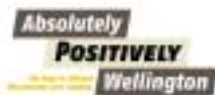


On the beaches 2006/07

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 2006/07 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 2006/07 summer bathing season (1 November 2006 to 31 March 2007 inclusive).



Figure 1.1: Hataitai Beach in Wellington City, 8 February 2007.

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.

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 and Wyatt 2006a). Updated SFRGs reflecting the 2006/07 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 fresh waters

3.1 Introduction

Recreational water quality was monitored at 22 freshwater sites across the Wellington region over 2006/07 (Figure 3.1, Appendix 1), as follows:

- Kapiti Coast District – 4 sites
- Hutt River catchment – 6 sites
- Wairarapa – 12 sites

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

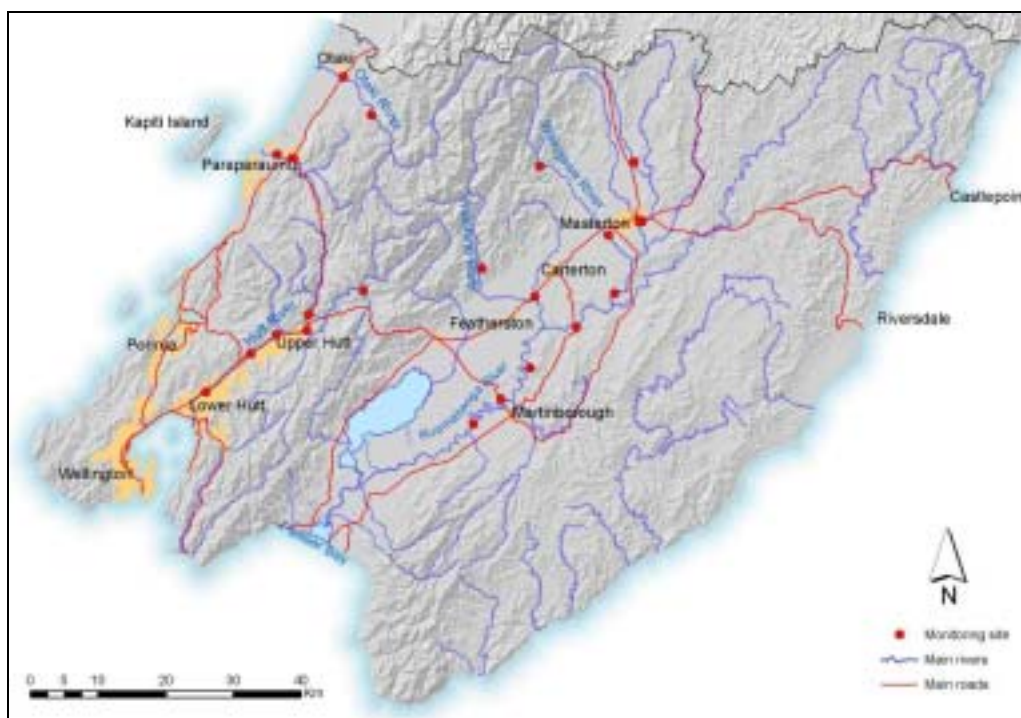


Figure 3.1: Freshwater recreation sites monitored over 2006/07.

3.2 Monitoring protocol

Sites were sampled weekly during the bathing season, with the exception of the Otaki River at Pots (Kapiti) and the Waiohine River at Gorge (Wairarapa) which were sampled monthly under Greater Wellington’s Rivers State of the Environment (RSoE) monitoring programme³. On each sampling occasion a

³ 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 and Wyatt (2006a) 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.

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 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 and 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 (8/1,000 risk). 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.

3.3.1 Periphyton guidelines

The MfE (2000) periphyton⁴ 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 has 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. Such blooms have occurred in recreational waters in the Wellington region in the past. For example, Milne and Wyatt (2006b) and Milne and Watts (2007) reported on the presence of benthic cyanobacteria proliferations in several of Wellington's rivers over the 2005/06 summer. Proliferations were present in some rivers again in early 2007.

3.5 Results

Action level *E. coli* results recorded during routine monitoring over 2006/07 are summarised below for bathing sites in Kapiti Coast, Hutt and Wairarapa rivers. The number of surveillance, alert and action level results recorded at each of the 22 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/100mL on one occasion during the 2006/07 bathing season, as follows:

- 30 January 2007 – Waikanae River at State Highway 1 (1,000 cfu/100 mL) and Greenaway Road (1,130 cfu/100 mL).

These action level *E. coli* results coincided with heavy rainfall; 27.5 mm fell in the 24 hour period to 9:00 am on 30 January, with a total of 60 mm recorded in the 72 hours prior to sampling.

The Otaki River at State Highway 1 exceeded the filamentous periphyton cover threshold on one sampling occasion in early January 2007. The threshold for benthic cyanobacteria cover was not exceeded at any site, although thick growths of the toxin-producing cyanobacterium *Phormidium* sp. were observed

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

on parts of the bed of the Otaki River (State Highway 1) and Waikanae River (Greenaway Road) in February 2007, prompting the Kapiti Coast District Council to issue a media release and erect health warning signs advising the public against going into the water.

