Bathing Beach Recreational Water Quality
State of the Environment
Annual Report
2018-2019

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Executive summary

This report provides an assessment of microbial water quality at 14 coastal bathing beach sites in the Taranaki region, based on summer monitoring of faecal indicator bacteria conducted by the Council between November 2018 and March 2019. The report focusses on enterococci results, as this indicator is considered by health authorities to provide the closest correlation with risks of health effects in New Zealand coastal waters. Results have been assessed for compliance with microbiological water quality guidelines prepared by the Ministry for the Environment (MfE) and the Ministry of Health (MfE, 2003).

Thirteen samples were collected at every monitored beach under dry weather conditions for State of the Environment Monitoring (SEM) purposes, except when it was unsafe to do so. At eight of the ten coastal sites monitored every year, an extra eight samples were collected to satisfy MfE requirements for the number of seasonal samples to be used for grading purposes and to provide more timely results during the holiday periods. Follow up samples were often collected following instances where enterococci counts exceeded 140 cfu/100 ml.

Microbiological water quality results were regularly reported on the Taranaki Regional Council website (www.trc.govt.nz) and there was timely liaison with territorial local authorities and the Health Protection Unit of the Taranaki District Health Board throughout the summer bathing season of 2018-2019.

During the 2018-2019 summer season, 243 routine samples were collected across 14 sites; of which 91.8% remained within Surveillance mode (≤140 cfu/100 ml). Guideline exceedances were relatively sporadic during what was a drier than usual summer, although a wet weather survey and a pollution incident at Ngamotu Beach contributed to the highest counts of the season. Median enterococci counts recorded in the SEM programme were lower or equal at seven sites, and higher at seven sites, when compared with their respective historical medians.

The normal mode of monitoring is deemed the 'Surveillance' mode. Additional monitoring is considered if a sample exceeds the 'Alert' mode (140 cfu/100 ml). The 'Action' mode guideline is reached when enterococci counts in two consecutive samples exceed 280 enterococci cfu/100 ml, and requires public notification by health authorities. There was one Action mode event during the summer which was associated with the Ngamotu Beach pollution incident. The latter resulted in enforcement action by the Council.

Over both the SEM programme and the extended (MfE) programme, Fitzroy Beach, Opunake Beach, and Oakura Beach (camping ground site) had the best water quality, and Ohawe Beach the lowest (although the median count here was still less than one-third of the 'Alert' threshold). No sample at Ohawe Beach reached the 'Action' threshold. High counts at Ohawe Beach were associated strongly with low conductivity (riverine influence). Five sites had every sample below the 'Alert' threshold, with another four sites above this threshold only once.

Mann-Kendall tests were performed in order to assess long term trends in microbiological water quality. One site, Fitzroy Beach, showed a significant decrease in median enterococci counts (improving quality) over the 24 years it has been monitored, indicating an overall improvement in microbiological water quality. Several sites have water quality so consistently high that further significant reductions in bacteriological counts cannot be expected. No site showed a significant increase in enterococci medians over the time period monitored i.e. deterioration in water quality.

Two sites, Waitara East and Oakura Beach in front of the camping ground, were showing indications of improving quality although at a lower level of certainty than required for statistically-based confidence.

Through the Council's Long Term Plan (LTP), the Council's target in respect of the microbiological state of coastal bathing sites is that there is maintenance or increase in the number of annual monitoring sites from the 2003-2004 summer that are compliant with the contact recreational guidelines (MfE, 2003). In the 2003-2004 summer, seven of the nine coastal bathing sites were compliant with the guidelines (Action levels). In

the season under review, one site (Ngamotu Beach) exceeded this guideline. The LTP target was therefore met.

Continuation of the Bathing Beach Recreational Water Quality Programme in the 2019-2020 year is recommended.

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1 Introduction

1.1 General

The Resource Management Act 1991 (RMA) established new requirements for local authorities to undertake environmental monitoring. Section 35 of the RMA requires local authorities to monitor, among other matters, the state of the environment of their region or district, to the extent that is appropriate to enable them to effectively carry out their functions under the Act.

To this effect, the Taranaki Regional Council ('the Council') has established a state of the environment monitoring (SEM) programme for the region. This programme is outlined in the Council's 'State of the Environment Monitoring Procedures Document', which was prepared in 1997. The monitoring programme is based on the significant resource management issues that were identified in the Council's Regional Policy Statement for Taranaki (1994).

The SEM programme is made up of a number of individual monitoring activities, many of which are undertaken and managed on an annual basis (from 1 July to 30 June). For these annual monitoring activities, summary reports are produced following the end of each monitoring year (i.e., after 30 June). Where possible, individual consent monitoring programmes have been integrated within the SEM programme to save duplication of effort and minimise costs. The purpose of annual SEM reports is to summarise regional environmental monitoring activity results for the year, and provide an interpretation of these results, together with an update of trends in the data.

Annual SEM reports act as 'building blocks' towards the preparation of the regional state of the environment report every five years. The Council's first, or baseline, state of the environment report was prepared in 1996 (TRC, 1996b), summarising the region's progress in improving environmental quality in Taranaki over the past two decades. The second report (for the period 1995-2000) was published in 2003 (TRC, 2003). Data spanning the ten year period 1995 to 2005 have been used in the preparation of a trend report (TRC, 2006). The third State of the Environment report (for the period 1995 to 2007) was published (TRC, 2009a) and included trend reporting, and the fourth report (for the 1995 to 2014 period) has been published (TRC, 2015a). The provision of appropriate computer software statistical procedures allows regular reporting on trends in the environmental quality over time, in relation to Council's ongoing monitoring activities, now that there has been an accumulation of a comprehensive dataset of sufficient duration to permit a meaningful analysis of trends (i.e. minimum of 10 years).

This report summarises the results for the sites surveyed in the Bathing Beach Recreational Water Quality SEM programme over the 2018-2019 monitoring year, the 24th year of the programme.

1.2 Background

In coastal waters, faecal indicator bacteria (enterococci, *E. coli* and faecal coliforms) can be monitored to assess contamination from human or animal excreta. Levels of these faecal indicators are of particular interest where the coast is used for recreational activities due to the potential health risks associated.

The Taranaki Regional Council has monitored faecal indicator bacteria at bathing beaches along the Taranaki coast since 1979, with systematic surveys undertaken from 1987. A more comprehensive annual bathing beach monitoring programme has been implemented from the 1995-1996 summer as an on-going component of the SEM programme for the Taranaki region.

The Bathing Beach Recreational Water Quality programme has three objectives:

- to characterise the bacteriological quality of principal recreation waters in the Taranaki area, and more specifically to determine their suitability for contact recreation;

- to identify changes in contact recreational water quality over time. Therefore the detection of trends is an important component in programme design;
- to assess compliance with recreational water quality guidelines.

*[**Note**: Contact recreation concerns water-based activities involving a high probability of accidental water ingestion. This mainly applies to bathing, but may also include other high-contact water sports e.g. jet-skiing, surfing, kayaking]*

2 Standards and guidelines

2.1 Microbiological water quality guidelines

Guidelines for microbiological water quality of marine recreational areas have been prepared by the Ministry for the Environment in conjunction with the Ministry of Health (MfE, 2003). The guidelines use a combination of a qualitative risk grading of the catchment, together with direct measurements of appropriate faecal indicators to assess the suitability of a site for recreation (see Section 3.2).

In addition, 'Alert' and 'Action' guideline levels are used for surveillance throughout the bathing season. These guideline levels are summarized in Table 1 and are based on keeping illness risk associated with recreational water use to less than approximately 2%. Levels are based on enterococci counts as these bacteria are the preferred indicators for marine waters. Research has shown that enterococci are the indicator most closely correlated with health effects in New Zealand marine waters, in common with general findings overseas (New Zealand Marine Bathing Study).

Table 1 Surveillance, Alert and Action levels for marine waters (2003)

	Mode		
	Surveillance	Alert	Action
Enterococci (cfu/100ml)	No single sample >140	Single sample >140	Two consecutive single samples >280
Recommended procedure	• Continue routine monitoring	• Increase sample to daily ('Follow up sampling') • Undertake sanitary survey • Identify sources of contamination • Consult CAC to assist in identifying possible source	• Increase sample to daily • Undertake sanitary survey • Identify sources of contamination • Consult CAC to assist in identifying possible source • Erect warning signs • Inform the public through the media that a public health problem exists

CAC = Catchment Assessment Checklist

It should be noted that in 'Alert' mode, the beach is still considered suitable for swimming, but monitoring becomes more focused.

Over the 2018-2019 summer season, warning signs were erected by the New Plymouth District Council (NPDC) once in response to an 'Action' mode event. Also, daily follow up sampling was often not practicable or appropriate (see Section 3.1.3 for more information on follow up sampling).

2.2 Suitability for recreational grading (SFRG) of sites

The guidelines (MfE, 2003) provide for the grading of recreational water bodies based on two components:

- The Microbiological Assessment Category (MAC): this is established on the basis of five years' enterococci data for a particular site, providing a quantitative measurement of the actual water quality over time. Sites are assigned MAC categories ranging from A to D, with definitions provided in Table 2. For the Taranaki region, the Taranaki Regional Council provides the Ministry for the Environment with these data collected as part of the annual bathing beach monitoring programme.
- The Sanitary Inspection Category (SIC): generates a measure of the deemed susceptibility of a water body to faecal contamination. A site is allocated a category of either Very High, High, Moderate, Low or Very Low, which is determined using the SIC flow chart. Information used in the flow chart comes

from the Catchment Assessment Checklist (CAC) which provides qualitative risk information on the catchment. Detailed information about SIC, including the SIC flow chart and the CAC can be found in the 2003 Microbiological Water Quality Guidelines (MfE, 2003).

The SIC is combined with the MAC to determine a Suitability for Recreation Grade (SFRG) for each site (Table 2). The SFRG therefore describes the general condition of a site based on both qualitative risk grading of the catchment and the quantitative measurement of faecal indicators. A grade is established on the basis of the most recent five years' data and recalculation of a grade is typically performed annually.

Table 2 Microbiological Assessment Categories

MAC	MAC definitions for marine waters
A	Sample 95 percentile ≤ 40 enterococci/100ml
B	Sample 95 percentile 41 - 200 enterococci/100ml
C	Sample 95 percentile 201 - 500 enterococci/100ml
D	Sample 95 percentile > 500 enterococci/100ml

SFRGs, as defined and interpreted by the Ministry for the Environment, are:

- Very good: considered satisfactory for swimming at all times.
- Good: satisfactory for swimming most of the time. Exceptions may include following rainfall.
- Fair: generally satisfactory for swimming, though there are many potential sources of faecal material. Caution should be taken during periods of high rainfall, and swimming avoided if water is discoloured.
- Poor: generally unsuitable for swimming, as indicated by historical results. Swimming should be avoided, particularly by the very young, the very old and those with compromised immunity.
- Very poor: avoid swimming.

Of the 19 total coastal sites monitored by the Council, 16 had sufficient data available to calculate SFRG grades for the period spanning November 2012 to April 2017. Of these 16 sites, 12 were graded 'good', 3 were graded 'fair' and 1 was graded 'poor'. None of the beaches graded 'very poor'. As 15 of the 16 beaches were assigned a SIC of 'moderate' it was not possible for any of these beaches to obtain a 'very good' SFRG grading regardless of the actual enterococci results used to calculate MAC. This was mainly related to either the agricultural nature of the catchment areas or the presence of nearby streams and rivers which heavily influenced the SIC assessment results.

It must be emphasized that the SFRG grade provides a conservative/precautionary guideline intended for assessing the suitability of beaches for contact recreation from a public health perspective. The grade is of limited use for assessing the state of the environment, as it includes the SIC: a static assessment based on qualitative information. Instead, the remainder of this report will focus on presenting and interpreting actual faecal indicator data collected during routine monitoring. This quantitative information enables the assessment of general trends in coastal water quality, and can be used to measure how well management practices and policies are working, and whether environmental outcomes are being achieved.

It should be noted that the Ministry itself states that the SFRG *'reflects a precautionary approach to managing public health risks and does not represent an accurate picture of water quality in the catchment.*

The grades reflect a precautionary approach to managing health risk and are not designed to represent health risks on a particular day. They tend to reflect the poorest water quality measured at a site rather than the

average water quality. A site may be graded as poor but still be suitable for swimming much of the time. The indicator does not replace the site-specific information available on council websites' [1]

Note: The grades presented in Table 3 take into account all routine sampling results; comprising SEM and extended monitoring results (see Section 3).

Table 3 Suitability for recreation grade for the period November 2013 to April 2018

Site	Sanitary Inspection Category	MAC			SFRG Grade	% of all inspection in compliance
		95th percentile	No of samples	Category		
Wai-iti	Moderate 13	664.0	26	D	Poor	96%
Urenui	Moderate 13	186.6	22	B	Good	95%
Onaero (surf club)	Moderate 13	222.0	108	C	Fair	96%
Onaero (settlement)	Low 14	114.0	20	B	Good	100%
Waitara (East)	Moderate 13	268.0	86	C	Fair	95%
Waitara (West)	Moderate 13	175.0	75	B	Good	97%
Bell Block	Moderate 3	162.4	26	B	Good	96%
Fitzroy	Moderate 3	92.1	109	B	Good	98%
East End	Moderate 3	115.0	65	B	Good	98%
Ngamotu	Moderate 3	172.0	109	B	Good	98%
Back Beach	Low 14	896.0	26	D	Poor	88%
Oakura (surf club)	Moderate 13	210.0	110	C	Fair	96%
Oakura (camp ground)	Moderate 13	78.0	65	B	Good	100%
Opunake	Moderate 3	30.1	108	A	Good	100%
Ohawe	Moderate 13	340.5	87	C	Fair	94%
Patea	Moderate 13	Insufficient data (triennial monitoring)				
Waverley	Moderate 13	Insufficient data (triennial monitoring)				
Waiinu	Moderate 13	Insufficient data (triennial monitoring)				

13 = River - agricultural activities/birds/feral animal

14 = River - focal points of discharge

3 = Urban stormwater

[1] *Suitability for swimming: Indicator update July 2013: INFO 690*, Ministry for the Environment

3 Monitoring methodology

3.1 Programme design

The Council's Bathing Beach Recreational Water Quality programme consists of two primary components: State of the Environment monitoring and extended (MfE) monitoring.

The SEM component involves ten annual sampling sites and nine rotational sites (Figure 1). The rotational sites are sampled on a three year rotation, with Year 3 beaches sampled during the 2018-2019 monitoring programme (Table 4). Thirteen samples are collected per site for the SEM component.

The extended monitoring component has been included in order to meet requirements of the revised guidelines for microbiological water quality of marine recreational areas (MfE, 2003). Since the 2016-2017 bathing season, additional samples are collected at eight SEM sites as part of this extended (MfE) monitoring (Figure 1). Approximately ten samples are collected during the extended monitoring regime.

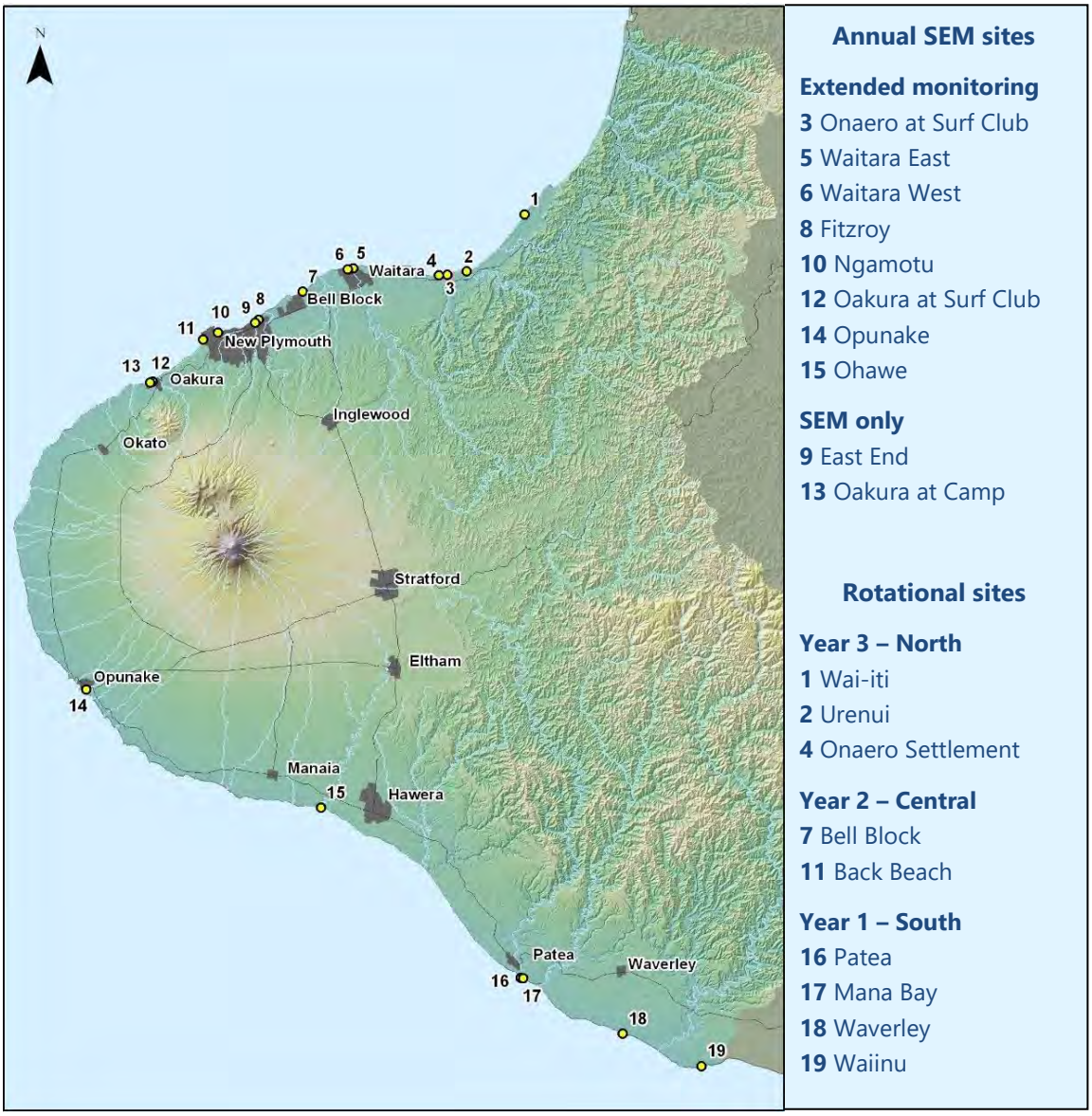


Figure 1 Bathing beach monitoring sites

The fourteen beaches that were sampled during the 2018-2019 bathing season are specified in Table 4.

Table 4 Beach sites sampled during the 2018-2019 bathing season

Beach	Location	GPS	Site code
Onaero	Opposite surf lifesaving club	2628254-6244898	SEA900085
Waitara	East Beach	1706602-5683915	SEA901033
Waitara	West Beach	1705951-5683802	SEA901037
Fitzroy	Opposite surf lifesaving club	2605036-6239351	SEA902025
East End	Opposite surf lifesaving club	2604605-6239000	SEA902035
Ngamotu	Centre of beach	2600022-6237765	SEA902062
Back	To the north of the Herekawe Stream	2598198-6236896	SEA902070
Oakura	Opposite surf lifesaving club, south of Wairau Stream	2591974-6231726	SEA903030
Oakura	Opposite motorcamp, south of Waimoku Stream	2591700-6231600	SEA903032
Opunake	Centre of beach	2583775-6193800	SEA904090
Ohawe	Adjacent to boat ramp, east of Waingongoro River	2612688-6179169	SEA906010
Patea	100 m north of northern breakwater (and Patea River)	2637262-6158165	SEA907020
Waverley	Adjacent to boat ramp	2649820-6151265	SEA907085
Waiinu	Adjacent to boat launching area	2659507-6147292	SEA907095

The purpose of each monitoring component, and their respective sampling protocols, are discussed in sections 3.1.1 and 3.1.2.

3.1.1 State of the Environment monitoring

The monitoring network is designed to assess coastal water quality in terms of its suitability for contact recreation. As such, the network targets the main bathing times and avoids, as far as possible, the localized influence of diffuse sources (i.e. streams and rivers) on adjacent coastal water quality. For these reasons the following criteria have been adopted for this SEM protocol:

Sample collection, field measurements, transport and analyses were undertaken according to documented Taranaki Regional Council procedures. It was intended that on average, four samples would be collected from each of the sites in each month when hydrological flow conditions permitted, within two hours of high tide. SEM sampling was performed only under dry weather flow conditions (i.e. not within three days of a fresh) to ensure, as far as practicable, consistent environmental factors. Bathing water samples were taken between the hours of 0900 and 1800 hours (NZDT) to reflect the most likely period for swimming. Where necessary, a 2 m sampling pole was used for bacteriological sample collection immediately beneath the water surface and at a minimum of knee depth at the sites.

In the 2018-2019 summer period, 13 SEM surveys were undertaken. However, due to unsafe sampling conditions, not all sites were sampled on every occasion.

3.1.2 Extended (MfE) monitoring

The revised guidelines for microbiological water quality of marine recreational areas (MfE, 2003) envisaged weekly surveillance monitoring during the 5-month recreational period, with a minimum of 20 sampling dates, regardless of weather conditions or state of the tide. This number of samples each season is regarded

as providing the most robust dataset for site categorisation purposes. In the 2002-2003 summer period, following consultation with the territorial local authorities and the Taranaki District Health Board, TRC added seven sampling dates to the SEM protocol at five of the most popular marine recreational sites (Onaero, Fitzroy, Ngamotu, Oakura and Opunake beaches). These seven sampling dates were systematically selected (one per week) in weeks not sampled by the SEM programme. Sampling was undertaken regardless of prior weather conditions or tides but adhering to all other SEM programme protocols.

In the 2016-2017 summer period, monitoring frequency was increased to at least weekly between December and February at eight of the most popular coastal recreational sites (Onaero, Waitara West, Waitara East, Fitzroy, Ngamotu, Oakura Surf Club, Opunake and Ohawe Beaches), to align fully with the MfE guidelines and the reporting protocols for the Land, Air, Water Aotearoa (LAWA) website. When possible, the SEM protocol of dry weather monitoring was followed. In weeks when weather or tide did not meet the SEM protocol, sampling occurred no later than Thursday to allow public posting of results before the weekend.

In the 2018-2019 summer period, an additional eight samples were collected at the eight sites listed above, following the extended monitoring protocol. In the discussion that follows, these samples are described as 'extended' or 'MfE' samples.

3.1.3 Follow up monitoring

As recommended by the national guidelines (MfE, 2003), a follow up sample may be collected when a routine monitoring sample reaches 'Alert' mode (see Section 2.1). Follow up samples can be useful in determining the source of a high enterococci count, the longevity of the event, and for updating the site's suitability for bathing. These samples are generally collected as soon as reasonably practicable in the days following the high result, though follow ups may be deemed inappropriate under certain circumstances. For example, if wet weather ensues, a follow up sample may not be collected due to contamination from nearby freshwater inputs masking the source in question. In some instances, when routine surveys are scheduled within close succession, the subsequent survey may substitute a dedicated follow up survey.

3.2 Analysis

3.2.1 Sample analysis

Historically, samples were analysed for enterococci, *E. coli*, faecal coliforms and conductivity. E. coli and faecal coliform numbers were obtained using the mTEC agar method #9213-d, Standard Methods for the Examination of Waters and Wastewaters (APHA, 2005). Enterococci were quantified using the EPA modified method #1600 on mEI agar (EPA, 1986).

In the 2017-2018 summer period, it was decided to stop analysing for *E.coli* and faecal coliforms, in order to optimise the efficiency of the laboratory; given the increase in overall sampling intensity in recent years. *E.coli* and faecal coliforms are inferior indicators of faecal contamination in marine waters, when compared with enterococci (see Section 3.1). Follow up enterococci samples were quantified using the Enterolert (IDEXX) Quanti-Tray system (see Section 3.1 for an explanation of when follow up samples are required).

The 2018-2019 summer marked the first bathing season following the closure of the Council laboratory. Instead, all samples were sent to Hill Laboratories for analysis. Enterococci were quantified using a membrane filtration method (APHA, 9230 C (modified) 23rd ed. 2017) during routine sampling and using the Enterolert method (APHA, 9230 D 23rd ed. 2017) for follow up sampling. Specific conductivity was also measured at the laboratory using a conductivity meter (APHA, 2510 B 23rd ed. 2017).

At each of the sites the following additional information was recorded: time, water temperature, weather condition, wind condition, surf condition, colour/appearance of water, and number of bathers and other users.

Once verified, all results were posted on the Taranaki Regional Council website (www.trc.govt.nz).

3.2.2 Data analysis

Long term trend analysis is only carried out with the results from samples collected within the SEM schedule of the complete programme, in order to determine the trends of recreational water quality around Taranaki under dry weather conditions (i.e. samples collected under reproducible conditions). For sites with sufficient data (≥10 years), non-parametric trend analysis was performed using annual median enterococci data. For each site, a LOWESS (Logically Weighted Scatterplot) line (tension 0.4) was fitted to a temporal scatter plot of the enterococci median data. Statistical significance of the trend was tested using a Mann-Kendall test. The sign (+/-) of the Kendall tau value was used to assess whether the trend was positive or negative and the significance of the trend was determined using the p value ($p < 0.05$ = significant).

When multiple correlations are undertaken, there is a chance that some will be found to be significant purely by chance. In order to deal with this potential problem, the Benjamini-Hochberg False Discovery Rate (FDR) method was applied to the results of the Mann-Kendall test. Further justification for this statistical approach can be found in Stark and Fowles (2006).

4 Results

During the 2018-2019 bathing season, sampling was generally confined to weekdays, with no statutory holidays included. For these reasons, recreational usage of the waters at the time was generally less intensive, often with no apparent usage at the time of sampling. However, all sites are known to be regularly utilized for bathing and other contact recreational activities, particularly at weekends, dependent on suitable weather conditions.

Whenever possible, no sampling for SEM purposes was undertaken within three days following significant river freshes. However, it is recognised that water conditions at the time of sampling was occasionally affected by localized rainfall and elevated river flows. The extended ('MfE') monitoring was preferentially, but not exclusively, undertaken during fine weather. Given these sampling criteria, the results presented here generally reflect coastal water quality under fine weather conditions (that is, conditions where bathing would be typically most popular).

All results (SEM, MfE and follow up monitoring), from the 2018-2019 bathing season are presented and discussed on a site by site basis in this report. The statistical analyses do not include follow-up sampling results, as they're collected in response to particular events (resulting in high enterococci counts) and are therefore not random, and potentially not representative of typical bathing conditions.

Supplementary data and observations are presented in Appendices I and II.

4.1 Onaero Beach (Surf Club)

Onaero Beach (Photo 1), located in North Taranaki, is a relatively popular bathing beach, particularly over the Christmas holiday period. The Onaero River drains to the southern end of the beach, making a significant contribution to bacteria counts following rainfall events.

Photo 1 Onaero Beach

All enterococci data for this site, from the 2018-2019 summer period, is presented in Figure 2. All sample results and field observations are presented in Appendices I and II, respectively. A total of 22 samples were collected at this site across the summer. All 13 scheduled SEM samples were collected, as well as eight MfE samples and one follow up.

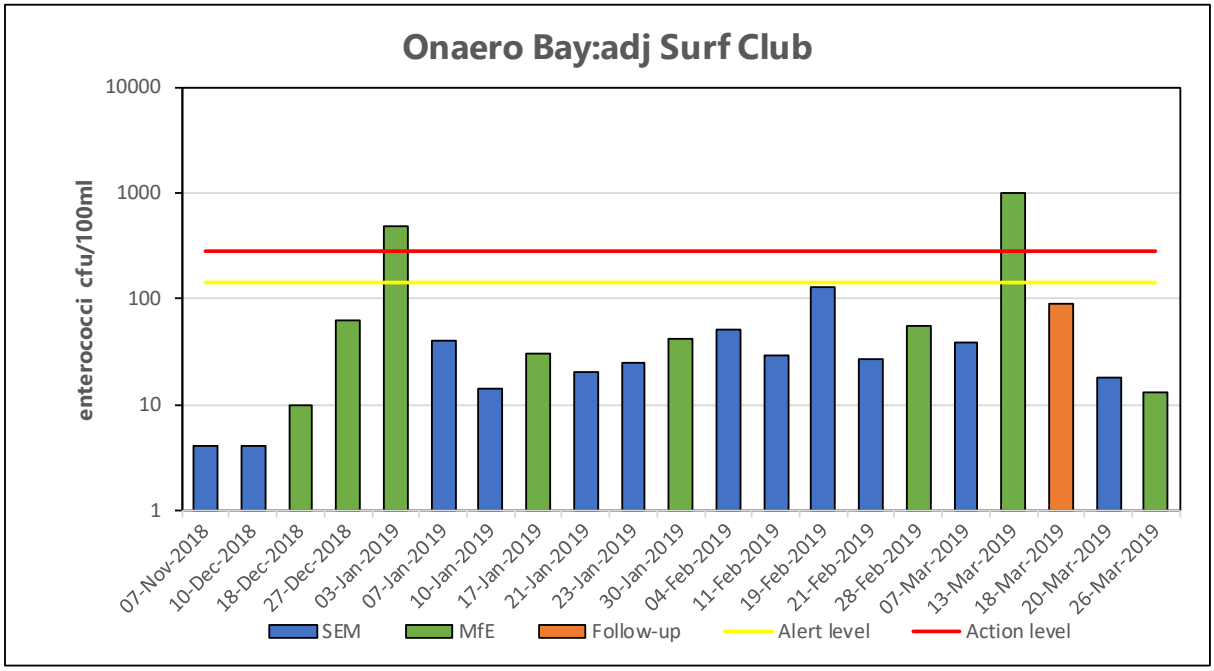


Figure 2 Enterococci results for Onaero Beach at the Surf Club

The monitoring data is summarized in Table 5.

Table 5 Statistical summary for Onaero Beach (at the Surf Club)

Parameter		Units	Number of samples	Minimum	Maximum	Median
SEM samples	Specific conductivity	µS/cm@25°C	13	46,200	55,000	52,400
	Enterococci	cfu/100 ml	12	4	130	26
	Temperature	°C	13	16.0	23.8	19.6
SEM & MfE samples	Specific conductivity	µS/cm@25°C	21	41,200	55,000	52,200
	Enterococci	cfu/100 ml	20	4	1000	29.5
	Temperature	°C	21	16	23.8	20

4.1.1 Comparison with guidelines

Enterococci counts from Onaero Beach at the Surf Club over the 2018-2019 summer are summarized against the guidelines in Table 6. 'Alert' mode was reached following two MfE surveys carried out on 3 January and 13 March 2019 (480 and 1000 cfu/100 ml, respectively). Both samples were collected close to low tide with gulls present on the beach (Appendix I, II). The January exceedance occurred during dry and calm conditions, however the March exceedance was preceded by significant rainfall. The conductivity results associated with both samples were indicative of a freshwater influence. The remaining 20 samples collected over the summer were within 'Surveillance' mode.

Table 6 Performance against guidelines at Onaero Beach (at the Surf Club)

Parameter	Number of exceedances of enterococci guidelines	
	ALERT Single sample >140/100 ml	ACTION Two consecutive single samples >280/100 ml
SEM samples	0 [0%]	0 [0]
SEM & MfE samples	2 [9%]	0 [0]

4.1.2 Comparison with previous summer surveys

Summary statistics for the SEM enterococci data collected at Onaero Beach over 20 summers are presented in Figure 3. The distribution of results from the 2018-2019 summer period were relatively high compared with previous summers, recording the highest median count to date (26 cfu/100 ml, Figure 3, Table 5).

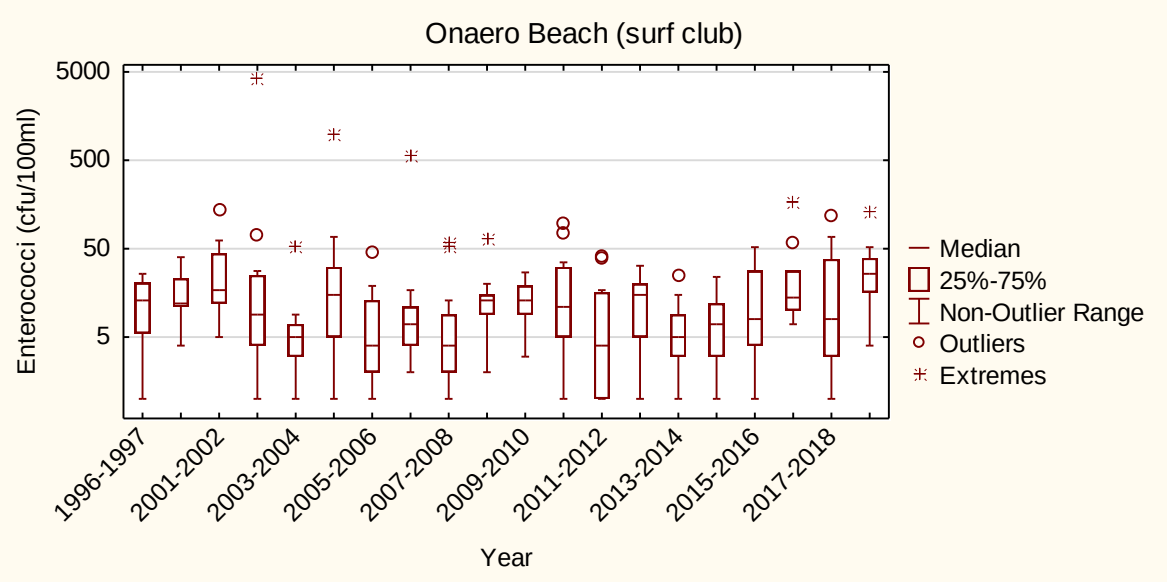


Figure 3 Box and whisker plots of enterococci for all summer SEM surveys at Onaero Beach

4.1.3 Long-term trend analysis

Trend analysis was performed by applying a LOWESS fit (tension 0.4) to a time scatterplot of the median enterococci data for 20 summer seasons (Figure 4) and testing the significance of any trend using the Mann-Kendall test at the 5% level, followed by Benjamini-Hochberg False Discovery Rate (FDR) analysis.

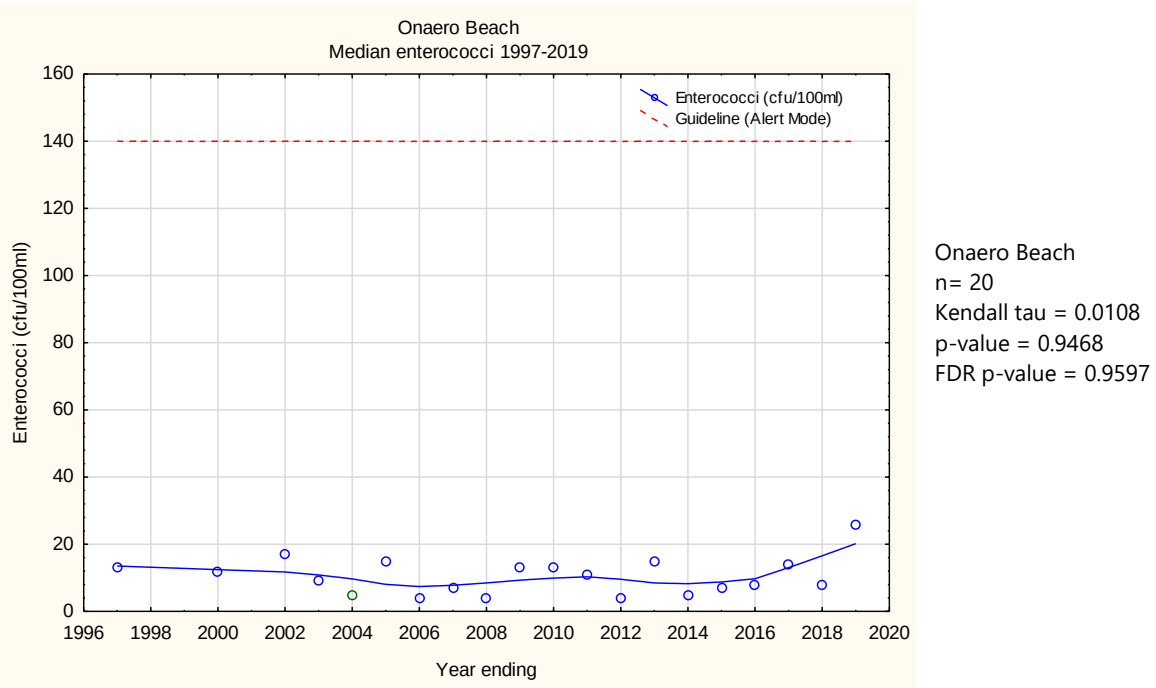


Figure 4 LOWESS trend analysis of median enterococci data at Onaero Beach

Over the 20 seasons monitored, there was a positive trend (i.e. an increase) in median enterococci counts (Kendall tau = 0.011) that was not significant at the 5% level (p = 0.947).

4.2 Waitara East Beach

Waitara East Beach is located to the east of the Waitara River mouth (Photo 2). Results at this site are influenced by the Waitara River which drains a large agricultural catchment and often contains high levels of bacteria.

Prior to October 2014, municipal wastewater from the Waitara township was discharged through the Waitara Marine Outfall approximately 1.8 km out to sea. Since October 2014, New Plymouth District Council (NPDC) has pumped municipal wastewater from the Waitara township to the New Plymouth Wastewater Treatment Plant and sewage is no longer discharged through the Waitara Marine Outfall during normal operation of the wastewater system.

