

Waikato River Water Quality Monitoring Programme: Data Report 2010

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1 Introduction

1.1 Background

The year 2010 report follows the format of the previous data report (Beard, 2009).

To effectively manage water quality, the Waikato River 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 Waikato River?

The monitoring information allows the Council to:

- determine compliance with classification standards
- define 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 Waikato River: its state, the pressures on it and its response to these pressures. We need to continue to gather comprehensive, reliable and good quality data on the Waikato River to protect and enhance its values into the future.

This report is the 20th since the re-design of the Waikato River Monitoring Programme (WARIMP) implemented in 1989. Copies of reports can be obtained via the Waikato Regional Council Internet site <http://www.ew.govt.nz/Publications/> or by contacting Waikato Regional Council (the Library) on 0800 800 401, e-mail: inforeq@ew.govt.nz.

1.2 Report content

The report provides information on:

1. Routine monthly monitoring of water quality at 10 sites:
 - Year 2010 summary data, tabulated by parameter for each location and reported with the median of the previous 5 years.
 - Key parameter graphs showing the average water quality for 2010 at each location, compared to results of the previous 5 years.
 - Summary tables identifying the number of samples meeting 'satisfactory' and 'excellent' water quality standards and guidelines.
 - Raw data for 2010.
2. Additional information is provided in the appendices on:
 - Flow (*Appendix I*).
 - The effect of flow is important to assessing water quality and making comparisons between years. Appendix I provides information on annual median flow at some locations for the previous 10 years.
 - Datasonde deployments
 - Plots of deployments undertaken during 2010 showing the level of diurnal and seasonal variation at five Waikato River sites (*Appendix II*).

1.3 Water quality guidelines and standards

Table 1 lists the physical and chemical water quality standards and guidelines used to assess the condition of the Waikato River in 2010. The standards mainly relate to either the protection of the ecological health of rivers and streams or to whether they are suitable for water-based recreation, especially swimming.

Some water quality guidelines and standards are relevant to the use of the Waikato River for both general water supply (industrial/cooling water, irrigation, stock water etc.) and as a source of municipal drinking water. In most cases two criteria are shown. The less stringent criteria define water that is “satisfactory” for the desired use; these are mostly based on existing national and other guidelines and standards (Appendix IV). The more stringent criteria identify “excellent” water, and reflect expert opinion. Samples gathered in 2010 whose results do not comply with the “satisfactory” criteria (Table 1) are underlined in raw data summaries.

Table 1: Guidelines and standards for physicochemical water quality for ecological health and for human uses of water

Water Quality Measure	Relevance ¹	Satisfactory	Excellent
Ecological health			
Dissolved oxygen (% 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/m ³)	aquatic life (toxicity)	<0.88	<0.1
Temperature (°C) (May-Sep)	fish (spawning)	<12	<10
(Oct-Apr)		<20	<16
Total phosphorus (g/m ³)	nuisance plant growth	<0.04	<0.01
Total nitrogen (g/m ³)	nuisance plant growth	<0.5	<0.1
Human uses - recreation			
Baseflow water clarity (m)	visibility	>1.6	>4
Escherichia coli (no./100 mL)	human health	<550	<55
Median Escherichia coli (no./100 mL)	human health	<126	<23
Human uses - water supply			
Phytoplankton chlorophyll a (g/m ³)	filter blockage	<0.02	<0.005
Human uses - drinking water			
Arsenic (g/m ³)	human health (toxicity)	<0.01	–
Boron (g/m ³)	human health (toxicity)	<1.4	–

¹ Refer to Appendix IV for description of guideline and standards values used. These guidelines and standards are also defined on the Waikato Regional Council Internet site; www.ew.govt.nz

2 The Waikato River monitoring programme design

2.1 Sampling collection

Sample collection occurs monthly, as two sampling runs. Locations in the upper catchment from Taupo to Waipapa are visited as part of the first run, and locations in the middle and lower catchments from Hamilton (at the Narrows) to Tuakau are visited on the next. Each location is sampled at a similar time on each occasion (coefficient of variation $\approx 2-6\%$) to minimise the effect of diurnal variation on the measurement of water quality parameters. Sample times are recorded in New Zealand Standard Time (NZST). Because of the controlled nature of the river, our daytime samples are generally collected at higher than median flows.

2.2 Sample locations

Routine water quality monitoring locations of the Waikato River Monitoring Programme and additional locations used during the summer microbiological surveys are summarised in *Table 2* and illustrated in *Figure 1*.

Table 2: Routine sampling and bathing water monitoring locations

Location Number	Distance ¹ (km)	Location name	Map Ref.	Field ¹ Measurements
1131.127	0.1	Taupo Gates	U18:772-757	–
1131.119 ^{*d}	1.2	Taupo – Reids Farm	U18:778:763	true left bank
1131.70 ^b	6.0	Huka Falls	U18:789-792	–
1131.244 ^d	7.8	Downstream Huka Falls	U18:797-809	river boat jetty ²
1131.105 ^d	36.5	Ohaaki Bridge	U17:981-914	at bridge, true left bank
1131.107	75.8	Ohakuri Tailrace Bridge	U17:796-061	boat ramp ³
1131.147	105.0	Whakamaru Tailrace	T17:552-056	boat ramp ⁴
1131.143	126.1	Waipapa Tailrace	T16:448-200	boat ramp ⁵
1131.81 ^b	166.7	Lake Karapiro Boat Ramp	T15:436-570	Horahora domain
1131.328	202.2	Hamilton – Narrows	S14:168-710	boat ramp ⁶
1131.145 ^{*b}	210.8	Hamilton – Wellington St Bch	S14:117-757	at jetty, true right bank
1131.64 ^d	211.5	Hamilton – Traffic Bridge	S14:118-764	true right bank
1131.121 ^b	219.8	Hamilton – Sewer Bridge	S14:082-823	true left bank
1131.69	225.6	Horotiu Bridge	S14:048-871	d/s of bridge
1131.102 ^b	232.3	Ngaruawahia Bridge	S14:997-912	u/s of confluence ⁷
1131.77	246.5	Huntly – Tainui Bridge	S13:003-018	true left bank
1131.117 ^{*d}	262.3	Rangiriri Bridge	S13:989-167	true right bank
1131.91	286.3	Mercer Bridge	S12:919-336	–
1131.133	296.8	Tuakau Bridge	R12:828-320	boat ramp ⁸
1131.131 ^d	306.5	Tuakau – Elbows Landing	R12:745-352	NZ Steel Ltd pumping station

¹ approximate distance (in kilometres) from Lake Taupo's outlet.

² river boat jetty and boat ramp, true left bank, about 1.8km downstream of Huka Falls

³ boat ramp in recreation reserve immediately upstream from dam (true left bank).

⁴ boat ramp at Whakamaru Power Station.

⁵ river access d/s of Lake Waipapa, about 500 m off S.H. 32 along a gravel road (true left bank).

⁶ boat ramp accessed via Narrows Lane (true right bank)

⁷ road bridge upstream of Waipa River confluence.

⁸ immediately d/s of bridge, at Reserve (true right bank).

^b bathing season intensive microbiological survey locations only – survey conducted over the 2010/11 summer.

* Locations at **Taupo (Reids Farm, 1.1 km d/s from Taupo Gates)**, at **Hamilton (Wellington Street jetty)** and at **Rangiriri (Rangiriri Bridge)** are sampled and reported as part of the National River Water Quality Network undertaken by NIWA. Contact person: Graham Bryers, NIWA, Hamilton.

[†] Logistic considerations mean field measurements are often made at slightly different locations from sample collection (e.g. sampling from bridges).

[‡] Datasonde deployment sites.

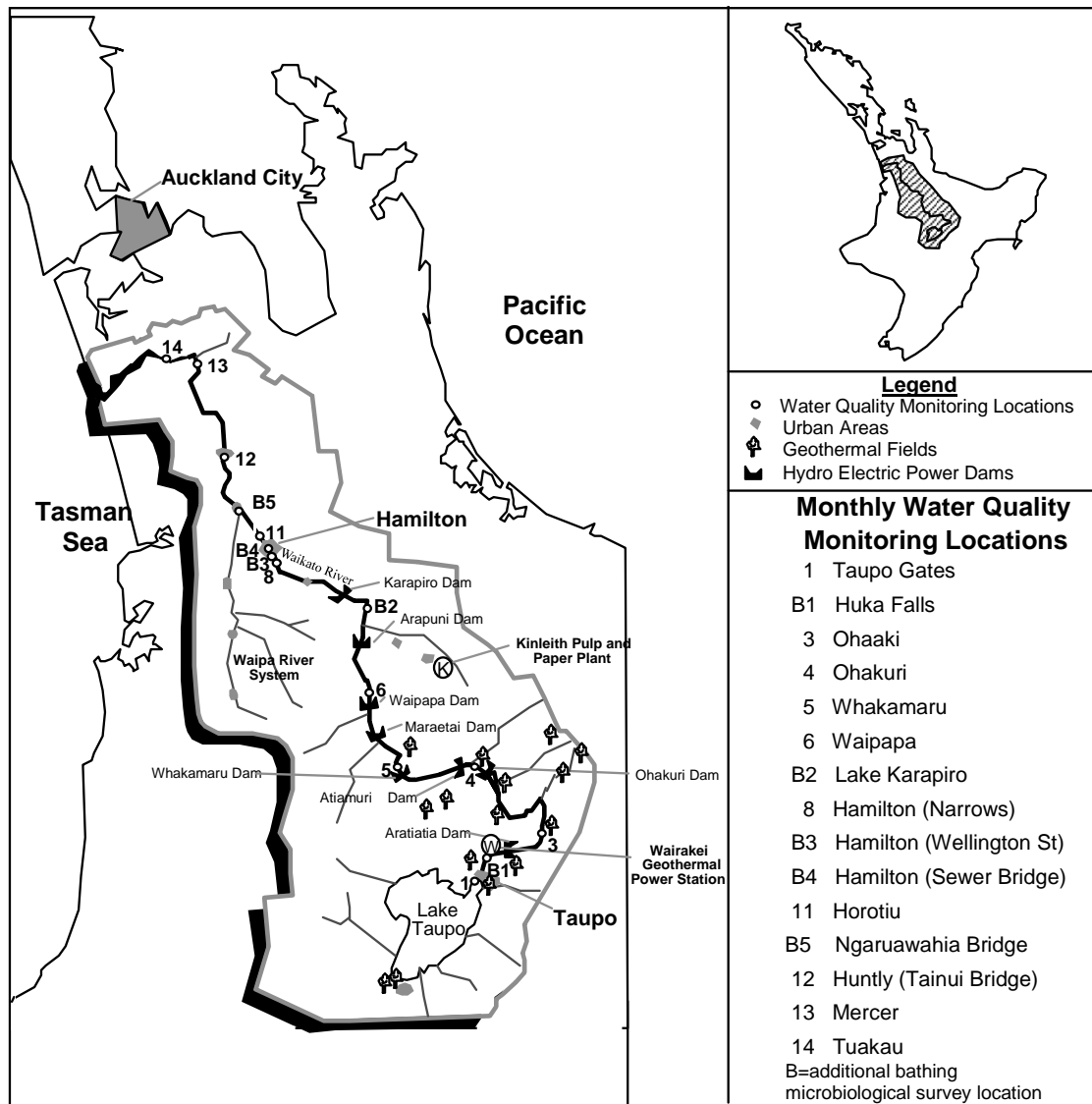


Figure 1: Waikato River water quality monitoring locations

Ten locations along the river are visited monthly (Taupo, Ohaaki, Ohakuri, Whakamaru, Waipapa, Hamilton-Narrows, Hamilton-Horotiu, Huntly, Mercer and Tuakau), and an additional four locations are included for the summer intensive microbiological survey (see Table 2, Figure 1). The major tributaries that enter the Waikato River are also monitored monthly as part of the Regional River Monitoring Programme (RERIMP) initiated in 1993 (Huser and Wilson, 1996b). Three locations (Taupo at Reids Farm, Hamilton at Wellington Street, and Rangiriri) are sampled by NIWA as part of the 'National River Water Quality Network' (Table 2).

2.3 Water quality parameters

Water quality of the Waikato River is assessed by measuring up to 40 parameters (27 routinely). Some parameters are measured in the field, but the majority of parameters are analysed in a laboratory using standard analytical methods. Details of field measurements and analytical methods used are appended (Appendix IV).

2.4 Quality control, data storage and analysis

Quality control measures are undertaken in accordance with Waikato Regional Council's ISO 9001:2008 standards including procedures for the collection, transport, 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 Waikato Regional Council's water quality archiving database (TimeStudio).

Data analysis was performed using Statistica (version 6.0) and DataDesk (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. $>x = x$).

2.5 Reports

Waikato Regional Council's State of the Environment Report summarises the state of the Waikato River, other rivers in the region, and common pressures (Environment Waikato, 1999).

Environment Waikato Technical Report 2008/33, Trends in River Water Quality in the Waikato Region, 1987–2007 (Vant, 2008) outlines the trends in the Waikato River and other rivers in the region. Copies are available in electronic format from the publications page of the Waikato Regional Council website:

<http://www.ew.govt.nz/Publications/Technical-Reports/>

The data contained in these Waikato River reports is updated to the Waikato Regional Council "Waikato River" Internet page:

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

The "How healthy are our rivers?" link provides details of the guidelines and standards used to assess the condition of the Waikato River and other rivers in the region. A link to water quality at other regional river monitoring sites is also available from this page.

3 Results

The results are divided up into 2 sections. Section 3.1 contains the results and statistical summaries of the routine analysis monitoring of the Waikato River. Section 3.2 reports the results and statistical summaries of the summer intensive microbiological survey. The raw data is included with each section, placed last.

3.1 Waikato River monitoring programme

Routine water quality monitoring

Summary statistics

Key parameter graphs

Comparison with water quality standards

Raw data

Absorbance of filtered sample at 340 nm (units: /cm)

Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.002	0.001	0.001	0.004	0.001	1.05	0.001
Ohaaki Bridge	12	0.003	0.004	0.001	0.006	0.001	-0.07	0.003
Ohakuri Tailrace Bridg	12	0.006	0.007	0.004	0.011	0.004	0.46	0.005
Whakamaru Tailrace	12	0.008	0.008	0.004	0.018	0.006	0.97	0.007
Waipapa Tailrace	12	0.010	0.010	0.007	0.014	0.003	0.73	0.010
Narrows	12	0.013	0.011	0.006	0.026	0.006	1.03	0.012
Horotiu Bridge	12	0.014	0.013	0.006	0.026	0.007	0.68	0.012
Huntly-Tainui Bridge	12	0.019	0.016	0.003	0.038	0.012	0.54	0.019
Mercer Bridge	12	0.028	0.025	0.011	0.050	0.028	0.19	0.022
Tuakau Bridge	12	0.030	0.023	0.011	0.057	0.037	0.30	0.027

Absorbance of filtered sample at 440 nm (units: /cm)

Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.001	0.001	0.001	0.002	0.000	<u>3.02</u>	0.001
Ohaaki Bridge	12	0.001	0.001	0.001	0.001	0.000	-1.00	0.001
Ohakuri Tailrace Bridg	12	0.001	0.001	0.001	0.002	0.000	<u>1.79</u>	0.001
Whakamaru Tailrace	12	0.002	0.001	0.001	0.003	0.001	0.79	0.001
Waipapa Tailrace	12	0.002	0.001	0.001	0.003	0.001	0.95	0.001
Narrows	12	0.002	0.002	0.001	0.004	0.002	0.55	0.002
Horotiu Bridge	12	0.003	0.003	0.001	0.004	0.001	-0.25	0.002
Huntly-Tainui Bridge	12	0.003	0.003	0.001	0.008	0.003	0.67	0.004
Mercer Bridge	12	0.005	0.005	0.001	0.010	0.005	0.15	0.004
Tuakau Bridge	12	0.005	0.004	0.001	0.010	0.006	0.16	0.005

Arsenic - Total (g/m³)

Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.011	0.011	0.009	0.012	0.001	-0.44	0.011
Ohaaki Bridge	12	0.028	0.026	0.020	0.038	0.012	0.47	0.027
Ohakuri Tailrace Bridg	12	0.032	0.031	0.024	0.040	0.008	0.18	0.035
Whakamaru Tailrace	12	0.030	0.031	0.024	0.037	0.006	0.00	0.032
Waipapa Tailrace	12	0.026	0.026	0.019	0.031	0.008	-0.24	0.028
Narrows	12	0.023	0.024	0.013	0.031	0.007	-0.06	0.025
Horotiu Bridge	12	0.023	0.022	0.015	0.031	0.009	0.13	0.024
Huntly-Tainui Bridge	12	0.017	0.018	0.008	0.027	0.013	-0.15	0.019
Mercer Bridge	12	0.016	0.017	0.007	0.026	0.012	-0.06	0.017
Tuakau Bridge	12	0.016	0.018	0.007	0.024	0.011	-0.22	0.017

Boron (g/m³)

Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.17	0.17	0.16	0.20	0.02	1.00	0.17
Ohaaki Bridge	12	0.35	0.31	0.26	0.55	0.12	1.10	0.30
Ohakuri Tailrace Bridg	12	0.34	0.35	0.25	0.44	0.06	0.04	0.34
Whakamaru Tailrace	12	0.34	0.35	0.25	0.40	0.04	-0.75	0.33
Waipapa Tailrace	12	0.30	0.30	0.21	0.36	0.06	-0.37	0.28
Narrows	12	0.26	0.26	0.19	0.37	0.06	0.58	0.26
Horotiu Bridge	12	0.26	0.26	0.20	0.32	0.06	-0.08	0.26
Huntly-Tainui Bridge	12	0.20	0.21	0.11	0.30	0.11	-0.04	0.20
Mercer Bridge	12	0.20	0.22	0.11	0.29	0.11	-0.17	0.20
Tuakau Bridge	12	0.20	0.21	0.12	0.29	0.09	-0.10	0.20

Skew = skewness. Underlined values = non-normal distribution. IQR = Inter Quartile Range

Black Disk (m)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	-	-	-	-	-	-	-	-
Ohaaki Bridge	11	3.4	3.1	2.0	5.2	1.2	0.57	4.3
Ohakuri Tailrace Bridg	11	2.1	1.8	1.3	3.3	1.0	0.53	2.4
Whakamaru Tailrace	10	1.8	1.7	1.2	2.7	0.7	0.56	1.9
Waipapa Tailrace	11	1.7	1.6	0.9	2.6	1.1	0.32	1.9
Narrows	12	1.3	1.3	0.3	2.1	0.7	-0.24	1.3
Horotiu Bridge	12	1.0	1.0	0.4	1.7	0.4	0.24	1.1
Huntly-Tainui Bridge	12	0.8	0.8	0.2	1.4	0.5	0.04	0.8
Mercer Bridge	-	-	-	-	-	-	-	-
Tuakau Bridge	12	0.6	0.5	0.1	1.0	0.4	-0.05	0.6

Biochemical Oxygen Demand - 5 day (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	1.0	1.1	0.2	2.0	0.6	0.31	0.5
Ohaaki Bridge	12	0.9	0.8	0.5	2.4	0.3	<u>2.37</u>	0.5
Ohakuri Tailrace Bridg	12	1.0	1.0	0.6	1.6	0.3	0.95	0.7
Whakamaru Tailrace	12	1.2	1.0	0.7	2.5	0.6	1.32	0.8
Waipapa Tailrace	12	0.9	0.8	0.6	1.6	0.3	1.20	0.8
Narrows	12	1.1	1.2	0.2	1.7	0.6	-0.59	0.9
Horotiu Bridge	12	1.1	1.1	0.5	1.8	0.8	0.08	0.8
Huntly-Tainui Bridge	12	1.1	1.1	0.5	1.5	0.6	-0.24	0.9
Mercer Bridge	12	1.4	1.1	0.6	4.1	1.0	<u>1.97</u>	1.2
Tuakau Bridge	12	1.3	1.2	0.7	2.4	0.5	1.03	1.2

Carbon - Dissolved Organic (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.85	0.78	0.70	1.30	0.24	1.37	0.80
Ohaaki Bridge	12	0.96	1.01	0.60	1.30	0.31	-0.23	0.90
Ohakuri Tailrace Bridg	12	1.09	1.05	0.70	1.80	0.36	0.74	0.99
Whakamaru Tailrace	12	1.36	1.14	0.90	2.30	0.60	1.03	1.10
Waipapa Tailrace	12	1.32	1.32	1.00	1.70	0.20	0.36	1.30
Narrows	12	1.56	1.37	1.20	2.30	0.55	0.88	1.30
Horotiu Bridge	12	1.65	1.45	0.95	2.70	0.65	0.71	1.50
Huntly-Tainui Bridge	12	2.11	1.90	1.21	3.90	0.70	1.34	1.90
Mercer Bridge	12	2.57	2.05	1.24	5.00	1.90	0.65	2.10
Tuakau Bridge	12	2.72	2.70	1.10	4.60	2.42	0.14	2.35

Carbon - Total Organic (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	1.13	1.05	0.92	1.40	0.25	0.52	1.00
Ohaaki Bridge	12	1.25	1.10	0.79	2.10	0.47	1.04	1.05
Ohakuri Tailrace Bridg	12	1.32	1.40	1.00	1.50	0.29	-0.59	1.30
Whakamaru Tailrace	12	1.60	1.55	1.10	2.40	0.55	0.51	1.45
Waipapa Tailrace	12	1.69	1.63	1.37	2.40	0.30	1.37	1.60
Narrows	12	2.01	1.80	1.70	3.30	0.35	<u>1.89</u>	1.90
Horotiu Bridge	12	2.28	2.05	1.80	3.30	0.65	1.03	2.10
Huntly-Tainui Bridge	12	2.77	2.40	1.91	4.30	1.45	0.67	2.80
Mercer Bridge	12	3.56	3.40	1.88	5.60	2.30	0.28	3.55
Tuakau Bridge	12	3.69	3.30	1.87	6.40	3.26	0.36	3.50

Skew = skewness. Underlined values = non-normal distribution. IQR = Inter Quartile Range

Chloride (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	8	8	8	9	0	-1.26	9
Ohaaki Bridge	12	20	19	15	32	6	1.22	17
Ohakuri Tailrace Bridg	12	22	22	16	28	4	0.09	21
Whakamaru Tailrace	10	22	22	20	25	3	0.58	21
Waipapa Tailrace	12	19	19	16	23	3	0.32	19
Narrows	12	18	19	15	21	3	-0.46	18
Horotiu Bridge	12	19	19	16	21	2	-0.31	18
Huntly-Tainui Bridge	12	17	17	13	21	5	0.16	17
Mercer Bridge	12	17	17	14	22	3	0.40	17
Tuakau Bridge	12	18	17	14	22	3	0.41	17

Chlorophyll a (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.002	0.002	0.002	0.002	0.000	1.00	0.002
Ohaaki Bridge	12	0.002	0.002	0.002	0.002	0.000	1.00	0.002
Ohakuri Tailrace Bridg	12	0.005	0.003	0.002	0.009	0.004	0.48	0.004
Whakamaru Tailrace	12	0.011	0.007	0.002	0.045	0.006	<u>2.17</u>	0.007
Waipapa Tailrace	12	0.007	0.004	0.002	0.025	0.004	<u>2.19</u>	0.004
Narrows	12	0.009	0.008	0.002	0.023	0.006	1.26	0.008
Horotiu Bridge	12	0.010	0.009	0.002	0.023	0.005	0.96	0.009
Huntly-Tainui Bridge	12	0.008	0.008	0.002	0.018	0.006	0.52	0.007
Mercer Bridge	12	0.014	0.014	0.006	0.029	0.007	1.20	0.013
Tuakau Bridge	12	0.014	0.015	0.003	0.028	0.008	0.36	0.014

Colour (Munsell Colour Units)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	-	-	-	-	-	-	-	-
Ohaaki Bridge	12	51.7	52.5	42.5	60.0	6.3	-0.22	50.0
Ohakuri Tailrace Bridg	12	40.6	40.0	32.5	52.5	11.3	0.37	40.0
Whakamaru Tailrace	11	38.0	40.0	30.0	42.5	5.0	-0.71	37.5
Waipapa Tailrace	12	38.3	37.5	35.0	45.0	3.8	0.79	35.0
Narrows	11	36.4	37.5	32.5	42.5	6.9	0.22	35.0
Horotiu Bridge	12	34.4	33.8	30.0	40.0	3.8	0.51	32.5
Huntly-Tainui Bridge	12	33.1	33.8	25.0	37.5	7.5	-0.52	32.5
Mercer Bridge	-	-	-	-	-	-	-	-
Tuakau Bridge	12	30.4	31.3	22.5	37.5	5.0	-0.29	30.0

