

# **Regional Rivers Water Quality Monitoring Programme Data Report 2008**

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03 June 2009

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# **Acknowledgement**

Thanks to Naomi Crawford, Sally Grant, Rebecca Ireland, Claire Kotze, Ralph Ostertag and Chris Service for their commitment and reliability in undertaking field measurements and sample collection; and Ian Buchanan for co-ordinating the laboratory analyses and assisting with co-ordination of the field aspects of sample collection.



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# 1 Introduction

## 1.1 Background

To effectively manage water quality, the Regional Rivers monitoring programme addresses the following questions:

1. What is the quality of the water now?
2. Why is the water of the observed level of quality?
3. Is water quality getting better or worse? If so - what makes it change?
4. How can we improve the quality, ecological health and integrity of the region's rivers and streams?

The monitoring information allows Environment Waikato to:

- determine compliance with classification standards
- assess the suitability of the resource for various beneficial uses and values of the water
- monitor the impact of major discrete point source discharges on water quality
- monitor the impacts of diffuse discharges on water quality
- provide a basis for evaluating the effectiveness of resource management measures.

This dataset is invaluable for the evaluation of the region's rivers: their state, the pressures on them and our response to these pressures. We need to continue to gather comprehensive, reliable and good quality data on the region's rivers to protect and enhance their values into the future.

This report is the 14<sup>th</sup> since the implementation of the Regional Rivers monitoring programme (RERIMP) in 1993<sup>1</sup> and follows the format of the previous data report (Beard, 2008). Copies of reports as described in the list of references (page 30) can be obtained by contacting Environment Waikato (the Library) on 0800 800 401, or in electronic format from the publications page of the Environment Waikato website: [www.ew.govt.nz/publications](http://www.ew.govt.nz/publications) or email: [inforeq@ew.govt.nz](mailto:inforeq@ew.govt.nz)

## 1.2 Report content

The report provides information on the routine monthly monitoring of water quality at 99 locations across the Waikato region, and includes:

- year 2008 summary statistics tabulated by parameter and reported together
- spatial contour plots for four water quality parameters using spatial interpolation of the median of the previous 5 years
- summary tables identifying the number of samples meeting 'satisfactory' and 'excellent' water quality guidelines and standards.

## 1.3 Water quality guidelines and standards

Table 1 lists the physical, chemical (physico-chemical) and microbiological water quality guidelines and standards used to assess the condition of the region's rivers in 2008. The standards relate to either the protection of the ecological health of rivers and streams or to the suitability for direct-contact water-based recreation (for example swimming).

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<sup>1</sup> Waikato River reported on separately — see Beard, 2008.

**Table 1: Guidelines and Standards for Physico-chemical Water Quality for Ecological Health and for Human Uses of Water. See Appendix I for a description of the Guidelines and Standards used.**

Water quality measure	Relevance <sup>1</sup>	Satisfactory	Excellent
<b>Ecological health</b>			
Dissolved oxygen (% of saturation)	aquatic life (breathing)	>80	>90
pH	aquatic life (acidity)	6.5–9	7–8
Turbidity (NTU)	plant growth (clarity)	<5	<2
Ammoniacal-N (g N/m <sup>3</sup> )	aquatic life (toxicity)	<0.88	<0.1
Temperature (°C) (May-Sep)	fish (spawning)	<12	<10
(Oct-Apr)		<20	<16
Total phosphorus (g/m <sup>3</sup> )	nuisance plant growth	<0.04	<0.01
Total nitrogen (g/m <sup>3</sup> )	nuisance plant growth	<0.5	<0.1
<b>Human uses—recreation</b>			
Baseflow water clarity (m)	visibility	>1.6	>4
<i>Escherichia coli</i> (no./100 mL)	human health	<550	<55
Median <i>E. coli</i> (no./100 mL)	human health	<126	<23

<sup>1</sup> Refer to Appendix II for further information. These guidelines and standards are also described on the Environment Waikato Internet site; [www.ew.govt.nz](http://www.ew.govt.nz)

In each case two values are shown. The less stringent values define water that is “satisfactory” for the desired use; these are mostly based on existing national and other Guidelines and Standards (Appendix I). The more stringent values identify “excellent” water, and reflect expert opinion.

## 2 Regional Rivers monitoring design

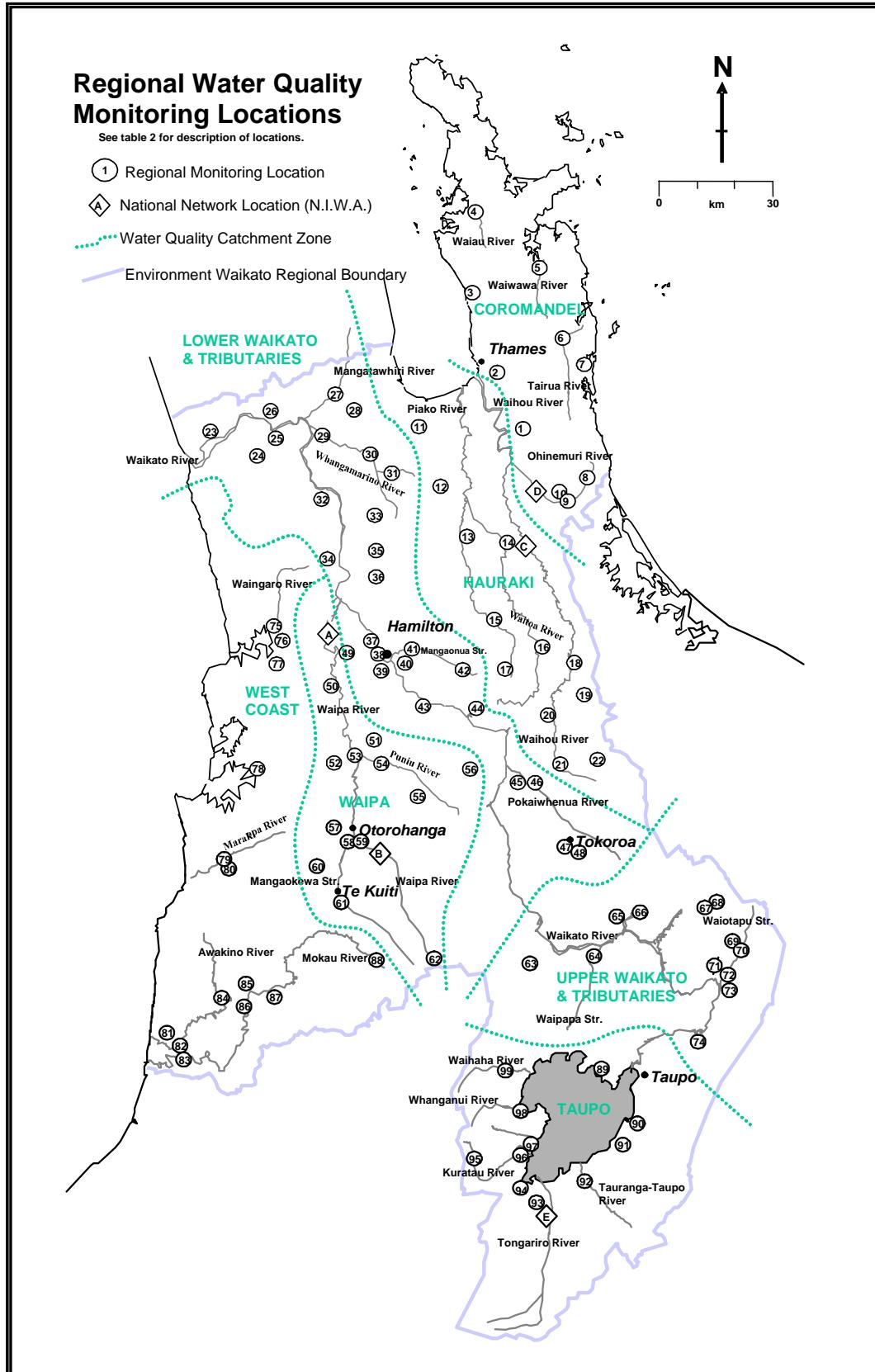
### 2.1 Sampling locations

Routine water quality monitoring locations of the Regional Rivers monitoring programme are summarised in *Table 2* and illustrated in *Figure 1*. Ninety nine were sampled regularly by Environment Waikato. A further 5 locations form part of N.I.W.A.’s National Water Quality Network, whose data are reported annually.

