



# On the beaches 2008/09

Annual recreational water quality monitoring report  
for the Wellington region

Quality for Life



greater WELLINGTON  
REGIONAL COUNCIL

Environment



# On the beaches 2008/09

Annual recreational water quality monitoring report  
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 2008/09 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](http://www.gw.govt.nz/on-the-beaches).

This report summarises the results of routine sampling undertaken over the 2008/09 summer bathing season (1 November 2008 to 31 March 2009 inclusive).

## **2. Recreational water quality monitoring 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 pathogens<sup>1</sup>. 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 (2003<sup>2</sup>) 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 2006a). Updated SFRGs reflecting the 2008/09 microbiological water quality results are summarised in Appendix 3.

<sup>1</sup> 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.

<sup>2</sup> The guidelines were published in June 2002 and updated in June 2003.



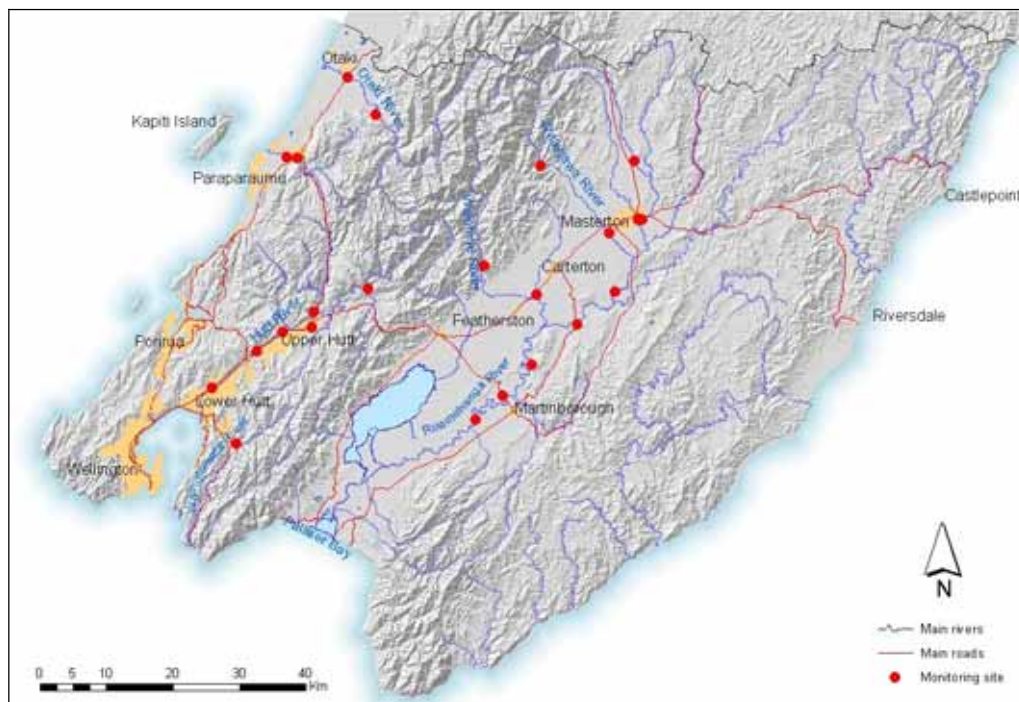
### 3. Recreational water quality in fresh waters

#### 3.1 Introduction

Recreational water quality was monitored at 23 freshwater sites across the Wellington region over 2008/09 (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, surfing, and boating.



**Figure 3.1: Freshwater recreation sites monitored over 2008/09**

#### 3.2 Monitoring protocol

Sites were sampled weekly 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 programme<sup>3</sup>. 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. This analytical method provides

<sup>3</sup> 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.



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. Excessive amounts of periphyton, in particular filamentous algae, can reduce the amenity value of waterways by decreasing their aesthetic appearance, reducing visibility, and being a physical nuisance to swimmers. Some species of cyanobacteria (blue-green algae) can also produce natural toxins (cyanotoxins) which are harmful to humans and animals, particularly dogs (Milne & Watts 2007).

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

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.

### 3.3.1 Periphyton guidelines

The MfE (2000) periphyton<sup>4</sup> 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.

### 3.4 Data analysis, limitations and cautionary notes

All sampling and evaluation of results have been undertaken in accordance with the MfE/MoH (2003) recreational water quality guidelines. However, the guidelines do not cover toxic algal blooms or proliferations, which in certain places and under certain conditions, may pose a significant risk to contact recreation. Toxic algae blooms were recorded at popular recreational spots in the Hutt and Waipoua rivers over much of the 2008/09 recreational season and were also present in several of Wellington's rivers over the 2007/08 and 2005/06 summers (Ryan & Warr 2008, Milne & Watts 2007). The response to toxic algal blooms is managed by a working party of Regional Public Health, Wairarapa Public Health, Territorial Authority and Greater Wellington staff. It includes close monitoring of 'flushing' river flows<sup>5</sup> and the use of two different warning signs (Figure 3.2):

- 'medium risk' – when there have been no flushing flows for two weeks and flows are low or significant cover of cyanobacterial mats (20-30%) is present.
- 'high risk' – where cyanobacterial mats cover more than 50% of the river bed, dislodged cyanobacterial mats are present in shallow waters or a dog or human illness is reported.



**Figure 3.2: Medium (left) and high risk (right) warnings signs used to inform the public of the health risk from cyanobacterial mats**

<sup>4</sup> Periphyton refers to the slime coating on a riverbed, composed largely of algae and cyanobacteria.

<sup>5</sup> 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.

### 3.5 Results

Action level *E. coli* results recorded during routine monitoring over 2008/09 are summarised below for bathing sites in 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

Two of the four freshwater bathing sites on the Kapiti Coast exceeded the action guideline of 550 cfu/100 mL during the 2008/09 bathing season:

- 25 November 2008 – Waikanae River at State Highway 1 (1,100 cfu/100 mL) and Waikanae River at Jim Cooke Park (1,400 cfu/100 mL)

These exceedances coincided with 14.5 mm of rainfall in the 24 hours prior to sampling. Results from additional samples collected the following day at both sites complied with the surveillance guideline.

Coverage of mat algae was within guideline values on all sampling occasions at all sites. However, the guideline value for filamentous algae cover was exceeded at the Otaki River at State Highway 1 on 4 February 2009 (59%). Shortly after this a 'fresh' in the river cleared this filamentous algal cover.

Growth of potentially toxic cyanobacteria was observed in the Waikanae River at State Highway 1 and Jim Cooke Park from early December 2008 onwards. This prompted the Kapiti Coast District Council to erect 'medium risk' health warning signs at these sites as a precautionary measure. These signs remained in place for the rest of the summer bathing season.

