

Healthy Estuary and Rivers of the City

*Water quality and ecosystem health
monitoring programme of Ihutai*

Water quality for contact recreation

Summary report on data collected over the
summer of 2010-2011

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1 Introduction

The monitoring of water quality for contact recreation in the Avon-Heathcote Estuary/Ihutai and the Avon and Heathcote rivers has been underway for some time. This monitoring is one of the four monitoring¹ programmes described in The Healthy Estuary and Rivers of the City: Water quality and ecosystem health monitoring programme of Ihutai document (Batchelor, *et al.*, 2009)².

Over the summer months in particular, people of Christchurch like to partake in recreational activities in nearby waterways including the Avon and Heathcote rivers and the Avon-Heathcote Estuary/Ihutai. These activities include swimming, kayaking, wind surfing, kite surfing and yachting. While swimming tends to result in total immersion in water, such immersion can occur when things don't go according to plan when undertaking the other activities. Due to the presence of bacteria, protozoa and/or viruses there can be risks associated with immersion and ingestion if there is faecal contamination of the water. Such contamination can result in stomach upsets, skin infections, ear infections and respiratory infections. To reduce the risk of becoming sick as a result of immersion in water people need to be informed about the quality of the water for contact recreation so they can then make the choice of whether or not they carry out a recreational activity in or on the water, and where.

Escherichia coli (*E. coli*) is a bacteria that is found in high numbers in the stomachs and intestines of warm-blooded animals (including birds) and people. The presence of high concentrations of *E. coli* in fresh water indicates the likely presence of faecal material and, with it, the possibility that other disease-causing organisms may be present. While *E. coli* is used as an indicator of faecal contamination in fresh water, enterococci are used as the indicator of faecal contamination in sea water. Faecal contamination of water can occur through inadequately treated sewage, stormwater drains, septic tanks, runoff from pastoral farm land, and from wildlife such as waterfowl living in and around waterways.

E. coli concentrations in freshwater and enterococci concentrations in sea water are used to determine if water quality is suitable for contact recreation. As the water within the estuary is a mix of fresh and sea water, the samples collected were analysed for enterococci and *E. coli*.

Prior to 4 March 2010, the water within the Avon-Heathcote Estuary/Ihutai was a mix of the fresh water flowing out of the Avon and Heathcote rivers, the sea water from Pegasus Bay flowing into the estuary as the tide rises and the tertiary treated wastewater discharged from the oxidation ponds. On 4 March 2010 the discharge of tertiary treated wastewater into the estuary ceased. That is, there was no tertiary treated wastewater discharged into the estuary over the period the data presented in this report were collected.

On 4 September 2010 a 7.1 magnitude earthquake struck Canterbury. For a period of eight weeks after the earthquake there were discharges of untreated human sewage into the Avon River. These discharges ceased before the routine sampling for this programme began in November 2010.

¹ Monitoring is the routine collection of data over time in order to assess the state of the environment and identify changes over time.

² Batchelor, L., Bolton-Ritchie, L., Bond, J., Dagg, D., Dickson, P., Drysdale, A., Handforth, D and Hayward, S. 2009. Healthy Estuary and Rivers of the City: Water quality and ecosystem health monitoring programme of Ihutai. Environment Canterbury Report No RO9/8. 60pp.

2 Sampling

2.1 Sampling sites

Samples were collected from one site on each of the rivers and from seven sites in the Avon-Heathcote Estuary/Ihutai. The sites sampled are shown in Figure 1.

The Avon River site at Kerrs Reach is an area used by high numbers of rowers and kayakers. The Heathcote River site at Catherine Street is an area used by kayakers and swimmers, particularly children. Three of the Avon-Heathcote Estuary/Ihutai sites - Pleasant Point Yacht Club, Mount Pleasant Yacht Club and Moncks Bay are at, or near, yacht clubs. Humphreys Drive is a high usage wind surfing and kite surfing area. Penguin Street is an area of the estuary used by local kayakers and shallow hulled yachts. South Spit and Beachville Road jetty are areas used for swimming.

