

# Waikato River water quality monitoring programme: Data report 2014

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# Table of contents

<b>Acknowledgement</b>	<b>i</b>
<b>1 Introduction</b>	<b>1</b>
1.1 Background	1
1.2 Report content	1
1.3 Water quality guidelines and standards	2
<b>2 The Waikato River monitoring programme design</b>	<b>3</b>
2.1 Sampling collection	3
2.2 Sample locations	3
2.3 Water quality parameters	4
2.4 Quality control, data storage and analysis	5
2.5 Reports	5
<b>3 Results</b>	<b>5</b>
3.1 Waikato River Monitoring Programme	5
Routine Water Quality Monitoring	5
Summary Statistics	5
Key Parameter Graphs	5
Comparison with Water Quality Standards	5
Raw Data	5
3.2 Waikato River Monitoring Programme	24
Bathing Season Microbiological Survey	24
Summary Statistics	24
Comparison with Water Quality Standards	24
Parameter Graph	24
Raw Data	24
<b>References</b>	<b>27</b>
<b>Appendix I:</b>	<b>28</b>
Flow Information	28
<b>Appendix II</b>	<b>30</b>
Datasonde deployments	30
Diurnal variation of selected water quality parameters	30
<b>Appendix III:</b>	<b>45</b>
Water quality parameters	45
Guidelines and standards	45
Analytical methods	45

# Tables

Table 1:	Guidelines and standards for physicochemical water quality for ecological health and for human uses of water	2
Table 2:	Routine sampling and bathing water monitoring locations	4
Table 3:	Samples (year 2014) complying with the 'satisfactory' water quality guidelines and standards. n = 12.	17
Table 4:	Samples (year 2014) complying with the 'excellent' water quality guidelines and standards. n = 12	17
Table 5:	Bathing Season Statistics of E. coli Bacteria.	24
Table 6:	Year 2014/15 Bathing Season E. coli survey results complying with the "Satisfactory" and "Excellent" Water Quality Guidelines. n = 13 (except * where n = 12).	25

# Figures

Figure 1:	Waikato River water quality monitoring locations	3
Figure 2:	E. coli - five bathing season data	25





# 1 Introduction

## 1.1 Background

The year 2014 report follows the format of the previous data report (Tulagi, 2014).

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 24<sup>th</sup> 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.waikatoregion.govt.nz/Publications/> or by contacting Waikato Regional Council (the Library) on 0800 800 401, e-mail: [inforeq@waikatoregion.govt.nz](mailto:inforeq@waikatoregion.govt.nz).

## 1.2 Report content

The report provides information on:

1. Routine monthly monitoring of water quality at 10 sites:
  - Year 2014 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 2014 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 2014.
  - Raw data for the 2-yearly bathing season microbiological survey (17 sites, weekly sampling).
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 provide information on annual median flow at some locations for the previous 10 years.
  - Datasonde deployments
    - Plots of deployments undertaken during 2014 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 2014. 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 III). The more stringent criteria identify “excellent” water, and reflect expert opinion. Samples gathered in 2014 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 <sup>1</sup>	Satisfactory	Excellent
<b>Ecological health</b>			
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 <sup>3</sup> )	aquatic life (toxicity)	<0.88	<0.1
Temperature (°C)	fish (spawning)	<12 (May-Sep) <20 (Oct-Apr)	<10 <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
Escherichia coli (no./100 mL)	human health	<550	<55
Median Escherichia coli (no./100 mL)	human health	<126	<23
<b>Human uses - water supply</b>			
Phytoplankton chlorophyll a (g/m <sup>3</sup> )	filter blockage	<0.02	<0.005
<b>Human uses - drinking water</b>			
Arsenic (g/m <sup>3</sup> )	human health (toxicity)	<0.01	–
Boron (g/m <sup>3</sup> )	human health (toxicity)	<1.4	–

<sup>1</sup> Refer to Appendix III for description of guideline and standards values used. These guidelines and standards are also defined on the Waikato Regional Council Internet site; [www.waikatoregion.govt.nz](http://www.waikatoregion.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 illustrated in *Figure 1* and summarised in *Table 2*.