#### 3.5.2 Hutt and Wainuiomata

All 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 Hutt River at Silverstream site exceeded the action guideline on four occasions. The action level events recorded in the Hutt and Wainuiomata river catchments during 2008/09 were:

- 18 November 2008 – Wainuiomata River at Richard Prouse Park (800 cfu/100 mL)
- 25 November 2008 – Hutt River at Silverstream (560 cfu/100 mL), Hutt River at Boulcott (980 cfu/100 mL)
- 9 December 2008 – Pakuratahi River at Forks (820 cfu/100 mL), Hutt River at Silverstream (860 cfu/100 mL), Hutt River at Boulcott (780 cfu/100 mL)

cfu/100 mL) and Wainuiomata River at Richard Prouse Park (3,100 cfu/100 mL)

- 16 December 2008 – Pakuratahi River at Forks (960 cfu/100 mL), Hutt River at Birchville (2,100 cfu/100 mL), Hutt River at Maoribank Corner (2,300 cfu/100 mL), Hutt River at Poets Park (1,100 cfu/100 mL) Hutt River at Silverstream (2,400 cfu/100 mL), Hutt River at Boulcott (2,900 cfu/100 mL) and Wainuiomata River at Richard Prouse Park (1,600 cfu/100 mL)
- 10 February 2009 – Hutt River at Birchville (580 cfu/100 mL), Hutt River at Maoribank Corner (1,800 cfu/100 mL), Hutt River at Poets Park (580 cfu/100 mL), Hutt River at Silverstream (1,800 cfu/100 mL) and Wainuiomata River at Richard Prouse Park (600 cfu/100 mL)

Most breaches of the action guideline coincided with at least 10 mm of rainfall in the 24 hours prior to sampling. For example, the action level *E. coli* results recorded at all sites on 16 December 2008 coincided with 46 mm and 23 mm of rain in the Hutt and Wainuiomata catchments respectively.

The action guideline exceedance in the Wainuiomata River at Richard Prouse Park coincided with 5.5 mm of rainfall in the 48 hours prior to sampling as well as rainfall on the day. There was little or no rainfall in the 72 hours prior to the action guideline exceedances at five sites on 10 February 2009 although rainfall was recorded in both the Hutt and Wainuiomata catchments on the day of sampling. Additional samples were collected following all breaches of the action guideline and most complied with the surveillance guideline.

Coverage of filamentous and mat algae was within guideline values on all sampling occasions at all sites. However, potentially toxic cyanobacterial mats were observed in the Hutt River at and downstream of Birchville from early December 2008 onwards (Figure 3.3) prompting Hutt City Council, Upper Hutt City Council and Greater Wellington to erect 'medium risk' warning signs at key access points to the river. These signs remained in place for the duration of the bathing season.

'High risk' warning signs were erected at the Hutt River at Silverstream site on 15 December 2009 following observations of widespread cyanobacterial cover as well as dislodged cyanobacterial mats (signs were also erected at sites at Kennedy Good and Ewan bridges). These signs were removed on 17 December following a 'fresh' in the river that successfully removed the mats from the river bed.

A report of a dog illness after being in the Hutt River at the Melling Bridge in late January prompted Hutt City Council to erect 'high risk' warning signs at several sites along the Hutt River downstream of the suburb of Belmont, including the Boulcott monitoring site. Samples of both attached and detached cyanobacterial mats were taken from the Hutt River at the Melling Bridge for toxin analysis on 30 January 2009. Toxin concentrations in these samples were either very low or below detection limits in all cases. 'High risk' warning signs remained in place at these sites until a 'fresh' occurred on 16 February 2009, clearing the mats from the river bed.



**Figure 3.3: Cyanobacterial mats along the left bank of the Hutt River at Silverstream**

### 3.5.3 Wairarapa

Two of the 12 bathing sites monitored in Wairarapa rivers exceeded the action guideline during the summer bathing season:

- 2 March 2009 – Ruamahanga River at Te Ore Ore (1,300 cfu/100 mL) and Ruamahanga River at Bentleys Beach (580 cfu/100 mL)

These breaches of the action guideline coincided with extremely heavy rainfall (121.5 mm) in the 72 hours prior to sampling. Results from additional samples collected at both sites complied with the surveillance guideline.

The filamentous periphyton cover threshold was exceeded on one occasion at two sites; the Waiohine River at State Highway 2 and the Ruamahanga River at Bentleys Beach. Both of these exceedances occurred on 3 February 2009. Although there were no exceedances of the 60% cover threshold for mat-forming algae, potentially toxic cyanobacterial mats were widespread in the Waipoua River at Colombo Road (Masterton) for much of the bathing season, prompting the placement of 'high risk' warning signs at this site on 7 January 2009. These signs remained in place until the end of the bathing season.

On 29 January 2009, following a report of human illness after swimming, samples of cyanobacterial mats were taken for toxicity testing from a site in the Waipoua River at Kiriwhakapapa Road. It was concluded that the concentrations of toxins in these samples were high enough (100-230 µg/kg) to cause human illness (Dr Susie Wood, Cawthron Institute, pers comm.). No warning signs were erected as the swimming hole is on private property and solely used by the landowner.

### 3.6 Synthesis

Of the 21 freshwater sites monitored weekly over the 2008/09 summer bathing season, 11 (52%) exceeded the action guideline on at least one occasion (Table 3.2). Two sites (Hutt River at Silverstream and Wainuiomata River at Richard Prouse Park) exceeded the action guideline on four occasions.

**Table 3.2: Summary of action guideline breaches from routine weekly monitoring at 21 freshwater sites over the 2008/09 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	1	0	9	10	47.6
1	2	0	2	4	19.0
2	0	4	0	4	19.0
3	0	1	0	1	4.8
4	0	2	0	2	9.5

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

A total of 23 (5.2%) routine sampling results exceeded the action guideline of 550 cfu/100 mL. The same number of exceedances were recorded during the 2007/08 summer (Ryan & Warr 2008).

The majority (17) of the 23 action level results were associated with at least 10 mm 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 & Wyatt 2006, Milne 2005).



