



Marlborough's Freshwater Bathing Water Quality

2006-07

Prepared by:

F S Tiernan

Environmental Science and Monitoring

Marlborough District Council



EXECUTIVE SUMMARY

A number of freshwater locations in Marlborough are monitored on a weekly basis during the summer months and assessed against the Ministry for the Environment's (MfE's) bathing water guidelines. Marlborough's rivers are generally of good quality and are safe for recreational activities. However rivers that drain urban and intensive agriculture areas are more prone to poor water quality and are often not safe for recreational activities, even during dry weather. During the 2006-07 bathing water season, less than half of sites monitored were categorised as safe for recreational use for more than 90% of the time. The poorest performing sites e.g. the Rai at Brown River Reserve and Taylor at Riverside are safe for recreational use for only approximately 70% of the time. Suitability for recreation grades (SFRG) have been derived based on the most recent five years of microbiological data and sanitary inspections (carried out in 2004). Many sites do not have enough samples to determine a suitable grade and therefore regular monitoring of each site is recommended to allow for comparisons in freshwater quality each year and to assign complete SFRG grades to each site.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

1.	INTRODUCTION	1
2.	SITES	1
3.	SAMPLING	2
3.1.	Indicator Organisms	2
3.2.	Guideline Values	2
3.2.1.	Microbiological Assessment Category (MAC)	3
3.2.2.	Sanitary Inspection Category (SIC)	3
3.2.3.	Suitability for Recreation Grades (SFRG)	4
4.	BATHING WATER QUALITY RESULTS 2006-07	5
4.1.	Rainfall Effects	6
4.2.	Suitability For Recreation Grades (SFRG's) 2006-07	9
5.	CONCLUSIONS AND RECOMMENDATIONS	11
6.	REFERENCES	12
APPENDIX 1	Freshwater Bathing Site Locations	13
APPENDIX 2	Results from the Bathing Water (Freshwaters) sampling from November 2006 to March 2007 inclusive	14
APPENDIX 3	Graphed results for each Freshwater Bathing site for the Summer 2006-07 period in relation to MfE's bathing water standards (action level and alert levels)	15
APPENDIX 4	2006-07 Microbiological Assessment Category Results	19

1. INTRODUCTION

District councils are required under the Health Act 1956 to monitor environmental factors affecting public health and to abate conditions likely to be offensive or injurious to health. Water quality in our rivers and coastal areas can have an impact on public health.

Regional councils have responsibilities under the Resource Management Act 1991 for planning and management of natural resources including fresh and coastal water. The Marlborough District Council as a unitary authority has responsibility for both district and regional functions.

Guidelines for the safe use of recreational waters are defined by the Ministry of the Environment in the Microbiological Water Quality Guidelines (MfE, 2003). The recreational waters in Marlborough are sampled in accordance with these guidelines.

2. SITES

During the summer of 2006-07 a total of 13 freshwater bathing sites were monitored on a weekly basis from November to March inclusive, the location of these sites are shown in Appendix 1. Table 1 details the name, location and grid reference of each site. In general the freshwaters of Marlborough are suitable for contact recreational activities, however there are areas which are more susceptible to contamination which can lead to an increased risk of illness and infection. The 13 sites that are chosen to be monitored each bathing water season are deemed high use and/or high risk sites. For example the Lower Wairau and the Rai River both have a high amenity value where kayaking, rowing and swimming are routinely undertaken during the summer months, these rivers are also deemed high risk due to land use practices which can lead to diffuse pollution within the catchments, which can impact of bathing water quality.

Table 1: Freshwater Sites 2006-07

Site name	Site ID	Grid Reference (NZTM)
Taylor @ Hutcheson Street Bridge	TYR-5	2589749, 5965963
Taylor @ Riverside	TYR-16	2590036, 5965687
Opawa @ Malthouse Reserve	OPR-40	2594039, 5964404
Opawa @ Elizabeth Street Footbridge	OPL-1	2590450, 5966000
Wairau @ Blenheim Rowing Club	WRR-1	2594332, 5968306
Wairau @ Wairau Rowing Club	WRR-9	2592398, 5969476
Wairau @ Ferry Bridge	WRR-8	2591253, 5971829
Wairau Diversion @ Neals Road	WDV-1	2594005, 5973346
Pelorus @ Totara Flat	PLR-3	2558264, 5989435
Rai @ Brown River Reserve	RAR-2	2559215, 5998566
Rai @ Rai Falls	RAR-1	2558020, 5990970
Pelorus @ Pelorus Bridge	PLR-2	2558079, 5989795
Waihopai @ Craiglochart Bridge # 2	WHR-3	2565059, 5952794

3. SAMPLING

The water quality at each site is tested for the presence of *Escherichia coli* (*E. coli*) and the results are reported in MPN/100mL (most probable number). All laboratory testing is carried out by the Cawthron Institute in Blenheim. *E. coli* is chosen as the indicator bacteria for freshwater as it is deemed to be a good indicator of recent sewage and/or faecal contamination.

3.1 Indicator Organisms

An indicator organism can be defined as an organism which is used to indicate the **potential** presence of another organism. *E. coli* is the indicator organism used when monitoring freshwater recreational sites. When monitoring freshwaters used for recreational purposes, the primary concern is the presence of organisms which can cause illness and/or infection in people. It may not always be possible to identify specific disease causing organisms due to their low numbers, difficulty and expense of analysis among other reasons; therefore the waters are tested for indicator organisms, in this case *E. coli*. The advantages of using *E. coli* as the indicator organism are 1) it is easy to sample and inexpensive to measure and 2) it can survive for several weeks in freshwater and is therefore a definite indication of recent faecal contamination. *E. coli* is present in the gut of all warm blooded animals (including humans, mammals and birds), all of which are potential carriers of disease causing organisms in humans.

The number of *E. coli* present in a water sample (100mL) denotes the potential health risk of the waters to humans, it is not a direct measurement of the actual health risks, and therefore an exceedance of the guideline value will indicate that there is an increased risk to bathers in the area. Further details on how this risk is quantified are available in Appendix 2 of the Microbiological Water Quality Guidelines (MfE, 2003).

3.2 Guideline Values

The guideline values for safe freshwater recreational sites have been determined by MfE and are as follows:

	For a <i>single</i> sample		Requirement	
Acceptable <i>'Green Mode'</i>	< 260 <i>E.coli</i> / 100mL	Highly likely to be uncontaminated	Routine monitoring	Safe 😊
Alert <i>'Amber Mode'</i>	> 260 <i>E.coli</i> / 100mL	Potentially contaminated	Investigate likely causes	OK 😐
Action <i>'Red Mode'</i>	> 550 <i>E.coli</i> / 100mL	Highly likely to be contaminated	Further investigation, inform relevant interested parties	Unsafe 😞

In addition, the Ministry of the Environment has developed Suitability for Recreation Grades (SFRG's). These are defined using the Microbiological Assessment Category (MAC) and the Sanitary Inspection Category (SIC).

3.2.1 Microbiological Assessment Category (MAC)

The Microbiological Assessment Category is assessed using data from the previous 5 years. A minimum of 100 samples over five bathing water seasons (November to March inclusive) is required in order to establish a complete MAC, if there are less than 100 samples over this 5 year period then the MAC status is defined as being incomplete. Marlborough District Council has been carrying out monitoring of freshwater bathing sites since 1996, however in order to obtain a completed MAC grade a minimum of 20 samples for each bathing water season is required. For the 13 sites sampled this year the number of samples per year (over the last 5 years) ranges from 69 to over 100. Table 2 below defines the MAC grades.