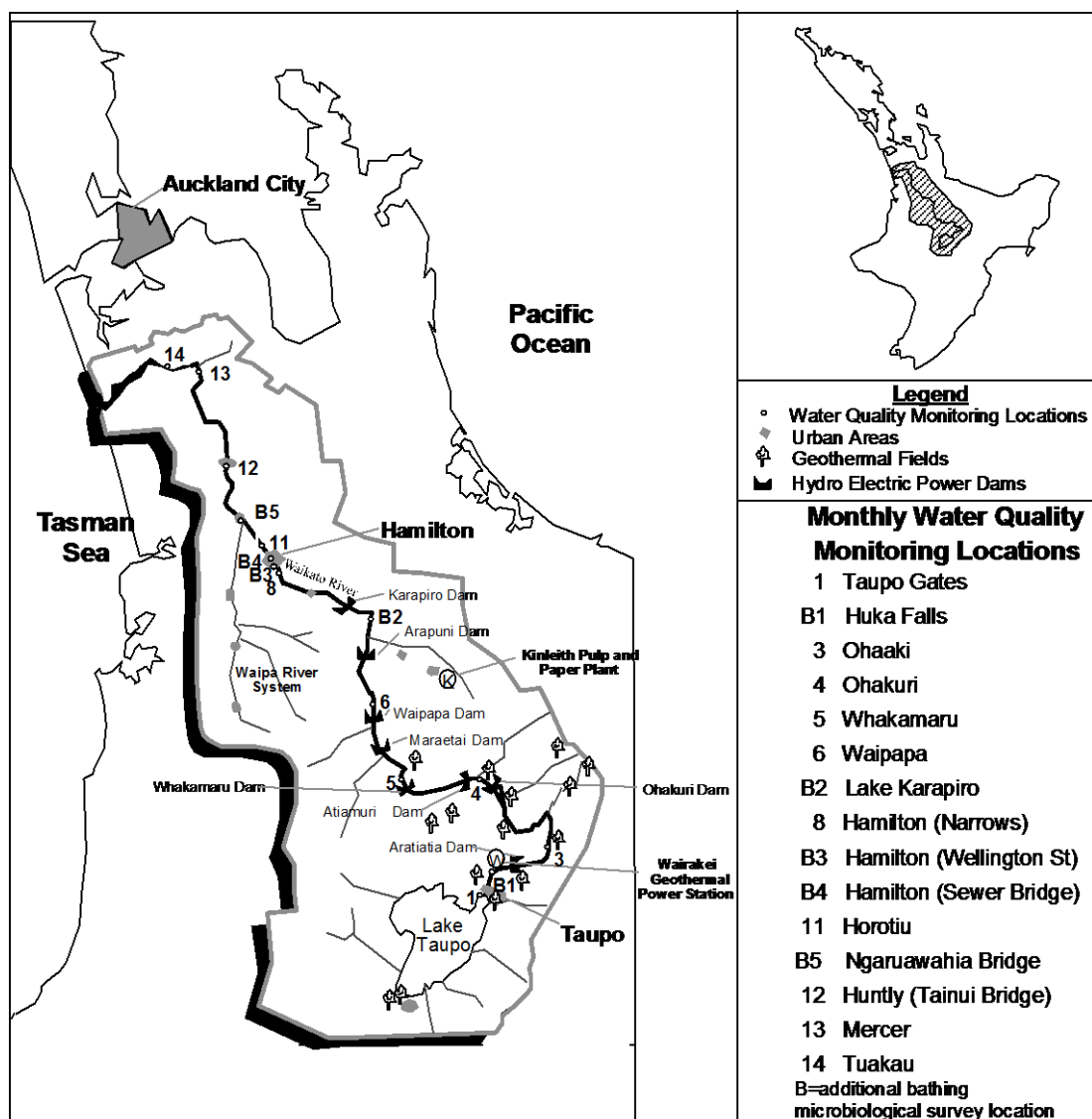


Figure 1: Waikato River water quality monitoring locations

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).

**Table 2: Routine sampling and bathing water monitoring locations**

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

<sup>1</sup> approximate distance (in kilometres) from Lake Taupo's outlet.

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

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

<sup>4</sup> boat ramp at Whakamaru Power Station.

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

<sup>6</sup> boat ramp accessed via Narrows Lane (true right bank)

<sup>7</sup> road bridge upstream of Waipa River confluence.

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

<sup>b</sup> bathing season intensive microbiological survey locations only – survey conducted over the 2014/15 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.

<sup>†</sup> Logistic considerations mean field measurements are often made at slightly different locations from sample collection (e.g. sampling from bridges).

<sup>d</sup> Datasonde deployment sites.

## 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 III*).

## 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 database called WISKI.

Data analysis was performed using Statistica (version 11.0) 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).

Waikato Regional Council Technical Report 2013/20, Trends in River Water Quality in the Waikato Region, 1993–2012 (Vant, 2013) 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.waikatoregion.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.waikatoregion.govt.nz/Fresh-water-quality>

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

## 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	0.001	0.001	0.001	0.002	0.000	<u>3.02</u>	0.001
Ohaaki Bridge	12	0.003	0.003	0.001	0.005	0.003	0.00	0.003
Ohakuri Tailrace Bridge	12	0.005	0.005	0.002	0.008	0.001	0.26	0.005
Whakamaru Tailrace	12	0.007	0.007	0.003	0.014	0.002	1.50	0.007
Waipapa Tailrace	12	0.010	0.009	0.007	0.015	0.002	1.14	0.010
Narrow s	12	0.012	0.011	0.008	0.023	0.003	1.54	0.011
Horotiu Bridge	12	0.013	0.012	0.008	0.028	0.003	<u>2.00</u>	0.012
Huntly-Tainui Bridge	12	0.019	0.017	0.011	0.037	0.005	1.42	0.018
Mercer Bridge	12	0.021	0.019	0.010	0.038	0.013	0.65	0.021
Tuakau Bridge	12	0.022	0.020	0.008	0.042	0.013	0.63	0.024

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	0.001	0.000	-1.00	0.001
Ohaaki Bridge	12	0.001	0.001	0.001	0.001	0.000	-1.00	0.001
Ohakuri Tailrace Bridge	12	0.001	0.001	0.001	0.001	0.000	-1.00	0.001
Whakamaru Tailrace	12	0.001	0.001	0.001	0.003	0.000	<u>3.02</u>	0.001
Waipapa Tailrace	12	0.002	0.001	0.001	0.004	0.002	0.75	0.001
Narrow s	12	0.002	0.002	0.001	0.004	0.002	0.79	0.002
Horotiu Bridge	12	0.002	0.001	0.001	0.005	0.002	1.25	0.002
Huntly-Tainui Bridge	12	0.003	0.003	0.002	0.007	0.001	1.59	0.003
Mercer Bridge	12	0.004	0.003	0.001	0.008	0.002	0.83	0.004
Tuakau Bridge	12	0.004	0.004	0.001	0.008	0.002	0.66	0.004

Arsenic - Total (g/m <sup>3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.012	0.012	0.010	0.013	0.001	-0.33	0.011
Ohaaki Bridge	12	0.027	0.026	0.020	0.041	0.008	0.99	0.027
Ohakuri Tailrace Bridge	12	0.030	0.029	0.027	0.036	0.004	0.85	0.031
Whakamaru Tailrace	12	0.029	0.029	0.023	0.035	0.007	-0.04	0.030
Waipapa Tailrace	12	0.025	0.025	0.020	0.031	0.004	0.44	0.026
Narrow s	12	0.022	0.023	0.017	0.029	0.005	0.36	0.023
Horotiu Bridge	12	0.023	0.023	0.017	0.029	0.006	0.11	0.023
Huntly-Tainui Bridge	12	0.016	0.016	0.006	0.027	0.007	0.06	0.017
Mercer Bridge	12	0.017	0.018	0.008	0.025	0.008	-0.07	0.017
Tuakau Bridge	12	0.017	0.016	0.010	0.028	0.007	0.67	0.017