Conductivity at 25 °C (ms/m)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	12.0	12.0	11.6	12.5	0.1	0.68	12.0
Ohaaki Bridge	12	16.2	15.5	14.2	19.6	3.2	0.75	15.2
Ohakuri Tailrace Bridg	12	17.5	17.1	15.1	20.9	2.1	0.55	17.7
Whakamaru Tailrace	12	17.2	17.5	14.8	18.5	1.4	-0.86	17.0
Waipapa Tailrace	12	16.6	16.5	13.9	18.5	1.9	-0.41	16.2
Narrows	12	16.0	16.2	13.6	17.8	1.6	-0.42	15.9
Horotiu Bridge	12	16.2	16.5	14.0	18.0	1.7	-0.14	16.0
Huntly-Tainui Bridge	12	15.1	15.7	12.6	17.5	2.6	-0.32	14.9

Skew = skewness. Underlined values = non-normal distribution. IQR = Inter Quartile Range

Dissolved Oxygen (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	9.7	9.8	8.7	10.6	0.7	-0.16	9.7
Ohaaki Bridge	12	9.8	9.6	8.2	12.0	1.5	0.49	9.6
Ohakuri Tailrace Bridg	12	9.7	9.5	8.2	11.9	1.8	0.50	9.5
Whakamaru Tailrace	12	10.2	10.2	8.3	12.2	1.8	0.04	10.0
Waipapa Tailrace	12	10.1	9.9	8.2	12.8	2.0	0.47	9.9
Narrows	12	9.9	9.9	8.1	12.3	2.1	0.44	9.8
Horotiu Bridge	12	10.0	9.7	8.4	12.4	2.1	0.53	9.7
Huntly-Tainui Bridge	12	9.8	9.9	8.1	11.5	1.4	0.00	9.3
Mercer Bridge	12	9.5	9.5	8.0	10.9	1.2	-0.13	9.3
Tuakau Bridge	12	9.6	9.5	8.0	12.2	0.7	1.19	9.5

Dissolved Oxygen (% Saturation)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	101.0	99.5	94.7	111.1	5.4	0.92	100.1
Ohaaki Bridge	12	102.9	102.0	93.6	117.6	10.2	0.65	101.9
Ohakuri Tailrace Bridg	12	102.8	100.6	91.9	117.9	12.9	0.52	100.7
Whakamaru Tailrace	12	106.8	106.0	93.2	125.1	17.6	0.26	103.1
Waipapa Tailrace	12	104.5	101.5	94.1	119.4	14.9	0.39	99.9
Narrows	12	100.9	96.3	90.3	121.2	16.7	0.84	96.4
Horotiu Bridge	12	101.2	97.6	92.9	118.2	11.4	0.92	96.6
Huntly-Tainui Bridge	12	99.4	98.6	89.1	117.6	10.2	0.80	96.1
Mercer Bridge	12	97.9	97.9	88.2	113.2	8.5	0.61	95.9
Tuakau Bridge	12	99.9	98.0	86.5	127.6	12.6	1.12	97.0

Enterococci (cfu/100 mL)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	37	2	1	310	12	<u>2.58</u>	1
Ohaaki Bridge	12	41	14	3	250	47	<u>2.45</u>	8
Ohakuri Tailrace Bridg	12	151	5	1	1700	17	<u>3.01</u>	2
Whakamaru Tailrace	12	15	9	1	50	26	0.94	8
Waipapa Tailrace	12	27	6	1	200	27	<u>2.76</u>	5
Narrows	12	399	40	7	1800	709	1.31	25
Horotiu Bridge	12	356	120	8	3100	151	<u>2.97</u>	70
Huntly-Tainui Bridge	12	315	73	13	2600	148	<u>2.88</u>	59
Mercer Bridge	12	197	28	7	1600	47	<u>2.65</u>	31
Tuakau Bridge	12	212	28	6	1900	38	<u>2.84</u>	28

Escherichia coli (cfu/100 mL)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	3	2	1	8	4	0.98	1
Ohaaki Bridge	12	36	13	3	110	63	0.90	12
Ohakuri Tailrace Bridg	12	8	3	1	36	5	<u>1.79</u>	3
Whakamaru Tailrace	12	14	7	3	60	11	<u>1.74</u>	6
Waipapa Tailrace	12	47	13	2	280	41	<u>2.25</u>	8
Narrows	12	221	55	15	1700	109	<u>2.83</u>	40
Horotiu Bridge	12	249	150	33	1100	240	<u>2.18</u>	140
Huntly-Tainui Bridge	12	339	110	20	2100	290	<u>2.64</u>	130
Mercer Bridge	12	219	75	30	1200	220	<u>2.30</u>	105
Tuakau Bridge	12	261	70	30	1800	110	<u>2.64</u>	85

Skew = skewness. Underlined values = non-normal distribution. IQR = Inter Quartile Range

Faecal Coliforms (cfu/100 mL)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	3	2	1	9	5	0.97	2
Ohaaki Bridge	12	39	14	3	130	60	1.07	16
Ohakuri Tailrace Bridg	12	10	4	1	50	6	<u>1.83</u>	4
Whakamaru Tailrace	12	16	7	3	60	11	1.64	6
Waipapa Tailrace	12	53	15	3	280	41	<u>1.84</u>	9
Narrows	12	418	66	16	2300	225	<u>1.85</u>	50
Horotiu Bridge	12	266	165	33	1100	250	<u>1.99</u>	175
Huntly-Tainui Bridge	12	373	160	20	2100	365	<u>2.47</u>	135
Mercer Bridge	12	240	90	30	1200	228	<u>2.15</u>	160
Tuakau Bridge	12	311	85	40	2100	90	<u>2.55</u>	115

Lithium (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.040	0.039	0.036	0.045	0.003	0.67	0.040
Ohaaki Bridge	12	0.102	0.091	0.073	0.152	0.039	0.85	0.090
Ohakuri Tailrace Bridg	12	0.118	0.117	0.076	0.155	0.029	-0.17	0.120
Whakamaru Tailrace	12	0.117	0.124	0.078	0.134	0.014	-1.37	0.120
Waipapa Tailrace	12	0.100	0.098	0.068	0.121	0.019	-0.44	0.100
Narrows	12	0.092	0.092	0.067	0.131	0.021	0.54	0.091
Horotiu Bridge	12	0.091	0.093	0.067	0.118	0.022	-0.03	0.092
Huntly-Tainui Bridge	12	0.067	0.074	0.039	0.091	0.040	-0.29	0.068
Mercer Bridge	12	0.065	0.068	0.035	0.089	0.035	-0.23	0.064
Tuakau Bridge	12	0.065	0.067	0.039	0.091	0.030	-0.22	0.064

Nitrate/Nitrite Nitrogen (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.006	0.002	0.001	0.054	0.002	<u>3.00</u>	0.001
Ohaaki Bridge	12	0.038	0.032	0.013	0.076	0.026	0.55	0.034
Ohakuri Tailrace Bridg	12	0.090	0.089	0.005	0.220	0.098	0.55	0.085
Whakamaru Tailrace	12	0.107	0.089	0.008	0.260	0.164	0.35	0.086
Waipapa Tailrace	12	0.176	0.153	0.080	0.320	0.130	0.56	0.155
Narrows	12	0.301	0.190	0.105	0.860	0.279	1.30	0.210
Horotiu Bridge	12	0.300	0.240	0.150	0.550	0.252	0.50	0.239
Huntly-Tainui Bridge	12	0.488	0.315	0.200	0.990	0.540	0.49	0.355
Mercer Bridge	12	0.470	0.330	0.150	0.910	0.605	0.44	0.355
Tuakau Bridge	12	0.460	0.310	0.133	0.950	0.666	0.46	0.340

Nitrogen - Ammoniacal (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.01	0.01	0.01	0.02	0.00	<u>3.02</u>	0.005
Ohaaki Bridge	12	0.01	0.01	0.01	0.05	0.01	<u>1.94</u>	0.005
Ohakuri Tailrace Bridg	12	0.01	0.01	0.01	0.02	0.00	<u>1.87</u>	0.005
Whakamaru Tailrace	12	0.01	0.01	0.01	0.01	0.00	1.00	0.005
Waipapa Tailrace	12	0.02	0.01	0.01	0.04	0.02	0.56	0.012
Narrows	12	0.02	0.02	0.01	0.04	0.01	0.60	0.017
Horotiu Bridge	12	0.01	0.01	0.01	0.03	0.01	0.16	0.012
Huntly-Tainui Bridge	12	0.01	0.01	0.01	0.03	0.01	0.96	0.012
Mercer Bridge	12	0.01	0.01	0.01	0.02	0.00	1.62	0.005
Tuakau Bridge	12	0.01	0.01	0.01	0.02	0.00	1.50	0.005

Skew = skewness. Underlined values = non-normal distribution. IQR = Inter Quartile Range

Nitrogen - Total Kjeldahl (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.11	0.08	0.03	0.52	0.04	<u>2.73</u>	0.08
Ohaaki Bridge	12	0.11	0.08	0.06	0.27	0.01	<u>1.77</u>	0.09
Ohakuri Tailrace Bridg	12	0.12	0.11	0.06	0.20	0.06	0.48	0.13
Whakamaru Tailrace	12	0.20	0.15	0.10	0.85	0.06	<u>2.87</u>	0.16
Waipapa Tailrace	12	0.14	0.14	0.10	0.21	0.07	0.43	0.16
Narrows	12	0.20	0.19	0.12	0.32	0.09	0.48	0.21
Horotiu Bridge	12	0.21	0.20	0.14	0.28	0.06	0.51	0.21
Huntly-Tainui Bridge	12	0.27	0.24	0.17	0.45	0.11	0.98	0.27
Mercer Bridge	12	0.39	0.32	0.19	1.12	0.18	<u>2.30</u>	0.34
Tuakau Bridge	12	0.35	0.35	0.16	0.54	0.24	0.01	0.35

Nitrogen - Total (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.12	0.08	0.03	0.57	0.04	<u>2.77</u>	0.08
Ohaaki Bridge	12	0.14	0.11	0.07	0.35	0.04	<u>1.68</u>	0.12
Ohakuri Tailrace Bridg	12	0.21	0.20	0.11	0.37	0.12	0.52	0.21
Whakamaru Tailrace	12	0.31	0.25	0.18	0.86	0.12	<u>2.27</u>	0.27
Waipapa Tailrace	12	0.32	0.31	0.19	0.48	0.07	0.52	0.32
Narrows	12	0.50	0.38	0.29	1.18	0.28	1.51	0.43
Horotiu Bridge	12	0.51	0.43	0.35	0.83	0.27	0.77	0.45
Huntly-Tainui Bridge	12	0.76	0.55	0.40	1.44	0.63	0.64	0.66
Mercer Bridge	12	0.86	0.64	0.36	2.01	0.75	1.05	0.72
Tuakau Bridge	12	0.81	0.58	0.32	1.42	0.83	0.45	0.67

pH (pH Units)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	7.5	7.5	7.0	7.8	0.4	-0.35	7.6
Ohaaki Bridge	12	7.2	7.3	6.8	7.5	0.3	-0.73	7.3
Ohakuri Tailrace Bridg	12	7.2	7.3	6.9	7.4	0.3	-0.73	7.3
Whakamaru Tailrace	12	7.4	7.5	7.1	7.7	0.4	-0.08	7.5
Waipapa Tailrace	12	7.3	7.3	7.2	7.4	0.2	0.00	7.4
Narrows	12	7.4	7.4	6.8	7.8	0.4	-0.57	7.5
Horotiu Bridge	12	7.4	7.5	7.2	7.8	0.3	0.34	7.5
Huntly-Tainui Bridge	12	7.4	7.5	7.1	7.7	0.4	-0.08	7.5
Mercer Bridge	12	7.4	7.4	7.0	7.7	0.3	-0.01	7.5
Tuakau Bridge	12	7.4	7.4	7.0	7.8	0.5	0.09	7.5

Phosphorus - Dissolved Reactive (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.002	0.002	0.002	0.004	0.000	<u>3.02</u>	0.002
Ohaaki Bridge	12	0.008	0.008	0.002	0.013	0.003	0.22	0.006
Ohakuri Tailrace Bridg	12	0.009	0.008	0.002	0.017	0.004	0.48	0.008
Whakamaru Tailrace	12	0.009	0.008	0.002	0.015	0.006	-0.01	0.007
Waipapa Tailrace	12	0.015	0.016	0.002	0.027	0.007	-0.30	0.015
Narrows	12	0.016	0.017	0.002	0.030	0.010	-0.07	0.015
Horotiu Bridge	12	0.023	0.023	0.006	0.039	0.010	-0.05	0.024
Huntly-Tainui Bridge	12	0.023	0.024	0.007	0.037	0.008	-0.27	0.024
Mercer Bridge	12	0.019	0.019	0.002	0.045	0.011	0.67	0.020
Tuakau Bridge	12	0.018	0.018	0.004	0.030	0.005	-0.34	0.017

Skew = skewness. Underlined values = non-normal distribution. IQR = Inter Quartile Range

Phosphorus - Total (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.004	0.004	0.002	0.011	0.004	1.29	0.005
Ohaaki Bridge	12	0.014	0.015	0.010	0.022	0.006	0.47	0.016
Ohakuri Tailrace Bridg	12	0.024	0.023	0.013	0.038	0.012	0.39	0.026
Whakamaru Tailrace	12	0.028	0.024	0.015	0.062	0.011	1.81	0.028
Waipapa Tailrace	12	0.032	0.030	0.021	0.052	0.015	0.82	0.034
Narrows	12	0.037	0.034	0.024	0.069	0.010	1.48	0.042
Horotiu Bridge	12	0.046	0.045	0.026	0.079	0.014	0.77	0.052
Huntly-Tainui Bridge	12	0.063	0.055	0.048	0.105	0.017	1.38	0.063
Mercer Bridge	12	0.073	0.065	0.054	0.122	0.028	1.17	0.070
Tuakau Bridge	12	0.067	0.064	0.048	0.098	0.030	0.54	0.069

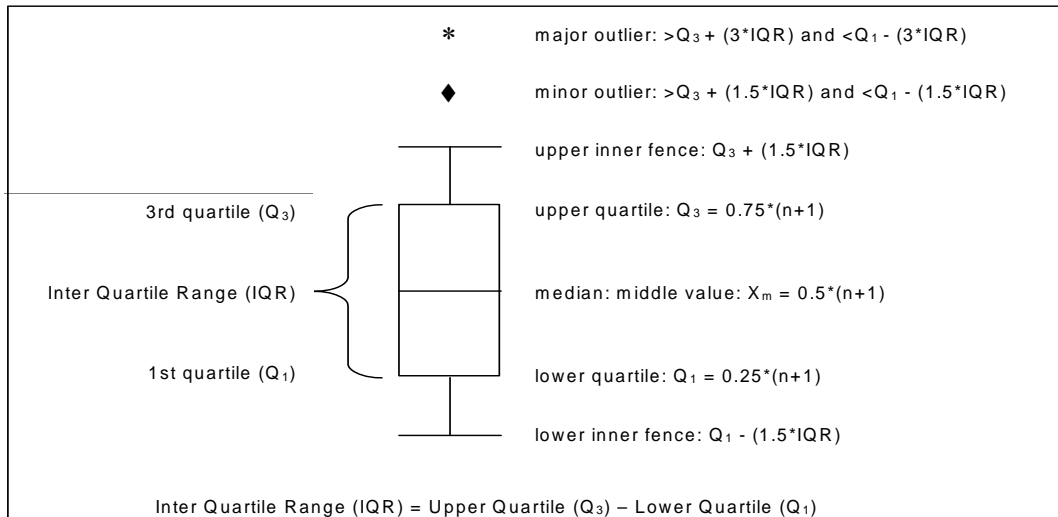
Temperature (°C)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	15.4	14.7	11.3	19.8	6.3	0.19	14.7
Ohaaki Bridge	12	16.3	15.4	12.1	21.7	6.5	0.43	15.9
Ohakuri Tailrace Bridg	12	17.0	16.7	12.3	22.4	8.3	0.18	16.5
Whakamaru Tailrace	12	17.1	16.9	11.8	21.9	7.1	0.06	16.5
Waipapa Tailrace	12	16.8	16.4	11.6	22.2	6.7	0.11	16.1
Narrows	12	16.7	16.2	11.4	22.2	6.9	0.13	16.2
Horotiu Bridge	12	16.4	15.8	11.5	21.9	6.7	0.20	15.8
Huntly-Tainui Bridge	12	16.5	16.1	11.5	22.1	7.9	0.13	15.6
Mercer Bridge	12	17.2	17.0	11.9	22.8	8.5	0.13	16.5
Tuakau Bridge	12	17.5	17.0	11.8	22.9	8.4	0.07	16.9

Dissolved Solids - Total (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	90	88	73	109	8	0.40	87
Ohaaki Bridge	12	116	113	93	146	30	0.45	110
Ohakuri Tailrace Bridg	12	130	131	111	145	21	-0.24	130
Whakamaru Tailrace	12	128	126	108	147	17	0.08	130
Waipapa Tailrace	12	127	130	105	152	18	0.11	126
Narrows	12	121	121	102	155	14	0.83	121
Horotiu Bridge	12	126	127	97	153	19	-0.07	122
Huntly-Tainui Bridge	12	123	119	94	188	17	1.64	120
Mercer Bridge	12	120	118	102	152	16	0.90	120
Tuakau Bridge	12	120	120	103	152	16	0.94	120

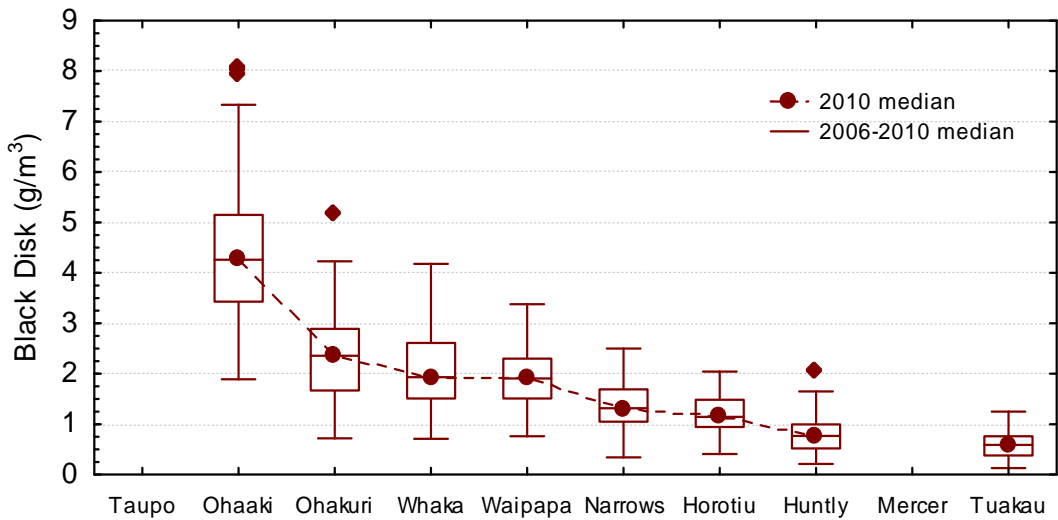
Turbidity (NTU)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.5	0.5	0.2	1.3	0.3	1.68	0.4
Ohaaki Bridge	12	1.4	0.7	0.4	8.1	0.5	2.90	0.6
Ohakuri Tailrace Bridg	12	1.4	1.1	0.7	2.7	0.6	1.24	1.0
Whakamaru Tailrace	12	1.7	1.1	0.7	4.3	1.4	1.30	1.2
Waipapa Tailrace	12	1.5	1.3	0.7	2.4	0.7	0.60	1.3
Narrows	12	3.7	2.4	1.7	16.3	1.6	2.76	2.3
Horotiu Bridge	12	3.7	3.1	2.0	8.6	2.0	1.40	2.7
Huntly-Tainui Bridge	12	9.8	6.9	2.6	30	6.5	1.53	6.1
Mercer Bridge	12	14.9	10.1	5.2	52	9.0	2.01	9.0
Tuakau Bridge	12	12.4	8.2	3.5	36.0	8.4	1.42	8.8

Skew = skewness. Underlined values = non-normal distribution. IQR = Inter Quartile Range