3.5.2 Hutt

All six bathing sites in the Hutt River catchment exceeded the action guideline on at least one occasion during the summer bathing season. The Hutt River at Silverstream and Boulcott both exceeded the action guideline on three occasions. This is a better result than in 2005/06 when the Silverstream site exceeded the action guideline six times (Milne and Wyatt 2006b). The action level events recorded in the Hutt River catchment during 2006/07 were:

- 7 November 2006 – Hutt River at Silverstream (700 cfu/100 mL) and Boulcott (1,100 cfu/100 mL).
- 2 January 2007 – Hutt River at Silverstream (860 cfu/100 mL) and Boulcott (660 cfu/100 mL).
- 30 January 2007 – Hutt River at Birchville (1,000 cfu/100 mL), Maoribank (1,400 cfu/100 mL), Poets Park (1,300 cfu/100 mL), Silverstream (1,200 cfu/100 mL) and Boulcott (1,800 cfu/100 mL), and Pakuratahi River at Forks (840 cfu/100 mL).
- 13 March 2007 – Pakuratahi River at Forks (560 cfu/100 mL).

All breaches of the action guideline coincided with at least 5 mm of rainfall in the upstream catchment in the 24 hours prior to sampling. The action level *E. coli* results recorded at all six bathing sites on 30 January 2007 were preceded by 34 mm of rainfall in the 72 hours prior to sampling, of which 19.5 mm fell in the 24 hours prior to sampling. Greater Wellington did not conduct any follow-up sampling.

Both bathing sites on the lower reaches of the Hutt River (Silverstream and Boulcott) exceeded periphyton cover guidelines during January 2007. Filamentous periphyton cover exceeded the 30% threshold at both sites in early January. Cyanobacteria mat coverage exceeded the 60% threshold at Boulcott at the same time and coverage at Silverstream came close to this threshold on one occasion in both January and February. Health warning signs were not erected at either site as the mats were not exposed at the river's edge. Instead a general warning of the presence of thick growths of cyanobacteria in a number of rivers in the region was issued by Regional Public Health and posted on Greater Wellington's website in late February⁵.

3.5.3 Wairarapa

Eight of the 12 bathing sites monitored in Wairarapa rivers exceeded the action guideline on one or more occasions during the summer bathing season. The same number of sites exceeded the guideline the previous summer, although

⁵ The cyanobacteria proliferations coincided with prolonged dry weather and stable or declining flows in affected rivers.

the 2005/06 summer included Riversdale Lagoon as a bathing site. The 2006/07 action events are summarised below:

- 7 November 2006 – Ruamahanga River at Te Ore Ore (900 cfu/100 mL).
- 14 November 2006 – Ruamahanga River at Te Ore Ore (680 cfu/100 mL) and The Cliffs (960 cfu/100 mL).
- 28 November 2006 – Ruamahanga River at Te Ore Ore (2,200 cfu/100 mL), The Cliffs (1,000 cfu/100 mL), Kokotau (1,800 cfu/100 mL), Waihenga (1,300 cfu/100 mL), and Bentleys Beach (1,600 cfu/100 mL), and Waipoua River at Colombo Road (1,400 cfu/100 mL).
- 30 January 2007 – Ruamahanga River at Te Ore Ore (740 cfu/100 mL) and Waihenga (840 cfu/100 mL), and Waingawa River at Kaituna (780 cfu/100 mL).
- 27 February 2007 – Ruamahanga River at Te Ore Ore (2,000 cfu/100 mL) and Kokotau (1,400 cfu/100 mL).
- 13 March 2007 – Ruamahanga River at Double Bridges (680 cfu/100).

The majority of the elevated *E. coli* results coincided with significant rainfall prior to or during sampling. For example, over 100 mm of rain was recorded in the Ruamahanga catchment (at Mount Bruce) in the 48 hours prior to sampling on 28 November 2006. The only occasion where action level results did not coincide with rainfall in the three days preceding sampling was on 27 February 2007.

New and multiple sampling personnel led to some inconsistencies in periphyton assessments and reporting during 2006/07. While this prevents an accurate determination of the number of times each bathing site exceeded guidelines for periphyton cover, some sites did exceed guidelines in early 2007. These included:

- The Ruamahanga River at Double Bridges, Kokotau and Bentleys Beach, and the Waiohine River at State Highway 2, exceeded the threshold for filamentous periphyton (30% cover) in late January 2007. The threshold was also exceeded in the Ruamahanga River at The Cliffs, Morrisons Bush and Bentleys Beach in March.
- The Waipoua River at Colombo Road exceeded the 60% cover threshold for diatoms/cyanobacteria throughout most of January, February and March 2007, reaching over 90% coverage on three sampling occasions. Benthic cyanobacteria mats in the Ruamahanga River at Kokotau, Waihenga and Bentleys Beach also exceeded the 60% threshold on one or more occasions during late January to March.

A general warning of the presence of thick growths of potentially toxic cyanobacteria at bathing sites on the Waipoua and Ruamahanga rivers was posted on Greater Wellington's website in late February.

3.6 Synthesis

Sixteen of the 20 freshwater sites (80%) monitored weekly over the 2006/07 summer bathing season exceeded the action guideline on at least one occasion (Table 3.2). Nine sites exceeded the guideline once and four sites exceeded the guideline twice.

Table 3.2: Summary of action guideline breaches from routine weekly monitoring at 20 freshwater sites over the 2006/07 summer bathing season†.