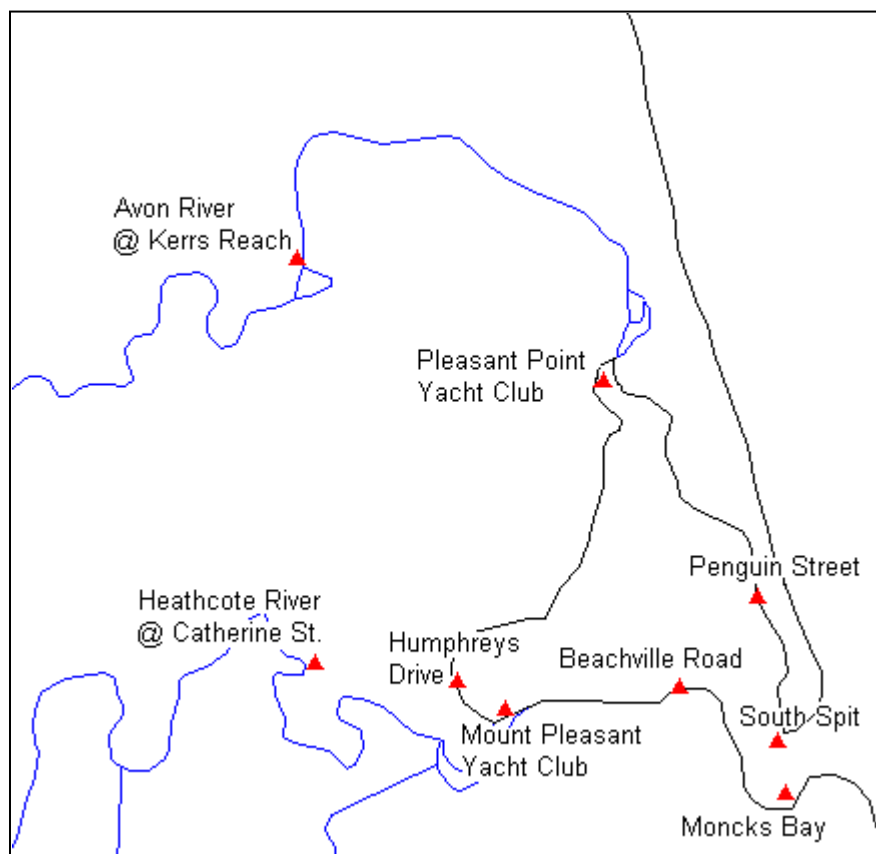


Figure 1: Sampling sites

2.2 Sample collection

One water sample was collected from each site, each week, from 17 November 2010 to 16 February 2010. No samples were collected after the 22 February 6.3 magnitude earthquake in Christchurch. Following the earthquake laboratory services were disrupted for a number of weeks and untreated human sewage was discharged into both rivers and the estuary. Samples were collected for 14 weeks in total. The river samples were collected by an Environment Canterbury staff member while the estuary samples were collected by volunteers from the local community.

At the estuary sites the samples were collected three hours after high tide at Lyttelton and at approximately the same time at all sites. The three hour difference takes into account an hour for daylight saving, the hour difference in the time of high tide between Lyttelton Harbour and the inner region of the estuary, and an hour to ensure sampling was when the tide was beginning to go out. Sampling was undertaken at this state of the tide as it was likely the worst case scenario for recreational water quality when tertiary treated wastewater was discharged into the estuary around high tide. In addition it is around high tide when the extensive mudflats are covered by water that the popular water-based activities such as wind surfing, kite surfing, yachting and kayaking take place. Sampling at the river sites was not determined by the state of the tide.

The water samples collected were analysed to determine the concentration of the faecal indicator organisms. The samples collected from the estuary were analysed for enterococci and *E. coli* while the samples from the rivers were only analysed for *E. coli*.

3 Results

The concentrations of *E. coli* in the samples collected at the river sites are given in Table 1. The concentrations of enterococci and *E. coli* in the samples collected at the estuary sites are given in Table 2 and values that exceed the alert trigger level are shaded. The alert trigger level³ is where there is potential for faecal contamination of the water and hence potential for human health effects. Where there is no signage warning of poor water quality for contact recreation, exceedence of the alert trigger level results in re-sampling of the site. Where signage is present no re-sampling is undertaken.

The alert trigger level for *E. coli* is 260/100mL. The alert trigger level for enterococci is 140/100mL.

³ MfE/MoH. 2003. Microbiological Water Quality Guidelines for Marine and Freshwater Recreational areas. Ministry for the Environment and Ministry of Health, Wellington. (<http://mfe.govt.nz/publications/water/microbiological-quality-jun03/>)

Table 1: *E.coli* concentrations (number/100mL) at the Avon and Heathcote river sites

SHADING OF CELLS: yellow depicts exceedence of the alert trigger value

Date	Avon River	Heathcote River
17-Nov-10	2400	920
24-Nov-10	260	330
1-Dec-10	18	230
8-Dec-10	410	370
15-Dec-10	520	1100
22-Dec-10	>2400	1
29-Dec-10	460	2400
5-Jan-11	>2400	690
12-Jan-11	340	650
19-Jan-11	>2400	>2400
26-Jan-11	520	330
2-Feb-11	420	230
9-Feb-11	550	440
16-Feb-11	550	580

At both river sites the *E.coli* concentrations exceeded the alert trigger level on the majority of sampling occasions. There were always numerous water fowl present at both sites with these birds likely to be the main source of the faecal contamination of river water.