Boron (g/m <sup>3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.17	0.17	0.16	0.19	0.01	0.28	0.17
Ohaaki Bridge	12	0.31	0.31	0.22	0.47	0.11	0.76	0.28
Ohakuri Tailrace Bridge	12	0.33	0.33	0.28	0.39	0.06	0.16	0.33
Whakamaru Tailrace	12	0.32	0.33	0.27	0.37	0.06	-0.14	0.33
Waipapa Tailrace	12	0.29	0.29	0.23	0.32	0.04	-0.65	0.29
Narrow s	12	0.25	0.26	0.21	0.28	0.03	-0.57	0.25
Horotiu Bridge	12	0.26	0.26	0.21	0.29	0.04	-0.58	0.26
Huntly-Tainui Bridge	12	0.19	0.19	0.08	0.29	0.05	-0.27	0.19
Mercer Bridge	12	0.20	0.22	0.11	0.27	0.07	-0.41	0.20
Tuakau Bridge	12	0.21	0.22	0.14	0.29	0.06	-0.03	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	12	4.3	4.0	2.5	9.0	1.5	1.64	3.5
Ohakuri Tailrace Bridge	12	2.5	2.4	1.8	3.8	0.9	0.66	2.3
Whakamaru Tailrace	12	2.3	2.2	1.8	3.4	0.4	1.15	1.9
Waipapa Tailrace	12	2.0	2.0	1.0	2.5	0.4	-0.98	1.9
Narrow s	12	2.0	1.9	1.0	3.5	1.1	0.55	1.6
Horotiu Bridge	12	1.6	1.5	0.9	3.5	0.6	<u>1.78</u>	1.3
Huntly-Tainui Bridge	12	1.1	1.2	0.3	2.6	0.6	1.21	0.9
Mercer Bridge	-	-	-	-	-	-	-	-
Tuakau Bridge	12	0.7	0.7	0.4	1.4	0.4	0.87	0.6

Biochemical Oxygen Demand - 5 day (g/m <sup>3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.8	0.7	0.2	1.6	0.5	0.45	0.7
Ohaaki Bridge	12	0.9	1.0	0.5	1.3	0.3	-0.07	0.8
Ohakuri Tailrace Bridge	12	1.0	1.0	0.4	1.9	0.5	0.52	0.9
Whakamaru Tailrace	12	1.1	1.1	0.4	1.7	0.8	-0.01	1.0
Waipapa Tailrace	12	1.0	1.0	0.2	1.6	0.5	-0.20	0.8
Narrow s	12	1.1	1.2	0.6	1.5	0.3	-0.58	1.0
Horotiu Bridge	12	1.2	1.2	0.4	1.8	0.7	-0.24	1.0
Huntly-Tainui Bridge	12	1.4	1.3	0.6	3.7	0.5	<u>2.38</u>	1.1
Mercer Bridge	12	1.4	1.5	0.7	1.8	0.4	-0.93	1.2
Tuakau Bridge	12	1.5	1.6	0.5	2.0	0.4	-1.10	1.3

Carbon - Dissolved Organic (g/m <sup>3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	1.03	0.95	0.50	1.80	0.70	0.58	0.95
Ohaaki Bridge	12	0.87	0.85	0.60	1.20	0.35	0.20	1.00
Ohakuri Tailrace Bridge	12	1.15	1.05	0.70	2.40	0.35	<u>1.82</u>	1.10
Whakamaru Tailrace	12	1.21	1.20	0.70	2.00	0.50	0.39	1.20
Waipapa Tailrace	12	1.35	1.30	1.00	2.00	0.15	1.37	1.37
Narrow s	12	1.56	1.40	1.10	2.60	0.60	0.94	1.50
Horotiu Bridge	12	1.66	1.65	1.00	3.00	0.30	1.28	1.60
Huntly-Tainui Bridge	12	2.19	1.85	1.10	3.80	1.40	0.63	2.00
Mercer Bridge	12	2.16	1.70	1.10	4.20	1.35	0.97	2.10
Tuakau Bridge	12	2.33	2.00	1.30	4.70	1.10	1.16	2.35

Carbon - Total Organic (g/m <sup>3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	1.12	0.90	0.60	2.50	0.40	<u>1.68</u>	1.15
Ohaaki Bridge	12	0.92	0.90	0.60	1.20	0.15	-0.13	1.12
Ohakuri Tailrace Bridge	12	1.20	1.10	0.90	2.60	0.25	<u>2.60</u>	1.30
Whakamaru Tailrace	12	1.30	1.25	0.80	2.20	0.45	0.82	1.50
Waipapa Tailrace	12	1.48	1.45	1.10	2.20	0.30	1.11	1.70
Narrow s	12	1.83	1.65	1.20	3.30	0.55	<u>1.71</u>	1.90
Horotiu Bridge	12	1.87	1.70	1.10	3.30	0.45	1.30	2.00
Huntly-Tainui Bridge	12	2.69	2.05	1.60	5.20	1.90	0.90	2.60
Mercer Bridge	12	2.71	2.25	1.70	5.10	1.30	1.21	3.10
Tuakau Bridge	12	2.97	2.80	1.60	5.60	1.30	1.05	3.35