No. of Times Site Exceeded the Action Guideline	No. of Sites in each Exceedance Category			Total No. of Sites (20)	% of Sites
	Kapiti (3 sites)	Hutt (6 sites)	Wairarapa (11 sites)		
0	1	0	3	4	20
1	2	3	4	9	45
2	0	1	3	4	20
3	0	2	0	2	10
4	0	0	0	0	0
5	0	0	1	1	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 28 routine sampling results exceeded the action guideline of 550 cfu/100mL. While this is eight fewer than the previous summer, the 2005/06 statistics included Riversdale Lagoon which exceeded the action guideline six times (Milne and Wyatt 2006b).

The majority (25) of the 28 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 and Wyatt 2006a, Milne 2005).

The high correlation between rainfall events and high bacteria counts supports advice from Greater Wellington and the Ministry of Health to avoid swimming and other contact recreation activities in freshwaters during and for up to several days after heavy rainfall.

4. Recreational water quality in marine waters

4.1 Introduction

Recreational water quality was monitored at 76 marine sites across the Wellington region over 2006/07 (Figure 4.1, Appendix 1), as follows:

- Kapiti Coast District – 20 sites
- Porirua City – 14 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.

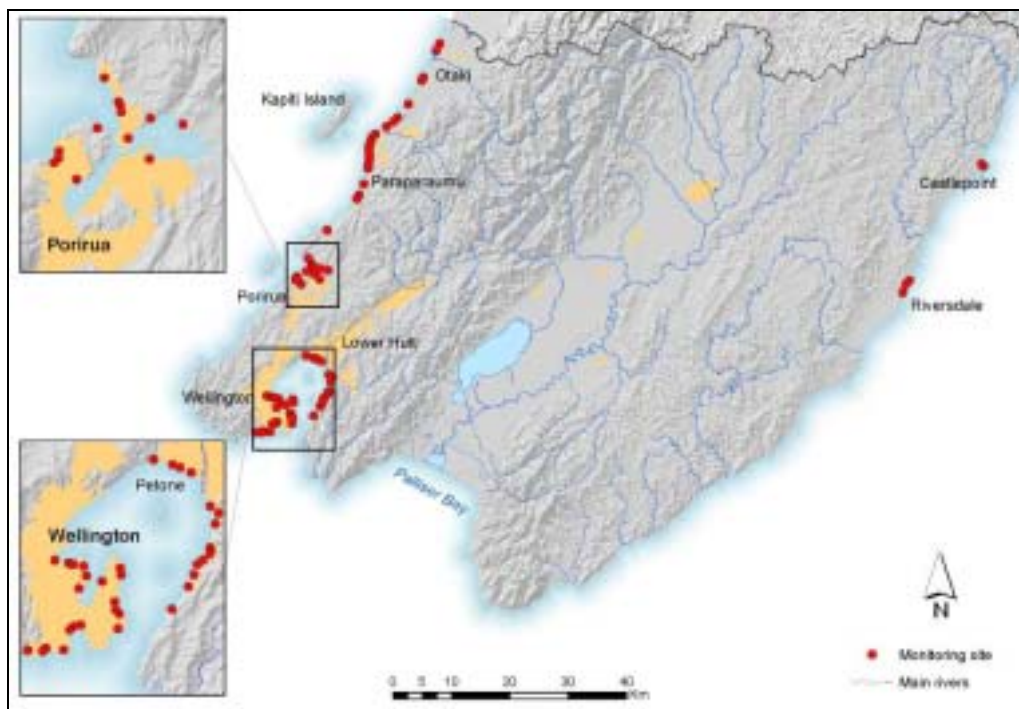


Figure 4.1: Marine recreation sites monitored over 2006/07.

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 fortnightly⁶. 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

⁶ Milne and Wyatt (2006a) 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.

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 seaweed. Under warm conditions when seaweed is excessively photosynthesising or decaying, enterococci may feed off the decayed seaweed or increased carbonaceous material produced by the seaweed during photosynthesis.

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 (19/1000 risk). 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.

4.4 Data analysis, limitations and cautionary notes

All sampling and evaluation of results has 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 76 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., beach closure, 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 2006/07 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 76 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

Seven of the 20 marine sites monitored along the Kapiti Coast exceeded the action guideline of 280 cfu/100 mL during the summer bathing season. This is a significant improvement on the 2005/06 summer when 14 sites exceeded the guideline, with nine sites exceeding on two or more occasions (Milne and Wyatt 2006b). In 2006/07, just one site – Otaki Beach at Rangiora Road – exceeded the guideline more than once. The 2006/07 action events are summarised below:

- 6 November 2006 – Paraparaumu Beach at Ngapotiki Street (315 cfu/100 mL) and McLean Park (315 cfu/100 mL).
- 20 November 2006 – Otaki Beach at Rangiora Road (325 cfu/100 mL).
- 30 January 2007 – Peka Peka Beach at Road End (285 cfu/100 mL).

- 20 March 2007 – Otaki Beach at Surf Club (1,150 cfu/100 mL), Otaki Beach at Rangiuru Road (1,130 cfu/100 mL), Te Horo Beach south of Mangaone Stream (740 cfu/100 mL) and Te Horo Beach at Kitchener Street (530 cfu/100 mL).