In the estuary *E.coli* and enterococci alert trigger levels were not exceeded at Beachville Road and Moncks Bay. The enterococci but not the *E.coli* Alert trigger level was exceeded at Mount Pleasant Yacht Club and at Penguin Street. Both trigger levels were exceeded at South Spit (on one occasion), Pleasant Point Yacht Club and Humphreys Drive.

At the Pleasant Point Yacht Club the *E.coli* alert trigger level was exceeded on nine of the 14 sampling occasions. The enterococci alert trigger level was exceeded on two of the 14 sampling occasions. These results suggest that the recreational water quality at the Pleasant Point Yacht Club is affected by the water from the Avon River.

At Humphreys Drive the *E.coli* alert trigger level was exceeded on seven of the 14 sampling occasions. The enterococci alert trigger level was exceeded on six of the 14 sampling occasions. There are numerous potential sources of faecal contamination to this site including the City Drain, water fowl, the Heathcote River and decaying seaweed.

Table 2: Enterococci and E.coli concentrations (number/100mL) at sites within the Avon-Heathcote Estuary/Ihutai

SHADING OF CELLS: Enterococci – orange depicts exceedence of the alert trigger value
E. coli –yellow depicts exceedence of the alert trigger value

Date	South spit		Penguin Street		Pleasant Point YC		Humphreys Drive		Mt. Pleasant YC		Beachville Road		Moncks Bay	
	Enterococci	E.coli	Enterococci	E.coli	Enterococci	E.coli	Enterococci	E.coli	Enterococci	E.coli	Enterococci	E.coli	Enterococci	E.coli
17-Nov-10	18	10	<2	10	14	84	700	52	4	<10	<2	<10	4	<10
24-Nov-10	4	10	<2	<10	10	240	110	160	34	20	<2	<10	2	<10
1-Dec-10	4	10	2	<10	4	84	86	150	8	<10	<2	<10	2	<10
8-Dec-10	10	20	2	20	20	350	310	460	30	20	2	<10	<2	<10
15-Dec-10	<2	20	4	<10	16	220	160	130	4	<10	<2	<10	16	<10
22-Dec-10	220	380	260	260	120	540	96	86	18	63	20	41	10	30
29-Dec-10	10	<10	<2	<10	18	270	80	1700	6	52	<2	10	2	31
5-Jan-11	12	<10	10	20	58	170	220	340	8	63	6	<10	8	<10
12-Jan-11	<2	<10	<2	74	34	730	300	360	2	10	4	<10	2	<10
19-Jan-11	110	160	50	20	1800	20000	1000	2300	26	10	44	63	14	10
26-Jan-11	6	<10	2	<10	230	1300	72	710	26	62	2	<10	<2	<10
2-Feb-11	2	20	<2	20	92	500	300	63	10	31	14	<10	4	<10
9-Feb-11	6	<10	<2	41	33	320	160	530	20	51	12	<10	2	<10
16-Feb-11	<2	20	<2	20	72	1200	73	230	1200	210	<2	10	2	<10

4 Grading of a site for contact recreation

The Ministry for the Environment and Ministry of Health Microbiological Water Quality Guidelines (2003) describe the method to be used to determine the suitability of a site for contact recreation. This guideline integrates two components to give a **Suitability for Recreation Grade (SFRG)**. The two components are:

- a qualitative measure of the susceptibility of the water at the site to faecal contamination – this is known as the **Sanitary Inspection Category (SIC)**.
- microbiological results based ideally on the last 5 years of data; this provides a measure of water quality over time. This generates a **Microbiological Assessment Category (MAC)** which is based on the 95th percentile value of all the data.

There are five SFRG – **very good, good, fair, poor and very poor**.

In sea water

For sites graded **very good** there are few/low level sources of faecal contamination to the site and the 95th percentile value is less than or equal to 200 enterococci/100mL, consequently the health risk from water contact at the beach is low. For sites graded **very poor** there are significant sources of faecal contamination to the site and the 95th percentile value is more than 500 enterococci/100mL, consequently the health risk from water contact is high.