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

Chloride (g/m <sup>3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	7.8	7.9	7.4	8.2	0.5	-0.15	8.4
Ohaaki Bridge	12	16.9	15.7	10.8	24.0	6.7	0.39	16.6
Ohakuri Tailrace Bridge	12	18.9	18.5	14.9	22.0	3.9	-0.12	19.7
Whakamaru Tailrace	12	19.2	18.6	16.5	23.0	3.6	0.50	19.9
Waipapa Tailrace	12	18.1	18.2	15.5	21.0	2.1	0.37	18.6
Narrow s	12	17.7	17.8	15.5	19.6	2.4	-0.15	17.8
Horotiu Bridge	12	17.8	17.9	14.8	19.6	2.4	-0.49	17.8
Huntly-Tainui Bridge	12	15.9	15.8	11.9	19.0	2.9	-0.26	16.3
Mercer Bridge	12	16.8	16.9	14.7	18.5	1.8	-0.26	17.4
Tuakau Bridge	12	17.1	17.1	15.0	19.2	1.9	0.07	17.5

Chlorophyll a (g/m <sup>3</sup> )								
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 Bridge	12	0.004	0.004	0.002	0.008	0.004	0.26	0.003
Whakamaru Tailrace	12	0.008	0.008	0.004	0.016	0.005	0.98	0.006
Waipapa Tailrace	12	0.006	0.006	0.003	0.011	0.005	0.23	0.004
Narrow s	12	0.008	0.007	0.002	0.021	0.007	1.02	0.006
Horotiu Bridge	12	0.008	0.007	0.002	0.019	0.008	0.84	0.006
Huntly-Tainui Bridge	12	0.008	0.006	0.002	0.018	0.011	0.49	0.006
Mercer Bridge	12	0.012	0.011	0.003	0.027	0.012	0.55	0.011
Tuakau Bridge	12	0.017	0.016	0.005	0.038	0.014	0.74	0.012

Colour (Munsell Colour Units)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	-	-	-	-	-	-	-	-
Ohaaki Bridge	11	53.0	50.0	45.0	65.0	6.9	0.91	50.0
Ohakuri Tailrace Bridge	11	48.0	47.5	40.0	65.0	7.5	1.05	40.0
Whakamaru Tailrace	11	42.3	42.5	35.0	55.0	4.4	0.83	40.0
Waipapa Tailrace	11	41.4	40.0	35.0	47.5	2.5	0.28	40.0
Narrow s	11	36.1	37.5	25.0	40.0	4.4	-1.36	37.5
Horotiu Bridge	11	35.7	35.0	27.5	40.0	4.4	-0.68	35.0
Huntly-Tainui Bridge	11	33.4	32.5	27.5	40.0	10.6	0.17	35.0
Mercer Bridge	-	-	-	-	-	-	-	-
Tuakau Bridge	11	32.0	30.0	25.0	42.5	10.6	0.55	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	11.9	11.7	12.4	0.2	0.81	11.9
Ohaaki Bridge	12	15.6	15.3	13.4	18.1	2.2	0.29	15.1
Ohakuri Tailrace Bridge	12	17.0	17.1	15.6	18.6	1.9	-0.05	16.9
Whakamaru Tailrace	12	16.8	16.7	15.6	18.5	1.5	0.35	16.8
Waipapa Tailrace	12	16.3	16.4	14.6	17.2	1.1	-0.61	16.3
Narrow s	12	16.2	16.2	15.1	17.0	1.3	-0.12	16.0
Horotiu Bridge	12	16.3	16.4	14.9	17.4	1.1	-0.45	16.0
Huntly-Tainui Bridge	12	15.0	15.2	12.5	16.9	2.0	-0.41	15.0
Mercer Bridge	12	16.0	16.2	14.7	16.8	1.1	-0.39	15.8
Tuakau Bridge	12	16.0	16.1	14.8	17.0	1.0	-0.28	15.8

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



Dissolved Oxygen (g/m <sup>3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	9.9	10.0	9.1	11.0	1.0	0.18	9.7
Ohaaki Bridge	12	9.8	9.7	8.3	12.0	2.1	0.34	9.6
Ohakuri Tailrace Bridge	12	9.8	9.8	8.8	11.2	1.2	0.36	9.8
Whakamaru Tailrace	12	10.0	10.1	9.1	11.7	1.2	0.53	10.3
Waipapa Tailrace	12	10.1	9.8	8.9	11.7	1.1	0.57	9.8
Narrow s	12	10.0	10.3	7.9	11.5	1.8	-0.34	9.9
Horotiu Bridge	12	9.9	10.0	8.0	11.6	1.5	-0.06	9.7
Huntly-Tainui Bridge	12	9.6	9.8	7.6	11.3	1.6	-0.45	9.7
Mercer Bridge	12	9.6	9.7	8.5	10.8	1.5	-0.07	9.5
Tuakau Bridge	12	9.8	9.6	8.7	11.0	1.0	0.13	9.5

Dissolved Oxygen (% Saturation)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	101.5	102.0	96.1	106.4	4.5	-0.18	101.1
Ohaaki Bridge	12	101.3	100.4	94.9	114.1	7.8	0.88	102.4
Ohakuri Tailrace Bridge	12	102.9	101.1	99.0	111.3	6.5	0.77	101.5
Whakamaru Tailrace	12	103.8	102.7	96.2	109.7	5.5	0.01	103.7
Waipapa Tailrace	12	104.0	103.9	98.3	111.2	7.3	0.13	101.9
Narrow s	12	99.0	101.1	88.1	104.1	7.0	-0.91	97.9
Horotiu Bridge	12	99.0	99.8	88.1	107.8	8.0	-0.36	98.1
Huntly-Tainui Bridge	12	96.7	98.5	82.6	105.8	8.5	-0.68	96.5
Mercer Bridge	12	98.5	99.2	87.8	104.5	5.0	-1.15	96.5
Tuakau Bridge	12	100.8	101.9	85.8	112.0	7.2	-0.72	98.0