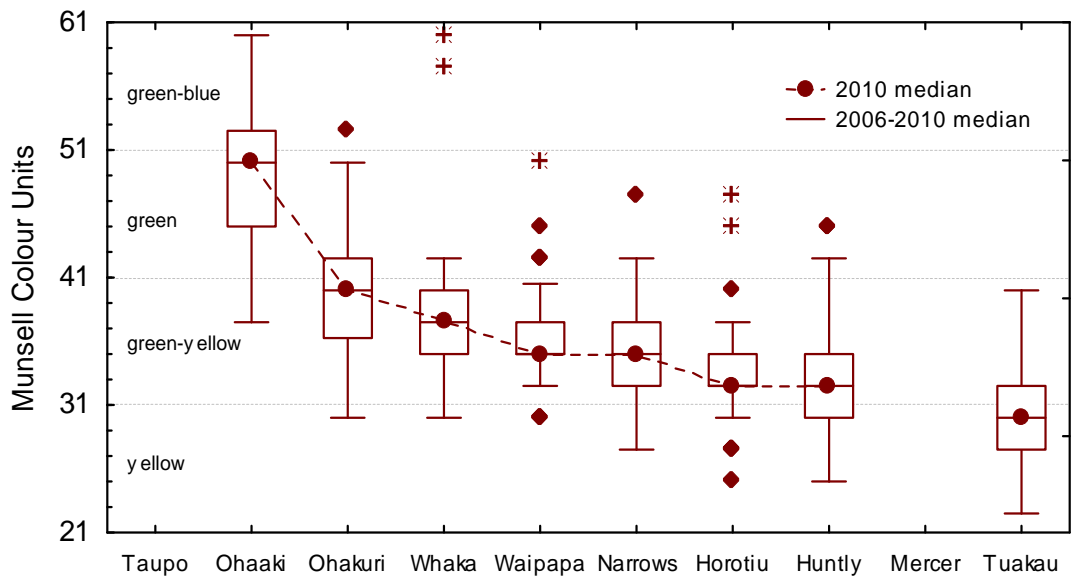
Boxplots are used to present data



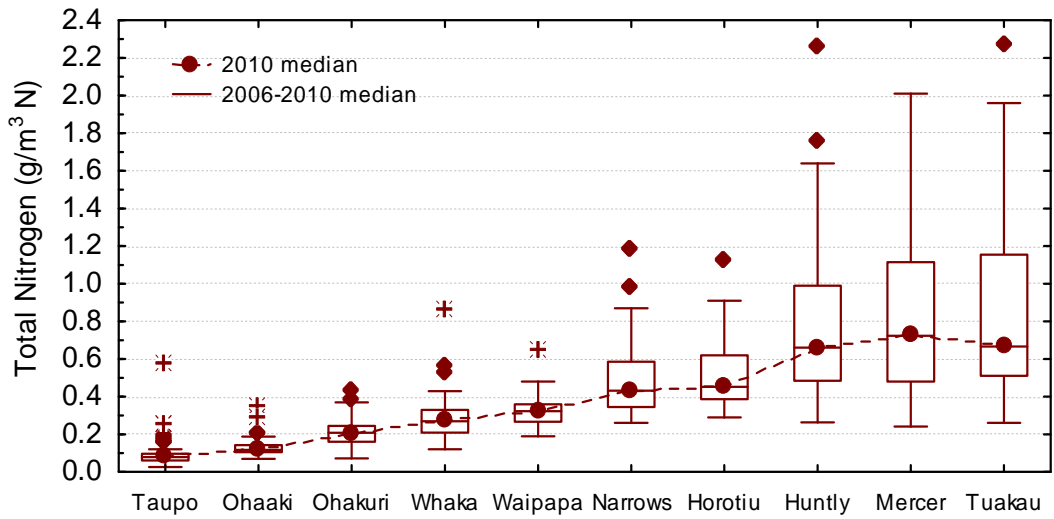
Black Disk, 2006-2010 Data



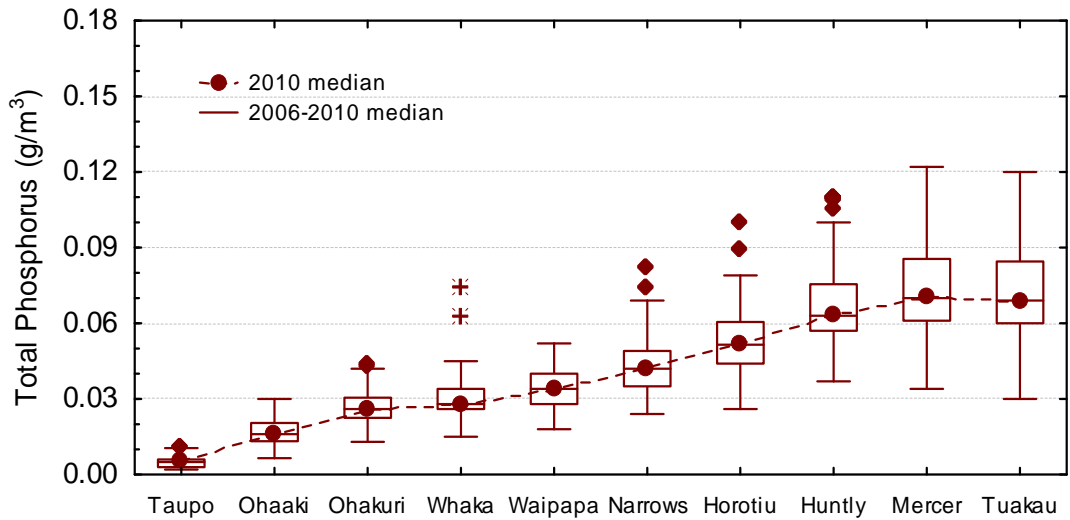
Colour, 2006-2010 Data



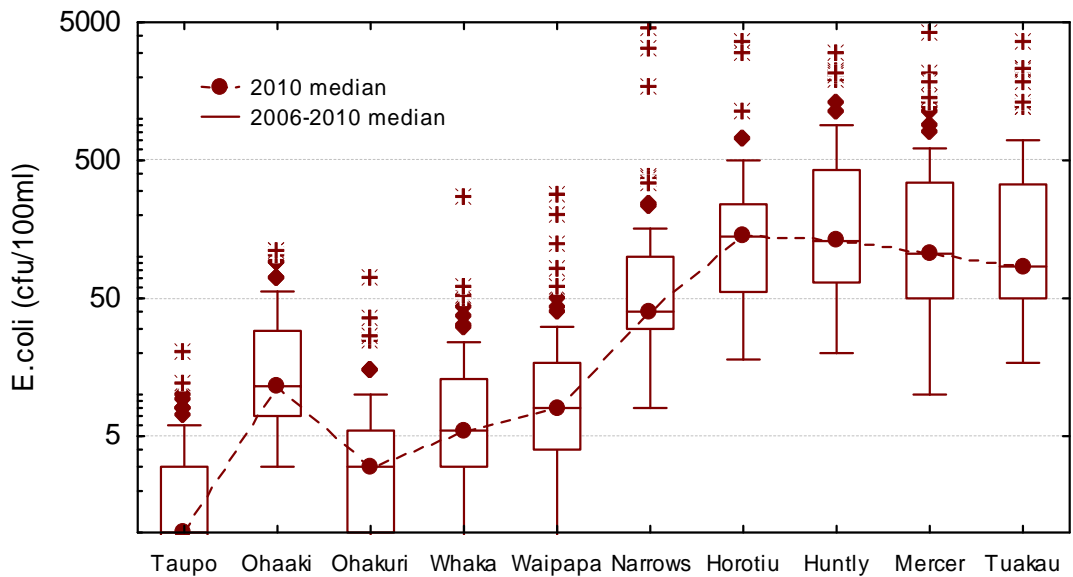
Total Nitrogen, 2006-2010 Data



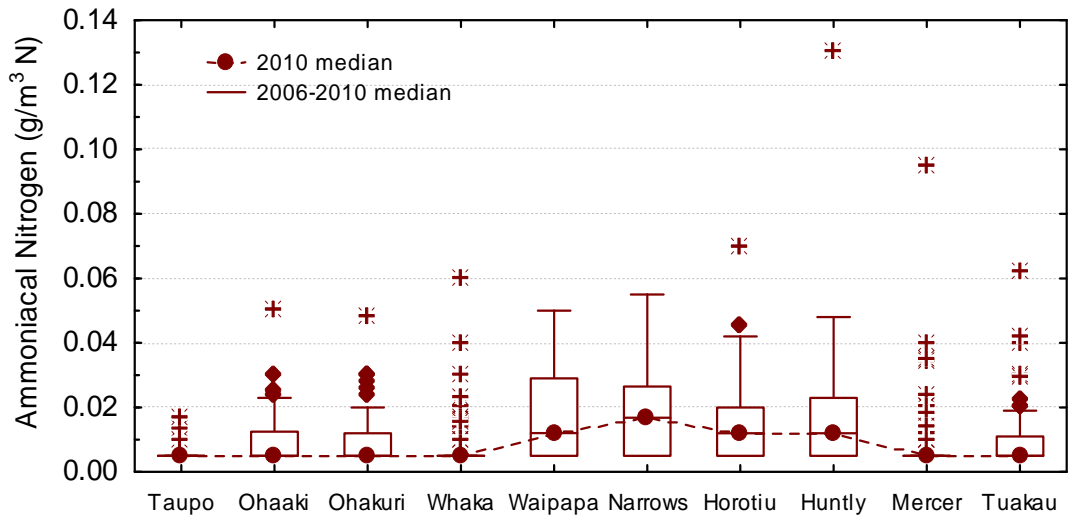
Total Phosphorus, 2006-2010 Data



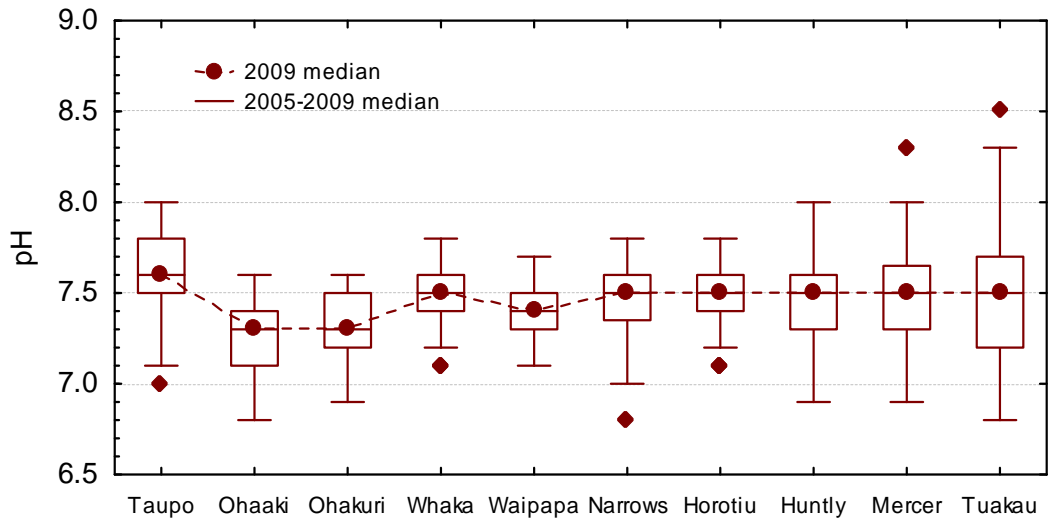
E.coli, 2006-2010 Data



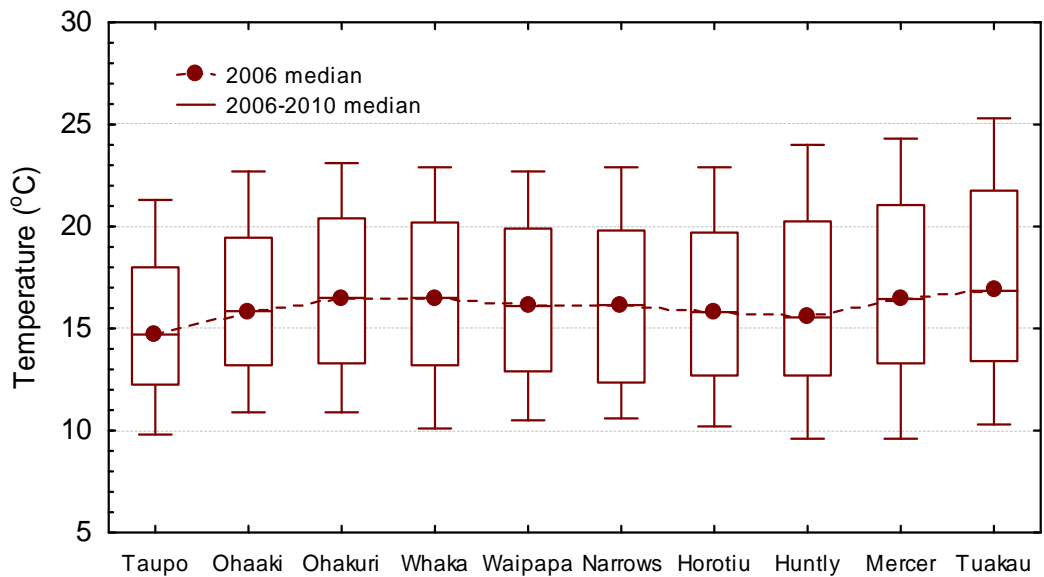
Ammoniacal Nitrogen, 2006-2010 Data



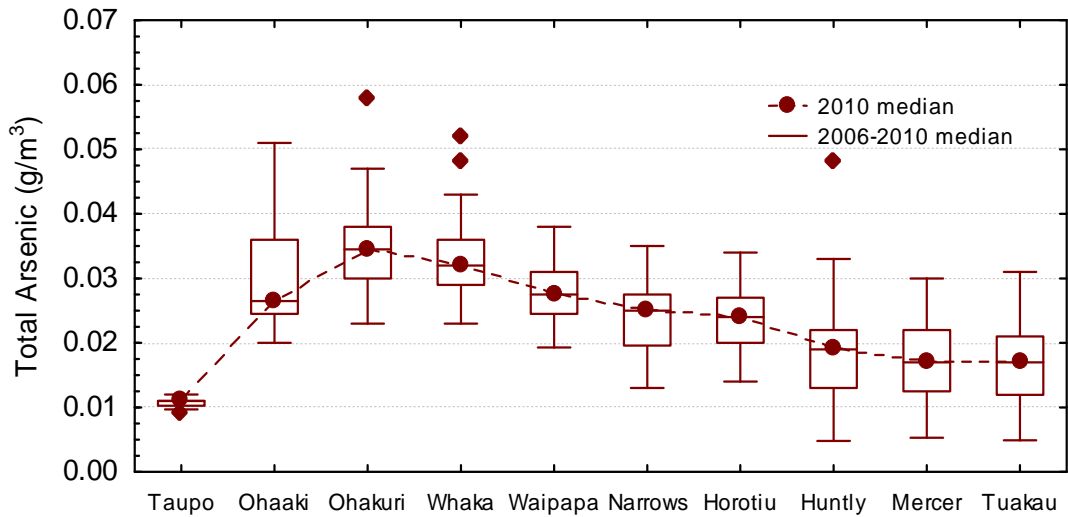
pH, 2006-2010 Data



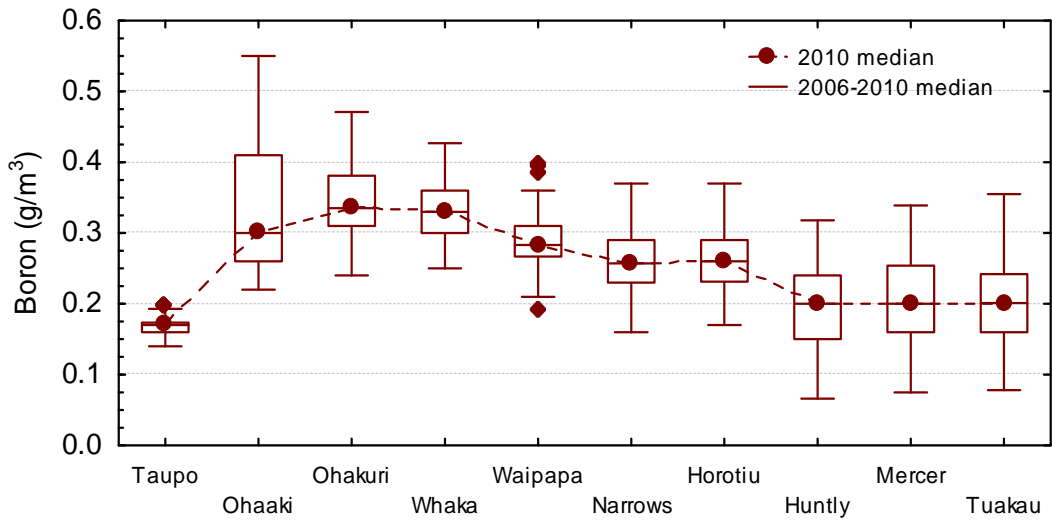
Temperature, 2006-2010 Data



Total Arsenic, 2006-2010 Data



Boron, 2009-2010 Data



Dissolved Oxygen, 2006-2010 Data

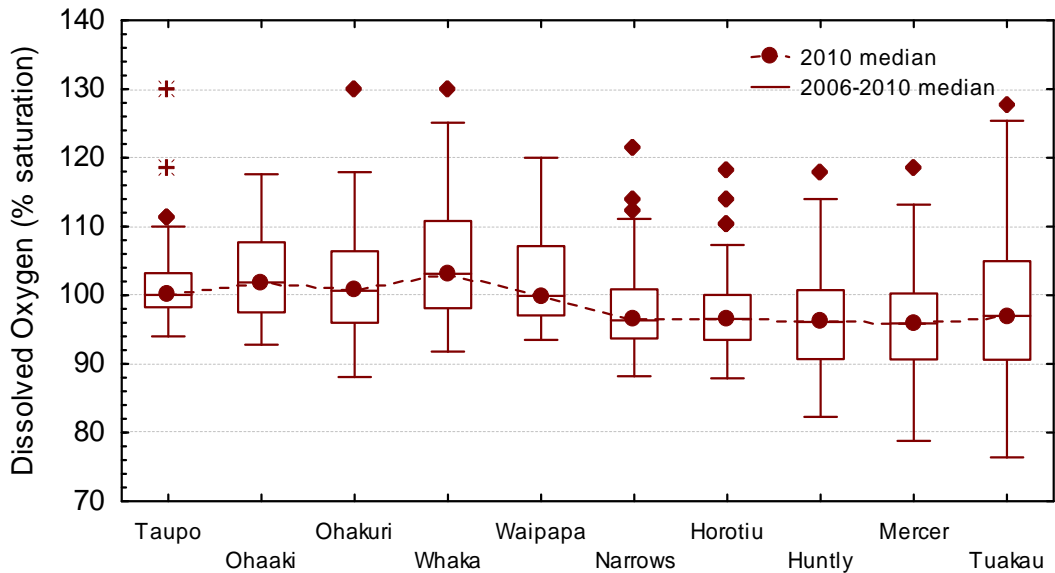


Table 3: Samples (year 2010) complying with the ‘satisfactory’ water quality guidelines and standards. n = 12 (except * where n = 11).

Location	ECOLOGICAL HEALTH							HUMAN USES					
								Recreation			water supply	drinking water	
	DO	pH	Turb	NH ₄ N	Temp	TP	TN	Bk ¹ Disk	E coli	Median E coli	CHLa	As	B
Taupo Gates	12	12	12	12	9	12	11	-	12	Y	12	1	12
Ohaaki Bridge	12	12	11	12	4	12	12	9/9*	12	Y	12	0	5
Ohakuri Tailrace Br	12	12	12	12	3	12	12	5/9	12	Y	12	0	2
Whakamaru Tailrace	12	12	12	12	4	11	11	5/10	12	Y	10	0	2
Waipapa Tailrace	12	12	12	12	4	9	12	4/7*	12	Y	11	0	6
Hamilton – Narrows	12	12	11	12	4	9	8	2/9	11	Y	11	0	11
Horotiu Bridge	12	12	10	12	6	3	7	1/10	11	N	11	0	9
Huntly – Tainui Br	12	12	5	12	5	0	5	0/11	11	Y	12	3	11
Mercer Bridge	12	12	0	12	4	0	3	-	11	Y	11	4	12
Tuakau Bridge	12	12	2	12	4	0	2	-	10	Y	11	4	12

¹ samples complying with the baseflow water clarity guideline from the number of samples measured when flow was below the upper decile of all flows

Table 4: Samples (year 2010) complying with the ‘excellent’ water quality guidelines and standards. n = 12 (except * where n = 11).

Location	ECOLOGICAL HEALTH							HUMAN USES					
								Recreation			water supply	Drinking water	
	DO	pH	Turb	NH ₄ N	Temp	TP	TN	Bk ¹ Disk	E coli	Median E coli	CHLa	As	B
Taupo Gates	12	12	12	12	1	11	8	-	12	Y	12	n/a	n/a
Ohaaki Bridge	12	11	11	12	2	0	2	1/9*	8	Y	12	n/a	n/a
Ohakuri Tailrace Br	12	11	10	12	1	0	0	0/7	12	Y	7	n/a	n/a
Whakamaru Tailrace	12	12	8	12	1	0	0	0/9	11	Y	2	n/a	n/a
Waipapa Tailrace	12	12	10	12	1	0	0	0/7*	9	Y	7	n/a	n/a
Hamilton – Narrows	12	11	4	12	1	0	0	0/9	6	N	1	n/a	n/a
Horotiu Bridge	12	12	1	12	2	0	0	0/10	2	N	2	n/a	n/a
Huntly – Tainui Br	11	12	0	12	1	0	0	0/11	2	N	3	n/a	n/a
Mercer Bridge	10	12	0	12	1	0	0	-	3	N	0	n/a	n/a
Tuakau Bridge	10	12	0	12	1	0	0	-	4	N	1	n/a	n/a

¹ samples complying with the baseflow water clarity guideline from the number of samples measured when flow was below the upper decile of all flows

DATE	TIME*	FLOW	BDISK	COLOR	COND	pH	TEMP	DO	PCDO	BOD5	TURB	TDS	NNN	NO3-N	NH4-N
dd/mm/yy	hh:mm	m ³ /s	m	units	mS/m	units	°C	g/m ³	%Sat	g/m ³	NTU	g/m ³	g/m ³	g/m ³	g/m ³
Satisfactory Water		>1.6	-	-	6.5-9	<12 (May-Sep)	>80	-	<5	-	-	-	-	-	<0.88
Quality Guideline/Standard						<20 (Oct-Apr)									

1131-127 UD = 263 m³/s (Flows from "Reids Farm")

Waikato River at Taupo Control Gates

04/01/10	8:15 a.m.	175	-	-	12.0	7.6	18.6	9.4	104.7	1.1	0.29	85	0.002	<0.002	<0.01
02/02/10	8:45 a.m.	209	-	-	11.8	7.6	19.7	8.7	98.4	<0.4	0.50	87	0.002	<0.002	<0.01
05/03/10	8:40 a.m.	209	-	-	11.6	7.0	19.8	9.1	103.8	1.1	0.21	86	0.003	<0.002	<0.01
08/04/10	9:40 a.m.	217	-	-	11.9	7.8	16.6	9.5	100.5	0.7	1.30	97	0.003	0.003	<0.01
04/05/10	9:40 a.m.	105	-	-	12.0	7.3	<u>15.9</u>	9.4	98.3	1.2	0.65	109	0.003	0.003	<0.01
01/06/10	9:30 a.m.	73	-	-	12.0	7.7	<u>12.8</u>	10.3	101.9	0.7	0.36	73	0.002	<0.002	<0.01
06/07/10	10:05 a.m.	256	-	-	12.2	7.4	<u>13.3</u>	9.8	98.5	1.2	0.46	86	0.003	<0.002	<0.01
04/08/10	9:10 a.m.	55	-	-	12.0	7.2	11.5	9.8	94.7	1.3	0.70	92	0.002	<0.002	<0.01
14/09/10	9:20 a.m.	308	-	-	12.0	7.5	11.3	10.3	98.2	1.3	0.55	89	0.003	0.003	<0.01
05/10/10	9:05 a.m.	313	-	-	12.5	7.5	12.8	10.6	103.4	2.0	0.42	93	0.054	0.054	0.02
02/11/10	8:40 a.m.	295	-	-	11.9	7.3	13.5	9.9	97.9	0.7	0.38	94	0.002	<0.002	<0.01
01/12/10	8:45 a.m.	197	-	-	12.0	7.8	19.5	9.8	111.1	0.5	0.60	86	0.002	0.002	<0.01

1131-105 UD = 274 m³/s (Flows from Ohaaki Bridge Recorder, +/- 20%)

Waikato River at Ohaaki Br

04/01/10	8:45 a.m.	75	4.0	42.5	14.8	7.4	19.2	9.2	103.1	0.9	0.55	98	0.013	0.013	<0.01
02/02/10	9:20 a.m.	89	2.7	52.5	18.6	7.2	<u>21.7</u>	8.2	95.0	0.5	0.69	140	0.032	0.030	<0.01
05/03/10	9:30 a.m.	165	5.2	45.0	15.9	6.8	<u>20.8</u>	8.5	98.2	1.0	0.44	110	0.031	0.028	<0.01
08/04/10	10:15 a.m.	132	3.9	60.0	15.1	7.5	16.6	9.6	100.9	0.8	0.52	116	0.031	0.031	<0.01
04/05/10	10:30 a.m.	94	3.8	55.0	17.1	7.1	<u>15.8</u>	9.6	99.1	0.9	0.90	141	0.046	0.043	<0.01
01/06/10	10:15 a.m.	75	2.6	52.5	19.2	7.3	<u>15.0</u>	9.4	96.8	0.8	0.55	122	0.061	0.061	0.02
06/07/10	10:45 a.m.	253		47.5	14.6	7.2	<u>12.5</u>	11.3	111.4	0.9	1.58	96	0.025	0.025	0.02
04/08/10	9:45 a.m.	68	2.0	50.0	19.6	7.1	<u>13.8</u>	9.3	93.6	0.5	0.93	146	0.076	0.076	0.05
14/09/10	10:10 a.m.	338	(3.0)	57.5	14.2	7.3	<u>12.1</u>	10.7	103.3	0.9	1.16	93	0.015	0.014	<0.01
05/10/10	10:00 a.m.	319	(3.1)	52.5	14.6	7.3	13.4	12.0	117.6	2.4	<u>8.10</u>	104	0.054	0.053	0.02
02/11/10	9:20 a.m.	193	2.9	50.0	15.2	7.1	13.6	10.7	105.0	0.8	0.70	119	0.046	0.046	<0.01
01/12/10	9:50 a.m.	202	3.6	55.0	15.8	7.4	<u>21.4</u>	9.5	110.4	0.5	0.62	106	0.023	0.022	<0.01

1131-107 UD = 319 m³/s (Flows from Ohakuri Dam - Total)