## 4. Recreational water quality in marine waters

### 4.1 Introduction

Recreational water quality was monitored at 77 marine sites across the Wellington region over 2008/09 (Figure 4.1, Appendix 1), as follows:

- Kapiti Coast District – 20 sites
- Porirua City – 15 sites
- Hutt City – 15 sites
- Wellington City – 22 sites
- Wairarapa – 5 sites

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

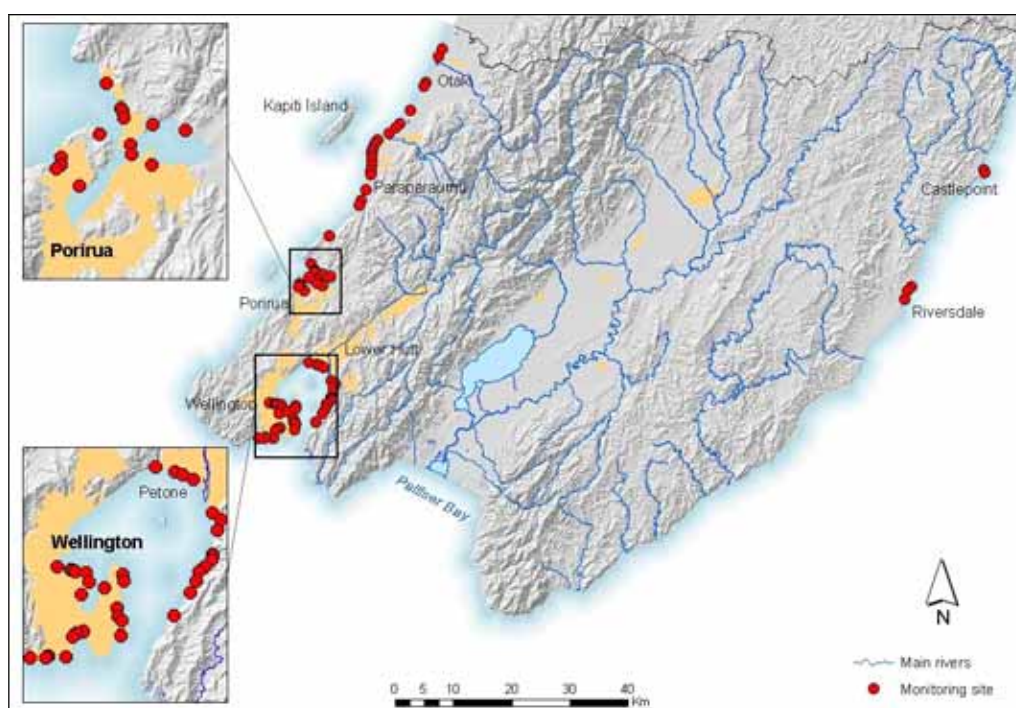


Figure 4.1: Marine recreation sites monitored over 2008/09

### 4.2 Monitoring protocol

Sites were sampled weekly during the bathing season, with the exception of Camp Bay (Hutt City), Breaker Bay (Wellington City), Princess Bay (Wellington City) and Riversdale Beach South (Wairarapa) which were sampled fortnightly<sup>6</sup>. 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.

<sup>6</sup> 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.

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 $\leq 140$	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 sampling and evaluation of results have been undertaken 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 77 sites, the approach taken by Greater Wellington is to treat any single result greater than 280 enterococci/100 mL obtained from routine weekly monitoring 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 monitoring over 2008/09 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 77 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

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

- 12 February 2009 - Otaki Beach at Surf Club site (490 cfu/100 mL)

This exceedance coincided with 13 mm of rainfall in the 72 hours prior to sampling and 44 mm on the day of sampling. A follow-up sample collected by Kapiti Coast District Council staff complied with the surveillance guideline ( $\leq 140$  cfu/100mL).

The number of action guideline exceedances at Kapiti Coast marine bathing sites was considerably lower in 2008/09 than in preceding bathing seasons.

For example in 2007/08 and 2006/07 nine and seven sites exceeded the action guideline respectively.

#### 4.5.2 Porirua

Thirteen of the 15 sites monitored in Porirua City exceeded the action guideline during the bathing season, with one site (Porirua Harbour at Rowing Club) exceeding the guideline five times. The 2008/09 action events are summarised below:

- 25 November 2008 – South Beach at Plimmerton (790 cfu/100 mL) and Pauatahanui Inlet at Browns Bay (1,900 cfu/100 mL)
- 2 December 2008 – Titahi Bay at Access Rd (1,200 cfu/100 mL)
- 9 December 2008 – Pukerua Bay (1,300 cfu/100 mL), Karehana Bay at Cluny Rd (900 cfu/100 mL), Pauatahanui Inlet at Water Ski Club (850 cfu/100 mL), Paremata Beach at Pascoe Avenue (400 cfu/100 mL), Porirua Harbour at Rowing Club (1,200 cfu/100 mL) and Titahi Bay at Access Road (1,500 cfu/100 mL)
- 16 December 2008 – Karehana Bay at Cluny Rd (490 cfu/100 mL), Plimmerton Beach at Bath Street (540 cfu/100 mL), Plimmerton Beach at Queens Avenue (600 cfu/100 mL), South Beach at Plimmerton (380 cfu/100 mL), Pauatahanui Inlet at Motukaraka Point (1,400 cfu/100 mL), Pauatahanui Inlet at Browns Bay (470 cfu/100 mL), Titahi Bay at Bay Drive (390 cfu/100 mL), Titahi Bay at Toms Road (380 cfu/100 mL) and Titahi Bay at Access Road (500 cfu/100 mL)
- 22 December 2008 – Porirua Harbour at Rowing Club (820 cfu/100 mL)
- 3 February 2009 – South Beach at Plimmerton (480 cfu/100 mL)
- 17 February 2009 – Pauatahanui Inlet at Water Ski Club (310 cfu/100 mL) and Porirua Harbour at Rowing Club (1,600 cfu/100 mL)
- 24 February 2009 – Plimmerton Beach at Bath Street (310 cfu/100 mL), Pauatahanui Inlet at Water Ski Club (290 cfu/100 mL) and Porirua Harbour at Rowing Club (1,200 cfu/100 mL)
- 3 March 2009 – Porirua Harbour at Rowing Club (800 cfu/100 mL)

Most of these action guideline exceedances coincided with at least 10 mm of rainfall in the 72 hours prior to sampling. For example, exceedance of the action guideline at nine sites on 16 December 2008 coincided with 37.5 mm of rainfall in the 24 hours prior to sampling.

However, no significant rainfall was recorded in the 72 hours prior to action guideline exceedances on 2 December 2008, 24 February and 3 March 2009. The exceedances recorded on 24 February were particularly unusual; there was no significant rainfall before sampling and results from follow up samples

continued to exceed guidelines (the alert guideline at Plimmerton at Bath Street and Pauatahanui at Water Ski Club, and the action guideline at Porirua Harbour at Rowing Club). A further follow-up sample collected at Plimmerton at Bath Street complied with the surveillance guideline but results exceeded the alert threshold at the Pauatahanui Inlet at Water Ski Club and Porirua Harbour at Rowing Club sites. No cause for these exceedances is apparent from the field observations recorded during sampling although turbidity was high (59.7 NTU) at the Pauatahanui Inlet at Water Ski Club site on 24 February 2009.