**Table 2: Environment Waikato's sampling locations**

Map No.	Location	Location Id	Map Ref.
<b>Coromandel</b>			
1	Hikutaia River at Old Maratoto Rd	169.2	T12:471-312
2	Kauaeranga River at Smiths Cableway/Recorder	234.11	T12:404-461
9	Ohinemuri River at Queens Head	619.19	T13:576-170
8	Ohinemuri River at SH25 Bridge	619.20	T13:641-213
6	Tairua River at Morrisons Bridge Hikuia	940.10	T12:567-548
3	Tapu River at Tapu-Coroglen Rd	954.5	T11:332-658
4	Waiau River at E309 Rd Ford	1105.3	T11:357-866
10	Waitekauri River at U/S Ohinemuri Confluence	1239.32	T13:566-168
5	Waiwawa River at SH25 Coroglen	1257.3	T11:503-717
7	Wharekawa River at SH25	1312.3	T12:628-478
<b>Hauraki</b>			
12	Mangawhero Stm (Kaihere) at Mangawara Rd	489.2	S13:249-195
20	Oraka Stm at Lake Rd	669.6	T15:536-607
15	Piako River at Kiwitahi	749.10	T14:398-856
13	Piako River at Paeroa-Tahuna Rd Bridge	749.15	T13:318-068
17	Piakonui Stm at Piakonui Rd	753.4	T14:417-719
18	Waihou River at Okauia	1122.18	T14:602-756
21	Waihou River at Whites Rd	1122.41	T15:572-500
22	Waiohotu Stm at Waiohotu Rd (Off SH5)	1173.2	T15:665-513
19	Waiomou Stm at Matamata-Tauranga Rd	1174.4	T15:623-683
11	Waitakaruru River (Hauraki Plains) at Coxhead Rd Bridge	1230.1	S12:194-339
16	Waitoa River at Landsdowne Rd Bridge	1249.15	T14:517-783
14	Waitoa River at Mellon Rd Recorder	1249.18	T13:426-047
<b>Tributaries to the lower Waikato River</b>			
23	Awaroa River (Waiuku) at Otau Rd Bridge opp Moseley Rd	41.9	R12:662-319
34	Awaroa Stm (Rotowaro) at Sansons Bridge–Rotowaro-Huntly	39.11	S14:948-997
44	Karapiro Stm at Hickey Rd Bridge	230.5	T15:331-639
37	Kirikiriroa Stm at Tauhara Drive	253.4	S14:095-817
36	Komakorau Stm at Henry Rd	258.4	S14:091-949
45	Little Waipa Stm at Arapuni – Putararu Rd	335.1	T15:489-462
39	Mangakotukutuku Stm (Rukuhia) at Peacock Rd	398.1	S14:127-743
47	Mangamingi Stm (Tokoroa) at Paraonui Rd Bridge	407.1	T16:588-302
40	Mangaone Stm at Annebrooke Rd Bridge	417.7	S14:159-744
41	Mangaonua Stm at Hoeka Rd	421.10	S14:205-776
42	Mangaonua Stm at Te Miro Rd	421.16	T14:314-731
28	Mangatangi River at SH2 Maramarua	453.6	S12:042-372
27	Mangatawhiri River at Lyons Rd at Buckinghamshire Bridge	459.6	S12:997-427
35	Mangawara Stm at Rutherford Rd Bridge	481.7	S13:084-023
43	Mangawhero Stm (Cambridge) at Cambridge-Ohaupo Rd	488.1	S15:217-653
33	Matahuru Stm at Waiterimu Rd Br	516.5	S13:083-109
25	Ohaeroa Stm at SH22 Bridge	612.9	R12:834-303
24	Opuatia Stm at Ponganui Rd	665.5	R13:773-245
46	Pokaiwhenua Stm at Arapuni-Putaruru Rd	786.2	T15:491-458
31	Waerenga Stm at Taniwha Rd	1098.1	S13:131-217
38	Waitawhirihiri Stm at Edgecumbe Street	1236.2	S14:102-787
26	Whakapihi Stm at SH22 Bridge	1282.8	R12:812-365
48	Whakauru Stm at U/S SH1 Bridge	1287.7	T16:614-282
29	Whangamarino River at Island Block Rd	1293.7	S12:954-308
30	Whangamarino River at Jefferies Rd Bridge	1293.9	S13:084-273
32	Whangape Stm at Rangiriri-Glen Murray Rd	1302.1	S13:950-154