Photo 2 Waitara East Beach

All enterococci data for this site, from the 2018-2019 summer period, is presented in Figure 5. All sample results and field observations are presented in Appendices I and II, respectively. Due to unsafe sampling conditions, one of the 13 scheduled SEM samples could not be collected. In addition to the SEM samples, eight MfE samples were also collected (20 in total).

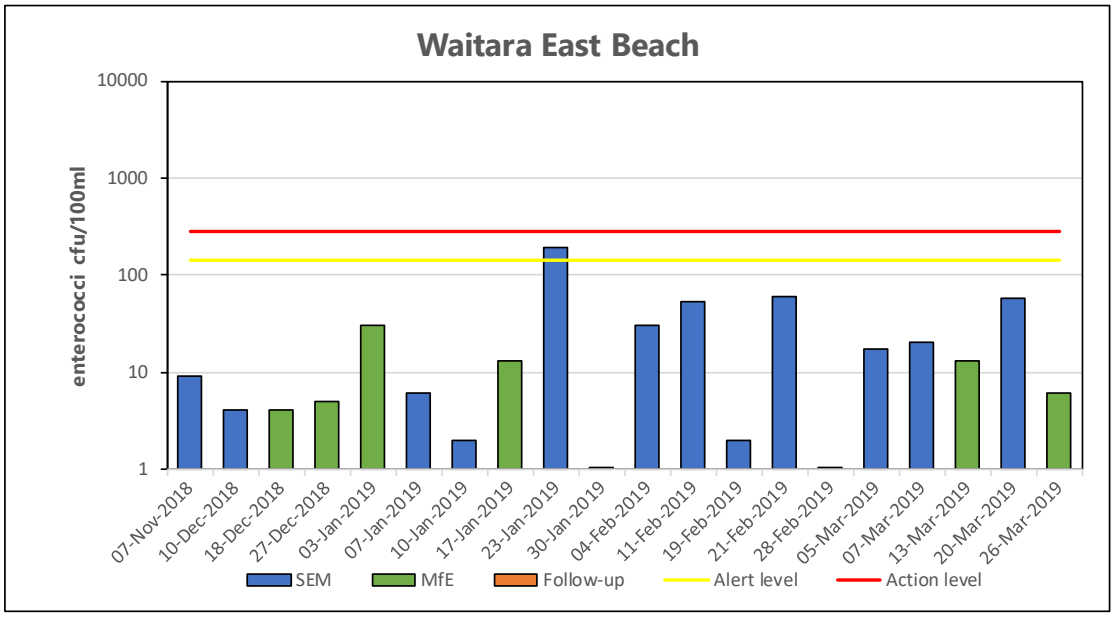


Figure 5 Enterococci results (presented on a logarithmic scale) for Waitara East Beach

The monitoring data is summarized in Table 7.

Table 7 Statistical summary for Waitara East Beach

Parameter		Units	Number of samples	Minimum	Maximum	Median
SEM samples	Specific conductivity	µS/cm@25°C	12	46,800	54,900	53,750
	Enterococci	cfu/100 ml	12	2	190	18.5
	Temperature	°C	12	15.8	24.4	19.6
MfE & SEM samples	Specific conductivity	µS/cm@25°C	20	43,200	54,900	52,250
	Enterococci	cfu/100 ml	20	1	190	11
	Temperature	°C	20	15.8	24.8	20.3

4.2.1 Comparison with guidelines

Enterococci counts from Waitara East over the 2018-2019 summer are summarized against the guidelines in Table 8. 'Alert' mode was reached once following an SEM survey due to an elevated count (190 cfu/100 ml on 23 January 2019). There had been no significant rainfall preceding the survey and the associated conductivity result was not indicative of a freshwater influence (Appendix I, II). The sample was collected close to high tide during a king tide cycle and a large swell was noted. The remaining 19 samples were within 'Surveillance' mode.

Table 8 Performance against guidelines at Waitara East Beach

Parameter	Number of exceedances of enterococci guidelines	
	ALERT Single sample >140/100 ml	ACTION Two consecutive single samples >280/100 ml
SEM samples	1 [8%]	0 [0]
SEM & MfE samples	1 [5%]	0 [0]

4.2.2 Comparison with previous summer surveys

Summary statistics for SEM enterococci data collected at Waitara East Beach over 24 summers are presented in Figure 6. The results from the 2018-2019 summer period were comparable with previous summers. The 2018-2019 median count (18.5 cfu/100 ml; Table 7) is higher than the overall median from the 24 surveys carried out at this site.

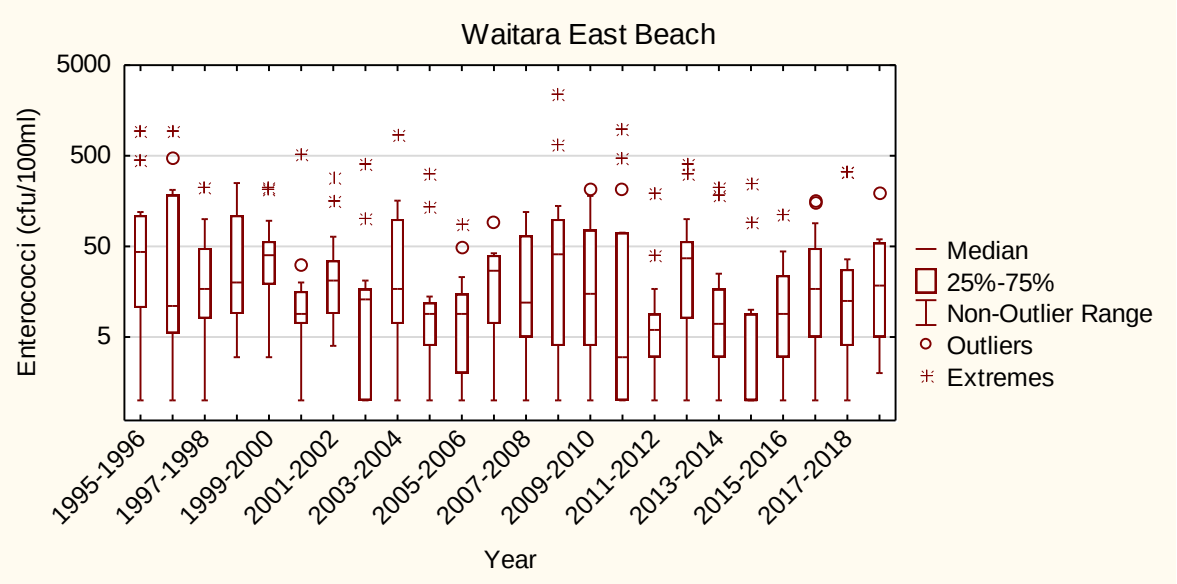


Figure 6 Box and whisker plots of enterococci for all summer SEM surveys at Waitara East Beach

4.2.3 Long-term trend analysis

Trend analysis was performed by applying a LOWESS fit (tension 0.4) to a time scatterplot of the median enterococci data for 24 summer seasons (Figure 7) and testing the significance of any trend using the Mann-Kendall test at the 5% level, followed by Benjamini-Hochberg False Discovery Rate (FDR) analysis.

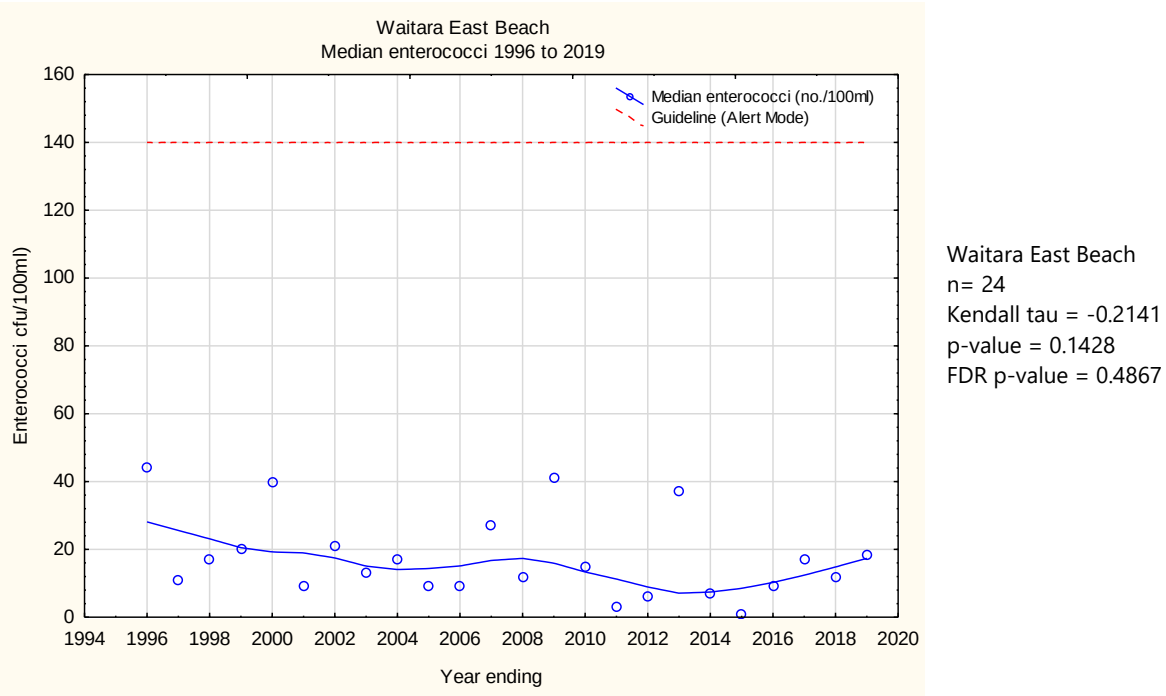


Figure 7 LOWESS trend analysis of median enterococci data at Waitara East Beach

Over 24 seasons, there was a negative trend (i.e. a decrease) in median enterococci counts (Kendall tau = -0.214) that was not significant at the 5% level (p = 0.143).

4.3 Waitara West Beach

Waitara West Beach is located to the west of the Waitara River mouth (Photo 3). As with Waitara East Beach, the results at this site can be influenced by the Waitara River.

Since October 2014, municipal wastewater from the Waitara Township has been directed to the New Plymouth Wastewater Treatment Plant and is no longer discharged through the Waitara Marine Outfall during normal operation of the wastewater system.

Photo 3 Waitara West Beach

All enterococci data for this site, from the 2018-2019 summer period, is presented in Figure 8. All sample results and field observations are presented in Appendices I and II, respectively. A total of 21 samples were collected at this site across the summer, including all 13 scheduled SEM samples and eight MfE samples.

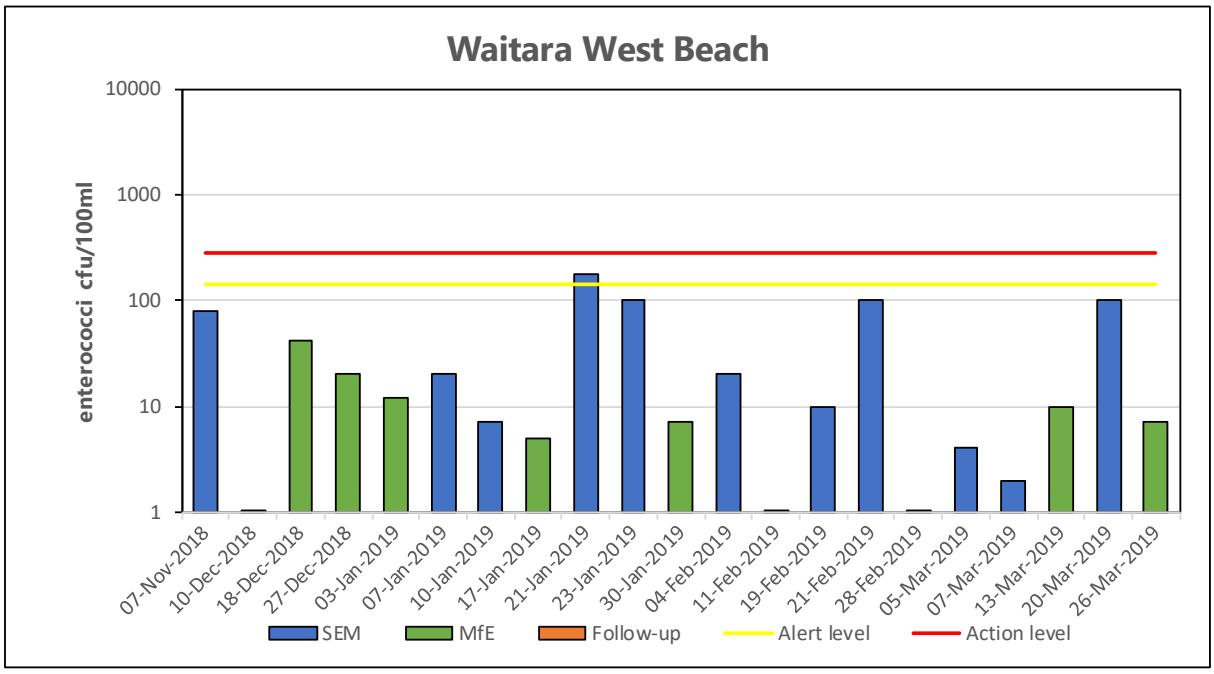


Figure 8 Enterococci results (presented on a logarithmic scale) for Waitara West Beach

The monitoring data is summarized in Table 9.

Table 9 Statistical summary for Waitara West Beach

Parameter		Units	Number of samples	Minimum	Maximum	Median
SEM samples	Specific conductivity	µS/cm@25°C	13	22,500	54,800	53,500
	Enterococci	cfu/100 ml	13	<1	180	20
	Temperature	°C	13	15.9	25.7	19.4
SEM & MfE samples	Specific conductivity	µS/cm@25°C	21	22,500	54,800	51,600
	Enterococci	cfu/100 ml	21	<1	180	10
	Temperature	°C	21	15.9	25.7	20.5

4.3.1 Comparison with guidelines

Enterococci counts from Waitara West over the 2018-2019 summer are summarized against the guidelines in Table 10. 'Alert' mode was prompted once following a high count from an SEM sample on 21 January 2019 (180 cfu/100 ml). There had been no significant rainfall preceding the survey and the associated conductivity result was not indicative of a freshwater influence (Appendix I, II). The 20 remaining samples were within 'Surveillance' mode limits.

Table 10 Performance against guidelines at Waitara West Beach

Parameter	Number of exceedances of enterococci guidelines	
	ALERT Single sample >140/100 ml	ACTION Two consecutive single samples >280/100 ml
SEM samples	1 [8%]	0 [0]
SEM & MfE samples	1 [5%]	0 [0]

4.3.2 Comparison with previous summer surveys

Summary statistics for SEM enterococci data collected at Waitara East Beach over 24 summers are presented in Figure 9. The distribution of counts from the 2018-2019 summer period was comparable with previous summers. The median count (20 cfu/100 ml; Table 9) is higher than the overall median from the 24 surveys carried out at this site.

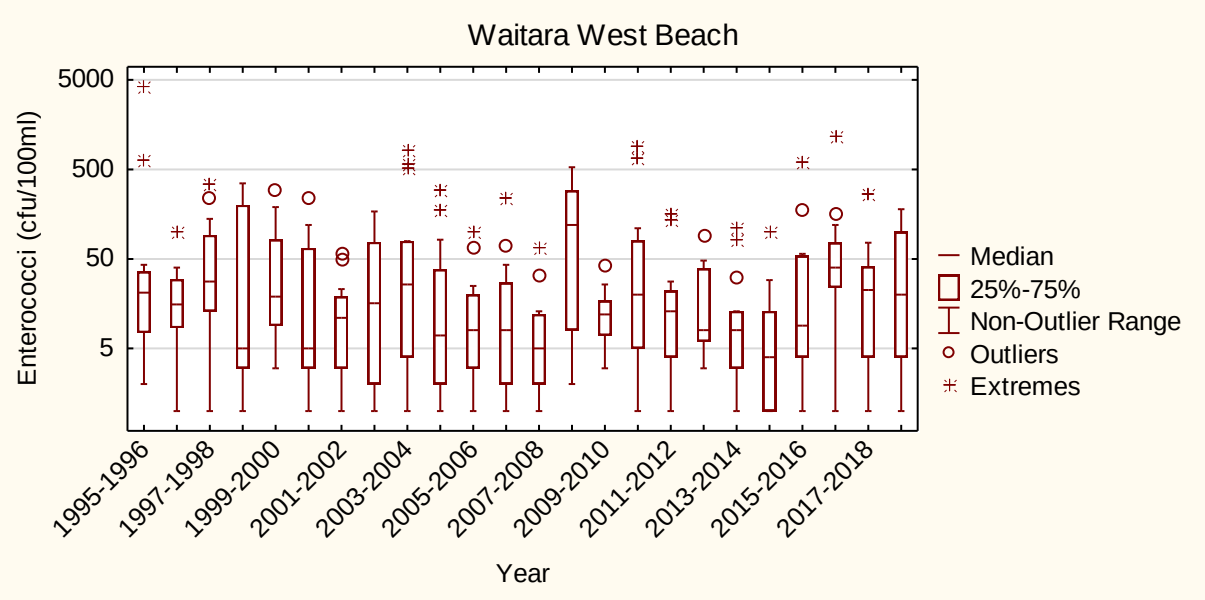


Figure 9 Box and whisker plots of enterococci for all summer SEM surveys at Waitara West Beach

4.3.3 Long-term trend analysis

Trend analysis was performed by applying a LOWESS fit (tension 0.4) to a time scatterplot of the median enterococci data for 24 summer seasons (Figure 10) and testing the significance of any trend using the Mann-Kendall test at the 5% level, followed by Benjamini-Hochberg False Discovery Rate (FDR) analysis.

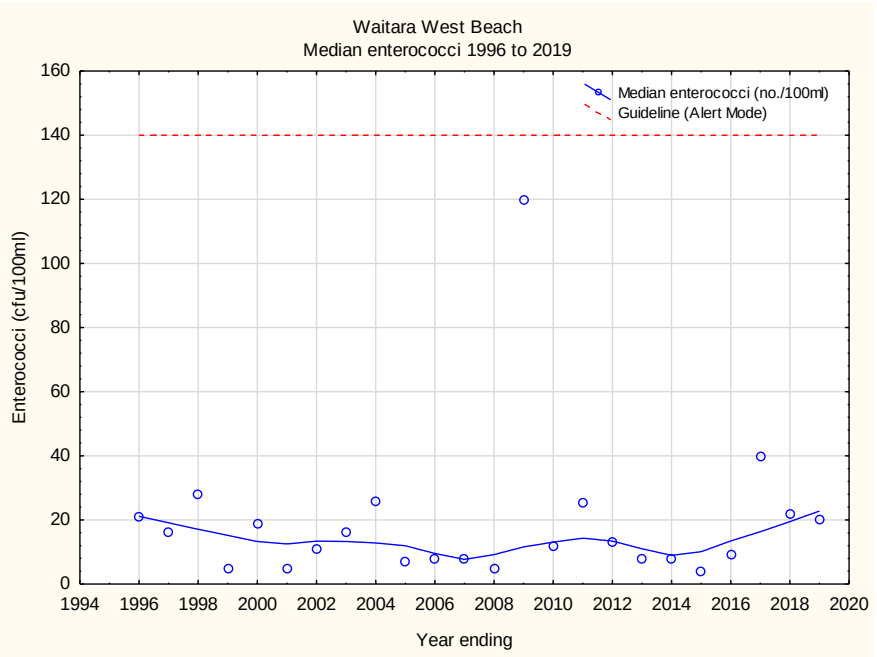


Figure 10 LOWESS trend analysis of median enterococci data at Waitara West Beach

Over 24 seasons, there was a positive trend (i.e. an increase) in median enterococci counts (Kendall tau = 0.007) that was not significant at the 5% level (p = 0.959).

4.4 Fitzroy Beach

Fitzroy Beach is situated in New Plymouth and is one of the most popular bathing beaches in Taranaki. It is also a very popular surfing beach due to its central location and high quality waves (Photo 4).

The mouth of the Waiwhakaiho River enters the sea at the eastern end of the beach, approximately 800 m from the sample site, which can contribute significant amounts of freshwater during floods. Draining from a highly modified agricultural and industrial catchment, this can have a significant impact on bacteriological water quality subsequent to heavy rainfall. The river typically has a high level of contamination from birdlife.

Photo 4 Fitzroy Beach

All enterococci data for this site, from the 2018-2019 summer period, is presented in Figure 11. All sample results and field observations are presented in Appendices I and II, respectively. A total of 22 samples were collected, comprising 13 SEM samples, eight MfE samples and one follow up sample.

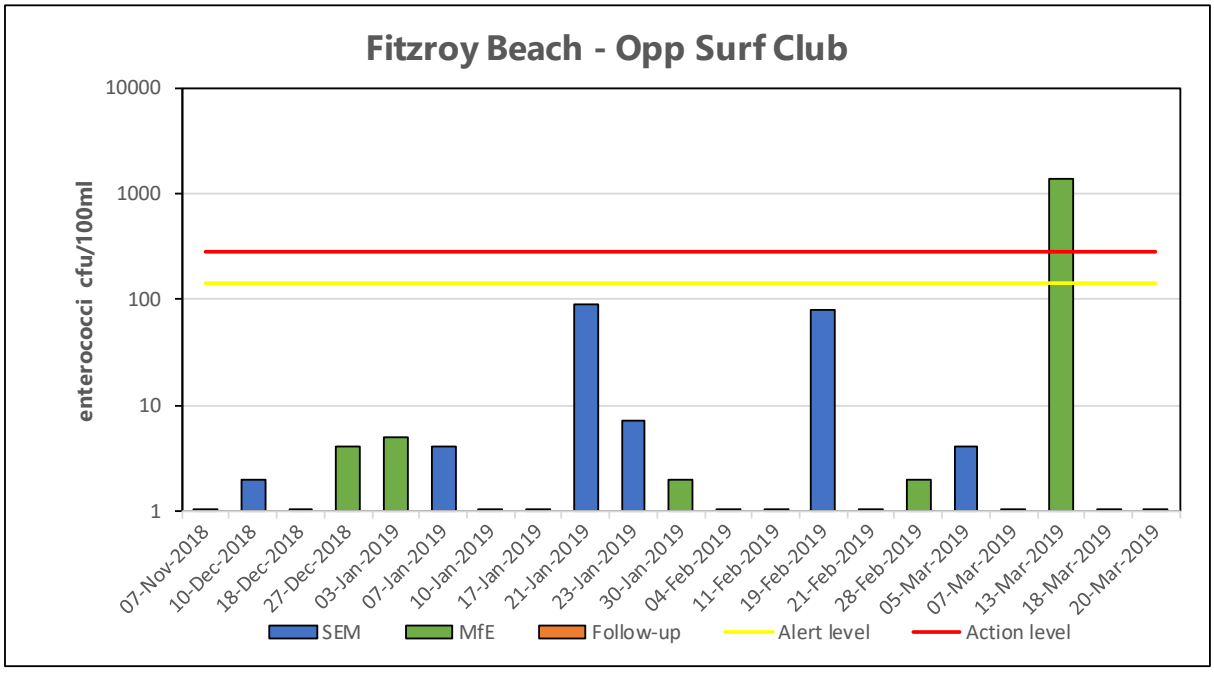


Figure 11 Enterococci results for Fitzroy Beach

The monitoring data is summarized in Table 11.

Table 11 Statistical summary for Fitzroy Beach

Parameter		Units	Number of samples	Minimum	Maximum	Median
SEM samples	Specific conductivity	µS/cm@25°C	13	52,700	54,900	54,100
	Enterococci	cfu/100 ml	13	<1	90	1
	Temperature	°C	13	15.0	23.1	18.9
SEM & MfE samples	Specific conductivity	µS/cm@25°C	21	47,500	54,900	54,300
	Enterococci	cfu/100 ml	21	<1	1,400	2
	Temperature	°C	21	15.0	23.1	18.9

4.4.1 Comparison with guidelines

Enterococci counts from Fitzroy Beach over the 2018-2019 summer are summarized against the guidelines in Table 12. 'Alert' mode was reached once following an MfE survey on 13 March (1400 cfu/100 ml). Significant rainfall preceded this survey and the associated conductivity result was also indicative of a freshwater influence (Appendix I, II). It was noted during the survey that the sea appeared dirtier than usual at this site, with a large amount of suspended debris in the shoreline waters. The remaining 21 samples were within the 'Surveillance' limits.

Table 12 Performance against guidelines at Fitzroy Beach

Parameter	Number of exceedances of enterococci guidelines	
	ALERT Single sample >140/100 ml	ACTION Two consecutive single samples >280/100 ml
SEM samples	0 [0	0 [0]
SEM & MfE samples	1 [5%]	0 [0]

4.4.2 Comparison with previous summer surveys

Summary statistics for SEM enterococci data collected at Fitzroy Beach over 24 summers are presented in Figure 12. The distribution of results from the 2018-2019 summer period was relatively low compared with previous years; with a median count of 1 cfu/100 ml, and an upper quartile limit below 5 cfu/100 ml.

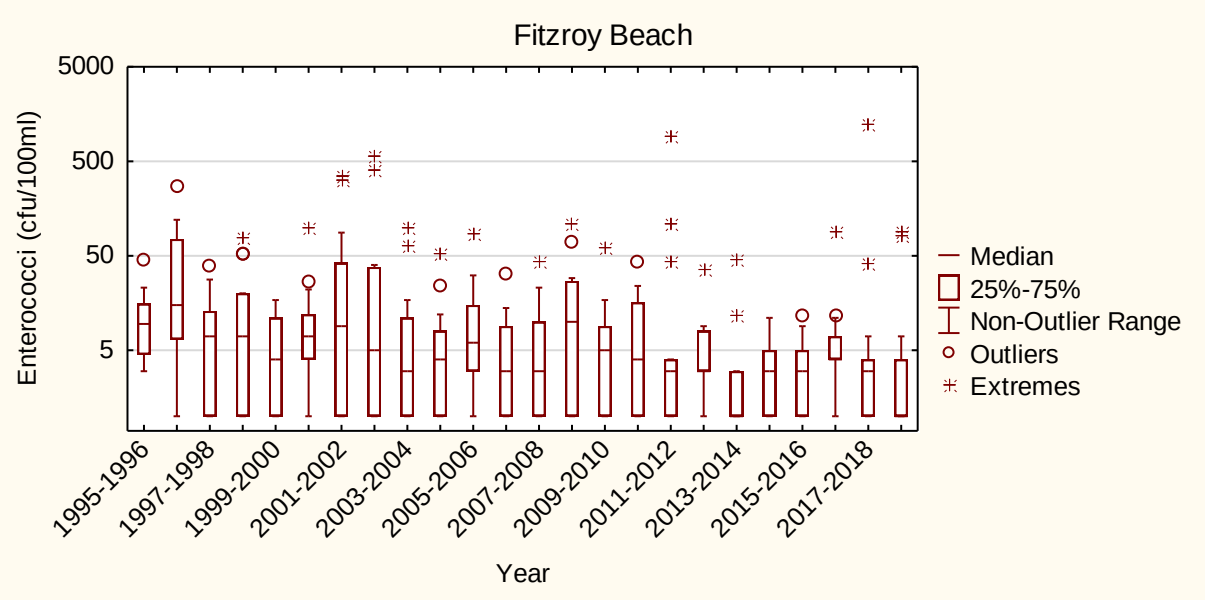


Figure 12 Box and whisker plots of enterococci for all summer SEM surveys at Fitzroy Beach

4.4.3 Long-term trend analysis

Trend analysis was performed by applying a LOWESS fit (tension 0.4) to a time scatterplot of the median enterococci data for 24 summer seasons (Figure 13) and testing the significance of any trend using the Mann-Kendall test at the 5% level, followed by Benjamini-Hochberg False Discovery Rate (FDR) analysis.

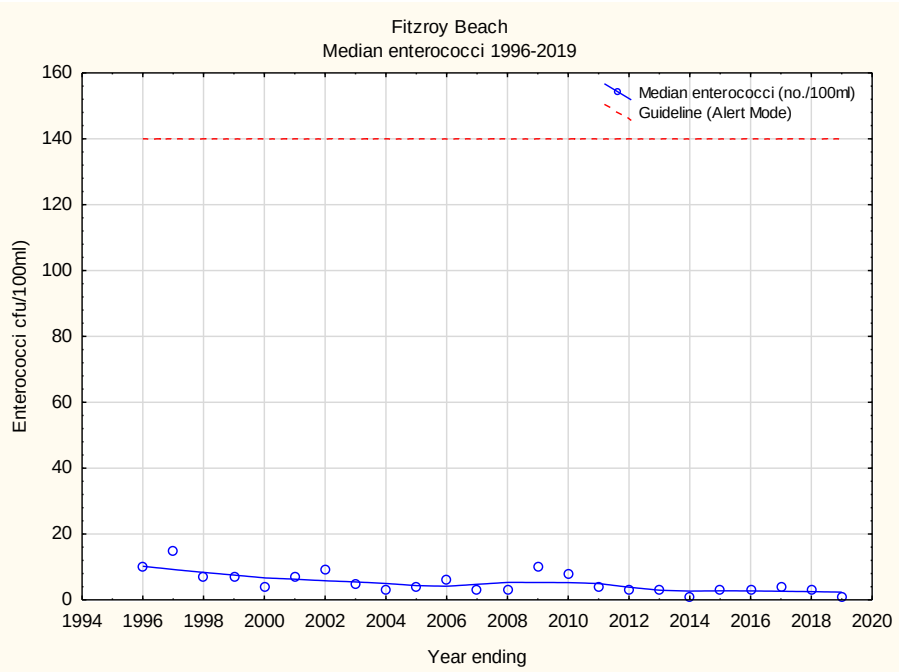


Figure 13 LOWESS trend analysis of median enterococci data at Fitzroy Beach

Over the 24 seasons monitored, there was a decrease in median enterococci counts (Kendall tau = -0.5591). This negative trend was significant using the Mann-Kendall test ($p = 0.0001$) and after FDR application ($p = 0.0013$).

4.5 East End Beach

East End Beach is situated approximately 500m south-west of Fitzroy Beach in New Plymouth (Photo 5). This beach is popular with summer bathers and has its own Surf Life-saving Club. The Te Henui Stream enters the sea approximately 200 m to the south-west of the sample site, which can result in high freshwater inputs during significant rainfall events.

Photo 5 East End Beach

All data for this site, from the 2018-2019 summer period, is presented in Figure 14. All sample results and field observations are presented in Appendices I and II, respectively. A total of 13 SEM samples were collected over the season.

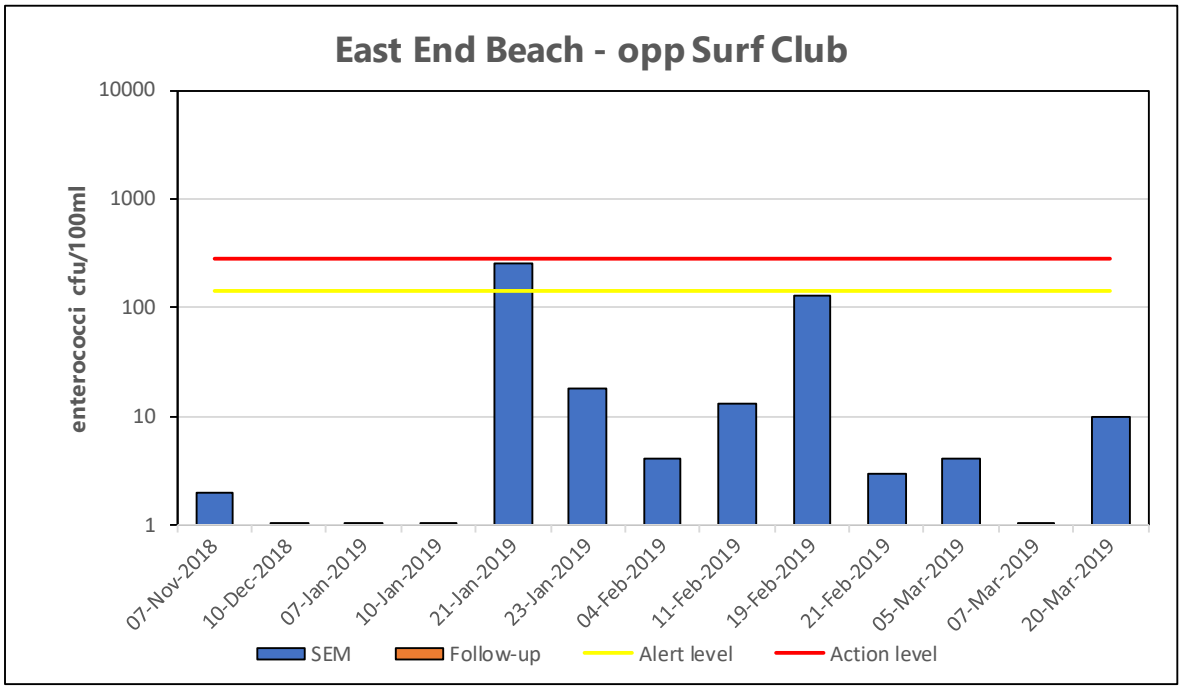


Figure 14 Enterococci results for East End Beach

The monitoring results are summarized in Table 13.

Table 13 Statistical summary for East End Beach

Parameter	Units	Number of samples	Minimum	Maximum	Median
Specific conductivity	µS/cm@25°C	13	51,700	54,900	54,100
Enterococci	cfu/100 ml	13	<1	250	4
Temperature	°C	13	15.0	22.8	18.7

4.5.1 Comparison with guidelines

Enterococci counts from East End Beach over the 2018-2019 summer are summarized against the guidelines in Table 14. 'Alert' mode was reached once following an SEM survey on 21 January 2019 (250 cfu/100 ml). There had been no significant rainfall preceding the survey and the associated conductivity result was not indicative of a freshwater influence (Appendix I, II). The remaining 12 samples were within the 'Surveillance' limits.

Table 14 Performance against guidelines at East End Beach

Monitoring regime	Number of exceedances of enterococci guidelines	
	ALERT Single sample >140/100 ml	ACTION Two consecutive single samples >280/100 ml
SEM samples	1 [8%]	0 [0]

4.5.2 Comparison with previous summer surveys

Summary statistics for SEM enterococci data collected at East End Beach over 16 summers are presented in Figure 15. The distribution of results from the 2018-2019 summer period was relatively low compared with previous summers. The median count (4 cfu/100 ml; Table 9) represents the 7th percentile of all medians from the 16 surveys carried out at this site.

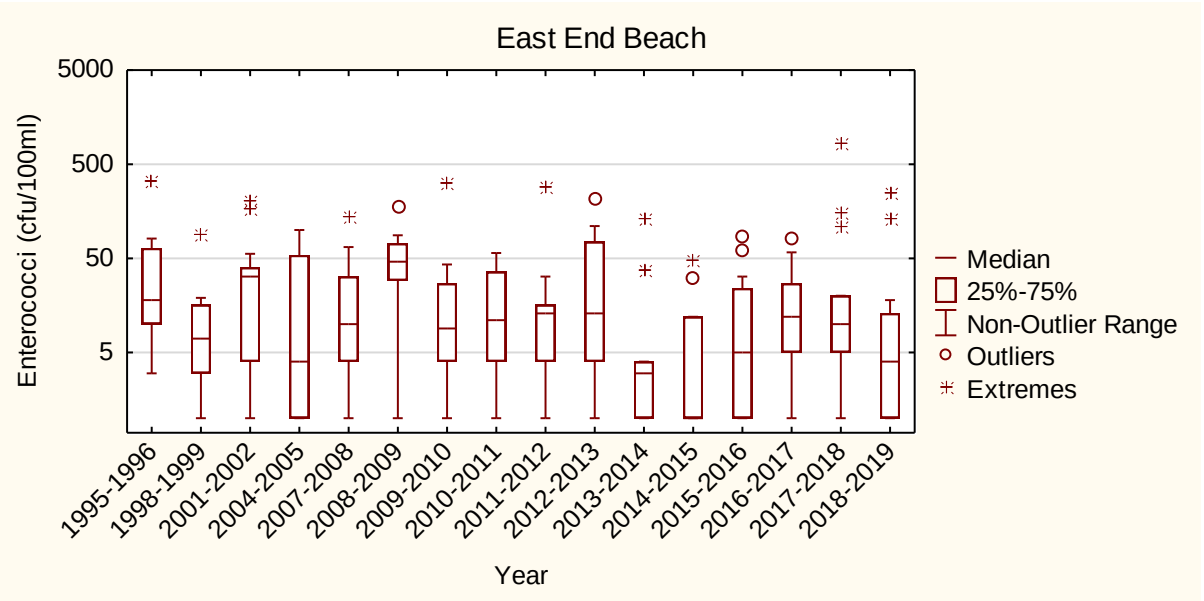


Figure 15 Box and whisker plots of enterococci for all summer SEM surveys at East End Beach

4.5.3 Long-term trend analysis

Trend analysis was performed by applying a LOWESS fit (tension 0.4) to a time scatterplot of the median enterococci data for 16 summer seasons (Figure 16) and testing the significance of any trend using the Mann-Kendall test at the 5% level, followed by Benjamini-Hochberg False Discovery Rate (FDR) analysis.

