



On the beaches 2010/11

Annual recreational water quality monitoring report
for the Wellington region

Quality for Life



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REGIONAL COUNCIL
Te Pane Matua Taiao



On the beaches 2010/11

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for the Wellington region

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1. Introduction

Regional and territorial authorities monitor recreational water quality to identify risks to public health from disease-causing organisms and advise the public of these risks. People can then make informed decisions about where, when, and how they use rivers and the marine environment for recreation.

Recreational water quality monitoring in the Wellington region over 2010/11 was once again a joint effort involving the Greater Wellington Regional Council (Greater Wellington) and its constituent local councils, in particular the Kapiti Coast District Council, Porirua City Council, Hutt City Council and Wellington City Council. Regional Public Health and Wairarapa Public Health were consulted on occasions when the results of the monitoring indicated a serious health risk might exist. During the summer bathing season, weekly water test results were collated by Greater Wellington and displayed at www.gw.govt.nz/on-the-beaches.

This report summarises the results of routine sampling undertaken over the 2010/11 summer bathing season (1 November 2010 to 31 March 2011 inclusive).

2. Recreational water quality in the Wellington region

From the start of the 2000/01 summer, recreational water quality monitoring in the Wellington region has been a joint effort involving Greater Wellington and its constituent local councils. The sites monitored reflect their use by the public for contact recreation; in particular, swimming, canoeing, rafting, surfing, and boating.

2.1 Monitoring objectives

The aims of Greater Wellington's recreational water quality monitoring programme are to:

1. Determine the suitability of selected sites in marine and fresh waters for contact recreation;
2. Determine the suitability of marine water in designated areas for the gathering of shellfish for human consumption;
3. Assist in safeguarding public health and the environment;
4. Provide a mechanism to determine the effectiveness of regional plans;
5. Provide information to assist in determining spatial and temporal changes in the environment (State of the Environment (SoE) monitoring); and
6. Provide information to assist in targeted investigations where remedial action or mitigation of poor water quality is desired.

2.2 Microbiological water quality indicators and guidelines

Water contaminated by human or animal excreta may contain a diverse range of pathogenic (disease-causing) micro-organisms such as bacteria, viruses, and protozoa (e.g., salmonella, campylobacter, cryptosporidium, giardia, etc). These organisms may pose a health hazard when the water is used for recreational activities such as swimming. The most common illness from swimming in contaminated water is gastroenteritis, but recent evidence shows that respiratory illness and skin infections are also quite common. In most cases, the ill-health effects from exposure to contaminated water are minor and short-lived, although the potential for more serious diseases such as Hepatitis A, Giardiasis, Cryptosporidiosis, Campylobacteriosis, and Salmonellosis can not be discounted. It is likely that many cases of illness contracted through contact recreation activities in contaminated water go unreported.

In 2003 the Ministry for the Environment (MfE) and the Ministry of Health (MoH) finalised microbiological water quality guidelines for recreational waters which are based on an assessment of the risk from exposure to contaminated water. These guidelines use bacteriological indicators associated with the gut of warm-blooded animals to assess the risk of faecal

contamination and therefore the potential presence of harmful pathogens¹. The indicators used are:

- Freshwater (including estuarine waters): *Escherichia coli* (*E. coli*)
- Marine waters: Enterococci
- Recreational shellfish-gathering waters: Faecal coliforms

Compliance with the MfE/MoH (2003²) microbiological water quality guidelines (from this point on referred to as *the recreational water quality guidelines*) should ensure that people using water for contact recreation are not exposed to significant health risks. The guideline values are outlined in Sections 3 (fresh waters), 4 (marine waters), and 5 (shellfish gathering waters) of this report. The guidelines for fresh and marine waters are essentially "trigger" values to help water managers determine when management intervention is required. The "trigger" values underpin a three-tier management framework analogous to traffic lights (Table 2.1).

Table 2.1: Three-tier management framework for recreational waters advocated by MfE/MoH (2003)

Mode	Management response
Green/Surveillance	Routine monitoring
Amber/Alert	Increased monitoring, investigation of source and risk assessment
Red/Action	Closure, public warnings, increased monitoring and investigation of source

2.2.1 Beach grading

The MfE/MoH (2003) guidelines outline a process to grade the suitability of marine and fresh waters for recreational use from a public health perspective. This involves combining a qualitative assessment of the susceptibility of a recreational site to faecal contamination, and direct measurements of the appropriate bacteriological indicator at the site to generate a "Suitability for Recreation Grade" (SFRG) for the site. The SFRG describes the general condition of the water at a site at any given time.

SFRGs have already been determined for recreational sites in the Wellington region using microbiological data obtained from routine weekly sampling over the 2001/02 to 2005/06 summer bathing seasons (Milne & Wyatt 2006). Updated SFRGs reflecting the 2006/07-2010/11 microbiological water quality results are summarised in Appendix 3.

¹ Indicator bacteria are monitored because individual pathogenic organisms are often present in very low numbers, can be hard to detect, and the analytical tests are expensive.

² The guidelines were published in June 2002 and updated in June 2003.

3. Recreational water quality in freshwaters

3.1 Introduction

Recreational water quality was monitored at 23 river sites across the Wellington region over 2010/11 (Figure 3.1, Appendix 1), as follows:

- Kapiti Coast District – 4 sites
- Hutt and Wainuiomata river catchments – 7 sites
- Wairarapa – 12 sites

The sites monitored reflect their use by the public for contact recreation; in particular, swimming and boating³.

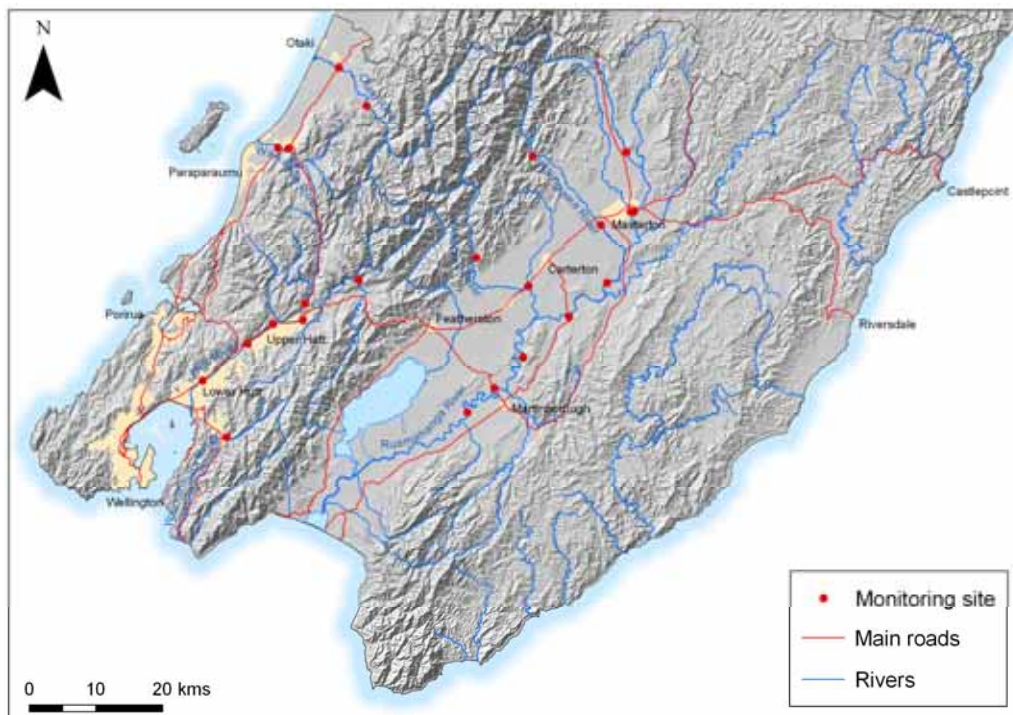


Figure 3.1: Freshwater recreation sites monitored over 2010/11

3.2 Monitoring protocol

Sites were sampled weekly – for 20 weeks – during the bathing season, with the exception of the Otaki River at Pots (near Pukehinau on the Kapiti Coast) and the Waiohine River at Gorge (Wairarapa) which were sampled monthly under Greater Wellington’s Rivers State of the Environment (RSoE) monitoring programme⁴. On each sampling occasion a single water sample was collected 0.2 metres below the surface in 0.5 metres water depth and analysed for *E. coli* indicator bacteria using a membrane filtration method.

³ The recreational water quality monitoring programme does not include monitoring of artificial water-bodies such as Henley Lake in Masterton or water-bodies on private land such as Lake Waitawa on the Kapiti Coast.

⁴ Historically these sites were sampled separately under two Greater Wellington water quality monitoring programmes; recreational water quality and RSoE water quality. As both river sites have a “very low” to “low” risk of microbiological contamination and a high level of compliance with recreational water quality guidelines, Milne & Wyatt (2006) recommended that routine weekly sampling under the recreational water quality monitoring programme cease; the monthly microbiological water quality results obtained from these sites under the RSoE monitoring programme are now used to assess recreational water quality.

This analytical method provides a result in 24 hours, therefore enabling prompt re-sampling in the event that a result exceeds recommended guideline values.

Measurements of water temperature and turbidity, and visual estimates of periphyton (algae) cover, were also made at each site. An estimate of the daily rainfall in the catchment adjoining each site over the bathing season was made by obtaining records from the nearest rain gauge. Rainfall can have a significant impact on water quality, as a result of runoff from rural or urban land and re-suspension of riverbed sediments.

A list of field and laboratory methods can be found in Appendix 2.

3.3 Guidelines

3.3.1 Microbiological guidelines

As outlined in Section 2.2, the MfE/MoH (2003) recreational water quality guidelines use bacteriological "trigger" values to help water managers determine when management intervention is required. The "trigger" values underpin a three-tier management framework analogous to traffic lights (Table 3.1).