Map No.	Location	Location Id	Map Ref.
<b>Waipa River and tributaries</b>			
50	Kaniwhaniwha Stm at Wright Rd	222.16	S15:985-680
56	Mangaohoi Stm at South Branch Maru Rd	411.9	T15:329-471
61	Mangaokewa Stm at Te Kuiti Borough Water Supply Intake	414.12	S16:998-161
51	Mangapiko Stm (Pirongia/Te Awamutu) at Bowman Rd	438.3	S15:093-560
58	Mangapu River at Otorohanga	443.3	S16:033-318
55	Mangatutu Stm (Waikeria) at Walker Rd Bridge	476.7	S15:203-422
52	Mangauika Stm at Te Awamutu Borough Water Supply Intake	477.10	S15:980-504
49	Ohote Stm at Whatawhata/Horotiu Rd	624.5	S14:997-794
54	Puniu River at Bartons Corner Rd Bridge	818.2	S15:115-500
62	Waipa River at Mangaokewa Rd	1191.5	S17:233-028
53	Waipa River at Pirongia-Ngutunui Rd Bridge	1191.10	S15:037-529
59	Waipa River at SH3 Otorohanga	1191.12	S16:036-322
57	Waitomo Stm at SH31 Otorohanga	1253.5	S16:022-335
60	Waitomo Stm at Tumutumu Rd	1253.7	S16:938-249
<b>Tributaries to the upper Waikato River</b>			
69	Kawaunui Stm at SH5 Bridge	240.5	U17:021-081
65	Mangaharakeke Stm (Atiamuri) at SH30 (Off Jct SH1)	359.1	U16:733-129
71	Mangakara Stm (Reporoa) at SH5	380.2	U17:996-003
63	Mangakino River (Whakamaru) at Sandel Rd	388.1	T17:486-013
67	Otamakokore Stm at Hossack Rd	683.4	U16:955-166
74	Pueto Stm at Broadlands Rd Bridge	802.1	U17:938-827
66	Tahunaatara Stm at Ohakuri Rd	934.1	U16:785-138
73	Torepatutahi Stm at Vaille Rd Bridge	1057.6	U17:985-965
70	Waiotapu Stm at Campbell Rd Bridge	1186.2	U17:024-082
72	Waiotapu Stm at Homestead Rd Bridge	1186.4	U17:003-000
64	Waipapa Stm (Mokai) at Tirohanga Rd Bridge	1202.7	T17:685-047
68	Whirinaki Stm at Corbett Rd	1323.1	U16:957-171
<b>West Coast</b>			
84	Awakino River at Gribbon Rd	33.6	R17:702-918
82	Awakino River at SH3 Awakau Rd Junction	33.9	R18:588-799
81	Manganui River at Off Manganui Rd	410.4	R17:554-831
85	Mangaotaki River at SH3 Bridge	428.3	R17:764-963
79	Marokopa River at Speedies Rd (Off Te Anga Rd)	513.3	R16:708-256
83	Mokau River at Awakau Rd	556.2	R18:601-785
88	Mokau River at Mangaokewa Rd (Off SH30)	556.5	S17:096-017
86	Mokau River at Totoro Rd Recorder	556.9	R17:759-907
87	Mokauiti Stm at Three Way Point – Aria	557.5	R17:828-929
77	Ohautira River at Waingaro - Te Uku Rd	616.1	R14:842-803
78	Oparau River at Langdon Rd (Off Okupata Rd)	658.1	R15:799-494
80	Tawarau River at Off Speedies Rd	976.1	R16:718-249
75	Waingaro River (Pukemiro) at Ruakiwi Rd Off SH22	1167.4	R14:837-837
76	Waitetuna River at Te Uku-Waingaro Rd	1247.2	R14:842-742
<b>Inflows to Lake Taupo</b>			
91	Hinemaiaina River at SH1	171.5	U18:722-567
96	Kuratau River at Te Rae Street	282.5	T18:502-536
95	Kuratau River at SH41 Moerangi	282.4	T18:356-537
89	Mapara Stm at Off Mapara Rd (Whakaipo Reserve)	504.2	T18:681-750
92	Tauranga-Taupo River at Te Kono Slackline	971.4	T19:636-473
94	Tokaanu Power Station Tailrace Canal at SH41 Bridge	1491.1	T19:504-435
93	Tokaanu Stm at Off SH41 Turangi	1045.3	T19:517-423
99	Waihaha River at SH32	1106.4	T18:434-747
90	Waitahanui River at Blake Rd	1226.1	U18:781-627
98	Whanganui Stream at Lakeside Lake Taupo	1301.1	T18:473-653
97	Whareroa Stream at Lakeside Lake Taupo	1318.4	T18:515-568



**Figure 1: Monitoring locations**

The sampling locations are reasonably evenly distributed across the Waikato region (Figure 1). To assist assessment of water quality, sites in the region were divided into 7 water quality zones. This division is based on expert opinion, and reflects river catchments and some broad ecological features, including geology, altitude, winter temperatures, vegetation cover and land use. The boundaries of these water quality zones are shown on Figure 1.

## **2.2 Sample collection**

Sample collection occurs monthly. The 99 locations sampled by Environment Waikato staff are divided between 7 sampling runs. The runs are sampled in the same order each month, and by the same group of field staff. Sampling is assigned to either the second, third or fourth week of each month. A similar time of sampling ( $\pm 1$  hour) is maintained for subsequent visits to a location to minimise the effect of any diurnal variation on water quality parameters, thereby increasing long term trend detection power.

## **2.3 Water quality parameters**

Water quality of the region's rivers is assessed by measuring up to 32 parameters (16 routinely). Seventy-four locations are measured quarterly for enterococci, *E.coli* and faecal coliform bacteria. Some parameters are measured in the field, but most are analysed by laboratories using standard analytical methods. Details of field measurements and analytical methods are given in Appendix II.

## **2.4 Quality control, data storage and analysis**

Quality control measures are undertaken in accordance with Environment Waikato's ISO 9001:2000 standards including procedures for the collection, transport and storage of samples, and methods for data verification and quality assurance to ensure the consistency of data across the programme. Samples are sent to IANZ registered laboratories for analysis. Back-up samples are held for two months until results have been verified by routine quality assurance procedures. All data from field measurements and laboratory analyses are stored in Environment Waikato's water quality archiving database (HYDSTRA).

Data analysis was performed using Data Desk (version 6.0.1). For the purpose of data analysis, non-detect results (i.e. results with "less than" values) were assumed to be equal to half the corresponding limit of detection (i.e.  $< x = x/2$ ), and results greater than the value reported were taken as equal to the value reported (i.e.  $> x = x$ ).

The water quality spatial contour plots were created using Surfer (version 8). To present the spatial contour plots the kriging spatial interpolation procedure was used to estimate the variable at unsampled locations, using weighted sums of the variable at neighbouring sample points. The procedure is designed to minimize the variance of the estimation errors. In some cases artificial sites were used at points downstream of lowland sample sites to show a catchment flow-through effect.

## **2.5 Reports**

A report on Regional Water Quality Trends (Vant 2008) summarises the trends and patterns in regional water quality during 1990 to 2007. Environment Waikato's State of the Environment Report briefly summarises the state of the rivers in the region, and common pressures (Environment Waikato, 1999).

The data contained in these Regional Rivers reports is updated to the Environment Waikato "Healthy Rivers" internet page:

<http://www.ew.govt.nz/Environmental-information/Rivers-lakes-and-wetlands/>

This page also provides a link to details of the water quality guidelines and standards used to assess the condition of the region's rivers, as well as other information relating to lakes, rivers and wetlands.

# **3 Results**

The results are divided into 2 sections. Section 3.1 has a statistical summary of routine monitoring of the region's rivers in 2008 and provides the spatial contour plots using water quality data from four parameters, based on median values for the last 5 years. Section 3.2 compares the results with water quality guidelines and standards for compliance.

## **3.1 Regional Rivers monitoring programme summary statistics**



























**Waipa River and Tributaries**

Kaniwhaniwha Stm at Wright Rd	12	12.1	12.0	6.7	23.0	7.9	0.71	6.3
Mangaohoi Stm at South Branch Maru Rd	12	1.5	1.4	0.9	2.7	0.4	1.01	1.9
Mangaokewa Stm at Te Kuiti Borough W/S Intake	12	8.3	5.0	2.2	22.0	10.1	0.85	4.4
Mangapiko Stm (Pirongia/Te Awamutu) at Bowman Rd	12	18.3	19.5	2.4	46.0	15.0	0.65	16.3
Mangapu River at Otorohanga	12	12.5	10.7	1.7	30.0	17.3	0.46	10.0
Mangatutu Stm (Waikaria) at Walker Rd Br	12	6.9	5.2	1.0	24.0	5.5	1.56	3.7
Mangauika Stm at Te Awamutu Borough W/S Intake	12	1.4	1.2	0.8	3.2	0.7	1.40	1.4
Ohote Stm at Whatawhatia/Horotiu Rd	12	22.3	10.2	7.0	48.0	34.8	0.55	10.8
Puniu River at Bartons Corner Rd Br	12	15.6	9.8	0.8	95.0	10.4	<u>2.64</u>	5.7
Waipa River at Mangaokewa Rd	12	2.5	2.1	0.9	5.7	1.9	1.01	2.2
Waipa River at Pirongia-Ngutunui Rd Br	12	15.2	12.0	3.0	39.0	21.1	0.80	10.7
Waipa River at SH3 Otorohanga	12	11.1	5.8	1.2	35.0	19.2	0.92	4.1
Waitomo Stm at SH31 Otorohanga	12	15.6	11.2	1.5	44.0	21.4	0.72	11.2
Waitomo Stm at Tumutumu Rd	12	11.2	5.5	1.4	64.0	6.4	<u>2.53</u>	6.7