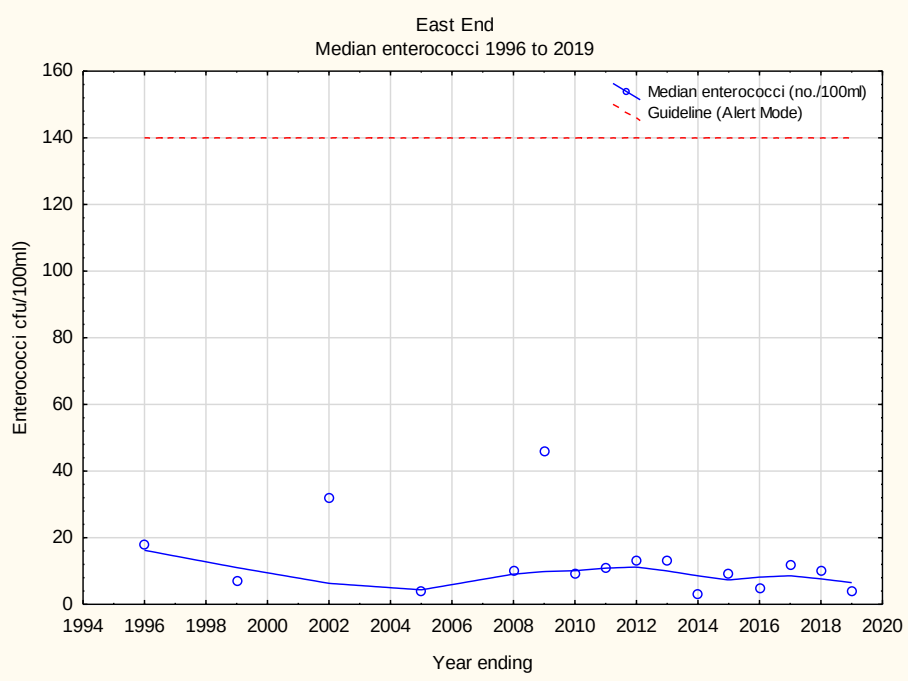


Figure 16 LOWESS trend analysis of median enterococci data at East End Beach

Over the 16 seasons monitored, there was a decreasing trend in median enterococci counts (Kendall tau = -0.220) that was not significant at the 5% level (p = 0.234).

4.6 Ngamotu Beach

Ngamotu Beach (Photo 6) is situated within Port Taranaki, in close proximity to boat traffic and Port activities. It receives urban stormwater and a piped stream. Due to its sheltered location, situated between two breakwaters, this beach is very popular with young children and school groups and is often used for sports events.

Photo 6 Ngamotu Beach

All enterococci data for this site, from the 2018-2019 summer period, is presented in Figure 17. All sample results and field observations are presented in Appendices I and II, respectively. In addition to the routine SEM and MfE samples, nine follow up samples were collected at this site due to a localised pollution incident that was discovered towards the end of the bathing season.

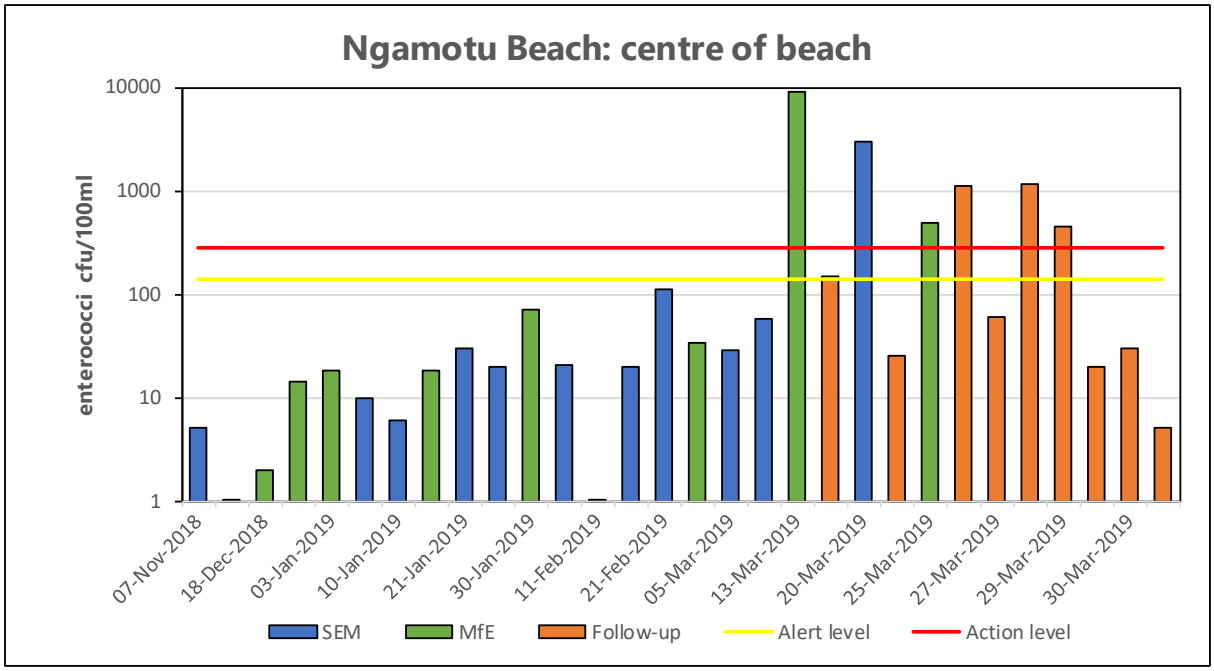


Figure 17 Enterococci results (presented on a logarithmic scale) for Ngamotu Beach

The monitoring results are summarised in Table 15.

Table 15 Statistical summary for Ngamotu Beach

Parameter		Units	Number of samples	Minimum	Maximum	Median
SEM samples	Specific conductivity	µS/cm@25°C	13	53,600	55,200	54,300
	Enterococci	cfu/100 ml	13	<1	3,000	20
	Temperature	°C	13	15.1	22.8	18.8
SEM & MfE samples	Specific conductivity	µS/cm@25°C	21	50,500	55,200	54,300
	Enterococci	cfu/100 ml	21	<1	9,100	20
	Temperature	°C	21	15.1	22.8	19.1

4.6.1 Comparison with guidelines

Enterococci counts from Ngamotu Beach over the 2018-2019 summer are summarized against the guidelines in Table 16. A string of guideline exceedances occurred toward the end of the monitoring period, including results from three routine surveys carried out on 13, 20 and 25 March 2019 (9,100, 3,000 and 480 cfu/100 ml, respectively). Action mode was reached following the elevated result from 20 March, as this was the second consecutive routine sample to exceed the 280 cfu/100 ml threshold (not including the interim follow up result which only exceeded the 140 cfu/100 ml threshold). Over the week following the initiation of 'Action' mode, daily samples were collected and potential sources of contamination were investigated. Ultimately, a stormwater drain discharging onto the eastern corner of Ngamotu Beach was identified as the source of contamination. Dried distillers grain from a storage facility on the adjacent reclamation had been rotting within the local stormwater network; producing high numbers of faecal indicator bacteria which were then discharging into the sea. Further information, including remedial and enforcement action, will be provided in the 2018-2019 Port Taranaki Industries Compliance Monitoring Report (TRC, in press).

Table 16 Performance against guidelines at Ngamotu Beach

Parameter	Number of exceedances of enterococci guidelines	
	ALERT Single sample >140/100 ml	ACTION Two consecutive single samples >280/100 ml
SEM samples	0 [0]	1 [8%]
SEM & MfE samples	1 [5%]	2 [10%]

4.6.2 Comparison with previous summer surveys

Summary statistics for SEM enterococci data collected at Ngamotu Beach over 24 summers is presented in Figure 18. The distribution of counts recorded over the 2018-2019 summer was relatively high compared with previous years. The 2018-2019 median count (20 cfu/100 ml) is higher than the overall median from the 24 surveys carried out at this site. The maximum count from this summer was also the highest ever recorded at this site during an SEM survey (3,000 cfu/100 ml; Table 15).

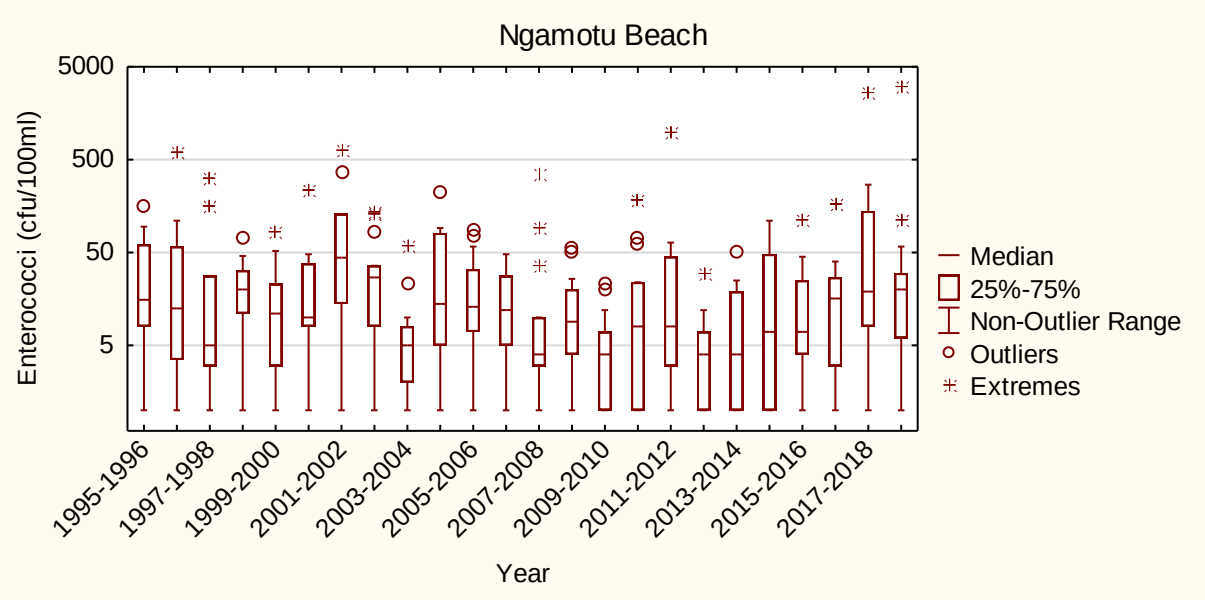


Figure 18 Box and whisker plots of enterococci for all summer SEM surveys at Ngamotu Beach

4.6.3 Long-term trend analysis

Trend analysis was performed by applying a LOWESS fit (tension 0.4) to a time scatterplot of the median enterococci data for 24 summer seasons (Figure 19) and testing the significance of any trend using the Mann-Kendall test at the 5% level, followed by Benjamini-Hochberg False Discovery Rate (FDR) analysis.

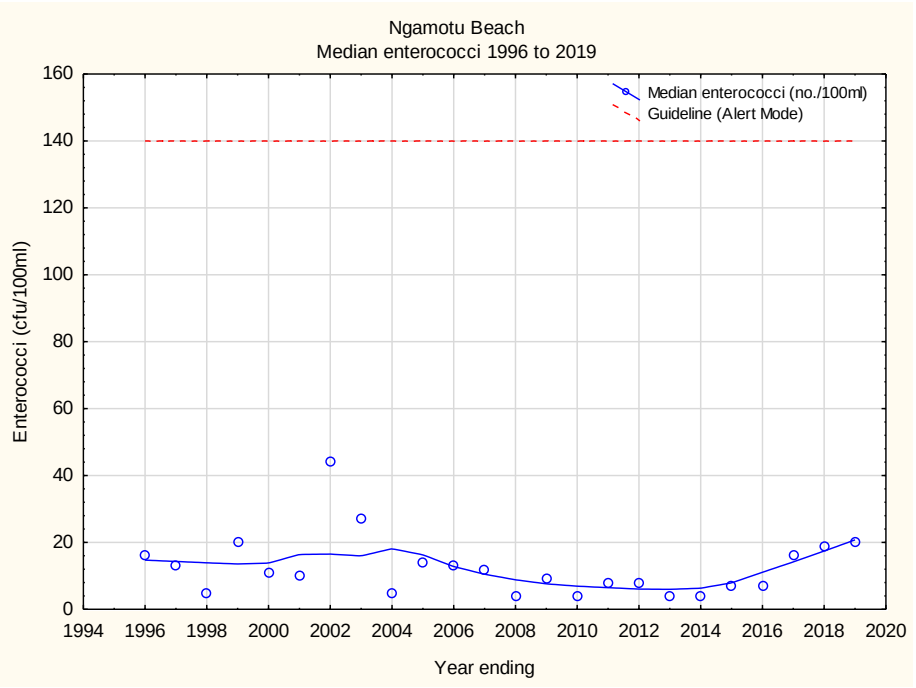


Figure 19 LOWESS trend analysis of median enterococci data at Ngamotu Beach

Over the 24 seasons monitored, there was a decreasing trend in median enterococci counts (Kendall tau = -0.170) that was not significant at the 5% level (p = 0.243).

4.7 Back Beach

Back Beach (Photo 7) is situated to the west of New Plymouth. It is a very well used beach for swimming over the summer months and popular with surfers year-round. The Herekawe Stream enters the beach approximately 50 m from the sampling site.

Photo 7 Back Beach

All enterococci data for this site, from the 2018-2019 summer period, is presented in Figure 20. All sample results and field observations are presented in Appendices I and II, respectively. A total of 13 SEM samples and two follow up samples were collected over the season.

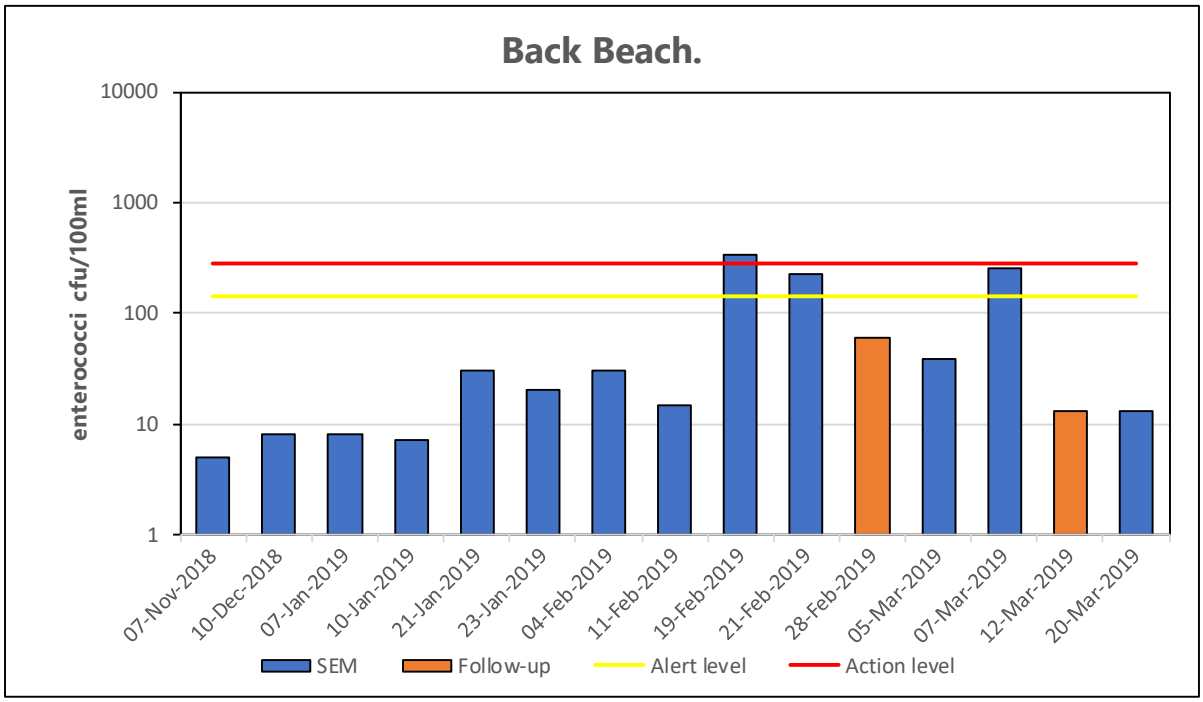


Figure 20 Enterococci results (presented on a logarithmic scale) for Back Beach

The monitoring results are summarized in Table 17.

Table 17 Statistical summary for Back Beach

Parameter	Units	Number of samples	Minimum	Maximum	Median
Specific conductivity	µS/cm@25°C	13	53,500	55,100	54,200
Enterococci	cfu/100 ml	13	5	340	20
Temperature	°C	13	14.8	22.8	18.3

4.7.1 Comparison with guidelines

Enterococci counts from Back Beach over the 2018-2019 summer are summarized against the guidelines in Table 18. 'Alert' mode was reached on three occasions following MfE surveys carried out on 19 February, 21 February and 7 March 2019 (340, 230 and 260 cfu/100 ml, respectively). There had been no significant rainfall preceding any of the three surveys and the associated conductivity results were not indicative of freshwater influences (Appendix I, II). Gulls and dogs were often observed near the sampling site. The remaining ten samples were within the 'Surveillance' limits.

Table 18 Performance against guidelines at Back Beach

Parameter	Number of exceedances of enterococci guidelines	
	ALERT Single sample >140/100 ml	ACTION Two consecutive single samples >280/100 ml
SEM samples	3 [23%]	0 [0]

4.7.2 Comparison with previous summer surveys

Summary statistics for SEM enterococci data collected at Back Beach over nine summers are presented in Figure 21. The results from the 2018-2019 summer period were comparable with previous summers; the median count (20 cfu/100 ml) represents the 50th percentile of all medians from the nine surveys carried out at this site.

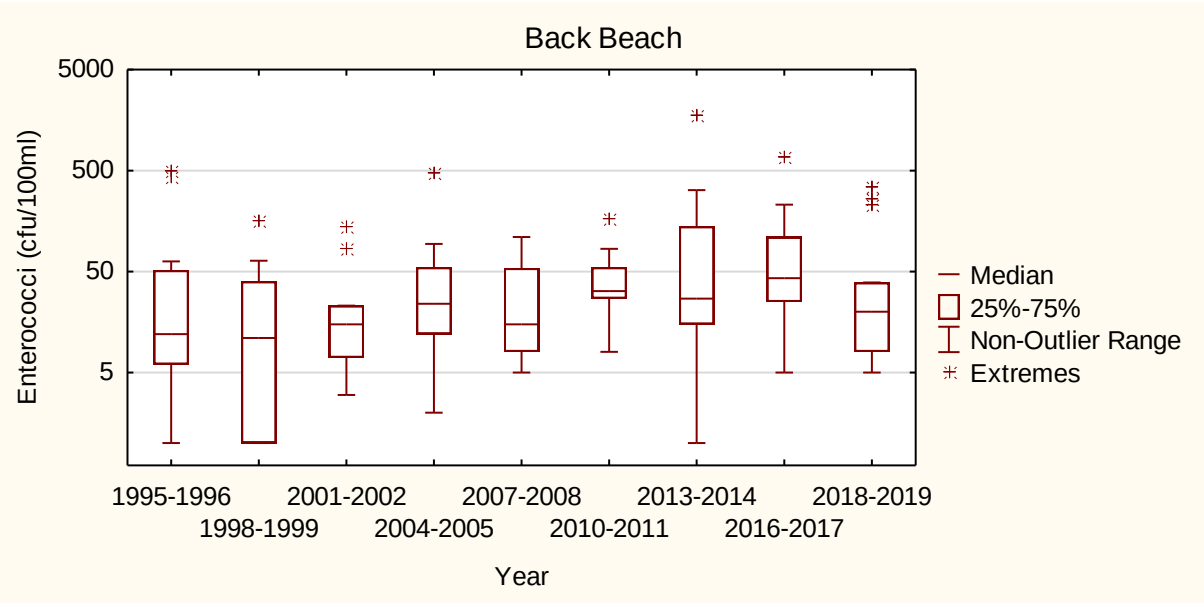


Figure 21 Box and whisker plots of enterococci for all summer SEM surveys at Back Beach

4.7.3 Long-term trend analysis

Long term trend analysis was not performed with data from this site as there were an insufficient number of samples (only triennial data available).

4.8 Oakura Beach (Surf Club)

Oakura Beach (Photo 8) is popular with beach bathers during summer, and frequented by surfers all year-round. Two small lowland streams (Waimoku and Wairau) enter the beach on either side of the site, and as a consequence concentrations of faecal indicator bacteria can increase significantly during periods of high rainfall.

Photo 8 Oakura Beach at Surf Club

All enterococci data for this site, from the 2018-2019 summer period, is presented in Figure 22. All sample results and field observations are presented in Appendices I and II, respectively. This beach was sampled on 22 occasions throughout the summer. However, due to a laboratory error, a result was not received for one of the 13 SEM samples. Eight MfE samples and one follow up sample were also collected.

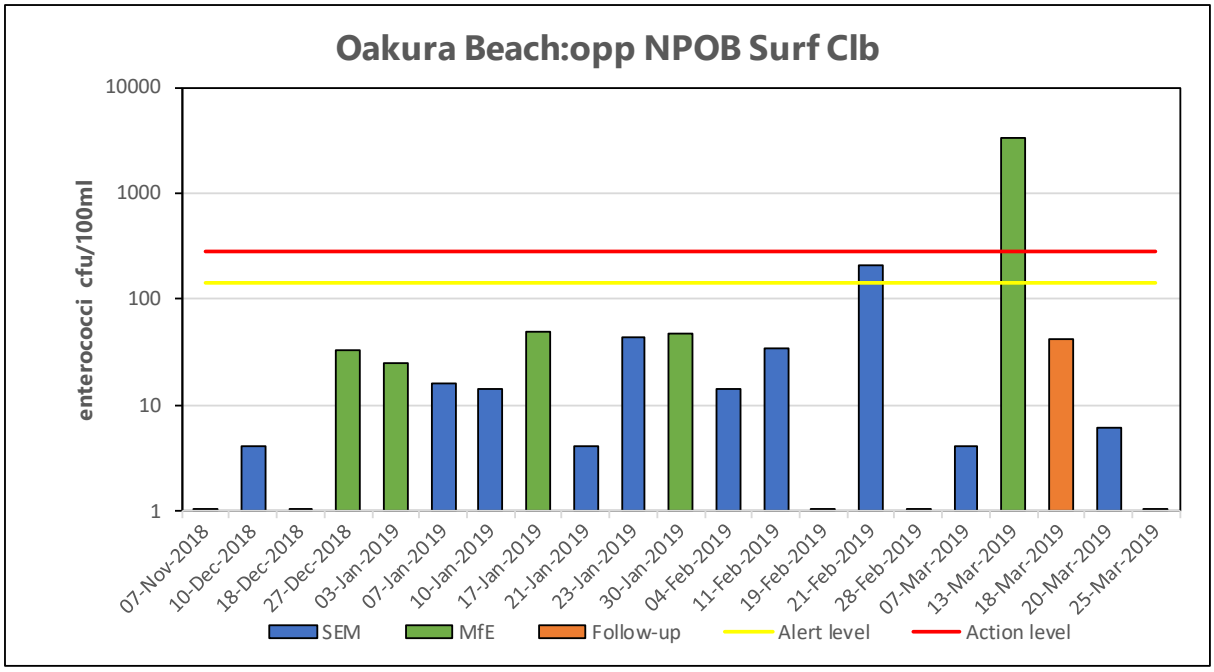


Figure 22 Enterococci results (presented on a logarithmic scale) for the Surf Club at Oakura Beach

The monitoring results are summarised in Table 19.

Table 19 Statistical summary for Oakura Beach (Surf Club)

Parameter		Units	Number of samples	Minimum	Maximum	Median
SEM samples	Specific conductivity	µS/cm@25°C	13	53,000	54,900	54,100
	Enterococci	cfu/100 ml	12	<1	210	10
	Temperature	°C	13	14.6	22.6	18.1
SEM & MfE samples	Specific conductivity	µS/cm@25°C	21	53,000	55,000	54,400
	Enterococci	cfu/100 ml	20	<1	3,300	14
	Temperature	°C	21	14.6	22.6	18.3

4.8.1 Comparison with guidelines

Enterococci counts from the Surf Club at Oakura Beach over the 2018-2019 summer are summarized against the guidelines in Table 20. 'Alert' mode was reached twice following an SEM survey and an MfE survey on 21 February and 13 March 2019 (210 and 3300 cfu/100 ml, respectively). The associated conductivity results did not indicate an obvious freshwater influence, however the second high result was preceded by significant rainfall (Appendix I, II). The 21 remaining results were within 'Surveillance' limits.

Table 20 Performance against guidelines at Oakura Beach (Surf Club)

Parameter	Number of exceedances of enterococci guidelines	
	ALERT **Single sample >140/100 ml**	**ACTION** **Two consecutive single samples >280/100 ml**
SEM samples	1 [8%]	0 [0]
SEM & MfE samples	2 [10%]	0 [0]

4.8.2 Comparison with previous summer surveys

Summary statistics for SEM enterococci data collected from Oakura Beach at the Surf Club over 24 summers are presented in Figure 23. The distribution of results from the 2018-2019 summer period were relatively low compared with previous summers, with just one result above 50 cfu/100 ml (210 cfu/100 ml; statistically classified as an extreme outlier). The 2018-2019 median count (10 cfu/100 ml) is lower than the overall median from the 24 surveys carried out at this site.

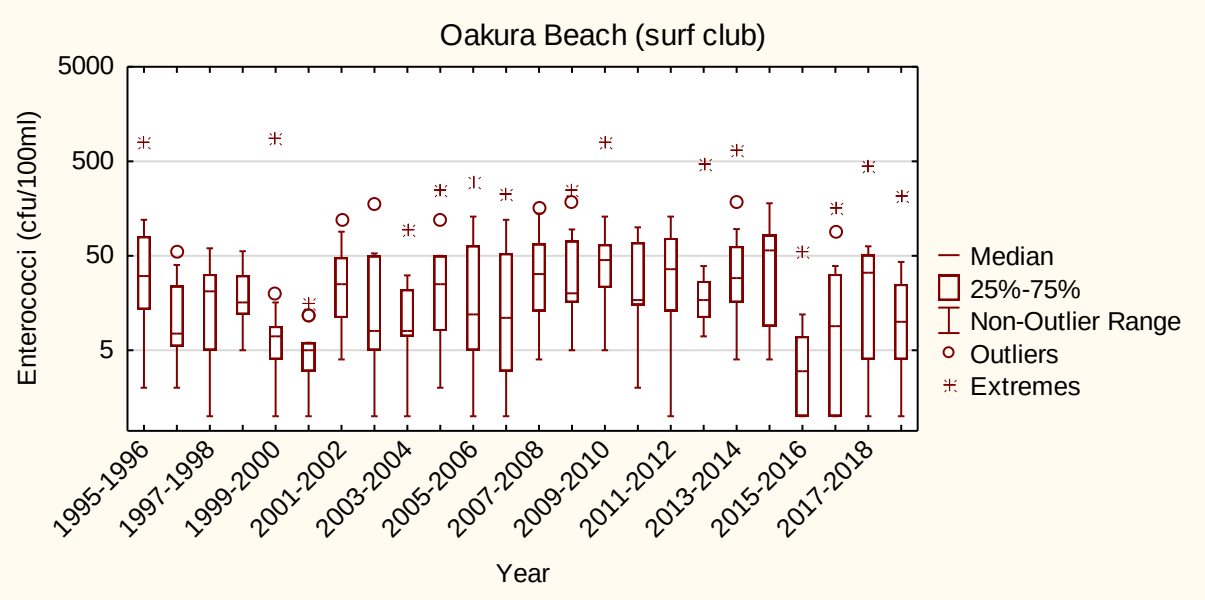


Figure 23 Box and whisker plots of enterococci for all summer SEM surveys at Oakura Beach at the Surf Club

4.8.3 Long-term trend analysis

Trend analysis was performed by applying a LOWESS fit (tension 0.4) to a time scatterplot of the median enterococci data for 23 summer seasons (Figure 24) and testing the significance of any trend using the Mann-Kendall test at the 5% level, followed by Benjamini-Hochberg False Discovery Rate (FDR) analysis.

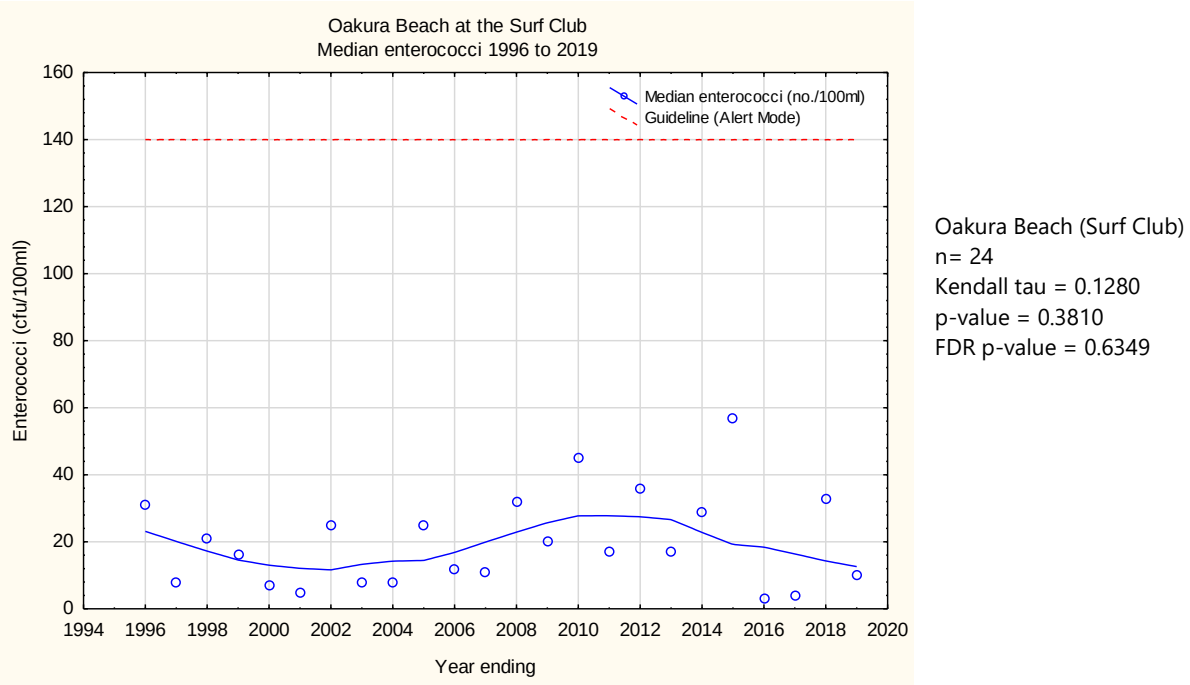


Figure 24 LOWESS trend analysis of median enterococci data at Oakura Beach (Surf Club)

Over the 24 seasons monitored, there was a positive trend (i.e. an increase) in median enterococci counts (Kendall tau = 0.128) that was not significant at the 5% level (p = 0.381).

4.9 Oakura Beach (campground)

This site, situated at the west end of Oakura Beach in front of the campground, is a popular site with bathers and surfers (Photo 9).

Photo 9 Oakura Beach, opposite the campground

All enterococci data for this site, from the 2018-2019 summer period, is presented in Figure 25. All sample results and field observations are presented in Appendices I and II, respectively. A total of 13 SEM samples were collected over the season.

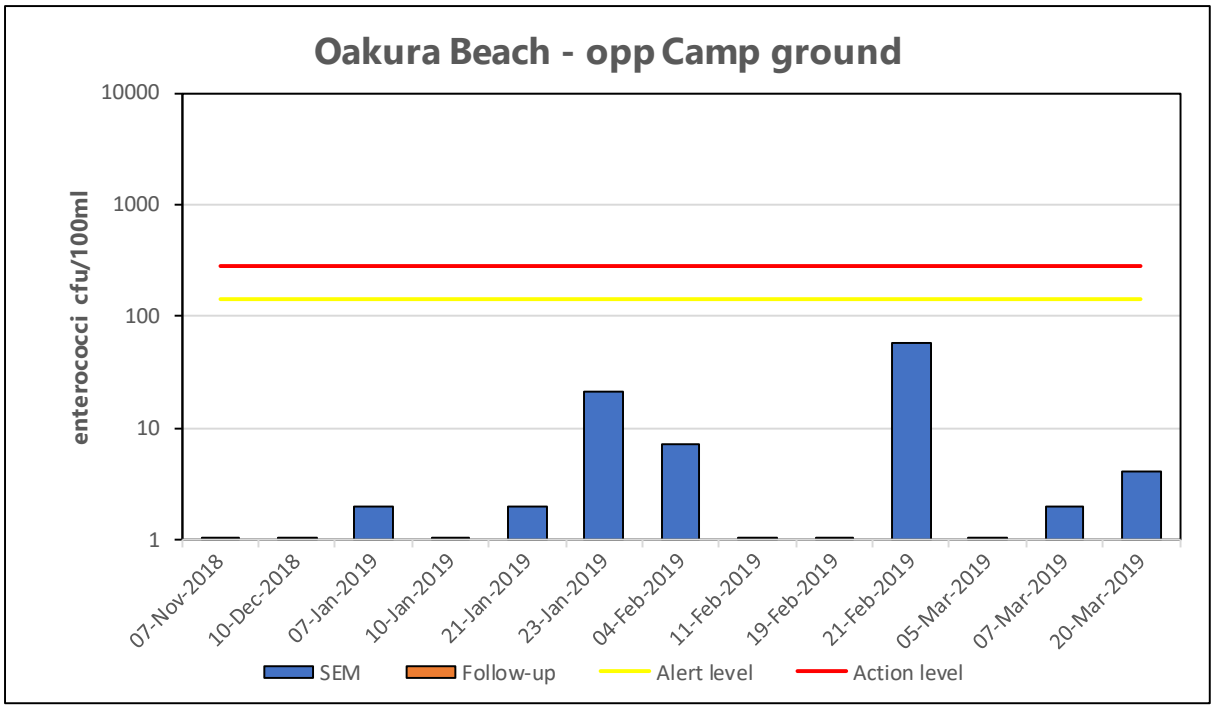


Figure 25 Enterococci results (presented on a logarithmic scale) for Oakura Beach at the campground

The monitoring results are summarized in Table 21.

Table 21 Statistical summary for Oakura Beach (campground)

Parameter	Units	Number of samples	Minimum	Maximum	Median
Specific conductivity	µS/cm@25°C	13	53,800	55,000	54,600
Enterococci	cfu/100 ml	13	<1	58	2
Temperature	°C	13	14.7	22.8	18.2

4.9.1 Comparison with guidelines

Enterococci counts from Oakura Beach at the campground over the 2018-2019 summer are summarised against the guidelines in Table 22. All 13 samples remained within the 'Surveillance' limits.

Table 22 Performance against guidelines at Oakura Beach (campground)

Parameter	Number of exceedances of enterococci guidelines	
	ALERT Single sample >140/100 ml	ACTION Two consecutive single samples >280/100 ml
SEM samples	0 [0%]	0 [0]

4.9.2 Comparison with previous summer surveys

Summary statistics for SEM enterococci data collected at Oakura Beach (at the campground) over 24 summers are presented in Figure 26. The distribution of results from the 2018-2019 summer period was relatively low compared with previous summers. The 2018-2019 median count (2 cfu/100 ml) is lower than the overall median from the 24 surveys carried out at this site.

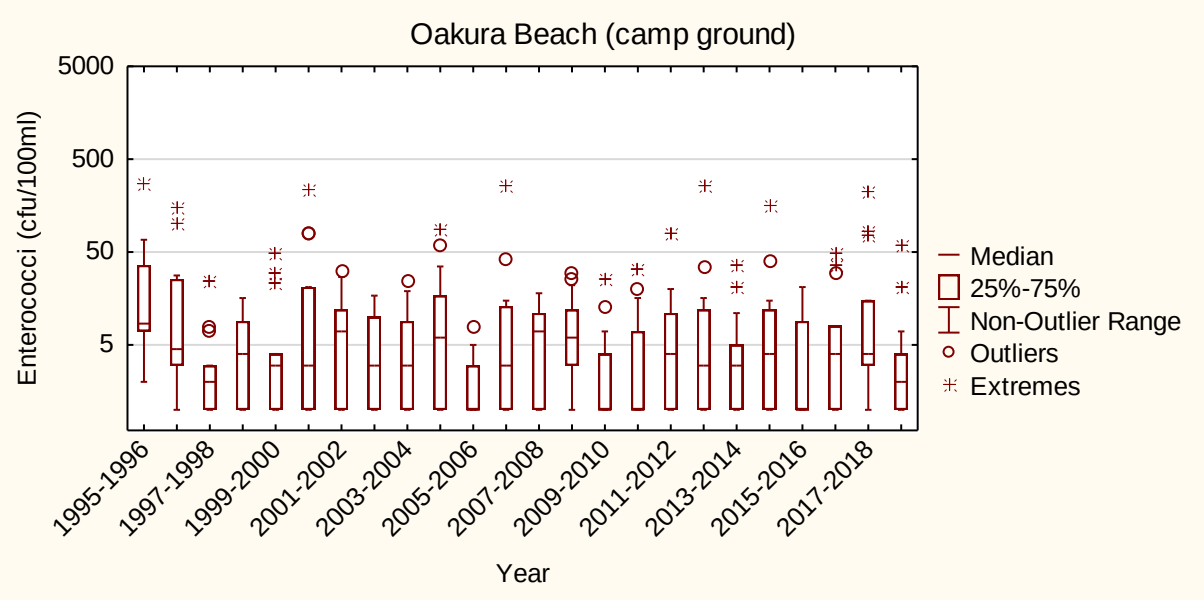
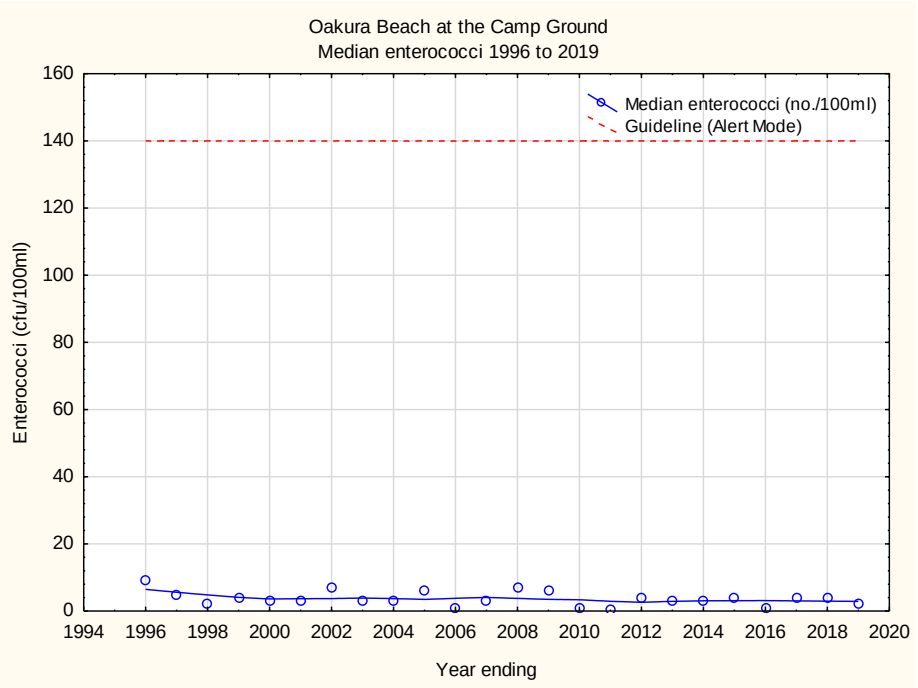


Figure 26 Box and whisker plots of enterococci for all summer SEM surveys at Oakura Beach opposite the campground

4.9.3 Long-term trend analysis

Trend analysis was performed by applying a LOWESS fit (tension 0.4) to a time scatterplot of the median enterococci data for 24 summer seasons (Figure 27) and testing the significance of any trend using the Mann-Kendall test at the 5% level, followed by Benjamini-Hochberg False Discovery Rate (FDR) analysis.