Enterococci (cfu/100 mL)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	4	2	1	19	5	<u>1.8</u>	1
Ohaaki Bridge	12	11	7	1	37	13	1.3	8
Ohakuri Tailrace Bridge	12	6	5	1	20	7	1.4	2
Whakamaru Tailrace	12	7	4	1	26	10	1.3	4
Waipapa Tailrace	12	11	3	1	59	12	<u>2.0</u>	4
Narrow s	12	60	30	11	240	66	1.6	31
Horotiu Bridge	12	93	46	11	460	83	<u>2.4</u>	50
Huntly-Tainui Bridge	12	181	63	9	1000	212	<u>2.4</u>	48
Mercer Bridge	12	73	21	1	380	44	<u>1.8</u>	25
Tuakau Bridge	12	79	21	1	460	45	<u>2.0</u>	21

Escherichia coli (cfu/100 mL)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	3	3	1	8	4	0.5	2
Ohaaki Bridge	12	17	15	1	50	14	1.2	14
Ohakuri Tailrace Bridge	12	2	1	1	6	3	0.7	2
Whakamaru Tailrace	12	13	6	2	50	18	1.5	7
Waipapa Tailrace	12	20	5	1	160	6	<u>2.7</u>	8
Narrow s	12	81	35	17	500	39	<u>2.8</u>	39
Horotiu Bridge	12	92	75	27	260	40	<u>1.8</u>	90
Huntly-Tainui Bridge	12	311	145	30	1600	225	<u>2.2</u>	125
Mercer Bridge	12	127	50	10	800	77	<u>2.7</u>	80
Tuakau Bridge	12	131	55	20	700	30	<u>2.2</u>	80

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	3	1	8	5	0.4	2
Ohaaki Bridge	12	18	15	1	50	14	1.1	14
Ohakuri Tailrace Bridge	12	3	3	1	6	3	0.3	3
Whakamaru Tailrace	12	14	7	2	60	18	<u>1.9</u>	8
Waipapa Tailrace	12	25	5	1	210	6	<u>2.8</u>	9
Narrow s	12	86	38	20	500	46	<u>2.7</u>	51
Horotiu Bridge	12	97	90	27	260	40	1.5	100
Huntly-Tainui Bridge	12	332	170	45	1600	290	<u>2.1</u>	135
Mercer Bridge	12	138	56	20	800	76	<u>2.7</u>	95
Tuakau Bridge	12	139	65	26	700	42	<u>2.1</u>	85

Lithium (g/m <sup>3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.041	0.043	0.036	0.044	0.005	-0.684	0.040
Ohaaki Bridge	12	0.093	0.087	0.061	0.138	0.034	0.658	0.088
Ohakuri Tailrace Bridge	12	0.110	0.107	0.089	0.136	0.025	0.277	0.113
Whakamaru Tailrace	12	0.113	0.111	0.091	0.129	0.023	-0.213	0.117
Waipapa Tailrace	12	0.098	0.099	0.083	0.114	0.016	-0.071	0.100
Narrow s	12	0.087	0.086	0.068	0.101	0.008	-0.294	0.089
Horotiu Bridge	12	0.089	0.086	0.071	0.107	0.010	0.119	0.091
Huntly-Tainui Bridge	12	0.062	0.062	0.024	0.096	0.021	-0.305	0.066
Mercer Bridge	12	0.065	0.069	0.033	0.091	0.025	-0.322	0.066
Tuakau Bridge	12	0.067	0.068	0.041	0.100	0.022	0.286	0.065

Nitrate/Nitrite Nitrogen (g/m <sup>3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.001	0.001	0.001	0.001	0.000	-1.00	0.001
Ohaaki Bridge	12	0.034	0.031	0.018	0.057	0.014	0.54	0.039
Ohakuri Tailrace Bridge	12	0.070	0.085	0.003	0.144	0.090	-0.12	0.086
Whakamaru Tailrace	12	0.097	0.091	0.004	0.210	0.110	0.22	0.101
Waipapa Tailrace	12	0.182	0.179	0.092	0.300	0.105	0.28	0.164
Narrow s	12	0.258	0.220	0.095	0.560	0.195	0.83	0.235
Horotiu Bridge	12	0.272	0.206	0.099	0.660	0.243	1.01	0.260
Huntly-Tainui Bridge	12	0.443	0.380	0.056	1.100	0.430	0.80	0.365
Mercer Bridge	12	0.403	0.330	0.060	1.000	0.418	0.75	0.365
Tuakau Bridge	12	0.386	0.315	0.010	0.960	0.393	0.70	0.325

Nitrogen - Ammoniacal (g/m <sup>3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.005	0.005	0.005	0.005	0.000	1.00	0.005
Ohaaki Bridge	12	0.008	0.005	0.005	0.026	0.003	<u>2.03</u>	0.005
Ohakuri Tailrace Bridge	12	0.006	0.005	0.005	0.020	0.000	<u>3.02</u>	0.005
Whakamaru Tailrace	12	0.005	0.005	0.005	0.005	0.000	1.00	0.005
Waipapa Tailrace	12	0.011	0.013	0.005	0.018	0.010	-0.25	0.015
Narrow s	12	0.018	0.020	0.005	0.027	0.014	-0.66	0.017
Horotiu Bridge	12	0.010	0.009	0.005	0.019	0.008	0.49	0.012
Huntly-Tainui Bridge	12	0.008	0.005	0.005	0.022	0.007	1.44	0.011
Mercer Bridge	12	0.006	0.005	0.005	0.013	0.000	<u>3.02</u>	0.005
Tuakau Bridge	12	0.006	0.005	0.005	0.022	0.000	<u>3.02</u>	0.005