In fresh water

For sites graded **very good** there are few/low level sources of faecal contamination to the site and the 95th percentile value is less than or equal to 260 *E.coli*/100mL, consequently the health risk from water contact at the beach is low. For sites graded **very poor** there are significant sources of faecal contamination to the site and the 95th percentile value is more than 550 *E.coli*/100mL, consequently the health risk from water contact is high.

The risk of becoming sick from immersion in water increases from sites graded 'very good' to 'very poor'. Sites graded 'very good', 'good' and 'fair' are considered suitable for contact recreation, although 'good' and 'fair' sites may at times not be suitable (for example after heavy rainfall resulting in high bacterial counts). Sites graded 'poor' and 'very poor' are generally considered unsuitable for contact recreation based on both risk and indicator bacteria counts.

The SFRG generated through the combination of the SIC and MAC describes the GENERAL CONDITION of the site with respect to public health risk. The grades are re-evaluated at the end of each summer season and do not change through the summer.

4.1 Site gradings

4.1.1 Sanitary Inspection Category (SIC)

The Sanitary Inspection Category identifies susceptibility of the water at a site to faecal contamination.

The potential sources of faecal contamination at **all estuary sites** were:

- urban stormwater protected from sewage ingress
- incidence and density of bird life

At the Pleasant Point Yacht Club and the Mount Pleasant Yacht Club another potential source of faecal contamination is:

- River discharging close to the recreational area with the river potentially affected by:
 - urban stormwater protected from sewage ingress
 - incidence and density of bird life

At all estuary sites the SIC is **moderate**.

The potential sources of faecal contamination at the **river sites** are:

- urban stormwater protected from sewage ingress
- incidence and density of bird life

At the river sites the SIC is **high**.

4.1.2 Microbiological Assessment Category (MAC)

There are four MACs. The actual values for each MAC differ between faecal indicator bacteria. These values are shown in Table 3.

Table 3: The 95th percentile values for each MAC for both enterococci and *E.coli*

	95th percentile value	
MAC	Enterococci	<i>E.coli</i>
A	≤40/100mL	≤ 130/100mL
B	41 - 200/100mL	131 - 260/100mL
C	201 - 500/100mL	261 - 550/100mL
D	>500/100mL	>550/100mL

The 2010-2011 enterococci data, in combination with the data from the previous four summers, were used to calculate the MAC at each estuary site. The enterococci MAC at each estuary site is shown in Figure 2.

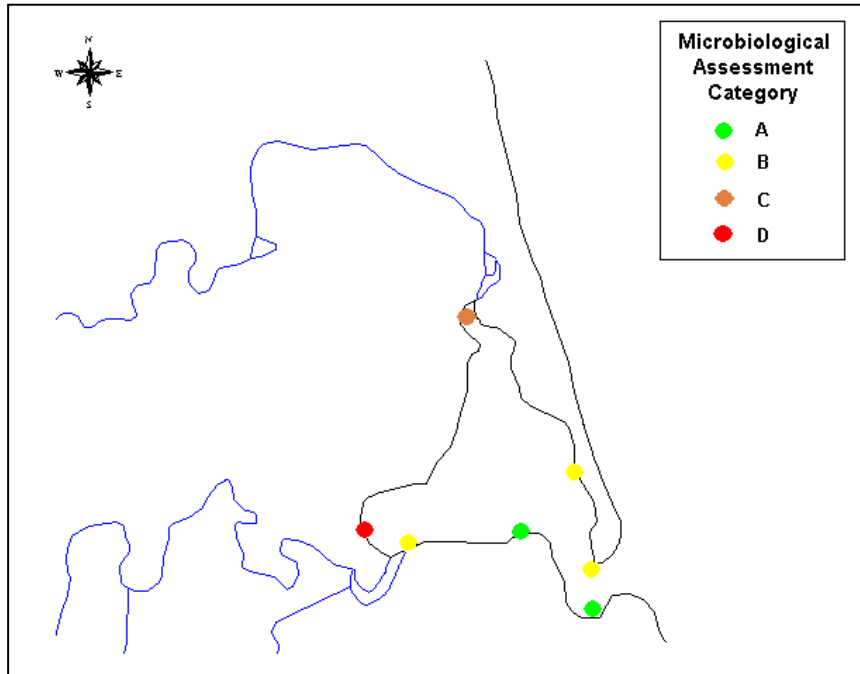


Figure 2: MAC at each site based on enterococci concentrations

The 2010-2011 *E.coli* data, in combination with the data from the previous four summers, were used to calculate the MAC at each estuary and each river site. The *E.coli* MAC at each site is shown in Figure 3.