Waikato River at Ohakuri Tailrace Br

04/01/10	9:28 a.m.	203	2.5	32.5	18.3	7.4	<u>21.4</u>	8.9	103.2	0.9	1.00	120	0.005	0.005	<0.01
02/02/10	10:15 a.m.	393	<u>(1.5)</u>	35.0	16.7	7.4	<u>22.4</u>	8.2	96.9	0.7	0.98	140	0.038	0.036	<0.01
05/03/10	10:10 a.m.	303	3.3	35.0	15.9	6.9	<u>21.6</u>	8.4	98.2	1.0	0.73	120	0.020	0.018	<0.01
08/04/10	11:00 a.m.	184	<u>1.3</u>	40.0	18.5	7.4	17.9	9.1	96.9	1.6	2.40	142	0.049	0.048	0.02
04/05/10	11:30 a.m.	195	2.3	40.0	19.3	7.2	<u>17.4</u>	8.6	91.9	0.8	1.28	143	0.086	0.077	<0.01
01/06/10	11:10 a.m.	198	<u>1.5</u>	47.5	20.9	7.3	<u>14.5</u>	9.1	92.8	0.7	1.06	145	0.220	0.220	0.02
06/07/10	11:55 a.m.	428		45.0	17.0	7.2	<u>12.3</u>	10.9	106.5	0.9	1.10	137	0.161	0.159	<0.01
04/08/10	10:30 a.m.	198	2.9	32.5	17.1	7.1	<u>12.5</u>	11.9	114.5	0.6	0.99	124	0.115	0.115	<0.01
14/09/10	10:55 a.m.	425	(2.4)	50.0	15.8	7.3	<u>12.8</u>	10.1	99.0	1.1	1.80	111	0.157	0.153	<0.01
05/10/10	10:45 a.m.	383	(1.8)	52.5	15.1	7.2	13.7	11.6	113.0	1.0	0.98	111	0.092	0.092	<0.01
02/11/10	10:00 a.m.	319	<u>(1.6)</u>	35.0	16.7	7.1	15.9	9.9	102.2	1.0	1.34	135	0.097	0.096	<0.01
01/12/10	10:46 a.m.	298	1.8	42.5	18.3	7.4	<u>21.6</u>	10.1	117.9	1.5	2.70	126	0.038	0.037	<0.01

1131-147 UD = 305 m³/s (Flows from Whakamaru Dam - Total)

Waikato River at Whakamaru Tailrace

04/01/10	10:12 a.m.	277	2.3	30.0	18.1	7.7	<u>21.3</u>	10.0	115.8	2.4	1.30	120	0.019	0.019	<0.01
02/02/10	11:00 a.m.	240	<u>1.2</u>	35.0	17.1	7.5	<u>21.9</u>	8.3	96.6	1.2	3.00	140	0.027	0.027	<0.01
05/03/10	10:55 a.m.	265	2.7	32.5	15.4	7.1	<u>21.8</u>	8.7	101.5	1.1	1.00	120	0.008	0.008	<0.01
08/04/10	11:40 a.m.	139	<u>1.4</u>	40.0	18.2	7.6	18.1	9.6	102.1	1.1	0.90	136	0.070	0.070	<0.01
04/05/10	12:15 p.m.	154	1.8	40.0	18.5	7.2	<u>17.3</u>	9.1	96.4	0.7	0.70	147	0.108	0.105	<0.01
01/06/10	11:40 a.m.	214	1.9	42.5	18.3	7.3	<u>14.1</u>	9.4	93.2	0.7	1.08	139	0.183	0.182	<0.01
06/07/10	12:30 p.m.	353		42.5	17.9	7.2	<u>12.2</u>	10.3	99.2	0.8	0.96	130	0.240	0.240	<0.01
04/08/10	11:15 a.m.	206	1.7	40.0	16.7	7.2	11.8	12.2	115.2	0.8	0.97	121	0.162	0.161	<0.01
14/09/10	11:40 a.m.	404			16.9	7.5	<u>14.6</u>	10.9	109.9	1.0	2.10	122	0.260	0.260	<0.01
05/10/10	11:30 a.m.	347	(2.1)	35.0	14.8	7.4	14.3	11.3	111.3	1.0	1.03	108	0.179	0.177	<0.01
02/11/10	10:40 a.m.	265	<u>1.3</u>	40.0	16.8	7.5	16.5	11.2	115.8	2.5	4.30	127	0.008	0.007	<0.01
01/12/10	11:36 a.m.	209	<u>1.5</u>	40.0	17.9	7.6	<u>21.3</u>	10.9	125.1	1.5	2.60	125	0.016	0.015	<0.01

Note: < = less than value stated
UD = upper decile flow (period 1991-2010 inclusive)

Underlined values don't comply with the "satisfactory" water quality Guidelines and Standards – Table 1

* New Zealand Standard Time

() black disk measurements taken in flows above upper decile value – don't assess for compliance

TKN g/m ³	TN g/m ³	DRP g/m ³	TP g/m ³	CL g/m ³	AS g/m ³	B g/m ³	LI g/m ³	A340F /cm	A440F /cm	ENT cfu/100mL	FC cfu/100mL	E coli cfu/100mL	CHLA g/m ³	DOC g/m ³	TOC g/m ³
-	<0.5	-	<0.04	-	<0.01	<0.3	-	-	-	<77	-	<550	<0.02		

0.05	0.05	0.004	<0.004	8.7	<u>0.010</u>	0.17	0.039	<0.002	<0.002	3	1	1	<0.003	0.84	1
0.07	0.07	<0.004	<0.004	8.2	0.009	0.18	0.040	<0.002	<0.002	310	3	2	<0.003	0.75	1
0.08	0.08	<0.004	<0.004	8.4	<u>0.011</u>	0.17	0.039	<0.002	<0.002	<1	1	1	<0.003	0.76	1.2
0.10	0.10	<0.004	0.011	8.5	<u>0.011</u>	0.17	0.041	<0.002	<0.002	4	3	3	<0.003	0.72	0.92
0.15	0.15	<0.004	<0.004	8.6	<u>0.011</u>	0.17	0.036	0.003	<0.002	2	8	8	<0.003	1.02	1.38
0.08	0.08	<0.004	0.004	8.4	<u>0.010</u>	0.17	0.037	<0.002	<0.002	100	9	7	<0.003	1	1
0.05	0.05	<0.004	0.005	8.8	<u>0.011</u>	0.20	0.045	<0.002	<0.002	<1	2	2	<0.003	0.7	1.2
0.07	0.07	<0.004	0.004	8.5	<u>0.010</u>	0.19	0.043	0.004	<0.002	20	9	8	<0.003	0.7	1.1
0.06	0.06	<0.004	0.006	8.5	<u>0.011</u>	0.18	0.041	0.004	0.002	<1	<1	<1	<0.003	0.9	1
0.52	<u>0.57</u>	<0.004	0.006	9.5	<u>0.012</u>	0.17	0.038	0.002	<0.002	<1	1	<1	<0.003	0.7	1.3
<0.05	0.03	<0.004	0.004	8.5	<u>0.010</u>	0.17	0.038	<0.002	<0.002	<1	<1	<1	<0.003	0.8	1
0.10	0.10	<0.004	0.004	8.3	<u>0.011</u>	0.16	0.039	0.002	<0.002	1	2	1	<0.003	1.3	1.4

0.06	0.07	0.007	0.010	16.0	<u>0.025</u>	0.26	0.082	0.003	<0.002	70	100	100	<0.003	0.83	0.85
0.08	0.11	0.010	0.016	25.0	<u>0.034</u>	<u>0.50</u>	0.140	0.005	<0.002	24	14	11	<0.003	0.75	1.1
0.09	0.12	0.008	0.010	18.0	<u>0.028</u>	<u>0.32</u>	0.093	0.004	<0.002	33	70	70	<0.003	1.1	0.97
0.08	0.11	0.007	0.014	16.6	<u>0.026</u>	0.28	0.089	<0.002	<0.002	<u>250</u>	130	110	<0.003	0.92	0.79
0.09	0.13	0.008	0.016	22.0	<u>0.035</u>	<u>0.36</u>	0.111	0.002	<0.002	69	70	70	<0.003	1.15	1.14
0.09	0.15	0.013	0.017	26.0	<u>0.038</u>	<u>0.44</u>	0.132	0.004	<0.002	11	9	6	<0.003	1.1	1
0.08	0.11	0.006	0.011	14.7	<u>0.021</u>	<u>0.31</u>	0.087	<0.002	<0.002	4	14	14	<0.003	1.3	1.7
0.27	0.35	0.013	0.017	26.0	<u>0.038</u>	<u>0.55</u>	0.152	0.006	<0.002	5	11	9	<0.003	0.6	1
0.08	0.09	0.005	0.012	13.9	<u>0.020</u>	0.28	0.078	0.004	<0.002	16	6	6	<0.003	1.1	2.1
0.23	0.28	<0.004	0.022	14.5	<u>0.022</u>	0.26	0.073	0.003	<0.002	3	3	3	<0.003	1.1	2
0.06	0.11	0.008	0.016	16.5	<u>0.023</u>	0.28	0.084	0.003	<0.002	3	13	11	<0.003	0.7	1.2
0.08	0.10	0.006	0.010	17.8	<u>0.025</u>	<u>0.30</u>	0.097	0.004	<0.002	8	23	19	<0.003	0.9	1.1

0.11	0.12	0.007	0.022	23.0	<u>0.036</u>	<u>0.35</u>	0.130	0.006	<0.002	3	<1	<1	0.007	1.1	1.5
0.09	0.13	0.010	0.032	19.0	<u>0.028</u>	<u>0.36</u>	0.110	0.007	<0.002	<u>1700</u>	5	4	0.003	0.76	1.2
0.09	0.11	0.008	0.022	18.0	<u>0.032</u>	0.29	0.100	0.005	<0.002	5	3	2	0.003	1.1	1.3
0.20	0.25	0.008	0.038	24.0	<u>0.040</u>	<u>0.38</u>	0.139	0.004	<0.002	14	4	3	<0.003	0.99	1.12
0.11	0.19	0.012	0.023	26.0	<u>0.035</u>	<u>0.39</u>	0.136	0.005	<0.002	<1	1	1	0.003	1.17	1.4
0.15	0.37	0.017	0.034	28.0	<u>0.038</u>	<u>0.44</u>	0.155	0.011	0.002	50	36	26	<0.003	1.8	1.5
0.12	0.28	0.013	0.018	20.0	<u>0.028</u>	<u>0.33</u>	0.110	0.004	<0.002	5	3	3	0.008	1	1.5
0.08	0.20	0.009	0.018	20.0	<u>0.028</u>	<u>0.36</u>	0.123	0.004	<0.002	20	10	9	0.005	0.7	1
0.16	0.31	0.008	0.025	16.8	<u>0.026</u>	<u>0.31</u>	0.098	0.008	<0.002	9	50	36	0.003	1.5	1.4
0.06	0.15	0.006	0.013	15.2	<u>0.024</u>	0.25	0.076	0.007	<0.002	<1	2	2	0.003	0.7	1.1
0.11	0.21	0.005	0.019	19.6	<u>0.029</u>	<u>0.32</u>	0.108	0.008	<0.002	<1	4	2	0.009	1	1.4
0.18	0.22	<0.004	0.029	22.0	<u>0.035</u>	<u>0.34</u>	0.128	0.008	0.002	<1	6	5	0.007	1.3	1.4

0.18	0.20	0.015	0.026	23.0	<u>0.037</u>	<u>0.35</u>	0.130	0.008	0.002	32	13	13	0.010	2.3	2.4
0.18	0.21	0.009	<u>0.062</u>	20.0	<u>0.031</u>	<u>0.39</u>	0.120	0.010	0.002	22	10	10	<u>0.022</u>	1.1	1.2
0.17	0.18	0.005	0.024	17.0	<u>0.031</u>	0.26	0.090	0.004	<0.002	9	6	6	0.007	1	1.1
0.12	0.19	0.007	0.022	23.0	<u>0.035</u>	<u>0.34</u>	0.134	0.004	<0.002	9	4	3	0.005	1.12	1.11
0.12	0.23	0.009	0.020	25.0	<u>0.032</u>	<u>0.40</u>	0.126	0.004	<0.002	9	3	3	0.006	1.15	1.69
0.13	0.31	0.012	0.028	24.0	<u>0.030</u>	<u>0.35</u>	0.124	0.018	0.003	33	58	43	<0.003	2.1	2
0.10	0.34	0.013	0.021	22.0	<u>0.028</u>	<u>0.36</u>	0.127	0.006	<0.002	<1	4	4	0.004	0.9	1.5
0.13	0.29	0.008	0.015	19.9	<u>0.025</u>	<u>0.36</u>	0.124	0.012	0.003	15	8	8	0.008	1.1	1.6
0.17	0.43	0.012	0.034	19.2	<u>0.027</u>	<u>0.35</u>	0.118	0.012	0.002	50	60	60	0.007	1.7	1.7
0.10	0.28	0.007	0.018	14.8	<u>0.024</u>	0.25	0.078	0.008	<0.002	<1	4	3	0.006	1	1.5
0.85	<u>0.86</u>	<0.004	0.038	19.8	<u>0.030</u>	<u>0.32</u>	0.108	0.008	<0.002	2	4	4	<u>0.045</u>	1.6	2
0.20	0.22	0.004	0.023	21.0	<u>0.034</u>	<u>0.32</u>	0.126	0.007	<0.002	<1	16	16	0.012	1.2	1.4

Note: < = less than value stated

Underlined values don't comply with the "satisfactory" water quality Guidelines and Standards – Table 1

DATE	TIME*	FLOW	BDISK	COLOR	COND	PH	TEMP	DO	PCDO	BOD5	TURB	TDS	NNN	NO3-N	NH4-N
dd/mm/yy	hh:mm	m ³ /s	m	units	mS/m	units	°C	g/m ³	%Sat	g/m ³	NTU	g/m ³	g/m ³	g/m ³	g/m ³
Satisfactory Water		>1.6	-	-	6.5-9	<12 (May-Sep)	>80	-	<5	-	-	-	-	-	<0.88
Quality Guideline/Standard						<20 (Oct-Apr)									

1131-143 UD = 359 m³/s (Flows from Waipapa Dam - Total)

Waikato River at Waipapa Tailrace

04/01/10	10:50 a.m.	255	2.6	37.5	17.3	7.4	<u>20.7</u>	8.9	100.9	0.9	1.20	130	0.110	0.110	0.03
02/02/10	11:30 a.m.	268	<u>1.4</u>	35.0	16.1	7.4	<u>21.7</u>	8.2	94.1	0.7	1.30	130	0.100	0.099	0.04
05/03/10	11:30 a.m.	440	(2.5)	37.5	16.0	7.2	<u>22.2</u>	8.6	100.3	0.8	1.20	120	0.080	0.077	0.02
08/04/10	12:20 p.m.	174	<u>1.1</u>	40.0	18.0	7.4	<u>18.5</u>	9.6	102.1	0.8	2.30	141	0.141	0.139	0.03
04/05/10	12:50 p.m.	179	2.4	40.0	18.5	7.2	<u>16.7</u>	9.4	97.4	0.7	0.72	152	0.165	0.161	0.01
01/06/10	12:10 p.m.	190	1.9	40.0	17.8	7.3	<u>13.9</u>	9.8	96.6	0.6	1.00	130	0.240	0.240	<0.01
06/07/10	1:10 p.m.	343		40.0	17.5	7.2	<u>12.0</u>	10.2	96.9	0.8	1.16	141	0.320	0.320	<0.01
04/08/10	11:45 a.m.	179	<u>1.4</u>	35.0	15.3	7.2	11.6	12.8	119.4	0.8	1.29	112	0.220	0.220	0.01
14/09/10	12:15 p.m.	450	(0.9)	37.5	15.6	7.4	<u>13.7</u>	11.2	109.7	1.0	2.40	116	0.320	0.320	<0.01
05/10/10	12:10 p.m.	428	(1.6)	45.0	13.9	7.3	13.8	11.6	112.2	1.4	1.23	105	0.220	0.220	<0.01
02/11/10	11:25 a.m.	465	(1.0)	35.0	16.2	7.4	16.1	11.1	112.2	1.6	1.94	131	0.100	0.099	<0.01
01/12/10	12:38 p.m.	249	1.6	37.5	16.8	7.2	<u>20.2</u>	10.0	111.9	1.1	1.89	121	0.096	0.093	0.03

1131-328 UD = 371 m³/s (Flows from Karapiro Dam - Total)

Waikato River at Narrows Boat Ramp

06/01/10	7:40 a.m.	164	<u>1.5</u>	42.5	16.4	6.8	<u>20.4</u>	8.7	95.6	1.4	1.70	120	0.150	0.150	0.04
05/02/10	10:10 a.m.	217	<u>1.6</u>	32.5	16.7	7.4	<u>22.2</u>	8.1	91.9	0.5	3.60	130	0.170	0.170	0.02
01/03/10	8:00 a.m.	162	<u>1.0</u>	37.5	16.2	7.4	<u>22.0</u>	8.2	93.8	< .4	1.80	110	0.130	0.130	0.02
07/04/10	9:20 a.m.	157	<u>1.6</u>	32.5	16.0	7.6	18.7	9.0	96.2	1.3	2.40	122	0.105	0.102	0.02
05/05/10	9:15 a.m.	161	2.1	37.5	17.8	7.0	<u>16.3</u>	9.0	90.3	0.7	1.74	155	0.210	0.200	0.02
03/06/10	9:07 a.m.	151	1.9	40.0	17.6	7.2	<u>14.1</u>	9.9	96.4	0.9	1.86	137	0.340	0.330	0.02
07/07/10	8:35 a.m.	430	(1.1)	37.5	16.8	7.2	<u>12.1</u>	10.0	94.1	1.4	2.30	116	0.490	0.490	<0.01
05/08/10	8:50 a.m.	150	<u>0.3</u>	35.0	15.2	7.8	11.4	12.3	114.0	1.1	<u>16.30</u>	123	0.860	0.860	0.02
07/09/10	9:20 a.m.	309	<u>0.6</u>	32.5	15.1	7.4	<u>12.6</u>	10.2	96.3	1.4	4.80	121	0.550	0.550	<0.01
06/10/10	8:00 a.m.	488	(1.2)	32.5	13.6	7.6	14.1	11.7	112.3	1.0	2.50	102	0.340	0.340	<0.01
04/11/10	8:00 a.m.	395	(0.9)		14.9	7.7	16.0	12.0	121.2	1.7	3.20	103	0.142	0.140	0.01
02/12/10	8:04 a.m.	222	<u>1.4</u>	40.0	16.2	7.6	<u>20.1</u>	9.9	108.9	1.2	2.20	118	0.126	0.124	0.03

1131-69 UD = 384 m³/s (Flows from Hamilton - Bridge Street Bridge)

Waikato River at Horotiu Br

06/01/10	8:15 a.m.	180	<u>1.0</u>	32.5	16.6	7.2	<u>20.4</u>	9.0	98.4	1.2	2.10	120	0.170	0.160	0.02
05/02/10	10:50 a.m.	259	<u>1.2</u>	32.5	16.8	7.4	<u>21.9</u>	8.6	96.8	0.5	4.20	130	0.210	0.210	0.02
01/03/10	8:35 a.m.	174	<u>0.9</u>	37.5	16.5	7.5	<u>21.8</u>	8.4	94.8	0.5	2.00	130	0.150	0.150	0.01
07/04/10	10:00 a.m.	156	<u>0.9</u>	32.5	15.9	7.6	17.9	9.1	95.2	1.0	<u>6.30</u>	129	0.177	0.175	0.01
05/05/10	10:00 a.m.	153	<u>1.5</u>	35.0	18.0	7.3	<u>15.7</u>	9.4	92.9	0.6	1.95	153	0.270	0.260	0.02
03/06/10	10:20 a.m.	167	1.7	32.5	17.9	7.3	<u>13.7</u>	9.9	95.4	0.8	2.80	143	0.420	0.420	0.01
07/07/10	9:10 a.m.	394	(1.0)	37.5	16.8	7.2	11.6	10.1	94.0	1.5	2.80	147	0.520	0.510	<0.01
05/08/10	9:30 a.m.	215	<u>0.4</u>	35.0	15.0	7.6	11.5	12.4	113.8	1.1	<u>8.60</u>	119	0.430	0.420	0.01
07/09/10	10:20 a.m.	260	<u>0.6</u>	32.5	15.1	7.4	<u>13.0</u>	10.8	102.4	1.5	4.60	124	0.550	0.530	<0.01
06/10/10	9:15 a.m.	435	(1.1)	30.0	14.0	7.5	14.1	11.5	110.3	1.1	3.20	103	0.370	0.370	<0.01
04/11/10	8:48 a.m.	199	<u>0.9</u>	35.0	15.1	7.8	15.8	11.8	118.2	1.6	3.50	97	0.162	0.156	0.02
02/12/10	9:10 a.m.	206	<u>1.3</u>	40.0	16.4	7.5	19.7	9.4	102.3	1.8	2.90	116	0.176	0.175	0.03

1131-77 UD = 582 m³/s (Flows from Huntly Power Station Recorder)

Waikato River at Huntly-Tainui Br

06/01/10	8:45 a.m.	304	<u>0.8</u>	37.5	15.6	7.2	<u>20.8</u>	8.9	98.5	0.9	4.50	110	0.240	0.230	<0.01
05/02/10	11:25 a.m.	363	<u>0.9</u>	32.5	16.2	7.6	<u>22.1</u>	8.1	91.9	0.6	<u>8.00</u>	130	0.250	0.250	<0.01
01/03/10	9:10 a.m.	228	<u>1.1</u>	37.5	16.2	7.5	<u>21.7</u>	8.3	94.7	0.5	3.90	120	0.200	0.200	<0.01
07/04/10	10:30 a.m.	184	<u>0.9</u>	37.5	16.0	7.6	18.3	10.1	106.0	1.2	4.60	122	0.230	0.230	<0.01
05/05/10	10:40 a.m.	180	<u>1.2</u>	30.0	17.5	7.5	<u>15.5</u>	10.1	98.7	0.7	2.60	147	0.360	0.360	0.02
03/06/10	10:55 a.m.	329	<u>0.3</u>	27.5	13.9	7.2	<u>12.7</u>	9.5	89.1	1.2	<u>30.00</u>	117	0.990	0.980	0.03
07/07/10	9:45 a.m.	491	<u>0.7</u>	37.5	15.8	7.1	11.5	9.7	90.1	1.4	<u>6.40</u>	121	0.710	0.700	0.02
05/08/10	10:00 a.m.	494	<u>0.2</u>	35.0	12.8	7.5	11.7	11.4	105.1	1.0	<u>23.00</u>	104	0.850	0.840	0.02
07/09/10	10:40 a.m.	506	<u>0.4</u>	32.5	13.3	7.2	<u>12.8</u>	10.4	98.1	1.4	<u>12.20</u>	188	0.850	0.840	0.01
06/10/10	9:40 a.m.	610	(0.6)	30.0	12.6	7.3	14.3	10.5	100.7	0.9	<u>9.90</u>	94	0.670	0.670	<0.01
04/11/10	9:15 a.m.	324	<u>0.6</u>	25.0	14.6	7.7	16.6	11.5	117.6	1.4	<u>7.40</u>	108	0.270	0.270	<0.01
02/12/10	9:55 a.m.	231	<u>1.4</u>	35.0	16.5	7.4	<u>20.5</u>	9.2	101.9	1.5	4.80	112	0.240	0.240	<0.01

Note: < = less than value stated
UD = upper decile flow (period 1991-2010 inclusive)

Underlined values don't comply with the "satisfactory" water quality Guidelines and Standards – Table 1

* New Zealand Standard Time

() black disk measurements taken in flows above

TKN	TN	DRP	TP	CL	AS	B	LI	A340F	A440F	ENT	FC	E coli	CHLA	DOC	TOC
g/m ³	g/m ³	g/m ³	g/m ³	g/m ³	g/m ³	g/m ³	g/m ³	/cm	/cm	cfu/100mL	cfu/100mL	cfu/100mL	g/m ³	g/m ³	g/m ³
-	<0.5	-	<0.04	-	<0.01	<0.3	-	-	-	<77	-	<550	<0.02		