Table 2: Microbiological Assessment Category (MAC) definitions

Grade	95 th Percentile
A	≤ 130 <i>E.coli</i> / 100mL
B	131 - 260 <i>E.coli</i> / 100mL
C	≥ 261 - 550 <i>E.coli</i> / 100mL
D	> 550 <i>E.coli</i> / 100mL

The MAC grade will be assessed each year based on the previous 5 years of data. The MAC is used in conjunction with the SIC to obtain a Suitability for Recreation Grade (SFRG). There are between 21 and 22 weeks in the bathing water season so it is important to ensure each site is consistently monitored over the bathing water season to ensure accurate reporting of MAC grades and Suitability for Recreation Grades (SFRGs).

3.2.2 Sanitary Inspection Category (SIC)

The SIC assigns a category to the site based on the risk of contamination associated with faecal sources in the vicinity. Figure 1 details this risk. Marlborough District Council assigned SIC classes to the freshwater bathing sites in 2004 (MDC, 2004).

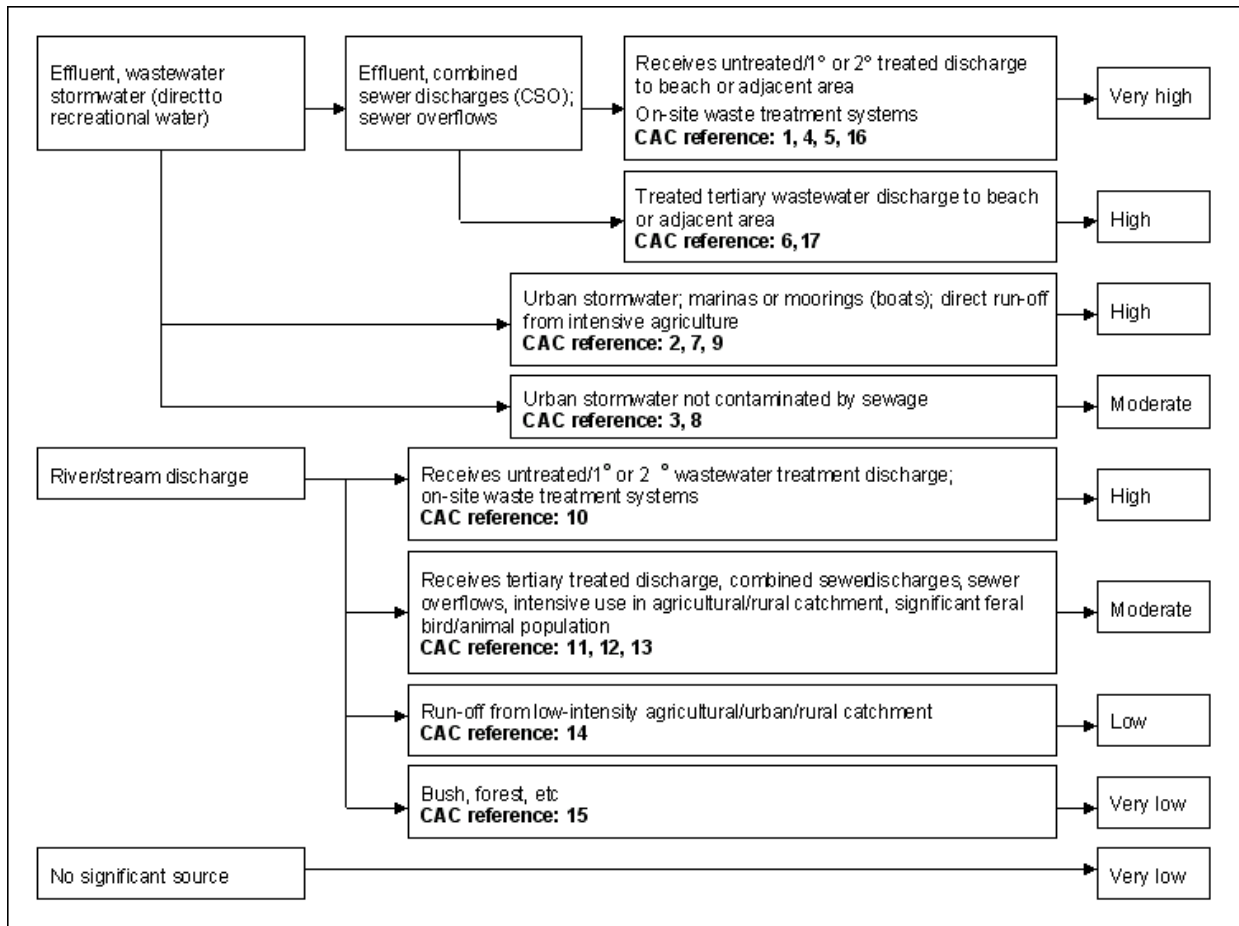


Figure 1: Sanitary Inspection Category for freshwater sites (MfE, 2003)

3.2.3 Suitability for Recreation Grade (SFRG)




Bathing water sites are graded according to the SFRGs, which are Very Good, Good, Fair, Poor and Very Poor. Suitability for Recreation Grades (SFRGs) are obtained using the MAC in conjunction with the SICs.

4. BATHING WATER QUALITY RESULTS 2006-07

The results of the summer 2006-07 sampling are shown in Appendix 2. These results are graphed for each site and are shown in Appendix 3. The results are graphed on a log scale and plotted against both the alert and action levels.

Table 3 shows the percentage of time the sites were deemed safe or otherwise for swimming and are ranked accordingly. The Rai and the Taylor River had the poorest water quality during the summer 2006-07 season and the Wairau and Opawa had the best.

Table 3: Freshwater bathing sites ranked according to the percentage of time they were suitable for contact recreation.

SITE NAME	SITE ID	% of time <i>E.coli</i> numbers < 260 MPN/100mL	% of time <i>E.coli</i> numbers >260 <550 MPN/100mL	% of time <i>E.coli</i> numbers > 550 MPN/100mL
		Suitable for recreational use 	OK for recreational use 	Unsuitable for recreational use 
Wairau @ Blenheim Rowing Club	WRR-1	100	0	0
Wairau @ Wairau Rowing Club	WRR-9	100	0	0
Opawa @ Elizabeth Street Footbridge	OPL-1	95	0	5
Wairau @ Ferry Bridge	WRR-8	94	6	0
Waihopai @ Craiglochart Bridge #2	WHR-3	94	0	6
Wairau Diversion @ Neals Road	WDV-1	89	11	0
Opawa @ Malthouse Reserve	OPR-40	84	5	11
Pelorus @ Totara Flat	PLR-3	84	5	11
Pelorus @ Pelorus Bridge	PLR-2	84	11	5
Taylor @ Hutcheson Street Bridge	TYR-5	74	26	0
Rai @ Brown River Reserve	RAR-2	74	16	11
Rai @ Rai Falls	RAR-1	74	5	21
Taylor @ Riverside	TYR-16	68	32	0

When the median count for each site is looked at (Table 4) the sites are ranked slightly differently from best water quality to poorest water quality. This reflects, in part, the susceptibility of water quality to high *E. coli* counts following heavy rainfall. The Waihopai, the Wairau and the Pelorus all have the lowest median *E. coli* count, implying that they have the safest water quality except at times following heavy rainfall. The Taylor and Opawa both have the highest median *E. coli* counts reflecting the various stormwater inputs in the catchments and a general degradation of the water quality throughout the bathing season.

Table 4: Freshwater bathing sites ranked according to the Median *E. coli* count recorded during the 2006-07 bathing water season.