Table 3.1: MfE/MoH (2003) surveillance, alert and action levels for fresh waters

Mode	Guideline <i>E. coli</i> (cfu/100 mL)	Management response
Green/Surveillance	Single sample ≤ 260	Routine monitoring
Amber/Alert	Single sample > 260 and ≤ 550	Increased monitoring, investigation of source and risk assessment
Red/Action	Single sample > 550	Closure, public warnings, increased monitoring and investigation of source

When water quality falls in the "surveillance mode", this indicates that the risk of illness from bathing is acceptable (for freshwaters the accepted level of risk is 8 in every 1,000 bathers). If water quality falls into the "alert" category, this indicates an increased risk of illness from bathing, but still within an acceptable range. However, if water quality enters the "action" category, then the water poses an unacceptable health risk from bathing (MfE/MoH 2003). At this point, warning signs are erected at the bathing site, and the public is informed that it is unsafe to swim at that site. The only time a warning is unlikely to be issued is when an action level result is preceded by rainfall. This is because it is widely known that rainfall is highly correlated with elevated bacteria counts in rivers (see Section 3.6). For this reason Greater Wellington and the Ministry of Health advise avoiding swimming and other contact recreation activities in freshwaters during and for up to several days after heavy rainfall.

3.3.2 Nuisance periphyton guidelines

In fresh waters, excessive amounts of periphyton can reduce the amenity value of waterways by decreasing their aesthetic appearance, reducing visibility, and being a physical nuisance to swimmers.

The MfE (2000) periphyton⁵ guidelines provide two maximum thresholds for periphyton cover in gravel/cobble bed streams managed for aesthetic and recreational values: 30% filamentous algae >2 cm long, and 60% cover for diatoms/cyanobacteria >0.3 cm thick. These thresholds relate to the visible areas of stream bed only.

3.3.3 Interim cyanobacteria guidelines

Growth of benthic cyanobacteria in rivers can pose a health risk as some species produce toxins which are harmful to humans and animals, particularly dogs (Milne & Watts 2007, MfE/MoH 2009).

In 2009, interim New Zealand guidelines for cyanobacteria in recreational lakes and rivers were released (MfE/MoH 2009) for trial by monitoring and health agencies⁶. The interim guidelines for rivers identify a three-tiered alert level framework for benthic cyanobacteria (Table 3.2) which was based on a system that has been applied in the Wellington region for the past two years. Alert and action level signs used to warn the public of the risk from benthic cyanobacteria are shown in Figure 3.2.

Table 3.2: Alert-level framework for benthic cyanobacteria cover in rivers (Modified from MfE/MOH 2009)

Alert level	Guideline	Management action
Surveillance (green mode)	≤20% coverage of potentially toxic cyanobacteria attached to substrate.	Undertake routine monitoring.
Alert (amber mode)	20-50% coverage of potentially toxic cyanobacteria attached to substrate.	Notify public health, erect signs with information on appearance of mats and potential risks and consider testing for cyanotoxins.
Action (red mode)	>50% cyanobacteria coverage or cyanobacteria are visibly detaching from substrate and accumulating on the river's edge or becoming exposed on river's edge and the river level drops.	Notify public health unit, notify the public of potential risk to health, and consider testing for cyanotoxins.

In the Wellington region, the response to toxic algal blooms in rivers is managed by a working party of Regional Public Health, Wairarapa Public Health, Territorial Authority and Greater Wellington staff. Close monitoring of 'flushing' river flows⁷ and the potential for occurrence of cyanobacteria blooms is a critical part of this process.

⁵ Periphyton refers to the slime coating on a riverbed, composed largely of algae and cyanobacteria.

⁶ The interim version of the cyanobacteria guidelines will be trialled until the end of the 20011/12 summer at which point they will be revised based on feedback from practitioners and released as a final version.

⁷ A 'flushing' flow is a high river flow (usually defined as 3x the median river flow) that generally follows a heavy rainfall event and can 'scour' periphyton from the riverbed.



Figure 3.2: Alert (left) and action (right) level warnings signs used to inform the public of the health risk from cyanobacterial mats in rivers in the Wellington region

3.4 Data analysis

All results have been assessed in accordance with the MfE/MoH (2003) recreational water quality guidelines for fresh waters (Table 3.1), the nuisance periphyton guidelines outlined in Section 3.3.2 and the interim cyanobacteria guidelines (Table 3.2).

3.5 Results

Action level *E. coli* results recorded during routine weekly sampling over the 2010/11 summer are summarised below for bathing sites on Kapiti Coast, Hutt, Wainuiomata and Wairarapa rivers. The number of surveillance, alert and action level results recorded at each of the 23 bathing sites are summarised in Appendix 3. Follow-up sampling is generally conducted when a routine sample returns a result that exceeds the alert or action guideline. The key exception is when routine sampling coincides with, or is followed by, heavy rainfall and elevated river flows. Only action level-related follow-up sampling results are discussed here.

3.5.1 Kapiti

Only one of the four freshwater bathing sites on the Kapiti Coast exceeded the action guideline of 550 cfu/100 mL during the 2010/11 bathing season:

- 19 January 2011 – Otaki River at State Highway 1 (2,100 cfu/100 mL).

This exceedance coincided with 39 mm of rainfall in the 24 hours prior to sampling. The result from a sample taken the following day complied with the alert guideline and no further action was taken.

The Otaki River at State Highway 1 site exceeded the filamentous periphyton cover guideline on 22 March 2011. There were no exceedances of the guideline for mat periphyton.

The alert level cyanobacteria guideline of 20% cover was exceeded at the Waikanae River at Jim Cooke Park site on 23 November prompting Kapiti Coast District Council (KCDC) to erect warning signs at key river access points in the area. The action level guideline was breached at both Waikanae River sites at (State Highway 1 and Jim Cooke Park) on 11 March due to the presence of dislodged cyanobacterial mats on the river's edge. Action level warning signs were put up along the lower reaches of the river by KCDC staff and remained in place until 11 April when a fresh occurred.

3.5.2 Hutt and Wainuiomata

Five of the seven bathing sites in the Hutt and Wainuiomata river catchments exceeded the action guideline on at least one occasion during the summer bathing season. The action level events recorded in the Hutt and Wainuiomata river catchments during 2010/11 were:

- 14 December 2010 – The Hutt River at Birchville (1,640 cfu/100 mL), Maoribank Corner (1,740 cfu/100 mL) and Silverstream (620 cfu/100 mL).
- 8 February 2011 – The Hutt River at Maoribank Corner (640 cfu/100 mL), Hutt River at Silverstream (640 cfu/100 mL) and Hutt River at Boulcott (740 cfu/100 mL), as well as the Wainuiomata River at Richard Prouse Park (580 cfu/100 mL).
- 22 February 2011 – The Hutt River at Boulcott (600 cfu/100 mL).

Action guideline exceedances on 14 December and 8 February coincided with 8 and 28 mm of rainfall in the 72 hours prior to sampling respectively. Although no rainfall was recorded in the three days prior to the exceedance at Boulcott on 22 February, 6.5 mm of rainfall was recorded on the day of sampling. On all occasions follow up samples collected the next day complied with the surveillance guideline.

The Wainuiomata River at Richard Prouse Park exceeded the filamentous periphyton cover guideline on ten separate occasions throughout the bathing season. The Hutt River at Boulcott exceeded the filamentous periphyton guideline on 16 November. This site also exceeded the mat periphyton guideline on 7 December.

Coverage of potentially toxic cyanobacteria mats frequently exceeded the alert level guideline of 20% at all sites along the Hutt River. The alert level guideline was first exceeded at the Hutt River at Birchville site on 23 November, then at Hutt River at Poets Park on 7 December. Alert level warning signs were erected at key river access points in these areas by the Upper Hutt City Council. On 3 December action level signs were erected at Hutt River at Birchville due to the presence of large amounts of dislodged mats on the river's edge and extended down to Hutt River at Silverstream on

8 December. On 11 December a dog died after coming into contact with cyanobacteria mats near Melling; this resulted in action level warning signs being extended down to the river mouth.

Action level warning signs along the Hutt River were replaced with alert level signs on 21 December following a fresh that removed the majority of cyanobacterial mats from the river bed.

The action level guideline of 50% cyanobacteria cover was again exceeded on 22 March at the Hutt River at Silverstream and Hutt River at Boulcott sites. High risk warning signs were erected at key access points in these areas and remained in place until 11 April when a fresh occurred.

3.5.3 Wairarapa

Nine of the 12 river bathing sites monitored in the Wairarapa exceeded the action guideline during the summer bathing season on at least one occasion:

- 21 December 2010 – Waingawa River at South Road (1,460 cfu/100 mL), Waiohine River at State Highway 2 (1,320 cfu/100 mL) and Ruamahanga River at Morrisons Bush (1,640 cfu/100 mL).
- 29 December 2010 – Waipoua River at Colombo Road (840 cfu/100 mL), Ruamahanga River at The Cliffs, (740 cfu/100 mL), Ruamahanga River at Kokotau (1,000 cfu/100 mL), Ruamahanga River at Waihenga (1,060 cfu/100 mL) and Ruamahanga River at Bentleys Beach (560 cfu/100 mL).
- 25 January 2011 – Ruamahanga River at Te Ore Ore (2,380 cfu/100 mL), Waipoua River at Colombo Road (740 cfu/100 mL), Ruamahanga River at The Cliffs, (1,980 cfu/100 mL), Ruamahanga River at Kokotau (2,320 cfu/100 mL), Ruamahanga River at Morrisons Bush (1,380 cfu/100 mL), Ruamahanga River at Waihenga (1,360 cfu/100 mL) and Ruamahanga River at Bentleys Beach (1,120 cfu/100 mL).
- 22 March 2011 – Waipoua River at Colombo Road (900 cfu/100 mL) and Waingawa River at South Road (3,700 cfu/100 mL).