**Tributaries to the upper Waikato River**

Kawaunui Stm at SH5 Br	12	6.2	4.0	1.5	26.0	3.6	<u>2.16</u>	4.2
Mangaharakeke Stm (Atiamuri) at SH30 (Off Jct SH1)	12	6.1	4.8	3.0	13.0	4.6	1.01	4.7
Mangakara Stm (Reporoa) at SH5	12	13.1	6.0	2.5	66.0	12.4	<u>2.37</u>	5.4
Mangakino Stm (Whakamaru) at Sandel Rd	12	2.0	1.2	0.6	5.4	1.9	1.16	1.5
Otamakokore Stm at Hossack Rd	12	5.3	3.7	2.1	19.0	2.9	<u>2.18</u>	3.3
Pueti Stm at Broadlands Rd Br	12	2.4	2.1	1.1	3.8	1.7	0.21	2.3
Tahunaatara Stm at Ohakuri Rd	12	13.2	2.8	1.5	120.0	3.6	<u>3.00</u>	2.8
Torepatutahi Stm at Vaiile Rd Br	12	1.0	1.0	0.8	1.4	0.3	0.61	1.0
Waiotapu Stm at Campbell Rd Br	12	8.3	7.2	3.3	16.0	4.1	0.83	6.4
Waiotapu Stm at Homestead Rd Br	12	14.0	13.5	3.8	30.0	14.8	0.42	13.7
Waipapa Stm (Mokai) at Tirohanga Rd Br	12	35.6	14.5	4.1	280.0	6.6	<u>3.00</u>	4.2
Whirinaki Stm at Corbett Rd	12	1.2	0.5	0.2	5.4	0.7	<u>1.87</u>	0.5

**West Coast**

Awakino River at Gribbon Rd	12	2.5	1.8	0.3	9.3	3.3	1.36	1.6
Awakino River at SH3 Awakau Rd Junction	12	6.5	2.2	0.8	24.0	8.3	1.31	3.9
Manganui River at Off Manganui Rd	12	9.4	5.6	1.6	26.0	16.4	0.76	5.5
Mangaotaki River at SH3 Br	12	22.8	5.9	1.2	200.0	10.6	<u>2.95</u>	5.8
Marokopa River at Speedies Rd (Off Te Anga Rd)	12	13.6	4.2	1.2	110.0	4.8	<u>2.91</u>	3.7
Mokau River at Awakau Rd	12	25.6	18.0	3.9	110.0	27.0	<u>1.91</u>	16.1
Mokau River at Mangaokewa Rd (Off SH30)	12	3.7	3.3	1.4	7.8	2.3	0.73	2.9
Mokau River at Totoro Rd Recorder	12	17.2	5.7	1.2	110.0	15.8	<u>2.62</u>	8.2
Mokautui Stm at Three Way Point - Aria	12	35.1	8.7	2.2	280.0	21.7	<u>2.92</u>	14.1
Ohautira Stm at Waingaro Te Uku Rd	12	16.9	8.4	4.9	61.0	9.6	1.64	9.0
Opatahi River at Langdon Rd (Off Okupata Rd)	12	6.7	4.0	1.4	21.0	8.7	1.14	3.2
Tawarau River at Off Speedies Rd	12	10.8	3.3	1.2	78.0	4.3	<u>2.80</u>	3.8
Waingaro River (Pukemiro) at Ruakiwi Rd Off SH22	12	18.3	10.4	3.6	76.0	10.2	<u>1.88</u>	11.4
Waitetuna River at Te Uku-Waingaro Rd	12	17.7	11.5	4.1	71.0	14.3	<u>2.02</u>	9.3

**Inflows to Lake Taupo**

Hinemaiaina River at SH1	12	1.4	1.1	0.7	4.5	0.4	<u>2.67</u>	1.1
Kuratau River at SH41 Moerangi	12	1.6	1.5	0.9	3.1	0.6	1.36	1.6
Kuratau River at 43 Te Rae Street	12	1.5	1.0	0.5	5.7	0.7	<u>2.39</u>	1.1
Mapara Stm (Lake Taupo) at Off Mapara Rd (Whakaipo Res)	12	2.6	2.6	1.2	4.0	1.4	0.00	2.9
Tauranga-Taupo River at Te Kono Slackline	12	1.8	1.0	0.4	7.0	1.6	1.62	0.7
Tokaanu Power Station Tailrace Canal at SH41 Bridge Over Canal	12	2.2	1.5	1.0	9.4	0.7	<u>2.81</u>	1.2
Tokaanu Stm at Off SH41 Turangi	12	0.2	0.2	0.1	0.3	0.1	0.75	0.1
Waihaha River at SH32	12	0.9	0.5	0.3	2.8	0.7	1.47	0.6
Waitahanui River at Blake Rd	12	0.9	0.8	0.2	2.1	0.7	0.88	0.7
Whanganui Stm at Lakeside Lake Taupo	12	3.3	1.1	0.7	22.0	2.1	<u>2.85</u>	1.4
Wharerua Stm (Taupo District) at Lakeside Lake Taupo	12	6.1	2.7	1.5	37.0	3.8	<u>2.83</u>	3.1

IQR = Inter quartile range; Underlined values indicate parameters having non-normal distributions

**E. Coli (n/100mL)**

Location	Count	Mean	Median	Min	Max	IQR	Skew	04-08 Median
<b>Coromandel</b>								
Hikutaia River at Old Maratoto Rd	4	490	240	79	1400	751	1.06	235
Kauaeranga River at Smiths Cableway/Recorder	4	373	115	60	1200	585	1.15	105
Ohinemuri River at Queens Head	4	3865	212	37	15000	7650	1.15	320
Ohinemuri River at SH25 Br	4	9441	355	52	37000	18699	1.15	225
Tairua River at Morrisons Br Hikuai	4	1238	210	33	4500	2234	1.15	155
Tapu River at Tapu-Coroglen Rd	4	403	201	11	1200	754	0.90	100
Waiau River at E309 Rd Ford	4	992	210	46	3500	1777	1.15	175
Waitekauri River at U/S Ohinemuri Conflu	4	2648	270	50	10000	5115	1.15	129
Waiwawa River at SH25 Coroglen	4	968	485	100	2800	1585	1.01	175
Wharekawa River at SH25	4	7665	1250	160	28000	14270	1.15	400

**Hauraki**

Mangawhero Stm (Kaihere) at Mangawara Rd	4	195	165	8	440	341	0.24	75
Oraka Str at Lake Rd	4	1000	1000	800	1200	300	0.00	850
Piako River at Kuitihi	4	2328	1700	510	5400	3345	0.66	770
Piako River at Paeroa-Tahuna Rd Br	4	1550	1100	400	3600	1800	0.92	900
Piakonui Stm at Piakonui Rd	4	772	179	32	2700	1466	1.12	90
Waihou River at Okauia	4	410	405	290	540	140	0.16	370
Waihou River at Whites Rd	4	631	105	15	2300	1178	1.15	37
Waiohotu Stm at Waiohotu Rd (Off SH5)	4	415	75	10	1500	780	1.14	47
Waioomou Stm at Matamata-Tauranga Rd	4	348	355	220	460	195	-0.10	420
Waitakaruru River (Hauraki Plains) at Coxhead Rd Br	4	1525	850	700	3700	1550	1.14	465
Waitoa River at Landsdowne Rd Br	4	2290	800	360	7200	3520	1.14	430
Waitoa River at Mellon Rd Recorder	4	1225	1150	500	2100	1150	0.24	755