Health warning signs were erected at the Porirua Harbour at Rowing Club site following consecutive action mode exceedances on 23 December 2008, 12 February and 25 February 2009 and remained in place until sample results complied with the surveillance guideline.

The high frequency of exceedances of the microbiological water quality guidelines at the Porirua Harbour at Rowing Club site is of concern. In addition to the five exceedances of the action threshold, the alert threshold was also exceeded on three routine sampling occasions at this site. On many of these occasions enterococci counts also exceeded the alert or action thresholds in one or two consecutive follow up samples.

A sample was taken near the mouth of an unnamed stream that enters the Porirua Harbour immediately adjacent to the Rowing Club site on 16 January 2009. The *E. coli* count in this sample was 6,400 cfu/100 mL indicating that contamination of the stream may be linked to the ongoing breaches at the Rowing Club site. A further five samples were collected from the lower reaches of the stream by Porirua City Council staff on 3 March 2009 following repeated exceedances of the action and alert thresholds at the Rowing Club site. The *E. coli* counts from these samples ranged from 450 cfu/100 mL 200m from the stream mouth to 2,200 cfu/100 mL at Dimock Street (approximately 600m from the stream mouth). Further sampling is to be undertaken in the stream catchment to identify the source of these high indicator bacteria counts.

#### 4.5.3 Hutt

Only one of the 15 marine sites monitored in Hutt City exceeded the action guideline of 280 cfu/100 mL during the summer bathing season:

- 11 November 2008 - Days Bay at Wellesley College site (450 cfu/100 mL)

The reason for this exceedance is unclear. A follow-up sample collected the next day complied with the surveillance guideline ( $\leq 140$  cfu/100 mL).

The number of action guideline exceedances at Hutt City marine bathing sites was considerably lower in 2008/09 than preceding bathing seasons. For example in 2007/08 and 2006/07 fourteen and eight sites exceeded the action guideline respectively.

On 26 March 2009, two days after the final routine summer sampling was conducted at Hutt City coastal recreational sites, five major leaks were found in the main sewer pipeline that runs along the eastern bays to the main discharge

outfall at Pencarrow. In order to repair the leaks, treated sewage from the Seaview Wastewater Treatment Plant was diverted to the mouth of the Waiwhetu Stream. Hutt City Council erected health warning signs at bathing beaches in the vicinity of the Waiwhetu Stream mouth and overflow sites between Seaview and Pencarrow. The identification of further leaks during the repair process meant that the discharge to the Waiwhetu Stream continued until 19 May. Regular monitoring of coastal water quality was undertaken in the vicinity of the Waiwhetu Stream and the overflow sites until repairs were completed and discharge at the Pencarrow outfall reinstated.

On 27 May a further crack in the sewer was detected and treated sewage was again discharged at the mouth of the Waiwhetu Stream. At the time of publication it was estimated that this discharge would continue until at least the end of June.

#### 4.5.4 Wellington City

Only two of the 22 marine sites monitored in Wellington City exceeded the action guideline during the bathing season. This is a similar result to the 2006/07 season when three sites exceeded the action guideline. Eleven sites exceeded the action guideline during the 2007/08 season. The 2008/09 action events are summarised below:

- 22 December 2008 – Mahanga Bay (500 cfu/100 mL)
- 19 January 2009 – Owhiro Bay (630 cfu/100 mL)
- 9 March 2009 – Owhiro Bay (340 cfu/100 mL)

All three of these action guideline exceedances coincided with more than 10 mm of rainfall in the 72 hours prior to sampling; 32.5 mm, 19.4 mm and 16.4 mm for exceedances on 22 December 2008, 19 January and 9 March 2009 respectively.

The Wellington City Council collected additional samples following all exceedances of the action guideline. All but one of the follow-up sample results complied with the surveillance guideline. The exception was the result from sampling following the breach at Owhiro Bay on 19 January 2009 which exceeded the alert guideline. The result from a second follow-up sample complied with the surveillance guideline.

#### 4.5.5 Wairarapa

Castlepoint Beach at Castlepoint Stream was the only one of the five marine bathing sites in the Wairarapa that exceeded the action guideline of 280 cfu/100 mL during the 2008/09 summer:

- 8 December 2008 – Castlepoint Beach at Castlepoint Stream (890 cfu/100 mL)

The cause of this exceedance is unclear as no rainfall was recorded in the 72 hours prior to sample collection though 1.2 mm of rainfall was recorded on the



day of sampling, and rotting seaweed and a dead seagull were also recorded at this site. The result of a follow-up sample collected by Greater Wellington staff complied with the surveillance guideline.

## 4.6 Synthesis

Eighteen of the 77 marine sites (23%) monitored over the 2008/09 summer bathing season exceeded the action guideline, although many of these (10 sites) exceeded the guideline on only one occasion (Table 4.2).

**Table 4.2: Summary of action guideline breaches from routine weekly monitoring at 77 marine sites over the 2008/09 summer bathing season†**

No. of Times Site Exceeded the Action Guideline	No. of Sites in each Exceedance Category					Total No. of Sites (77)	% of Sites
	Kapiti (20 sites)	Porirua (15 sites)	Hutt (15 sites)	Wellington (22 sites)	Wairarapa (5 sites)		
0	19	2	14	20	4	59	76.6
1	1	6	1	1	1	10	13.0
2	0	3	0	1	0	4	5.2
3	0	3	0	0	0	3	3.9
4	0	0	0	0	0	0	0
5	0	1	0	0	0	1	1.3

† includes four sites (one in Hutt City and the Wairarapa and two in Wellington City) sampled fortnightly.

A total of 32 (2%) routine sampling results exceeded the action guideline of 550 cfu/100 mL. This is approximately half the number of exceedances recorded during the 2007/08 summer (66) (Ryan & Warr 2008).

The majority (24) of the 32 action events were associated with at least 10 mm of rainfall in the three days prior to sampling; 14 were associated with more than 10 mm of rainfall in the 24 hours prior to 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).