All breaches of the action guideline coincided with at least 10 mm rainfall in the 72 hours prior to sampling. Follow up samples taken after the exceedances on 21 December complied with the surveillance guideline. No follow up samples were taken after exceedances on the 29 December, 25 January and 22 March as they coincided with high rainfall. Based on previous data collected at these sites, it is expected that *E. coli* counts will comply with the surveillance guideline within three days once rainfall has stopped.

All Ruamahanga River sites exceeded the filamentous periphyton cover guideline at least once throughout the bathing season. Out of a total of twelve exceedances, all but two occurred from late February onwards. There were no exceedances of the 60% cover guideline for mat-forming algae.

Cyanobacteria growth in the Waipoua River at Colombo Road exceeded the alert level guideline on 15 February and the action guideline a week later. Following the action level exceedance, Masterton District Council staff erected warning signs at key river access points; these stayed in place for the remainder of the bathing season.

The alert level guideline for cyanobacteria was exceeded at Ruamahanga River at Te Ore Ore on 1 March and again on sampling occasions from 15 March until the end of the bathing season. However, no warning signs were put in place at this site.

3.6 Synthesis

Of the 21 freshwater sites monitored weekly over the 2010/11 summer bathing season, 15 (71.4%) exceeded the action guideline on at least one occasion (Table 3.3).

Table 3.3: Summary of action guideline breaches from routine weekly monitoring at 21 freshwater sites over the 2010/11 summer bathing season†

No. of times site exceeded the action guideline	No. of sites in each exceedance category			Total no. of sites (21)	% of sites
	Kapiti (3 sites)	Hutt and Wainuiomata (7 sites)	Wairarapa (11 sites)		
0	2	2	2	6	28.6
1	1	2	2	5	23.8
2	0	3	6	9	42.9
3	0	0	1	1	4.8

† This analysis excludes Otaki River at The Pots (Kapiti) and Waiohine River at Gorge (Wairarapa); these sites are only sampled monthly under Greater Wellington's RSoE water quality monitoring programme.

A total of 26 out of 420 (6.2%) routine sample results exceeded the action guideline of 550 cfu/100 mL. This was more than in the 2009/10, 2008/09, and 2007/08 summers where only 18, 23 and 23 exceedances occurred, respectively (Ryan & Warr 2010, Warr 2009, Ryan & Warr 2008).

The majority (22) of the 26 action level results were associated with at least 10mm of rainfall in the 72 hours prior to sampling. This finding is consistent with previous observations; elevated *E. coli* counts in fresh water are typically related to diffuse-source runoff, urban stormwater (including sewer overflows), and re-suspension of sediments during rainfall events (Milne 2005, Milne & Wyatt 2006).

4. Recreational water quality in marine waters

4.1 Introduction

Recreational water quality was monitored at 74 marine sites across the Wellington region over 2010/11 (Figure 4.1, Appendix 1), as follows:

- Kapiti Coast District – 20 sites
- Porirua City – 13 sites
- Hutt City – 15 sites
- Wellington City – 21 sites
- Wairarapa – 5 sites

One site in Porirua City – the Pauatahanui Inlet at Browns Bay – remained in the monitoring programme but was sampled less frequently; this site is not recommended for contact recreation but water quality in Browns Bay is of community interest.

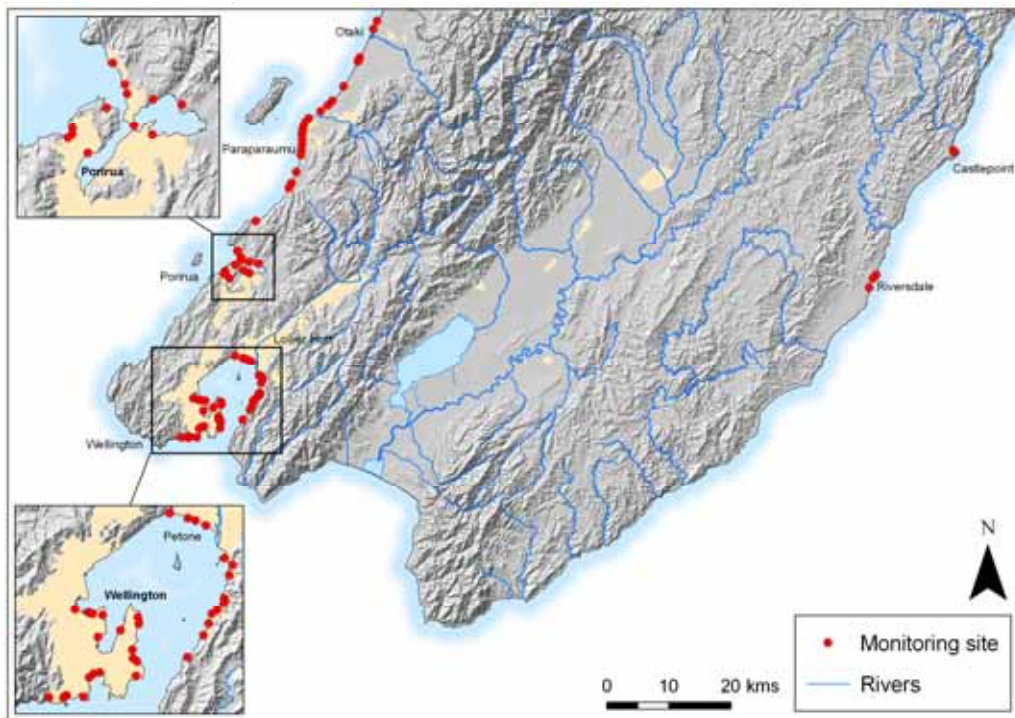


Figure 4.1: Marine recreation sites monitored over 2010/11

4.2 Monitoring protocol

Sites were sampled weekly – for 20 weeks – during the bathing season. The exceptions were Breaker Bay (Wellington City), Princess Bay (Wellington City) and Riversdale Beach South (Wairarapa) which were sampled fortnightly and Camp Bay (Hutt City) which was sampled monthly⁸. Only 19 sample results were available for Pauatahanui Inlet at Paremata Bridge (Porirua) as the water sample collected on 7 December 2010 was mistakenly not sent to the

⁸ Milne & Wyatt (2006) recommended the frequency of sampling reduce from weekly to fortnightly from 1 November 2006 because these sites have a “very low” to “low” risk of microbiological contamination and a high level of compliance with recreational water quality guidelines. The frequency of sampling at Camp Bay was reduced to monthly in November 2009 as indicator bacteria counts at this site are consistently below surveillance guideline (140 enterococci/ 100 mL) indicating that there is a low risk to bathers.

laboratory for analysis. Although only monthly sampling was intended to be undertaken in the Pauatahanui Inlet at Browns Bay (5 samples), sampling was undertaken approximately fortnightly giving 10 sample results. All results for this site are reported here.

On each sampling occasion a single water sample was collected 0.2 metres below the surface in 0.5 metres water depth and analysed for enterococci indicator bacteria using a membrane filtration method. This analytical method provides a result in 24 hours, therefore enabling prompt re-sampling in the event that a result exceeds recommended guideline values.

Observations of weather and the state of the tide, and visual estimates of seaweed cover, were also made at each site to assist with the interpretation of the monitoring results. For example:

- Rainfall may increase enterococci counts by flushing accumulated debris from urban and agricultural areas into coastal waters.
- Wind direction can influence the movement of currents along the coastline and can therefore affect water quality at a particular site.
- In some cases, an increase in enterococci counts may be due to the presence of decaying seaweed. There is evidence that some strains of enterococci are able to replicate or persist in decaying seaweed (Anderson 2000).

An estimate of the daily rainfall in the catchment adjoining each site over the bathing season was made by obtaining records from the nearest rain gauge.

A list of field and laboratory methods can be found in Appendix 2.

4.3 Guidelines

As outlined in Section 2.2, the MfE/MoH (2003) recreational water quality guidelines use bacteriological "trigger" values to help water managers determine when management intervention is required. The "trigger" values underpin a three-tier management framework analogous to traffic lights (Table 4.1).

Table 4.1: MfE/MoH (2003) surveillance, alert and action levels for marine waters

Mode	Guideline Enterococci (cfu/100 mL)	Management response
Green/Surveillance	Single sample ≤ 140	Routine monitoring
Amber/Alert	Single sample > 140	Increased monitoring, investigation of source and risk assessment
Red/Action	Two consecutive samples within 24 hours > 280	Closure, public warnings, increased monitoring and investigation of source

When water quality falls in the “surveillance mode”, this indicates that the risk of illness from bathing is acceptable (for marine waters the accepted level of risk is 19 in every 1,000 bathers). If water quality falls into the “alert” category, this indicates an increased risk of illness from bathing, but still within an acceptable range. However, if the water quality enters the “action” category, then the water poses an unacceptable health risk from bathing. At this point, warning signs are erected at the bathing site, and the public is informed that it is unsafe to swim at that site. The only time a warning is unlikely to be issued is when an action level result is preceded by heavy rainfall. This is because it is widely known that rainfall is often correlated with elevated bacteria counts in marine waters (see Section 4.6). For this reason Greater Wellington and the Ministry of Health advise avoiding swimming and other contact recreation activities in marine waters during and for up to several days after heavy rainfall.