Oakura Beach
(campground)
n= 24
Kendall tau = -0.1908
p-value = 0.1915
FDR p-value = 0.4867

Figure 27 LOWESS trend analysis of median enterococci data at Oakura Beach (at the campground)

Over the 24 seasons monitored, there was a negative trend (i.e. a decrease) in median enterococci counts (Kendall tau = -0.191) that was not significant at the 5% level (p = 0.192).

4.10 Opunake Beach

Opunake Beach (Photo 10) is a very popular swimming beach in South Taranaki. There are no large rivers in the vicinity. However, the outlet of a freshwater stream from the Opunake Power Station enters at the southern end of the beach.

Photo 10 Opunake Beach

All enterococci data for this site, from the 2018-2019 summer period, is presented in Figure 28. All sample results and field observations are presented in Appendices I and II, respectively. This beach was sampled on 21 occasions throughout the summer; comprising 13 SEM samples and eight MfE samples.

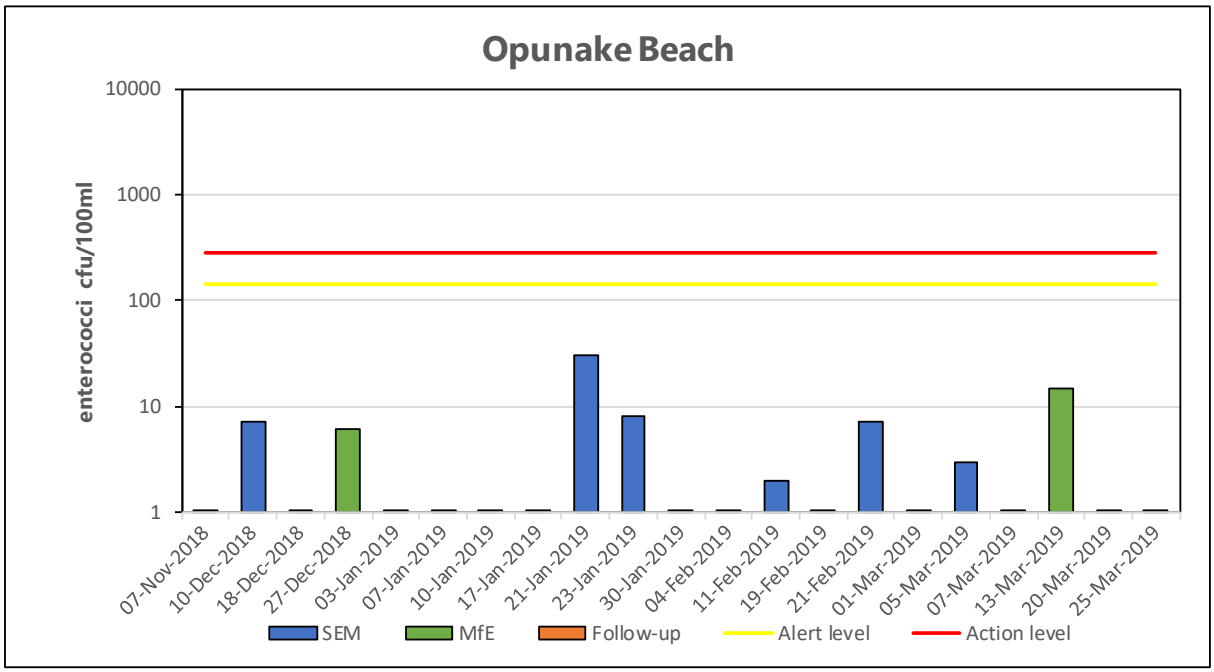


Figure 28 Enterococci results (presented on a logarithmic scale) for the Surf Club at Opunake Beach

The monitoring results are summarized in Table 23.

Table 23 Statistical summary for Opunake Beach

Parameter		Units	Number of samples	Minimum	Maximum	Median
SEM samples	Specific conductivity	µS/cm@25°C	13	53,400	54,900	54,300
	Enterococci	cfu/100 ml	13	<1	30	1
	Temperature	°C	13	17.5	23.7	20.0
SEM & MfE samples	Specific conductivity	µS/cm@25°C	21	47,000	55,200	54,500
	Enterococci	cfu/100 ml	21	<1	30	1
	Temperature	°C	21	17.0	23.7	19.9

4.10.1 Comparison with guidelines

Enterococci counts from Opunake Beach over the 2018-2019 summer are summarized against the guidelines in Table 24. All 21 samples were within the 'Surveillance' limits.

Table 24 Performance against guidelines at Opunake Beach

Parameter	Number of exceedances of enterococci guidelines	
	ALERT Single sample >140/100 ml	ACTION Two consecutive single samples >280/100 ml
SEM samples	0 [0]	0 [0]
SEM & MfE samples	0 [0]	0 [0]

4.10.2 Comparison with previous summer surveys

Summary statistics for SEM enterococci data collected at Opunake Beach over 24 summers are presented in Figure 29. The distribution of results from the 2018-2019 summer period remained low, comparable with previous summers. The 2018-2019 median count (1 cfu/100 ml) is lower than the overall median from the 24 surveys carried out at this site.

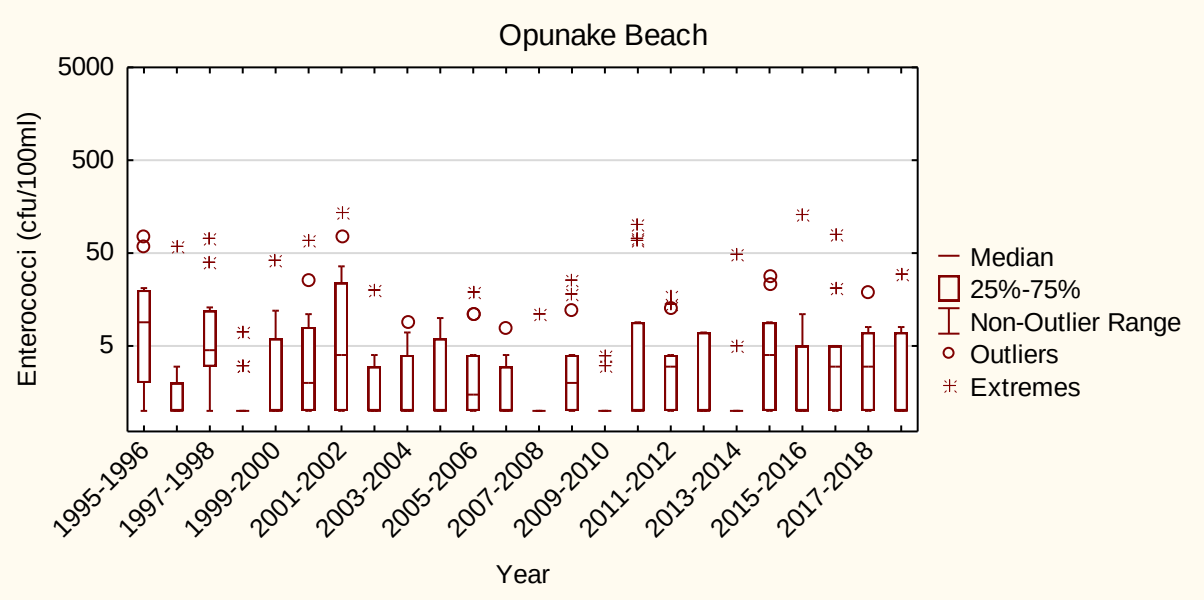


Figure 29 Box and whisker plots of enterococci for all summer SEM surveys at Opunake Beach

4.10.3 Long-term trend analysis

Trend analysis was performed by applying a LOWESS fit (tension 0.4) to a time scatterplot of the median enterococci data for 24 summer seasons (Figure 30) and testing the significance of any trend using the Mann-Kendall test at the 5% level, followed by Benjamini-Hochberg False Discovery Rate (FDR) analysis.

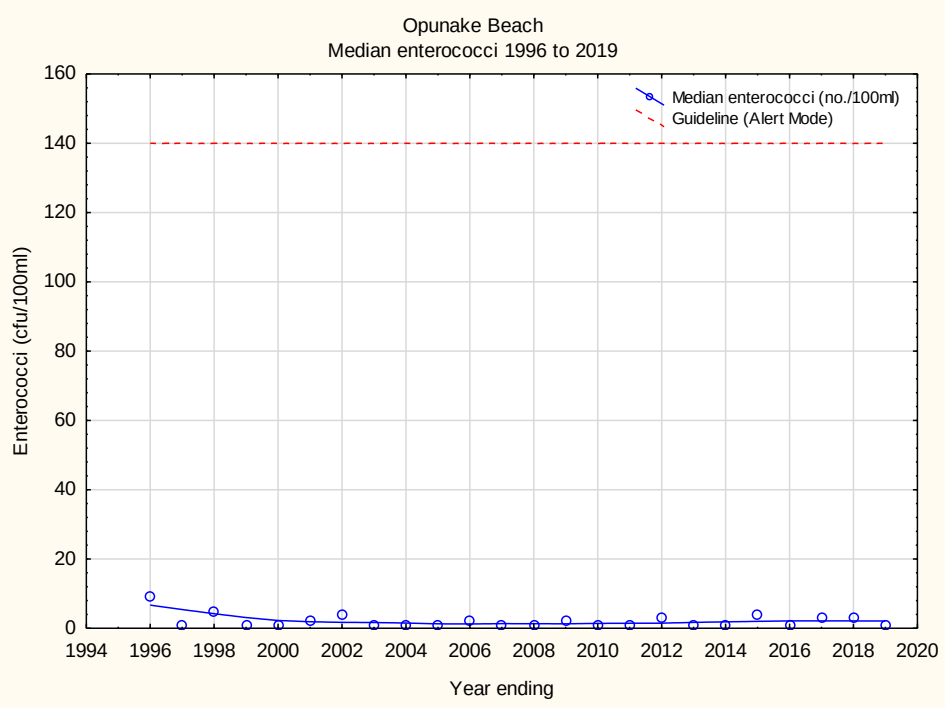


Figure 30 LOWESS trend analysis of median enterococci data at Opunake Beach

Over the 24 seasons monitored, there was a negative trend (i.e. a decrease) in median enterococci counts (Kendall tau = -0.074) that was not significant at the 5% level (p = 0.612).

4.11 Ohawe Beach

Ohawe Beach (Photo 11) is located close to the large Waingongoro River in South Taranaki. The river catchment drains highly modified agricultural land.

Photo 11 Ohawe Beach

All enterococci data for this site, from the 2018-2019 summer period, is presented in Figure 31. All sample results and field observations are presented in Appendices I and II, respectively. This beach was sampled on 21 occasions throughout the summer; comprising 13 SEM samples and eight MfE samples.

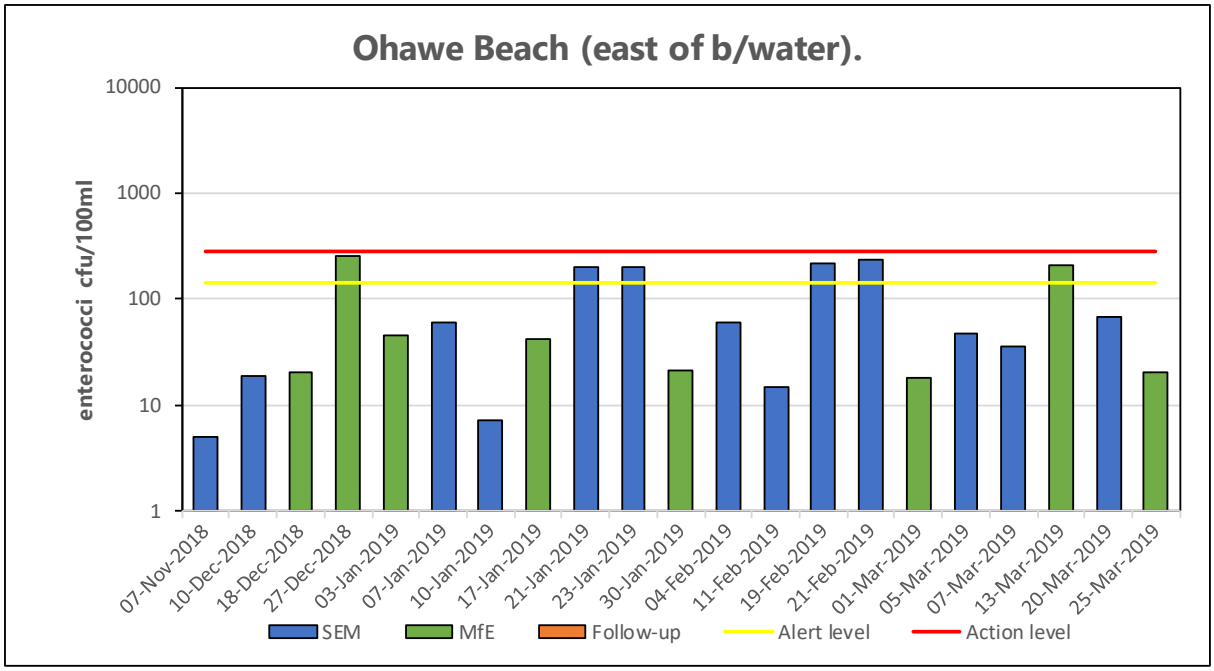


Figure 31 Enterococci results (presented on a logarithmic scale) for Ohawe Beach

The monitoring results are summarized in Table 25.

Table 25 Statistical summary for Ohawe Beach

Parameter		Units	Number of samples	Minimum	Maximum	Median
SEM samples	Specific conductivity	µS/cm@25°C	13	44,000	51,500	46,500
	Enterococci	cfu/100 ml	13	5	240	60
	Temperature	°C	13	17.0	23.5	20.5
SEM & MfE samples	Specific conductivity	µS/cm@25°C	21	18,010	51,500	46,500
	Enterococci	cfu/100 ml	21	5	260	45
	Temperature	°C	21	17.0	23.5	20.5

4.11.1 Comparison with guidelines

Enterococci counts from Ohawe Beach over the 2018-2019 summer are summarized against the guidelines in Table 32. 'Alert' mode was prompted on six occasions following surveys on 27 December 2018, 21 January, 23 January, 19 February, 21 February and 13 March 2019 (260, 200, 200, 220, 240 and 210 cfu/100 ml, respectively). These elevated counts were often associated with lower conductivities; indicative of freshwater influence from the adjacent Waingongoro River mouth (Appendix I). Considerable rainfall also preceded three of these surveys. The remaining 15 routine samples remained within 'Surveillance' limits.

Table 26 Performance against guidelines at Ohawe Beach

Parameter	Number of exceedances of enterococci guidelines	
	ALERT Single sample >140/100 ml	ACTION Two consecutive single samples >280/100 ml
SEM samples	4 [31%]	0 [0]
SEM & MfE samples	6 [29%]	0 [0]

4.11.2 Comparison with previous summer surveys

Summary statistics for SEM enterococci data collected at Ohawe Beach over 23 summers are presented in Figure 32. The distribution of results from the 2018-2019 summer period were relatively high compared with previous summers, recording the highest median count to date (60 cfu/100 ml, Table 25, Figure 32).

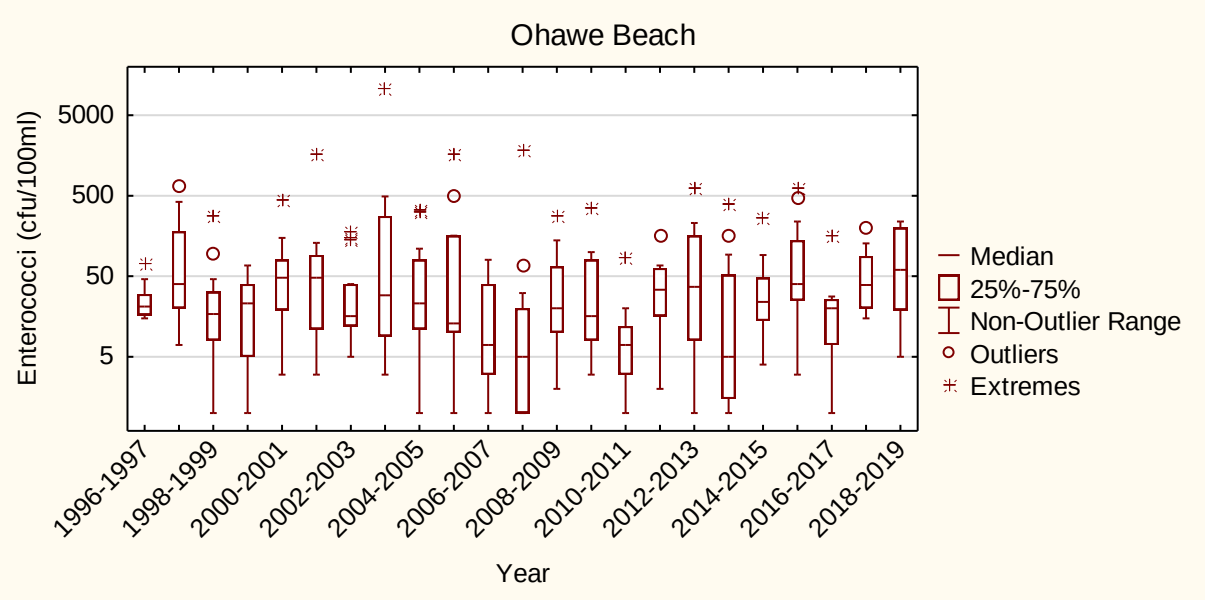


Figure 32 Box and whisker plots of enterococci for all summer SEM surveys at Ohawe Beach

4.11.3 Long-term trend analysis

Trend analysis was performed by applying a LOWESS fit (tension 0.4) to a time scatterplot of the median enterococci data for 23 summer seasons (Figure 33) and testing the significance of any trend using the Mann-Kendall test at the 5% level, followed by Benjamini-Hochberg False Discovery Rate (FDR) analysis.

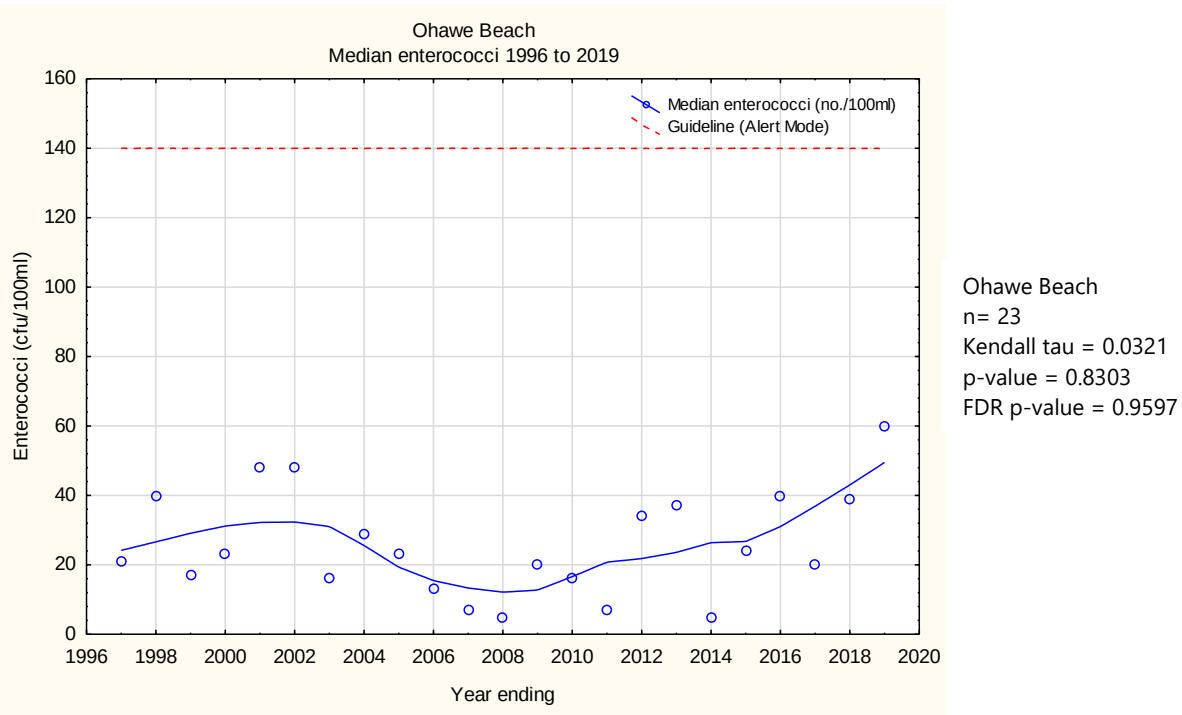


Figure 33 LOWESS trend analysis of median enterococci data at Ohawe Beach

Over the 23 seasons monitored, there was an increasing trend in median enterococci counts (Kendall tau = 0.032) that was not significant at the 5% level (p = 0.830).

4.12 Patea Beach

Patea Beach (Photo 12) is situated at the mouth of the Patea River, which has the third largest catchment area in Taranaki. The sampling site is separated from the river by the northern of two moles, which direct the freshwater flow away from the shore. Recreational use is high over the summer holiday period, however younger swimmers tend to use the more sheltered adjacent area of Mana Bay.

Photo 12 Patea Beach

All enterococci data for this site, from the 2018-2019 summer period, is presented in Figure 34. All sample results and field observations are presented in Appendices I and II, respectively. A total of 13 SEM samples were collected over the season.

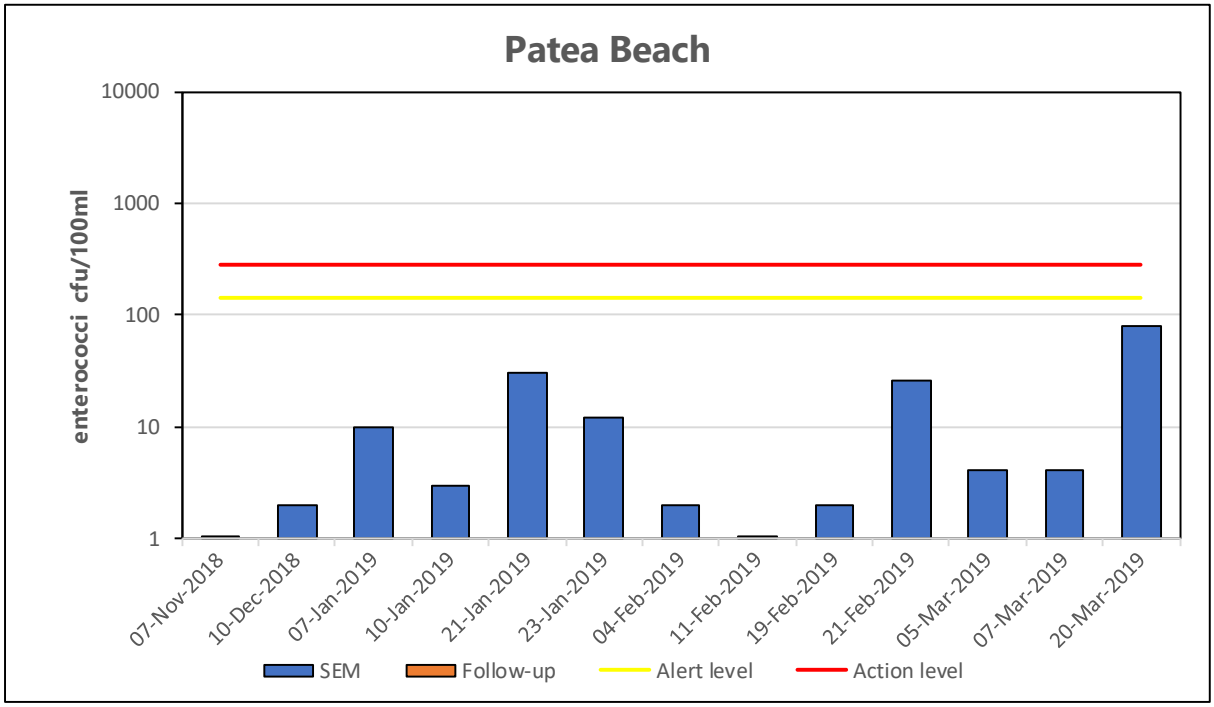


Figure 34 Enterococci results (presented on a logarithmic scale) for Patea Beach

The monitoring results are summarized in Table 27.

Table 27 Statistical summary for Patea Beach

Parameter	Units	Number of samples	Minimum	Maximum	Median
Specific conductivity	µS/cm@25°C	13	53,400	54,900	54,200
Enterococci	cfu/100 ml	13	<1	80	4
Temperature	°C	13	16.5	23.2	20.8

4.12.1 Comparison with guidelines

Enterococci counts from Patea Beach over the 2018-2019 summer are summarized against the guidelines in Table 28. All 13 samples remained within the 'Surveillance' limits.

Table 28 Performance against guidelines at Patea beach

Parameter	Number of exceedances of enterococci guidelines	
	ALERT Single sample >140/100 ml	ACTION Two consecutive single samples >280/100 ml
SEM samples	0 [0]	0 [0]

4.12.2 Comparison with previous summer surveys

Summary statistics for SEM enterococci data collected at Patea Beach over eight summers are presented in Figure 35. The distribution of results from the 2018-2019 summer period remained low, comparable with previous summers. The 2018-2019 median count (4 cfu/100 ml) is slightly lower than the overall median from the eight surveys carried out at this site.

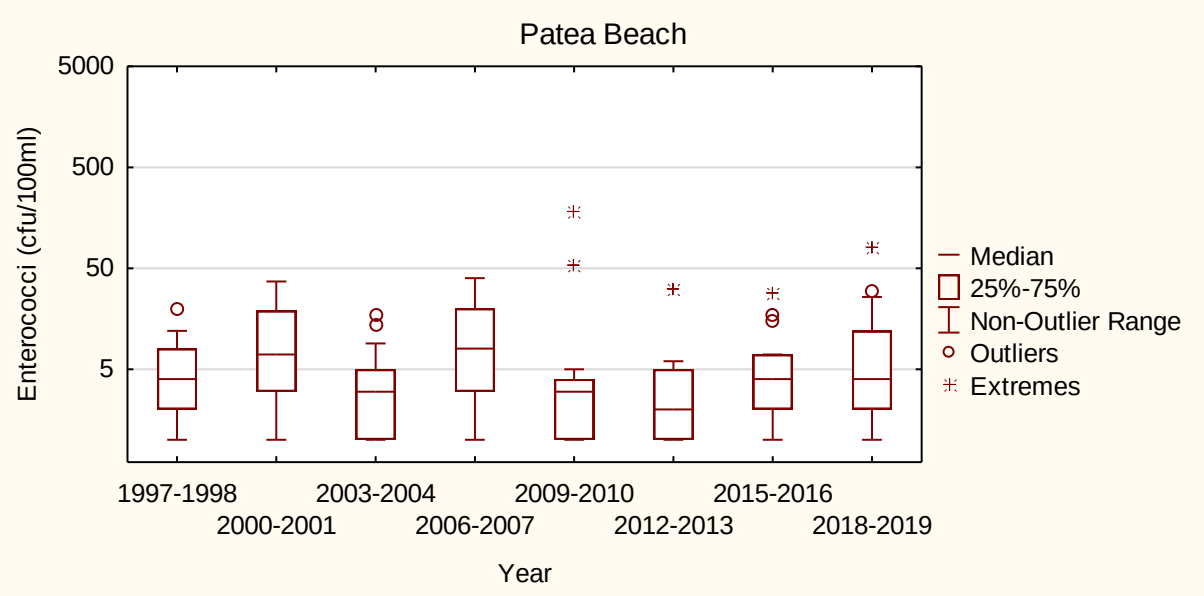


Figure 35 Box and whisker plots of enterococci for all summer SEM surveys at Patea Beach

4.12.3 Long-term trend analysis

Long term trend analysis was not performed with data from this site as there were an insufficient number of samples (only triennial data available).

4.13 Waverley Beach

Waverley Beach (Photo 13) is well used during the summer months, in part due to the location of a popular campground nearby. As the beach is relatively sheltered, it provides a safe area for recreational water sports.

Photo 13 Waverley Beach

All enterococci data for this site, from the 2018-2019 summer period, is presented in Figure 36. All sample results and field observations are presented in Appendices I and II, respectively. A total of 13 SEM samples were collected over the season.

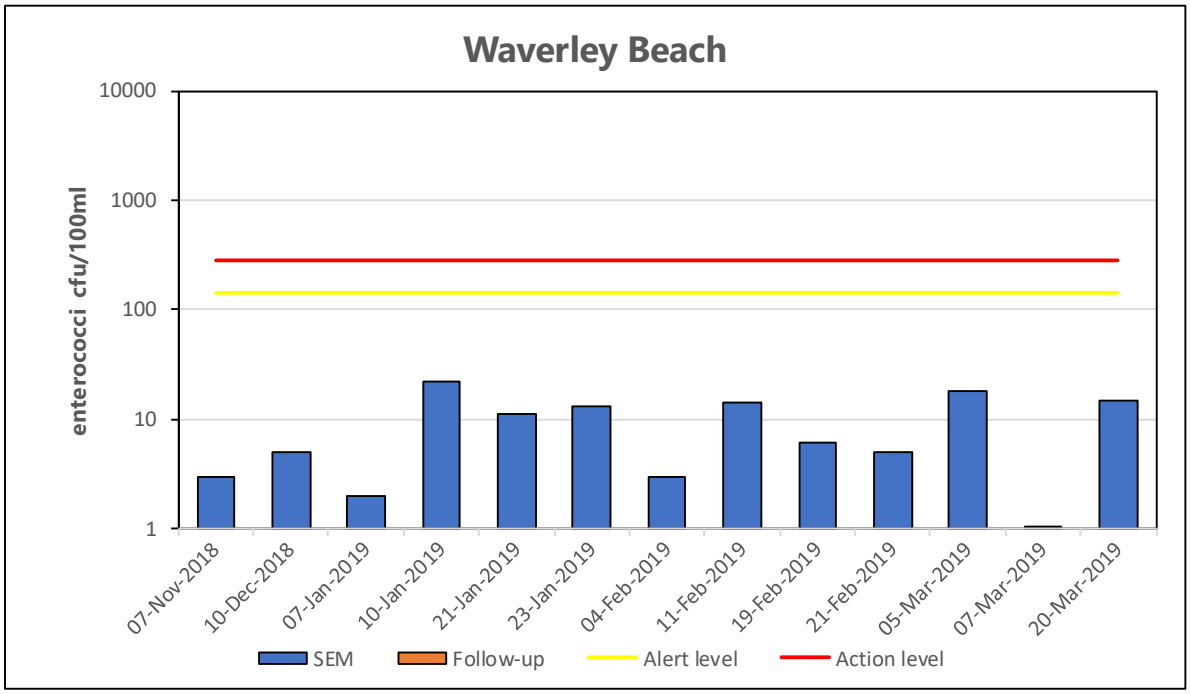


Figure 36 Enterococci results (presented on a logarithmic scale) for Waverley Beach

The monitoring results are summarized in Table 29.

Table 29 Statistical summary for Waverley Beach

Parameter	Units	Number of samples	Minimum	Maximum	Median
Specific conductivity	µS/cm@25°C	13	52,700	54,700	53,800
Enterococci	cfu/100 ml	13	<1	22	6
Temperature	°C	13	15.9	23.5	20.4

4.13.1 Comparison with guidelines

Enterococci counts from Waverley Beach over the 2018-2019 summer are summarized against the guidelines in Table 30. All 13 samples remained within the 'Surveillance' limits.

Table 30 Performance against guidelines at Waverley Beach

Parameter	Number of exceedances of enterococci guidelines	
	ALERT Single sample >140/100 ml	ACTION Two consecutive single samples >280/100 ml
SEM samples	0 [0]	0 [0]

4.13.2 Comparison with previous summer surveys

Summary statistics for SEM enterococci data collected at Waverley Beach over eight summers are presented in Figure 37. The distribution of results from the 2018-2019 summer period remained low, comparable with previous summers. The 2018-2019 median count (6 cfu/100 ml) is higher than the overall median from the eight surveys carried out at this site.

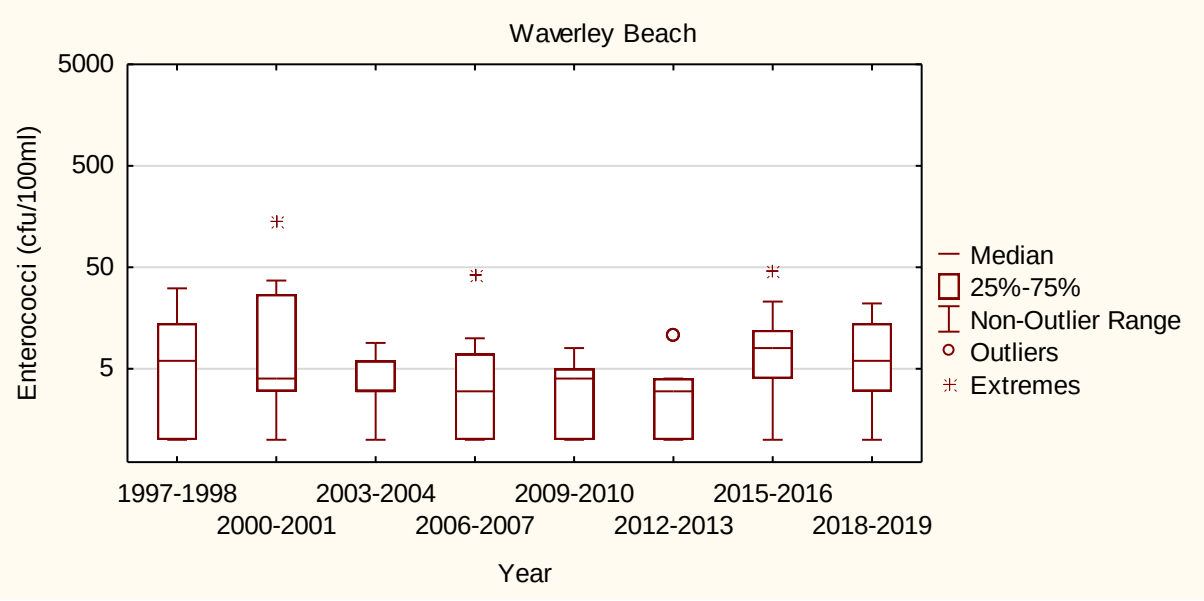


Figure 37 Box and whisker plots of enterococci for all summer SEM surveys at Waverley Beach

4.13.3 Long-term trend analysis

Long term trend analysis was not performed with data from this site as there were an insufficient number of samples (only triennial data available).

4.14 Waiinu Beach

Waiinu Beach (Photo 14) is the southern-most beach in the SEM programme. The site is adjacent to the Waiinu Beach settlement and campground. Small fishing boats are launched over the iron-sand beach.

Photo 14 Waiinu Beach

All enterococci data for this site, from the 2018-2019 summer period, is presented in Figure 38. All sample results and field observations are presented in Appendices I and II, respectively. A total of 13 SEM samples were collected over the season.