0.14	0.25	0.027	0.032	21.0	<u>0.031</u>	0.29	0.100	0.011	0.002	11	7	7	0.004	1.3	1.5
0.17	0.27	0.016	<u>0.052</u>	18.0	<u>0.026</u>	<u>0.33</u>	0.100	0.012	0.003	35	31	31	0.003	1.4	1.8
0.11	0.19	0.015	0.030	19.0	<u>0.031</u>	0.27	0.095	0.007	<0.002	3	3	3	0.004	1.2	1.4
0.18	0.32	0.019	<u>0.044</u>	22.0	<u>0.029</u>	<u>0.31</u>	0.119	0.008	<0.002	<u>200</u>	190	120	<0.003	1.34	1.37
0.11	0.27	0.017	0.028	24.0	<u>0.030</u>	<u>0.36</u>	0.114	0.008	<0.002	5	4	4	0.004	1.4	1.65
0.10	0.34	0.021	0.029	22.0	<u>0.026</u>	<u>0.32</u>	0.112	0.011	<0.002	7	15	12	<0.003	1.6	1.6
0.11	0.43	0.017	0.023	22.0	<u>0.025</u>	<u>0.34</u>	0.121	0.009	<0.002	2	5	5	0.004	1	1.5
0.12	0.34	0.015	0.021	17.7	<u>0.019</u>	0.26	0.088	0.010	0.002	32	280	280	0.007	1.2	1.7
0.16	0.48	0.015	0.034	17.4	<u>0.022</u>	<u>0.30</u>	0.095	0.014	0.003	27	60	60	0.010	1.7	1.9
0.13	0.35	0.008	0.023	13.9	<u>0.021</u>	0.21	0.068	0.010	<0.002	5	26	24	0.007	1.1	1.8
0.19	0.29	<0.004	<u>0.043</u>	18.2	<u>0.023</u>	0.28	0.093	0.008	<0.002	<1	3	2	<u>0.025</u>	1.2	2.4
0.21	0.30	0.006	0.025	18.1	<u>0.030</u>	0.27	0.096	0.009	<0.002	<1	15	14	0.008	1.4	1.6

0.19	0.34	0.012	0.035	19.0	<u>0.031</u>	0.25	0.094	0.009	<0.002	<u>450</u>	120	60	0.006	1.3	1.7
0.19	0.36	0.018	<u>0.042</u>	20.0	<u>0.031</u>	0.29	0.100	0.014	0.003	<u>1800</u>	2300	130	0.009	2.3	2
0.16	0.29	0.019	0.036	18.0	<u>0.025</u>	0.29	0.097	0.009	<0.002	31	50	40	0.007	1.3	1.9
0.20	0.30	0.011	0.034	18.0	<u>0.023</u>	0.26	0.086	0.008	<0.002	<u>1000</u>	340	340	0.014	1.21	1.7
0.12	0.32	0.015	0.032	21.0	<u>0.026</u>	0.29	0.102	0.009	0.002	23	55	15	0.008	1.43	1.8
0.16	0.49	0.020	0.034	21.0	<u>0.024</u>	<u>0.37</u>	0.131	0.014	0.003	<u>86</u>	72	62	0.005	1.8	1.7
0.14	<u>0.63</u>	0.023	0.034	20.0	<u>0.020</u>	0.29	0.105	0.016	0.002	13	40	33	<0.003	1.2	2.1
0.32	<u>1.18</u>	0.030	<u>0.069</u>	15.4	<u>0.013</u>	0.19	0.069	0.026	0.004	<u>1300</u>	1700	<u>1700</u>	0.007	2.2	3.3
0.27	<u>0.82</u>	0.024	<u>0.050</u>	16.8	<u>0.017</u>	0.24	0.087	0.023	0.004	48	210	160	0.014	1.9	2.6
0.24	<u>0.58</u>	0.013	0.026	13.7	<u>0.018</u>	0.21	0.067	0.013	0.002	12	60	50	0.009	1.3	1.8
0.25	0.39	<0.004	0.024	15.2	<u>0.019</u>	0.22	0.075	0.006	<0.002	7	16	16	<u>0.023</u>	1.3	1.7
0.20	0.32	0.007	0.024	16.9	<u>0.026</u>	0.25	0.090	0.009	<0.002	19	50	50	0.005	1.5	1.8

0.20	0.36	0.017	<u>0.043</u>	20.0	<u>0.031</u>	0.26	0.096	0.011	0.002	<u>110</u>	240	240	0.009	1.4	1.8
0.19	0.40	0.027	<u>0.053</u>	20.0	<u>0.030</u>	0.29	0.100	0.015	0.003	<u>210</u>	170	170	0.008	2.7	3.3
0.20	0.35	0.021	<u>0.043</u>	18.0	<u>0.027</u>	<u>0.30</u>	0.098	0.010	<0.002	<u>80</u>	110	80	0.009	1.7	2.1
0.22	0.40	0.020	<u>0.050</u>	17.9	<u>0.021</u>	0.24	0.077	0.012	0.003	<u>3100</u>	1100	<u>1100</u>	0.013	1.49	2.3
0.14	0.40	0.024	<u>0.044</u>	21.0	<u>0.025</u>	<u>0.30</u>	0.104	0.010	0.002	<u>150</u>	180	130	0.010	0.95	2
0.19	<u>0.61</u>	0.029	<u>0.045</u>	22.0	<u>0.023</u>	<u>0.32</u>	0.118	0.018	0.003	<u>150</u>	160	160	0.004	2.3	2
0.18	<u>0.69</u>	0.027	<u>0.046</u>	20.0	<u>0.020</u>	0.28	0.103	0.017	0.003	19	33	33	<0.003	1.4	1.9
0.26	<u>0.68</u>	0.035	<u>0.079</u>	15.9	<u>0.015</u>	0.23	0.083	0.026	0.004	<u>260</u>	450	400	0.009	2	3.1
0.28	<u>0.81</u>	0.039	<u>0.064</u>	17.0	<u>0.016</u>	0.24	0.088	0.024	0.004	<u>130</u>	480	410	0.015	2	2.9
0.16	<u>0.53</u>	0.019	0.030	13.9	<u>0.018</u>	0.20	0.067	0.014	0.003	15	80	80	0.009	1.2	2
0.28	0.44	0.006	0.026	15.3	<u>0.020</u>	0.21	0.073	0.006	<0.002	8	50	40	<u>0.023</u>	1.3	1.8
0.19	0.37	0.012	0.032	17.0	<u>0.027</u>	0.26	0.090	0.008	<0.002	40	140	140	0.005	1.4	2.1

0.21	0.44	0.020	<u>0.054</u>	18.0	<u>0.024</u>	0.21	0.075	0.017	0.003	<u>110</u>	420	330	0.011	1.7	2.1
0.23	0.48	0.026	<u>0.074</u>	19.0	<u>0.027</u>	0.25	0.088	0.023	0.005	<u>120</u>	200	150	0.010	2.5	4.3
0.20	0.40	0.027	<u>0.052</u>	18.0	<u>0.022</u>	<u>0.30</u>	0.091	0.014	0.002	24	70	70	0.010	2.3	2.2
0.22	0.45	0.030	<u>0.056</u>	17.9	<u>0.019</u>	0.21	0.072	0.012	<0.002	<u>200</u>	440	370	0.013	1.72	2.2
0.17	<u>0.53</u>	0.037	<u>0.057</u>	20.0	<u>0.021</u>	0.27	0.089	0.015	0.003	30	60	60	0.006	1.21	1.91
0.45	<u>1.43</u>	0.020	<u>0.105</u>	15.1	0.008	0.14	0.045	0.036	0.007	<u>2600</u>	2100	<u>2100</u>	<0.003	3.9	3.8
0.27	<u>0.97</u>	0.018	<u>0.051</u>	18.6	<u>0.016</u>	0.23	0.080	0.022	0.004	19	50	50	<0.003	2	2.7
0.39	<u>1.23</u>	0.022	<u>0.095</u>	13.1	0.008	0.11	0.040	0.038	0.008	<u>440</u>	600	500	0.004	2.8	3.8
0.32	<u>1.16</u>	0.025	<u>0.062</u>	14.2	0.008	0.13	0.044	0.003	<0.002	<u>150</u>	330	290	0.009	2.1	3.4
0.25	<u>0.92</u>	0.027	<u>0.052</u>	12.8	<u>0.011</u>	0.12	0.039	0.026	0.005	34	120	70	0.006	1.8	2.6
0.30	<u>0.57</u>	0.007	<u>0.048</u>	15.0	<u>0.016</u>	0.18	0.061	0.011	<0.002	13	20	20	0.018	1.6	2
0.19	0.43	0.017	<u>0.048</u>	17.3	<u>0.022</u>	0.24	0.078	0.013	0.002	35	70	60	0.006	1.7	2.2

upper decile value – don't assess for compliance

Note: < = less than value stated

Underlined values don't comply with the "satisfactory" water quality Guidelines and Standards – Table 1

DATE	TIME*	FLOW	BDISK	COLOR	COND	PH	TEMP	DO	PCDO	BOD5	TURB	TDS	NNN	NO3-N	NH4-N
dd/mm/yy	hh:mm	m ³ /s	m	units	mS/m	units	'C	g/m ³	%Sat	g/m ³	NTU	g/m ³	g/m ³	g/m ³	g/m ³
Satisfactory Water		>1.6	-	-	6.5-9	<12 (May-Sep	>80	-	<5	-	-	-	-	-	<0.88
Quality Guideline/Standard						<20 (Oct-Apr)									

1131-91 UD = 675 m³/s (Flows from Mercer Bridge Recorder)

Waikato River at Mercer Br

06/01/10	9:40 a.m.	299	-	-	16.2	7.4	<u>22.1</u>	8.8	99.8	0.8	<u>10.00</u>	120	0.230	0.220	<0.01
05/02/10	12:15 p.m.	353	-	-	16.3	7.4	<u>22.8</u>	8.0	92.2	0.7	<u>12.00</u>	130	0.300	0.290	<0.01
01/03/10	9:45 a.m.	238	-	-	16.5	7.4	<u>22.1</u>	8.1	93.1	0.6	<u>5.20</u>	120	0.170	0.170	<0.01
07/04/10	11:20 a.m.	176	-	-	16.4	7.7	<u>18.5</u>	9.4	99.5	1.2	<u>5.70</u>	131	0.150	0.150	<0.01
05/05/10	11:20 a.m.	176	-	-	18.0	7.5	<u>16.2</u>	9.7	96.5	1.3	<u>6.70</u>	152	0.360	0.360	<0.01
03/06/10	11:40 a.m.	395	-	-	16.9	7.0	<u>13.5</u>	9.2	88.2	4.1	<u>52.00</u>	103	0.890	0.880	<0.01
07/07/10	10:25 a.m.	552	-	-	16.3	7.1	<u>11.9</u>	9.6	89.5	0.8	<u>15.90</u>	126	0.910	0.900	0.02
05/08/10	11:05 a.m.	534	-	-	14.1	7.4	<u>12.6</u>	10.9	102.4	1.0	<u>29.00</u>	112	0.850	0.850	0.01
07/09/10	11:20 a.m.	524	-	-	15.0	7.2	<u>13.2</u>	10.1	96.1	1.6	<u>15.90</u>	113	0.790	0.780	<0.01
06/10/10	10:50 a.m.	773	-	-	14.0	7.2	<u>14.7</u>	10.2	99.3	1.0	<u>9.30</u>	102	0.550	0.540	<0.01
04/11/10	9:52 a.m.	343	-	-	15.0	7.7	<u>17.8</u>	10.9	113.2	1.9	<u>10.10</u>	114	0.240	0.230	<0.01
02/12/10	10:41 a.m.	253	-	-	16.6	7.4	<u>21.5</u>	9.4	105.4	1.9	<u>7.20</u>	115	0.200	0.200	0.01

1131-133

Waikato River at Tuakau Br

06/01/10	10:05 a.m.	-	<u>0.8</u>	32.5	16.4	7.6	<u>22.3</u>	9.2	105.3	1.2	<u>7.00</u>	120	0.270	0.260	<0.01
05/02/10	12:45 p.m.	-	<u>0.5</u>	27.5	16.4	7.4	<u>22.9</u>	8.0	92.1	0.7	<u>14.00</u>	130	0.270	0.260	<0.01
01/03/10	10:05 a.m.	-	<u>0.7</u>	37.5	16.7	7.6	<u>22.5</u>	8.9	102.2	1.0	4.20	120	0.140	0.140	<0.01
07/04/10	12:00 p.m.	-	<u>0.8</u>	32.5	16.4	7.7	<u>19.6</u>	9.5	102.9	0.8	3.50	127	0.133	0.133	<0.01
05/05/10	11:50 a.m.	-	<u>1.0</u>	32.5	18.1	7.2	<u>16.2</u>	9.7	97.2	0.8	<u>5.50</u>	152	0.350	0.350	0.01
03/06/10	12:15 p.m.	-	<u>0.3</u>	22.5	17.0	7.1	<u>14.3</u>	9.0	88.2	1.2	<u>36.00</u>	105	0.890	0.880	<0.01
07/07/10	10:50 a.m.	-	<u>0.4</u>	30.0	16.6	7.0	<u>11.8</u>	9.2	86.5	1.1	<u>12.50</u>	128	0.950	0.950	0.02
05/08/10	11:25 a.m.	-	<u>0.1</u>	30.0	14.4	7.3	<u>12.5</u>	10.6	98.7	1.4	<u>27.00</u>	118	0.880	0.880	0.02
07/09/10	11:45 a.m.	-	<u>0.3</u>	32.5	15.0	7.2	<u>13.2</u>	9.5	91.0	1.3	<u>15.30</u>	119	0.780	0.770	<0.01
06/10/10	12:15 p.m.	-	<u>0.6</u>	27.5	13.9	7.1	<u>14.8</u>	9.7	94.5	1.4	<u>8.80</u>	103	0.530	0.530	<0.01
04/11/10	10:27 a.m.	-	<u>0.5</u>	27.5	15.0	7.8	<u>17.7</u>	12.2	127.6	2.4	<u>7.10</u>	110	0.156	0.152	<0.01
02/12/10	11:10 a.m.	-	<u>0.9</u>	32.5	16.8	7.7	<u>22.0</u>	9.8	112.5	2.0	<u>7.60</u>	113	0.172	0.169	<0.01

Note: < = less than value stated
UD = upper decile flow (period 1991-2010 inclusive)

Underlined values don't comply with the "satisfactory" water quality Guidelines and Standards – Table 1

* New Zealand Standard Time

() black disk measurements taken in flows above upper decile value – don't assess for compliance

TN	DRP	TP	CL	AS	B	LI	A340F	A440F	ENT	FC	E coli	CHLA	DOC	TOC
g/m ³	g/m ³	g/m ³	g/m ³	g/m ³	g/m ³	g/m ³	/cm	/cm	cfu/100mL			g/m ³	g/m ³	g/m ³
<0.5	-	<0.04	-	<0.01	<0.3	-	-	-	<77	-	<550	<0.02		

0.49	0.020	<u>0.096</u>	19.0	<u>0.026</u>	0.24	0.082	0.013	<0.002	<u>90</u>	410	410	0.014	1.5	2.4
<u>0.60</u>	0.025	<u>0.079</u>	19.0	<u>0.022</u>	0.25	0.077	0.033	0.006	32	170	140	0.015	3.6	4
0.36	0.021	<u>0.054</u>	18.0	<u>0.021</u>	0.29	0.086	0.016	0.003	13	65	60	0.013	1.8	2.6
0.39	0.022	<u>0.054</u>	18.3	<u>0.020</u>	0.24	0.076	0.012	0.003	25	75	70	0.017	1.49	1.88
<u>0.57</u>	0.030	<u>0.065</u>	21.0	<u>0.021</u>	0.27	0.089	0.015	0.003	21	60	60	0.009	1.24	2
<u>2.00</u>	<0.004	<u>0.122</u>	18.6	<u>0.011</u>	0.19	0.057	0.043	0.010	<u>1600</u>	1200	<u>1200</u>	0.010	5	5.6
<u>1.28</u>	0.045	<u>0.065</u>	17.4	0.009	0.15	0.051	0.038	0.006	34	80	80	0.006	3.2	4.3
<u>1.33</u>	0.017	<u>0.089</u>	13.7	0.007	0.11	0.035	0.050	0.009	<u>480</u>	500	400	0.008	3.9	5.4
<u>1.23</u>	0.018	<u>0.075</u>	15.6	0.008	0.13	0.039	0.049	0.008	30	150	110	0.018	3.4	5.2
<u>0.83</u>	0.015	<u>0.060</u>	13.7	0.010	0.15	0.043	0.042	0.008	18	100	30	0.009	2.3	3.9
<u>0.65</u>	0.006	<u>0.058</u>	15.4	<u>0.015</u>	0.18	0.059	0.017	0.003	7	30	30	<u>0.029</u>	1.7	2.9
<u>0.53</u>	0.011	<u>0.054</u>	17.4	<u>0.022</u>	0.26	0.082	0.011	<0.002	10	40	40	0.015	1.7	2.5
<u>0.53</u>	0.020	<u>0.069</u>	19.0	<u>0.024</u>	0.24	0.080	0.014	: 0.002	21	110	110	0.016	1.5	2.1
<u>0.57</u>	0.024	<u>0.084</u>	19.0	<u>0.024</u>	0.24	0.079	0.030	0.006	60	210	210	0.014	3.3	4.3
0.34	0.019	<u>0.051</u>	18.0	<u>0.021</u>	0.29	0.091	0.014	0.002	6	40	30	0.017	2.3	2.4
0.32	0.021	<u>0.048</u>	18.3	<u>0.020</u>	0.24	0.072	0.011	0.003	19	90	50	0.019	1.47	1.87
<u>0.51</u>	0.030	<u>0.062</u>	21.0	<u>0.021</u>	0.26	0.085	0.015	0.003	33	80	70	0.012	1.28	1.99
<u>1.40</u>	0.014	<u>0.098</u>	18.6	<u>0.012</u>	0.18	0.062	0.040	0.008	<u>1900</u>	2100	<u>1800</u>	0.009	4.4	6.4
<u>1.38</u>	0.020	<u>0.065</u>	18.6	0.010	0.17	0.056	0.049	0.009	48	70	70	0.003	3.7	4.8
<u>1.42</u>	0.017	<u>0.087</u>	14.6	0.007	0.12	0.039	0.057	0.010	<u>380</u>	750	<u>550</u>	0.009	4.6	6.1
<u>1.29</u>	0.017	<u>0.078</u>	15.4	0.008	0.13	0.043	0.052	0.008	29	80	60	0.018	4.1	5.8
<u>0.88</u>	0.017	<u>0.056</u>	13.8	0.010	0.14	0.041	0.054	0.010	26	70	50	0.011	3.1	4
<u>0.57</u>	0.004	<u>0.052</u>	15.5	<u>0.017</u>	0.19	0.060	0.016	: 0.002	6	90	90	<u>0.028</u>	1.1	1.9
<u>0.51</u>	0.009	<u>0.050</u>	17.6	<u>0.021</u>	0.23	0.076	0.012	0.002	13	40	40	0.016	1.8	2.6

Note: < = less than value stated

Underlined values don't comply with the "satisfactory" water quality Guidelines and Standards – Table 1

3.2 Waikato River Monitoring Programme

Bathing Season Microbiological Survey

Summary Statistics

Comparison with Water Quality Standards

Parameter Graph

Raw Data

Table 5: Bathing Season Statistics of E. coli Bacteria.

Location Name	BATHING SEASON MEDIAN					5 Season
	02/03	04/05	06/07	08/09	10/11	Median
Taupo Gates	1	1	2	3	8	2
Huka Falls	5	4	8	13	15	8
Ohaaki Bridge	18	22	16	41	19	19
Ohakuri Tailrace Br	2	4	2	3	3	3
Whakamaru Tailrace	6	7	6	10	18	7
Waipapa Tailrace	6	9	6	6	7	6
Lake Karapiro Boatramp	25	27	8	25	45	25
Narrows Br	26	28	55	83	60	55
Wellington Street Beach	39	43	84	80	80	80
Sewer Br Alandale	44	75	100	120	130	100
Horotiu Br	44	90	150	120	110	110
Ngaruawahia Br	160	80	140	120	240	140
Huntly-Tainui Br	175	135	150	160	160	160
Mercer Br	70	36	85	115	160	85
Tuakau Br	70	44	50	105	80	70
Waipa River (Ngaruawahia Br)	86	95	90	130	100	95

Table 6: Year 2010/11 Bathing Season E. coli survey results complying with the “Satisfactory” and “Excellent” Water Quality Guidelines. n = 12 (except * where n = 11).

Location Name	HUMAN USES - RECREATION			
	SATISFACTORY		EXCELLENT	
	<i>E. coli</i> Samples < 550	<i>E. coli</i> Median <126	<i>E. coli</i> Samples < 55	<i>E. coli</i> Median <23
Taupo Gates	13	Y	13	12
Huka Falls	13	Y	12	11
Ohaaki Bridge	13	Y	12	8
Ohakuri Tailrace Br	13	Y	12	12
Whakamaru Tailrace	11*	Y	10*	7
Waipapa Tailrace	13	Y	11	11
Lake Karapiro Boatramp	13	Y	8	4
Narrows Br	13	Y	5	0
Wellington Street Beach	13	Y	3	0
Sewer Br Alandale	12	Y	0	0
Horotiu Br	13	Y	0	0
Ngaruawahia Br	12	N	0	0
Huntly-Tainui Br	11	N	0	0
Mercer Br	11	Y	3	0
Tuakau Br	11	Y	2	0
Waipa River (Ngaruawahia Br)	11	Y	2	0