Site Name	Site ID	Median <i>E.coli</i> count (MPN/100mL)
Waihopai @ Craiglochart Bridge #2	WHR-3	20
Wairau @ Blenheim Rowing Club	WRR-1	30
Pelorus @ Pelorus Bridge	PLR-2	30
Wairau @ Wairau Rowing Club	WRR-9	40
Pelorus @ Totara Flat	PLR-3	40
Rai @ Rai Falls	RAR-1	53
Opawa @ Malthouse Reserve	OPR-40	64
Wairau Diversion @ Neals Road	WDV-1	64
Rai @ Brown River Reserve	RAR-2	74
Wairau @ Ferry Bridge	WRR-8	87
Opawa @ Elizabeth Street Footbridge	OPL-1	111
Taylor @ Hutcheson Street Bridge	TYR-5	164
Taylor @ Riverside	TYR-16	164

4.1 Rainfall Effects

E. coli numbers have been shown to be highly correlated with turbidity (Davies-Colley *et al.*, 2004) and in many instances turbidity can be used as a surrogate for *E. coli* numbers, both in large and small

agricultural catchments (Collins 2002, Nagels *et al.*, 2002, Muirhead *et al.*, 2004). However the degree of correlation between turbidity and *E. coli* numbers is site specific (Collins, 2002).

Water turbidity increases following rainfall and therefore rainfall levels can be a good indicator of *E. coli* numbers. This is reflected in the summer bathing water results where high rainfall¹ is associated with high *E. coli* numbers, particularly at sites such as the Waihopai, Pelorus and Rai Rivers (Figures 2-4).

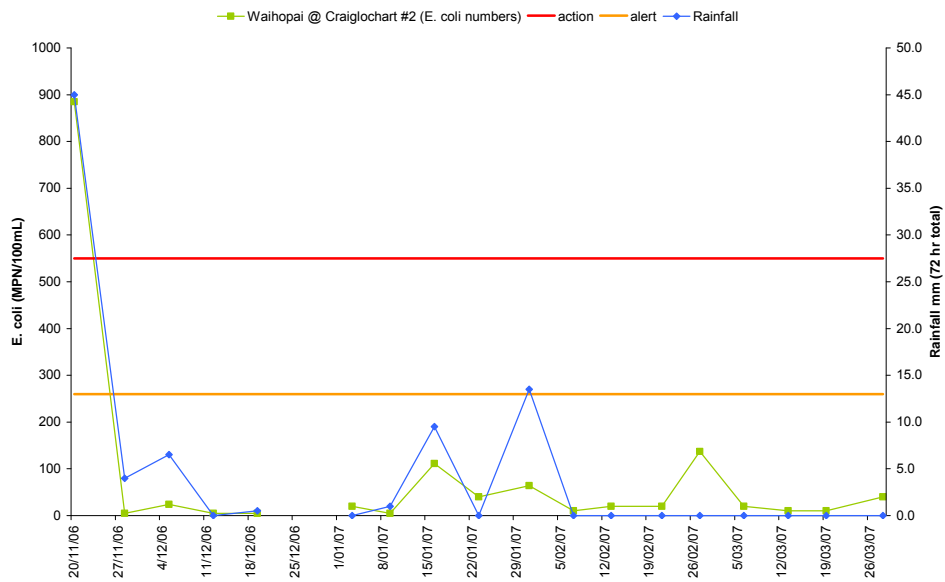


Figure 2: Relationship between rainfall and *E. coli* numbers at the Waihopai bathing water site

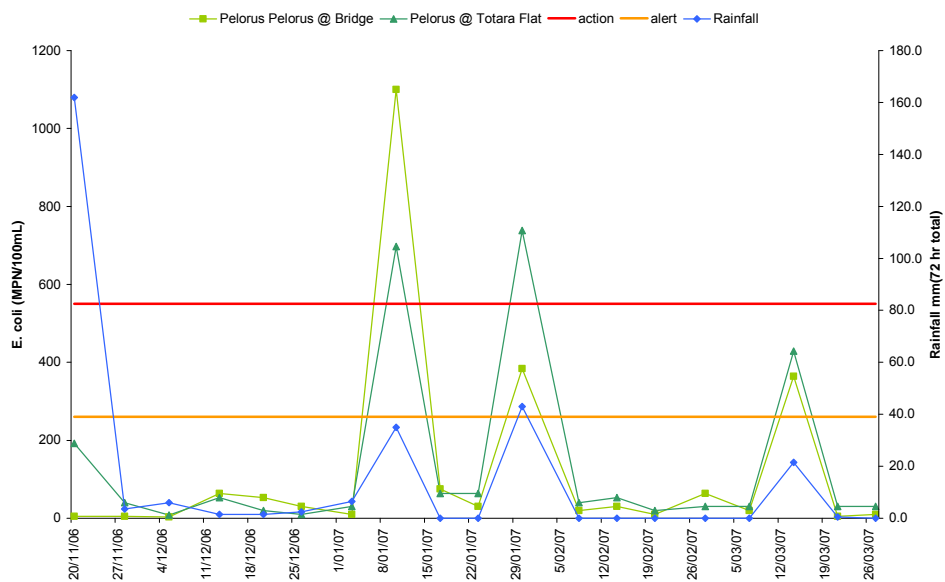


Figure 3: Relationship between rainfall and *E. coli* numbers at the Pelorus bathing water sites

¹ Rainfall stations are located at the Waihopai at Bridge number 1, at the Rai Falls and in Blenheim.

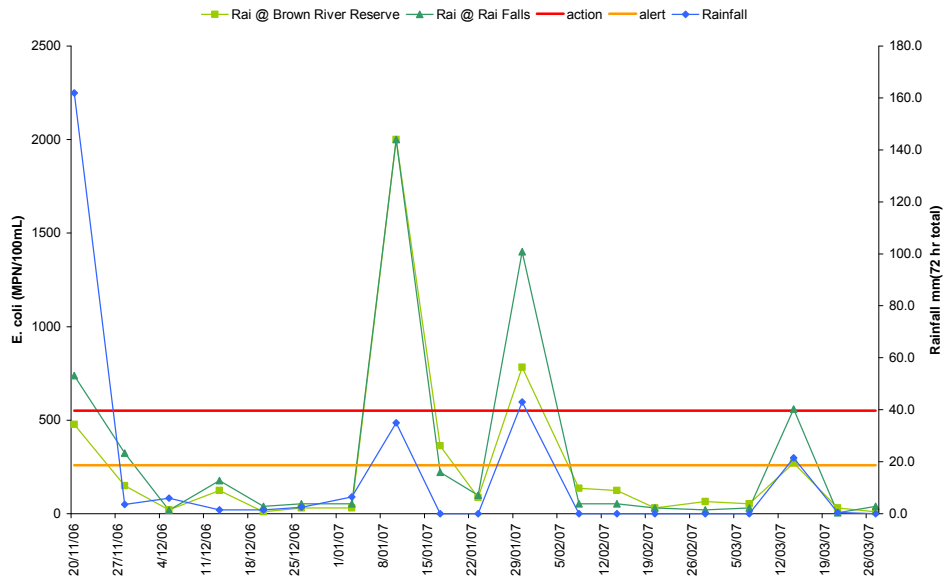


Figure 4: Relationship between rainfall and *E. coli* numbers at the Rai bathing water sites

There are some sites which also show high bacteria numbers during dry weather. Figure 5 shows the relationship between rainfall and bacteria numbers in the urban bathing water sites (Taylor and Opawa sites). The Opawa sites generally exhibit low bacteria numbers except during rainfall, whereas in contrast, the Taylor River sites are elevated during dry weather (although generally below guidelines and therefore safe for swimming).