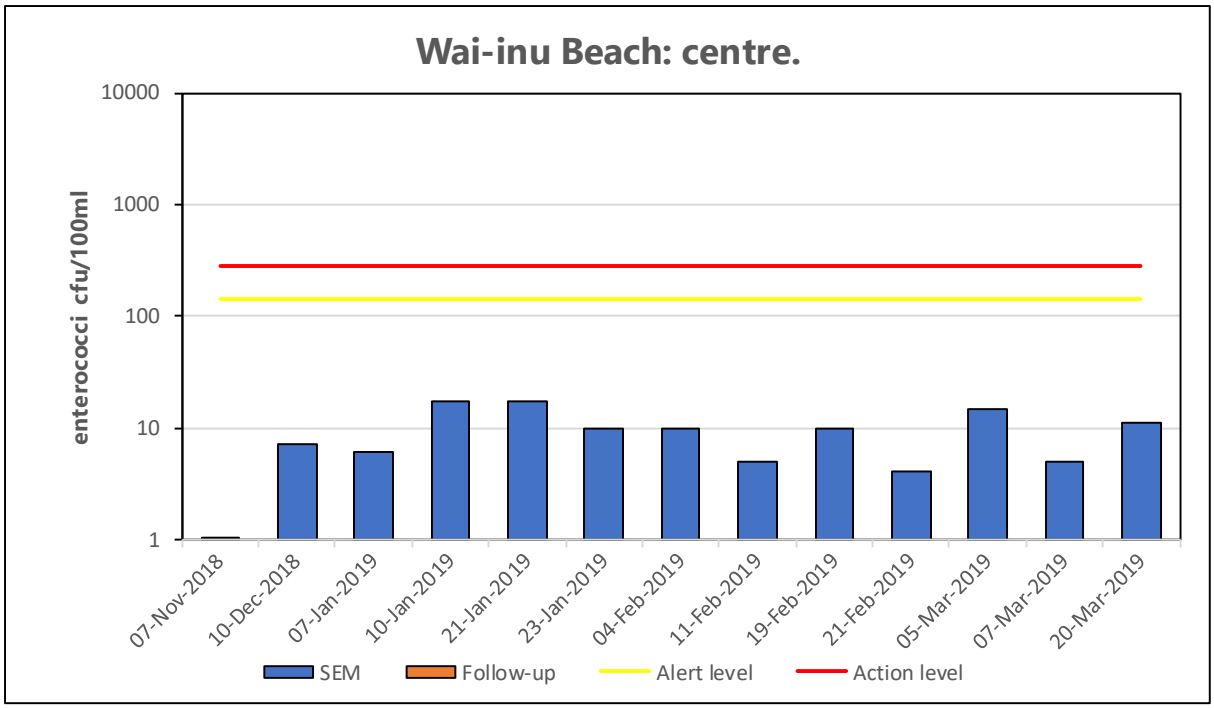


Figure 38 Enterococci results (presented on a logarithmic scale) for Waiinu Beach

The monitoring results are summarized in Table 31.

Table 31 Statistical summary for Waiinu Beach

Parameter	Units	Number of samples	Minimum	Maximum	Median
Specific conductivity	µS/cm@25°C	13	49,700	54,300	52,300
Enterococci	cfu/100 ml	13	<1	17	10
Temperature	°C	13	15.0	23.4	19.8

4.14.1 Comparison with guidelines

Enterococci counts from Waiinu Beach over the 2018-2019 summer are summarized against the guidelines in Table 32. All 13 samples remained within the 'Surveillance' limits.

Table 32 Performance against guidelines at Waiinu Beach

Parameter	Number of exceedances of enterococci guidelines	
	ALERT Single sample >140/100 ml	ACTION Two consecutive single samples >280/100 ml
SEM samples	0 [0]	0 [0]

4.14.2 Comparison with previous summer surveys

Summary statistics for SEM enterococci data collected at Waiinu Beach over eight summers are presented in Figure 39. Despite recording the highest median count to date (10 cfu/100 ml; Table 31), the overall distribution of results from the 2018-2019 summer period remained low, comparable with previous summers.

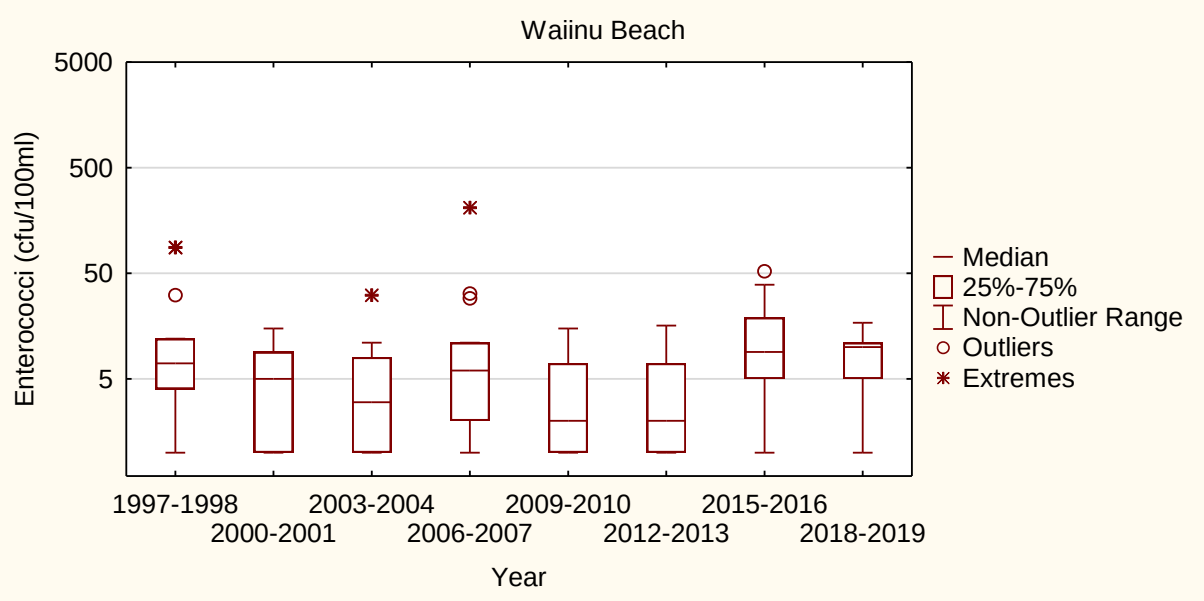


Figure 39 Box and whisker plots of enterococci for all summer SEM surveys at Waiinu Beach

4.14.3 Long-term trend analysis

Long term trend analysis was not performed with data from this site as there were an insufficient number of samples (only triennial data available).

5 Discussion

5.1 Regional overview

Given the influence of faecal contaminants of terrestrial origin on recreational water quality, it is necessary to consider rainfall when interpreting results. When examining the entire summer period (November 2018 to March 2019), rainfall levels were notably lower in most parts of the region, compared with historical results (Figure 40). During this drier than usual summer, elevated enterococci counts in coastal waters were relatively infrequent. However, there were two instances during the summer where this trend was bucked. The first of which arose from an MfE survey which was undertaken in March during marginal weather conditions and was preceded by significant rainfall. This survey showed significantly elevated enterococci counts at the majority of North Taranaki sampling sites.

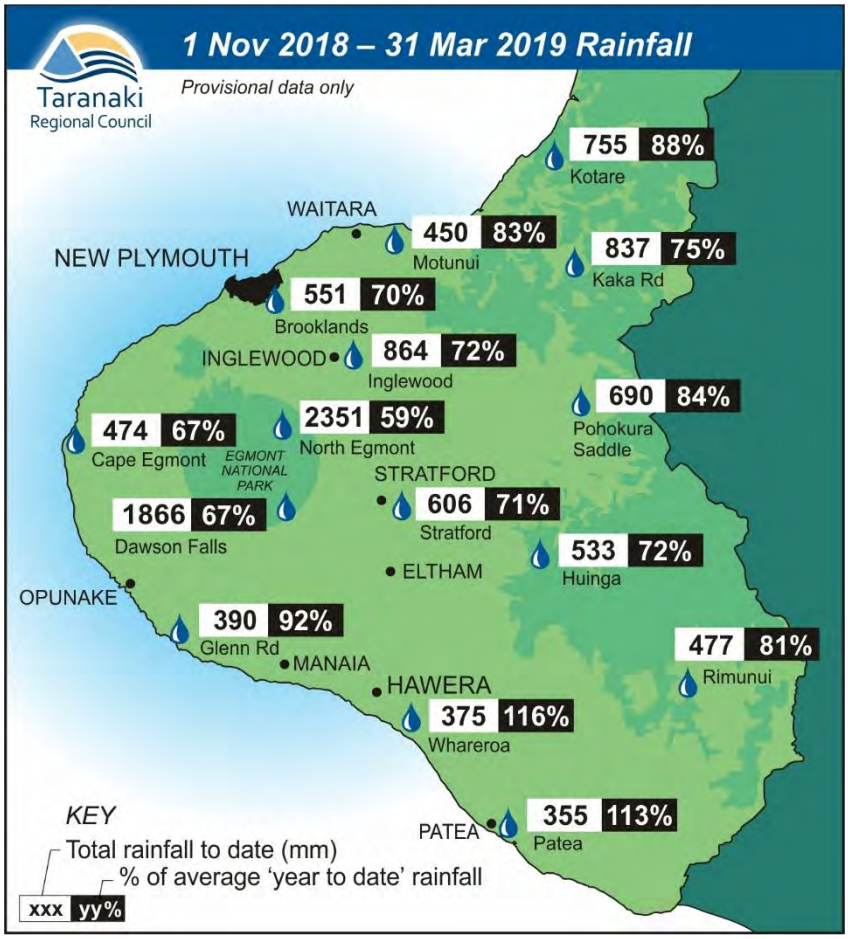


Figure 40 Average rainfall data for Taranaki, November 2018 to April 2019

The second instance occurred towards the end of the 2018-2019 summer season, when there was an extended period of poor water quality at Ngamotu Beach. Once it was recognized that there was a persisting cause of contamination somewhere within the harbor, the source was isolated within the week; at which point operational interventions were undertaken, preventing any further pollution. Sampling showed that water quality at the beach improved following this intervention. Further information, including remedial and enforcement action, will be provided in the 2018-2019 Port Taranaki Industries Compliance Monitoring Report (TRC, in press).

5.2 Guidelines and grades

A summary of results for all bathing beach sites monitored over the 2018-2019 summer period is presented in Table 33, in ascending order of median count. In this table, the performance of each site is summarised in terms of the MfE Guidelines and the Suitability for Recreation Grades (2014/15 - 2018/19), based on routine samples collected over the summer (SEM and MfE monitoring).

Table 33 Summary of bathing beach performance against relevant guidelines and grades

Beach	Median	Number of samples	Number of samples reaching Alert mode [% of samples]	Number of samples reaching Action mode [% of samples]	Suitability for Recreation Grade (SFRG)
Opunake Beach	1	21	0 [0%]	0 [0%]	Good
Fitzroy Beach	2	21	1 [5%]	0 [0%]	Good
Oakura Beach (camp ground)	2	13	0 [0%]	0 [0%]	Good
East End Beach	4	13	1 [8%]	0 [0%]	Good
Patea Beach	4	13	0 [0%]	0 [0%]	Good
Waverley Beach	6	13	0 [0%]	0 [0%]	Good
Waitara West Beach	10	21	1 [5%]	0 [0%]	Good
Waiinu Beach	10	13	0 [0%]	0 [0%]	Good
Waitara East Beach	11	20	1 [5%]	0 [0%]	Fair
Oakura Beach (surf club)	14	20	2 [10%]	0 [0%]	Fair
Ngamotu Beach	20	21	1 [5%]	2 [10%]	Fair
Back Beach	20	13	3 [23%]	0 [0%]	Fair
Onaero Beach (surf club)	29.5	20	2 [9%]	0 [0%]	Fair
Ohawe Beach	45	21	6 [29%]	0 [0%]	Fair

During the 2018-2019 summer period, a total of 243 routine samples were collected across 14 sites. Of these, 223 samples (91.8%) remained in Surveillance mode (≤140 cu/100 ml), 18 samples (7.4%) reached Alert mode (>140 cfu/100 ml) and two samples (0.8%) were associated with an Action mode event (2x >280 cfu/100 ml). The proportion of samples which remained within Surveillance mode was higher than in the previous bathing season (89.4% of routine samples were within Surveillance mode in 2017-2018). Aside from the Action mode event which occurred at Ngamotu Beach, all follow up samples indicated subsequent improvements in water quality following the initial guideline exceedances.

Although correlation cannot directly infer causation, it is worth noting that wet weather and/or low sample conductivity was associated with 11 of the guideline exceedances, while a high presence of birds (10+) in the vicinity of the sampling site was also associated with three exceedances. The relationship between a contaminated stormwater network and water quality at Ngamotu Beach was less ambiguous, however, with the issue resulting in guideline exceedances in three routine samples and enforcement actions by the Council.

Sites that were monitored during the 2018-2019 summer were also assigned a Suitability for Recreation Grade, which reflects a qualitative risk grading of the catchment in addition to quantitative enterococci

results since the 2014-2015 summer (see Section 3.2). The majority of sites (8/14) were graded 'good' and the remaining six sites were graded 'fair'. No sites were graded 'poor' or 'very poor'. These grades are similar to those following the 2017-2018 bathing season, where 8/13 sites were graded 'good', 4/13 'fair' and 1/13 were 'poor'. The grading for Ngamotu Beach has decreased from good to fair since last summer, while Back Beach has improved from poor to fair since it was last assessed following the 2016-2017 summer. Complete grading results are presented in Appendix III.

5.3 State of the Environment samples

The bathing beach results from SEM surveys over the 2018-2019 summer period are summarised in Table 34, in ascending order of median enterococci count. For each site, Table 34 also includes the median enterococci count from all surveys[2] and long term trend analysis statistics.

Table 34 Summary of SEM enterococci results, including overall medians and trend analysis statistics

Beach	Median enterococci count			Long term trend analysis		
	2018-2019 summer survey	All summer surveys	no. of surveys	Kendall tau	Mann-Kendall p- value	False Discovery Rate p-value
Fitzroy Beach	1	4	24	-0.559	0.000	0.001
Opunake Beach	1	1	24	-0.074	0.612	0.875
Oakura Beach (camp ground)	2	3	24	-0.191	0.192	0.487
East End Beach	4	10	16	-0.220	0.234	0.487
Patea Beach	4	4	8	Insufficient data (triennial)		
Waverley Beach	6	4	8	Insufficient data (triennial)		
Oakura Beach (surf club)	10	17	24	0.128	0.381	0.635
Waiinu Beach	10	5.5	8	Insufficient data (triennial)		
Waitara East Beach	18.5	14	24	-0.214	0.143	0.487
Back Beach	20	20	9	Insufficient data (triennial)		
Ngamotu Beach	20	10.5	24	-0.170	0.243	0.487
Waitara West Beach	20	12.5	24	0.007	0.960	0.960
Onaero Beach	26	10	20	0.011	0.947	0.960
Ohawe Beach	60	23	23	0.032	0.830	0.960

From all of the 2018-2019 SEM results, Fitzroy and Opunake Beach shared the lowest median enterococci count (1 cfu/100 ml; Table 34). The enduring high standard of recreational water quality at these two sites is likely attributed to their distance from riverine inputs and other point source discharges.

The median enterococci count was the highest at Ohawe Beach, (60 cfu/100 ml; Table 34), and is very likely attributable to the considerable influence of the adjacent Waingongoro River mouth. Here, conductivity results were much lower than those at any other site, indicative of a large freshwater influence even during dry weather conditions (Figure 41).

[2] *For each site, calculated as the median of all summer survey median enterococci counts*

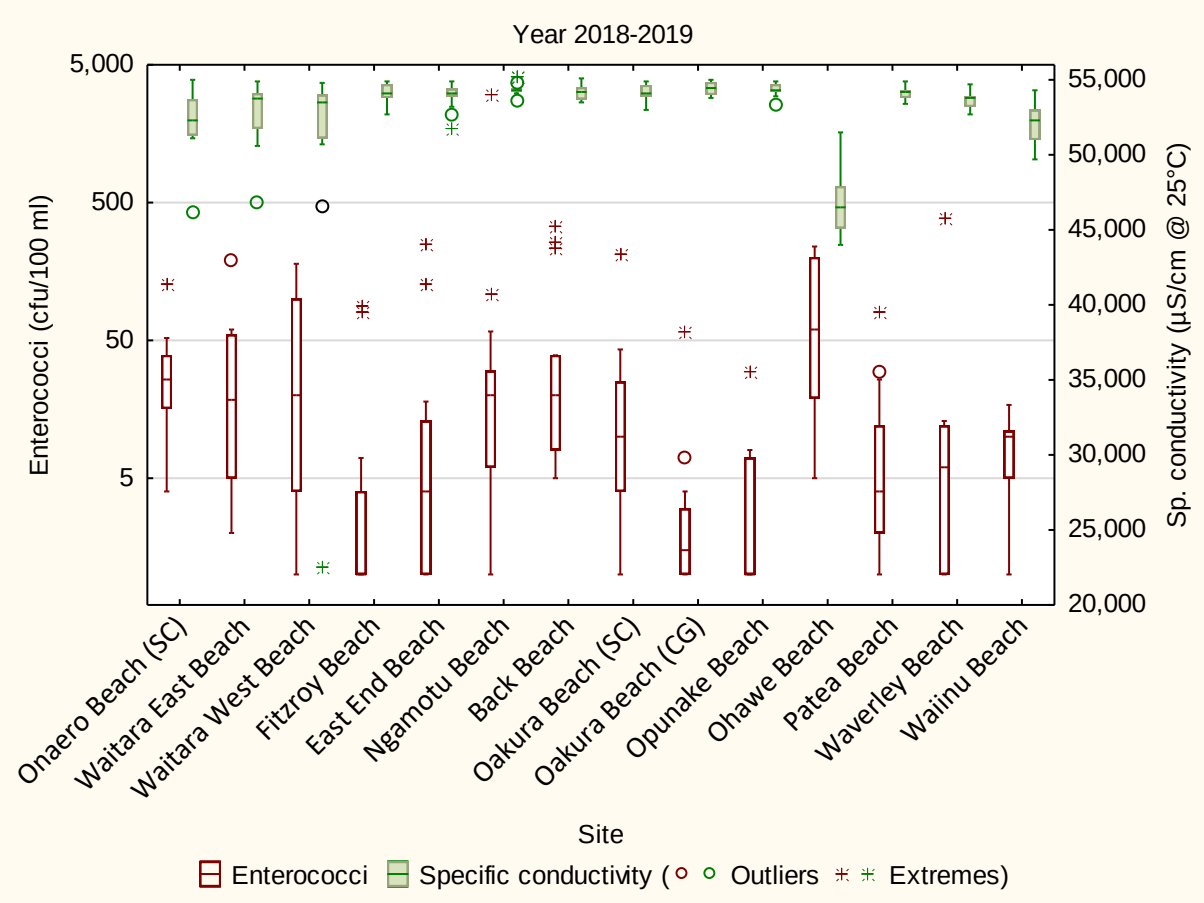


Figure 41 Box and whisker plots of enterococci and specific conductivity at all sites during the 2018-2019 season (SEM data only)

At seven sites, median enterococci counts from the 2018-2019 survey were lower than or equal to their respective overall medians. Of these sites, Oakura Beach at the surf club showed the greatest difference (7 cfu/100 ml; Table 34). Oakura Beach at the surf club is located between two small streams which have historically been attributed to high enterococci counts. However, the results from the 2018-2019 survey suggest that these inputs had less influence on water quality than in previous summers. This is of particular interest given the sand-driven meander of the Waimoku and Wairau Streams which was observed again over the 2018-2019 summer. Ultimately, the meander of these streams resulted in the Waimoku Stream entering the sea immediately adjacent to the site, and the Wairau Stream entering the sea at least 100 metres further up the coast (Photo 15).

Photo 15 Seasonal meander of Waimoku Stream towards the surf club

At the remaining seven sites, median enterococci counts from the 2018-2019 survey were higher than their respective overall medians. The difference was most pronounced at Ohawe Beach, followed by Onaero (37 and 16 cfu/100 ml, respectively; Table 34). Similar to Ohawe, Onaero Beach is located next to a considerable freshwater input; the Onaero River. When compared against results from the remaining sites, conductivity at this site was indicative of a minor freshwater influence; of similar scale to that at the Waitara sites but much less pronounced than at Ohawe Beach (Figure 41).

Of the ten sites with sufficient data to undertake trend analyses, four sites demonstrated positive trends (i.e. increases in enterococci counts), that were not significant (at the 5% level). Five sites demonstrated negative trends (i.e. decreases in enterococci counts), that were not significant (at the 5% level). One site, Fitzroy Beach, demonstrated a significant negative trend (Kendall tau = -0.559, Mann-Kendall p value <0.001; Table 34). Improvements in water quality at this site might have arisen in part or in whole due to work undertaken by NPDC as part of the Stormwater Upgrade Project at Fitzroy. As a result of this project there is now less flow of stormwater to the stormwater infiltration galleries located in the Fitzroy Beach car park.

5.4 Conclusion

During the 2018-2019 summer season, 243 routine samples were collected across 14 sites; of which 91.8% remained within Surveillance mode (≤140 cfu/100 ml). Guideline exceedances were relatively sporadic during what was a drier than usual summer, although a wet weather survey and a pollution incident at Ngamotu Beach contributed to the highest counts of the season.

Based on SEM samples, recreational water quality was generally comparable with historical results. At seven sites, median enterococci counts from the 2018-2019 survey were lower than or equal to their respective overall medians. This statistic was higher than the historical equivalent at the remaining seven sites. One site, Fitzroy Beach, continued to demonstrate a significant negative trend in median enterococci counts (improving quality) based on 24 years of monitoring data.

Many of the popular beach sites monitored in Taranaki happen to be located close to stream or river mouths which can act as a source of contamination during heavy rainfall. The majority of these rivers and streams drain catchments with intensive agricultural land use, including dairying. Microbial source tracking has revealed that in addition to ruminants, birds (wildfowl and gulls) can also act as a key source of contamination in Taranaki freshwater and downstream environments (TRC 2017). In order to minimize potential health and safety risks, the Council recommends reducing coastal recreational activities in the vicinity of stream mouths for up to three days following heavy rainfall.

Photo 16 Black-backed gulls at the mouth of the Waiwhakaiho River

6 Recommendations

As a result of the 2018-2019 bathing beach recreational water quality survey it is recommended:

1. THAT the 2019-2020 summer survey be performed at 12 sites continuing with the existing sampling protocol (sites monitored annually, plus Year 2 sites).
2. THAT the 2019-2020 summer survey also includes weekly 'MfE samples' at eight sites (Onaero, Waitara West, Waitara East, Fitzroy, Ngamotu, Oakura Surf Club, Opunake and Ohawe) between December and February in accordance with MfE, 2003 guidelines to provide up to date public information on beach conditions throughout the holiday periods.
3. THAT follow-up sampling be performed as deemed necessary by Council staff.
4. THAT public reporting of results be performed as appropriate during the season, and in an annual report upon completion of the season's programme.

Glossary of common terms and abbreviations

The following abbreviations and terms are used within this report:

Action mode	Two consecutive single samples greater than 280 enterococci cfu/100ml
Alert mode	Single sample greater than 140 enterococci cfu/100ml
Bacteriological faecal indicators	Micro-organisms selected as indicators of faecal contamination
Bathers	Those who enter the water, and either partially or fully immerse themselves
Bathing season	The bathing season generally extends between 1 November and 31 March
Beach	The shore or any access point to the sea
cfu	Colony forming units. A measure of the concentration of bacteria usually expressed as per 100 ml sample
Specific conductivity	Conductivity, an indication of the level of dissolved salts in a sample, measured at 25°C and expressed in microsiemens/centimetre (µS/cm)
Contact recreation	Recreation activities that bring people physically in contact with water, involving a risk of involuntary ingestion or inhalation of water
E.coli	*Escherichia coli*, member of the Enterobacteriaceae, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample
Enterococci	Members of the Streptococcus group of bacteria characterised as faecal in origin. Enterococci provide an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre of sample
Faecal coliform	An indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample
False Discovery Rate (FDR)	The expected proportion of true hypothesis rejected out of the total number of rejections
Follow-up sample	Second sample taken to confirm an initial high result; usually within 24-72 hours depending on accessibility/sample turnaround time, etc.
Median	Central value when values are arranged in order of magnitude
Microbiological Assessment Category (MAC)	A measurement of water quality over time as provided by historical (five years) microbiological results – A, B, C or D
RMA	Resource Management Act 1991 and subsequent amendments
Sanitary Inspection Category (SIC)	A measure of the susceptibility of a water body to faecal contamination – Very High, High, Moderate, Low or Very Low
Suitability for Recreation Grade (SFRG)	A combination of Sanitary Inspection Category (SIC) and Microbiological Assessment Category (MAC), describes the general hypothetical condition of a site in the absence of specific monitoring data, based on both risk and past indicator bacteria counts
Temp	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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Appendix I

Complete marine recreational water quality results for 2018-2019 summer season

Onaero Beach (Surf Club)

Programme	Date	Time	Temperature	Sp. conductivity	Enterococci	High tide		Preceding rainfall (mm)	
		NZST	°C	µS/cm@25°C	cfu/100ml	Time (NZST)	Height (m)	24 hrs	72 hrs
SEM	07 Nov 2018	10:00	16	51,800	4	09:16	3.6	0.0	0.5
SEM	10 Dec 2018	12:20	20	51,100	4	11:26	3.3	0.0	0.0
MFE	18 Dec 2018	10:50	22.2	53,900	10	05:44	2.8	0.0	2.0
MFE	27 Dec 2018	11:00	23	43,400	63	13:14	3.5	0.0	21.5
MFE	03 Jan 2019	13:10	21.8	41,700	480	07:53	3.1	0.0	0.4
SEM	07 Jan 2019	09:25	19.2	51,400	40	10:34	3.4	0.0	0.0
SEM	10 Jan 2019	10:50	21.1	51,200	14	12:18	3.3	1.0	1.0
MFE	17 Jan 2019	11:50	21.6	41,200	30	05:56	2.9	0.0	15.0
SEM	21 Jan 2019	09:30	16.9	55,000	20	09:42	3.7	0.0	0.5
SEM	23 Jan 2019	11:20	16.4	55,000	25	11:19	3.8	0.0	0.0
MFE	30 Jan 2019	09:10	19.7	53,200	42	05:19	2.8	0.0	0.0
SEM	04 Feb 2019	09:15	20	53,000	52	09:41	3.3	5.5	6.5
SEM	11 Feb 2019	12:45	23.8	52,400	29	13:41	3.1	0.0	0.0
SEM	19 Feb 2019	11:15	21.6	46,200	130	09:27	3.7	0.0	0.0
SEM	21 Feb 2019	11:20	20.9	53,900	27	11:02	3.9	0.0	0.0
MFE	28 Feb 2019	12:45	21.6	50,400	55	04:39	2.7	0.0	0.0
SEM	05 Mar 2019	09:00	18.7	52,600	-	09:18	3.2	0.0	0.0
SEM	07 Mar 2019	10:30	19.5	52,200	38	10:23	3.4	0.0	0.0
MFE	13 Mar 2019	09:45	19.6	41,200	1000	13:57	3.0	26.8	26.8
FOLLOW UP	18 Mar 2019	12:45	22.6	49,700	90	07:21	3.2	0.0	0.0
SEM	20 Mar 2019	08:30	19.6	53,500	18	09:08	3.7	0.0	0.0
MFE	26 Mar 2019	10:10	21.1	54,500	13	13:37	3.1	1.2	2.4

Tide data from Port Taranaki

Rainfall data from TRC rain gauge at Motonui

Waitara East Beach

Programme	Date	Time	Temperature	Sp. conductivity	Enterococci	High tide		Preceding rainfall (mm)	
		NZST	°C	µS/cm@25°C	cfu/100ml	Time (NZST)	Height (m)	24 hrs	72 hrs
SEM	07 Nov 2018	11:05	15.8	46,800	9	09:16	3.6	0.0	0.5
SEM	10 Dec 2018	11:45	19.4	52,000	4	11:26	3.3	0.0	0.0
MFE	18 Dec 2018	10:20	23.7	50,800	4	05:44	2.8	0.0	2.0
MFE	27 Dec 2018	10:30	24.8	50,500	5	13:14	3.5	0.0	21.5
MFE	03 Jan 2019	12:45	21.8	51,600	30	07:53	3.1	0.0	0.4
SEM	07 Jan 2019	10:45	19.6	50,600	6	10:34	3.4	0.0	0.0
SEM	10 Jan 2019	12:05	20.1	51,500	2	12:18	3.3	1.0	1.0
MFE	17 Jan 2019	11:20	23	52,000	13	05:56	2.9	0.0	15.0
SEM	23 Jan 2019	11:50	17.1	54,900	190	11:19	3.8	0.0	0.0
MFE	30 Jan 2019	08:30	18.1	52,700	< 1	05:19	2.8	0.0	0.0
SEM	04 Feb 2019	10:05	21.8	53,700	30	09:41	3.3	5.5	6.5
SEM	11 Feb 2019	12:15	24.4	52,500	53	13:41	3.1	0.0	0.0
SEM	19 Feb 2019	10:10	20.2	54,200	2	09:27	3.7	0.0	0.0
SEM	21 Feb 2019	13:35	20.9	54,000	60	11:02	3.9	0.0	0.0
MFE	28 Feb 2019	12:15	19.6	54,300	< 1	04:39	2.7	0.0	0.0
SEM	05 Mar 2019	08:35	18.3	54,000	17	09:18	3.2	0.0	0.0
SEM	07 Mar 2019	10:00	18.7	53,800	20	10:23	3.4	0.0	0.0
MFE	13 Mar 2019	10:15	21.3	43,200	13	13:57	3.0	26.8	26.8
SEM	20 Mar 2019	09:00	20.4	54,300	57	09:08	3.7	0.0	0.0
MFE	26 Mar 2019	10:35	21.1	50,800	6	13:37	3.1	1.2	2.4

Tide data from Port Taranaki

Rainfall data from TRC rain gauge at Motonui

Waitara West Beach

Programme	Date	Time	Temperature	Sp. conductivity	Enterococci	High tide		Preceding rainfall (mm)	
		NZST	°C	µS/cm@25°C	cfu/100ml	Time (NZST)	Height (m)	24 hrs	72 hrs
SEM	07 Nov 2018	11:45	15.9	22,500	80	09:16	3.6	0	0.5
SEM	10 Dec 2018	11:15	19.4	46,600	1	11:26	3.3	0	0
MFE	18 Dec 2018	10:00	21.8	38,300	42	05:44	2.8	0	2
MFE	27 Dec 2018	10:00	23.4	48,900	20	13:14	3.5	0	21.5
MFE	03 Jan 2019	12:30	20.8	39,900	12	07:53	3.1	0	0.4
SEM	07 Jan 2019	11:15	19	54,000	20	10:34	3.4	0	0
SEM	10 Jan 2019	12:40	20.2	51,100	7	12:18	3.3	1	1
MFE	17 Jan 2019	11:00	22.7	36,000	5	05:56	2.9	0	15
SEM	21 Jan 2019	11:30	18.2	54,300	180	09:42	3.7	0	0.5
SEM	23 Jan 2019	12:25	17.9	54,800	100	11:19	3.8	0	0
MFE	30 Jan 2019	08:15	18.5	51,600	7	05:19	2.8	0	0
SEM	04 Feb 2019	10:40	21.7	50,700	20	09:41	3.3	5.5	6.5
SEM	11 Feb 2019	11:55	25.7	53,200	< 1	13:41	3.1	0	0
SEM	19 Feb 2019	11:00	20.6	54,000	10	09:27	3.7	0	0
SEM	21 Feb 2019	09:45	20.5	53,500	100	11:02	3.9	0	0
MFE	28 Feb 2019	11:50	20.9	53,000	< 1	04:39	2.7	0	0
SEM	05 Mar 2019	08:00	18.6	53,700	4	09:18	3.2	0	0
SEM	07 Mar 2019	09:15	18.1	53,000	2	10:23	3.4	0	0
MFE	13 Mar 2019	10:35	20.2	51,100	10	13:57	3	26.8	26.8
SEM	20 Mar 2019	09:35	20.9	54,000	100	09:08	3.7	0	0
MFE	26 Mar 2019	11:00	21.7	49,700	7	13:37	3.1	1.2	2.4

Tide data from Port Taranaki

Rainfall data from TRC rain gauge at Motonui

Fitzroy Beach

Programme	Date	Time	Temperature	Sp. conductivity	Enterococci	High tide		Preceding rainfall (mm)	
		NZST	°C	µS/cm@25°C	cfu/100ml	Time (NZST)	Height (m)	24 hrs	72 hrs
SEM	07 Nov 2018	10:10	15.0	53,800	1	09:16	3.6	0	0
SEM	10 Dec 2018	09:45	16.2	54,900	2	11:26	3.3	0	0
MFE	18 Dec 2018	12:15	21.4	53,800	< 1	05:44	2.8	0	0
MFE	27 Dec 2018	09:00	18.7	54,600	4	13:14	3.5	0	14.8
MFE	03 Jan 2019	11:00	17.2	54,700	5	07:53	3.1	0	0.2
SEM	07 Jan 2019	11:05	17.6	54,300	4	10:34	3.4	0.4	0.4
SEM	10 Jan 2019	10:35	18.4	54,000	1	12:18	3.3	1.8	2.2
MFE	17 Jan 2019	09:45	21.4	54,900	< 1	05:56	2.9	0	10.8
SEM	21 Jan 2019	10:10	18.9	54,800	90	09:42	3.7	0.4	1.4
SEM	23 Jan 2019	09:30	15.6	54,800	7	11:19	3.8	0	0.4
MFE	30 Jan 2019	07:20	17.7	54,700	2	05:19	2.8	0	1.4
SEM	04 Feb 2019	11:20	20.7	54,400	1	09:41	3.3	0	0
SEM	11 Feb 2019	14:47	23.1	52,700	< 1	13:41	3.1	0	0
SEM	19 Feb 2019	11:11	20.3	53,400	80	09:27	3.7	0	0
SEM	21 Feb 2019	09:25	19.7	53,900	1	11:02	3.9	1.2	1.2
MFE	28 Feb 2019	09:50	18.5	54,300	2	04:39	2.7	0	0
SEM	05 Mar 2019	11:15	18.6	54,100	4	09:18	3.2	0	0
SEM	07 Mar 2019	11:30	18.9	53,800	1	10:23	3.4	0	0
MFE	13 Mar 2019	11:30	19.7	47,500	1400	13:57	3	33.8	34.2
FOLLOW UP	18 Mar 2019	11:35	22.1	54,400	1	07:21	3.2	0	0.2
SEM	20 Mar 2019	10:15	20.7	54,700	< 1	09:08	3.7	0	0
MFE	26 Mar 2019	09:15	21.1	51,600	140	13:37	3.1	3.2	5.2

Tide data from Port Taranaki

Rainfall data from TRC rain gauge at Brooklands Zoo

East End Beach

Programme	Date	Time	Temperature	Sp. conductivity	Enterococci	High tide		Preceding rainfall (mm)	
		NZST	°C	µS/cm@25°C	cfu/100ml	Time (NZST)	Height (m)	24 hrs	72 hrs
SEM	07 Nov 2018	10:00	15	53,200	2	09:16	3.6	0	0
SEM	10 Dec 2018	09:55	16	54,900	< 1	11:26	3.3	0	0
SEM	07 Jan 2019	10:55	17.8	54,400	1	10:34	3.4	0.4	0.4
SEM	10 Jan 2019	11:00	18.5	54,100	< 1	12:18	3.3	1.8	2.2
SEM	21 Jan 2019	10:00	17.5	54,700	250	09:42	3.7	0.4	1.4
SEM	23 Jan 2019	09:45	15.6	54,300	18	11:19	3.8	0	0.4
SEM	04 Feb 2019	11:10	20.5	54,000	4	09:41	3.3	0	0
SEM	11 Feb 2019	14:40	22.8	52,700	13	13:41	3.1	0	0
SEM	19 Feb 2019	11:00	19.8	51,700	130	09:27	3.7	0	0
SEM	21 Feb 2019	09:45	19.5	54,100	3	11:02	3.9	1.2	1.2
SEM	05 Mar 2019	10:55	18.7	54,200	4	09:18	3.2	0	0
SEM	07 Mar 2019	11:20	19	53,900	< 1	10:23	3.4	0	0
SEM	20 Mar 2019	10:25	20.8	54,700	10	09:08	3.7	0	0

Tide data from Port Taranaki

Rainfall data from TRC rain gauge at Brooklands Zoo

Ngamotu Beach

Programme	Date	Time	Temperature	Sp. conductivity	Enterococci	NP WWTP Laboratory			High tide		Preceding rainfall (mm)	
						Sp. conductivity	Enterococci	Faecal coliforms				
		NZST	°C	µS/cm@25°C	cfu/100ml	µS/cm@25°C	cfu/100ml	cfu/100ml	Time	Height	24 hrs	72 hrs
SEM	07 Nov 2018	09:10	15.9	54,400	5	-	-	-	09:16	3.6	0	0
SEM	10 Dec 2018	10:45	18.2	54,200	< 1	-	-	-	11:26	3.3	0	0
MFE	18 Dec 2018	12:40	22.7	54,500	2	-	-	-	05:44	2.8	0	0
MFE	27 Dec 2018	08:30	18	54,700	14	-	-	-	13:14	3.5	0	14.8
MFE	03 Jan 2019	10:30	16.8	54,900	18	-	-	-	07:53	3.1	0	0.2
SEM	07 Jan 2019	10:00	17.4	54,800	10	-	-	-	10:34	3.4	0.4	0.4
SEM	10 Jan 2019	11:35	18.8	54,400	6	-	-	-	12:18	3.3	1.8	2.2
MFE	17 Jan 2019	09:20	20.3	54,700	18	-	-	-	05:56	2.9	0	10.8
SEM	21 Jan 2019	09:20	16.4	55,200	30	-	-	-	09:42	3.7	0.4	1.4
SEM	23 Jan 2019	10:30	15.1	55,200	20	-	-	-	11:19	3.8	0	0.4
MFE	30 Jan 2019	10:10	19.1	53,400	70	-	-	-	05:19	2.8	0	1.4
SEM	04 Feb 2019	10:10	20.7	54,300	21	-	-	-	09:41	3.3	0	0
SEM	11 Feb 2019	13:40	22.8	54,100	1	-	-	-	13:41	3.1	0	0
SEM	19 Feb 2019	10:15	19.3	54,100	20	-	-	-	09:27	3.7	0	0
SEM	21 Feb 2019	10:10	19.6	53,600	110	-	-	-	11:02	3.9	1.2	1.2
MFE	28 Feb 2019	09:30	18.4	54,200	34	-	-	-	04:39	2.7	0	0
SEM	05 Mar 2019	10:10	18.5	54,200	29	-	-	-	09:18	3.2	0	0
SEM	07 Mar 2019	10:15	19.2	54,200	58	-	-	-	10:23	3.4	0	0
MFE	13 Mar 2019	11:55	20.1	50,500	9100	-	-	-	13:57	3	33.8	34.2
FOLLOW UP	18 Mar 2019	10:15	22	53,800	150	-	-	-	07:21	3.2	0	0.2
SEM	20 Mar 2019	11:00	21.7	54,400	3000	-	-	-	09:08	3.7	0	0
FOLLOW UP	24 Mar 2019	15:35	22.9	-	-	53,050	<50	<10	12:07	3.6	0	0
MFE	25 Mar 2019	11:15	22.2	53,500	480	-	-	-	12:51	3.4	2	2
FOLLOW UP	26 Mar 2019	14:10	21.4	-	-	53,320	1120	4900	13:37	3.1	3.2	5.2