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

Nitrogen - Total Kjeldahl (g/m <sup>3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.068	0.065	0.025	0.140	0.030	0.77	0.070
Ohaaki Bridge	12	0.094	0.090	0.025	0.170	0.030	0.31	0.090
Ohakuri Tailrace Bridge	12	0.113	0.095	0.070	0.210	0.055	1.08	0.104
Whakamaru Tailrace	12	0.128	0.120	0.060	0.240	0.055	0.95	0.140
Waipapa Tailrace	12	0.128	0.130	0.070	0.170	0.020	-0.44	0.135
Narrow s	12	0.176	0.170	0.110	0.290	0.060	1.01	0.165
Horotiu Bridge	12	0.175	0.170	0.120	0.310	0.090	0.93	0.180
Huntly-Tainui Bridge	12	0.226	0.205	0.150	0.470	0.115	1.51	0.220
Mercer Bridge	12	0.263	0.250	0.160	0.390	0.155	0.40	0.300
Tuakau Bridge	12	0.278	0.245	0.150	0.560	0.140	1.18	0.290

Nitrogen - Total (g/m <sup>3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.069	0.066	0.026	0.141	0.030	0.77	0.071
Ohaaki Bridge	12	0.128	0.123	0.053	0.212	0.040	0.31	0.134
Ohakuri Tailrace Bridge	12	0.183	0.182	0.073	0.283	0.081	-0.19	0.216
Whakamaru Tailrace	12	0.225	0.230	0.124	0.300	0.081	-0.38	0.271
Waipapa Tailrace	12	0.311	0.299	0.231	0.440	0.120	0.58	0.336
Narrow s	12	0.434	0.398	0.235	0.760	0.188	0.79	0.410
Horotiu Bridge	12	0.447	0.409	0.286	0.890	0.208	1.32	0.441
Huntly-Tainui Bridge	12	0.669	0.585	0.220	1.570	0.445	1.04	0.585
Mercer Bridge	12	0.667	0.605	0.260	1.380	0.438	0.85	0.662
Tuakau Bridge	12	0.664	0.595	0.220	1.520	0.407	1.02	0.595

pH (pH Units)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	7.7	7.6	7.2	8.1	0.5	0.08	7.6
Ohaaki Bridge	12	7.3	7.3	7.1	7.6	0.2	0.17	7.3
Ohakuri Tailrace Bridge	12	7.4	7.4	7.2	7.6	0.1	-0.08	7.3
Whakamaru Tailrace	12	7.5	7.6	7.3	7.8	0.3	-0.09	7.5
Waipapa Tailrace	12	7.4	7.5	7.1	7.7	0.3	-0.16	7.4
Narrow s	12	7.6	7.6	7.2	8.1	0.4	0.47	7.5
Horotiu Bridge	12	7.5	7.5	6.8	7.8	0.3	-1.47	7.5
Huntly-Tainui Bridge	12	7.4	7.4	7.2	7.7	0.3	0.51	7.4
Mercer Bridge	12	7.5	7.6	6.9	7.8	0.3	-1.00	7.5
Tuakau Bridge	12	7.5	7.6	7.2	7.9	0.5	-0.01	7.5

Phosphorus - Dissolved Reactive (g/m <sup>3</sup> )								
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	0.007	0.008	0.005	0.010	0.003	0.14	0.006
Ohakuri Tailrace Bridge	12	0.009	0.009	0.002	0.016	0.005	0.00	0.009
Whakamaru Tailrace	12	0.009	0.008	0.005	0.018	0.006	1.01	0.008
Waipapa Tailrace	12	0.015	0.014	0.008	0.024	0.005	0.54	0.016
Narrow s	12	0.015	0.014	0.004	0.030	0.012	0.38	0.015
Horotiu Bridge	12	0.018	0.015	0.008	0.040	0.016	0.96	0.019
Huntly-Tainui Bridge	12	0.017	0.018	0.004	0.027	0.009	-0.46	0.020
Mercer Bridge	12	0.014	0.014	0.006	0.024	0.010	0.18	0.016
Tuakau Bridge	12	0.013	0.013	0.005	0.023	0.012	0.17	0.014

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

Phosphorus - Total (g/m <sup>3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.006	0.006	0.002	0.014	0.002	1.50	0.004
Ohaaki Bridge	12	0.011	0.011	0.007	0.015	0.003	-0.17	0.011
Ohakuri Tailrace Bridge	12	0.019	0.017	0.015	0.024	0.005	0.58	0.018
Whakamaru Tailrace	12	0.022	0.022	0.015	0.041	0.005	<u>2.00</u>	0.020
Waipapa Tailrace	12	0.027	0.026	0.020	0.038	0.009	0.57	0.026
Narrow s	12	0.029	0.029	0.020	0.044	0.008	1.04	0.029
Horotiu Bridge	12	0.036	0.037	0.024	0.062	0.017	0.85	0.036
Huntly-Tainui Bridge	12	0.043	0.037	0.028	0.079	0.019	1.12	0.046
Mercer Bridge	12	0.044	0.039	0.026	0.067	0.020	0.56	0.052
Tuakau Bridge	12	0.045	0.043	0.028	0.073	0.021	0.65	0.054