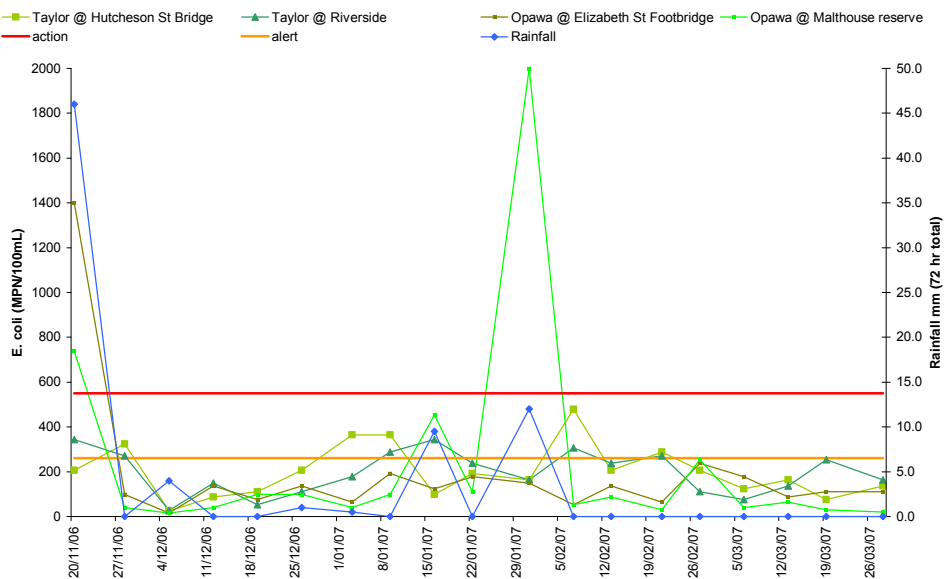


Figure 5: Relationship between rainfall and *E. coli* numbers in the urban bathing water sites (Taylor and Opawa).

Faecal contamination of freshwaters in agricultural areas can result from direct deposition from cattle entering streams and from overland flow following heavy rainfall. Correlation co-efficients were calculated

in excel to determine the extent to which rainfall and *E. coli* measurements “varied together”. The correlation coefficient lies between -1 and +1 inclusive. A positive correlation is when large values of one variable is associated with large values of another variable; a negative correlation is when small values of one variable are associated with large values of another variable; correlations close to zero occur when both variables are unrelated. The closer the number is to 1 (or -1) the more highly correlated (either positively or negatively) the variables are. In the Rai Valley (Summer 2006-07) *E. coli* numbers are highly correlated with rainfall (Table 5) suggesting that the main source of *E. coli* in the Rai Valley is from overland flow. In contrast *E. coli* numbers in the urban streams are less highly correlated with rainfall, with the exception of the Opawa at Malthouse Reserve (Table 5). However the Opawa at Malthouse Reserve is sufficiently far enough away from Blenheim’s urban centre to class it as a rural site.

Table 5: Correlation co-efficient’s (*r*) for freshwater sites (rainfall Vs *E. coli* numbers) (Summer 2006-07).

<i>Agricultural Sites</i>		<i>Urban Sites</i>	
Site Name	(<i>r</i>)	Site Name	(<i>r</i>)
Pelorus at Totara Flat	0.9773545	Opawa at Malthouse Reserve	0.836015
Rai at Rai Falls	0.9215106	Taylor at Riverside	0.085558
Pelorus at Pelorus Bridge	0.8148503	Opawa at Elizabeth Street Footbridge	-0.00464
Rai at Brown River Reserve	0.7797109	Taylor at Hutcheson Street Bridge	-0.28271

4.2 Suitability for Recreation Grades (SFRGs) 2006-07

The Suitability for Recreation Grades were calculated using the latest five years of microbiological data (Appendix 4) and the Sanitary Inspection Categories, which were calculated in 2004. It was not deemed necessary to recalculate the SIC as there have been no major changes in land-use or point source discharges in any of the catchments. The results are shown in Table 6.

Where there are apparent inconsistencies in the recorded microbiological data and the SIC, Bathewatch calculates the most conservative grade for the site and flags the grade as a ‘Follow-up Grade’. For example both the site at Pelorus Bridge and the site at Wairau Rowing Club both have a MAC grade C, yet Pelorus Bridge is deemed very low risk and Wairau Rowing Club is deemed very high risk.

Table 6: Suitability for Recreation Grades for Marlboroughs Freshwater Bathing sites

Site	MAC Grade* Summer season 2006-07	MAC Grade** long term (5 years)	SFRG	Status of SFRG grade
Wairau @ Blenheim Rowing Club	A	C	Poor	Interim
Wairau @ Wairau Rowing Club	A	C	Very Poor [†]	Interim

Wairau @ Ferry Bridge	B	C	Fair	Interim
Waihopai @ Craiglochart Bridge #2	B	C	Fair [†]	Interim
Taylor @ Hutcheson Street Bridge	C	D	Poor	Complete
Taylor @ Riverside	C	D	Poor	Interim
Opawa @ Elizabeth Street Footbridge	C	D	Very Poor	Complete
Wairau Diversion @ Neals Road	C	C	Fair	Interim
Pelorus @ Pelorus Bridge	C	C	Fair [†]	Complete
Opawa @ Malthouse Reserve	D	D	Very Poor	Complete
Pelorus @ Totara Flat	D	D	Poor	interim
Rai @ Brown River Reserve	D	D	Poor	Complete
Rai @ Rai Falls	D	D	Poor	Complete

* Based on the 95th percentile for the 2006-07 Bathing Water season.

** Calculated using MfEs' Bathewatch programme, includes the latest 5 years of microbiological data

[†] 'Follow-up grades', the Bathewatch model detected inconsistencies between the MAC and SIC. A conservative default grade was subsequently calculated by Bathewatch.

Based on the above grades the best freshwater bathing sites are only classed as Fair with most being classed as Poor or Very Poor. Only half of the sites have a complete Suitability for Recreation Grade so the above grades should be interpreted with caution.

5. CONCLUSIONS AND RECOMMENDATIONS

River and stream systems are highly valued in the Marlborough region and there is a perception/demand that the water quality is of a high enough standard that water-based recreational activities are safe, especially during the warmer summer months. Water quality monitoring during the 2006-07 period showed that less than half the sites monitored were safe for swimming for 90% or more of the time. There are few point source discharges to rivers and streams in the Marlborough region, with the exception of stormwater discharges in urban areas. The high correlation between *E. coli* numbers and rainfall shows the impact land-use has on water quality with urban areas and areas of intensive pastoral farming having the poorest water quality. This is not inconsistent with what has been reported on a national level (Larned *et al.*, 2004). Therefore in order to improve water quality for recreational use management strategies need to focus on diffuse sources of pollution. There are initiatives already in place e.g. Marlborough District Councils 'Stormwater Strategy' and the 'Clean Streams Accord', which focuses on water quality in Blenheim's urban area and in the Rai Valley respectively. Ongoing monitoring of recreational freshwaters will assess the effectiveness of these and other programmes.

In areas of high recreational use (such as the Rai and the Pelorus) where bacteria numbers are highly correlated with rainfall it would be useful to assess the degree of correlation and the relationship between *E. coli* numbers and turbidity. Turbidity can be monitored as a 'spot' i.e. single measurement. However it is more useful to have continuous monitoring of turbidity in place where turbidity is measured at regular time intervals e.g. every 15 minutes. Therefore it is proposed that turbidity loggers be placed at Rai Falls, the Taylor at Hutcheson Street Bridge and at the Wairau (location to be decided).