Programme	Date	Time	Temperature	Sp. conductivity	Enterococci	NP WWTP Laboratory			High tide		Preceding rainfall (mm)	
						Sp. conductivity	Enterococci	Faecal coliforms				
		NZST	°C	µS/cm@25°C	cfu/100ml	µS/cm@25°C	cfu/100ml	cfu/100ml	Time	Height	24 hrs	72 hrs
FOLLOW UP	27 Mar 2019	08:40	20.8	-	-	53,070	60	<100	14:28	2.9	0.2	5.4
FOLLOW UP	28 Mar 2019	10:20	20.9	-	-	53,120	1150	500	15:26	2.7	18.2	21.6
FOLLOW UP	29 Mar 2019	08:50	20.8	-	-	53,700	460	80	-	-	-	-
FOLLOW UP	29 Mar 2019	21:05	21.3	-	-	-	20	10	-	-	-	-
FOLLOW UP	30 Mar 2019	00:07	21.1	-	-	-	30	30	-	-	-	-
FOLLOW UP	09 Apr 2019	14:05	19.8	54,900	< 10	-	-	-	-	-	-	-

Tide data from Port Taranaki

Rainfall data from TRC rain gauge at Brooklands Zoo

Back Beach

Programme	Date	Time	Temperature	Sp. conductivity	Enterococci	High tide		Preceding rainfall (mm)	
		NZST	°C	µS/cm@25°C	cfu/100ml	Time (NZST)	Height (m)	24 hrs	72 hrs
SEM	07 Nov 2018	09:00	14.8	53,500	5	09:16	3.6	0	0
SEM	10 Dec 2018	11:05	15.9	54,700	8	11:26	3.3	0	0
SEM	07 Jan 2019	09:45	16.5	55,100	8	10:34	3.4	0.4	0.4
SEM	10 Jan 2019	13:12	18.1	54,500	7	12:18	3.3	1.8	2.2
SEM	21 Jan 2019	09:07	16.4	54,300	30	09:42	3.7	0.4	1.4
SEM	23 Jan 2019	10:40	15.2	55,100	20	11:19	3.8	0	0.4
SEM	04 Feb 2019	09:40	19.3	54,200	30	09:41	3.3	0	0
SEM	11 Feb 2019	13:20	22.8	53,600	15	13:41	3.1	0	0
SEM	19 Feb 2019	10:00	18.5	53,700	340	09:27	3.7	0	0
SEM	21 Feb 2019	10:25	19.3	53,800	230	11:02	3.9	1.2	1.2
FOLLOW UP	28 Feb 2019	09:20	19.4	54,100	59	04:39	2.7	0	0
SEM	05 Mar 2019	09:45	18.3	54,100	39	09:18	3.2	0	0
SEM	07 Mar 2019	10:00	18.5	53,500	260	10:23	3.4	0	0
FOLLOW UP	12 Mar 2019	13:45	20.5	54,500	13	13:10	3.1	0.6	0.8
SEM	20 Mar 2019	09:45	20.3	54,500	13	09:08	3.7	0	0

Tide data from Port Taranaki

Rainfall data from TRC rain gauge at Brooklands Zoo

Oakura Beach (Surf Club)

Programme	Date	Time	Temperature	Sp. conductivity	Enterococci	High tide		Preceding rainfall (mm)	
		NZST	°C	µS/cm@25°C	cfu/100ml	Time (NZST)	Height (m)	24 hrs	72 hrs
SEM	07 Nov 2018	08:25	14.6	54,600	1	09:16	3.6	0	0
SEM	10 Dec 2018	11:45	16.1	54,000	4	11:26	3.3	0	0
MFE	18 Dec 2018	13:00	19.7	54,600	< 1	05:44	2.8	0	0
MFE	27 Dec 2018	08:10	18.3	54,500	33	13:14	3.5	0	14.8
MFE	03 Jan 2019	10:06	18.2	54,700	25	07:53	3.1	0	0.2
SEM	07 Jan 2019	09:10	15.5	54,400	16	10:34	3.4	0.4	0.4
SEM	10 Jan 2019	12:30	18.1	53,800	14	12:18	3.3	1.8	2.2
MFE	17 Jan 2019	08:55	19.3	54,400	50	05:56	2.9	0	10.8
SEM	21 Jan 2019	08:35	16.9	54,700	4	09:42	3.7	0.4	1.4
SEM	23 Jan 2019	11:10	15.4	54,100	43	11:19	3.8	0	0.4
MFE	30 Jan 2019	10:40	17.8	53,500	48	05:19	2.8	0	1.4
SEM	04 Feb 2019	08:55	18.9	54,900	14	09:41	3.3	0	0
SEM	11 Feb 2019	12:45	22.6	53,000	34	13:41	3.1	0	0
SEM	19 Feb 2019	08:50	17.3	54,100	< 1	09:27	3.7	0	0
SEM	21 Feb 2019	11:45	19.4	54,100	210	11:02	3.9	1.2	1.2
MFE	28 Feb 2019	08:30	19.4	54,500	< 1	04:39	2.7	0	0
SEM	05 Mar 2019	08:55	18.1	53,700	-	09:18	3.2	0	0
SEM	07 Mar 2019	09:25	18.7	53,800	4	10:23	3.4	0	0
MFE	13 Mar 2019	12:30	19.4	53,300	3300	13:57	3	33.8	34.2
FOLLOW UP	18 Mar 2019	09:30	21.5	53,400	41	07:21	3.2	0	0.2
SEM	20 Mar 2019	08:45	20.3	54,800	6	09:08	3.7	0	0
MFE	25 Mar 2019	10:45	21.3	55,000	1	12:51	3.4	2	2

Tide data from Port Taranaki

Rainfall data from TRC rain gauge at Brooklands Zoo

Oakura Beach (Camp ground)

Programme	Date	Time	Temperature	Sp. conductivity	Enterococci	High tide		Preceding rainfall (mm)	
		NZST	°C	µS/cm@25°C	cfu/100ml	Time (NZST)	Height (m)	24 hrs	72 hrs
SEM	07 Nov 2018	08:15	14.7	53,900	< 1	09:16	3.6	0	0
SEM	10 Dec 2018	12:00	16.5	54,900	< 1	11:26	3.3	0	0
SEM	07 Jan 2019	09:00	15.4	55,000	2	10:34	3.4	0.4	0.4
SEM	10 Jan 2019	12:15	18.2	54,700	< 1	12:18	3.3	1.8	2.2
SEM	21 Jan 2019	08:20	15.8	54,800	2	09:42	3.7	0.4	1.4
SEM	23 Jan 2019	11:25	15.6	54,600	21	11:19	3.8	0	0.4
SEM	04 Feb 2019	08:35	19	55,000	7	09:41	3.3	0	0
SEM	11 Feb 2019	12:35	22.8	54,000	< 1	13:41	3.1	0	0
SEM	19 Feb 2019	09:05	17.4	54,000	1	09:27	3.7	0	0
SEM	21 Feb 2019	11:55	19.5	54,200	58	11:02	3.9	1.2	1.2
SEM	05 Mar 2019	08:40	18.2	54,200	< 1	09:18	3.2	0	0
SEM	07 Mar 2019	09:10	18.5	53,800	2	10:23	3.4	0	0
SEM	20 Mar 2019	08:30	20.3	54,800	4	09:08	3.7	0	0

Tide data from Port Taranaki

Rainfall data from TRC rain gauge at Brooklands Zoo

Opunake Beach

Programme	Date	Time	Temperature	Sp. conductivity	Enterococci	High tide		Preceding rainfall (mm)	
		NZST	°C	µS/cm@25°C	cfu/100ml	Time (NZST)	Height (m)	24 hrs	72 hrs
SEM	07 Nov 2018	11:15	17.5	54,200	1	09:16	3.6	0	1
SEM	10 Dec 2018	13:05	19.4	54,300	7	11:26	3.3	0	0
MFE	18 Dec 2018	12:20	21.9	54,300	< 1	05:44	2.8	0	0
MFE	27 Dec 2018	10:00	18.6	55,200	6	13:14	3.5	0	14.5
MFE	03 Jan 2019	12:10	21.3	55,000	< 1	07:53	3.1	1.5	1.5
SEM	07 Jan 2019	12:00	20.6	54,500	1	10:34	3.4	1	1
SEM	10 Jan 2019	13:50	21	54,700	1	12:18	3.3	0	1
MFE	17 Jan 2019	11:10	18	54,500	< 1	05:56	2.9	0	37
SEM	21 Jan 2019	11:55	19.3	54,900	30	09:42	3.7	3	6
SEM	23 Jan 2019	12:30	19.5	54,800	8	11:19	3.8	0	3
MFE	30 Jan 2019	11:50	19.7	54,800	< 1	05:19	2.8	0	1.5
SEM	04 Feb 2019	11:35	18.6	54,900	1	09:41	3.3	0	3.5
SEM	11 Feb 2019	12:35	23.7	53,400	2	13:41	3.1	0	0
SEM	19 Feb 2019	11:30	20.7	53,900	1	09:27	3.7	0	0
SEM	21 Feb 2019	12:50	20	54,300	7	11:02	3.9	0	0
MFE	01 Mar 2019	11:35	17	54,400	< 1	05:57	2.7	0	0
SEM	05 Mar 2019	11:15	18.2	54,300	3	09:18	3.2	0	0
SEM	07 Mar 2019	12:30	20.2	54,100	< 1	10:23	3.4	0	2
MFE	13 Mar 2019	10:40	19.9	47,000	15	13:57	3	17	17
SEM	20 Mar 2019	11:00	20.7	54,700	< 1	09:08	3.7	0	0
MFE	25 Mar 2019	10:00	22.1	55,000	< 1	12:51	3.4	0	0

Tide data from Port Taranaki

Rainfall data from TRC rain gauge at Eltham Road

Ohawe Beach

Programme	Date	Time	Temperature	Sp. conductivity	Enterococci	High tide		Preceding rainfall (mm)	
		NZST	°C	µS/cm@25°C	cfu/100ml	Time (NZST)	Height (m)	24 hrs	72 hrs
SEM	07 Nov 2018	10:25	17	47,400	5	09:16	3.6	0	0.5
SEM	10 Dec 2018	11:35	19.8	46,500	19	11:26	3.3	0	0
MFE	18 Dec 2018	11:00	21.1	33,300	20	05:44	2.8	0	0
MFE	27 Dec 2018	08:15	18.2	18,010	260	13:14	3.5	0	15
MFE	03 Jan 2019	10:25	21.6	37,100	45	07:53	3.1	0	0
SEM	07 Jan 2019	10:30	21	47,800	61	10:34	3.4	0.5	0.5
SEM	10 Jan 2019	12:30	21.7	47,900	7	12:18	3.3	0	0.5
MFE	17 Jan 2019	09:20	19.2	30,700	41	05:56	2.9	0	33.5
SEM	21 Jan 2019	10:25	19.9	46,500	200	09:42	3.7	2.5	5.5
SEM	23 Jan 2019	11:15	20.5	45,100	200	11:19	3.8	0	3
MFE	30 Jan 2019	10:40	20.5	49,700	21	05:19	2.8	0	0
SEM	04 Feb 2019	10:50	21.1	44,600	60	09:41	3.3	0	1
SEM	11 Feb 2019	13:35	23.5	45,300	15	13:41	3.1	0	0
SEM	19 Feb 2019	10:25	20.7	44,000	220	09:27	3.7	0	0
SEM	21 Feb 2019	11:40	21	51,500	240	11:02	3.9	0	0
MFE	01 Mar 2019	09:30	18.6	48,500	18	05:57	2.7	0	0
SEM	05 Mar 2019	10:30	18.3	45,000	48	09:18	3.2	0	0
SEM	07 Mar 2019	11:05	20	49,300	35	10:23	3.4	0	0
MFE	13 Mar 2019	09:30	19.8	36,300	210	13:57	3	6.5	6.5
SEM	20 Mar 2019	10:20	20.3	51,000	68	09:08	3.7	0	0
MFE	25 Mar 2019	11:15	21.2	50,600	20	12:51	3.4	0	0

Tide data from Port Taranaki

Rainfall data from TRC rain gauge at Glenn Road

Patea Beach

Programme	Date	Time	Temperature	Sp. conductivity	Enterococci	High tide		Preceding rainfall (mm)	
		NZST	°C	µS/cm@25°C	cfu/100ml	Time (NZST)	Height (m)	24 hrs	72 hrs
SEM	07 Nov 2018	09:30	16.5	54,100	< 1	09:16	3.6	0	0
SEM	10 Dec 2018	10:45	19.9	53,800	2	11:26	3.3	0	0
SEM	07 Jan 2019	09:50	20.9	54,300	10	10:34	3.4	0	0
SEM	10 Jan 2019	11:40	21.5	54,400	3	12:18	3.3	1	1
SEM	21 Jan 2019	09:40	19.8	54,300	30	09:42	3.7	0.4	3
SEM	23 Jan 2019	10:25	20.8	54,900	12	11:19	3.8	0	0
SEM	04 Feb 2019	10:00	21.7	54,400	2	09:41	3.3	0	4.6
SEM	11 Feb 2019	12:40	23.2	53,400	< 1	13:41	3.1	0	0
SEM	19 Feb 2019	09:25	21.4	54,100	2	09:27	3.7	0	0
SEM	21 Feb 2019	10:50	21	53,700	26	11:02	3.9	0	0
SEM	05 Mar 2019	09:25	18.6	54,200	4	09:18	3.2	0	0
SEM	07 Mar 2019	10:10	19.8	53,800	4	10:23	3.4	0	0
SEM	20 Mar 2019	09:25	20.4	54,300	80	09:08	3.7	0	0

Tide data from Port Taranaki

Rainfall data from TRC rain gauge at Patea

Waverley Beach

Programme	Date	Time	Temperature	Sp. conductivity	Enterococci	High tide		Preceding rainfall (mm)	
		NZST	°C	µS/cm@25°C	cfu/100ml	Time (NZST)	Height (m)	24 hrs	72 hrs
SEM	07 Nov 2018	08:35	15.9	53,100	3	09:16	3.6	0	0
SEM	10 Dec 2018	09:50	19.9	52,800	5	11:26	3.3	0	0
SEM	07 Jan 2019	09:00	20.9	54,000	2	10:34	3.4	0	0
SEM	10 Jan 2019	11:00	21.5	53,800	22	12:18	3.3	0.6	0.6
SEM	21 Jan 2019	09:00	20.1	53,200	11	09:42	3.7	1.6	3
SEM	23 Jan 2019	09:45	20.7	53,900	13	11:19	3.8	0	1.6
SEM	04 Feb 2019	09:00	21	54,600	3	09:41	3.3	0	4
SEM	11 Feb 2019	12:00	23.5	53,800	14	13:41	3.1	0	0
SEM	19 Feb 2019	08:45	20.4	53,800	6	09:27	3.7	0	0
SEM	21 Feb 2019	10:10	20.8	53,900	5	11:02	3.9	0	0
SEM	05 Mar 2019	08:35	18.3	52,700	18	09:18	3.2	0	0
SEM	07 Mar 2019	09:15	19.2	53,900	< 1	10:23	3.4	0	0
SEM	20 Mar 2019	08:35	19.4	54,700	15	09:08	3.7	0	0

Tide data from Port Taranaki

Rainfall data from TRC rain gauge at Hawken Road

Waiinu Beach

Programme	Date	Time	Temperature	Sp. conductivity	Enterococci	High tide		Preceding rainfall (mm)	
		NZST	°C	µS/cm@25°C	cfu/100ml	Time (NZST)	Height (m)	24 hrs	72 hrs
SEM	07 Nov 2018	08:00	15	53,000	< 1	09:16	3.6	0	0
SEM	10 Dec 2018	09:25	19.7	49,800	7	11:26	3.3	0	0
SEM	07 Jan 2019	08:30	20.7	52,400	6	10:34	3.4	0	0
SEM	10 Jan 2019	10:30	20.9	54,300	17	12:18	3.3	0.6	0.6
SEM	21 Jan 2019	08:30	19.8	51,000	17	09:42	3.7	1.6	3
SEM	23 Jan 2019	09:15	20.8	51,800	10	11:19	3.8	0	1.6
SEM	04 Feb 2019	08:04	19.9	53,900	10	09:41	3.3	0	4
SEM	11 Feb 2019	11:30	23.4	51,300	5	13:41	3.1	0	0
SEM	19 Feb 2019	08:05	19.4	52,300	10	09:27	3.7	0	0
SEM	21 Feb 2019	09:40	20.4	52,600	4	11:02	3.9	0	0
SEM	05 Mar 2019	08:00	18.1	49,800	15	09:18	3.2	0	0
SEM	07 Mar 2019	08:40	19	49,700	5	10:23	3.4	0	0
SEM	20 Mar 2019	08:00	19	53,800	11	09:08	3.7	0	0

Tide data from Port Taranaki

Rainfall data from TRC rain gauge at Hawken Road

Appendix II

Field observations from 2018-2019 summer surveys

Site: TASMAN SEA (Onaero Bay: adjacent to Surf Club) (Site code: SEA900085)

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
07 Nov 2018	SEM	Overcast	8/8 (overcast)	Downshore	3 (large wavelets)	Clear, grey/green	0/0	Significant swell
10 Dec 2018	SEM	Fine	0/8 (fine)	Onshore	2 (small wavelets)	Slightly turbid, blue/green	0/0	
18 Dec 2018	MFE	Fine	2/8 (few)	Onshore	1 (ripples with appearance of scales)	Clear, green/blue	6 people picnicking, 2 people walking/0	
27 Dec 2018	MFE	Fine	2/8 (few)	Upshore	1 (ripples with appearance of scales)	Slightly turbid, brown then blue further out	0/2	
03 Jan 2019	MFE	Cloudy	6/8 (broken)	Upshore	1 (ripples with appearance of scales)	Slightly turbid, blue	4/0	14 black backed gulls on beach
07 Jan 2019	SEM	Light rain, overcast	8/8 (overcast)	Onshore	2 (small wavelets)	Clear, blue/green	3/0	
10 Jan 2019	SEM	Overcast	8/8 (overcast)	Onshore	2 (small wavelets)	Clear, blue/green	2 people walking/0	
17 Jan 2019	MFE	Fine	0/8 (fine)	Upshore	1 (ripples with appearance of scales)	Slightly turbid, blue	14/2	6 seagulls on beach
21 Jan 2019	SEM	Partly cloudy	3/8 (scattered)	Upshore	3 (large wavelets)	Clear, blue/green	4 people walking/0	
23 Jan 2019	SEM	Fine	1/8 (few)	Onshore	4 (small waves)	Slightly turbid, blue/green (grey in wash)	0/0	Big swell and tide
30 Jan 2019	MFE	Fine, calm	8/8 (overcast)	No wind	0 (sea like a mirror)	Clear, blue/grey	0/0	30 seagulls 25m south of sampling site near river. A boat had recently been launched from the beach.
04 Feb 2019	SEM	Fine	2/8 (few)	Onshore	1 (ripples with appearance of scales)	Slightly turbid, blue	0/0	

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
11 Feb 2019	SEM	Fine, light sea breeze	1/8 (few)	Onshore	1 (ripples with appearance of scales)	Clear, blue/green	0/0	
19 Feb 2019	SEM	Fine	2/8 (few)	Onshore	2 (small wavelets)	Clear, blue/green/brown	0/0	25 seagulls at river mouth 50m south of site. Lots of brown sea foam on shore.
21 Feb 2019	SEM	Fine with light drizzle	8/8 (overcast)	Downshore	3 (large wavelets)	Turbid, blue/green/tan	0/0	Two seagulls 200 m offshore. Sea high on shore due to spring tide. Big waves and evidence of erosion of bank.
28 Feb 2019	MFE	Fine, strong SE gusts	0/8 (fine)	Offshore	1 (ripples with appearance of scales)	Clear, blue/green	0/0	30 seagulls at river mouth.
05 Mar 2019	SEM	Fine, still	6/8 (broken)	No wind	1 (ripples with appearance of scales)	Clear, blue/green	3 people fishing/0	
07 Mar 2019	SEM	Fine	7/8 (broken)	Onshore	2 (small wavelets)	Clear, blue/green	5 people fishing/0	
13 Mar 2019	MFE	Overcast	8/8 (overcast)	Onshore	3 (large wavelets)	Turbid, grey/brown 50 m out, then green	0/0	10 seagulls at rivermouth. Small volume of surf diatoms and beach cast algae at tide line.
18 Mar 2019	FOLLOW UP	Fine	4/8 (scattered)	No wind	1 (ripples with appearance of scales)	Slightly turbid, blue/black	1/1	
20 Mar 2019	SEM	Fine, still	8/8 (overcast)	No wind	2 (small wavelets)	Clear, blue/grey	0/0	One kingfisher
26 Mar 2019	MFE	Strong northerly wind	8/8 (overcast)	Onshore	4 (small waves)	Slightly turbid, grey	0/0	Six gulls at river mouth

Site: TASMAN SEA (Waitara East Beach) (Site code: SEA901033)

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
07 Nov 2018	SEM	Overcast	8/8 (overcast)	Downshore	4 (small waves)	Turbid, brown/green	0/0	One dog on shore
10 Dec 2018	SEM	Fine	0/8 (fine)	Downshore	1 (ripples with appearance of scales)	Slightly turbid, brown/blue	0/0	NPDC warning sign set to red
18 Dec 2018	MFE	Fine, strong breeze	0/8 (fine)	Onshore	1 (ripples with appearance of scales)	Clear, blue/green	0/0	NPDC warning sign set to red, Rahui health warning sign, One oystercatcher, three gulls
27 Dec 2018	MFE	Fine, strong breeze	1/8 (few)	Upshore	2 (small wavelets)	Clear, turquoise	0/2	NPDC warning sign set to green
03 Jan 2019	MFE	Cloudy	7/8 (broken)	Upshore	1 (ripples with appearance of scales)	Clear, blue/brown	3/0	NPDC warning sign set to green, eight black backed gulls
07 Jan 2019	SEM	Overcast	8/8 (overcast)	Onshore	2 (small wavelets)	Clear, green/grey	0/0	NPDC warning sign set to green
10 Jan 2019	SEM	Overcast	8/8 (overcast)	Onshore	1 (ripples with appearance of scales)	Clear, green/grey	0/1 surfer	NPDC warning sign set to green
17 Jan 2019	MFE	Fine	0/8 (fine)	Upshore	1 (ripples with appearance of scales)	Clear, blue/green	0/0	NPDC warning sign set to green, Rahui health warning sign,14 seagulls and one oystercatcher on the shore, 5 seagulls on the water
23 Jan 2019	SEM	FIne	3/8 (scattered)	Onshore	4 (small waves)	Turbid, brown/grey for approx. 200 m	0/5 surfers	NPDC warning sign set to green, big swell and tide
30 Jan 2019	MFE	Fine	8/8 (overcast)	No wind	0 (sea like a mirror)	Clear, blue/grey	0/0	NPDC warning sign set to green, One gull 20 m south of site 40 gulls 150 m north

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
04 Feb 2019	SEM	Fine	0/8 (fine)	Onshore	1 (ripples with appearance of scales)	Clear, blue	0/2 surfers	NPDC warning sign set to green, 2 dogs on the shore, Five seabirds were present on the water and more seabirds were present approx. 20m east (upshore) of site.
11 Feb 2019	SEM	Fine, light sea breeze	1/8 (few)	Onshore	1 (ripples with appearance of scales)	Clear, blue/green	0/0	NPDC warning sign set to green, 30 gulls 30 m west of site
19 Feb 2019	SEM	Fine	3/8 (scattered)	Upshore	2 (small wavelets)	Clear, blue/green	0/0	NPDC warning sign set to green,15 seagulls 30m south of site, 15 seagulls directly offshore from site, one dog
21 Feb 2019	SEM	Fine	8/8 (overcast)	Downshore	2 (small wavelets)	Turbid, green/grey	1/1	NPDC warning sign set to green, two gulls on water 60 m upshore from site
28 Feb 2019	MFE	Fine, moderate SE wind	0/8 (fine)	Offshore	1 (ripples with appearance of scales)	Turbid, blue/brown	1 walker/0	NPDC warning sign set to green, one dog and 10 gulls on the shore
05 Mar 2019	SEM	Fine, still	7/8 (broken)	No wind	1 (ripples with appearance of scales)	Clear, blue/green	0/0	NPDC warning sign set to green, 30 gulls and five terns 30 m downshore
07 Mar 2019	SEM	Fine	1/8 (few)	Downshore	2 (small wavelets)	Turbid, blue/green/brown	0/0	NPDC warning sign set to green. Three gulls 40 m offshore. Lots of erosion at coast. Strong rotting fish smell at site.
13 Mar 2019	MFE	Spitting	8/8 (overcast)	Onshore	3 (large wavelets)	Slightly turbid, grey/green to 100 m out, then green	0/0	NPDC warning sign set to green. 5 gulls on shore 50 m east, 10+ gulls 50 m west. Surf diatoms pushed on shore. Small patches of Ulva growing on intertidal reef.

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
20 Mar 2019	SEM	Fine, very light NW breeze	8/8 (overcast)	Offshore	2 (small wavelets)	Clear, blue/grey	0/0	NPDC warning sign set to green.
26 Mar 2019	MFE	Strong N wind	7/8 (broken)	Onshore	4 (small waves)	Clear, green/grey	0/0	NPDC warning sign set to green. 30 gulls on the shore to the west

Site: TASMAN SEA (Waitara West Beach) (Site code: SEA901037)

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
07 Nov 2018	SEM	Overcast	8/8 (overcast)	Downshore	4 (small waves)	Turbid, brown	0/0	One gull
10 Dec 2018	SEM	Fine	0/8 (fine)	Downshore	2 (small wavelets)	Slightly turbid, Blue/green with brown tinge	0/0	NPDC warning sign set to red
18 Dec 2018	MFE	Fine, light breeze	0/8 (fine)	Onshore	1 (ripples with appearance of scales)	Clear, blue with brown tinge	6 walking/0	NPDC warning sign set to red
27 Dec 2018	MFE	Fine, strong breeze	1/8 (few)	Upshore	1 (ripples with appearance of scales)	Turbid, grey/brown	1/0	NPDC warning sign set to green
03 Jan 2019	MFE	Overcast	7/8 (broken)	Upshore	1 (ripples with appearance of scales)	Turbid, brown/grey	5/0	NPDC warning sign set to green
07 Jan 2019	SEM	Overcast	8/8 (overcast)	Onshore	2 (small wavelets)	Clear, blue/grey	0/0	
10 Jan 2019	SEM	Overcast	8/8 (overcast)	Onshore	1 (ripples with appearance of scales)	Slightly turbid, grey/green	0/0	NPDC warning sign set to green
17 Jan 2019	MFE	Fine, strong wind	0/8 (fine)	Upshore	1 (ripples with appearance of scales)	Slightly turbid, brown tinge	1/0	NPDC warning sign set to green
21 Jan 2019	SEM	Overcast	8/8 (overcast)	Upshore	2 (small wavelets)	Turbid, blue/brown	0/0	NPDC warning sign set to green
23 Jan 2019	SEM	Overcast	6/8 (broken)	Onshore	3 (large wavelets)	Turbid, grey/brown to approx. 200 m	0/1 surfer	NPDC warning sign set to green, big swell and tide
30 Jan 2019	MFE	Fine	8/8 (overcast)	No wind	0 (sea like a mirror)	Slightly turbid, grey/blue	1 walker/0	NPDC warning sign set to green, three sparrows/swallows, lots of seaweed washed up on the shore.
04 Feb 2019	SEM	Fine	1/8 (few)	Onshore	1 (ripples with appearance of scales)	Slightly turbid, blue/green	1 walker/0	Turbid inshore water
11 Feb 2019	SEM	Fine, light westerly wind	1/8 (few)	Onshore	1 (ripples with appearance of scales)	Clear, green/grey	2 walkers/1 wading in water	NPDC warning sign set to green, water turbid inshore.

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
19 Feb 2019	SEM	Fine, light NE breeze	3/8 (scattered)	Upshore	2 (small wavelets)	Turbid, blue/green/brown	1 person walking, 1 person cutting driftwood/0	NPDC warning sign set to green, decaying seaweed on shore
21 Feb 2019	SEM	Fine, calm	8/8 (overcast)	No wind	1 (ripples with appearance of scales)	Turbid, green/blue/grey	4 people collecting firewood/0	NPDC warning sign set to green, big swell and tide
28 Feb 2019	MFE	Fine, moderate SE breeze	0/8 (fine)	Offshore	1 (ripples with appearance of scales)	Turbid, blue/brown	2 walking, 1 fishing/0	NPDC warning sign set to green, four dogs
05 Mar 2019	SEM	Fine, still	7/8 (broken)	No wind	1 (ripples with appearance of scales)	Turbid, brown/grey	0/0	NPDC warning sign set to green, one gull 30m downshore
07 Mar 2019	SEM	Fine	2/8 (few)	Downshore	2 (small wavelets)	Turbid, grey/blue	1 person/0	NPDC warning sign set to green, two dogs in water
13 Mar 2019	MFE	Overcast	8/8 (overcast)	Onshore	3 (large wavelets)	Turbid, dark grey to 5 m out; grey/green to 100 m; green	one walker/0	NPDC warning sign set to green, very slight volume of surf diatoms washed up, beach cast algae also along tide line.
20 Mar 2019	SEM	Fine, very light NW breeze	4/8 (scattered)	Offshore	2 (small wavelets)	Slightly turbid, green/brown	0/0	
26 Mar 2019	MFE	Strong N wind	7/8 (broken)	Onshore	4 (small waves)	Slightly turbid, green/grey	0/0	NPDC warning sign set to green

Site: TASMAN SEA (Fitzroy Beach - Opposite Surf Club) (Site code: SEA902025)

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
07 Nov 2018	SEM	Overcast	8/8 (overcast)	Downshore	1 (ripples with appearance of scales)	Slightly turbid, milky green/grey	5/18	
10 Dec 2018	SEM	Fine	1/8 (few)	Downshore	2 (small wavelets)	Clear, blue/green	20 surfing, 40 swimming	School group at beach - very busy
18 Dec 2018	MFE	Fine, strong breeze	1/8 (few)	Onshore	2 (small wavelets)	Clear, blue	40/20	10 seagulls on the beach
27 Dec 2018	MFE	Slightly cloudy	3/8 (scattered)	Upshore	1 (ripples with appearance of scales)	Clear, blue	30/20	Four seagulls on the beach
03 Jan 2019	MFE	Overcast	8/8 (overcast)	Upshore	1 (ripples with appearance of scales)	Clear, blue	9 at café, 6 on beach/8 surfers, 6 swimmers	
07 Jan 2019	SEM	Overcast drizzle	8/8 (overcast)	Downshore	1 (ripples with appearance of scales)	Clear, grey/blue	3/9 surfers, 3 swimmers	
10 Jan 2019	SEM	Overcast	8/8 (overcast)	Downshore	1 (ripples with appearance of scales)	Clear, blue	7 on beach, 3 at cafe/10 surfers, 2 swimming	
17 Jan 2019	MFE	Fine	0/8 (fine)	Upshore	1 (ripples with appearance of scales)	Clear, blue	20-25/8 surfers, 10 swimming,13 surf life savers	
21 Jan 2019	SEM	Overcast	6/8 (broken)	Upshore	3 (large wavelets)	Slightly turbid, green grey	10/11 surfers	Eight gulls on the beach
23 Jan 2019	SEM	Fine	4/8 (scattered)	Upshore	1 (ripples with appearance of scales)	Clear, blue	3/0	One dog
30 Jan 2019	MFE	Fine	8/8 (overcast)	No wind	0 (sea like a mirror)	Clear, grey	7 walker, 3 dogs/12 surfers, 17 surf life savers	
04 Feb 2019	SEM	Fine	1/8 (few)	Onshore	1 (ripples with appearance of scales)	Slightly turbid, blue /green	20 on beach/19 surfers, 5 swimmers	One dog

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
11 Feb 2019	SEM	Fine	0/8 (fine)	Onshore	1 (ripples with appearance of scales)	Clear, blue	20/12	
19 Feb 2019	SEM	Fine	0/8 (fine)	Onshore	1 (ripples with appearance of scales)	Clear, blue/green	5/0	Three gulls on beach
21 Feb 2019	SEM	Fine	8/8 (overcast)	Onshore	1 (ripples with appearance of scales)	Clear, blue/grey	2 walkers/15 surfers	Five gulls and one dog on beach
28 Feb 2019	MFE	Fine	1/8 (few)	Offshore	0 (sea like a mirror)	Slightly turbid, green	4 walking/7 surfing	
05 Mar 2019	SEM	Fine	8/8 (overcast)	Upshore	3 (large wavelets)	Slightly turbid, blue/green	5/0	Four gulls approx. 50 m E on beach
07 Mar 2019	SEM	Fine, light N breeze	0/8 (fine)	Downshore	1 (ripples with appearance of scales)	Clear, blue	3 walking/1 surfing	Three gulls and one dog on the beach
13 Mar 2019	MFE	Spitting	8/8 (overcast)	Onshore	3 (large wavelets)	Turbid, grey/green to approx. 200 m; then green	3 on beach/10 learning to surf	One dog on beach. More particulate in water than usual (e.g. plant matter and feathers), sea appeared quite dirty. Some surf diatoms at tide line. Small stream running over beach from s/w outlet (entered the sea at least 100 m E of sampling site).
18 Mar 2019	FOLLOW UP	Fine, calm	7/8 (broken)	No wind	1 (ripples with appearance of scales)	Clear, blue	3 walking/10	
20 Mar 2019	SEM	Fine	5/8 (broken)	Downshore	1 (ripples with appearance of scales)	Slightly turbid, green	9 on beach/4 surfers	Six gulls along beach
26 Mar 2019	MFE	Moderate N breeze	7/8 (broken)	Onshore	3 (large wavelets)	Slightly turbid, green/brown	3 walking/0	

Site: TASMAN SEA (East End Beach - opposite Surf Club) (Site code: SEA902035)

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
07 Nov 2018	SEM	Overcast	7/8 (broken)	Downshore	1 (ripples with appearance of scales)	Slightly turbid, milky green	0/0	
10 Dec 2018	SEM	Fine	2/8 (few)	Downshore	2 (small wavelets)	Slightly turbid, blue/green	1/0	
07 Jan 2019	SEM	Overcast	8/8 (overcast)	Downshore	1 (ripples with appearance of scales)	Clear, grey/blue	0/2	
10 Jan 2019	SEM	Overcast	8/8 (overcast)	Downshore	1 (ripples with appearance of scales)	Clear, blue	4/1	
21 Jan 2019	SEM	Overcast	8/8 (overcast)	Onshore	2 (small wavelets)	Slightly turbid, green/grey	0/1 paddle boarder, 1 swimmer	Three gulls on beach 20 m east
23 Jan 2019	SEM	Fine	3/8 (scattered)	Upshore	2 (small wavelets)	Clear, blue	1/1 swimmer, 1 kite surfer	
04 Feb 2019	SEM	Fine	1/8 (few)	Onshore	1 (ripples with appearance of scales)	Slightly turbid, blue/green	5 on beach/10 swimmers, 3 paddleboarders, 3 surfers	One dog and one gull on the beach
11 Feb 2019	SEM	Fine	0/8 (fine)	Onshore	1 (ripples with appearance of scales)	Clear, blue	10/6	
19 Feb 2019	SEM	Fine	0/8 (fine)	Onshore	1 (ripples with appearance of scales)	Clear, blue/green	3/1	
21 Feb 2019	SEM	Fine	8/8 (overcast)	Onshore	1 (ripples with appearance of scales)	Clear, blue/grey	0/5 surfers	One gull on beach
05 Mar 2019	SEM	Fine	8/8 (overcast)	Onshore	2 (small wavelets)	Slightly turbid, grey/blue	1 walker/0	
07 Mar 2019	SEM	Fine, light N breeze	0/8 (fine)	Downshore	1 (ripples with appearance of scales)	Clear, blue	0/0	One gull on beach

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
20 Mar 2019	SEM	Fine	5/8 (broken)	Downshore	2 (small wavelets)	Slightly turbid, blue/green	3 on beach/8 boogie boarders	

Site: TASMAN SEA (Ngamotu Beach: centre of beach) (Site code: SEA902062)

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
07 Nov 2018	SEM	Overcast	7/8 (broken)	Onshore	1 (ripples with appearance of scales)	Turbid, green/brown	3/0	
10 Dec 2018	SEM	Fine	1/8 (few)	No wind	1 (ripples with appearance of scales)	Clear, blue	8/1 swimmer, 10 paddleboarders, 10 kayaks	
18 Dec 2018	MFE	Fine, light breeze	0/8 (fine)	Onshore	1 (ripples with appearance of scales)	Clear, blue	30/15	Three seagulls on the beach
27 Dec 2018	MFE	Moderate breeze, slightly cloudy	4/8 (scattered)	Upshore	1 (ripples with appearance of scales)	Clear, blue	11/10 Waka	
03 Jan 2019	MFE	Overcast, light Breeze	8/8 (overcast)	Upshore	1 (ripples with appearance of scales)	Clear, blue	3/2	20-30 seagulls on the beach
07 Jan 2019	SEM	Overcast	8/8 (overcast)	Onshore	1 (ripples with appearance of scales)	Clear, blue/grey	8/0	10 seagulls on the beach
10 Jan 2019	SEM	Overcast	8/8 (overcast)	Downshore	1 (ripples with appearance of scales)	Clear, grey/blue	15/10, 2 waka	
17 Jan 2019	MFE	Fine	0/8 (fine)	Upshore	1 (ripples with appearance of scales)	Clear, blue	20/0	One heron on the water. Surf diatoms washed on the beach
21 Jan 2019	SEM	Fine	6/8 (broken)	Upshore	1 (ripples with appearance of scales)	Slightly turbid, green/grey	0/2 swimmers	50 gulls approx. 100m east. Yacht event setting up.
23 Jan 2019	SEM	Fine	2/8 (few)	Upshore	1 (ripples with appearance of scales)	Clear, blue	0/1	13 seagulls on the beach
30 Jan 2019	MFE	Fine	8/8 (overcast)	No wind	0 (sea like a mirror)	Slightly turbid, grey	4 walkers/1 snorkeler, 2 waders	
04 Feb 2019	SEM	Fine	2/8 (few)	Onshore	1 (ripples with appearance of scales)	Clear, blue/green	6/0	Two gulls on beach and fish present in the shallows. Detached ulva also drifting in shallows.