## 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 2008/09 (Figure 5.1, Appendix 1), as follows:

- Kapiti Coast District – 3 sites
- Porirua City – 3 sites<sup>7</sup>
- Hutt City – 1 site
- Wellington City – 2 sites

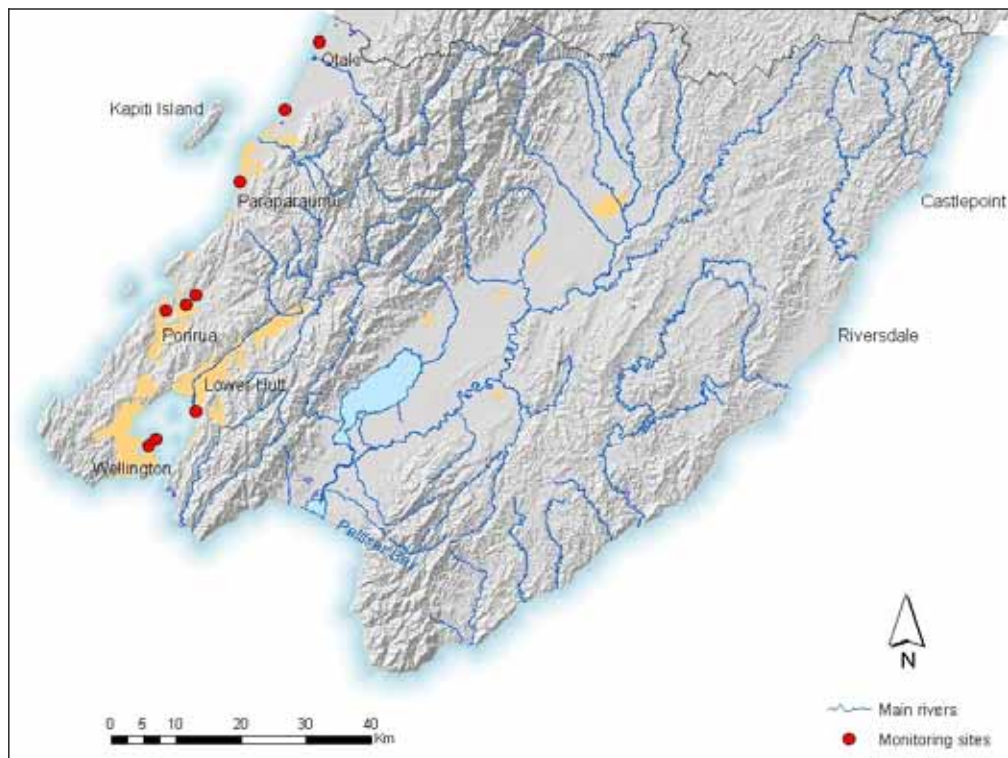


Figure 5.1: Recreational shellfish gathering water quality monitoring sites, 2008/09

### 5.2 Monitoring protocol

Sites were sampled weekly during 1 November 2008 to 31 March 2009 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.

<sup>7</sup> 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 400 mL respectively).

## 5.6 Results

Compliance with the shellfish gathering water quality guidelines over the 2008/09 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 2008/09 summer period (Table 5.1). Although the median faecal coliform count at the Peka Peka Beach monitoring site did not exceed the guideline of 14 cfu/100mL, more than 10% of water samples exceeded 43 cfu/100 mL. Otaki Beach at Surf Club and Raumati Beach at Hydes Road exceeded both guideline criteria.

**Table 5.1: Analysis of faecal coliform counts obtained from routine weekly monitoring during the 2008/09 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	16	570	6 (28.6%)	21
Peka Peka Beach – Road End	10	120	8 (38.1%)	21
Raumati Beach – Hydes Rd	15	170	5 (23.8%)	21

The maximum faecal coliform counts recorded at Peka Peka on 3 March 2009 and Raumati Beach on 23 February 2009 both coincided with more than 10 mm of rainfall in the 72 hours prior to sampling.

The maximum faecal bacteria count recorded at Otaki Beach (570 cfu/100 mL on 12 February 2009) coincided with a small amount of rainfall both prior to (<10 mm in previous 72 hours) as well as on the day of sampling.

### 5.6.2 Porirua

None of the three monitoring sites in Porirua complied with the recreational shellfish gathering water quality guidelines for the 2008/09 summer period. Although the median faecal bacteria guideline of 14 cfu/100 mL was not exceeded at any site, more than 10% of samples exceeded 43 cfu/100 mL at all three sites (Table 5.2).

**Table 5.2: Analysis of faecal coliform counts obtained from routine weekly monitoring during the 2008/09 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 at Browns Bay	8	770	9 (42.9%)	21
Pauatahanui Inlet at Motukaraka Point	4	860	3 (14.3%)	21
Porirua Harbour at Rowing Club	12	610	9 (42.9%)	21

The maximum faecal bacteria counts recorded at Browns Bay on 25 November 2008, Motukaraka Point on 16 December 2008 and at the Porirua Harbour at Rowing Club site on 17 February 2009 all coincided with more than 10 mm of rainfall in the 72 hours prior to sampling. The maximum faecal bacteria count recorded at Browns Bay also coincided with high turbidity and a strong northerly wind.

### 5.6.3 Wellington City

Of the monitoring sites in Wellington City, only Shark Bay complied fully with the recreational shellfish gathering water quality guidelines for the 2008/09 summer period. The median faecal count for Mahanga Bay did not exceed the guideline of 14 cfu/100 mL but more than 10% of water samples exceeded 43 cfu/100 mL (Table 5.3).

**Table 5.3: Analysis of faecal coliform counts obtained from routine weekly monitoring during the 2008/09 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	52	1 (4.8%)	21
Mahanga Bay	2	320	3 (14.3%)	21

Although no rainfall was recorded in the 72 hours prior to the maximum faecal bacteria count recorded at Mahanga Bay on 8 December 2008, rain fell on the day of sampling.

### 5.6.4 Hutt

In Hutt City, recreational shellfish gathering water quality was monitored at one site in Sorrento Bay. This site complied fully with the recreational shellfish gathering water quality guidelines for the 2008/09 summer period, despite two faecal coliform counts exceeding 43 cfu/100 mL (Table 5.4). The cause of the maximum faecal bacteria count recorded at Sorrento Bay (420 cfu/100 mL on 11 November 2008) is unclear as no rainfall occurred prior to or on the day of sampling.

**Table 5.4: Analysis of faecal coliform counts obtained from routine weekly monitoring during the 2008/09 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	2	420	2 (9.5%)	21

## 5.7 Synthesis

Porirua City and Kapiti Coast sites had high faecal coliform counts compared with other areas. Although Mahanga Bay did not fully comply with the MfE/MoH (2003) guidelines, water quality was consistently higher at Wellington and Hutt City monitoring sites. These results are consistent with those from the 2007/08 bathing season (Ryan & Warr 2008).

Analysis of rainfall records indicates that most elevated faecal coliform results coincided with significant rainfall events prior to sampling. As discussed in section 4.6, it is advisable to avoid contact with marine recreational waters for several days after heavy rain.



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<sup>8</sup> Published June 2002, updated June 2003.