4.4 Data analysis, limitations and cautionary notes

All results have been assessed in accordance with the MfE/MoH (2003) recreational water quality guidelines. However, it is not possible to accurately specify the number of true exceedances of the red/action mode of the guidelines. The guidelines state that a marine bathing site only enters the action mode when *two consecutive samples* exceed 280 enterococci/100 mL but, in practice, there can be delays in collecting a second sample (e.g., bad weather). Therefore to ensure that recreational water quality is assessed on an equal basis across all 74 marine sites, the approach taken by Greater Wellington is to treat any single result greater than 280 enterococci/100 mL obtained from routine weekly sampling as an exceedance of the red/action mode of the guidelines. This is also the approach taken by the Ministry for the Environment in its national recreational water quality monitoring reporting and means that a second consecutive action result is simply used to confirm the appropriate management response (e.g., erection of public warnings), (MfE 2005).

The MfE/MoH (2003) recreational water quality guidelines do not cover toxic algal blooms, which in certain places and under certain conditions may pose a significant risk to contact recreation. Such blooms have occurred in marine recreational waters in the Wellington region in the past.

4.5 Results

Action level enterococci results recorded during routine weekly sampling over the 2010/11 summer are summarised below for marine waters in Kapiti, Porirua City, Hutt City, Wellington City and the Wairarapa. The number of surveillance, alert and action level results recorded at each of the 74 bathing sites are summarised in Appendix 3. In accordance with the MfE/MoH (2003) recreational water quality guidelines, follow-up sampling is conducted when a routine sample returns a result that exceeds the alert or action guideline. Only action level-related follow-up sampling results are discussed here. On occasion, alert level follow-up sampling returns a result above the action guideline, triggering additional sampling or investigation.

4.5.1 Kapiti

Fourteen of the 20 marine sites monitored along the Kapiti Coast exceeded the action guideline of 280 cfu/100 mL during the summer bathing season:

- 22 November 2010 – Raumati Beach at Marine Gardens (1,030 cfu/100 mL) and Raumati Beach at Hydes Road (8,900 cfu/100 mL).
- 14 December 2010 – Paraparaumu Beach at Maclean Park (455 cfu/100 mL).
- 21 December 2010 – Paraparaumu Beach at Toru Road (590 cfu/100 mL), Paraparaumu Beach at Wharemauku Road (410 cfu/100 mL), Raumati Beach at Tainui Street (385 cfu/100 mL), Raumati Beach at Marine Gardens (1,950 cfu/100 mL) and Paekakariki Beach at Surf Club (600 cfu/100 mL).
- 19 January 2011 – Te Horo Beach at Mangaone Stream (1,090 cfu/100 mL), Te Horo Beach at Kitchener Street (340 cfu/100 mL), Peka Peka Beach at Road End (615 cfu/100 mL), Waikanae Beach at William Street (340 cfu/100 mL) and Waikanae Beach at Tutere Street Tennis Courts (330 cfu/100 mL).
- 8 February 2011 – Otaki Beach at Surf Club (735 cfu/100 mL), Otaki Beach at Rangiuru Road (790 cfu/100 mL), Te Horo Beach at Mangaone Stream (810 cfu/100 mL) and Te Horo Beach at Kitchener Street (450 cfu/100 mL).

All exceedances coincided with at least 8 mm of rainfall in the 72 hours prior to sampling. Follow-up samples collected by Kapiti Coast District Council staff all complied with the surveillance (≤ 140 cfu/100mL) guideline once rainfall ceased (up to two days after the first exceedance).

4.5.2 Porirua

Ten of the 13 sites monitored in Porirua City exceeded the action guideline during the bathing season, with Titahi Bay at South Beach Access Road and Porirua Harbour at Rowing Club exceeding this guideline on six and five routine sampling occasions respectively. The 2010/11 action events are summarised below:

- 23 November 2010 – Titahi Bay at Access Road (320 cfu/100 mL).
- 7 December 2010 – Porirua Harbour at Rowing Club (290 cfu/100 mL).
- 14 December 2010 – South Beach at Plimmerton (1,200 cfu/100 mL) and Pauatahanui Inlet at Browns Bay (570 cfu/100 mL).
- 21 December 2010 – Pukerua Bay (450 cfu/100 mL), Plimmerton Beach at Bath Street (330 cfu/100 mL), South Beach at Plimmerton (730 cfu/100 mL), Pauatahanui Inlet at Motukaraka Point (390 cfu/100 mL), Porirua Harbour at Rowing Club (740 cfu/100 mL), Titahi Bay at Bay Drive

(840 cfu/100 mL), Titahi Bay at Toms Road (610 cfu/100 mL) and Titahi Bay at Access Road (560 cfu/100 mL).

- 29 December 2010 – Porirua Harbour at Rowing Club (400 cfu/100 mL).
- 25 January 2011 – Porirua Harbour at Rowing Club (290 cfu/100 mL) and Pauatahanui Inlet at Paremata Beach (380 cfu/100 mL).
- 15 February 2011 – Titahi Bay at Access Road (400 cfu/100 mL).
- 22 February 2011 – Titahi Bay at Access Road (670 cfu/100 mL).
- 8 March 2011 – Plimmerton Beach at Bath Street (330 cfu/100 mL) and South Beach at Plimmerton (890 cfu/100 mL).
- 22 March 2011 – Porirua Harbour at Rowing Club (600 cfu/100 mL), Titahi Bay at Bay Drive (320 cfu/100 mL) and Titahi Bay at Access Road (290 cfu/100 mL).
- 29 March 2011 – Porirua Harbour at Rowing Club (480 cfu/100 mL) and Titahi Bay at Bay Drive (360 cfu/100 mL).

The action guideline exceedances on 23 November, 14 December, 21 December, 29 December, 25 January and 29 March all coincided with more than 10 mm of rainfall in the 72 hours prior to sampling. Follow up samples taken the next day complied with the surveillance guidelines on most occasions. No follow up samples were taken following exceedances on 21 December 2010.

The exceedances on 7 December, 15 February, 22 February, 8 March and 22 March coincided with little or no rainfall. However, apart from those taken at Porirua Harbour at Rowing Club and Titahi Bay at South Beach Access Road all follow up samples complied with the surveillance guideline and no further action was taken.

In total, six exceedances of the action guideline were recorded during routine monitoring at the Porirua Harbour at Rowing Club site. On two occasions (7 December and 29 March) follow up samples collected the next day also exceeded the action guideline and health warning signs were put in place. Investigation by Porirua City Council (PCC) staff into the source of contamination at this site following the exceedance on 29 March was inconclusive. However, investigations undertaken following repeated exceedances at this site during the 2008/09 bathing season identified a number of illegal sewer connections to the stormwater network at newly constructed properties in the Onepoto Stream catchment as a likely source of contamination affecting the Porirua Harbour at Rowing Club site (N. McDonald⁹, pers. comm). Although the illegal connections at these properties have since been fixed it is possible that there are further sewer cross connections with the

⁹ Nicholas McDonald, PCC Senior Environmental Health Officer.

stormwater system in the catchment. At the time of publication, PCC staff were investigating the Gloaming Hill sewer catchment.

Five exceedances of the action guideline were recorded at Titahi Bay at South Beach Access Road. Health warning signs were put up by PCC after the exceedance on 15 February when consecutive follow up samples exceeded the action and alert guidelines respectively. Warning signs remained in place until the end of the bathing season due to intermittent but ongoing exceedances of the action guideline. An investigation into the source of contamination following the 15 February exceedance identified an illegal connection of kitchen wastewater to the stormwater network. This is unlikely to be the sole source of contamination at the Titahi at South Beach Access Road site and so PCC staff are undertaking further investigations¹⁰.

4.5.3 Hutt

Nine of the 15 marine sites monitored in Hutt City exceeded the action level guideline of 280 cfu/100 mL on at least one sampling occasion during the summer bathing season:

- 7 December 2010 – Petone Beach at Water Ski Club (310 cfu/100 mL), Petone Beach at Sydney Street (720 cfu/100 mL) and Petone Beach at Settlers Museum (640 cfu/100 mL).
- 21 December 2010 – Petone Beach at Sydney Street (460 cfu/100 mL), Petone Beach at Settlers Museum (580 cfu/100 mL), Lowry Bay at Cheviot Road (1,000 cfu/100 mL), York Bay (340 cfu/100 mL), Days Bay at Wharf (770 cfu/100 mL) and Rona Bay at Cliff Bishop Park (560 cfu/100 mL).
- 22 February 2011 – Petone Beach at Water Ski Club (360 cfu/100 mL) and Rona Bay at Wharf (1,200 cfu/100 mL).
- 1 March 2011 – Days Bay at Wellesley College (740 cfu/100 mL).
- 29 March 2011 – Rona Bay at Wharf (1,300 cfu/100 mL).

The exceedances that occurred on 21 December and 29 March coincided with at least 15 mm of rainfall prior to sampling. All but one of the follow up samples collected following these exceedances complied with the surveillance guideline – the exception was the follow up sample collected from Petone Beach at Sydney Street which exceeded the action guideline again. However, a second follow up sample from this site complied with the surveillance guideline and no further action was taken.

No rainfall was recorded in the three days prior to the exceedances at Petone Beach at Water Ski Club and Rona Bay at Wharf on 22 February 2011 but heavy rainfall recorded on the day of sampling is likely to have contributed to

¹⁰ In December 2010, analysis of water samples taken from the stormwater network in the vicinity of the Titahi Bay at South Beach Access Road using PCR markers found a high likelihood that faecal contamination in the samples was from a human source.

these. A follow up sample collected the next day at Petone Beach at Water Ski Club complied with the surveillance guideline. The follow up sample taken at Rona Bay Wharf exceeded the action level guideline; investigation by Capacity (on behalf of Hutt City Council) found no obvious source of contamination so warning signs were not put up. A second follow up sample from this site complied with the surveillance guideline.