**Tributaries to the lower Waikato River**

Awaroa River (Waiuku) at Otau Rd Br opp Moseley Rd	-	-	-	-	-	-	-	-
Awaroa Stm (Rotowaro) at Sansons Br, Rotowaro-Huntly Rd	4	678	705	100	1200	945	-0.05	330
Karapiro Stm at Hickey Rd Bridge	4	2123	2400	490	3200	1755	-0.63	690
Kirikiriroa Stm at Tauhara Dr	4	2195	2300	380	3800	2710	-0.11	960
Komakorau Stm at Henry Rd	4	4300	3750	1700	8000	4500	0.44	1750
Little Waipa Stm at Arapuni - Putaruru Rd	4	225	95	70	640	310	1.13	155
Mangakotukutuk Stm (Rukuhia) at Peacockes Rd	4	1525	900	800	3500	1350	1.15	1250
Mangamingi Stm (Tokoroa) at Paraonui Rd Br	4	1150	1300	400	1600	700	-0.83	715
Mangaone Stm at Annebrooke Rd Br	4	1588	1225	600	3300	1925	0.61	1250
Mangaonua Stm at Hoeka Rd	4	5400	4750	1100	11000	5300	0.52	2850
Mangaonua Stm at Te Miro Rd	4	793	650	170	1700	1215	0.31	280
Mangatangi River at SH2 Maramarua	-	-	-	-	-	-	-	-
Mangatawhiri River at Lyons Rd At Buckingham Br	-	-	-	-	-	-	-	-
Mangawara Stm at Rutherford Rd Br	-	-	-	-	-	-	-	-
Mangawhero Stm (Cambridge) at Cambridge-Ohaupo Rd	4	2325	2150	1100	3900	1550	0.49	1300
Matahuru Stm at Waiterimu Road Below Confluence	-	-	-	-	-	-	-	-
Ohaeroa Stm at SH22 Br	-	-	-	-	-	-	-	-
Opautia Stm at Ponganui Rd	4	1773	1950	190	3000	1855	-0.40	275
Pokaiwhenua Stm at Arapuni - Putaruru Rd	4	545	360	160	1300	640	1.00	220
Waerenga Stm at Taniwha Rd	4	1898	1450	290	4400	2305	0.78	490
Waitawhirihiri Stm at Edgecumbe Street	4	8833	7500	330	20000	14335	0.33	1200
Whakapipi Stm at SH22 Br	-	-	-	-	-	-	-	-
Whakauru Stm at U/S. SH1 Br	4	640	650	460	800	220	-0.20	530
Whangamarino River at Island Block Rd	-	-	-	-	-	-	-	-
Whangamarino River at Jefferies Rd Br	-	-	-	-	-	-	-	-
Whangape Stm at Rangiriri-Glen Murray Rd	-	-	-	-	-	-	-	-

IQR = Inter quartile range; Underlined values indicate parameters having non-normal distributions

**Enterococci (n/100ml)**

Location	Count	Mean	Median	Min	Max	IQR	Skew	04-08 Median
<b>Enterococci (n/100ml)</b>								
Hikutaia River at Old Maratoto Rd	4	433	99	35	1500	794	1.13	64
Kauaeranga River at Smiths Cableway/Recorder	4	106	74	25	250	159	0.65	40
Ohinemuri River at Queens Head	4	544	34	7	2100	1050	1.15	18
Ohinemuri River at SH25 Br	4	4577	145	16	18000	9037	1.15	37
Tairua River at Morrisons Br Hikuai	4	412	270	9	1100	756	0.65	38
Tapu River at Tapu-Coroglen Rd	4	342	170	29	1000	596	0.96	70
Waiau River at E309 Rd Ford	4	613	260	30	1900	995	1.09	85
Waitekauri River at U/S Ohinemuri Conflu	4	433	62	9	1600	804	1.15	14
Waiwawa River at SH25 Coroglen	4	183	220	31	260	155	-0.79	68
Wharekawa River at SH25	4	10646	785	13	41000	20709	1.15	102



### Temperature (°C)

Location	Count	Mean	Median	Min	Max	IQR	04-08	
							Skew	Median
<b>Coromandel</b>								
Hikutaia River at Old Maratoto Rd	12	15.3	16.3	7.9	22.4	7.9	-0.09	13.9
Kauaeranga River at Smiths Cableway/Recorder	12	15.7	16.6	7.6	22.3	9.1	-0.15	14.8
Ohinemuri River at Queens Head	12	17.2	17.8	10.4	26.9	8.5	0.29	16.5
Ohinemuri River at SH25 Br	12	16.5	17.6	10.4	22.5	7.0	-0.18	16.2
Tairua River at Morrisons Br Hikui	12	16.8	17.3	10.1	24.1	9.1	-0.04	16.0
Tapu River at Tapu-Coroglen Rd	12	15.2	15.9	6.4	23.0	7.0	-0.16	14.6
Waiau River at E309 Rd Ford	12	14.8	15.4	7.8	20.1	6.2	-0.29	14.2
Waietekauri River at U/S Ohinemuri Conflu	12	16.2	16.9	8.9	26.4	7.6	0.35	15.3
Waiwawa River at SH25 Coroglen	12	15.8	16.8	8.7	22.6	8.2	-0.10	14.6
Wharekawa River at SH25	12	16.1	17.1	9.0	24.9	7.8	0.12	15.2
<b>Hauraki</b>								
Mangawhero Stm (Kaihere) at Mangawara Rd	12	14.5	13.4	10.4	23.0	5.1	0.89	13.6
Oraka Stm at Lake Rd	12	14.2	14.8	10.5	17.3	4.2	-0.31	14.5
Piako River at Kiwitahi	12	15.7	16.3	8.3	22.0	6.0	-0.23	16.1
Piako River at Paeroa-Tahuna Rd Br	12	14.9	15.2	7.7	21.5	5.6	0.03	15.5
Piakonui Stm at Piakonui Rd	12	13.3	13.5	7.6	17.5	4.9	-0.27	12.9
Waihou River at Okauia	12	14.4	14.9	11.4	17.4	4.4	-0.11	14.5
Waihou River at Whites Rd	12	13.7	13.9	12.3	15.1	1.6	-0.21	13.4
Waiohotu Stm at Waiohotu Rd (Off SH5)	12	11.5	11.3	7.5	14.5	4.5	-0.14	11.3
Waioomou Stm at Matamata-Tauranga Rd	12	13.8	13.6	9.4	17.3	5.5	-0.10	13.5
Waitakaruru River (Hauraki Plains) at Coxhead Rd Br	12	16.4	16.4	11.3	22.0	6.8	-0.01	16.2
Waitoa River at Landsdowne Rd Br	12	15.1	15.8	7.1	20.3	6.5	-0.48	15.0
Waitoa River at Mellon Rd Recorder	12	15.3	15.7	7.6	21.7	7.0	-0.06	15.7
<b>Tributaries to the lower Waikato River</b>								
Awaroa River (Waiuku) at Otava Rd Br opp Moseley Rd	12	17.2	17.3	11.4	23.2	7.1	0.12	17.1
Awaroa Stm (Rotowaro) at Sansons Br, Rotowaro-Huntly Rd	12	15.7	16.4	9.9	21.6	6.8	-0.02	14.6
Karapiro Stm at Hickey Rd Bridge	12	14.9	15.2	7.1	20.4	6.5	-0.38	14.9
Kirikiriroa Stm at Tauhara Dr	12	14.9	15.0	9.7	18.8	5.7	-0.18	15.1
Komakorau Stm at Henry Rd	12	16.1	16.2	10.6	22.4	5.8	0.12	15.1
Little Waipa Stm at Arapuni - Putaruru Rd	12	14.4	15.0	11.5	17.0	3.2	-0.35	14.5
Mangakotukutuku Stm (Rukuhia) at Peacockes Rd	12	14.9	15.5	8.7	19.9	6.0	-0.31	15.4
Mangamingi Stm (Tokoroa) at Paraonui Rd Br	12	14.3	14.8	8.6	19.9	5.7	-0.21	14.4
Mangaone Stm at Annebrooke Rd Br	12	13.4	13.6	6.8	17.7	5.2	-0.53	13.7
Mangaonua Stm at Hoeka Rd	12	13.5	13.6	7.1	18.1	5.9	-0.28	13.9
Mangaonua Stm at Te Miro Rd	12	14.4	14.5	8.3	19.1	5.7	-0.26	14.2
Mangatangi River at SH2 Maramarua	12	16.8	16.3	11.1	27.6	6.2	0.87	16.3
Mangatawhiri River at Lyons Rd At Buckingham Br	12	16.9	16.6	11.1	25.3	7.8	0.36	17.1
Mangawara Stm at Rutherford Rd Br	12	15.6	15.4	10.4	21.5	5.7	0.14	15.1
Mangawhero Stm (Cambridge) at Cambridge-Ohaupo Rd	12	14.0	14.4	7.8	17.5	5.2	-0.57	14.4
Matahuru Stm at Waiterimu Road Below Confluence	12	14.9	15.3	10.3	20.6	5.5	-0.01	14.8
Ohaeroa Stm at SH22 Br	12	15.1	14.1	11.0	20.5	5.8	0.35	14.5
Opautia Stm at Ponganui Rd	12	15.2	15.0	10.8	21.4	6.5	0.24	14.8
Pokaiwhenua Stm at Arapuni - Putaruru Rd	12	14.4	14.6	10.7	18.5	4.9	-0.08	14.0
Waerenga Stm at Taniwha Rd	12	14.7	14.3	9.9	20.8	5.5	0.16	14.1
Waitawhirihiri Stm at Edgecumbe Street	12	16.2	16.3	11.3	20.4	5.9	-0.15	16.4
Whakapipi Stm at SH22 Br	12	15.4	15.4	11.0	20.4	5.1	-0.05	15.4
Whakauru Stm at U/S SH1 Br	12	12.7	13.1	8.5	16.5	5.3	-0.16	12.4
Whangamarino River at Island Block Rd	12	17.7	17.9	11.6	24.7	8.4	-0.03	17.4
Whangamarino River at Jefferies Rd Br	12	15.4	14.8	9.8	22.2	6.2	0.19	14.7
Whangape Stm at Rangiriri-Glen Murray Rd	12	16.7	17.0	11.5	22.9	7.1	0.08	16.7