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
11 Feb 2019	SEM	Fine	0/8 (fine)	Onshore	1 (ripples with appearance of scales)	Clear, blue	15/6	
19 Feb 2019	SEM	Fine	2/8 (few)	Onshore	1 (ripples with appearance of scales)	Clear, blue	11/1	
21 Feb 2019	SEM	Fine	8/8 (overcast)	Onshore	1 (ripples with appearance of scales)	Slightly turbid, green/grey	0/0	30 gulls at northern end of beach
28 Feb 2019	MFE	Fine	1/8 (few)	Offshore	0 (sea like a mirror)	Clear, blue/green	1 /0	Approx. 100 gulls to either side of sampling site
05 Mar 2019	SEM	Fine	8/8 (overcast)	Upshore	1 (ripples with appearance of scales)	Slightly turbid, grey/green	4 volleyballers/6 small yachts	Approx. 100 gulls 100 m east. Palm kernel odour in air.
07 Mar 2019	SEM	Fine, still	4/8 (scattered)	No wind	1 (ripples with appearance of scales)	Slightly turbid, green/brown	50 school kids/10 school kids	Over 50 gulls at far east end of beach
13 Mar 2019	MFE	Overcast	8/8 (overcast)	Upshore	1 (ripples with appearance of scales)	Turbid, brown/grey to 100 m out, then green	0/0	A few gulls sparsely scattered along beach. High volumes of beach cast algae - mostly ulva. Very high volume of detached algae in knee depth waters. Water appeared quite dirty. S/w outlet immediately east of site had been discharging but was dry at time of sampling (channel carved into beach). Dredge vessel present in harbor.
18 Mar 2019	FOLLOW UP	Fine	7/8 (broken)	No wind	1 (ripples with appearance of scales)	Slightly turbid, brown/green	2 Walking/3	Over 100 gulls 20m North of site. Surf diatoms present on beach.
20 Mar 2019	SEM	Fine	2/8 (few)	Onshore	2 (small wavelets)	Turbid, brown in wash, then green	0/1	Gull colony present at eastern end of beach

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
24 Mar 2019	FOLLOW UP				1 (ripples with appearance of scales)	Slightly turbid, brown in wash, then blue	Swimmers present	Gull colony present at eastern end of beach
25 Mar 2019	MFE	Fine	4/8 (scattered)	Onshore	2 (small wavelets)	Turbid, grey/brown in wash, then green	0/0	Health warning sign erected. 10 - 20 gulls 100 m east. Weet-Bix triathlon being set up. Evidence that s/w drain next site was discharging earlier in day (recently wet channel in beach).
26 Mar 2019	FOLLOW UP	Strong onshore wind			4 (small waves)	grey/brown in wash then green		Reasonable shore break. Adjacent stormwater drain channel was dry.
27 Mar 2019	FOLLOW UP	Strong onshore wind (picking up)			4 (small waves)	brown/grey in wash, then grey/green		Surf diatom staining across beach.
28 Mar 2019	FOLLOW UP	Fine, moderate SE breeze	0/8 (fine)	Offshore	2 (small wavelets)	Turbid, brown	10 triathlon swimmers/supporters	

Site: TASMAN SEA (Back Beach) (Site code: SEA902070)

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
07 Nov 2018	SEM	Fine, slight wind	7/8 (broken)	Offshore	1 (ripples with appearance of scales)	Slightly turbid, green	2/2 surfers	One dog on beach
10 Dec 2018	SEM	Fine	1/8 (few)	Downshore	2 (small wavelets)	Slightly turbid, blue/green	3/3 swimmers, 2 surfers	Herekawe Stream heading directly to sea (no meander east toward sample site)
07 Jan 2019	SEM	Overcast	8/8 (overcast)	Onshore	1 (ripples with appearance of scales)	Clear, blue/grey	1/2 surfing	Four seagulls on beach
10 Jan 2019	SEM	Overcast	8/8 (overcast)	Downshore	1 (ripples with appearance of scales)	Clear, blue/green	6/8 surfers	
21 Jan 2019	SEM	Fine	6/8 (broken)	Onshore	3 (large wavelets)	Slightly turbid, green/grey	2/0	One dog on beach
23 Jan 2019	SEM	Fine	2/8 (few)	Onshore	1 (ripples with appearance of scales)	Clear, grey/green	3/0	Two dogs on beach
04 Feb 2019	SEM	Fine	2/8 (few)	Onshore	1 (ripples with appearance of scales)	Slightly turbid, blue/ green	7 on beach/16 surfers	Seven gulls at stream mouth and three dogs on the beach
11 Feb 2019	SEM	Fine	0/8 (fine)	Onshore	1 (ripples with appearance of scales)	Clear, blue	15/6	
19 Feb 2019	SEM	Fine	5/8 (broken)	Onshore	1 (ripples with appearance of scales)	Clear, blue	5/0	Eight gulls and one dog on beach
21 Feb 2019	SEM	Fine	8/8 (overcast)	Offshore	1 (ripples with appearance of scales)	Clear, blue	3 walking, 1 sitting/0	Five dogs on beach
28 Feb 2019	FOLLOW UP	Fine	1/8 (few)	Offshore	1 (ripples with appearance of scales)	Clear, blue/green	2 walking/4 surfing	Five gulls and three dogs on beach
05 Mar 2019	SEM	Fine	8/8 (overcast)	Onshore	3 (large wavelets)	Slightly turbid, blue/green/grey	3 walkers/0	Approx. 15 gulls at stream mouth and two dogs on beach

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
07 Mar 2019	SEM	Fine, very light breeze	0/8 (fine)	Offshore	1 (ripples with appearance of scales)	Clear, blue	3 walking/13 surfing, 1 swimming, 1 paddle skiing	Twelve gulls at stream mouth
12 Mar 2019	FOLLOW UP	Overcast, light wind	7/8 (broken)	Onshore	2 (small wavelets)	Clear, turquoise green	3/7 surfing	
20 Mar 2019	SEM	Fine	4/8 (scattered)	No wind	1 (ripples with appearance of scales)	Slightly Turbid, grey/brown in wash, then blue/green	6 on beach/18 surfers, 1 swimmer	Approx. 25 gulls at stream mouth

Site: TASMAN SEA (Oakura Beach: opposite NPOB Surf Club) (Site code: SEA903030)

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
07 Nov 2018	SEM	Overcast, windy	8/8 (overcast)	Downshore	1 (ripples with appearance of scales)	Turbid, green/brown	0/0	
10 Dec 2018	SEM	Fine	0/8 (fine)	No wind	1 (ripples with appearance of scales)	Turbid, blue/green/grey	13/5 swimming, 2 surfing	Significant sand accretion/beach volume. Wairau heading straight, Waimoku meandering.
18 Dec 2018	MFE	Fine	1/8 (few)	Onshore	1 (ripples with appearance of scales)	Clear, blue	15/15	Four seagulls on beach
27 Dec 2018	MFE	Slightly cloudy, strong Breeze	3/8 (scattered)	Upshore	1 (ripples with appearance of scales)	Clear, grey	13/0	Three seagulls on beach
03 Jan 2019	MFE	Moderate breeze, overcast	8/8 (overcast)	Upshore	1 (ripples with appearance of scales)	Clear, blue/grey	20/22 surf life savers and surfers	
07 Jan 2019	SEM	Overcast, spitting	8/8 (overcast)	Downshore	1 (ripples with appearance of scales)	Clear, blue/grey	3/3 surfer	Seven seagulls on the water
10 Jan 2019	SEM	Overcast	8/8 (overcast)	Downshore	1 (ripples with appearance of scales)	Clear, blue/grey	15/6 swimmers, 5 surfers	Three seagulls on the water
17 Jan 2019	MFE	Fine	0/8 (fine)	Upshore	1 (ripples with appearance of scales)	Clear, blue	11/15 surfers, 3 swim, 15 surf life savers	
21 Jan 2019	SEM	Fine	3/8 (scattered)	Upshore	3 (large wavelets)	Turbid, grey/green inshore, blue/green offshore	7/5 kayakers	One dog and two black backed gulls on beach. Waimoku Stream now crosses the beach immediately adjacent to sampling site.
23 Jan 2019	SEM	Fine	2/8 (few)	Onshore	1 (ripples with appearance of scales)	Turbid, blue/green offshore and brown inshore	8/0	
30 Jan 2019	MFE	Fine	8/8 (overcast)	No wind	0 (sea like a mirror)	Clear, green/grey	6 sunbathers /10 surfers	Two dogs on beach

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
04 Feb 2019	SEM	Fine	5/8 (broken)	Onshore	1 (ripples with appearance of scales)	Slightly turbid, blue/ green	5/7 surfers, 1 paddle boarder	Waimoku Stream has been straightened.
11 Feb 2019	SEM	Fine	0/8 (fine)	Onshore	1 (ripples with appearance of scales)	Clear, blue	6/2	
19 Feb 2019	SEM	Fine	7/8 (broken)	Upshore	1 (ripples with appearance of scales)	Slightly turbid, blue	1/0	30 terns and six gulls on the beach
21 Feb 2019	SEM	Fine	8/8 (overcast)	Offshore	1 (ripples with appearance of scales)	Clear, blue/grey	1 walking/2 swimming	One dog on beach
28 Feb 2019	MFE	Fine, slight southerly breeze	1/8 (few)	Onshore	1 (ripples with appearance of scales)	Clear, blue/green	7 walking/0	14 terns, and two gulls on beach.
05 Mar 2019	SEM	Fine	5/8 (broken)	Upshore	3 (large wavelets)	Slightly turbid, blue/green	0/0	Waimoku entering sea adjacent to sampling site.
07 Mar 2019	SEM	Fine, very light NW breeze	7/8 (broken)	Onshore	1 (ripples with appearance of scales)	Clear, grey/blue	1 walking/0	One dog on beach
13 Mar 2019	MFE	Overcast	8/8 (overcast)	Onshore	3 (large wavelets)	Slightly turbid, grey/green to surf zone, then green	0/0	A few gulls sparsely scattered along beach. Waimoku Stream now entering sea 20 m W of site. Wairau Stream entering sea >100 m N of site. Sea appeared relatively clean.
18 Mar 2019	FOLLOW UP	Fine, calm	6/8 (broken)	No wind	1 (ripples with appearance of scales)	Clear, blue/grey	0/1 paddle boarder, 4 swimmers	One gull on beach
20 Mar 2019	SEM	Fine	2/8 (few)	Downshore	1 (ripples with appearance of scales)	Slightly turbid, blue/green	0/0	
25 Mar 2019	MFE	Fine	5/8 (broken)	Onshore	3 (large wavelets)	Turbid, grey in wash, then blue/green	5/3 swimmers	One gull on beach. Waimoku Stream mouth completely choked - now pooling. Wairau Stream entering sea approx. 200 m N along beach.

Site: TASMAN SEA (Oakura Beach - opposite camp ground) (Site code: SEA903032)

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
07 Nov 2018	SEM	Overcast, windy	7/8 (broken)	Downshore	1 (ripples with appearance of scales)	Turbid, brown/green	1/0	
10 Dec 2018	SEM	Fine	1/8 (few)	No wind	1 (ripples with appearance of scales)	Turbid, blue/green/grey	5/0	Signs of horses on beach (horse droppings)
07 Jan 2019	SEM	Overcast, spitting	8/8 (overcast)	Downshore	1 (ripples with appearance of scales)	Clear, blue/grey	7/0	Three seagulls on the water
10 Jan 2019	SEM	Overcast	8/8 (overcast)	Downshore	1 (ripples with appearance of scales)	Clear, blue/grey	7/0	
21 Jan 2019	SEM	Fine, breezy	1/8 (few)	Upshore	1 (ripples with appearance of scales)	Turbid, green/brown at break, then blue/green	9/0	Two dogs on beach
23 Jan 2019	SEM	Fine	3/8 (scattered)	Onshore	1 (ripples with appearance of scales)	Turbid, brown/green inshore, blue/green offshore	3/0	
04 Feb 2019	SEM	Fine	3/8 (scattered)	Onshore	1 (ripples with appearance of scales)	Slightly Turbid, blue /green	2/0	Three dog walkers and one gull on beach
11 Feb 2019	SEM	Fine	0/8 (fine)	Onshore	1 (ripples with appearance of scales)	Clear, blue	1/1	
19 Feb 2019	SEM	Fine	7/8 (broken)	Upshore	1 (ripples with appearance of scales)	Slightly turbid, blue	3/0	
21 Feb 2019	SEM	Fine	8/8 (overcast)	Offshore	1 (ripples with appearance of scales)	Clear, blue/grey	0/0	
05 Mar 2019	SEM	Fine	5/8 (broken)	Upshore	3 (large wavelets)	Slightly turbid, blue/green	1 walker/0	Two gulls on beach
07 Mar 2019	SEM	Fine, light breeze	4/8 (scattered)	Onshore	1 (ripples with appearance of scales)	Clear, green/blue	0/0	One gull on beach
20 Mar 2019	SEM	Fine	2/8 (few)	Downshore	1 (ripples with appearance of scales)	Slightly turbid, blue/green	1/0	Two gulls and one dog on beach

Site: TASMAN SEA (Opunake Beach) (Site code: SEA904090)

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
07 Nov 2018	SEM	Fine, fairly strong wind	1/8 (few)	Offshore	1 (ripples with appearance of scales)	Slightly turbid, grey/blue	5/2	
10 Dec 2018	SEM	Overcast, windy	5/8 (broken)	Onshore	3 (large wavelets)	Clear, light green/blue	4/1 surfing	
18 Dec 2018	MFE	Fine	2/8 (few)	Downshore	1 (ripples with appearance of scales)	Clear, blue/green	3	
27 Dec 2018	MFE	Fine	3/8 (scattered)	Onshore	2 (small wavelets)	Clear, green/blue	4/1	
03 Jan 2019	MFE	Cloudy	6/8 (broken)	Onshore	2 (small wavelets)	Clear, blue/green	10/20 swimmers, 5 surfers	
07 Jan 2019	SEM	Overcast	7/8 (broken)	Onshore	2 (small wavelets)	Clear, blue/green	3/1 Surfer 2 Swimmers	Four seagulls on beach
10 Jan 2019	SEM	Cloudy	6/8 (broken)	Onshore	1 (ripples with appearance of scales)	Clear, blue	20+/20+	Two dogs on beach
17 Jan 2019	MFE	Fine	3/8 (scattered)	Onshore	1 (ripples with appearance of scales)	Clear, blue/green	15/16	One dog on beach
21 Jan 2019	SEM	Cloudy	8/8 (overcast)	Onshore	2 (small wavelets)	Slightly turbid, green/blue	15/18	Six seagulls on beach
23 Jan 2019	SEM	Fine	3/8 (scattered)	Onshore	2 (small wavelets)	Slightly turbid, green/blue	12/5	
30 Jan 2019	MFE	Fine	4/8 (scattered)	Onshore	1 (ripples with appearance of scales)	Clear, blue/green	20/10	Twelve seagulls on beach
04 Feb 2019	SEM	Fine, breezy	2/8 (few)	Onshore	2 (small wavelets)	Clear, blue	2 sunbathing/5 surfing/bodyboarding	One seagull on beach
11 Feb 2019	SEM	Fine	0/8 (fine)	Onshore	2 (small wavelets)	Clear, blue	0/approx. 40 school students + 2 others	
19 Feb 2019	SEM	Fine, light wind	5/8 (broken)	Onshore	2 (small wavelets)	Clear, blue/green	4/2 surfing	Six terns on beach

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
21 Feb 2019	SEM	Fine	8/8 (overcast)	No wind	1 (ripples with appearance of scales)	Clear, blue/green	0/0	Over ten birds on beach
01 Mar 2019	MFE	Fine, windy	0/8 (fine)	Upshore	3 (large wavelets)	Clear, grey/blue	0/0	20 seagulls on beach
05 Mar 2019	SEM	Fine, breezy	8/8 (overcast)	Onshore	3 (large wavelets)	Clear, grey/blue	2/1 surfer	One dog on beach
07 Mar 2019	SEM	Fine, light breeze	3/8 (scattered)	Onshore	2 (small wavelets)	Clear, blue	1/3 surfers	20 seagulls on beach
13 Mar 2019	MFE	Overcast, moderate rain	8/8 (overcast)	No wind	2 (small wavelets)	Clear, light green	2/0	Six seagulls on beach
20 Mar 2019	SEM	Fine, breezy	1/8 (few)	Onshore	3 (large wavelets)	Clear, blue	6/5 surfing	Two seagulls on beach
25 Mar 2019	MFE	Fine, light wind	2/8 (few)	Downshore	1 (ripples with appearance of scales)	Clear, blue/grey	3/0	Over 30 terns and six gulls on beach

Site: TASMAN SEA (Ohawe Beach - east of breakwater) (Site code: SEA906010)

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
07 Nov 2018	SEM	Fine, fairly strong wind	1/8 (few)	Offshore	1 (ripples with appearance of scales)	Turbid, green/grey	2/0	Two blackbirds on beach
10 Dec 2018	SEM	Fine, moderate wind	0/8 (fine)	Onshore	3 (large wavelets)	Turbid, brown/green	2/5 swimming	
18 Dec 2018	MFE	Fine, light breeze	3/8 (scattered)	Onshore	2 (small wavelets)	Slightly turbid, green/brown	10/8	Three dogs on beach, one dog in the water
27 Dec 2018	MFE	Overcast	7/8 (broken)	Downshore	2 (small wavelets)	Slightly turbid, brown/green	1/0	Three seagulls on beach. Slight foaming present on beach.
03 Jan 2019	MFE	Partly cloudy	5/8 (broken)	Onshore	2 (small wavelets)	Slightly turbid, brown/green	6/2 walking in water	
07 Jan 2019	SEM	Overcast	8/8 (overcast)	Downshore	1 (ripples with appearance of scales)	Turbid, green	0/0	
10 Jan 2019	SEM	Partly cloudy	6/8 (broken)	Downshore	1 (ripples with appearance of scales)	Slightly Turbid, green/grey	2 fishing/0	
17 Jan 2019	MFE		6/8 (broken)	Onshore	1 (ripples with appearance of scales)	Slightly turbid, green/blue	3/0	One seagull one beach
21 Jan 2019	SEM	Overcast	8/8 (overcast)	Downshore	1 (ripples with appearance of scales)	Turbid, green/grey	0/0	
23 Jan 2019	SEM	Fine, W breeze	2/8 (few)	Onshore	2 (small wavelets)	Turbid, brown	3/0	
30 Jan 2019	MFE	Fine, light NW	7/8 (broken)	Offshore	1 (ripples with appearance of scales)	Slightly turbid, green/blue	3/1 surfer	One dog on beach
04 Feb 2019	SEM	Fine, moderate breeze	6/8 (broken)	Downshore	2 (small wavelets)	Slightly turbid, blue/grey	3 dog walkers, 1 tractor, 2 fishing/1 jet skiing	Four dog and one seagull on beach
11 Feb 2019	SEM	Fine	1/8 (few)	Onshore	1 (ripples with appearance of scales)	Slightly turbid, grey/blue	3 walking/2 swimming	

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
19 Feb 2019	SEM	Fine, light wind	4/8 (scattered)	Downshore	2 (small wavelets)	Slightly turbid, green/brown	0/0	
21 Feb 2019	SEM	Fine	7/8 (broken)		2 (small wavelets)	Turbid, green/brown	2/1 surfer, 1 jet-ski	
01 Mar 2019	MFE	Fine, light breeze	0/8 (fine)	Onshore	1 (ripples with appearance of scales)	Slightly turbid, grey/blue	2/0	One seagull on beach
05 Mar 2019	SEM	Fine, moderate wind	8/8 (overcast)	Downshore	2 (small wavelets)	Turbid, grey	0/0	
07 Mar 2019	SEM	Fine, light breeze	1/8 (few)	Offshore	1 (ripples with appearance of scales)	Slightly turbid, grey/blue	3 fishing/0	
13 Mar 2019	MFE	Overcast, light wind	8/8 (overcast)	Downshore	2 (small wavelets)	Slightly turbid, grey/brown	3/0	Two dogs on beach
20 Mar 2019	SEM	Fine, moderate breeze	1/8 (few)	Upshore	2 (small wavelets)	Clear, blue	2 fishing/1 jet ski	
25 Mar 2019	MFE	Fine, light breeze	3/8 (scattered)	Downshore	3 (large wavelets)	Clear, green/brown	5 onshore/0	

Site: TASMAN SEA (Patea Beach) (Site code: SEA907020)

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
07 Nov 2018	SEM	Fine, fairly strong wind	0/8 (fine)	Offshore	4 (small waves)	Turbid, grey	0/0	Dead cow on beach
10 Dec 2018	SEM	Fine, windy	0/8 (fine)	Upshore	3 (large wavelets)	Slightly turbid, green/brown	0/0	
07 Jan 2019	SEM	Overcast	8/8 (overcast)	Downshore	2 (small wavelets)	Turbid, green/grey	1/0	Two seagulls on the beach. Slight foaming present on beach.
10 Jan 2019	SEM	Overcast	8/8 (overcast)	Downshore	2 (small wavelets)	Slightly turbid, blue/green	0/0	
21 Jan 2019	SEM	Overcast	7/8 (broken)	Downshore	2 (small wavelets)	Turbid, brown/green	0/0	Significant foaming present on beach.
23 Jan 2019	SEM	Fine	1/8 (few)	Downshore	2 (small wavelets)	Turbid, brown/green	0/0	Slight foaming present on beach.
04 Feb 2019	SEM	Fine, moderate breeze	2/8 (few)	Downshore	2 (small wavelets)	Turbid, grey green	2 fishing/0	
11 Feb 2019	SEM	Fine, light wind	0/8 (fine)	Onshore	2 (small wavelets)	Slightly turbid, turquoise blue	2/0	
19 Feb 2019	SEM	Fine, moderate wind	2/8 (few)	Downshore	3 (large wavelets)	Slightly turbid, green grey	0/0	
21 Feb 2019	SEM	Fine	8/8 (overcast)		3 (large wavelets)	Turbid, green/brown	1 fishing/0	
05 Mar 2019	SEM	Overcast, strong wind	8/8 (overcast)	Downshore	4 (small waves)	Slightly turbid, grey	2 walking/0	
07 Mar 2019	SEM	Fine, strong wind	1/8 (few)	Downshore	1 (ripples with appearance of scales)	Slightly turbid, grey/blue	2 fishing, 1 photographer/0	Two seagulls on the beach.

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
20 Mar 2019	SEM	Fine, slight breeze	2/8 (few)	Upshore	1 (ripples with appearance of scales)	Turbid, grey/blue	2 walking,1 fishing/0	Two dogs on the beach. Strong dead fish smell at site. Very high, strong waves.

Site: TASMAN SEA (Waverley Beach) (Site code: SEA907085)

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
07 Nov 2018	SEM	Fine	0/8 (fine)	No wind	2 (small wavelets)	Turbid, brown/grey	2 fishing/0	Large logs of driftwood in waves and on beach
10 Dec 2018	SEM	Fine, light breeze	0/8 (fine)	Onshore	2 (small wavelets)	Slightly turbid, green/brown	1/0	Sea foam present on beach
07 Jan 2019	SEM	Overcast, westerly breeze	7/8 (broken)	Downshore	2 (small wavelets)	Slightly turbid, green/grey	4 /2	
10 Jan 2019	SEM	Overcast	8/8 (overcast)	Downshore	1 (ripples with appearance of scales)	Slightly turbid, green/grey	0/3 swimmers	One dog in water
21 Jan 2019	SEM	Cloudy	6/8 (broken)	Downshore	2 (small wavelets)	Slightly turbid, green	0/0	
23 Jan 2019	SEM	Fine, strong W breeze	1/8 (few)	Downshore	2 (small wavelets)	Turbid, green/brown	0/0	Slight foaming present on beach
04 Feb 2019	SEM	Fine, light breeze	8/8 (overcast)	Downshore	1 (ripples with appearance of scales)	Clear, blue/green	0/0	
11 Feb 2019	SEM	Fine, light breeze	1/8 (few)	Onshore	2 (small wavelets)	Clear, turquoise blue	0/0	School of small mullet inshore
19 Feb 2019	SEM	Fine, light wind	1/8 (few)	Offshore	3 (large wavelets)	Slightly turbid, grey/green	0/0	Strong surge, floating debris and abundant sea foam.
21 Feb 2019	SEM	Fine	8/8 (overcast)		2 (small wavelets)	Slightly turbid, blue/green	3 fishing/0	
05 Mar 2019	SEM	Fine, light breeze	7/8 (broken)	Downshore	3 (large wavelets)	Turbid, grey	0/0	
07 Mar 2019	SEM	Fine, light breeze	0/8 (fine)	Downshore	1 (ripples with appearance of scales)	Slightly turbid, grey	1 walking/0	
20 Mar 2019	SEM	Overcast	8/8 (overcast)	No wind	1 (ripples with appearance of scales)	Slightly turbid, grey/blue	2 fishing/0	Strong waves.

Site: TASMAN SEA (Wai-inu Beach: centre) (Site code: SEA907095)

Collected date	Programme	Weather (general)	Cloud cover	Wind direction	Wind strength (Beaufort Scale)	Water appearance	Users (on beach / in water)	Miscellaneous (animals and other observations)
07 Nov 2018	SEM	Fine, light breeze	0/8 (fine)	Offshore	1 (ripples with appearance of scales)	Turbid, brown/grey	0/0	
10 Dec 2018	SEM		0/8 (fine)	Upshore	1 (ripples with appearance of scales)	Slightly turbid, green/brown	2/0	
07 Jan 2019	SEM	Partly cloudy, NW breeze	6/8 (broken)	Downshore	1 (ripples with appearance of scales)	Slightly turbid, brown/grey	0/0	Slight foaming on beach
10 Jan 2019	SEM	Overcast	8/8 (overcast)	Downshore	1 (ripples with appearance of scales)	Slightly turbid, green tinge	0/0	
21 Jan 2019	SEM	Overcast	6/8 (broken)	Offshore	2 (small wavelets)	Slightly turbid, brown/green	0	Two seagulls on beach
23 Jan 2019	SEM	Fine, W breeze	2/8 (few)	Downshore	2 (small wavelets)	Slightly turbid, brown/green	1/0	One dog on beach
04 Feb 2019	SEM	Fine, light N breeze	6/8 (broken)	Offshore	1 (ripples with appearance of scales)	Clear, blue	3 with boat, 3 fishing, 2 walking/0	
11 Feb 2019	SEM	Fine, light breeze	0/8 (fine)	Onshore	1 (ripples with appearance of scales)	Clear, turquoise blue	1/0	One dog on beach
19 Feb 2019	SEM	Fine, light breeze	0/8 (fine)	Offshore	1 (ripples with appearance of scales)	Clear, green/blue	0/2 swimming	
21 Feb 2019	SEM	Fine	8/8 (overcast)	Onshore	1 (ripples with appearance of scales)	Slightly turbid, green/brown	1/1 surfer	
05 Mar 2019	SEM	Fine, breezy	7/8 (broken)	Offshore	2 (small wavelets)	Turbid, grey	0/0	
07 Mar 2019	SEM	Fine, breezy	0/8 (fine)	Offshore	1 (ripples with appearance of scales)	Slightly turbid, grey/blue	0/0	
20 Mar 2019	SEM	Overcast, very foggy	8/8 (overcast)	Offshore	1 (ripples with appearance of scales)	Slightly turbid, grey/blue	1 fishing/1 boat	One dog on beach

Appendix III

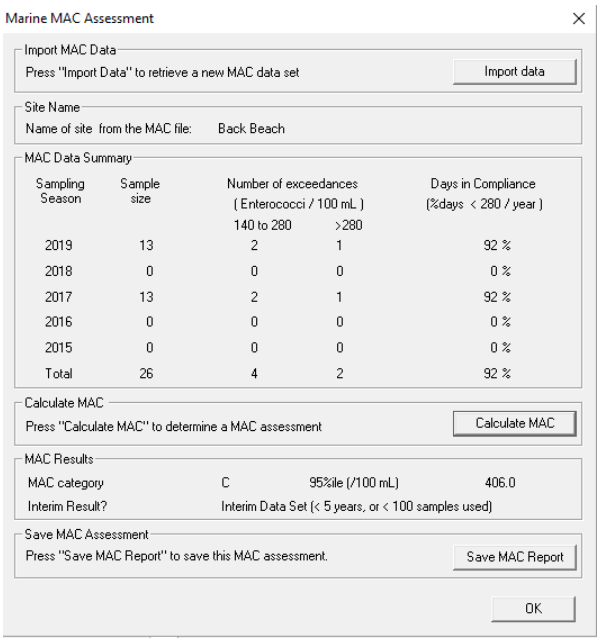
SFRG Assessments 2014-2019

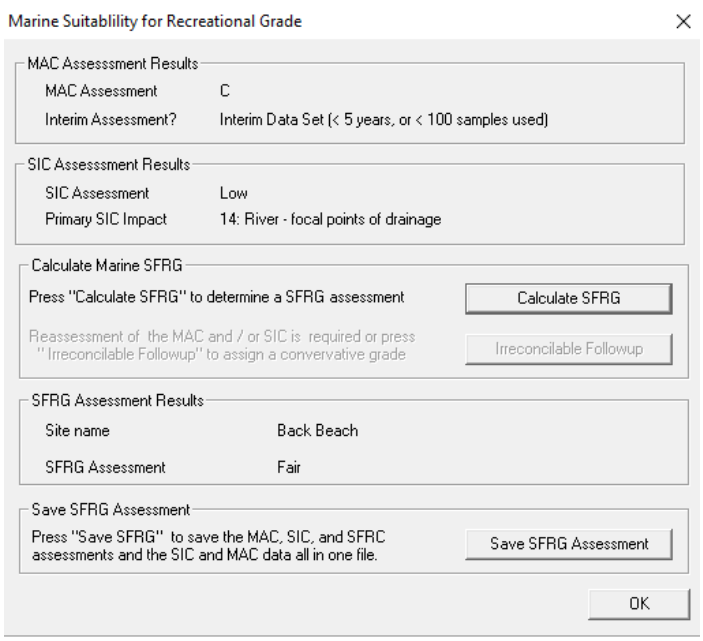
Site	Sanitary Inspection Category	MAC			SFRG Grade	%of all inspection in compliance
		95%ile	No of samples	Category		
Wai-iti	Moderate 13	664.0	26	D	Poor	96%
Urenui	Moderate 13	186.6	22	B	Good	95%
Onaero (SC)	Moderate 13	309.0	108	C	Fair	94%
Onaero Settlement	Low 14	114.0	20	B	Good	100%
Waitara (East)	Moderate 13	241.0	93	C	Fair	95%
Waitara (West)	Moderate 13	180.0	83	B	Good	97%
Bell Block	Moderate 3	ID	ID	ID	ID	ID
Fitzroy	Moderate 3	100.0	110	B	Good	97%
East End	Moderate 3	135.0	65	B	Good	98%
Ngamotu	Moderate 3	269.0	110	C	Fair	95%
Back Beach	Low 14	406.0	26	C	Fair	92%
Oakura (SC)	Moderate 13	213.5	109	C	Fair	96%
Oakura (CG)	Moderate 13	78.0	65	B	Good	100%
Opunake	Moderate 3	28.1	109	A	Good*	100%
Ohawe	Moderate 13	267.5	95	C	Fair	95%
Patea	Moderate 13	40.0	26	A	Good*	100%
Waverley	Moderate 13	27.4	26	A	Good*	100%
Waiinu	Moderate 13	41.6	26	B	Good	100%

* Irreconcilable Followup

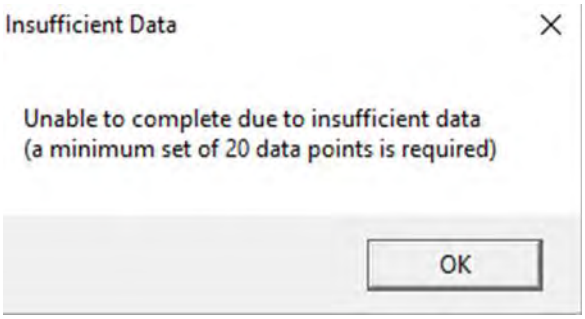
ID Insufficient data

Back Beach

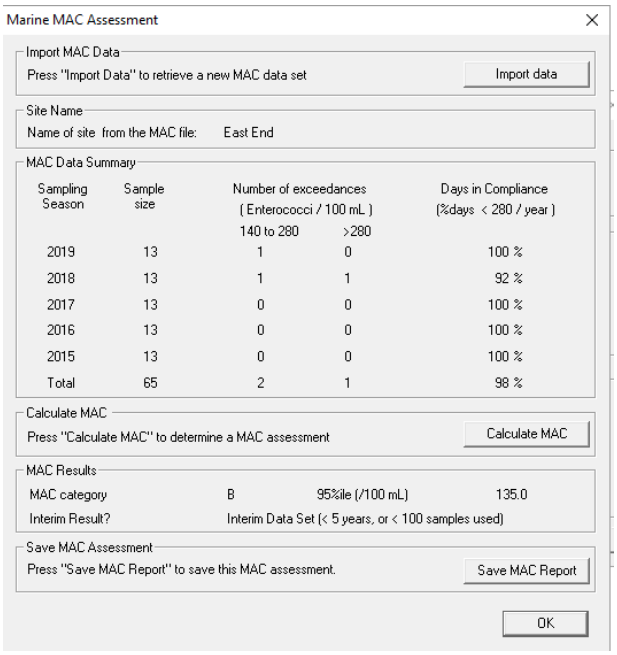


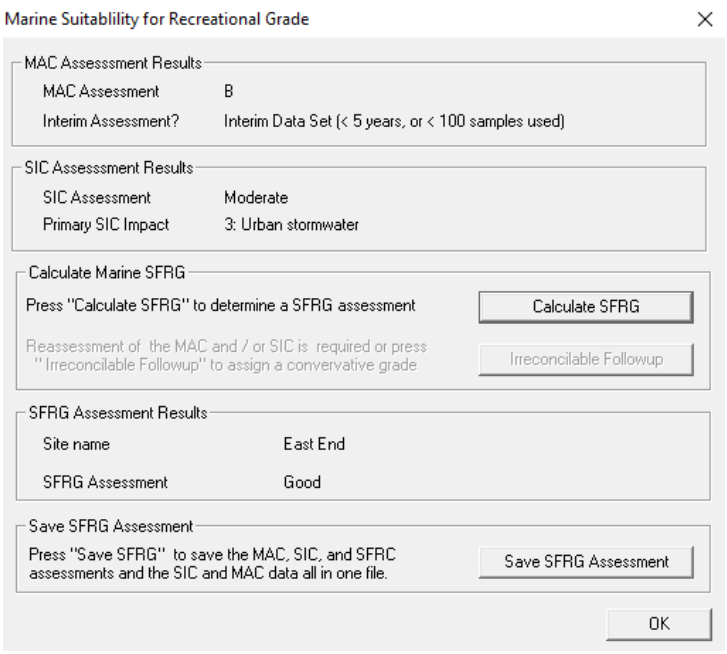


Bell Block



East End





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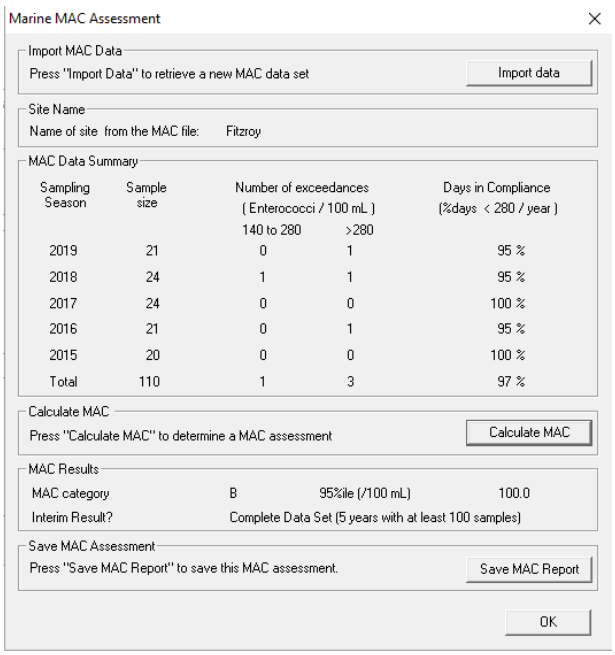