All of the enterococci counts that exceeded the action guideline coincided with some rainfall in the 72 hours prior to water sampling. For example, 27.5 mm of rain fell prior in the 24 hours prior to sampling at Peka Peka Beach on 30 January 2007. The elevated results recorded along Otaki and Te Horo beaches on 20 March 2007 may also in part be attributed to the influence of rivers further up the coast; the Mount Ruapehu lahar of 18 March caused flooding in the Whangaehu River, resulting in rotting leaves and other debris being discharged to coastal waters south of Wanganui.

The Kapiti Coast District Council collected additional samples following all exceedances of the action guideline. The results of all of these follow-up samples complied with the surveillance guideline (≤ 140 cfu/100 mL), indicating that no further management action was required.

4.5.2 Porirua

Twelve of the 14 sites monitored in Porirua City exceeded the action guideline of 280 cfu/100 mL during the bathing season, with four sites exceeding the guideline at least twice. In 2005/06, no sites exceeded the action guideline (Milne and Wyatt 2006b). The 2006/07 action events are summarised below:

- 7 November 2006 – Plimmerton Beach at both Bath Street (2,800 cfu/100 mL) and Queens Avenue (700 cfu/100 mL), Paremata Beach at Pascoe Avenue (400 cfu/100 mL) and Titahi Bay at both Bay Drive (400 cfu/100 mL) and Toms Road (300 cfu/100 mL).
- 19 December 2006 – Pauatahanui Inlet at Water Ski Club (1,700 cfu/100 mL), Motukaraka Point (2,100 cfu/100 mL) and Browns Bay (2,000 cfu/100 mL).
- 7 February 2007 – South Beach at Plimmerton (308 cfu/100 mL).
- 13 February 2007 – Pukerua Bay (2,000 cfu/100 mL), Karehana Bay at Cluny Road (2,400 cfu/100 mL), Plimmerton Beach at Bath Street (2,400 cfu/100 mL), Queens Avenue (600 cfu/100 mL) and South Beach (600 cfu/100 mL), and Titahi Bay at Toms Bay (500 cfu/100 mL).
- 20 February 2007 – South Beach at Plimmerton (1,100 cfu/100 mL).
- 13 March 2007 – Titahi Bay at South Beach Access Road (312 cfu/100 mL).

The November 2006 and March 2007 sampling results that exceeded the action guideline coincided with rainfall prior to, and on the day of, water sampling. The influence of rainfall on water quality in Pauatahanui Inlet on 19 December 2006 is unclear; 10.5 mm of rain fell in the preceding three days but only 0.5 mm of rainfall was recorded in the 48 hours prior to the day of sampling. None

of the action level results recorded across six sites during February coincided with any rainfall during or in the 72 hours prior to sampling.

The Porirua City Council collected additional samples following all exceedances of the action guideline. The results of most of these follow-up samples complied with the surveillance guideline (≤ 140 cfu/100 mL), indicating that no further management action was required. The exceptions were the results of follow-up sampling undertaken at the three Pauatahanui Inlet bathing sites on 20 December 2006; the Water Ski Club, Motukaraka Point and Browns Bay all exceeded the action guideline (4,000 cfu/100 mL, 1,000 cfu/100 mL and 5,200 cfu/100 mL respectively). Further sampling was conducted the next day; the Water Ski Club and Motukaraka Point sites again exceeded the action guideline (1,000 cfu/100 mL and 1,100 cfu/100 mL respectively), while Browns Bay exceeded the alert guideline (156 cfu/100 mL). Health warning signs were subsequently erected at all three sites. These signs remained in place over the Christmas and New Year period until 29 December; none of the results from routine sampling on 27 December exceeded the action guideline, although Browns Bay exceeded the alert guideline (212 cfu/100 mL). All three sites complied with the surveillance guideline on 3 January 2007.

A sanitary survey undertaken by the Porirua City Council in response to the consecutive action level results recorded in the Pauatahanui Inlet during December 2006 did not identify any obvious cause or source of faecal contamination⁷. However, 26.5 mm of rain fell in the 24 hour period to 9 am on 20 December which may have influenced the first set of follow-up sampling results.

4.5.3 Hutt

Eight of the 15 marine sites monitored in Hutt City exceeded the action guideline of 280 cfu/100 mL during the bathing season. A similar number of sites exceeded the guideline in 2006/07 (Milne and Wyatt 2006b). With the exception of Robinson Bay at HW Shortt Recreation Ground, all sites exceeded the guideline only once:

- 26 December 2006 – Robinson Bay at HW Shortt Recreation Ground (1,200 cfu/100 mL).
- 2 January 2007 – Petone Beach at the Water Ski Club (1,140 cfu/100 mL), Sydney Street (1,100 cfu/100 mL), Settlers Museum (1,600 cfu/100 mL) and Kiosk (1,600 cfu/100 mL), and Rona Bay at Cliff Bishop Park (320 cfu/100 mL).
- 13 February 2007 – Camp Bay (520 cfu/100 mL).
- 27 February 2007 – Robinson Bay at HW Shortt Recreation Ground (400 cfu/100 mL).
- 13 March 2007 – Robinson Bay at HW Shortt Recreation Ground (480 cfu/100 mL).

⁷ The sanitary survey incorporated additional water sampling in Pauatahanui Inlet and tributary streams.

The 2 January 2007 action events coincided with significant rainfall (19 mm in 24 hours) prior to sampling. It also rained during sampling on 13 March 2007. However no rainfall was recorded in the two days leading up to the December and February action events.