IQR = Inter quartile range; Underlined values indicate parameters having non-normal distributions

**Waipa River and Tributaries**

Kaniwhaniwa Stm at Wright Rd	12	15.8	16.2	10.7	21.7	6.2	0.03	14.3
Mangaohoi Stm at South Branch Maru Rd	12	14.4	14.4	11.4	18.1	5.1	0.05	13.2
Mangaokewa Stm at Te Kuiti Borough W/S Intake	12	14.2	14.1	7.6	20.7	6.1	0.10	12.6
Mangapiko Stm (Pirongia/Te Awamutu) at Bowman Rd	12	16.9	15.6	12.0	23.4	7.7	0.29	15.8
Mangapu River at Otorohanga	12	16.7	16.6	10.5	25.2	8.7	0.36	15.3
Mangatutu Stm (Waikeria) at Walker Rd Br	12	15.4	13.2	10.6	22.2	7.3	0.40	13.9
Mangauika Stm at Te Awamutu Borough W/S Intake	12	13.5	13.5	10.3	18.1	3.6	0.42	12.1
Ohote Stm at Whatawhata/Horotiu Rd	12	15.2	15.7	9.4	19.4	5.6	-0.31	15.7
Puniu River at Bartons Corner Rd Br	12	16.1	14.2	11.4	22.9	7.9	0.36	14.7
Waipa River at Mangaokewa Rd	12	14.2	14.8	8.6	19.3	7.7	-0.01	13.5
Waipa River at Pirongia-Ngutunui Rd Br	12	16.5	16.4	11.1	22.8	7.5	0.02	14.9
Waipa River at SH3 Otorohanga	12	16.2	16.3	9.6	23.0	9.9	0.16	15.0
Waimomo Stm at SH31 Otorohanga	12	16.0	15.7	11.6	22.1	6.5	0.33	14.8
Waitomo Stm at Tumutumu Rd	12	14.6	14.4	11.6	19.7	3.8	0.61	13.8

**Tributaries to the upper Waikato River**

Kawaunui Stm at SH5 Br	12	15.1	15.6	11.6	18.8	4.4	-0.01	14.5
Mangaharakeke Stm (Atiamuri) at SH30 (Off Jct SH1)	12	13.4	13.5	9.9	17.1	3.8	0.00	12.8
Mangakara Stm (Reporoa) at SH5	12	13.7	14.4	9.8	17.2	3.9	-0.23	13.5
Mangakino Stm (Whakamaru) at Sandel Rd	12	12.4	12.0	8.1	17.9	4.7	0.16	12.1
Otamakokore Stm at Hossack Rd	12	20.2	20.6	14.0	24.1	5.3	-0.52	20.5
Pueto Stm at Broadlands Rd Br	12	14.1	14.7	10.9	18.1	3.8	0.00	13.4
Tahunaatara Stm at Ohakuri Rd	12	13.8	14.1	8.3	18.9	6.2	-0.10	14.0
Torepatutahi Stm at Vaile Rd Br	12	14.6	14.9	10.6	19.8	4.8	0.10	14.4
Waiotapu Stm at Campbell Rd Br	12	28.2	28.6	23.7	32.3	4.9	-0.21	28.4
Waiotapu Stm at Homestead Rd Br	12	19.0	18.8	14.7	23.5	6.8	-0.07	18.8
Waipapa Stm (Mokai) at Tirohanga Rd Br	12	22.0	22.1	17.3	25.7	4.1	-0.16	22.0
Whirinaki Stm at Corbett Rd	12	12.7	13.1	10.5	14.5	2.2	-0.39	12.2