The exceedances that occurred on 7 December and 1 March coincided with little or no rainfall prior to sampling. However, on both occasions follow up samples taken the next day complied with the surveillance guideline and no further action was taken.

4.5.4 Wellington City

Ten of the 21 marine sites monitored in Wellington City exceeded the action guideline during the bathing season. The 2010/11 action events were summarised below:

- 29 November 2010 – Seatoun Beach at Inglis Street (660 cfu/100 mL).
- 20 December 2010 – Aotea Lagoon (1,600 cfu/100 mL) and Oriental Bay at the Band Rotunda (530 cfu/100 mL).
- 29 December 2010 – Shark Bay (690 cfu/100 mL).
- 7 February 2011 – Scorching Bay (1,000 cfu/100 mL), Worsler Bay (450 cfu/100 mL), Lyall Bay at Tirangi Road (4,800 cfu/100 mL) Island Bay at Surf Club (3,200 cfu/100 mL), Island Bay at Reef Street Recreation Ground (2,900 cfu/100 mL) and Owhiro Bay (430 cfu/100 mL).
- 7 March 2011 – Owhiro Bay (320 cfu/100 mL).

Action level exceedances on 20 December 2010, 29 December, 7 February and 7 March all coincided with significant rainfall either in the 72 hours prior to or on the day of sampling. Follow up samples taken the next day were within the surveillance guideline on all but two occasions. The exceptions were samples taken at Aotea Lagoon and Oriental Bay at the Band Rotunda following exceedances on 20 December which exceeded the action and alert guidelines respectively. These exceedances coincided with ongoing rainfall and no health warning signs were posted. A second consecutive follow up sample complied with the surveillance guideline at both sites.

No rainfall was recorded prior to or on the day of the exceedance at Seatoun Beach at Inglis Street on 29 November. However, a follow up sample taken the next day complied with the surveillance guideline and no further action was taken.

In addition to two exceedances of the action guideline at Owhiro Bay, the alert guideline was exceeded on four occasions during the 2010/11 season. Follow up samples complied with the surveillance guideline on all but one occasion. Owhiro Bay was affected by ongoing exceedances of the action guideline during 2009/10 (refer Ryan & Warr 2010). Investigations undertaken by

Capacity in response to these exceedances identified a number of faults in the private and public sewer system which were subsequently fixed (B. Gebreselassie¹¹, pers. comm).

4.5.5 Wairarapa

None of the Wairarapa marine sites exceeded the action guideline at any time during the bathing season. In contrast, four sites exceeded the action guideline during the 2009/10 summer (Ryan & Warr 2010), and one exceeded the action guideline in 2008/09 (Warr 2009).

4.6 Synthesis

Forty three of the 74 marine sites (58.1%) monitored over the 2010/11 summer bathing season exceeded the action guideline, although most of these (30 sites) exceeded the guideline on only one occasion (Table 4.2).

Table 4.2: Summary of action guideline breaches from routine weekly monitoring at 74 marine sites over the 2010/11 summer bathing season[†]

No. of times site exceeded the action guideline	No. of sites in each exceedance category					Total no. of sites (74)	% of sites
	Kapiti (20 sites)	Porirua (13 sites)	Hutt (15 sites)	Wellington (21 sites)	Wairarapa (5 sites)		
0	6	3	6	11	5	32	43.2
1	11	5	5	9	0	29	39.2
2	3	1	4	1	0	9	12.2
3	0	2	0	0	0	2	2.7
5	0	1	0	0	0	1	1.4
6	0	1	0	0	0	1	1.4

[†] Includes five sites (one each in Porirua City, Hutt City and the Wairarapa, and two in Wellington City) sampled fortnightly and one site in Hutt City sampled monthly.

A total of 65 out of 1,424 (4.5%) routine sample results exceeded the action guideline of 280 cfu/100 mL. This was greater than in the 2009/10 and 2008/09 bathing seasons when 61 and 32 exceedances were recorded, respectively (Warr 2009, Ryan & Warr 2010).

Almost two thirds (41) of the 65 action events were associated with at least 10 mm of rainfall in the three days prior to sampling. Of the 24 exceedances that were not, 19 were correlated with at least some rainfall – either less than 10 mm in the 72 hours prior or some rain on the day of sampling. This finding is consistent with previous observations; elevated enterococci counts in marine waters are often related to urban stormwater (including sewer overflows), diffuse-source runoff into rivers and streams and re-suspension of sediments during rainfall events. Re-suspension of sediments (due to winds and/or tidal action) can also affect some beaches in dry weather as can poor water quality in rivers, streams and drains discharging directly to the coast (Milne & Wyatt 2006).

¹¹ Bruck Gebreselassie, Investigation and Design Engineer, Capacity.

5. Recreational shellfish gathering water quality

5.1 Introduction

Recreational shellfish gathering water quality was monitored at nine marine sites across the Wellington region over 2010/11 (Figure 5.1, Appendix 1), as follows:

- Kapiti Coast District – 3 sites
- Porirua City – 3 sites¹²
- Hutt City – 1 site
- Wellington City – 2 sites

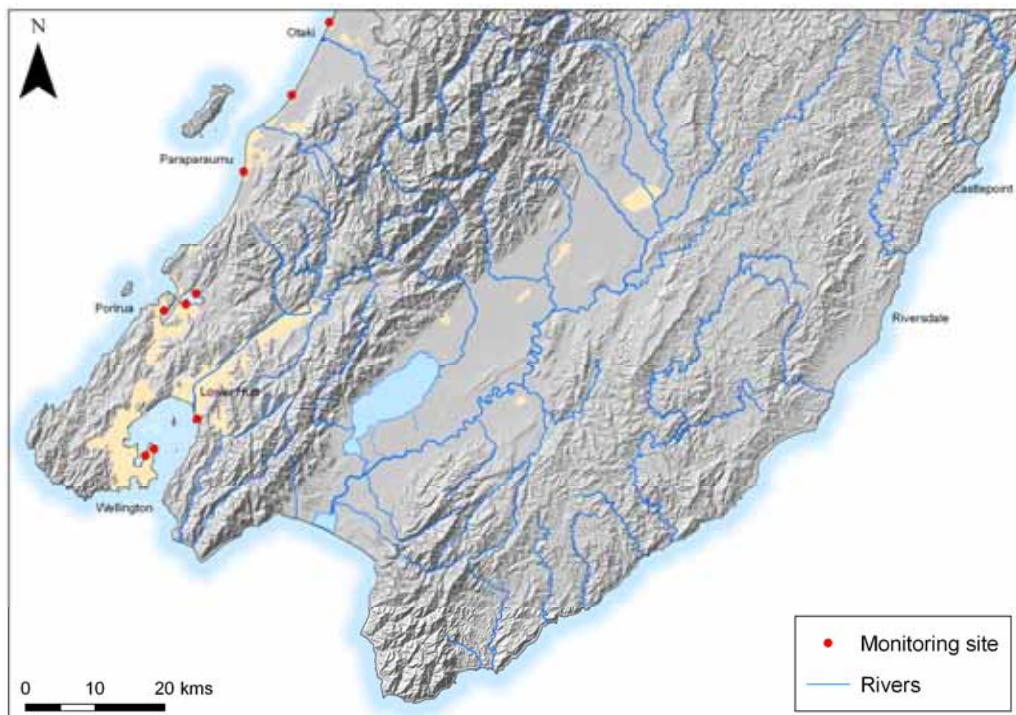


Figure 5.1: Recreational shellfish gathering water quality monitoring sites, 2010/11

5.2 Monitoring protocol

Sites were sampled weekly for 20 weeks from 1 November 2010 to 31 March 2011 inclusive and at least monthly during the remainder of the year, at the same time as marine recreational water quality sampling (all nine sites are also marine bathing sites). On each sampling occasion a single water sample was collected 0.2 metres below the surface in 0.5 metres water depth and analysed for faecal coliform indicator bacteria using membrane filtration. Although the MfE/MoH (2003) guidelines recommend the five-tube decimal dilution test (known as the Most Probable Number (MPN) method), membrane filtration produces an equivalent result in colony forming units (cfu) and is a faster test, providing a result in 24 hours.

¹² These sites, introduced in July 2007, are not recommended shellfish gathering sites but are monitored in response to community interest.

5.3 Guidelines

As outlined in Section 2.2, the MfE/MoH (2003) recreational water quality guidelines use faecal coliform bacteria as indicators of microbiological contamination in shellfish-gathering waters. The guidelines state:

- The median faecal coliform content of samples taken over a shellfish-gathering season shall not exceed 14 MPN/100 mL; and
- Not more than 10% of samples collected over a shellfish gathering season should exceed 43 MPN/100 mL.

The MfE/MoH (2003) guidelines also state the guideline values above should be applied in conjunction with a sanitary survey. Sanitary surveys are presented for each site in Appendix 3 in the form of the Sanitary Inspection Categories (SICs) which indicate the susceptibility of these sites to faecal contamination. More information on how these SICs were assigned can be found in Milne & Wyatt (2006).

5.4 Cautionary note

The MfE/MoH (2003) guidelines only address microbiological contamination. They do not address marine biotoxins, heavy metals, or harmful organic contaminants which in certain places and locations can pose a significant risk to people gathering shellfish. For this reason, the guidelines can not be used to determine whether shellfish are actually safe to eat. Monitoring of microbiological contaminants in *shellfish flesh* is needed to provide a direct measure of the risks associated with consuming shellfish. Greater Wellington periodically undertakes shellfish flesh monitoring; the most recent monitoring was undertaken in early 2006 (Milne 2006).