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## Appendix 1: Monitoring sites

Area	Site Name	NZ Map Grid		Type
		Easting	Northing	
Hutt	Petone Beach @ Water Ski Club	2665765	5996304	Marine
Hutt	Petone Beach @ Sydney Street	2667067	5995961	Marine
Hutt	Petone Beach @ Settlers Museum	2667577	5995770	Marine
Hutt	Petone Beach @ Kiosk	2668348	5995425	Marine
Hutt	Sorrento Bay	2669654	5993098	Marine*
Hutt	Lowry Bay @ Cheviot Road	2670228	5992605	Marine
Hutt	York Bay	2669999	5991874	Marine
Hutt	Days Bay @ Wellesley College	2669639	5990243	Marine
Hutt	Days Bay @ Wharf	2669677	5990027	Marine
Hutt	Days Bay @ Moana Road	2669605	5989834	Marine
Hutt	Rona Bay @ N end of Cliff Bishop Park	2669132	5989367	Marine
Hutt	Rona Bay @ Wharf	2668753	5989084	Marine
Hutt	Robinson Bay @ HW Shortt Rec Ground	2668542	5988387	Marine
Hutt	Robinson Bay @ Nikau Street	2668154	5987569	Marine
Hutt	Camp Bay	2667013	5986001	Marine
Hutt	Hutt River @ Silverstream Bridge	2677619	6004887	Freshwater
Hutt	Hutt River @ Boulcott	2670941	5999283	Freshwater
Hutt	Wainuiomata River @ Richard Prouse Park	2674559	5990855	Freshwater
Kapiti	Otaki Beach @ Surf Club	2688639	6050044	Marine*
Kapiti	Otaki Beach @ Rangiuru Road	2688028	6048783	Marine
Kapiti	Te Horo Beach S of Mangaone Stream	2685797	6044192	Marine
Kapiti	Te Horo Beach @ Kitchener Street	2685513	6043648	Marine
Kapiti	Peka Peka Beach @ Road End	2683233	6039620	Marine*
Kapiti	Waikanae Beach @ William Street	2681406	6037299	Marine
Kapiti	Waikanae Beach @ Tutere St Tennis Courts	2680673	6036577	Marine
Kapiti	Waikanae Beach @ Ara Kuaka Carpark	2679532	6035693	Marine
Kapiti	Paraparaumu Beach @ Ngapotiki Street	2677561	6034477	Marine
Kapiti	Paraparaumu Beach @ Nathan Avenue	2677051	6033889	Marine
Kapiti	Paraparaumu Beach @ Maclean Park	2676712	6032982	Marine
Kapiti	Paraparaumu Beach @ Toru Road	2676595	6032430	Marine
Kapiti	Paraparaumu Beach @ Wharemauku Road	2676521	6031785	Marine
Kapiti	Raumati Beach @ Tainui Street	2676549	6030944	Marine
Kapiti	Raumati Beach @ Marine Gardens	2676535	6030156	Marine
Kapiti	Raumati Beach @ Aotea Road	2676433	6029244	Marine
Kapiti	Raumati Beach @ Hydes Road	2676337	6028550	Marine*
Kapiti	Paekakariki Beach @ Whareroa Road	2675617	6025843	Marine
Kapiti	Paekakariki Beach @ Surf Club	2674810	6023988	Marine
Kapiti	Paekakariki Beach @ Memorial Hall	2674452	6023305	Marine
Kapiti	Otaki River @ The Pots	2695461	6040455	Freshwater
Kapiti	Otaki River @ State Highway 1	2691326	6046120	Freshwater
Kapiti	Waikanae River @ State Highway 1	2683770	6034011	Freshwater
Kapiti	Waikanae River @ Jim Cooke Park	2682173	6034092	Freshwater
Porirua	Pukerua Bay	2669309	6017968	Marine
Porirua	Karehana Bay @ Cluny Road	2666113	6013074	Marine
Porirua	Plimmerton Beach @ Bath Street	2666726	6012030	Marine
Porirua	Plimmerton Beach @ Queens Avenue	2666790	6011888	Marine
Porirua	South Beach @ Plimmerton	2666830	6011588	Marine
Porirua	Paremata Beach @ Pascoe Avenue	2667137	6010447	Marine
Porirua	Pauatahanui Inlet @ Water Ski Club	2668094	6011307	Marine
Porirua	Pauatahanui Inlet @ Motukaraka Point	2669506	6011052	Marine*
Porirua	Pauatahanui Inlet @ Paremata Bridge	2667173	6009998	Marine

Area	Site Name	NZ Map Grid		Type
		Easting	Northing	
Porirua	Pauatahanui Inlet @ Browns Bay	2668059	6009547	Marine*
Porirua	Porirua Harbour @ Rowing Club	2664911	6008661	Marine*
Porirua	Titahi Bay @ Bay Drive	2664152	6009883	Marine
Porirua	Titahi Bay @ Toms Road	2664130	6009571	Marine
Porirua	Titahi Bay @ South Beach Access Road	2663926	6009396	Marine
Porirua	Onehunga Bay	2665816	6010895	Marine
Upper Hutt	Pakuratahi River @ Forks	2694308	6014337	Freshwater
Upper Hutt	Hutt River @ Birchville	2686216	6010807	Freshwater
Upper Hutt	Hutt River @ Maoribank Corner	2685902	6008412	Freshwater
Upper Hutt	Hutt River @ Poets Park	2681482	6007807	Freshwater
Wairarapa	Ruamahanga River @ Double Bridges	2734363	6033494	Freshwater
Wairarapa	Ruamahanga River @ Te Ore Ore	2735543	6024638	Freshwater
Wairarapa	Waipoua River @ Colombo Road	2735010	6024610	Freshwater
Wairarapa	Waingawa River @ Kaituna	2720341	6032867	Freshwater
Wairarapa	Waingawa River @ South Road	2730565	6022599	Freshwater
Wairarapa	Ruamahanga River @ The Cliffs	2731492	6013902	Freshwater
Wairarapa	Ruamahanga River @ Kokotau	2725774	6008913	Freshwater
Wairarapa	Waiohine River @ Gauge	2711871	6017655	Freshwater
Wairarapa	Waiohine River @ State Highway 2	2719683	6013431	Freshwater
Wairarapa	Ruamahanga River @ Morrisons Bush	2718938	6002829	Freshwater
Wairarapa	Ruamahanga River @ Waihenga	2714631	5998182	Freshwater
Wairarapa	Ruamahanga River @ Bentleys Beach	2710556	5994533	Freshwater
Wairarapa	Castlepoint Beach @ Castlepoint Stream	2781366	6029287	Marine
Wairarapa	Castlepoint Beach @ Smelly Creek	2781670	6028931	Marine
Wairarapa	Riversdale Beach @ Lagoon Mouth	2768974	6009275	Marine
Wairarapa	Riversdale Beach Between the Flags	2768445	6008680	Marine
Wairarapa	Riversdale Beach South	2767844	6007246	Marine
Wellington	Aotea Lagoon	2659007	5989395	Marine
Wellington	Oriental Bay @ Freyberg Beach	2659942	5989176	Marine
Wellington	Oriental Bay @ Wishing Well	2660140	5989098	Marine
Wellington	Oriental Bay @ Band Rotunda	2660265	5989087	Marine
Wellington	Balaena Bay	2660980	5988979	Marine
Wellington	Kio Bay	2661163	5988311	Marine
Wellington	Hataitai Beach	2660654	5987442	Marine
Wellington	Shark Bay	2662233	5987909	Marine*
Wellington	Mahanga Bay	2663490	5988828	Marine*
Wellington	Scorching Bay	2663539	5988360	Marine
Wellington	Worser Bay	2663097	5986535	Marine
Wellington	Seatoun Beach @ Wharf	2663152	5985946	Marine
Wellington	Seatoun Beach @ Inglis Street	2663428	5985706	Marine
Wellington	Breaker Bay	2663335	5984682	Marine
Wellington	Lyll Bay @ Tirangi Road	2660770	5984942	Marine
Wellington	Lyll Bay @ Onepu Road	2660309	5984828	Marine
Wellington	Lyll Bay @ Queens Drive	2660013	5984580	Marine
Wellington	Princess Bay	2659609	5983216	Marine
Wellington	Island Bay @ Surf Club	2658400	5983302	Marine
Wellington	Island Bay @ Reef St Recreation Ground	2658252	5983254	Marine
Wellington	Island Bay @ Derwent Street	2658178	5983127	Marine
Wellington	Owhiro Bay	2657145	5983174	Marine