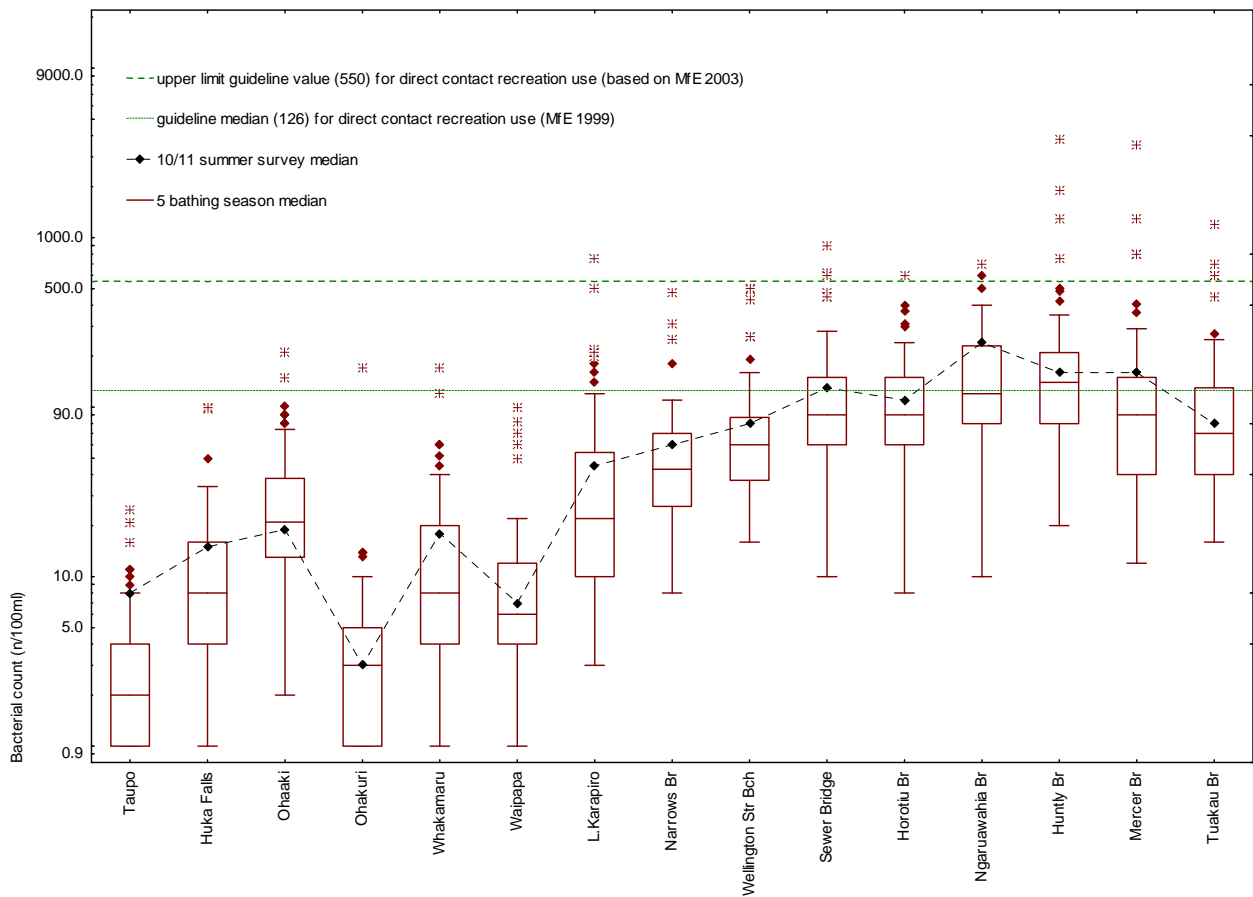


Figure 2: E. coli – 5 Bathing Season Data

DATE	EColi c/100ml	ENT c/100ml	FC c/100ml	DATE	EColi c/100ml	ENT c/100ml	FC c/100ml	DATE	EColi c/100ml	ENT c/100ml	FC c/100ml
Taupo Control Gates				Lake Karapiro Boatramp				Huntly-Tainui Bridge			
1/12/10	1	1	2	1/12/10	200	340	240	2/12/10	60	35	70
7/12/10	< 1	2	< 1	7/12/10	45	8	60	8/12/10	100	31	130
14/12/10	< 1	< 1	< 1	14/12/10	210	75	230	14/12/10	210	60	250
21/12/10	8	9	9	21/12/10	180	180	240	22/12/10	1300	390	1600
6/01/11	5	1	5	6/01/11	40	14	40	7/01/11	160	57	190
11/01/11	1	< 1	1	11/01/11	18	6	19	12/01/11	90	40	90
18/01/11	25	32	36	18/01/11	90	18	90	19/01/11	750	700	1100
25/01/11	< 1	1	< 1	25/01/11	500	150	900	26/01/11	500	900	800
2/02/11	< 1	2	< 1	2/02/11	50	13	60	3/02/11	130	200	150
10/02/11	9	2	9	10/02/11	8	8	8	9/02/11	100	26	150
14/02/11	11	5	13	14/02/11	32	13	44	17/02/11	180	110	230
24/02/11	1	2	3	24/02/11	10	2	10	23/02/11	350	280	350
3/03/11	21	16	39	3/03/11	9	9	12	2/03/11	120	90	140
Median	8	2	9	Median	45	13	60	Median	160	90	190
Huka Falls				Narrows Boat Ramp				Mercer Bridge			
1/12/10	2	3	2	2/12/10	50	19	50	2/12/10	40	10	40
7/12/10	15	7	16	7/12/10	70	29	80	8/12/10	60	9	60
14/12/10	100	21	100	14/12/10	80	30	90	14/12/10	50	20	70
21/12/10	28	23	28	21/12/10	310	280	310	22/12/10	1300	440	1300
6/01/11	13	< 1	18	7/01/11	47	80	51	7/01/11	160	26	160
11/01/11	5	2	8	11/01/11	36	30	41	12/01/11	130	19	150
18/01/11	20	19	31	18/01/11	80	110	90	19/01/11	290	120	400
25/01/11	9	11	18	25/01/11	470	120	590	26/01/11	800	1600	950
2/02/11	4	3	8	3/02/11	40	110	40	3/02/11	360	130	430
10/02/11	17	3	17	10/02/11	40	20	40	9/02/11	110	26	140
14/02/11	30	15	50	14/02/11	80	23	80	17/02/11	220	60	260
24/02/11	16	17	16	24/02/11	60	30	60	23/02/11	30	17	80
3/03/11	15	< 1	18	2/03/11	60	30	60	2/03/11	160	150	160
Median	15	11	18	Median	60	30	60	Median	160	26	160
Ohaaki Bridge				Wellington Street Beach				Tuakau Bridge			
1/12/10	19	8	23	2/12/10	130	90	130	2/12/10	40	13	40
7/12/10	11	1	15	8/12/10	44	25	56	8/12/10	60	210	70
14/12/10	14	9	14	14/12/10	70	32	70	14/12/10	80	9	80
21/12/10	45	33	64	22/12/10	190	160	230	22/12/10	700	310	1000
6/01/11	90	170	100	7/01/11	70	100	70	7/01/11	80	9	100
11/01/11	17	11	21	12/01/11	40	90	140	12/01/11	190	10	210
18/01/11	52	20	57	19/01/11	430	500	430	19/01/11	160	53	210
25/01/11	38	65	56	26/01/11	500	600	600	26/01/11	600	900	700
2/02/11	15	25	15	3/02/11	160	130	190	3/02/11	70	80	70
10/02/11	21	13	21	9/02/11	80	28	80	9/02/11	80	17	80
14/02/11	8	9	11	17/02/11	40	90	60	17/02/11	110	29	110
24/02/11	35	28	35	23/02/11	260	280	330	23/02/11	30	13	30
3/03/11	12	8	14	2/03/11	80	90	80	2/03/11	120	75	120
Median	19	13	21	Median	80	90	130	Median	80	29	100
Ohakuri Tailrace Bridge				Sewer Bridge Alandale				Waipa River @ Ngaruawahia			
1/12/10	5	< 1	6	2/12/10	90	100	120	2/12/10	50	32	60
7/12/10	3	< 1	3	8/12/10	80	42	80	8/12/10	110	31	130
14/12/10	3	< 1	3	14/12/10	210	140	230	14/12/10	120	37	150
21/12/10	5	3	6	22/12/10	170	260	230	22/12/10	2800	950	3600
6/01/11	1	< 1	1	7/01/11	200	130	240	7/01/11	80	42	90
11/01/11	2	< 1	2	12/01/11	90	110	110	12/01/11	50	80	50
18/01/11	8	4	14	19/01/11	470	430	470	19/01/11	470	330	530
25/01/11	170	230	290	26/01/11	600	1200	600	26/01/11	800	500	1500
2/02/11	9	4	9	3/02/11	70	120	90	3/02/11	65	46	90
10/02/11	3	1	3	9/02/11	100	50	110	9/02/11	100	22	130
14/02/11	1	1	2	17/02/11	90	100	90	17/02/11	360	320	360
24/02/11	1	< 1	1	23/02/11	450	320	450	23/02/11	90	19	100
3/03/11	1	2	1	2/03/11	130	50	170	2/03/11	80	46	80
Median	3	3	3	Median	130	120	170	Median	100	46	130
Whakamaru Tailrace				Horotiu Bridge				Waipa River @ Ngaruawahia			
1/12/10	16	< 1	16	2/12/10	140	40	140	2/12/10	50	32	60
7/12/10	40	10	40	8/12/10	70	20	70	8/12/10	110	31	130
14/12/10	11	6	12	14/12/10	110	320	150	14/12/10	120	37	150
21/12/10	45	18	59	22/12/10	300	190	450	22/12/10	2800	950	3600
6/01/11	30	19	35	7/01/11	160	100	190	7/01/11	80	42	90
11/01/11	< 1	< 1	< 1	12/01/11	60	50	100	12/01/11	50	80	50
18/01/11	60	24	70	19/01/11	400	600	500	19/01/11	470	330	530
				26/01/11	200	900	300	26/01/11	800	500	1500
10/02/11	6	7	6	3/02/11	60	150	70	3/02/11	65	46	90
14/02/11	8	10	8	9/02/11	110	60	140	9/02/11	100	22	130
24/02/11	5	6	6	17/02/11	60	80	100	17/02/11	360	320	360
3/03/11	20	28	20	23/02/11	370	260	370	23/02/11	90	19	100
Median	18	10	18	2/03/11	90	70	90	2/03/11	80	46	80
				Median	110	100	140	Median	100	46	130
Waipapa Tailrace				Ngaruawahia Bridge				Waipa River @ Ngaruawahia			
1/12/10	14	< 1	15	2/12/10	250	270	310	2/12/10	50	32	60
7/12/10	5	3	5	8/12/10	240	170	240	8/12/10	110	31	130
14/12/10	6	2	6	14/12/10	330	140	380	14/12/10	120	37	150
21/12/10	60	18	70	22/12/10	320	340	420	22/12/10	2800	950	3600
6/01/11	9	13	9	7/01/11	80	90	80	7/01/11	80	42	90
11/01/11	3	3	4	12/01/11	70	60	80	12/01/11	50	80	50
18/01/11	5	6	6	19/01/11	400	1600	400	19/01/11	470	330	530
25/01/11	100	1300	700	26/01/11	700	600	700	26/01/11	800	500	1500
2/02/11	10	7	10	3/02/11	100	150	130	3/02/11	65	46	90
10/02/11	7	8	7	9/02/11	150	70	150	9/02/11	100	22	130
14/02/11	6	8	6	17/02/11	80	60	120	17/02/11	360	320	360
24/02/11	3	9	3	23/02/11	350	340	350	23/02/11	90	19	100
3/03/11	12	< 1	12	2/03/11	170	220	230	2/03/11	80	46	80
Median	7	8	7	Median	240	170	240	Median	100	46	130

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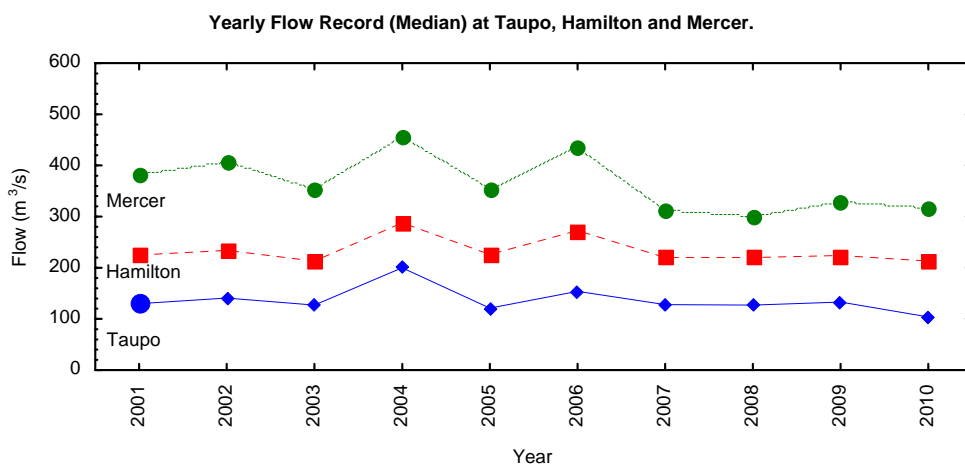
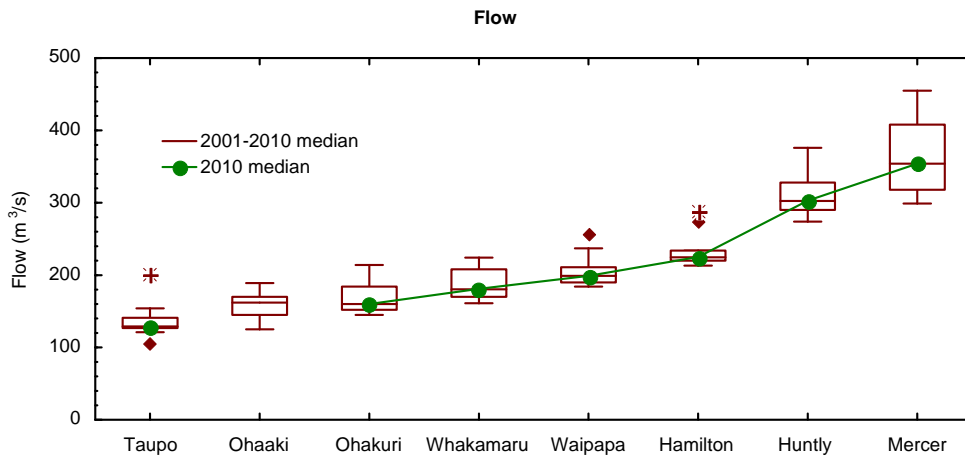
Appendix I:

Flow information

Median Flows of the Waikato River and Main Tributaries

Location	DISTANCE km	FLOW RATE ⁺ (m ³ /s)										10 YEAR
		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Median
Taupo	4.2	130	141	127	200	121	154	128	127	133	104	129
Ohakuri	75.8	150	164	157	214	152	184	157	163	145	192	160
Whakamaru	105.0	161	183	168	224	175	208	178	186	170	209	181
Waipapa	126.1	186	211	192	256	200	237	190	211	184	198	199
Hamilton	211.5	225	234	213	288	226	273	220	220	224	213	225
Huntly	246.5	299	328	315	376	290	343	282	274	306	296	303
Mercer	286.3	383	408	353	455	355	437	312	299	328	318	354
Waiotapu Stm	46.6	3.2	2.8	2.6	3.7	3.6	3.8	2.9	3.0	2.7	3.2	3.1
Waipa River	232.7	62	73	61	87	56	61	39	43	52	40	59

*Rating curve errors mean estimates of flow are ± 8%

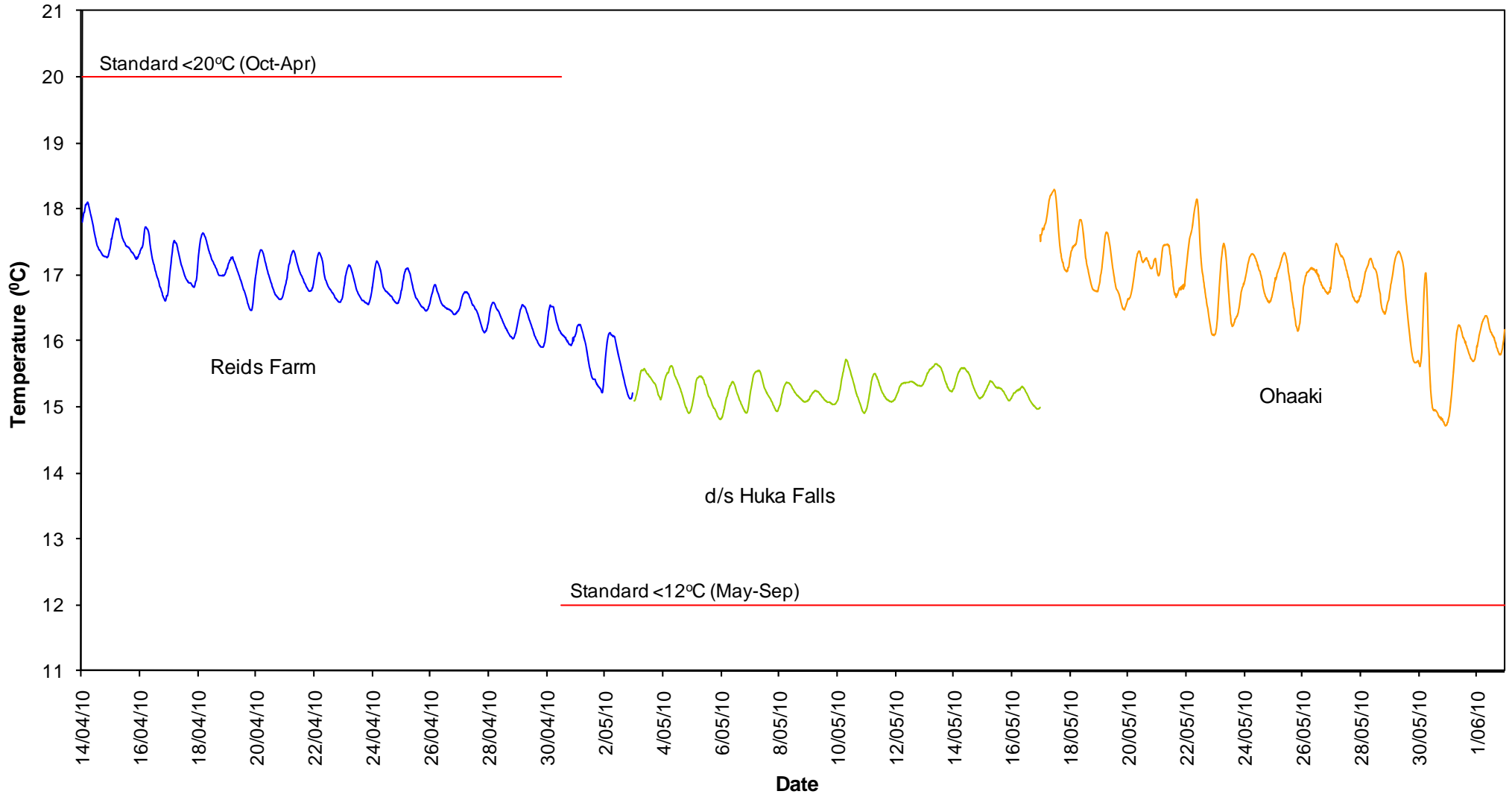


Appendix II

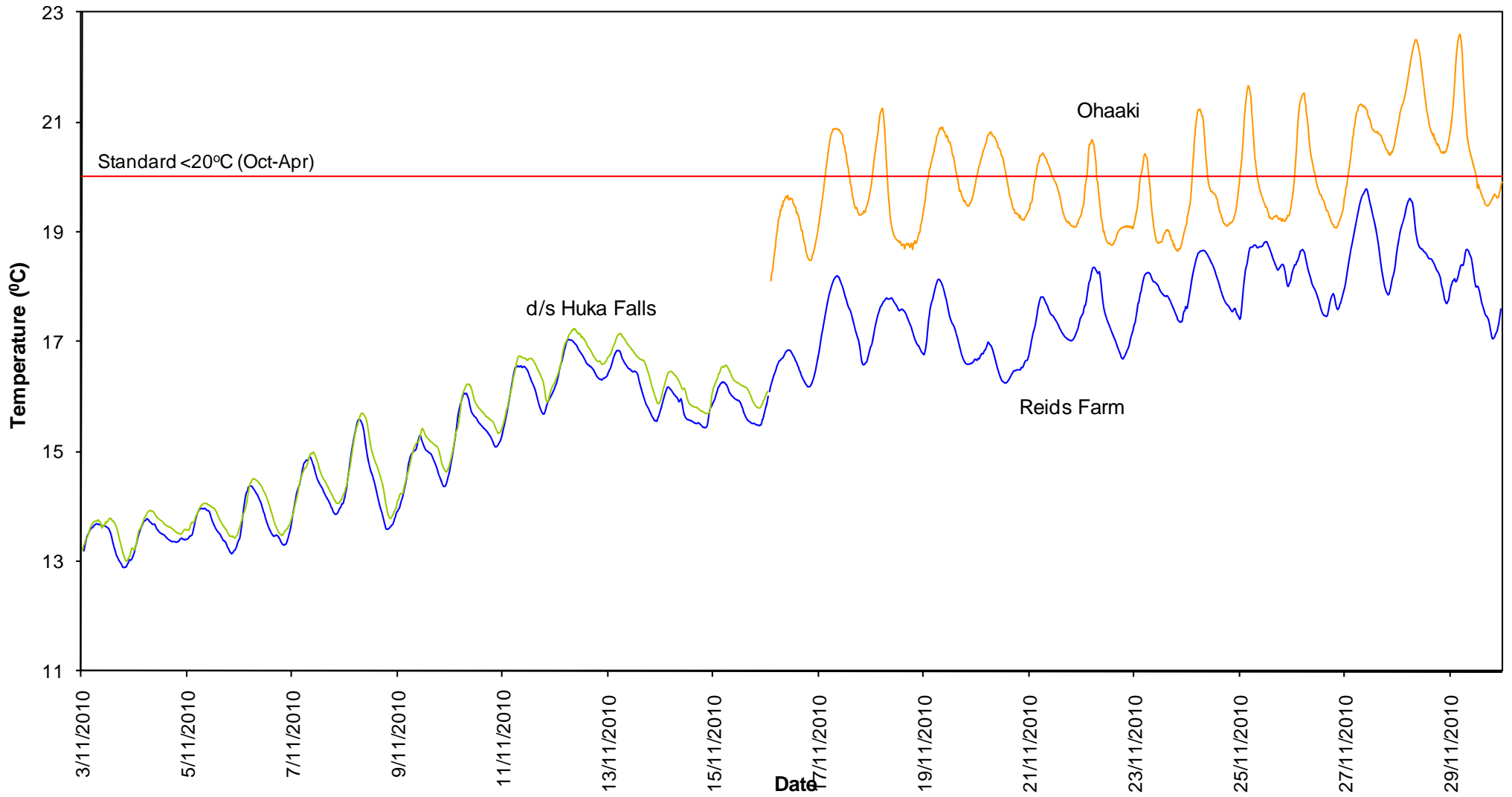
Datasonde deployments

Diurnal variation of some water quality parameters

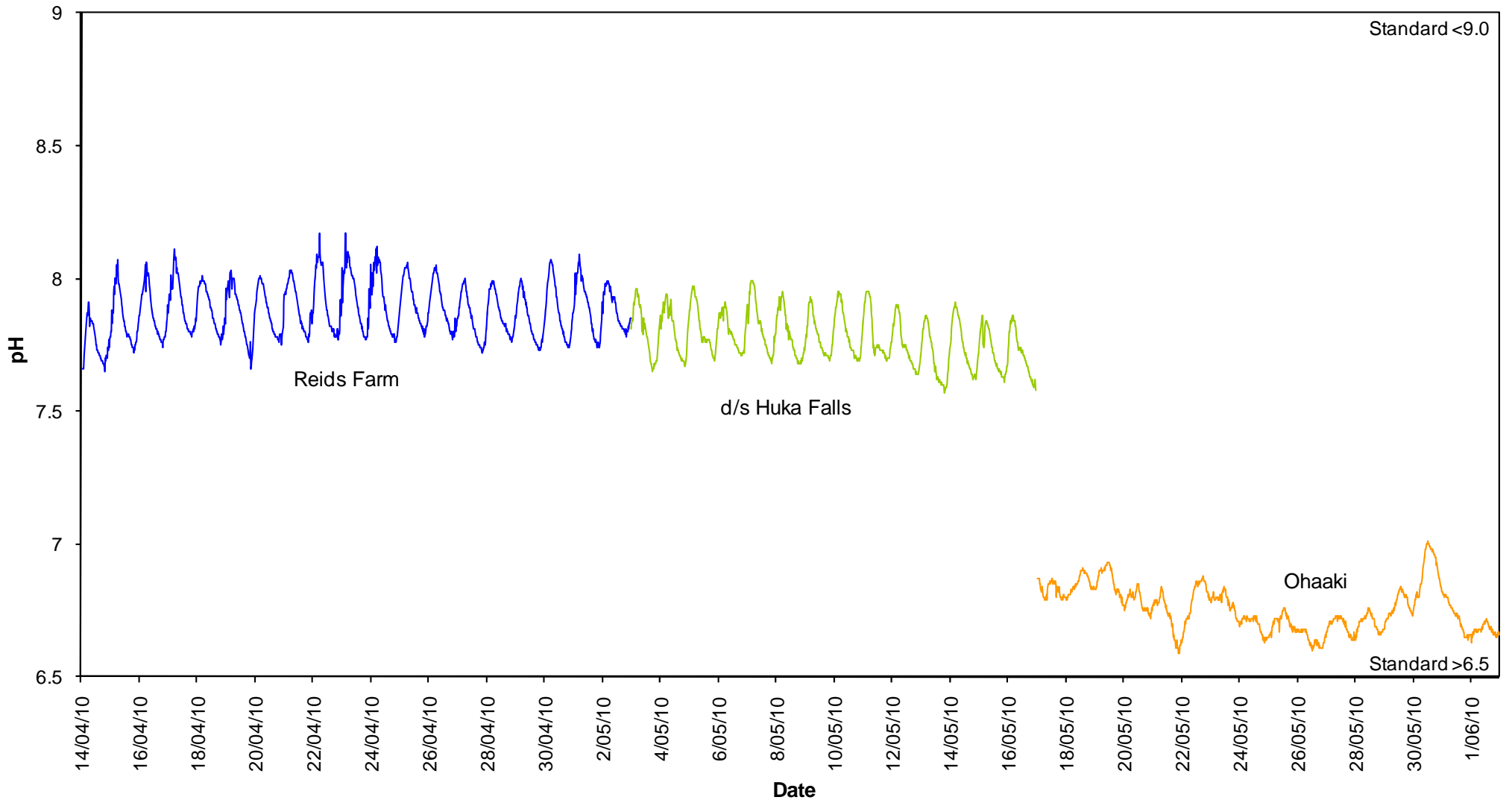
Temperature: Upper Waikato (April - June)