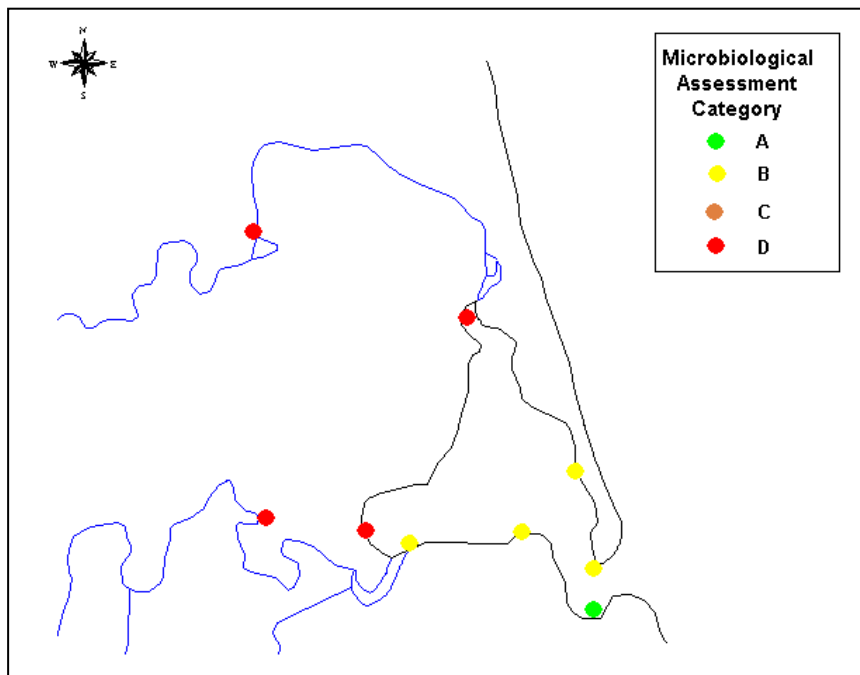


Figure 3: MAC at each site based on *E.coli* concentrations

4.1.3 Suitability for Recreation Grade (SFRG)

The MAC and SIC are used to determine the Suitability for Recreation Grade (SFRG) at a site.

The SFRG at the estuary sites based on the last five years of enterococci concentrations (including 2010-2011 data) are presented in Table 4.

Table 4: Calculation of the SFRG at estuary sites based on enterococci concentrations

	n	95%ile	MAC	SIC	SFRG
South Spit	73	108.5	B	Moderate	Good
Penguin Street	74	96.4	B	Moderate	Good
Pleasant Point Yacht Club	74	350	C	Moderate	Fair
Humphreys Drive	73	985	D	Moderate	Poor
Mount Pleasant Yacht Club	73	198.5	B	Moderate	Good
Beachville Road	74	18.8	A	Moderate	Good
Moncks Bay	73	25.1	A	Moderate	Good

The SFRG at the estuary sites based on the last five years of *E.coli* concentrations (including 2010-2011 data) are presented in Table 5.

Table 5: Calculation of the SFRG at estuary sites based on *E.coli* concentrations

	n	95%ile	MAC	SIC	SFRG
South Spit	73	154	B	Moderate	Good
Penguin Street	74	158.5	B	Moderate	Good
Pleasant Point Yacht Club	74	1136	D	Moderate	Poor
Humphreys Drive	72	2280	D	Moderate	Poor
Mount Pleasant Yacht Club	73	161	B	Moderate	Good
Beachville Road	74	48.2	B	Moderate	Good
Moncks Bay	73	28.5	A	Moderate	Good

At Pleasant Point Yacht Club there is a difference between the SFRG based on *E.coli* and that based on enterococci. As the SFRG is to inform people about the risk to their health when undertaking contact recreation the SFRG with the higher risk is applied. That is the SFRG that is reported for this site is Poor.

The SFRG at the river sites based on the last five years of *E.coli* concentrations (including 2010-2011 data) are presented in Table 6.

Table 6: Calculation of the SFRG at river sites based on *E.coli* concentrations

	n	95%ile	MAC	SIC	SFRG
Avon River	74	2400	D	High	Very Poor
Heathcote River	74	2400	D	High	Very Poor

5 Conclusions

At the sites on the rivers the recreational water quality is very poor. That is, they are generally unsuitable for contact recreation. The Suitability for Recreation Grade at the river sites is unlikely to change in the near future because of the abundance of waterfowl on the rivers.

The recreational water quality at five sites within the estuary is good while at two sites (Pleasant Point Yacht Club and Humphreys Drive) it is poor.