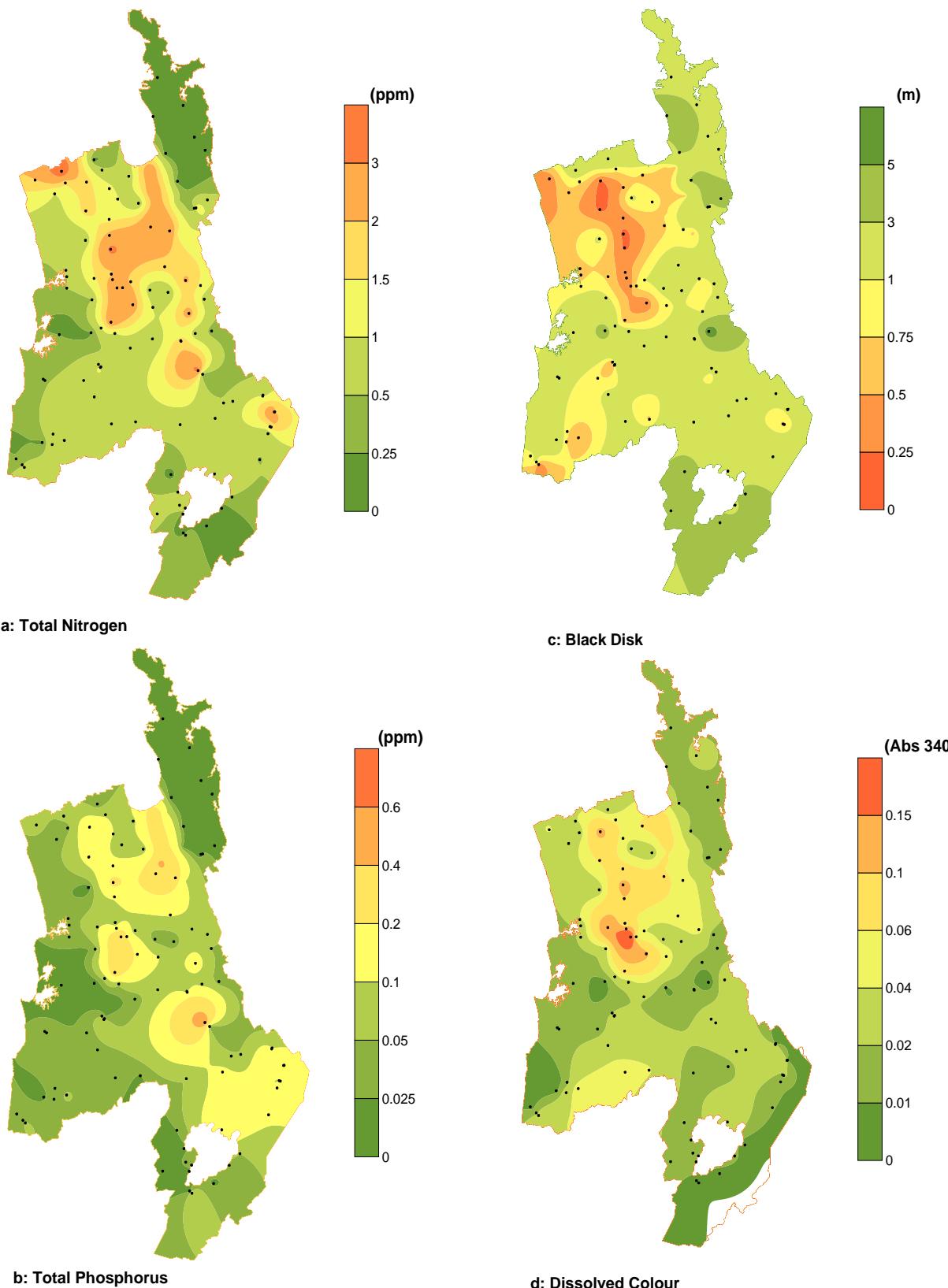
**West Coast**

Awakino River at Gribbon Rd	12	14.0	13.3	8.5	20.9	6.1	0.33	12.8
Awakino River at SH3 Awakau Rd Junction	12	15.4	14.7	9.6	24.3	8.5	0.41	14.7
Manganui River at Off Manganui Rd	12	14.7	13.8	8.2	21.7	7.7	0.21	13.8
Mangaotaki River at SH3 Br	12	14.1	13.9	8.1	20.7	6.0	0.17	13.4
Marokopa River at Speedies Rd (Off Te Anga Rd)	12	15.0	15.2	10.6	20.1	5.1	0.20	13.9
Mokau River at Awakau Rd	12	15.7	15.5	10.3	23.5	9.2	0.24	14.6
Mokau River at Mangaokewa Rd (Off SH30)	12	13.0	13.1	7.5	18.1	5.9	-0.03	12.5
Mokau River at Totoro Rd Recorder	12	15.4	15.4	9.7	22.1	7.6	0.21	14.5
Mokautiti Stm at Three Way Point - Aria	12	15.8	15.6	9.3	23.7	9.7	0.22	14.6
Ohautira Stm at Waingaro Te Uku Rd	12	14.2	13.5	9.9	20.8	5.6	0.44	12.9
Opurau River at Langdon Rd (Off Okupata Rd)	12	15.8	17.0	11.1	20.9	7.1	-0.19	14.2
Tawarau River at Off Speedies Rd	12	14.5	14.4	10.1	20.1	4.8	0.30	13.6
Waingaro River (Pukemiro) at Ruakiwi Rd Off SH22	12	16.2	16.7	10.7	23.0	7.9	0.05	15.2
Waitetuna River at Te Uku-Waingaro Rd	12	15.8	15.7	10.2	21.9	6.2	-0.08	14.3

**Inflows to Lake Taupo**

Hinemaiaia River at SH1	12	11.8	11.3	6.7	16.6	6.1	0.08	11.2
Kuratau River at SH41 Moerangi	12	9.6	9.3	5.4	13.1	3.6	-0.13	8.9
Kuratau River at 43 Te Rae Street	12	13.2	13.5	7.8	17.7	6.3	-0.15	12.9
Mapara Stm (Lake Taupo) at Off Mapara Rd (Whakaipo Res)	12	10.9	11.2	7.8	12.9	1.9	-0.73	10.8
Tauranga-Taupo River at Te Kono Slackline	12	10.5	10.0	5.8	15.5	5.5	0.17	9.8
Tokaanu Power Station Tailrace Canal at SH41 Bridge Over Canal	12	14.3	14.2	7.6	22.8	9.6	0.25	12.1
Tokaanu Stm at Off SH41 Turangi	12	12.5	12.5	10.8	14.0	1.2	-0.09	12.1
Waihaha River at SH32	11	11.3	10.5	6.7	17.4	4.9	0.33	10.6
Waitahanui River at Blake Rd	12	10.7	10.9	8.3	12.1	1.8	-0.66	10.5
Whanganui Stm at Lakeside Lake Taupo	12	11.8	11.3	6.6	18.5	5.5	0.21	10.9
Wharerua Stm (Taupo District) at Lakeside Lake Taupo	12	11.9	11.9	7.1	17.2	3.9	-0.06	11.2

IQR = Inter quartile range; Underlined values indicate parameters having non-normal distributions



**Figure 2:** Spatial contour plots of four water quality parameters (based on 5 year median values, 2004-2008); a: Total Nitrogen, b: Total Phosphorus, c: Black disk, d: Dissolved colour (Abs 340)