5.5 Data analysis and limitations

All sampling and evaluation of results have been undertaken in accordance with the MfE/MoH (2003) recreational water quality guidelines where possible. However, the guidelines do not define a shellfish gathering season, nor do they provide any guidance on the minimum number of samples that should be used to calculate compliance with the median guideline. In the absence of such guidance, the approach taken in this report is to align the shellfish gathering season with the summer bathing season (i.e., 1 November to 31 March inclusive), even though it is acknowledged that shellfish gathering is likely to occur year round at many sites to some degree.

In some cases, additional sampling was undertaken in conjunction with re-sampling of bathing sites following an exceedance of the alert or action levels of the marine recreational water quality guidelines. The results of these follow-up samples were excluded from the calculation of compliance with the recreational shellfish gathering water quality guidelines (i.e., only routine weekly sampling results are discussed here).

During data processing, any faecal coliform counts reported as less than or greater than detection limits were replaced by values one half of the detection

limit or the detection limit respectively (i.e., counts of <4 cfu/100 mL and >400 cfu/100 mL were treated as 2 cfu/100 mL and 200 mL, respectively).

5.6 Results

Compliance with the shellfish gathering water quality guidelines over the 2010/11 summer season is summarised below for marine waters in Kapiti, Porirua City, Wellington City and Hutt City.

5.6.1 Kapiti

None of the three monitoring sites on the Kapiti Coast complied with the recreational shellfish gathering water quality guidelines for the 2010/11 summer period (Table 5.1). While median faecal coliform counts for the Otaki Beach at Surf Club and Peka Peka Beach at Road End site were below the 14 cfu/100mL threshold, more than 10% of water samples at each site exceeded 43 cfu/100 mL.

Table 5.1: Analysis of faecal coliform counts obtained from routine weekly monitoring during the 2010/11 summer months against the MfE/MoH (2003) guideline levels for recreational shellfish-gathering waters

Site	Median (cfu/100 mL)	Maximum (cfu/100 mL)	No. (and percentage) of results >43 cfu/100 mL	Total no. of samples
Otaki Beach @ Surf Club	11.5	460	7 (35%)	20
Peka Peka Beach @ Road End	8	1,135	5 (25%)	20
Raumati Beach @ Hydes Rd	37.5	310	10 (50%)	20

All maximum faecal coliform counts coincided with more than 10 mm of rainfall in the 72 hours prior to sampling.

5.6.2 Porirua

None of the Porirua sites complied with the recreational shellfish gathering water quality guidelines for the 2010/11 summer period. While median faecal coliform counts for the two Pauatahanui Inlet sites were below the 14 cfu/100mL threshold, more than 10% of water samples at each site exceeded 43 cfu/100 mL.

Table 5.2: Analysis of faecal coliform counts obtained from routine weekly monitoring during the 2010/11 summer months against the MfE/MoH (2003) guideline levels for recreational shellfish-gathering waters

Site	Median (cfu/100 mL)	Maximum (cfu/100 mL)	No. (and percentage) of results >43 cfu/100 mL	Total no. of samples
Pauatahanui Inlet @ Browns Bay	10	390	2 (20%)	10
Pauatahanui Inlet @ Motukaraka Pt	4	300	4 (20%)	20
Porirua Harbour @ Rowing Club	58	620	12 (60%)	20

The maximum faecal bacteria counts recorded at the two Pauatahanui Inlet sites on 14 and 21 December both coincided with more than 10 mm of rainfall in the 24 hours prior to sampling.

The maximum faecal bacteria count recorded at the Porirua Harbour at Rowing Club site on 22 March did not coincide with any rainfall in the 72 hours before sampling, but did coincide with rainfall at the time of sampling. A large number of faecal coliform counts (12 or 60%) at this site were above the 43 cfu/100mL threshold. Some of these (7 December, 5 and 11 January, and 1 March) were not associated with any rainfall prior to or at the time of sampling.

5.6.3 Hutt

In Hutt City, recreational shellfish gathering water quality was monitored at one site in Sorrento Bay. This site did not comply with the recreational shellfish gathering water quality guidelines over the 2010/11 summer bathing season. Although the median faecal coliform count for the site was below the 14 cfu/100mL threshold, 25% of water samples taken exceeded the upper guideline of 43 cfu/100 mL. The maximum faecal bacteria count was recorded on 21 December and coincided with more than 20 mm of rainfall in the 48 hours prior to sampling.

Table 5.4: Analysis of faecal coliform counts obtained from routine weekly monitoring during the 2010/11 summer months against the MfE/MoH (2003) guideline levels for recreational shellfish-gathering waters

Site	Median (cfu/100 mL)	Maximum (cfu/100 mL)	No. (and percentage) of results >43 cfu/100 mL	Total no. of samples
Sorrento Bay	4	280	5 (25%)	20

5.6.4 Wellington City

Both Wellington City monitoring sites complied with the recreational shellfish gathering water quality guidelines for the 2010/11 summer period (Table 5.3). A large amount of rain (>30 mm) fell in the 48 hours prior to the maximum faecal bacteria counts recorded at Mahanga Bay and Shark Bay on 20 and 29 December 2010, respectively.

Table 5.3: Analysis of faecal coliform counts obtained from routine weekly monitoring during the 2010/11 summer months against the MfE/MoH (2003) guideline levels for recreational shellfish-gathering waters

Site	Median (cfu/100 mL)	Maximum (cfu/100 mL)	No. (and percentage) of results >43 cfu/100 mL	Total no. of samples
Shark Bay	2	110	2 (10%)	20
Mahanga Bay	3	52	1 (5%)	20

5.7 **Synthesis**

Only the Wellington City sites complied fully with shellfish gathering water quality guidelines for the 2010/11 summer period. In comparison, the Kapiti Coast, Porirua and Hutt monitoring sites had high faecal coliform levels. These results differ slightly from those in the 2009/10 and 2008/09 bathing seasons where both the Wellington City and Hutt sites complied with the shellfish gathering water quality guidelines, while the Kapiti and Porirua sites did not (Ryan & Warr 2010, Warr 2009).

Analysis of rainfall records indicates that most elevated faecal coliform results coincided with significant rainfall prior to sampling, with the exception of Porirua Harbour at Rowing Club. As discussed in Section 4.6, it is advisable to avoid contact with marine recreational waters for several days after heavy rain; this warning extends to shellfish collection.

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¹³ Published June 2002, updated June 2003.

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- Gary Stephenson (Coastal Marine Ecology Consultants).

Appendix 1: Monitoring sites

Area	Site Name	NZTM co-ordinates		Type
		Easting	Northing	
Hutt	Hutt River @ Birchville	1776196	5449091	Freshwater
Hutt	Hutt River @ Boulcott	1760920	5437569	Freshwater
Hutt	Hutt River @ Maoribank Corner	1775882	5446696	Freshwater
Hutt	Hutt River @ Poets Park	1771461	5446092	Freshwater
Hutt	Hutt River @ Silverstream Bridge	1767598	5443172	Freshwater
Hutt	Pakuratahi River @ Forks	1784288	5452620	Freshwater
Hutt	Wainuiomata River @ Richard Prouse Park	1764536	5429141	Freshwater
Hutt	Petone Beach @ Water Ski Club	1755744	5434591	Marine
Hutt	Petone Beach @ Sydney Street	1757045	5434248	Marine
Hutt	Petone Beach @ Settlers Museum	1757555	5434056	Marine
Hutt	Petone Beach @ Kiosk	1758326	5433711	Marine
Hutt	Sorrento Bay	1759632	5431384	Marine ¹
Hutt	Lowry Bay @ Cheviot Road	1760206	5430891	Marine
Hutt	York Bay	1759977	5430160	Marine
Hutt	Days Bay @ Wellesley College	1759616	5428529	Marine
Hutt	Days Bay @ Wharf	1759654	5428313	Marine
Hutt	Days Bay @ Moana Road	1759582	5428120	Marine
Hutt	Rona Bay @ N end of Cliff Bishop Park	1759109	5427654	Marine
Hutt	Rona Bay @ Wharf	1758730	5427371	Marine
Hutt	Robinson Bay @ HW Shortt Rec Ground	1758519	5426674	Marine
Hutt	Robinson Bay @ Nikau Street	1758131	5425856	Marine
Hutt	Camp Bay	1756990	5424288	Marine
Kapiti	Otaki River @ State Highway 1	1781309	5484406	Freshwater
Kapiti	Otaki River @ Pots	1785444	5478749	Freshwater
Kapiti	Waikanae River @ Jim Cooke Park	1772155	5472377	Freshwater
Kapiti	Waikanae River @ State Highway 1	1773752	5472296	Freshwater
Kapiti	Otaki Beach @ Surf Club	1778622	5488330	Marine ¹
Kapiti	Otaki Beach @ Rangiu Road	1778010	5487069	Marine
Kapiti	Te Horo Beach S of Mangaone Stream	1775779	5482478	Marine
Kapiti	Te Horo Beach @ Kitchener Street	1775495	5481933	Marine
Kapiti	Peka Peka Beach @ Road End	1773215	5477905	Marine ¹
Kapiti	Waikanae Beach @ William Street	1771388	5475584	Marine
Kapiti	Waikanae Beach @ Tutere St Tennis Courts	1770655	5474862	Marine
Kapiti	Waikanae Beach @ Ara Kuaka Carpark	1769514	5473978	Marine
Kapiti	Paraparaumu Beach @ Ngapotiki Street	1767543	5472762	Marine
Kapiti	Paraparaumu Beach @ Nathan Avenue	1767033	5472174	Marine
Kapiti	Paraparaumu Beach @ Maclean Park	1766694	5471267	Marine
Kapiti	Paraparaumu Beach @ Toru Road	1766577	5470715	Marine
Kapiti	Paraparaumu Beach @ Wharemauku Road	1766503	5470070	Marine
Kapiti	Raumati Beach @ Tainui Street	1766531	5469229	Marine
Kapiti	Raumati Beach @ Marine Gardens	1766516	5468441	Marine
Kapiti	Raumati Beach @ Aotea Road	1766414	5467529	Marine
Kapiti	Raumati Beach @ Hydes Road	1766318	5466835	Marine ¹
Kapiti	Paekakariki Beach @ Whareroa Road	1765598	5464128	Marine
Kapiti	Paekakariki Beach @ Surf Club	1764791	5462273	Marine
Porirua	Pukerua Bay	1759058 ²	5456278	Marine
Porirua	Karehana Bay @ Cluny Road	1756093	5451360	Marine
Porirua	Plimmerton Beach @ Bath Street	1756706	5450316	Marine
Porirua	South Beach @ Plimmerton	1756810	5449874	Marine
Porirua	Pauatahanui Inlet @ Water Ski Club	1758074	5449593	Marine
Porirua	Pauatahanui Inlet @ Motukaraka Point	1759486	5449338	Marine ¹