\* 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 <sup>th</sup> 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 <sup>th</sup> 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 <sup>th</sup> Ed.) 2130B	0.1 NTU
Periphyton cover (both filamentous and mat-forming algae)	Mean % of algae visually estimated (using a 20 cm diameter hoop) at 10 points on a single transect (or 5 points on two transects) across the river	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 2008/09 summer are summarised in the tables below. The Microbiological Assessment Category (MAC) values, and therefore the Suitability for Recreation Grades (SFRGs) determined by Milne and Wyatt (2006)<sup>9</sup>, have been updated using the 2004/05 – 2008/09 microbiological results.

### (a) Freshwaters

Bathing Site	Total no. of samples	No. sample results ( <i>E. coli</i> /100 mL)			Beach grading (2004/05 – 2008/09 data)		
		Surveillance (≤260)	Alert (261-550)	Action (>550)	SIC Grade	MAC Grade (95 <sup>th</sup> %-ile value)	SFRG†
<b>Kapiti</b>							
Otaki R @ Pots	5‡	5	0	0	Low	B (196)*	Good*
Otaki R @ SH 1	21	21	0	0	Moderate	C (261)	Fair
Waikanae R @ SH 1	21	20	0	1	Moderate	C (317)	Fair
Waikanae R @ Jim Cooke Park	21	19	1	1	Moderate§	C (276)	Fair§
<b>Hutt &amp; Wainuiomata</b>							
Pakuratahi R @ Forks	21	18	1	2	Moderate	D (824)	Poor
Hutt R @ Birchville	21	18	1	2	Moderate	D (968)	Poor
Hutt R @ Maoribank Corner	21	18	1	2	Moderate	D (676)	Poor
Hutt R @ Poets Park	21	19	0	2	Moderate	D (596)	Poor
Hutt R @ Silverstream	21	15	2	4	Moderate	D (1,900)	Poor
Hutt R @ Boulcott	21	18	0	3	Moderate	D (1,820)	Poor
Wainuiomata R @ RP Park	21	17	0	4	Moderate§	D (1,760)	Poor§
<b>Wairarapa</b>							
Ruamahanga R @ Double Bridges	21	21	0	0	Mod/High	D (658)	Poor/V. Poor
Ruamahanga R @ Te Ore Ore	21	20	0	1	High	D (1,369)	Very Poor
Ruamahanga R @ The Cliffs	21	20	1	0	High	D (720)	Very Poor
Ruamahanga R @ Kokotau	21	20	1	0	High	D (685)	Very Poor
Ruamahanga R @ Morrisons Bush	21	20	1	0	High	C (470)	Poor**
Ruamahanga R @ Waihenga	21	21	0	0	High	C (495)	Poor**
Ruamahanga R @ Bentleys Beach	21	19	1	1	High	D (635)	Very Poor
Waipoua R @ Colombo Rd	21	21	0	0	High	C (530)	Poor**
Waingawa R @ Kaituna	21	21	0	0	Low	B (221)	Good
Waingawa R @ South Rd	21	21	0	0	Moderate	B (181)	Good**
Waiohine R @ Gorge (Gauge)	5‡	5	0	0	Low	A (114)*	V. Good*
Waiohine R @ SH 2	21	21	0	0	Moderate	A (88)	Good

† 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).

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

\* based on 2001/02 – 2006/07 data as presented in Milne & Wyatt (2006).

\*\* indicates a change in MAC/SFRG from that determined by Milne & Wyatt (2006).

§ interim grading (SIC grading based on previously graded sites in the same catchment or catchment knowledge, MAC grade based on 2 years of data, n=42)