### **3.2 Regional Rivers monitoring programme comparison with water quality guidelines and standards**





# References

- Beard, S., 2008: *Regional Rivers Water Quality Monitoring Programme Data Report 2007*. Environment Waikato Technical Report 2008/19, Environment Waikato, Hamilton
- Beard, S., 2007: *Regional Rivers Water Quality Monitoring Programme Data Report 2006*. Environment Waikato Technical Report 2007/12, Environment Waikato, Hamilton
- Smith, P.A., 2006: *Regional Rivers Water Quality Monitoring Programme Data Report 2005*. Environment Waikato Technical Report 2006/29, Environment Waikato, Hamilton
- Smith, P.A., 2005: *Regional Rivers Water Quality Monitoring Programme Data Report 2004*. Environment Waikato Technical Report 2005/20, Environment Waikato, Hamilton
- Smith, P.A., 2004: *Regional Rivers Water Quality Monitoring Programme Data Report 2003*. Environment Waikato Technical Report 2004/04, Environment Waikato, Hamilton
- Smith, P.A., 2002: *Regional Rivers Water Quality Monitoring Programme Data Report 2001*. Environment Waikato Technical Report 2002/02, Environment Waikato, Hamilton
- Smith, P.A., 2003: *Waikato Rivers Water Quality Monitoring Programme Data Report 2002*. Environment Waikato Technical Report 2003/01, Environment Waikato, Hamilton
- Vant B. 2008: *Trends in River Water Quality in the Waikato Region, 1987-2007*. Environment Waikato Technical Report 2008/33, Environment Waikato, Hamilton.
- Wilson B.T. 1998a: *Regional Rivers Water Quality Monitoring Programme Data Report 1996*. Environment Waikato Technical Report 1998/11, Environment Waikato, Hamilton
- Wilson B.T. 1998b: *Regional Rivers Water Quality Monitoring Programme Data Report 1997*. Environment Waikato Technical Report 1998/12, Environment Waikato, Hamilton
- Wilson B.T. 1999: *Regional Rivers Water Quality Monitoring Programme Data Report 1998*. Environment Waikato Technical Report 1999/01, Environment Waikato, Hamilton
- Wilson B.T. 2000: *Regional Rivers Water Quality Monitoring Programme Data Report 1999*. Environment Waikato Technical Report 2000/06, Environment Waikato, Hamilton
- Wilson B.T., 2000: *Waikato River Water Quality Monitoring Programme Data Report 1999*. Environment Waikato Technical Report 2000/07, Environment Waikato, Hamilton

# Appendix I: Water quality guidelines and standards

Details of water quality guidelines and standards for “satisfactory” water quality

Parameter	Critical Value(s)	Source
Dissolved oxygen	>80% of saturation concentration	RMA Third Schedule, Classes AE, F, and FS.
pH	6.5–9	ANZECC (1992) and Canadian guidelines for freshwater aquatic life (1987).
Turbidity	<5 NTU	Studies of adverse effects on underwater light—and thus on plant and invertebrate production—in certain South Island streams (Davies-Colley 1991).
Ammoniacal-nitrogen	<0.88 g N/m <sup>3</sup>	USEPA (1998) value for 1-hour exposure at pH 9.
Temperature	<12°C (May – Sep) <20°C (Oct – Apr)	Environment Waikato Draft Regional Plan standards for trout fisheries and trout spawning (1997).
Total phosphorus	<0.04 g/m <sup>3</sup>	From upper quartile values for 77 New Zealand rivers in NIWA’s National Water Quality Network (after Smith & Maasdam 1994)—note that the guidelines for “excellent” conditions are the lower quartile concentrations for these rivers.
Total nitrogen	<0.5 g/m <sup>3</sup>	From upper quartile values for 77 New Zealand rivers in NIWA’s National Water Quality Network (after Smith & Maasdam 1994)—note that the guidelines for “excellent” conditions are the lower quartile concentrations for these rivers.
Water clarity at baseflow	>1.6 m	“Baseflow” defined as flows less than the upper decile flow. Guideline from Ministry for the Environment (1994).
<i>Escherichia coli</i>	<550/100 mL	Ministry of the Environment (2003) guidelines for the management of recreational and marine shellfish-gathering waters.
Median <i>Escherichia coli</i>	<126/100 mL	Ministry of the Environment (1999) guidelines for the management of recreational and marine shellfish-gathering waters.

# Appendix II: Water quality monitoring parameters

## Field instruments and analytical methods

### Regional Rivers water quality monitoring parameters

Water Quality Parameter	Reason For Monitoring	Parameter Monitored <sup>1</sup>	Comments <sup>2</sup>
<b>Dissolved Oxygen</b>	- requirement for aquatic life - indicator of organic pollution - indicator of photosynthesis (plant growth)	DO (conc.) DO (%sat.)	routine (field) routine (field)
<b>Temperature</b>	- indicator of biological activity - requirement for aquatic life - mixing processes - modelling studies (e.g. nutrient uptake)	Temperature	routine (field)
<b>Conductivity</b>	- indicator of total salts dissolved in water	Conductivity	routine
<b>pH</b>	- aquatic life protection - indicator of industrial discharges, mining	pH	routine
<b>Clarity</b>  <b>turbidity</b> <b>black disk</b> <b>(visual clarity)</b>	- aesthetic appearance - light availability for excessive plant growth - aquatic life protection - indicator of catchment condition, land use	Turbidity Black disk	routine routine (field)
<b>Colour</b>  <b>light absorption</b>	- light availability for excessive plant growth - indicator of presence of organic matter	Filtered Absorbance at: 340,440,780nm	routine
<b>Nutrients (N and P)</b>	- enrichment, excessive plant growth - nutrient limitation for plant/algae growth	NO <sub>3</sub> -N+NO <sub>2</sub> -N NH <sub>4</sub> -N,TKN DRP, TP	routine
<b>Faecal Indicators</b>  <b>E. coli</b> <b>enterococci</b> <b>faecal coliforms</b>	- indicator of pollution with faecal matter - disease risk for swimming etc.	E.coli ENT FC	quarterly

<sup>1</sup> see the next table for the meaning of the abbreviations.

<sup>2</sup> routine means sampled monthly.

## Regional Rivers monitoring - water quality parameters and analytical methods of analysis

Id <sup>1</sup>	Parameter	Method
A340F	Absorbance at 340 nm Filtered	Spectrophotometer, 1 cm path length, APHA method 5910B
A440F	Absorbance at 440 nm Filtered	Spectrophotometer, 1 cm path length, APHA method 5910B
A780F	Absorbance at 780 nm Filtered	Spectrophotometer, 1 cm path length, APHA method 5910B
BDISK	Black Disk	Field measurement, horizontal water transparency (20mm, 60mm, 100mm, 200mm disk) in river or trough (20mm only)
COND	Conductivity	Lab Meter at 25°C. APHA method 2510B
DO	Dissolved Oxygen	Field measurement (WTW DO meter, model 340A)
DO (% Sat)	Dissolved Oxygen (percent saturation)	Field measurement (WTW DO meter, model 340A)
pH	pH	Lab Meter at 25°C. APHA method 4500-H+B
TEMP	Temperature	Field measurement (WTW DO Meter, model 340A)
E. coli	Escherichia coli	Membrane Filtration (mFC Agar) confirmation by NA-MUG Agar. APHA method 9222G
ENT	Enterococci bacteria	Membrane Filtration (mE Agar) confirmation by EIA Agar. APHA method 9230
FC	Faecal Coliforms	Membrane Filtration (mFC Agar). APHA method 9222
NH <sub>4</sub> -N	Ammoniacal Nitrogen	Phenol/Hypochlorite Colorimetry. Flow injection analyser. APHA method 4500-NC (modified)
NNN	Nitrite/Nitrate Nitrogen	Automated Cadmium reduction. Flow injection analyser. APHA method 4500 – NO <sub>3</sub> (proposed).
TKN	Total Kjeldahl-Nitrogen	Acid digestion. Phenol/Hypochlorite Colorimetry. APHA method 4500-N <sub>org</sub> C (modified)
TN	Total Nitrogen	Calculated from NNN + TKN (Nitrite/Nitrate Nitrogen + Total Kjeldahl-Nitrogen)
DRP	Dissolved Reactive Phosphorus	Molybdenum Blue Colorimetry. Flow injection analyser. APHA 4500 PG (proposed)
TP	Total Phosphorus	Persulphate digestion, Colorimetry. NAWASCO method 8.
TURB	Turbidity	Turbidity Meter. APHA method 2130B

<sup>1</sup> Parameter Id ref