Area	Site Name	NZTM co-ordinates		Type
		Easting	Northing	
Porirua	Pauatahanui Inlet @ Browns Bay	1758039	5447833	Marine ¹
Porirua	Porirua Harbour @ Rowing Club	1754891	5446947	Marine ¹
Porirua	Titahi Bay @ Bay Drive	1754132	5448169	Marine
Porirua	Titahi Bay at Toms Road	1754110	5447857	Marine
Porirua	Titahi Bay @ South Beach Access Road	1753906	5447682	Marine
Porirua	Onehunga Bay	1755796	5449181	Marine
Porirua	Pauatahanui Inlet @ Paremata Bridge	1757153	5448284	Marine
Wairarapa	Ruamahanga River @ Bentleys Beach	1800534	5432813	Freshwater
Wairarapa	Ruamahanga River @ Double Bridges	1824350	5471775	Freshwater
Wairarapa	Ruamahanga River @ Kokotau	1815756	5447191	Freshwater
Wairarapa	Ruamahanga River @ Morrisons Bush	1808918	5441108	Freshwater
Wairarapa	Ruamahanga River @ Te Ore Ore	1825529	5462917	Freshwater
Wairarapa	Ruamahanga River @ The Cliffs	1821476	5452180	Freshwater
Wairarapa	Ruamahanga River @ Waihenga	1804610	5436461	Freshwater
Wairarapa	Waingawa River @ Kaituna	1810326	5471149	Freshwater
Wairarapa	Waingawa River @ South Road	1820550	5460878	Freshwater
Wairarapa	Waiohine River @ Gorge	1801853	5455936	Freshwater
Wairarapa	Waiohine River @ State Highway 2	1809665	5451711	Freshwater
Wairarapa	Waipoua River @ Colombo Road	1824996	5462889	Freshwater
Wairarapa	Castlepoint Beach @ Castlepoint Stream	1871366	5467559	Marine
Wairarapa	Castlepoint Beach @ Smelly Creek	1871670	5467202	Marine
Wairarapa	Riversdale Beach @ Lagoon Mouth	1858965	5447543	Marine
Wairarapa	Riversdale Beach Between the Flags	1858435	5446948	Marine
Wairarapa	Riversdale Beach South	1857834	5445514	Marine
Wellington	Aotea Lagoon	1748985	5427683	Marine
Wellington	Oriental Bay @ Freyberg Beach	1749920	5427464	Marine
Wellington	Oriental Bay @ Wishing Well	1750118	5427386	Marine
Wellington	Oriental Bay @ Band Rotunda	1750243	5427375	Marine
Wellington	Balaena Bay	1750958	5427267	Marine
Wellington	Hataitai Beach	1750632	5425730	Marine
Wellington	Shark Bay	1752211	5426197	Marine ¹
Wellington	Mahanga Bay	1753468	5427115	Marine ¹
Wellington	Scorching Bay	1753517	5426647	Marine
Wellington	Worser Bay	1753074	5424823	Marine
Wellington	Seatoun Beach @ Wharf	1753129	5424234	Marine
Wellington	Seatoun Beach @ Inglis Street	1753405	5423994	Marine
Wellington	Breaker Bay	1753312	5422970	Marine
Wellington	Lyall Bay @ Tirangi Road	1750747	5423230	Marine
Wellington	Lyall Bay @ Onepu Road	1750286	5423116	Marine
Wellington	Lyall Bay @ Queens Drive	1749990	5422868	Marine
Wellington	Princess Bay	1749586	5421504	Marine
Wellington	Island Bay @ Surf Club	1748377	5421590	Marine
Wellington	Island Bay @ Reef St Recreation Ground	1748229	5421542	Marine
Wellington	Island Bay @ Derwent Street	1748155	5421415	Marine
Wellington	Owhiro Bay	1747122	5421463	Marine

¹ Water quality is also monitored for recreational shellfish gathering purposes

Appendix 2: Laboratory and field methods

Kapiti Coast District Council collected and analysed water samples collected in their district. Water samples collected in Porirua, Wellington City, Hutt City and the Wairarapa were analysed by Environmental Laboratory Services (ELS).

Methods and detection limits

Determinant	Method	Detection Limit
<i>Escherichia coli</i> at 44.5°C	APHA Standard Methods (20 th Ed.) 9213D, Membrane filter on mTEC agar, Urea substrate	1-4/100 mL
Enterococci at 41°C	US EPA Method 1600, Membrane filter on mEI agar	1-5 cfu/100 mL
Faecal coliforms at 44.5°C	APHA Standard Methods (20 th Ed.) 9222D, Membrane filter on mFC agar	1-5 cfu/100 mL
Water temperature	Field meter or digital thermometer	0.1°C
Turbidity	APHA Standard Methods (20 th Ed.) 2130B	0.1 NTU
Periphyton cover (including filamentous and mat-forming algae as well as cyanobacteria)	Cyanobacteria cover was assessed using the method outlined in section 4.4.3 of the interim Cyanobacteria Guidelines (MfE&MoH 2009). Assessment of filamentous and mat-forming algae was undertaken using the same method.	5%
Seaweed cover	Visual estimate within 5 m radius around sample point, including both floating and attached seaweed	5%

Rainfall stations

Freshwater Recreational Sites

- Kapiti Coast District – Taungata Peak (Otaki River) and Waikanae Water Treatment Plant (Waikanae River)
- Hutt – Kaitoke Headworks (Pakuratahi River), Te Marua (Hutt River), Wainuiomata Reservoir (Wainuiomata River)
- Wairarapa – Mount Bruce (Ruamahanga River), Kaituna (Waipoua River, Waingawa River), Phelps (Waiohine River), Angle Knob (located in the upper Waingawa catchment and used as indicator of rainfall high in Tararua Range).

Marine Recreational Sites

- Kapiti Coast District – Otaki Depot (Otaki Beach, Te Horo Beach), Waikanae Water Treatment Plant (Peka Peka Beach, Waikanae Beach), Paraparaumu Aerodrome* (Paraparaumu Beach, Raumati Beach, Paekakariki Beach)
- Porirua City – Whenua Tapu
- Hutt City – Shandon
- Wellington City – Wellington Airport*
- Wairarapa – Castlepoint*

*NIWA rainfall stations

Appendix 3: Summary statistics and SFRGs

Microbiological water quality data for the 2010/11 summer are summarised in the tables below. The Microbiological Assessment Category (MAC) values and Suitability for Recreation Grades (SFRGs) determined by Milne & Wyatt (2006)¹⁴ have been updated using the 2006/07–2010/11 microbiological results.

(a) Fresh waters

Bathing Site	Total no. of samples	No. sample results (<i>E. coli</i> /100 mL)			Beach grading (2006/07–2010/11 data)		
		Surveillance (≤260)	Alert (261-550)	Action (>550)	SIC Grade	MAC Grade (95 th -ile value)	SFRG ¹
<i>Kapiti</i>							
Otaki R @ Pots	5 ²	5	0	0	Low	B (196) ³	Good ³
Otaki R @ SH 1	20	18	1	1	Moderate	B (234)	Good
Waikanae R @ SH 1	20	19	1	0	Moderate	C (353)	Fair
Waikanae R @ Jim Cooke Park	20	19	1	0	Moderate ⁴	C (370)	Fair ⁴
<i>Hutt & Wainuiomata</i>							
Pakuratahi R @ Forks	20	19	1	0	Moderate	D (637)	Poor
Hutt R @ Birchville	20	18	1	1	Moderate	D (779)	Poor
Hutt R @ Maoribank Corner	20	18	0	2	Moderate	D (1,127)	Poor
Hutt R @ Poets Park	20	19	1	0	Moderate	C (422)	Fair
Hutt R @ Silverstream	20	18	0	2	Moderate	D (860)	Poor
Hutt R @ Boulcott	20	18	0	2	Moderate	D (1,345)	Poor
Wainuiomata R @ RP Park	20	17	2	1	Moderate ⁴	D (716)	Poor ⁴
<i>Wairarapa</i>							
Ruamahanga R @ Double Bridges	20	20	0	0	Mod/High	C (326)	Fair/Poor
Ruamahanga R @ Te Ore Ore	20	18	1	1	High	D (1,066)	Very Poor
Ruamahanga R @ The Cliffs	20	17	1	2	High	C (523)	Poor
Ruamahanga R @ Kokotau	20	18	0	2	High	D (1,000)	Very Poor
Ruamahanga R @ Morrisons Bush	20	17	1	2	High	C (500)	Poor
Ruamahanga R @ Waihenga	20	17	1	2	High	D (710)	V. Poor
Ruamahanga R @ Bentleys Beach	20	17	1	2	High	D (567)	Very Poor
Waipoua R @ Colombo Rd	20	17	0	3	High	D (775)	V. Poor
Waingawa R @ Kaituna	20	20	0	0	Low	B (170)	Good
Waingawa R @ South Rd	20	18	0	2	Moderate	A (113)	ND ⁵
Waiohine R @ Gorge (Gauge)	5 ²	5	0	0	Low	A (114) ³	V. Good ³
Waiohine R @ SH 2	20	19	0	1	Moderate	A (76)	Good

¹ Note that the freshwater SFRGs better reflect the condition of the water during wet weather than dry weather when contact recreation would be greatest (see Milne & Wyatt 2006).