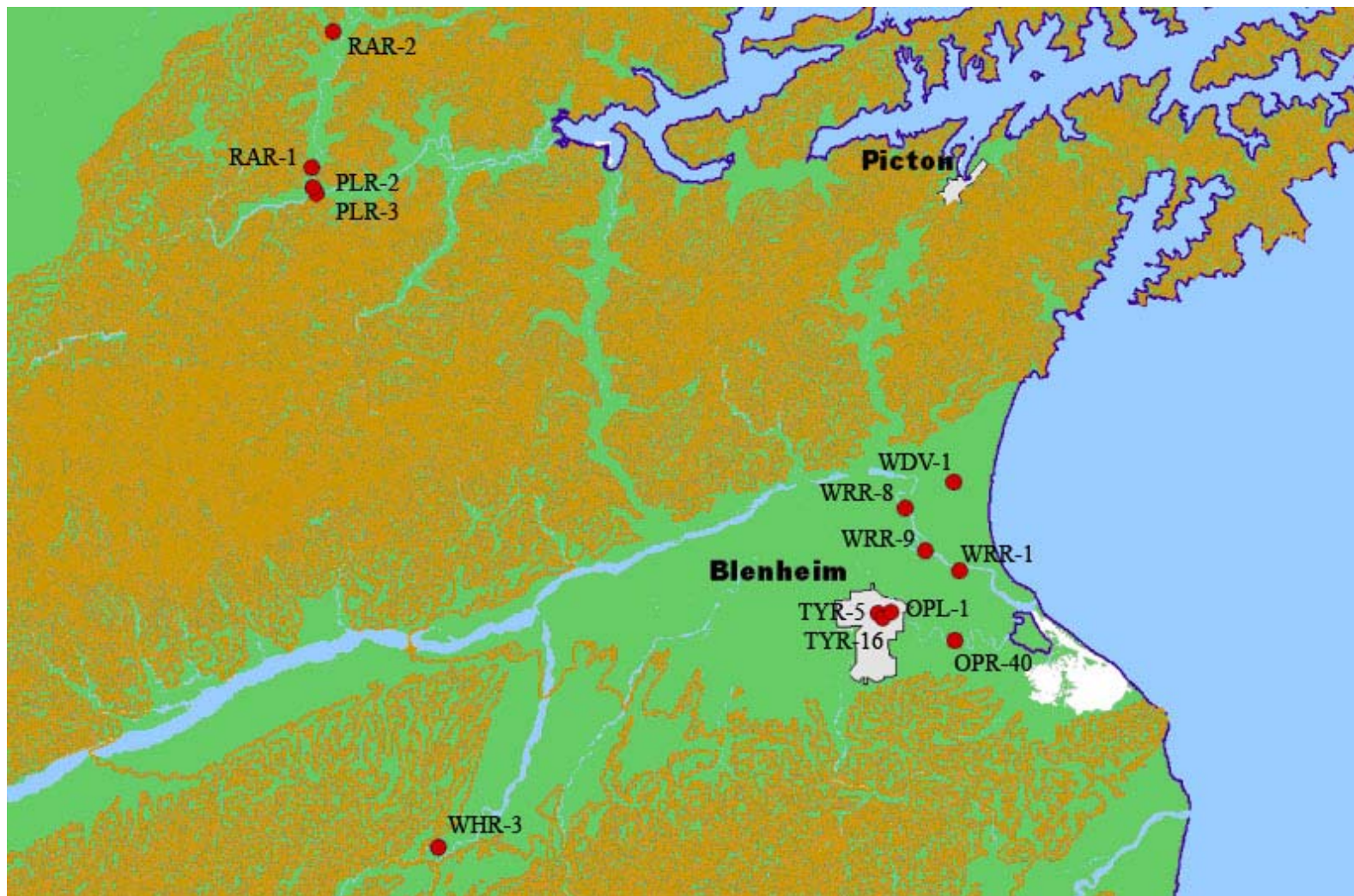
Regular monitoring of each site is recommended to allow for comparisons in freshwater quality each year and to assign complete SFRG grades to each site. It is also recommended that the Sanitary Inspection Categories be recalculated.

6. REFERENCES

- Collins, R. (2002) *Management strategies to mitigate faecal contamination inferred from analysis of data from the Waikato Region*. MAF Technical Publication Paper No: 2002/15.
- Davies-Colley, R., Nagels, J., Donnison, A. and Muirhead, R. (2004) *Flood flushing of bugs in agricultural streams*. Water and Atmosphere. Vol. 12 (2) 18-20.
- Larned, S. T., Scarsbrook, M. R., Snelder, T. H., Norton, N. J. and Biggs, B. J. F. (2004) *Water quality in low-elevation streams and rivers of New Zealand: recent state and trends in contrasting land-cover classes*. New Zealand Journal of Marine and Freshwater Research. Vol 38: 347-366.
- MDC (2004) *Freshwater Contact Recreational Monitoring Programme Summary Report 2003/2004*. Marlborough District Council.
- MfE (2003) *Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas*. Ministry for the Environment <http://www.mfe.govt.nz/publications/water/microbiological-quality-jun03/microbiological-quality-jun03.pdf>
- Muirhead, R. W., Davies-Colley, R. J., Donnison, A. M. and Nagels, J. W. (2004) *Faecal bacteria yields in artificial flood events: quantifying in-stream stores*. Water Research. Vol 38: (5), 1215-1224.
- Nagels, J. W., Davies-Colley, R. J., Donnison, A. M. and Muirhead, R. W. (2002) *Faecal contamination over flood events in a pastoral agricultural stream in New Zealand*. Water and Science Technology. Vol. 45, 45-52.

APPENDIX 1

Freshwater Bathing Site Locations



- OPL-1 Opawa @ Elizabeth Street Footbridge
- OPR-40 Opawa @ Malthouse Reserve
- PLR-2 Pelorus @ Pelorus Bridge
- PLR-3 Pelorus @ Totara Flat
- RAR-1 Rai @ Rai Falls
- RAR-2 Rai @ Brown River Reserve
- TYR-16 Taylor @ Riverside
- TYR-5 Taylor @ Hutcheson Street Bridge
- WDV-1 Wairau Diversion @ Neals Road
- WHR-3 Waihopai @ Craiglochart Bridge #2
- WRR-1 Wairau @ Blenheim Rowing Club
- WRR-8 Wairau @ Ferry Bridge
- WRR-9 Wairau @ Wairau Rowing Club

APPENDIX 2

Results from the Bathing Water (Freshwater) sampling from November 2006 to March 2007 inclusive