Follow-up samples collected by the Hutt City Council were all below the surveillance guideline.

4.5.4 Wellington City

Results from 19 of the 22 marine sites monitored in Wellington City remained below the action guideline of 280 cfu/100 mL throughout the bathing season, a slight improvement on 2005/06. The action guideline was exceeded on one occasion at each of the remaining three sites, as follows:

- 27 November 2006 – Lyall Bay at Onepu Road (690 cfu/100 mL) and Island Bay at both Surf Club (1,100 cfu/100 mL) and Reef Street Recreation Ground (1,700 cfu/100 mL).

These action level results coincided with rainfall on the day of sampling, with a moderate southerly wind also pushing debris onto shore at the Island Bay sites. Two other sites along Wellington's south coast exceeded the alert guideline (140 cfu/100 mL) on the same day – Lyall Bay at Queens Drive and Owhiro Bay.

Follow-up samples collected by the Wellington City Council over 29 November to 1 December 2007 all complied with the surveillance guideline, indicating no further management action was required.

4.5.5 Wairarapa

Castlepoint Beach at Smelly Creek was the only one of the five marine bathing sites in the Wairarapa that exceeded the action guideline of 280 cfu/100mL during the 2006/07 summer:

- 3 January 2007 – Castlepoint Beach at Smelly Creek (2,000 cfu/100 mL).

The elevated enterococci result followed 14.8 mm of rainfall in the 72 hours prior to sample collection which would have affected water quality in Smelly Creek. Greater Wellington collected a follow-up sample from the beach on 5 January; the result complied with the surveillance guideline.

4.6 Synthesis

Thirty of the 76 marine sites (39%) monitored over the 2006/07 summer bathing season exceeded the action guideline, although the majority of these (24 sites) exceeded the guideline on only one occasion (Table 4.2).

Table 4.2: Summary of action guideline breaches from routine weekly monitoring at 76 marine sites over the 2006/07 summer bathing season†.

No. of Times Site Exceeded the Action Guideline	No. of Sites in each Exceedance Category					Total No. of Sites (76)	% of Sites
	Kapiti (20 sites)	Porirua (14 sites)	Hutt (15 sites)	Wellington (22 sites)	Wairarapa (5 sites)		
0	13	2	8	19	4	46	60.5
1	6	8	6	3	1	24	31.6
2	1	3	0	0	0	4	5.3
3	0	1	1	0	0	2	2.6

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

The number of sites that remained below the action guideline of 280 cfu/100mL for the duration of the bathing period (46) was similar to 2005/06 (47 sites) (Milne and Wyatt 2006b). However, the total number of action events over 2006/07 was less (38 compared with 46 in 2005/06), reflecting the fact that most sites exceeded the guideline only once (Table 3.2).

The majority (27) of the 38 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 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. In some parts of the Wellington region, marine water quality can also be affected during dry weather by rivers, streams and drains discharging directly to the coast (Milne and Wyatt 2006a).

The relatively high correlation between rainfall events and high bacteria counts in marine waters supports advice from Greater Wellington and the Ministry of Health to avoid swimming and other contact recreation activities during and for up to several days after heavy rainfall.

5. Recreational shellfish gathering water quality

5.1 Introduction

Recreational shellfish gathering water quality was monitored at six marine sites across the Wellington region over 2006/07 (Figure 5.1, Appendix 1), as follows:

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

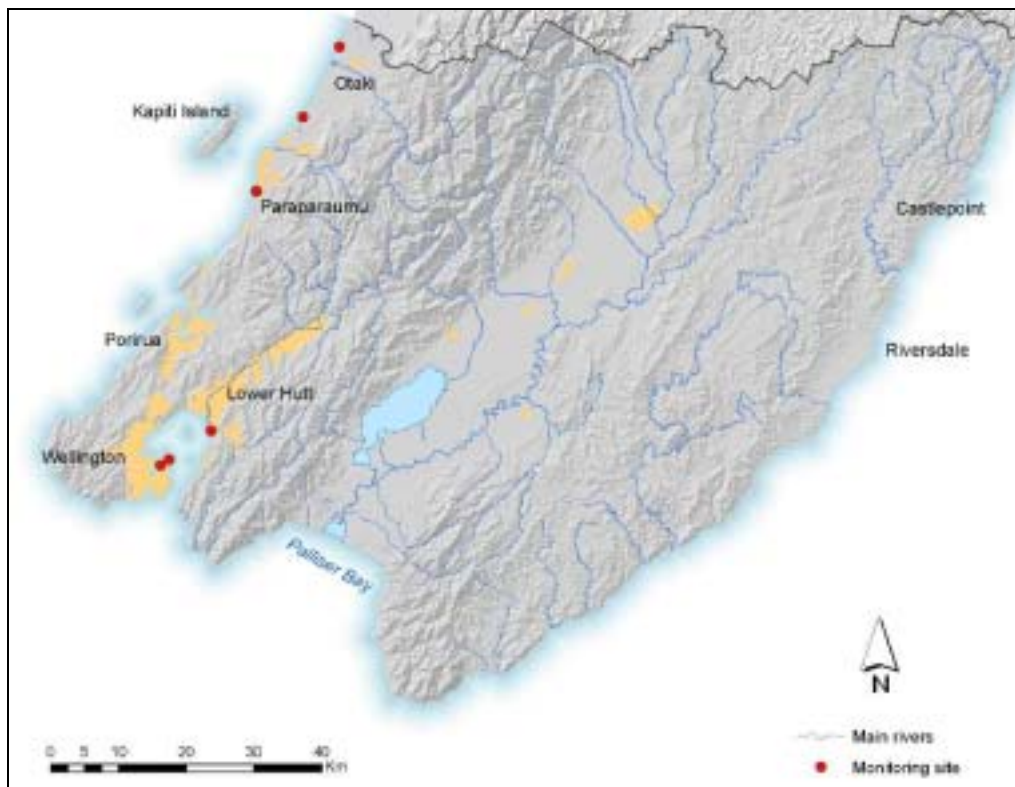


Figure 5.1: Recreational shellfish gathering water quality monitoring sites, 2006/07.

5.2 Monitoring protocol

Sites were sampled weekly during 1 November to 31 March inclusive and at least monthly during the remainder of the year, at the same time as marine recreational water quality sampling (all six 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.

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.

5.4 Data analysis, limitations and cautionary notes

All sampling and evaluation of results has 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 <1 cfu/100 mL and >400 cfu/100 mL were treated as 0.5 cfu/100 mL and 400 mL respectively).

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 Results

Compliance with the shellfish gathering water quality guidelines over the 2006/07 summer season is summarised below for marine waters in Kapiti, Hutt City and Wellington City.

5.6 Kapiti

None of the three monitoring sites on the Kapiti Coast complied with the recreational shellfish gathering water quality guidelines for the 2006/07 summer period (Table 5.1). The median faecal coliform count for Raumati Beach at Hydes Road did not exceed the guideline of 14 cfu/100 mL but more than 10% of water samples exceeded 43 cfu/100 mL. The Otaki Beach and Peka Peka Beach monitoring sites exceeded both guideline criteria.

Table 5.1: Analysis of faecal coliform counts obtained from routine weekly monitoring during the 2006/07 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	2,500	9 (42.9%)	21
Peka Peka Beach – Road End	34	700	9 (42.9%)	21
Raumati Beach – Hydes Rd	5	850	7 (33.3%)	21

The maximum faecal bacteria count recorded at Otaki Beach (2,500 cfu/100 mL on 20 November 2006) coincided with very turbid water as a result of a strong northwesterly wind. It also followed heavy rainfall; 52 mm was recorded at the Otaki Depot rainfall station in the 72 hours prior to sampling. The maximum faecal coliform counts at Peka Peka Beach and Raumati Beach were also recorded in turbid waters one and two days later respectively.

5.7 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 2006/07 summer period, despite two faecal coliform counts exceeding 43 cfu/100 mL (Table 5.2).

Table 5.2: Analysis of faecal coliform counts obtained from routine weekly monitoring during the 2006/07 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	88	2 (9.5%)	21

5.8 Wellington City

Both monitoring sites in Wellington City – Shark Bay and Mahanga Bay – complied fully with the recreational shellfish gathering water quality guidelines for the 2006/07 summer period. Neither site recorded a single result above 43 cfu/100 mL (Table 5.3).

Table 5.3: Analysis of faecal coliform counts obtained from routine weekly monitoring during the 2006/07 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	16	32	0 (0%)	21
Mahanga Bay	34	28	0 (0%)	21

5.9 Synthesis

This is the first time shellfish recreational water quality monitoring results have been reported in *On the Beaches* publications. The last comprehensive reporting of such monitoring results was by Milne (2005) and covered the four years 2001/02 to 2004/05. The 2006/07 results are consistent with the earlier results; the three monitoring sites on the Kapiti Coast recorded the greatest faecal coliform counts. In contrast, water quality was consistently higher at Shark Bay, Mahanga Bay and Sorrento Bay, with all three sites complying fully with the MfE/MoH (2003) guidelines over 2006/07.

Analysis of rainfall records indicates that the majority of elevated faecal coliform results coincided with turbid waters and/or significant rainfall events prior to sampling. As discussed in Section 4.6, it is advisable to avoid contact with marine recreational waters for up to two days after heavy rain.

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⁸ Published June 2002, updated June 2003.

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- Mike Butcher (Wairarapa Laboratory Services)
- Erin Kearney (Regional Public Health)
- Alton Perrie, Brett Cockerham, Ben Brown and Wendy Purdon (Greater Wellington)

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
Kapiti	Otaki Beach @ Surf Club	2688639	6050044	Marine*
Kapiti	Otaki Beach @ Rangioru 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 @ Greenaway Road	2681549	6034626	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

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 at 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 at 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 and Porirua City Council analysed water samples collected in their districts. Water samples from the Hutt and Wellington City were collected and analysed by Environmental Laboratory Services (ELS). ELS also collected and analysed freshwater samples from the Wairarapa. Wairarapa marine water samples were collected by Greater Wellington and analysed by Wairarapa Laboratory Services.

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 (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) and Te Marua (Hutt River)
- Wairarapa – Mount Bruce (Ruamahanga River), Kaituna (Waipoua River, Waingawa River), Phelps (Waiohine River)

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 2006/07 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 (2006a)⁹, have been updated using the 2002/03 – 2006/07 microbiological results.