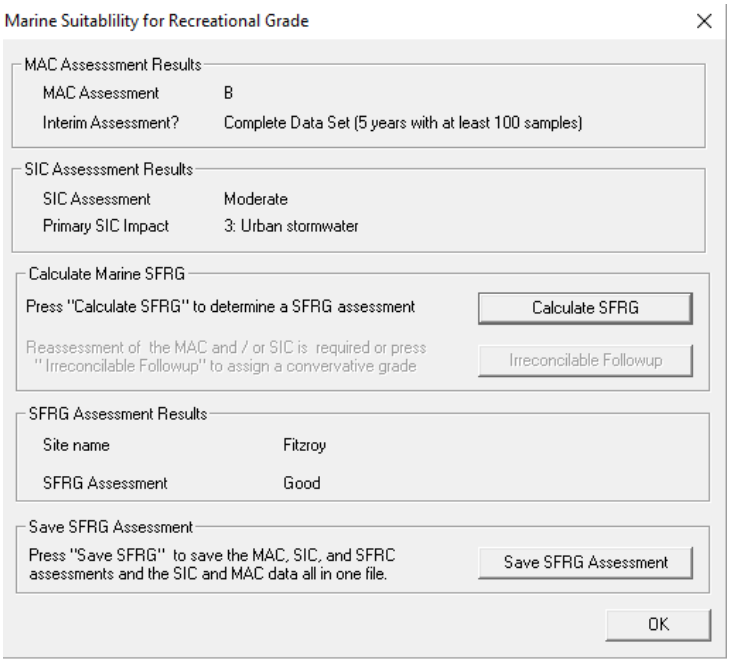

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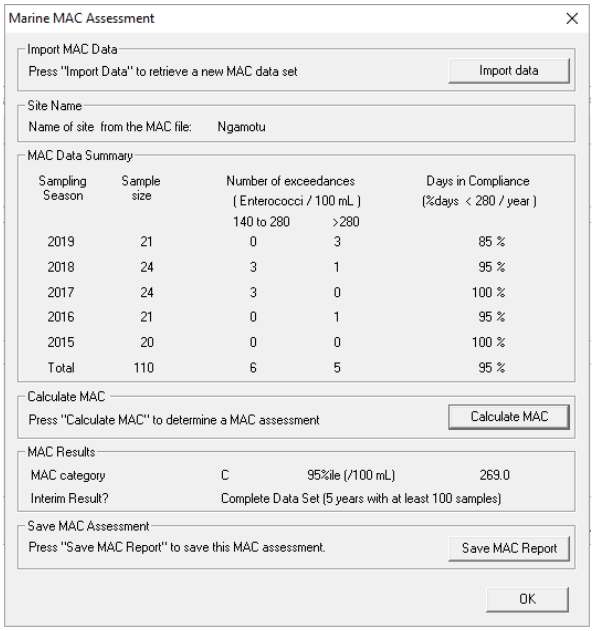
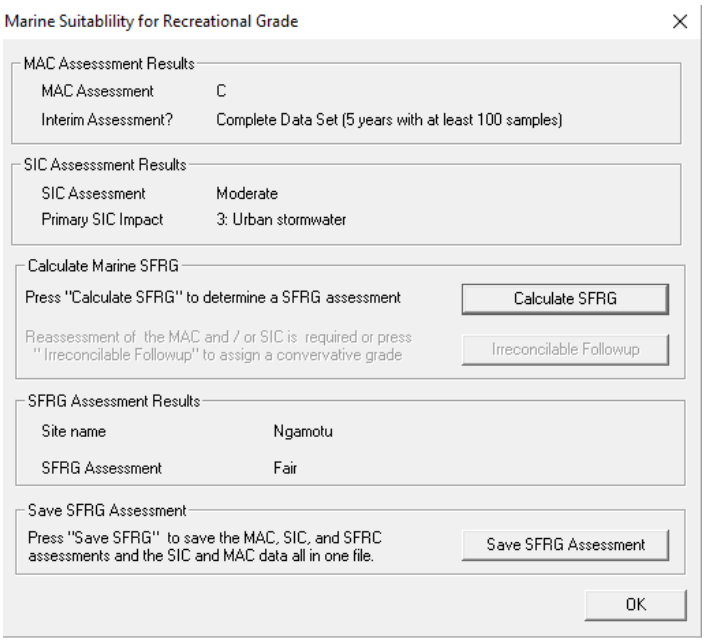
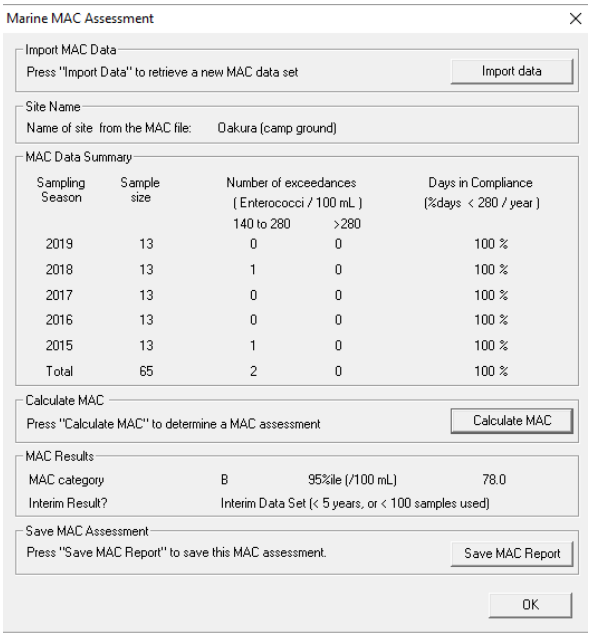
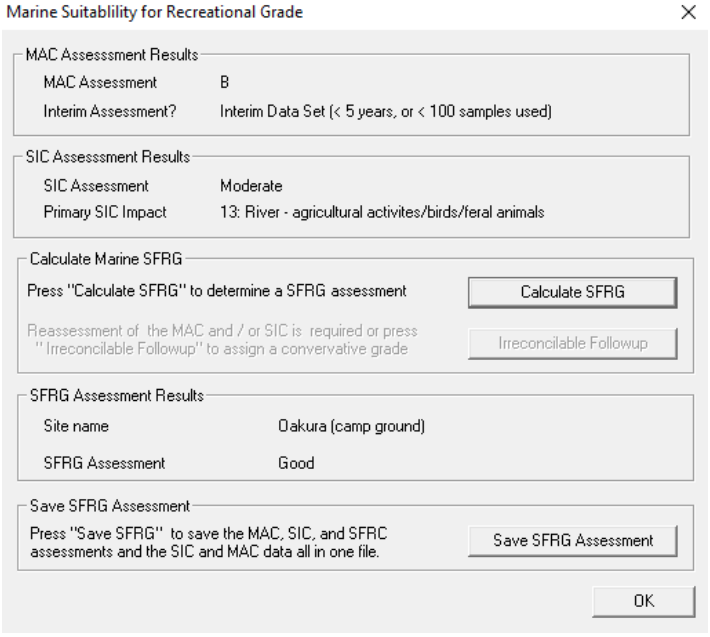


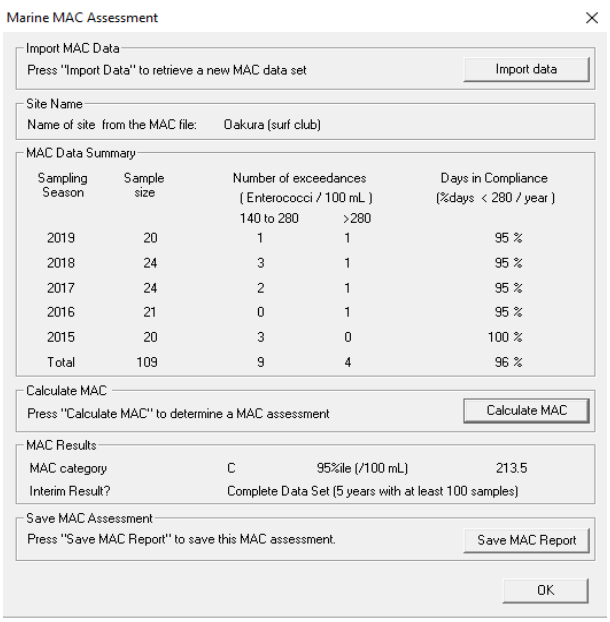


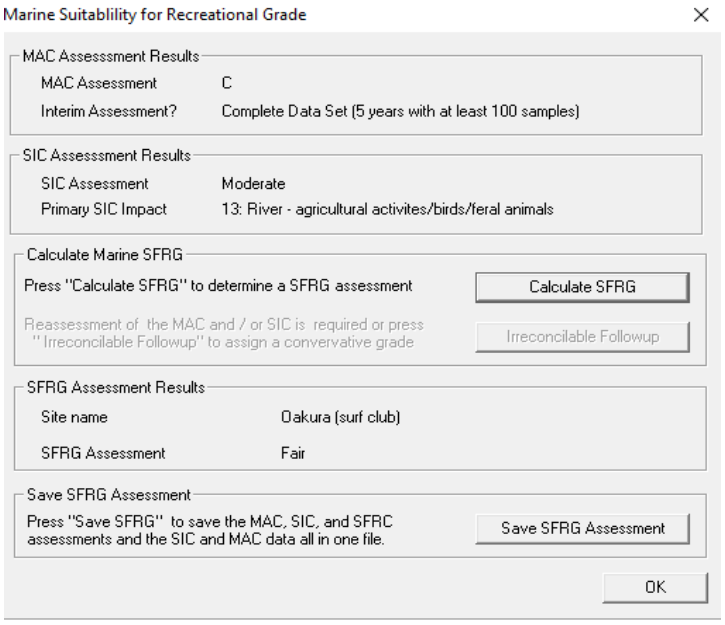
Oakura (Camp Ground)



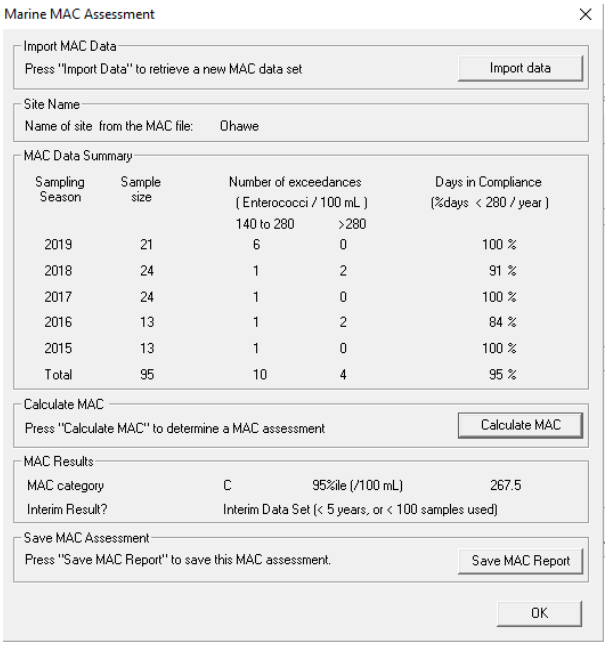


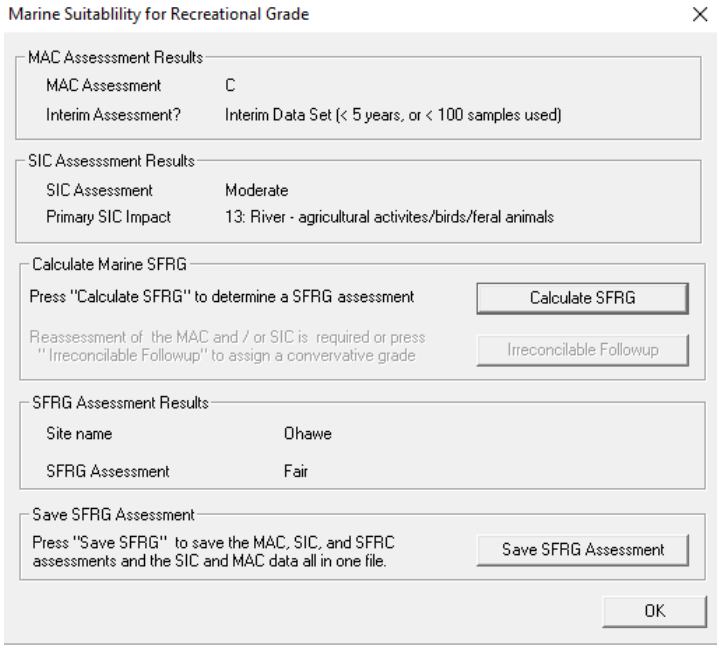
Oakura (Surf Club)



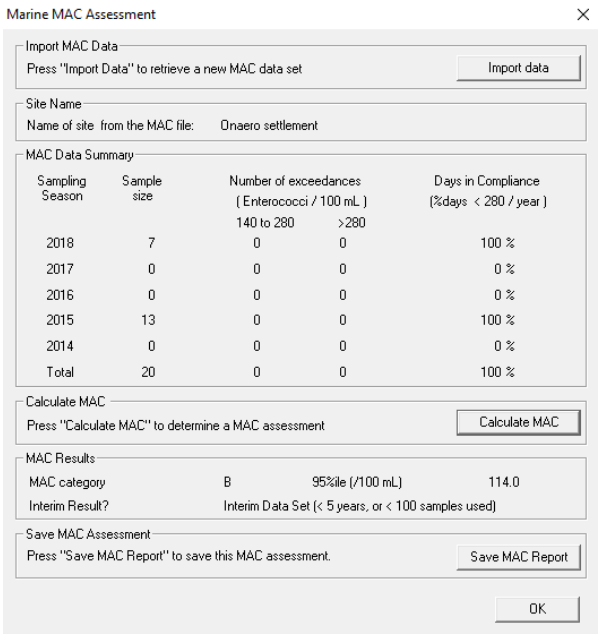


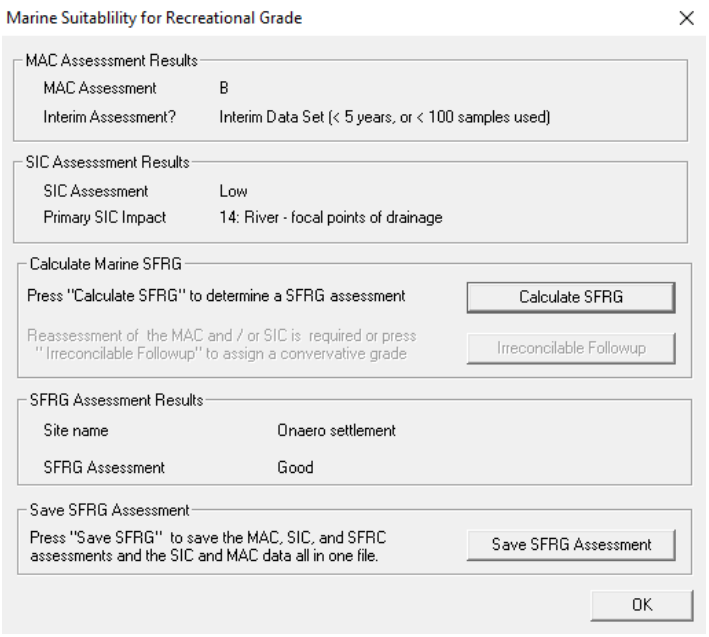
Ohawe



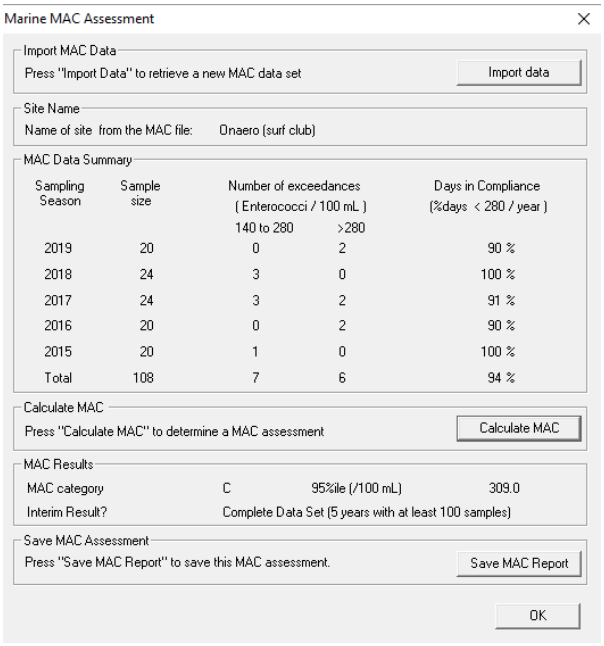


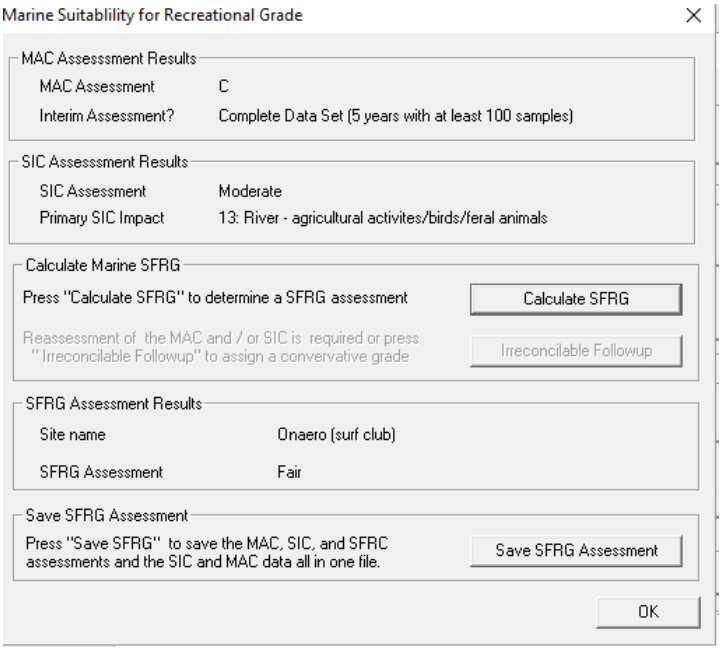
Onaero Settlement



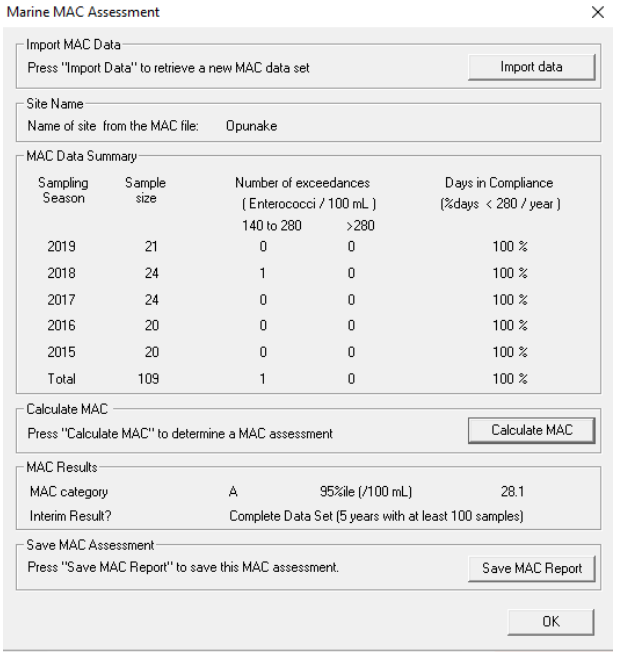


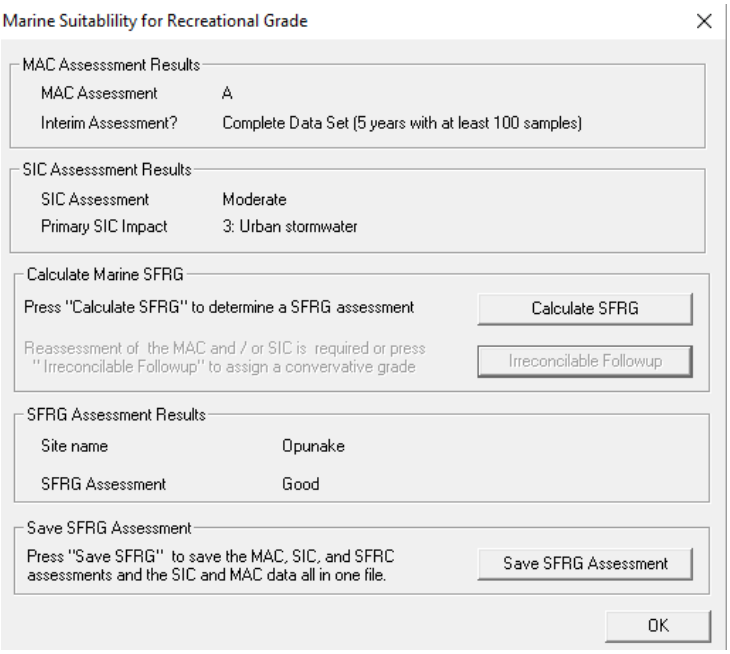
Onaero Surf Club



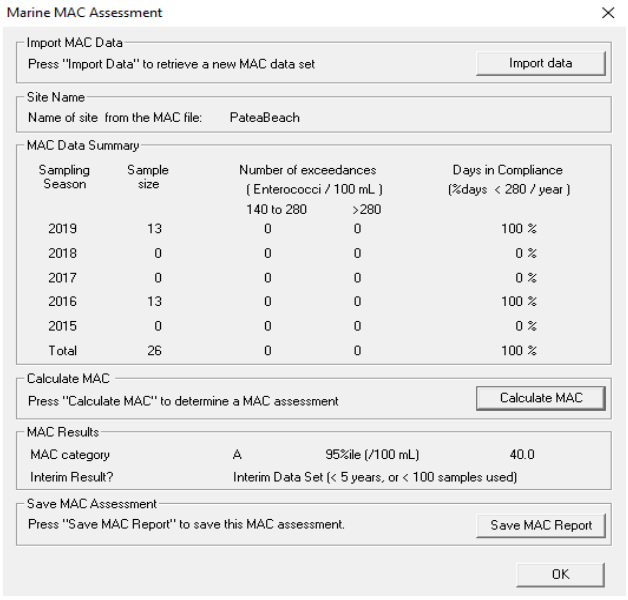


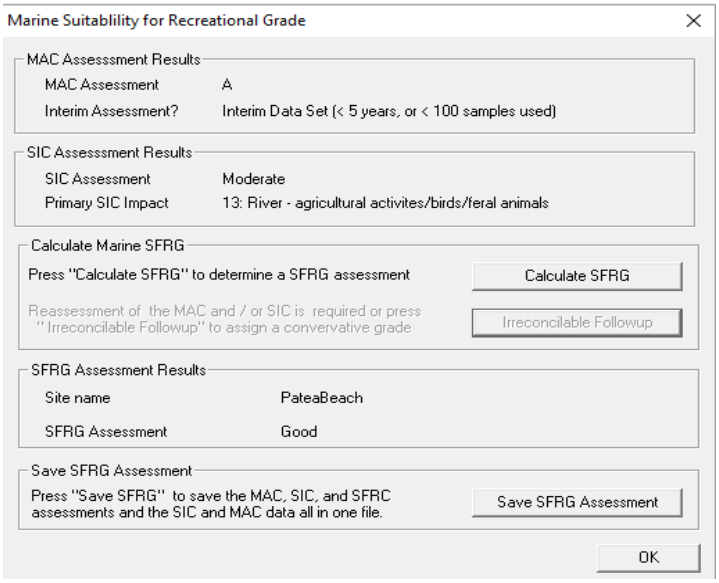
Opunake *



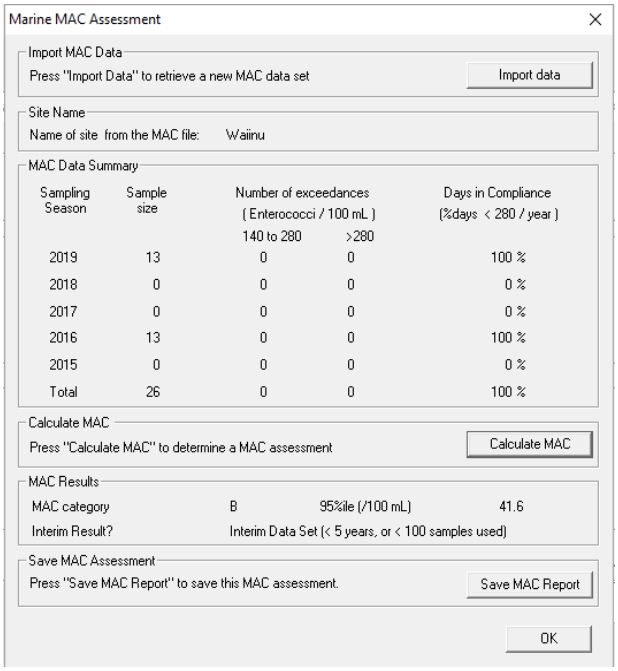


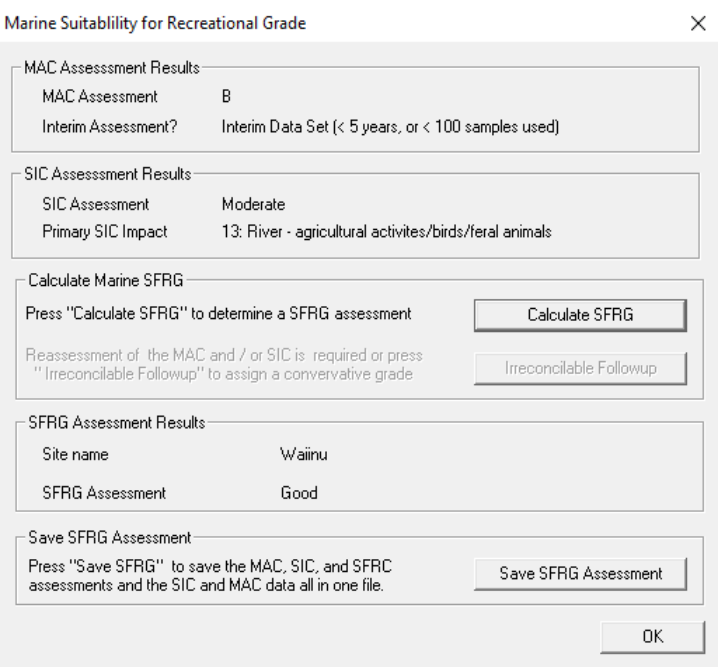
Patea



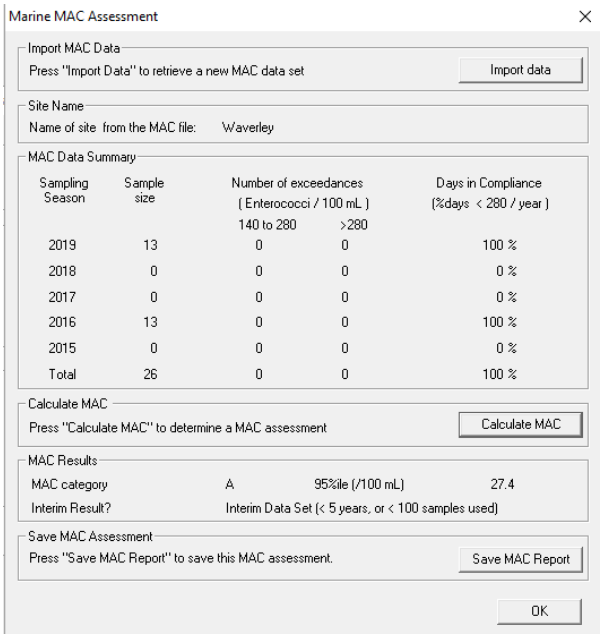


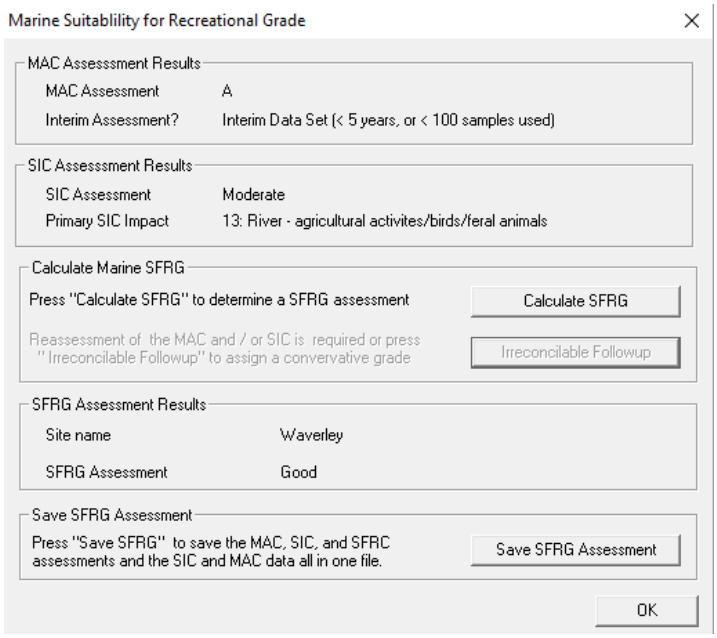
Waiinu



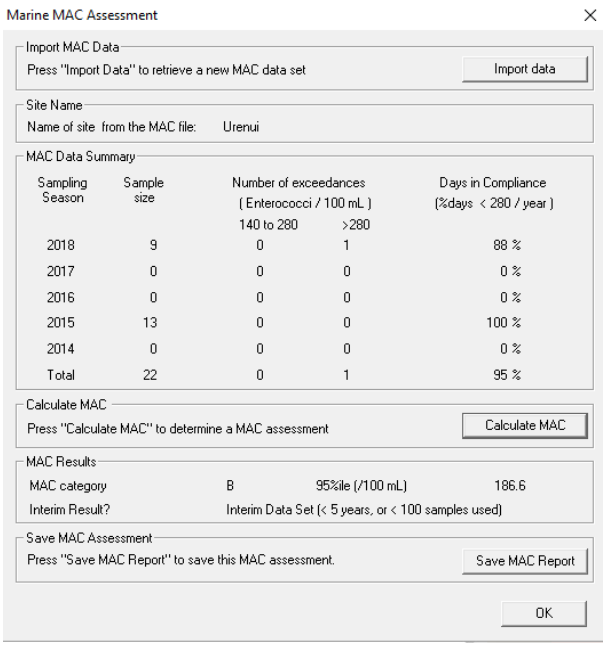


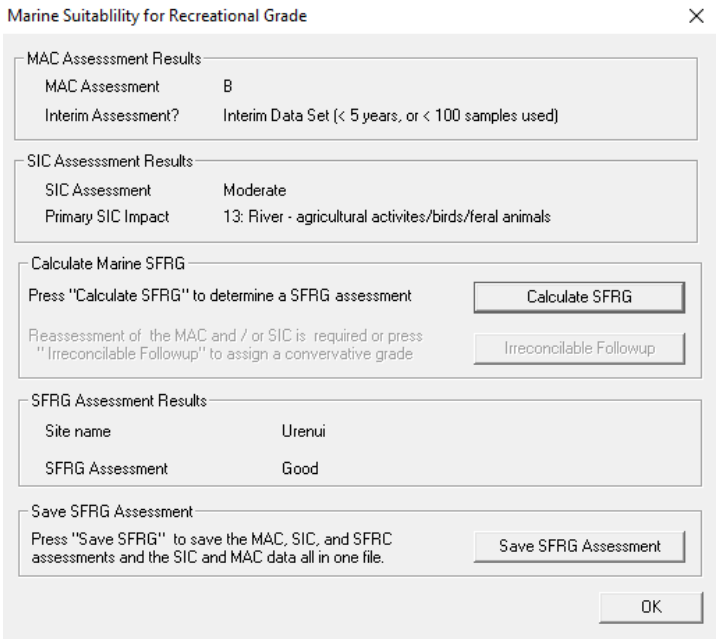
Waverley



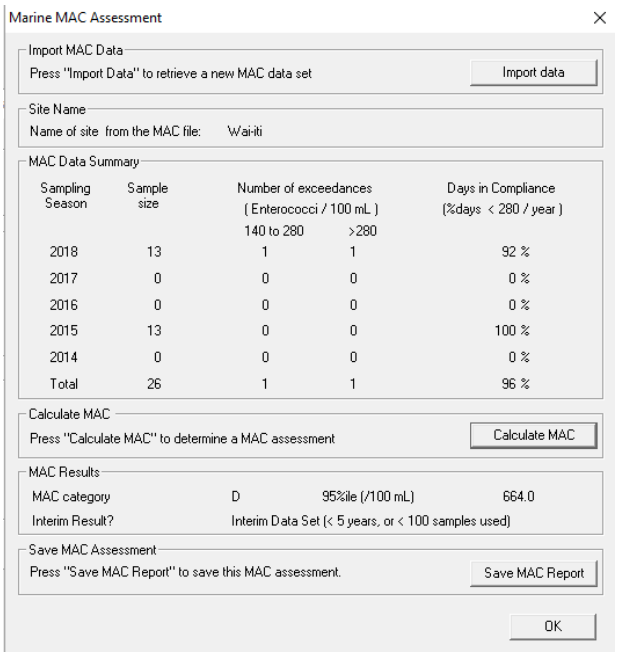


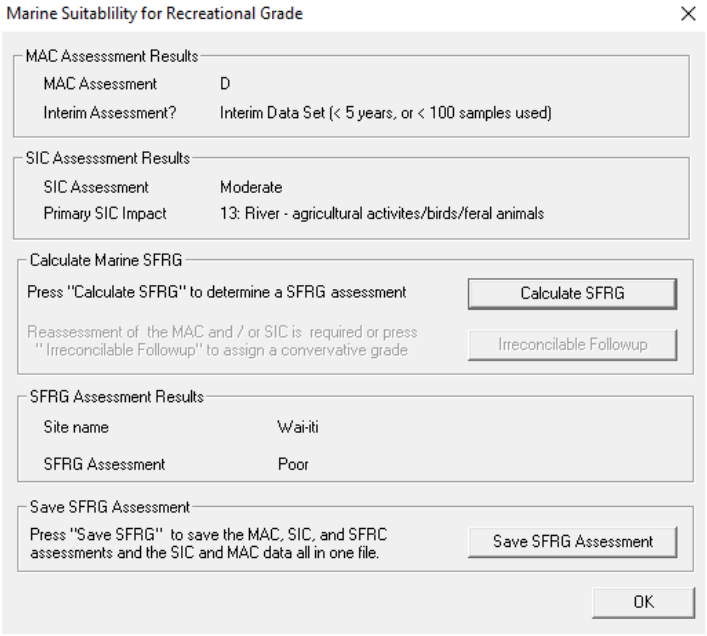
Urenui



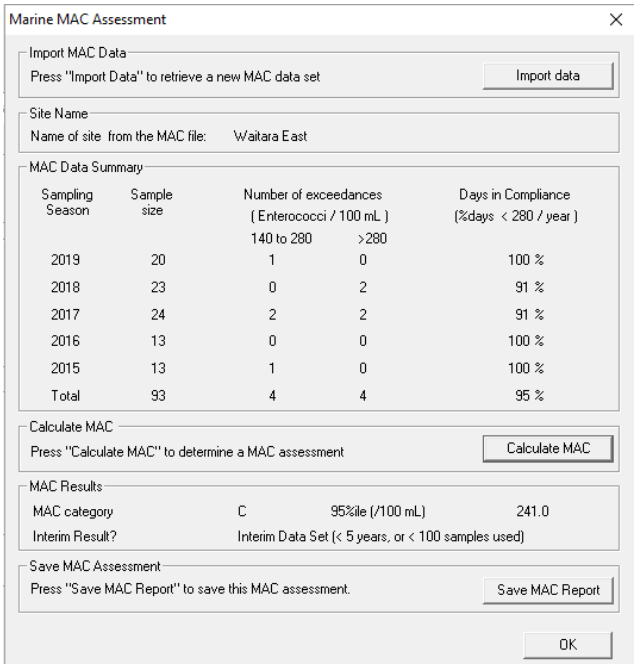


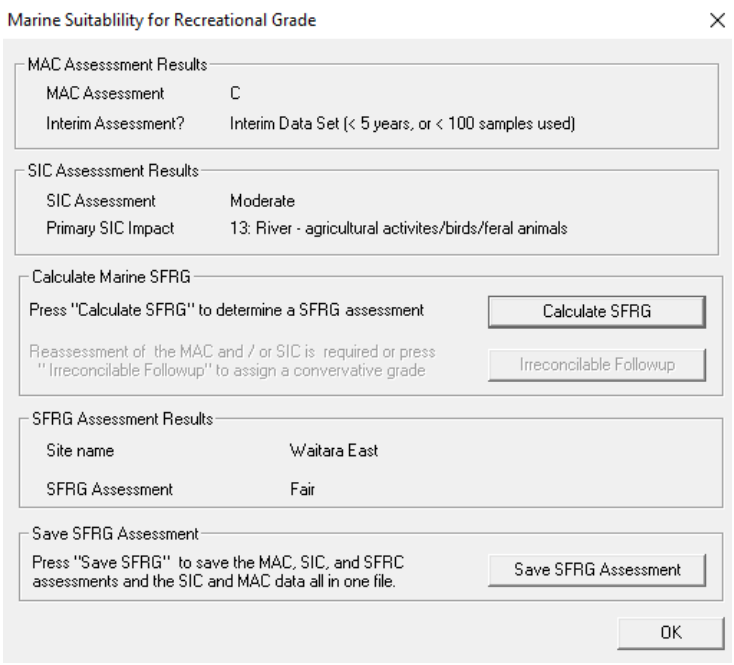
Wai-iti





Waitara (East)





Waitara (West)