² From November 2006, sampled monthly under Greater Wellington's Rivers State of the Environment water quality programme.

³ Based on 2001/02–2006/07 data as presented in Milne & Wyatt (2006).

⁴ Interim grading (SIC grading based on previously graded sites in the same catchment or catchment knowledge, MAC grade based on 3 years of data, n=62)

⁵ Not determined as this combination of SIC and MAC grades is unexpected and indicates that re-assessment of the SIC grade is needed.

¹³ The SFRGs are determined by the Sanitary Inspection Category (SIC) value and the MAC value. The SIC value (determined in 2006 and to be reviewed every five years) generally has the greatest influence on the SFRG. Milne & Wyatt (2006) provide a full explanation of the beach grades and the grading process.

(b) Marine waters

Bathing Site	Total no. of samples	No. sample results (Enterococci/100 mL)			Beach grading (2006/07-2010/11 data)		
		Surveillance (≤140)	Alert (141-280)	Action (>280)	SIC Grade	MAC Grade (95 th -ile value)	SFRG
<i>Kapiti</i>							
Otaki Beach @ Surf Club	20	19	0	1	Low	C (273)	Fair
Otaki Beach @ Rangiuuru Rd	20	19	0	1	Low	B (185)	Good
Te Horo Beach S of Mangaone Strm	20	16	2	2	Moderate	C (450)	Fair
Te Horo Beach @ Kitchener St	20	18	0	2	Moderate	C (298)	Fair
Peka Peka Beach @ Rd End	20	19	0	1	Low	B (117)	Good
Waikanae Beach @ William St	20	18	1	1	Moderate	B (114)	Good
Waikanae Beach @ Tutere St T.C.	20	19	0	1	Moderate	B (113)	Good
Waikanae Beach @ Ara Kuaka C.P.	20	20	0	0	Moderate	B (115)	Good
Paraparaumu Beach @ Ngapotiki St	20	19	1	0	Moderate	B (196)	Good
Paraparaumu Beach @ Nathan Ave	20	19	1	0	Moderate	B (185)	Good
Paraparaumu Beach @ Maclean Pk	20	18	1	1	Moderate	B (187)	Good
Paraparaumu Beach @ Toru Rd	20	18	1	1	Moderate	B (168)	Good
Paraparaumu Beach @ Wharemauku	20	19	0	1	Moderate	B (162)	Fair
Raumati Beach @ Tainui St	20	19	0	1	Moderate	B (118)	Good
Raumati Beach @ Marine Gardens	20	18	0	2	Moderate	C (268)	Fair
Raumati Beach @ Aotea Rd	20	18	2	0	Low/Mod	B (144)	Good
Raumati Beach @ Hydes Rd	20	18	1	1	Moderate	B (110)	Good
Paekakariki Beach @ Whareroa Rd	20	20	0	0	Low	B (72)	Good
Paekakariki Beach @ Surf Club	20	19	0	1	Low	B (64)	Good
Paekakariki Beach @ Memorial Hall	20	19	1	0	Low	A (40)	V. Good
<i>Porirua</i>							
Pukerua Bay	20	19	0	1	Low	C (321)	Fair
Karehana Bay @ Cluny Rd	20	20	0	0	Moderate	C (297)	Fair
Plimmerton Beach @ Bath St	20	17	1	2	Moderate	C (317)	Good
South Beach @ Plimmerton	20	16	1	3	Moderate	D (692)	Poor
Pauatahanui Inlet @ Water Ski Club	20	17	3	0	Moderate	C (283)	Fair
Pauatahanui Inlet @ Motukaraka Pt	20	18	1	1	Moderate	C (215)	Fair
Pauatahanui Inlet @ Browns Bay	10 ¹	9	0	1	Moderate	D (555)	Poor
Pauatahanui Inlet @ Paremata Bridge	19 ²	18	0	1	Moderate ³	B (124)	Good ³
Porirua Harbour @ Rowing Club	20	12	2	6	Moderate	D (1,340)	Poor
Titahi Bay @ Bay Drive	20	17	0	3	Moderate	C (370)	Fair
Titahi Bay @ Toms Rd	20	19	0	1	Moderate	C (328)	Fair
Titahi Bay @ South Beach Access Rd	20	13	2	5	Moderate	D (598)	Poor
Onehunga Bay	20	20	0	0	Moderate	B (70)	Good
<i>Hutt</i>							
Petone Beach @ Water Ski Club	20	18	0	2	Moderate	C (219)	Fair
Petone Beach @ Sydney St	20	18	0	2	Moderate	C (466)	Fair
Petone Beach @ Settlers Museum	20	18	0	2	Moderate	C (265)	Fair
Petone Beach @ Kiosk	20	19	1	0	Moderate	C(204)	Fair
Sorrento Bay	20	17	3	0	Low	B (110)	Good
Lowry Bay @ Cheviot Rd	20	19	0	1	Low	C (210)	Fair
York Bay	20	19	0	1	Low	B (137)	Good
Days Bay @ Wellesley College	20	19	0	1	Low	C (248)	Good
Days Bay @ Wharf	20	19	0	1	Low	C (220)	Fair
Days Bay @ Moana Rd	20	19	1	0	Low	B (175)	Good
Rona Bay @ N end of Cliff Bishop Pk	20	19	0	1	Low/Mod	C (219)	Fair
Rona Bay @ Wharf	20	17	1	2	Low/Mod	C (272)	Fair

Bathing Site	Total no. of samples	No. sample results (Enterococci/100 mL)			Beach grading (2006/07–2010/11 data)		
		Surveillance (≤ 140)	Alert (141-280)	Action (>280)	SIC Grade	MAC Grade (95 th -ile value)	SFRG
Robinson Bay @ HW Shortt Rec Grd	20	20	0	0	Low	D (693)	ND ⁴
Robinson Bay @ Nikau St	20	20	0	0	Low	B (103)	Good
Camp Bay	5 ⁵	5	0	0	Very Low	B (62)	V. Good
<i>Wellington City</i>							
Aotea Lagoon	20	19	0	1	Moderate	B (184)	Fair
Oriental Bay @ Freyberg Beach	20	20	0	0	Moderate	B (59)	Good
Oriental Bay @ Wishing Well	20	19	1	0	Moderate	B (200)	Good
Oriental Bay @ Band Rotunda	20	19	0	1	Moderate	B (123)	Good
Balaena Bay	20	20	0	0	Low	A (32)	V. Good
Hataitai Beach	20	20	0	0	Moderate	B (107)	Good
Shark Bay	20	18	1	1	Low	B (71)	Good
Mahanga Bay	20	20	0	0	Low	B (54)	Good
Scorching Bay	20	19	0	1	Low	A (32)	V. Good
Worser Bay	20	19	0	1	Low	B (41)	Good
Seatoun Beach @ Wharf	20	20	0	0	Low/Mod	B (63)	Good
Seatoun Beach @ Inglis St	20	19	0	1	Low/Mod	B (78)	Good
Breaker Bay	10 ⁶	10	0	0	V. Low	A (8)	V. Good
Lyll Bay @ Tirangi Rd	20	19	0	1	Moderate	B (131)	Good
Lyll Bay @ Onepu Rd	20	19	1	0	Moderate	A (39)	ND ⁷
Lyll Bay @ Queens Drive	20	20	0	0	Moderate	A (32)	ND ⁷
Princess Bay	10 ⁶	10	0	0	Low	A (4)	V. Good
Island Bay @ Surf Club	20	19	0	1	Moderate	C (271)	Fair
Island Bay @ Reef St Recreation Grd	20	19	0	1	Moderate	B (148)	Good
Island Bay @ Derwent St	20	20	0	0	Moderate	A (29)	ND ⁷
Owhiro Bay	20	14	4	2	Moderate	D (618)	Poor
<i>Wairarapa</i>							
Castlepoint Beach @ Castlepoint Strm	20	20	0	0	Moderate	B (150)	Good
Castlepoint Beach @ Smelly Creek	20	20	0	0	Moderate	A (39)	ND ⁷
Riversdale Beach @ Lagoon Mouth	20	19	1	0	Moderate	B (72)	Good
Riversdale Beach Between the Flags	20	20	0	0	Low	A (24)	V. Good
Riversdale Beach South	10	10	0	0	Very Low	A (12)	V. Good

¹ From November 2010 sampling frequency was set at monthly. Despite this, sampling at this site was undertaken roughly fortnightly during the 2010/11 season.

² A sample result is missing from this site in 2010/11 as the sample collected on 7 December 2010 was not sent to the laboratory for analysis.

³ Interim grade (SIC grading based on that for other Pauatahanui sites, MAC grade based on 3 years of data, n=62)

⁴ Not determined as this combination of SIC and MAC grades is unexpected and indicates that re-assessment of the SIC grade is needed. Based on the MAC grade, this site is expected to have a SFRG of "poor" or "fair".

⁵ From November 2009, sampled monthly.

⁶ From November 2006, sampled fortnightly.

⁷ Not determined as this combination of SIC and MAC grades is unexpected and indicates that re-assessment of the SIC grade is needed. Based on the MAC grade, this site is expected to have a SFRG of at least "good".

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Pauatahanui Inlet at
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