(a) Freshwaters

Bathing Site	Total no. of samples	No. sample results (<i>E. coli</i> /100 mL)			Beach grading (2002/03 – 2006/07 data)		
		Surveillance (≤260)	Alert (261-550)	Action (>550)	SIC Grade	MAC Grade (95 th -ile value)	SFRG†
Kapiti							
Otaki R @ Pots	5‡	5	5	5	Low	B (196)*	Good*
Otaki R @ SH 1	21	19	2	0	Moderate	C (281)	Fair
Waikanae R @ SH 1	21	19	1	1	Moderate	D (653)	Poor
Waikanae R @ Greenaway Rd	21	20	0	1	Moderate	D (699)	Poor
Hutt							
Pakuratahi R @ Forks	21	19	0	2	Moderate	D (636)	Poor
Hutt R @ Birchville	21	20	0	1	Moderate	D (1,030)	Poor
Hutt R @ Maoribank Corner	21	19	1	1	Moderate	D (656)	Poor
Hutt R @ Poets Park	21	19	1	1	Moderate	D (666)	Poor
Hutt R @ Silverstream	21	18	0	3	Moderate	D (1,090)	Poor
Hutt R @ Boulcott	21	18	0	3	Moderate	D (1,130)	Poor
Wairarapa							
Ruamahanga R @ Double Bridges	21	19	1	1	Mod/High	D (698)	Poor
Ruamahanga R @ Te Ore Ore	21	15	5	1	High	D (1,953)	Very Poor
Ruamahanga R @ The Cliffs	21	19	0	2	High	D (1,015)	Very Poor
Ruamahanga R @ Kokotau	21	17	2	2	High	D (1,519)	Very Poor
Ruamahanga R @ Morrisons Bush	21	20	1	0	High	D (620)	Very Poor
Ruamahanga R @ Waihenga	21	19	0	2	High	D (1,089)	Very Poor
Ruamahanga R @ Bentleys Beach	21	19	1	1	High	D (1,233)	Very Poor
Waipoua R @ Colombo Rd	21	18	2	1	High	D (1,242)	Very Poor
Waingawa R @ Kaituna	21	19	1	1	Low	C (341)**	Fair**
Waingawa R @ South Rd	21	20	1	0	Moderate	C (349)	Fair
Waiohine R @ Gorge (Gauge)	5‡	5	0	0	Low	A (114)*	V. Good*
Waiohine R @ SH 2	21	21	0	0	Moderate	A (93)**	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 and Wyatt 2006a).

‡ 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 by Milne and Wyatt (2006a).

** indicates a change in MAC/SFRG from that determined by Milne and Wyatt (2006a) using 2001/02 – 2005/06 data.

⁹ 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 and Wyatt (2006a) 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 (2002/03 – 2006/07 data)		
		Surveillance (≤260)	Alert (141-280)	Action (>280)	SIC Grade	MAC Grade (95 th -ile value)	SFRG
<i>Kapiti</i>							
Otaki Beach @ Surf Club	21	19	1	1	Low	C (233)**	Fair**
Otaki Beach @ Rangiuuru Rd	21	19	0	2	Low	C (330)**	Fair**
Te Horo Beach S of Mangaone Strm	21	16	4	1	Moderate	D (504)**	Poor**
Te Horo Beach @ Kitchener St	21	19	1	1	Moderate	C (282)	Fair
Peka Peka Beach @ Rd End	21	20	0	1	Low	B (120)	Good
Waikanae Beach @ William St	21	20	1	0	Moderate	B (167)	Good
Waikanae Beach @ Tutere St T.C.	21	21	0	0	Moderate	B (135)	Good
Waikanae Beach @ Ara Kuaka C.P.	21	20	1	0	Moderate	C (215)	Fair
Paraparaumu Beach @ Ngapotiki St	21	18	2	1	Moderate	C (327)	Fair
Paraparaumu Beach @ Nathan Ave	21	21	0	0	Moderate	C (238)	Fair
Paraparaumu Beach @ Maclean Pk	21	19	0	2	Moderate	C (316)	Fair
Paraparaumu Beach @ Toru Rd	21	21	0	0	Moderate	C (333)	Fair
Paraparaumu Beach @ Wharemauku Rd	21	21	0	0	Moderate	C (238)	Fair
Raumati Beach @ Tainui St	21	21	0	0	Moderate	B (169)**	Good**
Raumati Beach @ Marine Gardens	21	20	1	0	Moderate	C (238)	Fair
Raumati Beach @ Aotea Rd	21	21	0	0	Low/Mod	B (118)	Good
Raumati Beach @ Hydes Rd	21	21	0	0	Moderate	C (246)	Fair
Paekakariki Beach @ Whareroa Rd	21	21	0	0	Low	B (97)	Good
Paekakariki Beach @ Surf Club	21	21	0	0	Low	B (62)	Good
Paekakariki Beach @ Memorial Hall	21	21	0	0	Low	B (64)	Good
<i>Porirua</i>							
Pukerua Bay	21	19	1	1	Low	B (118)	Good
Karehana Bay @ Cluny Rd	21	18	2	1	Moderate	B (179)	Good
Plimmerton Beach @ Bath St	21	18	1	2	Moderate	D (515)	Poor
Plimmerton Beach @ Queens Ave	21	18	1	2	Moderate	C (202)	Fair
South Beach @ Plimmerton	21	16	2	3	Moderate	D (603)	Poor
Paremata Beach @ Pascoe Ave	21	20	0	1	Moderate	C (271)	Fair
Pauatahanui Inlet @ Water Ski Club	21	20	0	1	Moderate	C (206)	Fair
Pauatahanui Inlet @ Motukaraka Pt	21	19	1	1	Moderate	B (175)	Good
Pauatahanui Inlet @ Browns Bay	21	16	4	1	Moderate	D (632)	Poor
Porirua Harbour @ Rowing Club	21	20	1	0	Moderate	C (320)**	Fair**
Titahi Bay @ Bay Drive	21	18	2	1	Moderate	C (419)**	Fair**
Titahi Bay at Toms Rd	21	18	1	2	Moderate	C (330)	Fair
Titahi Bay @ South Beach Access Rd	21	19	1	1	Moderate	C (275)	Fair
Onehunga Bay	21	21	0	0	Moderate	C (237)**	Fair**
<i>Hutt</i>							
Petone Beach @ Water Ski Club	21	19	1	1	Moderate	C (328)	Fair
Petone Beach @ Sydney St	21	20	0	1	Moderate	C (375)	Fair
Petone Beach @ Settlers Museum	21	19	1	1	Moderate	B (175)	Good
Petone Beach @ Kiosk	21	19	1	1	Moderate	B (120)	Good