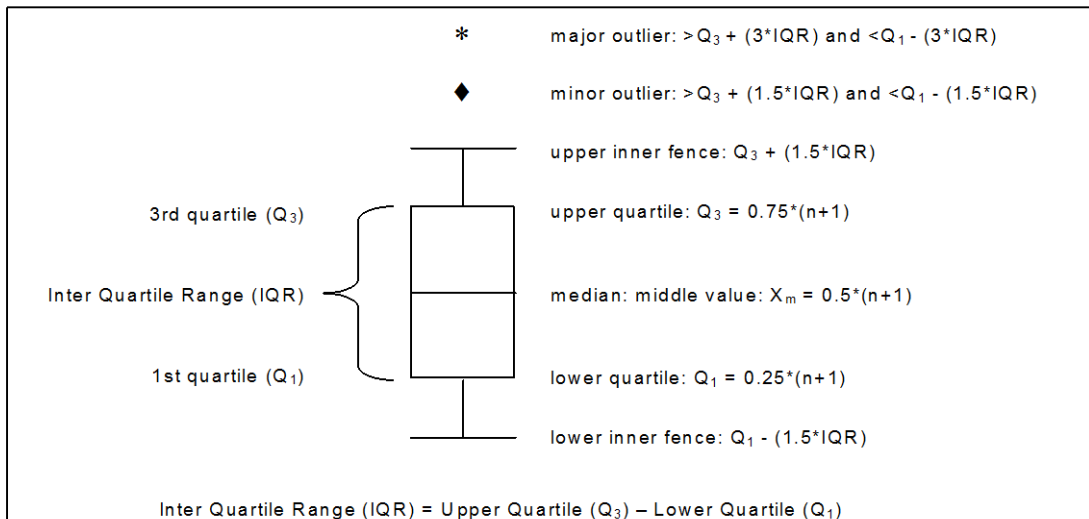
Temperature (°C)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	14.9	14.6	11.1	18.8	5.8	0.04	14.6
Ohaaki Bridge	12	16.2	15.6	11.9	20.7	6.6	0.15	16.0
Ohakuri Tailrace Bridge	12	16.7	16.5	12.8	21.8	6.3	0.31	16.4
Whakamaru Tailrace	12	16.5	16.6	11.6	21.8	6.5	0.18	16.5
Waipapa Tailrace	12	16.4	16.3	11.4	21.8	6.7	0.16	16.2
Narrow s	12	16.0	16.2	11.5	20.9	7.4	0.15	16.3
Horotiu Bridge	12	16.2	16.3	11.4	21.5	7.0	0.07	16.1
Huntly-Tainui Bridge	12	16.4	16.3	11.6	22	6.7	0.18	16.2
Mercer Bridge	12	17.1	17.2	12.2	23	7.4	0.12	16.8
Tuakau Bridge	12	17.4	17.5	12.0	24.0	7.5	0.14	17.1

Dissolved Solids - Total (g/m <sup>3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	88.8	88.5	81.0	99.0	6.0	0.36	87.5
Ohaaki Bridge	12	112.9	110.0	92.0	131.0	18.0	-0.04	110.0
Ohakuri Tailrace Bridge	12	124.3	120.5	113.0	154.0	11.5	<u>1.68</u>	123.0
Whakamaru Tailrace	12	127.3	127.0	112.0	150.0	15.5	0.57	127.0
Waipapa Tailrace	12	125.0	126.0	106.0	139.0	18.5	-0.25	125.0
Narrow s	12	128.3	127.0	117.0	139.0	12.5	0.21	122.0
Horotiu Bridge	12	127.8	131.5	96.0	142.0	10.0	-1.46	121.5
Huntly-Tainui Bridge	12	115.7	116.5	84.0	134	15.5	-0.89	113.5
Mercer Bridge	12	120.3	123.5	96.0	128	10.5	-1.60	119.0
Tuakau Bridge	12	120.7	121.0	94.0	132.0	8.5	-1.55	119.5

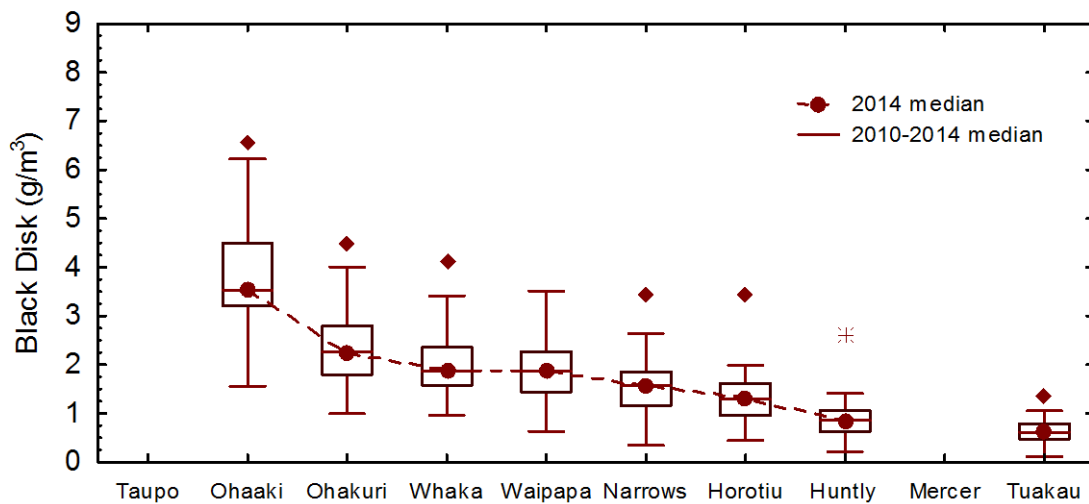
Turbidity (NTU)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.5	0.5	0.2	1.0	0.3	0.97	0.5
Ohaaki Bridge	12	0.8	0.8	0.4	1.4	0.2	1.32	0.8
Ohakuri Tailrace Bridge	12	1.0	0.9	0.5	1.6	0.5	0.50	1.0
Whakamaru Tailrace	12	1.1	1.1	0.6	1.5	0.4	-0.38	1.2
Waipapa Tailrace	12	1.3	1.4	0.7	2.3	0.7	0.46	1.3
Narrow s	12	2.2	1.7	1.3	6.0	1.3	<u>2.03</u>	1.9
Horotiu Bridge	12	2.6	2.0	1.4	4.5	1.9	0.66	2.6
Huntly-Tainui Bridge	12	8.4	4.5	1.8	40	5.1	<u>2.53</u>	5.7
Mercer Bridge	12	9.2	7.1	3.2	17	10.9	0.39	9.9
Tuakau Bridge	12	9.2	7.8	3.2	22.0	6.8	0.99	8.9