	Taylor @ Hutcheson Street Bridge	Taylor @ Riverside	Opawa @ Malthouse Reserve	Opawa @ Elizabeth Street Footbridge	Wairau @ Blenheim Rowing Club	Wairau @ Wairau Rowing Club	Wairau @ Ferry Bridge	Wairau Diversion @ Neals Road	Pelorus @ Totara Flat	Rai @ Brown River Reserve	Rai @ Rai Falls	Pelorus @ Pelorus Bridge	Waihopai @ Craiglochart Bridge #2	alert	action
Date	TYR-5	TYR-16	OPR-40	OPL-1	WRR-1	WRR-9	WRR-8	WDV-1	PLR-3	RAR-2	RAR-1	PLR-2	WHR-3		
20/11/2006	207	344	738	1400					192	478	738	5	885	260	550
28/11/2006	324	271	40	99	30	40	10	64	40	150	324	5	5	260	550
5/12/2006	25	27	15	16	1	9	4	2	8	21	19	3	24	260	550
12/12/2006	87	150	40	137	40	40	5	20	53	124	178	64	5	260	550
19/12/2006	111	53	99	75	5	10	10	40	20	10	40	53	5	260	550
26/12/2006	207	111	99	137	5	87	20	99	10	30	53	30		260	550
3/01/2007	364	178	40	64	5	20	5	99	30	30	53	10	20	260	550
9/01/2007	364	288	99	192	164	137	64	20	697	2000	2000	1100	5	260	550
16/01/2007	99	344	453	124	87	99	87	53	64	364	222	75	111	260	550
23/01/2007	192	238	111	178	5	64	40	75	64	87	99	30	40	260	550
30/01/2007	164	164	2000	150	99	87	40	30	738	782	1400	384	64	260	550
6/02/2007	478	306	53	53	30	10	10	164	40	137	53	20	10	260	550
13/02/2007	207	238	87	137	40	30	30	64	124	53	30	53	20	260	550
20/02/2007	288	271	30	64	20	178	178	344	20	30	30	10	20	260	550
27/02/2007	207	111	254	238	111	40	124	87	30	64	20	64	137	260	550
6/03/2007	124	75	40	178	64	87	178	504	53	30	20	30	20	260	550
13/03/2007	164	137	64	87	40	20	124	20	429	271	560	364	10	260	550
19/03/2007	75	254	30	111	20	40	364	99	30	30	5	5	10	260	550
28/03/2007	137	164	20	111	20	64	238	30	30	10	40	10	40	260	550

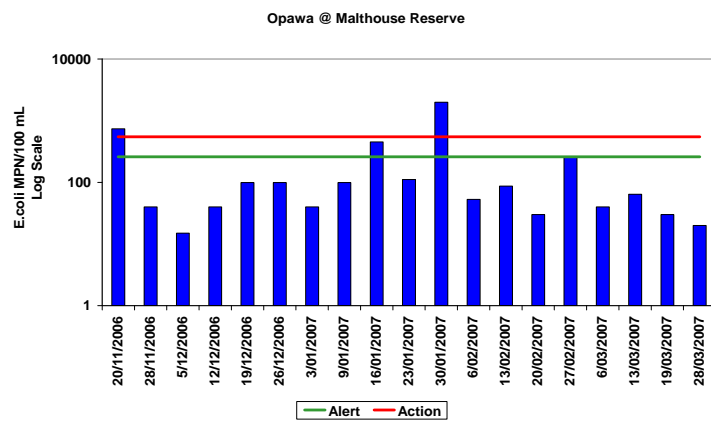
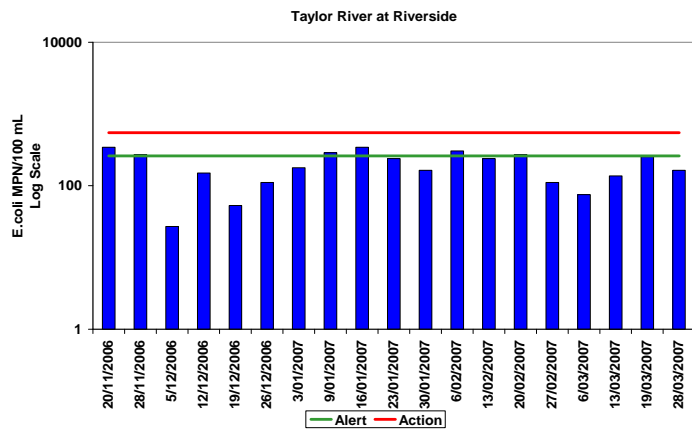
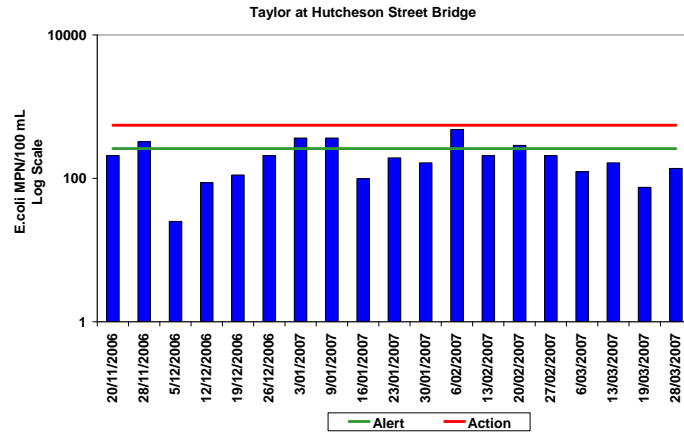
No sample taken due to time constraints

No samples taken as river was in flood.

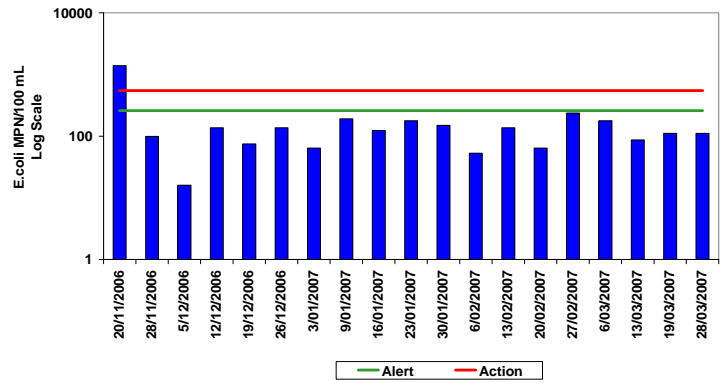
Less than values are halved i.e. <10 MPN/100mL becomes 5.

APPENDIX 3

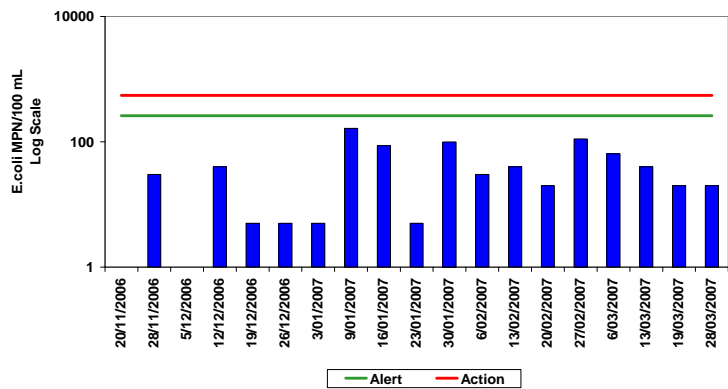
Graphed results for each Freshwater Bathing site for the Summer 2006-07 period in relation to MfE's bathing water standards (action level and alert levels)