Bathing Site	Total no. of samples	No. sample results (Enterococci/100 mL)			Beach grading (2002/03 – 2006/07 data)		
		Surveillance (≤260)	Alert (141-280)	Action (>280)	SIC Grade	MAC Grade (95 th -ile value)	SFRG
Sorrento Bay	21	21	0	0	Low	B (70)	Good
Lowry Bay @ Cheviot Rd	21	21	0	0	Low	C (263)	Fair
York Bay	21	20	1	0	Low	B (81)	Good
Days Bay @ Wellesley College	21	21	0	0	Low	B (85)	Good
Days Bay @ Wharf	21	21	0	0	Low	B (122)	Good
Days Bay @ Moana Rd	21	19	2	0	Low	B (136)	Good
Rona Bay @ N end of Cliff Bishop Pk	21	20	0	1	Low/Mod	C (342)	Fair
Rona Bay @ Wharf	21	19	2	0	Low/Mod	C (210)	Fair
Robinson Bay @ HW Shortt Rec Grd	21	18	0	3	Low	C (332)	Fair
Robinson Bay @ Nikau St	21	20	0	1	Low	B (189)	Good
Camp Bay	11†	10	0	1	Very Low	B (122)*	V. Good*
Wellington City							
Aotea Lagoon	21	21	0	0	Moderate	B (82)	Good
Oriental Bay @ Freyberg Beach	21	21	0	0	Moderate	B (138)	Good
Oriental Bay @ Wishing Well	21	20	0	1	Moderate	C (413)	Fair
Oriental Bay @ Band Rotunda	21	21	0	0	Moderate	C (285)	Fair
Balaena Bay	21	21	0	0	Low	B (42)	Good
Kio Bay	21	21	0	0	Low	B (103)	Good
Hataitai Beach	21	21	0	0	Moderate	C (222)	Fair
Shark Bay	21	21	0	0	Low	B (57)	Good
Mahanga Bay	21	21	0	0	Low	B (191)	Good
Scorching Bay	21	21	0	0	Low	B (47)	Good
Worser Bay	21	21	0	0	Low	B (46)	Good
Seatoun Beach @ Wharf	21	21	0	0	Low/Mod	B (74)	Good
Seatoun Beach @ Inglis St	21	21	0	0	Low/Mod	B (62)	Good
Breaker Bay	11†	11	0	0	V. Low	B (80)*	V. Good*
Lyllall Bay @ Tirangi Rd	21	20	1	0	Moderate	B (182)	Good
Lyllall Bay @ Onepu Rd	21	20	0	1	Moderate	B (73)	Good
Lyllall Bay @ Queens Drive	21	20	1	0	Moderate	B (60)	Good
Princess Bay	11†	11	0	0	Low	A (37)*	V. Good*
Island Bay @ Surf Club	21	20	0	1	Moderate	B (145)	Good
Island Bay @ Reef St Recreation Grd	21	20	0	1	Moderate	B (194)	Good
Island Bay @ Derwent St	21	21	0	0	Moderate	B (109)‡	Good‡
Owhiro Bay	21	18	3	0	Moderate	C (220)	Fair
Wairarapa							
Castlepoint Beach @ Castlepoint Strm	21	19	2	0	Moderate	C (223)	Fair
Castlepoint Beach @ Smelly Creek	21	20	0	1	Moderate	C (208)**	Fair**
Riversdale Beach @ Lagoon Mouth	21	21	0	0	Moderate	B (74)	Good
Riversdale Beach Between the Flags	21	21	0	0	Low	B (63)	Good
Riversdale Beach South	10†	10	0	0	Very Low	B (42)*	V. Good*

† from November 2006, sampled fortnightly.

* based on 2001/02 – 2005/06 data as presented by Milne and Wyatt (2006a).

** indicates a change in MAC/SFRG from that determined by Milne and Wyatt (2006a) using 2001/02 – 2005/06 data.

‡ Interim grade (based on only 2.5 years of data, n=53).