<sup>9</sup> 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 (2004/05 – 2008/09 data)		
		Surveillance (≤260)	Alert (141-280)	Action (>280)	SIC Grade	MAC Grade (95 <sup>th</sup> -ile value)	SFRG
Kapiti							
Otaki Beach @ Surf Club	20	0	1	21	Low	C (276)	Fair*
Otaki Beach @ Rangiuuru Rd	21	0	0	21	Low	C (278)	Fair*
Te Horo Beach S of Mangaone Strm	21	0	0	21	Moderate	C (355)	Fair
Te Horo Beach @ Kitchener St	21	0	0	21	Moderate	C (254)	Fair
Peka Peka Beach @ Rd End	21	0	0	21	Low	B (120)	Good
Waikanae Beach @ William St	21	0	0	21	Moderate	B (112)	Good
Waikanae Beach @ Tutere St T.C.	21	0	0	21	Moderate	B (110)	Good
Waikanae Beach @ Ara Kuaka C.P.	21	0	0	21	Moderate	B (196)	Good*
Paraparaumu Beach @ Ngapotiki St	21	0	0	21	Moderate	C (321)	Fair
Paraparaumu Beach @ Nathan Ave	20	1	0	21	Moderate	C (355)	Fair
Paraparaumu Beach @ Maclean Pk	19	2	0	21	Moderate	C (298)	Fair
Paraparaumu Beach @ Toru Rd	20	1	0	21	Moderate	C (237)	Fair
Paraparaumu Beach @ Wharemauku Rd	21	0	0	21	Moderate	B (167)	Good*
Raumati Beach @ Tainui St	21	0	0	21	Moderate	B (134)	Good*
Raumati Beach @ Marine Gardens	19	2	0	21	Moderate	C (247)	Fair
Raumati Beach @ Aotea Rd	21	0	0	21	Low/Mod	B (122)	Good
Raumati Beach @ Hydes Rd	21	0	0	21	Moderate	C (212)	Fair
Paekakariki Beach @ Whareroa Rd	21	0	0	21	Low	B (86)	Good
Paekakariki Beach @ Surf Club	21	0	0	21	Low	B (47)	Good
Paekakariki Beach @ Memorial Hall	21	0	0	21	Low	B (49)	Good
Porirua							
Pukerua Bay	20	0	1	21	Low	B (130)	Good
Karehana Bay @ Cluny Rd	17	2	2	21	Moderate	C (203)	Fair*
Plimmerton Beach @ Bath St	19	0	2	21	Moderate	C (257)	Fair*
Plimmerton Beach @ Queens Ave	19	1	1	21	Moderate	C (206)	Fair
South Beach @ Plimmerton	16	2	3	21	Moderate	C (483)	Fair*
Paremata Beach @ Pascoe Ave	18	2	1	21	Moderate	B (199)	Good*
Pauatahanui Inlet @ Water Ski Club	16	2	3	21	Moderate	B (186)	Good*
Pauatahanui Inlet @ Motukaraka Pt	17	3	1	21	Moderate	C (201)	Fair*
Pauatahanui Inlet @ Browns Bay	15	4	2	21	Moderate	C (278)	Fair*
Pauatahanui Inlet @ Paremata Bridge	21	0	0	21	Moderate§	B (124)	Good§
Porirua Harbour @ Rowing Club	13	3	5	21	Moderate	D (1,200)	Poor
Titahi Bay @ Bay Drive	18	2	1	21	Moderate	C (272)	Fair*
Titahi Bay @ Toms Rd	20	0	1	21	Moderate	B (166)	Good*
Titahi Bay @ South Beach Access Rd	18	0	3	21	Moderate	B (175)	Good*
Onehunga Bay	21	0	0	21	Moderate	B (63)	Good*
Hutt							
Petone Beach @ Water Ski Club	21	0	0	21	Moderate	C (202)	Fair
Petone Beach @ Sydney St	21	0	0	21	Moderate	B (130)	Good*
Petone Beach @ Settlers Museum	20	1	0	21	Moderate	C (203)	Fair*
Petone Beach @ Kiosk	21	0	0	21	Moderate	B(141)	Good

Bathing Site	Total no. of samples	No. sample results (Enterococci/100 mL)			Beach grading (2004/05 – 2008/09 data)		
		Surveillance (≤260)	Alert (141-280)	Action (>280)	SIC Grade	MAC Grade (95 <sup>th</sup> -ile value)	SFRG
Sorrento Bay	21	0	0	21	Low	B (56)	Good
Lowry Bay @ Cheviot Rd	21	0	0	21	Low	B (195)	Good*
York Bay	21	0	0	21	Low	B (53)	Good
Days Bay @ Wellesley College	20	0	1	21	Low	B (100)	Good
Days Bay @ Wharf	21	0	0	21	Low	B (139)	Good
Days Bay @ Moana Rd	21	0	0	21	Low	B (131)	Good
Rona Bay @ N end of Cliff Bishop Pk	21	0	0	21	Low/Mod	B (135)	Good*
Rona Bay @ Wharf	21	0	0	21	Low/Mod	B (193)	Good*
Robinson Bay @ HW Shortt Rec Grd	21	0	0	21	Low	C (281)	Fair
Robinson Bay @ Nikau St	21	0	0	21	Low	B (189)	Good
Camp Bay	11	0	0	11	Very Low	B (66)	V. Good
<b>Wellington City</b>							
Aotea Lagoon	21	0	0	21	Moderate	B (130)	Fair*
Oriental Bay @ Freyberg Beach	21	0	0	21	Moderate	B (57)	Good
Oriental Bay @ Wishing Well	20	1	0	21	Moderate	C (264)	Fair
Oriental Bay @ Band Rotunda	21	0	0	21	Moderate	C (226)	Fair
Balaena Bay	20	1	0	21	Low	A (40)	V. Good*
Kio Bay	21	0	0	21	Low	B (120)	Good
Hataitai Beach	21	0	0	21	Moderate	B (133)	Good*
Shark Bay	21	0	0	21	Low	B (61)	Good
Mahanga Bay	20	0	1	21	Low	B (191)	Good
Scorching Bay	21	0	0	21	Low	B (58)	Good
Worser Bay	21	0	0	21	Low	B (54)	Good
Seatoun Beach @ Wharf	21	0	0	21	Low/Mod	B (85)	Good
Seatoun Beach @ Inglis St	21	0	0	21	Low/Mod	B (47)	Good
Breaker Bay	11	0	0	11	V. Low	A (19)	V. Good
Lyll Bay @ Tirangi Rd	21	0	0	21	Moderate	B (192)	Good
Lyll Bay @ Onepu Rd	21	0	0	21	Moderate	B (69)	Good
Lyll Bay @ Queens Drive	21	0	0	21	Moderate	B (57)	Good
Princess Bay	11	0	0	11	Low	A (16)	V. Good
Island Bay @ Surf Club	21	0	0	21	Moderate	B (182)	Good
Island Bay @ Reef St Recreation Grd	21	0	0	21	Moderate	B (194)	Good
Island Bay @ Derwent St	21	0	0	21	Moderate	B (101)	Good†
Owhiro Bay	19	0	2	21	Moderate	C (383)	Fair
<b>Wairarapa</b>							
Castlepoint Beach @ Castlepoint Strm	19	1	1	21	Moderate	B (150)	Good
Castlepoint Beach @ Smelly Creek	21	0	0	21	Moderate	B (122)	Good**
Riversdale Beach @ Lagoon Mouth	21	0	0	21	Moderate	B (56)	Good
Riversdale Beach Between the Flags	21	0	0	21	Low	B (50)	Good
Riversdale Beach South	11	0	0	11	Very Low	A (31)	V. Good*

† from November 2006, sampled fortnightly.

\* indicates a change in MAC/SFRG from that determined by Milne &amp; Wyatt (2006).

‡ Interim grade (based on only 4.5 years of data, n=95).

§ Interim grade (SIC grading based on that for other Pauatahanui sites, MAC grade based on 2 years of data, n=42)



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