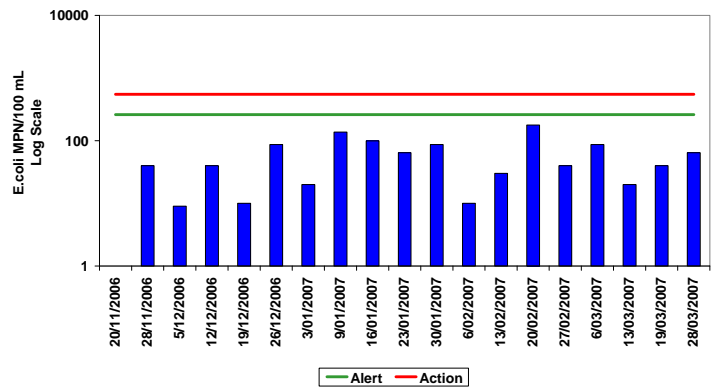
Opawa @ Elizabeth Street Footbridge



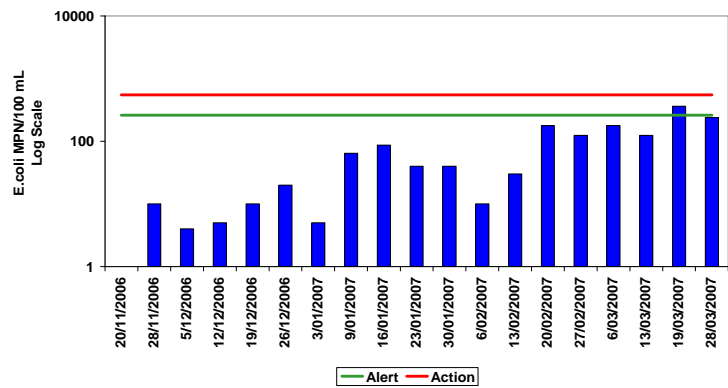
Wairau at Blenheim Rowing Club



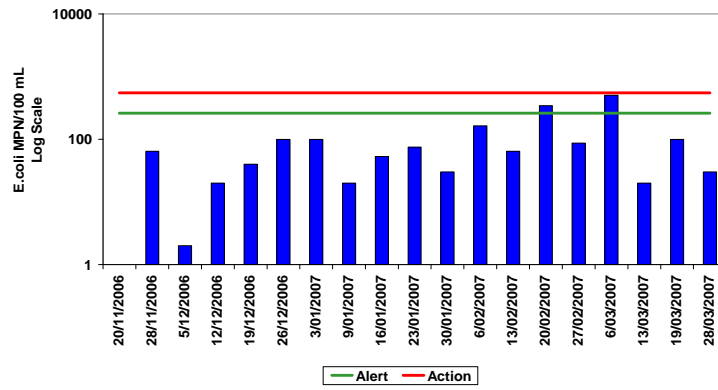
Wairau at Wairau Rowing Club



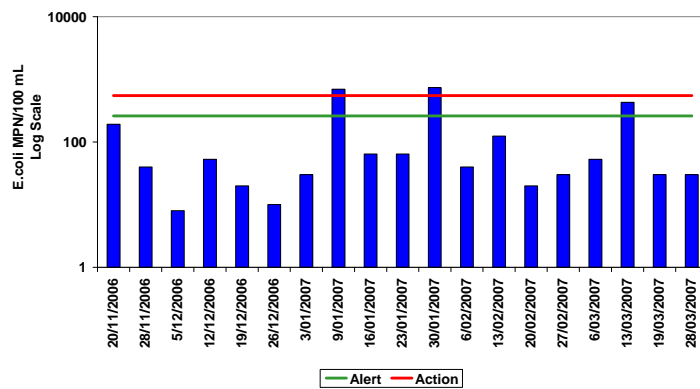
Wairau at Ferry Bridge



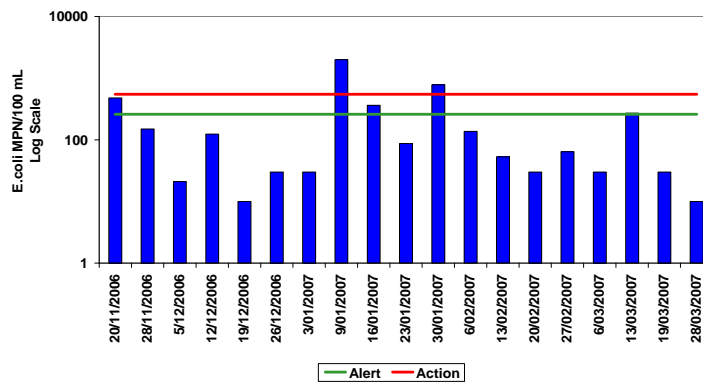
Wairau Diversion at Neals Road



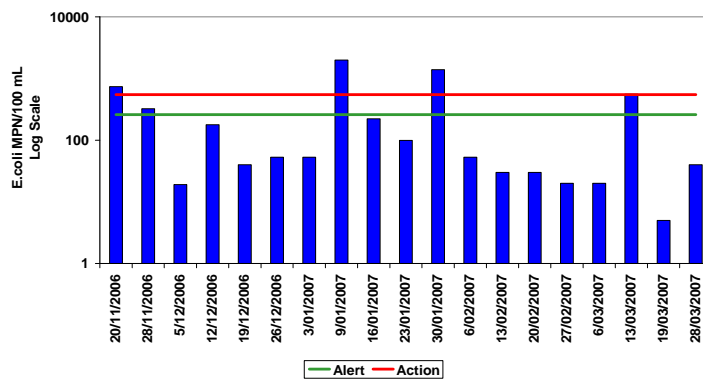
Pelorus at Totara Flat



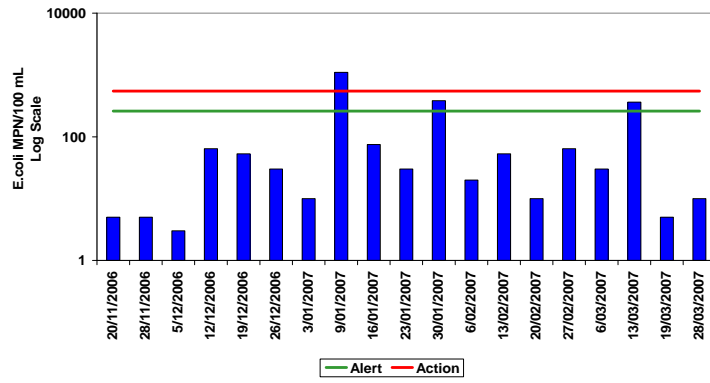
Rai at Brown River Reserve



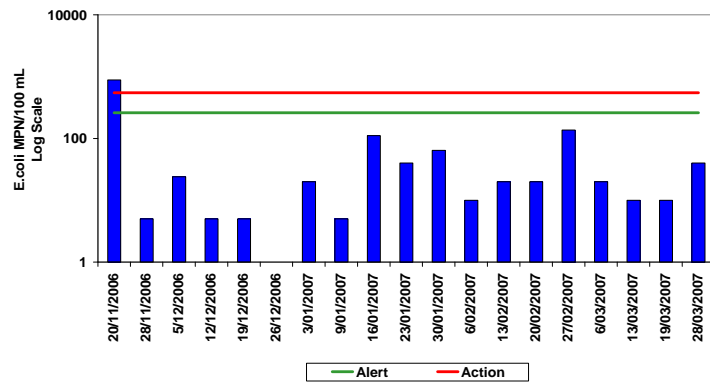
Rai at Rai Falls



Pelorus at Pelorus Bridge



Craiglochart at Bridge No. 2



APPENDIX 4

2006-07 Microbiological Assessment Category Results

Wairau Diversion at Neals Road

***** Microbiological Assessment Category *****
Annual exceedance information (for water year 01
November to 31 October)

	sample season	sample size	median	exceed 260 to 550	exceed >550	%days <550
Year	2006	18	64	2	0	100
Year	2005	21	75	0	0	100
Year	2004	20	81	3	1	95
Year	2003	19	178	6	1	94
Year	2002	10	124.5	0	1	90
Total	0	88	87	11	3	96

