcoprostanol/ 24-ethylcholestanol.	>0.5 indicative of faecal source of sterols.
Human indicative ratios (values exceeding threshold in red)		
H3	coprostanol/ 24-ethylcoprostanol	Ratio >1 suggests human source
H1	% coprostanol	Ratio >5-6% suggests human source
H2	coprostanol/(coprostanol+cholestanol)	Ratio >0.7 suggests human source
H4	coprostanol/(coprostanol+24-ethylcoprostanol)	Ratio >0.75 suggests human source
Ruminant indicative ratios (values exceeding threshold in blue)		
R3	24-ethylcholesterol/24-ethylcoprostanol	Ratio <1 suggests ruminant source, ratio >4 suggests plant decay
R1	% 24-ethylcoprostanol	Ratio >5-6% suggests ruminant source
R2	coprostanol/(coprostanol+24-ethylcoprostanol)	Ratio <30% suggests ruminant source
Avian indicative ratios (values exceeding threshold in yellow)		
A1	24-ethylcholestanol/(24-ethylcholestanol+24-ethylcoprostanol+24-ethylepicoprostanol)	A1 Ratio >0.4 suggests avian source AND A2 Ratio >0.5 suggests avian source
A2	cholestanol/(cholestanol+coprostanol+epicoprostanol)	

Appendix III

Daily effluent volume data provided by the consent holder for 2017-2018

WAI-ITI

Sewage Volumes

Date Read	Days	Volume	Average Volume per day
10/11/2017			
17/11/2017	7	7.74	1.11
24/11/2017	7	14.76	2.11
1/12/2017	7	10.16	1.45
8/12/2017	7	19.61	2.80
15/12/2017	7	16.91	2.42
22/12/2017	7	23.26	3.32
29/12/2017	7	48.66	6.95
5/01/2018	7	97.16	13.88
12/01/2018	7	60.33	8.62
19/01/2018	7	38.96	5.57
22/01/2018	3	20.25	6.75
23/01/2018	1	2.21	2.21
24/01/2018	1	7.04	7.04
25/01/2018	1	5.41	5.41
26/01/2018	1	5.51	5.51
27/01/2018	1	9.97	9.97
28/01/2018	1	9.79	9.79
29/01/2018	1	1.53	1.53
30/01/2018	1	0.86	0.86
1/02/2018	2	1.25	0.63
2/02/2018	1	1.35	1.35
3/02/2018	1	7.56	7.56
4/02/2018	1	6.29	6.29
5/02/2018	1	5.52	5.52
6/02/2018	1	5.47	5.47
7/02/2018	1	1.66	1.66
8/02/2018	1	1.74	1.74
9/02/2018	1	3.35	3.35
10/02/2018	1	8.42	8.42
11/02/2018	1	7.93	7.93
12/02/2018	1	1.62	1.62
16/02/2018	4	11.34	2.84
22/02/2018	6	30.34	5.06
4/03/2018	10	32.37	3.24
10/03/2018	6	66.4	11.07
17/03/2018	7	31.22	4.46
24/03/2018	7	18.52	2.65
1/04/2018	8	35.99	4.50
8/04/2018	7	18.55	2.65
15/04/2018	7	43.47	6.21
22/04/2018	7	7.24	1.03

27/04/2018	5	13.56	2.71
4/05/2018	7	20.45	2.92
11/05/2018	7	15.44	2.21
18/05/2018	7	32.08	4.58
25/05/2018	7	32.45	4.64
30/05/2018	5	19.13	3.83
1/06/2018	2	5.5	2.75
25/06/2018	24	68.74	2.86
26/06/2018	1	1.93	1.93
27/06/2018	1	5.21	5.21
28/06/2018	1	2.05	2.05
29/06/2018	1	2.4	2.40
30/06/2018	1	2.9	2.90
1/07/2018	1	3.02	3.02
3/07/2018	1	4.41	4.41
4/07/2018	1	1.73	1.73
5/07/2018	1	0.57	0.57

Average daily use 10 November 2017 - 5 July 2018 4.19