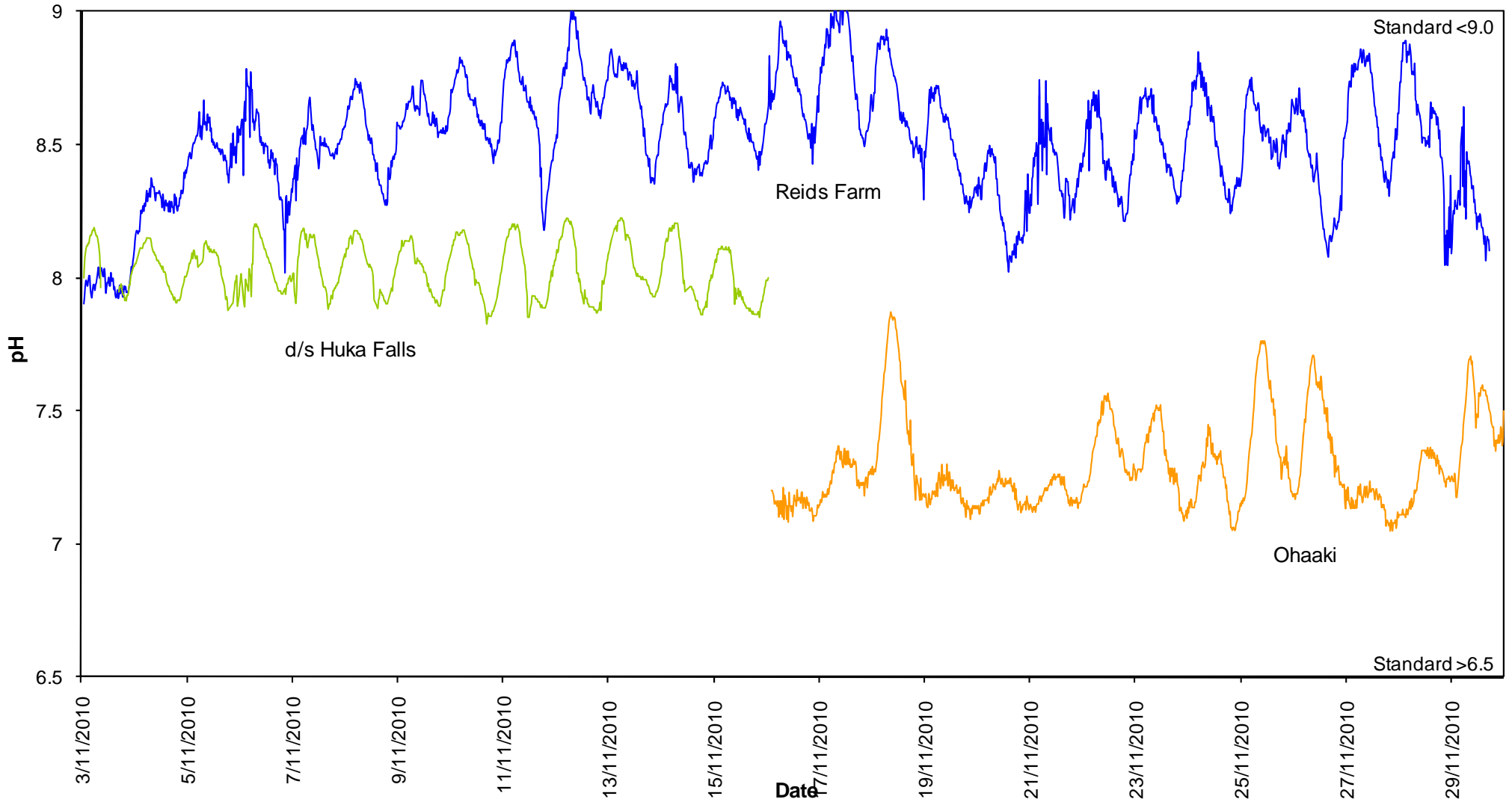
Temperature: Upper Waikato (November)



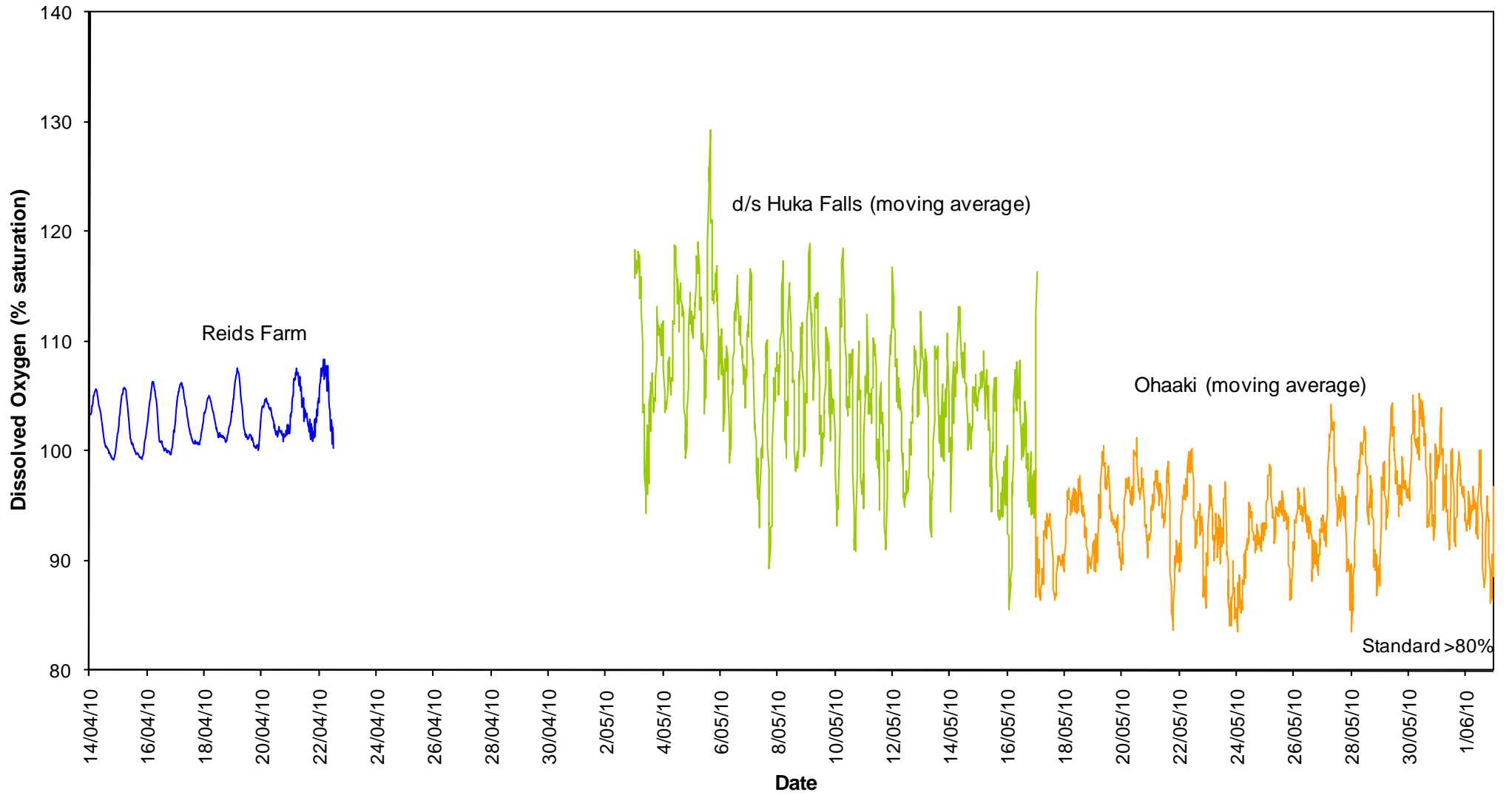
pH: Upper Waikato (April-June)



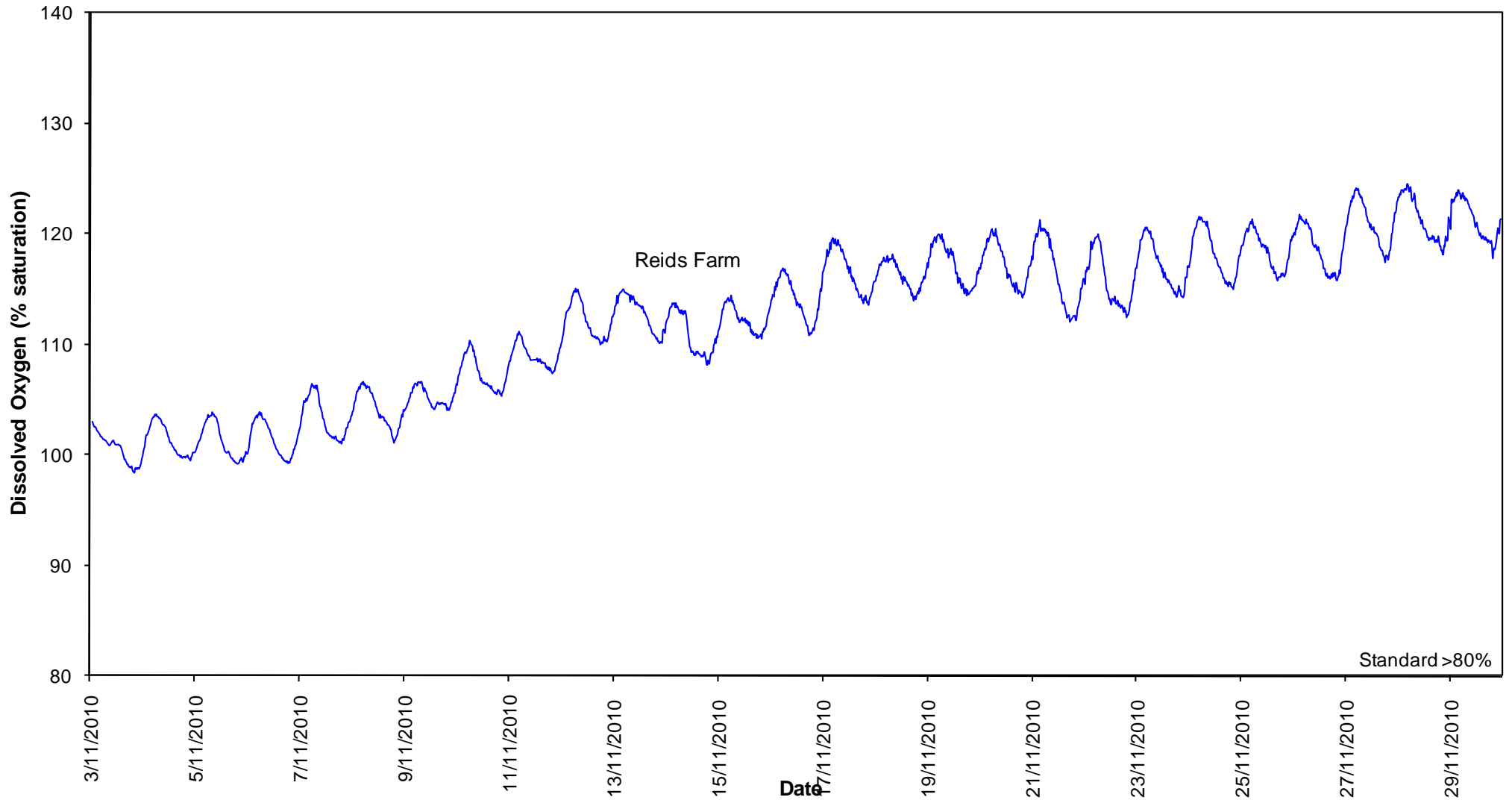
pH: Upper Waikato (November)



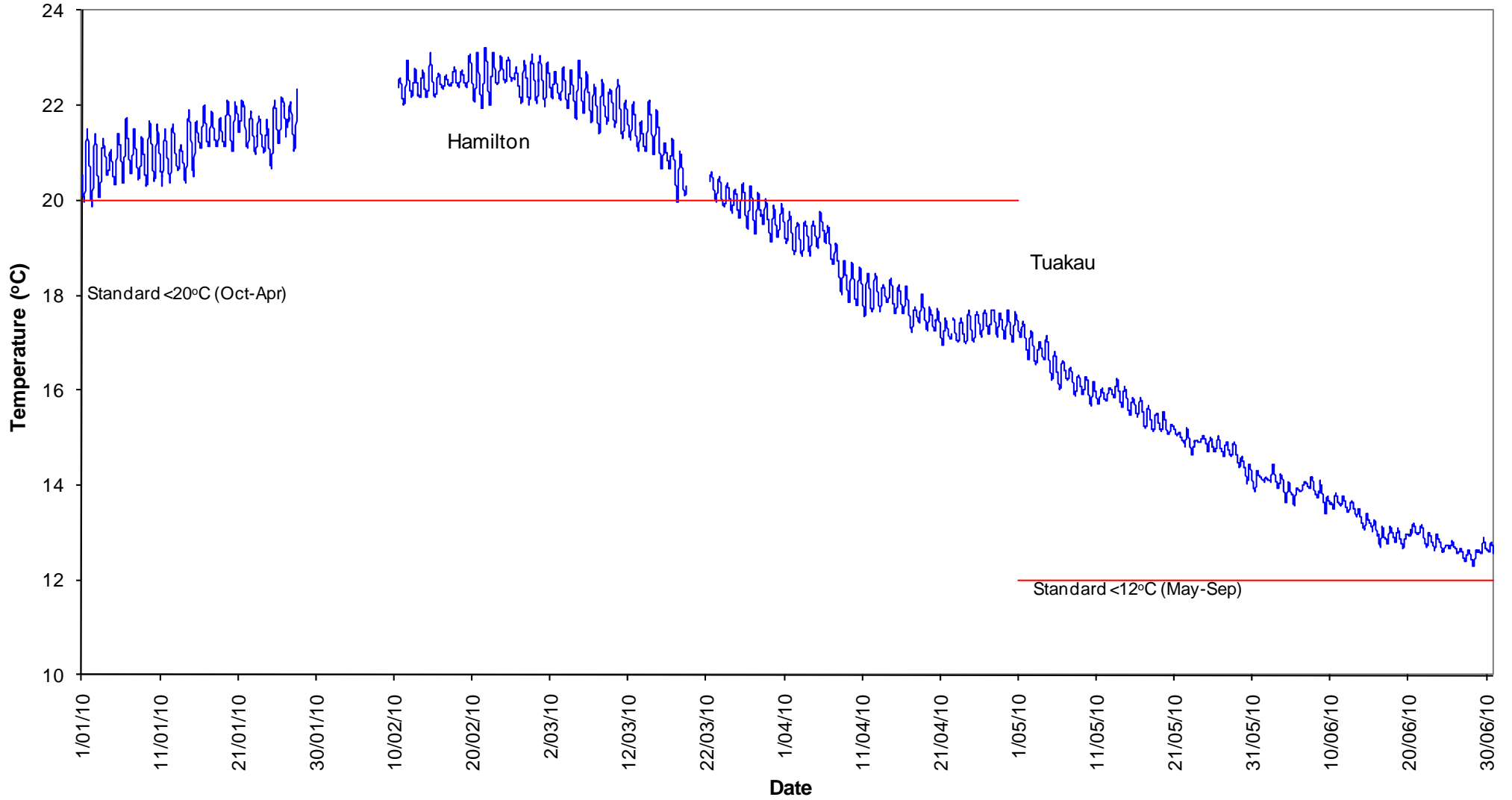
Dissolved Oxygen, % saturation: Upper Waikato (April - June)



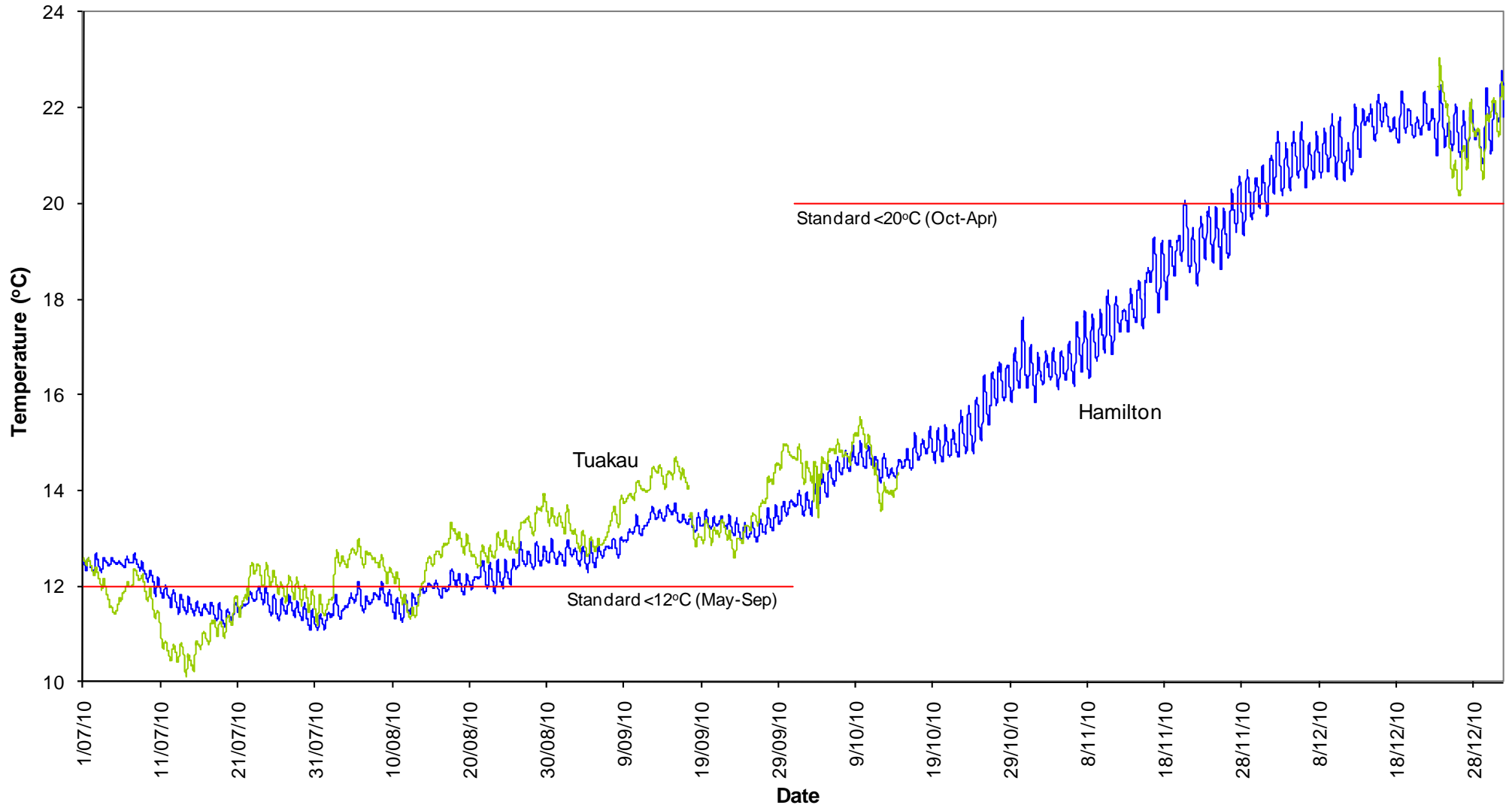
Dissolved Oxygen, % saturation: Upper Waikato (November)



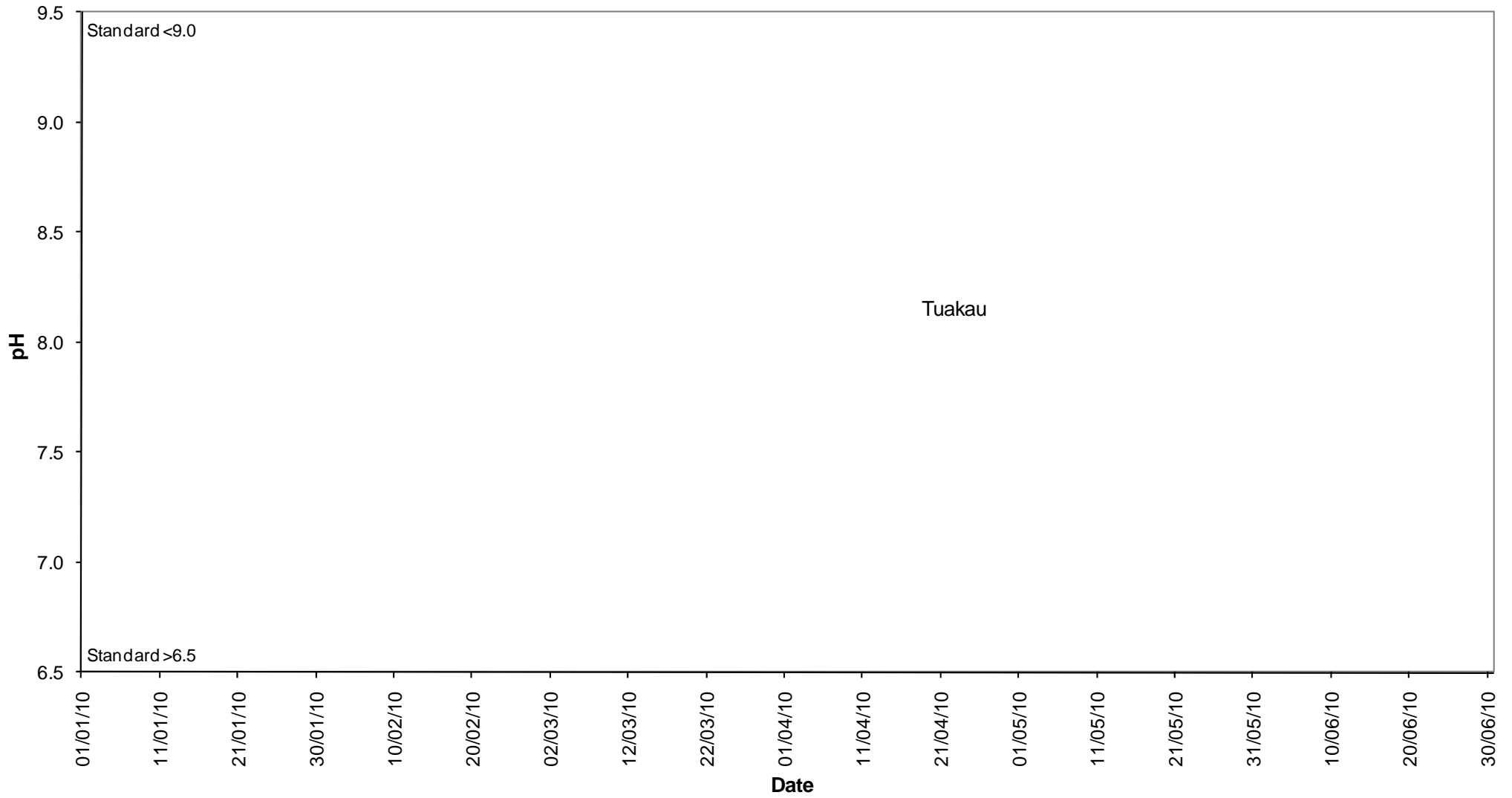
Temperature: Lower Waikato (January-June)