Assessment Results

Microbiological Assessment Grade - C

Hazen Percentile Result - 480.6

Data Set Extent - Interim Data Set (< 5 years or < 100
samples used)

Wairau at Wairau Rowing Club

***** Microbiological Assessment Category *****
Annual exceedance information (for water year 01
November to 31 October)

	sample season	sample size	median	exceed 260 to 550	exceed >550	%days <550
Year	2006	17	40	0	0	100
Year	2005	22	30	0	1	95
Year	2004	20	58.5	2	0	100
Year	2003	19	99	2	2	89
Year	2002	12	105	4	0	100
Total	0	90	58.5	8	3	96

Assessment Results

Microbiological Assessment Grade - C

Hazen Percentile Result - 478

Data Set Extent - Interim Data Set (< 5 years or < 100
samples used)

Wairau at Ferry Bridge

***** Microbiological Assessment Category *****
Annual exceedance information (for water year 01
November to 31 October)

	sample season	sample size	median	exceed 260 to 550	exceed >550	%days <550
Year	2006	18	40	1	0	100
Year	2005	21	75	0	0	100
Year	2004	20	64	3	0	100
Year	2003	19	40	1	0	100
Year	2002	12	227.5	3	3	75
Total	0	90	69.5	8	3	96

Assessment Results

Microbiological Assessment Grade - C

Hazen Percentile Result - 406

Data Set Extent - Interim Data Set (< 5 years or < 100 samples used)

Wairau at Blenheim Rowing Club

***** Microbiological Assessment Category *****

Annual exceedance information (for water year 01 November to 31 October)

	sample season	sample size	median	exceed 260 to 550	exceed >550	%days <550
Year	2006	18	30	0	0	100
Year	2005	21	40	0	1	95
Year	2004	20	25	2	0	100
Year	2003	19	75	3	0	100
Year	2002	12	47.5	1	0	100
Total	0	90	40	6	1	98

Assessment Results

Microbiological Assessment Grade - C

Hazen Percentile Result - 288

Data Set Extent - Interim Data Set (< 5 years or < 100 samples used)

Waihopai at Craiglochart

***** Microbiological Assessment Category *****

Annual exceedance information (for water year 01 November to 31 October)

	sample season	sample size	median	exceed 260 to 550	exceed >550	%days <550
Year	2006	19	20	0	1	94
Year	2005	14	35	0	1	92
Year	2004	20	46.5	1	1	95
Year	2003	18	75	1	0	100
Year	2002	12	46.5	1	0	100
Total	0	83	40	3	3	96

Assessment Results

Microbiological Assessment Grade - C

Hazen Percentile Result - 294.3

Data Set Extent - Interim Data Set (< 5 years or < 100 samples used)

Taylor at Riverside

***** Microbiological Assessment Category *****

Annual exceedance information (for water year 01 November to 31 October)

	sample season	sample size	median	exceed 260 to 550	exceed >550	%days <550
Year	2006	19	178	6	0	100
Year	2005	21	192	4	3	85
Year	2004	20	137	2	1	95
Year	2003	9	124	0	1	88

Year	2002	0	0	0	0	0
Total	0	69	164	12	5	92

Assessment Results

Microbiological Assessment Grade - D

Hazen Percentile Result - 701.25

Data Set Extent - Interim Data Set (< 5 years or < 100 samples used)

Taylor at Hutcheson

***** Microbiological Assessment Category *****

Annual exceedance information (for water year 01 November to 31 October)

	sample season	sample size	median	exceed 260 to 550	exceed >550	%days <550
Year	2006	19	192	5	0	100
Year	2005	21	207	4	4	80
Year	2004	20	171	3	1	95
Year	2003	23	124	2	2	91
Year	2002	21	137	4	0	100
Total	0	104	171	18	7	93

Assessment Results

Microbiological Assessment Grade - D

Hazen Percentile Result - 847.4

Data Set Extent - Complete Data Set (5 years with at least 100 samples)

Rai at Rai Falls

***** Microbiological Assessment Category *****

Annual exceedance information (for water year 01 November to 31 October)

	sample season	sample size	median	exceed 260 to 550	exceed >550	%days <550
Year	2006	19	53	1	4	78
Year	2005	26	87	1	4	84
Year	2004	43	137	9	5	88
Year	2003	56	192	10	9	83
Year	2002	38	111.5	5	6	84
Total	0	182	137	26	28	84

Assessment Results

Microbiological Assessment Grade - D

Hazen Percentile Result - 1180

Data Set Extent - Complete Data Set (5 years with at least 100 samples)

Rai at Brown River Reserve

***** Microbiological Assessment Category *****

Annual exceedance information (for water year 01 November to 31 October)

	sample season	sample size	median	exceed 260 to 550	exceed >550	%days <550
Year	2006	19	87	3	2	89

Year	2005	23	207	4	2	91
Year	2004	40	157	8	4	90
Year	2003	45	150	13	6	86
Year	2002	13	207	3	1	92
Total	0	140	150	31	15	89

Assessment Results

Microbiological Assessment Grade - D

Hazen Percentile Result - 1300

Data Set Extent - Complete Data Set (5 years with at least 100 samples)

Pelorus at Totara Flat

***** Microbiological Assessment Category *****

Annual exceedance information (for water year 01

November to 31 October)

	sample season	sample size	median	exceed 260 to 550	exceed >550	%days <550
Year	2006	19	40	1	2	89
Year	2005	24	20	2	1	95
Year	2004	19	111	2	2	89
Year	2003	19	87	2	2	89
Year	2002	12	69.5	1	0	100
Total	0	93	53	8	7	92

Assessment Results

Microbiological Assessment Grade - D

Hazen Percentile Result - 731.85

Data Set Extent - Interim Data Set (< 5 years or < 100 samples used)

Pelorus at Pelorus Bridge

***** Microbiological Assessment Category *****

Annual exceedance information (for water year 01

November to 31 October)

	sample season	sample size	median	exceed 260 to 550	exceed >550	%days <550
Year	2006	19	20	2	1	94
Year	2005	22	30	0	2	90
Year	2004	19	30	0	1	94
Year	2003	20	20	0	1	95
Year	2002	33	20	0	0	100
Total	0	113	20	2	5	95

Assessment Results

Microbiological Assessment Grade - C

Hazen Percentile Result - 381

Data Set Extent - Complete Data Set (5 years with at least 100 samples)

Opawa at Malthouse Reserve

***** Microbiological Assessment Category *****

Annual exceedance information (for water year 01

November to 31 October)

	sample season	sample size	median	exceed 260 to 550	exceed >550	%days <550
Year	2006	19	64	1	2	89
Year	2005	21	53	0	0	100
Year	2004	20	215	2	7	65
Year	2003	23	100	3	4	82
Year	2002	19	306	2	8	57
Total	0	102	99	8	21	79

Assessment Results

Microbiological Assessment Grade - D

Hazen Percentile Result - 2000

Data Set Extent - Complete Data Set (5 years with at least 100 samples)

Opawa at Elizabeth Street Footbridge

***** Microbiological Assessment Category *****

Annual exceedance information (for water year 01 November to 31 October)

	sample season	sample size	median	exceed 260 to 550	exceed >550	%days <550
Year	2006	18	130.5	0	1	94
Year	2005	22	178	5	1	95
Year	2004	20	111.5	1	0	100
Year	2003	23	124	2	2	91
Year	2002	19	100	0	2	89
Total	0	102	124	8	6	94

Assessment Results

Microbiological Assessment Grade - D

Hazen Percentile Result - 792

Data Set Extent - Complete Data Set (5 years with at least 100 samples)