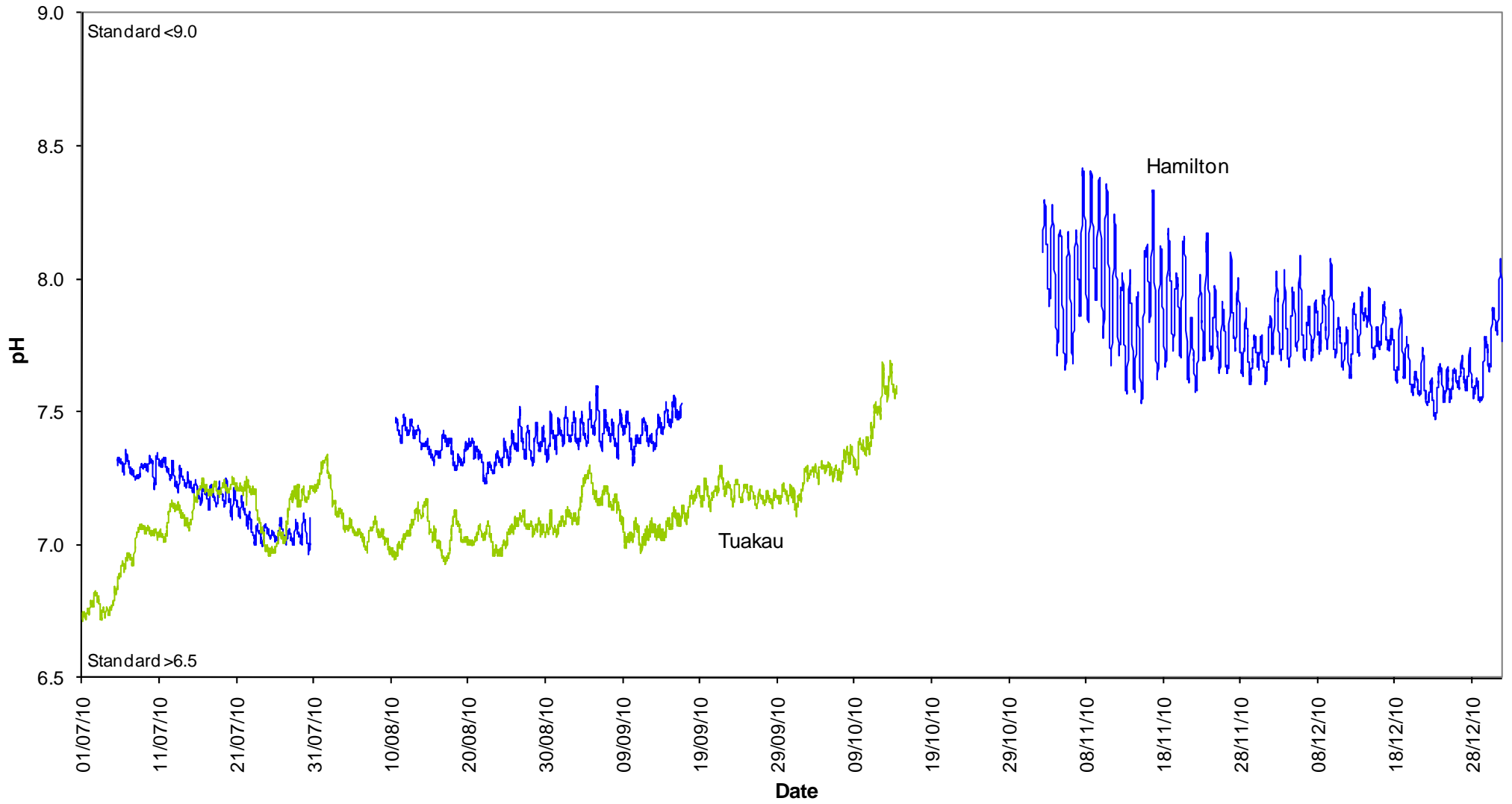
Temperature: Lower Waikato (July-December)



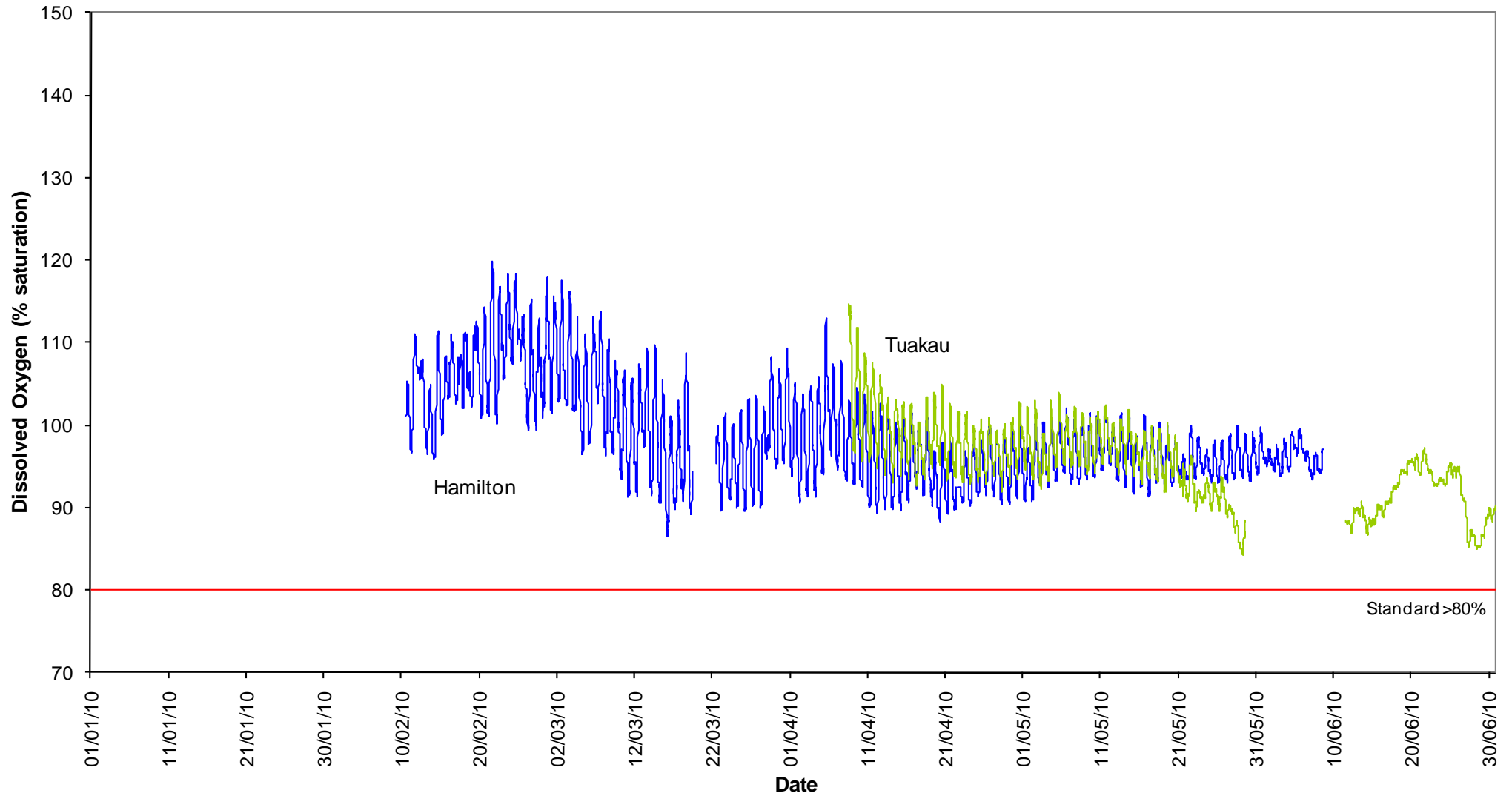
pH: Lower Waikato (January - June)



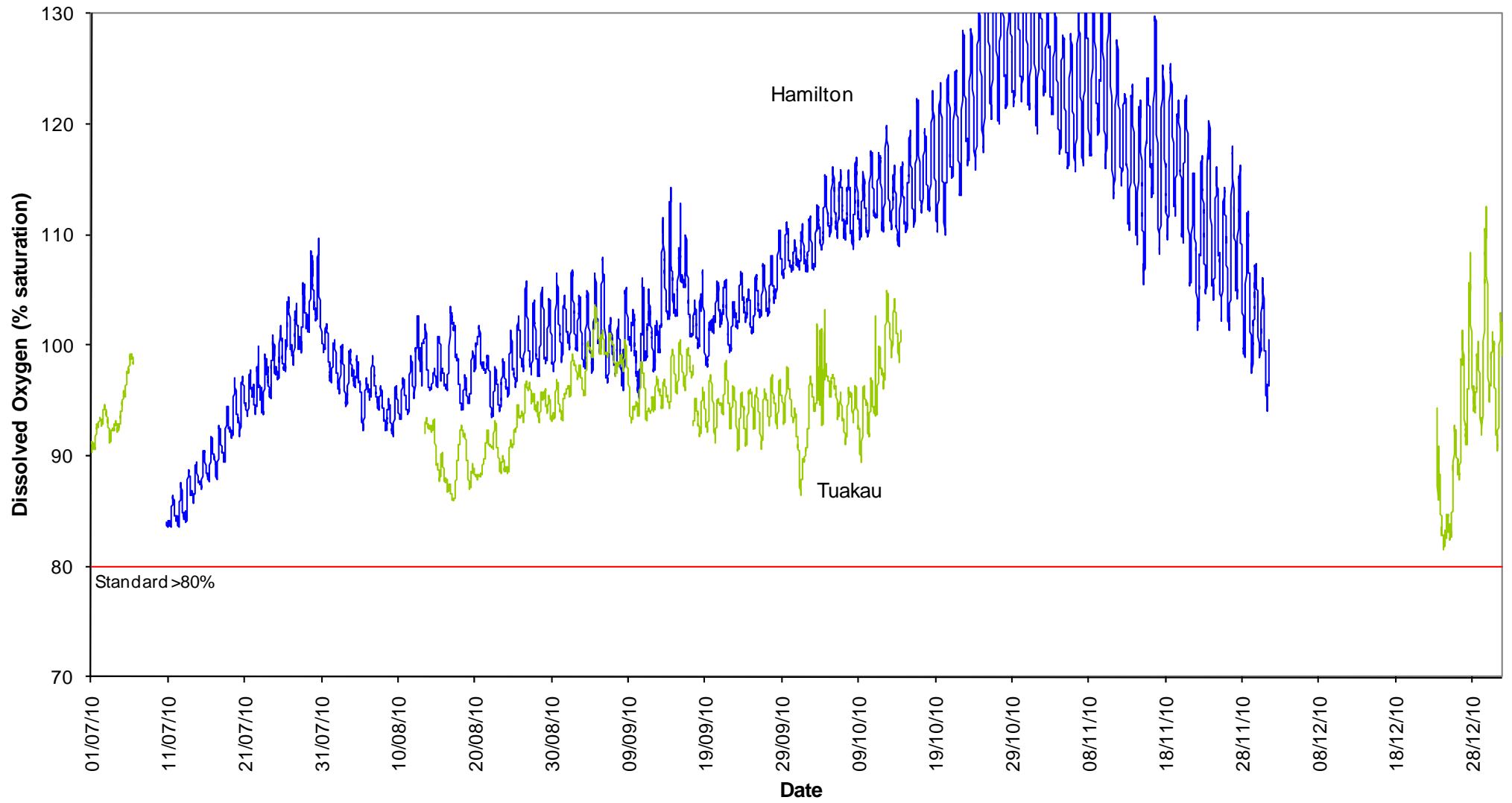
pH: Lower Waikato (July - December)



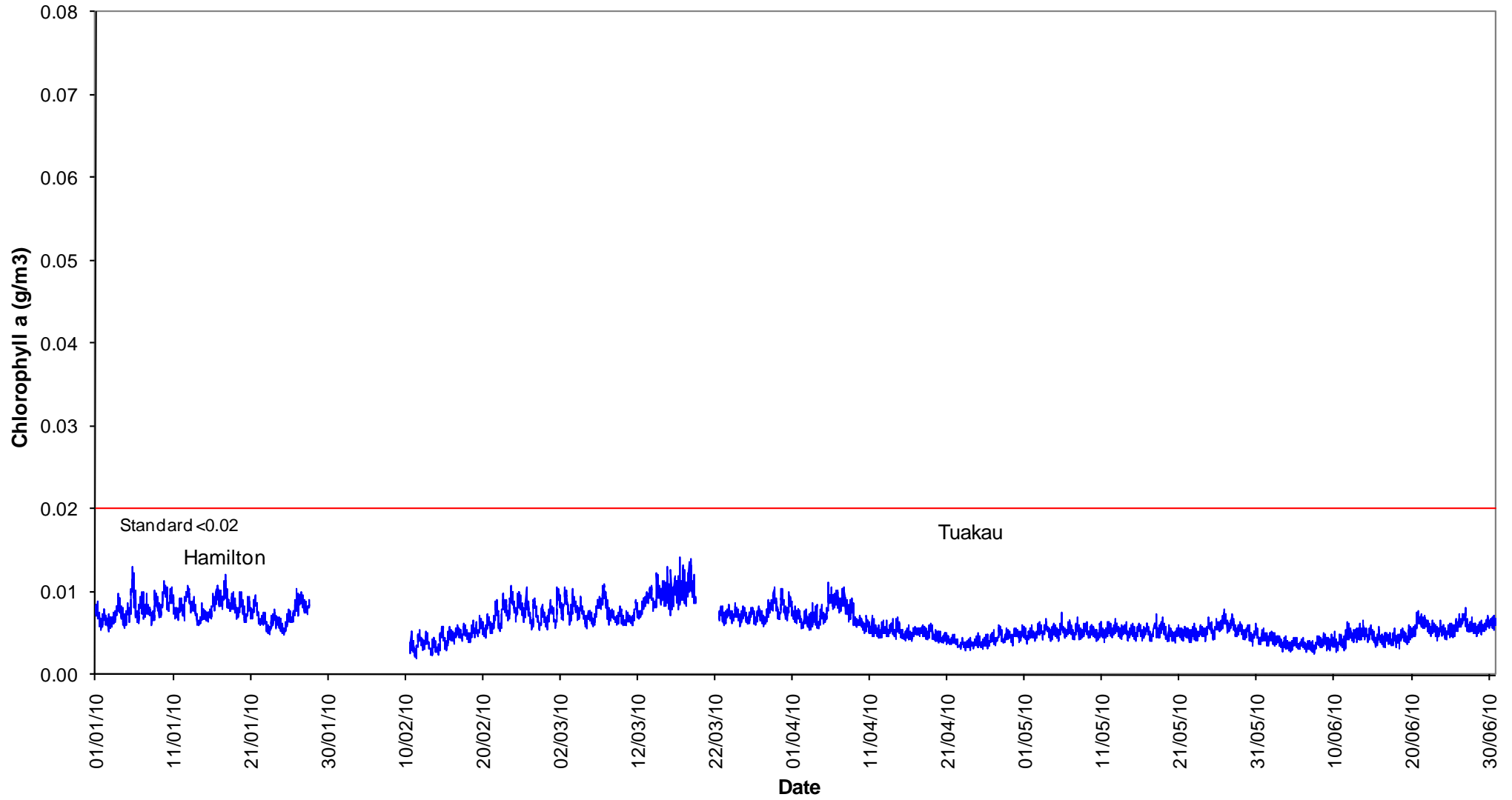
Dissolved Oxygen (% saturation): Lower Waikato (January - June)



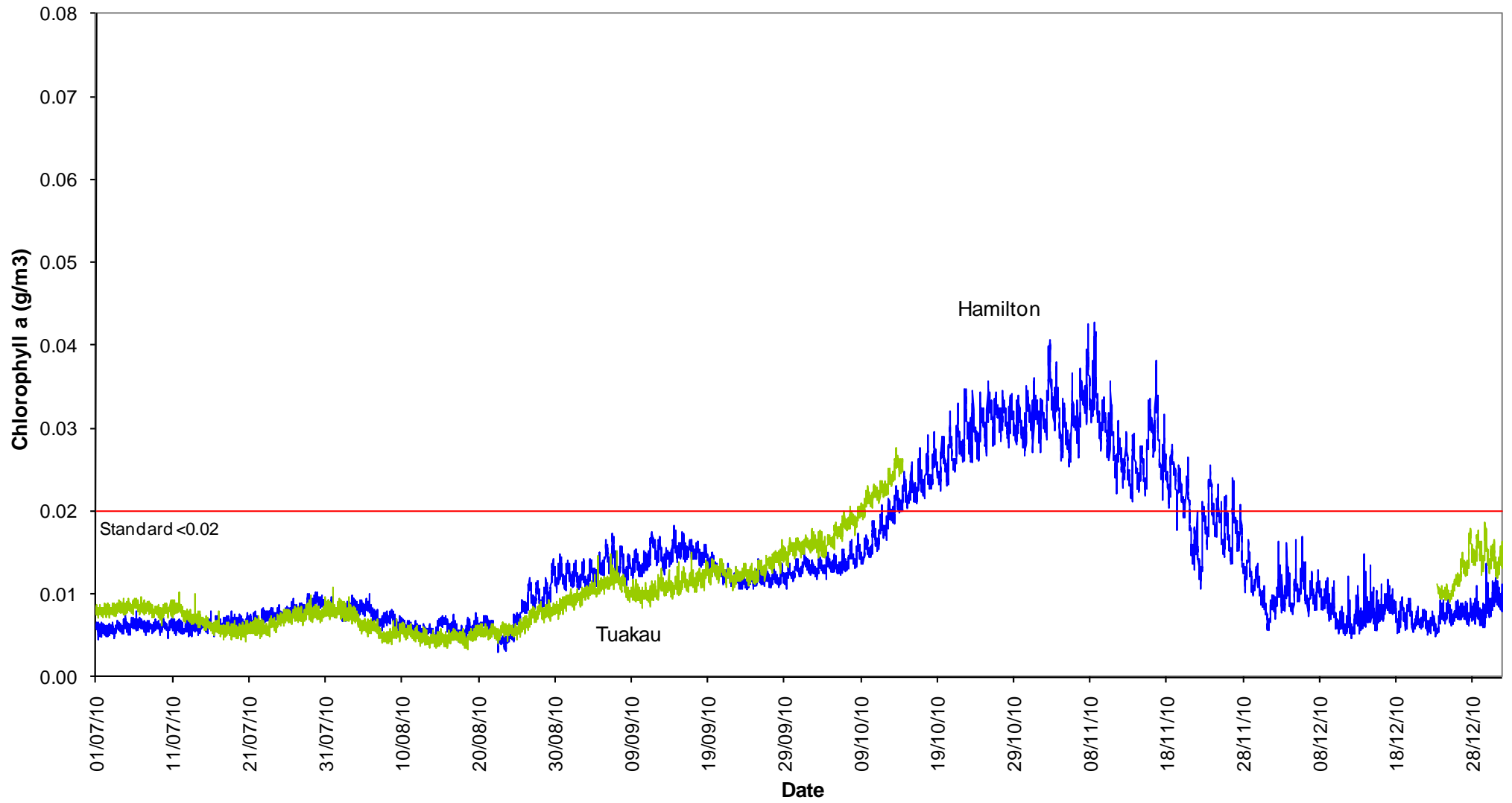
Dissolved Oxygen (% saturation): Lower Waikato (July - December)



Chlorophyll a: Lower Waikato (Jan - June)



Chlorophyll a: Lower Waikato (July - December)



Appendix III:
Water quality parameters
Guidelines and standards
Analytical methods

Waikato River water quality monitoring programme parameters

Water quality parameter	Reason for monitoring	Parameter monitored ¹	Comments ²
Dissolved oxygen	- requirement for aquatic life	DO (conc.)	routine (field)
	- indicator of organic pollution	DO (%sat.)	routine (field)
	- indicator of photosynthesis (plant growth)		
Temperature	- indicator of biological activity	Temperature	routine (field)
	- requirement for aquatic life		
	- mixing processes		
	- modelling studies (e.g. nutrient uptake)		
Conductivity	- indicator of total salts dissolved in water	Conductivity	routine
	- indicator for geothermal input	TDS	routine
pH	- aquatic life protection	pH	routine
	- indicator of industrial discharges, mining		
Clarity - turbidity - black disk (visual clarity)	- aesthetic appearance	Turbidity	routine
	- light availability for excessive plant growth	Black disk	routine (field)
	- aquatic life protection		
	- indicator of catchment condition, land use		
Colour - light absorption	- aesthetic appearance	Munsell colour	routine (field)
	- light availability for excessive plant growth	Absorbance at:	routine
	- indicator of presence of organic matter	340,440,780nm	
Nutrients (N and P) chlorophyll a	- enrichment, excessive plant growth	NO ₃ -N+NO ₂ -N	routine
	- nutrient limitation for plant/algal growth	NH ₄ -N,TKN DRP, TP, Chl <i>a</i>	
Geothermal contaminants	- indicators of geothermal inflows	Cl, Li, B, As	routine
	- aquatic life protection (ecotoxicity)		
	- drinking water (human health aspects)		
Organic carbon	- indicator of organic pollution	BOD ₅	routine
	- catchment characteristics	TOC/DOC	routine
Faecal bacteria - <i>E. coli</i> - enterococci - faecal coliforms	- indicator of pollution with faecal matter	<i>E. Coli</i>	routine
	- disease risk for swimming etc.	ENT	routine
		FC	routine

¹ see the page 54 for the meaning of the abbreviations.

² routine means sampled monthly.

Details of water quality standards and guidelines 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/m ³	USEPA (1998) value for 1-hour exposure at pH 9.
Temperature	<12°C (May – Sep) <20°C (Oct – Apr)	Waikato Regional Council Proposed Regional Plan standards for trout fisheries and trout spawning (1998).
Total phosphorus	<0.04 g/m ³	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 ³	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).
Escherichia coli	<550/100 mL	Ministry for the Environment (2003) guidelines for the management of recreational and marine shellfish-gathering waters.
Median Escherichia coli	<126/100 mL	Ministry for the Environment (1999) guidelines for the management of recreational and marine shellfish-gathering waters.
Enterococci	<77/100 mL	Department of Health (1992) guidelines for “moderate” level of recreational use.
Chlorophyll a	<0.02 g/m ³	Ministry for the Environment (1992).
Arsenic	<0.01 g/m ³	Ministry of Health (2001).
Boron	<1.4 g/m ³	Ministry of Health (2001).

Waikato River monitoring programme - water quality parameters and analytical methods

Id ¹	Parameter	Method
A340F	Absorbance @ 340 nm filtered	Spectrophotometer, 1 cm path length, APHA method 5910B
A440F	Absorbance @ 440 nm filtered	Spectrophotometer, 1 cm path length, APHA method 5910B
A780F [■]	Absorbance @ 780 nm filtered	Spectrophotometer, 1 cm path length, APHA method 5910B
As	Arsenic total	Nitric acid digestion, ICP-MS, APHA method 3125B
B	Boron	ICP-MS, APHA method 3125B
BDISK	Black disk	Field measurement, horizontal water transparency (20mm, 60mm, 100mm, 200mm disk) in river or trough (20mm only)
BOD ₅	Biochemical oxygen Demand (5 day)	Incubation 5 days at 20°C, DO-meter, No nitrification inhibitor added, unseeded, APHA method 5210B
CHLA	Chlorophyll a	Acetone extraction. Spectroscopy. APHA method 10200H
CI	Chloride	Filtered sample. Ion Chromatography APHA method 4110B
COLOUR	Colour	Field measurement, Munsell Colour Patches
COND	Conductivity	Lab Meter @ 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)
DOC	Dissolved organic Carbon	Filtration, acidification, purging to remove inorganic C, catalytic oxidation, IR detection. APHA method 5310B (modified)
DRP	Dissolved reactive Phosphorus	Molybdenum Blue Colorimetry. Flow injection analyser. APHA 4500 PG (proposed)
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 9230C
FC	Faecal coliforms	Membrane Filtration with resuscitation(mFC Agar). APHA method 9222D
Flow	Flow – instantaneous	Calculated from rating curve ± 8%
Li	Lithium	ICP-MS, method APHA 3125B
NH ₄ -N	Ammoniacal Nitrogen (Total)	Phenol/Hypochlorite Colorimetry. Flow injection analyser. APHA method 4500-NH ₃ H
NNN	Nitrite/Nitrate Nitrogen	Automated Cadmium reduction. Flow injection analyser. APHA method 4500 – NO ₃ I (proposed).
NO ₃ -N	Nitrate nitrogen	Calculation: (Nitrate-N + Nitrite -N) – Nitrite - N
pH	pH	Lab Meter @ 25°C. APHA method 4500-H ⁺ B
TDS	Total dissolved solids	Filtration, gravimetric. APHA 2540C (modified)
TEMP	Temperature	Field measurement (WTW DO meter, model 340A)
TKN	Total Kjeldahl-Nitrogen	Acid digestion. Phenol/Hypochlorite colorimetry. Flow injection analyser. APHA method 4500-N _{org} D (modified)
TOC	Total Organic Carbon	Acidification, purging to remove inorganic C, catalytic oxidation, IR detection. APHA method 5310B (modified)
TN	Total Nitrogen	Calculated from NNN + TKN (Nitrite/Nitrate Nitrogen + Total Kjeldahl-Nitrogen)
TP	Total Phosphorus	Acid persulphate digestion, Colorimetry. Discrete Analyser. APHA method 4500-PE (modified)
TURB	Turbidity	Turbidity Meter Hach 2100N. APHA method 2130B

¹ Water quality parameter identification code refers to Waikato Regional Council's water quality database (TimeStudio) parameter short name.

APHA = Standards Methods for the Examination of Water and Wastewater, 20th Edition, 1998, APHA, AWWA, WEF

ICP-MS = Inductively Coupled Plasma – Mass Spectroscopy