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

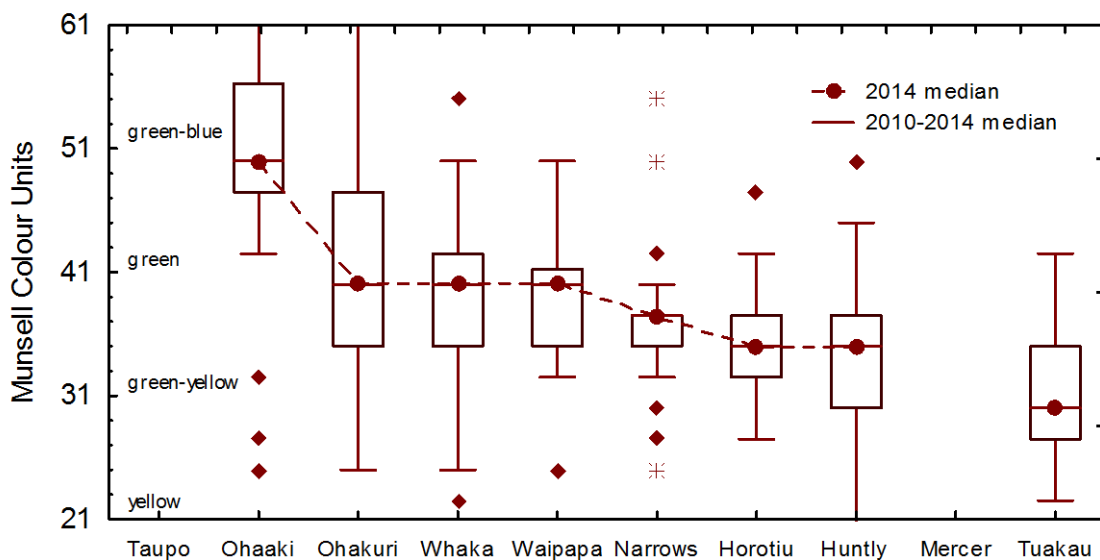
## Boxplots are used to present data



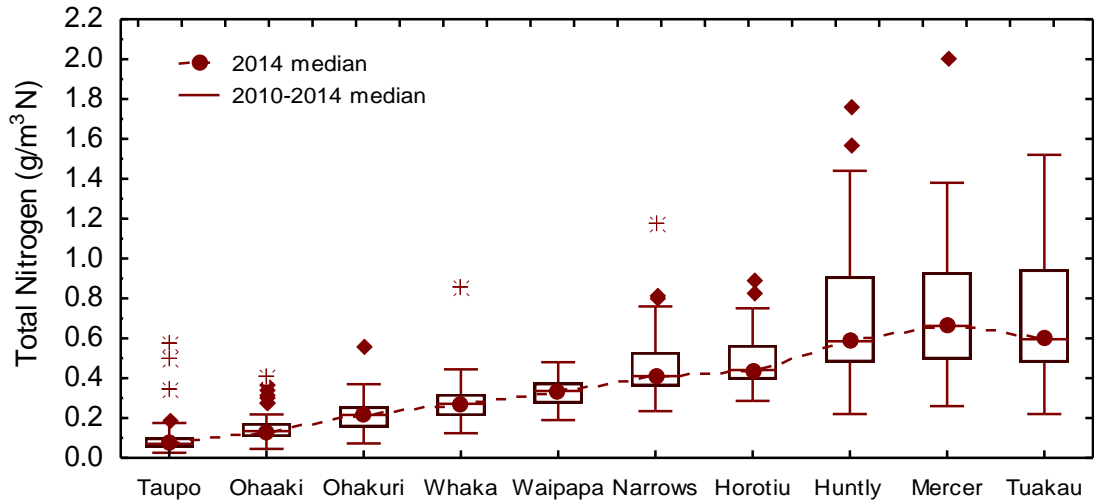
### Black Disk, 2010-2014 Data



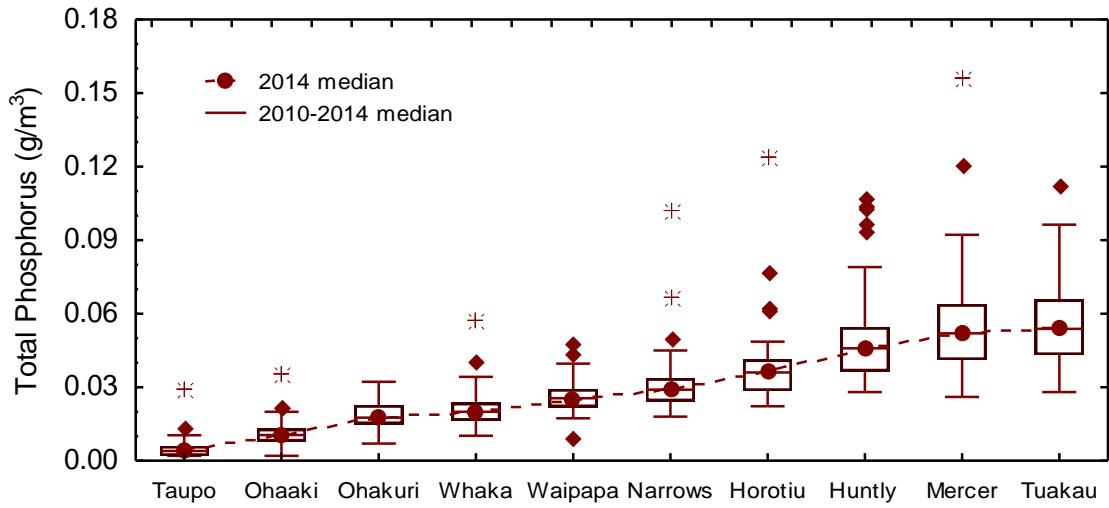
### Colour, 2010-2014 Data



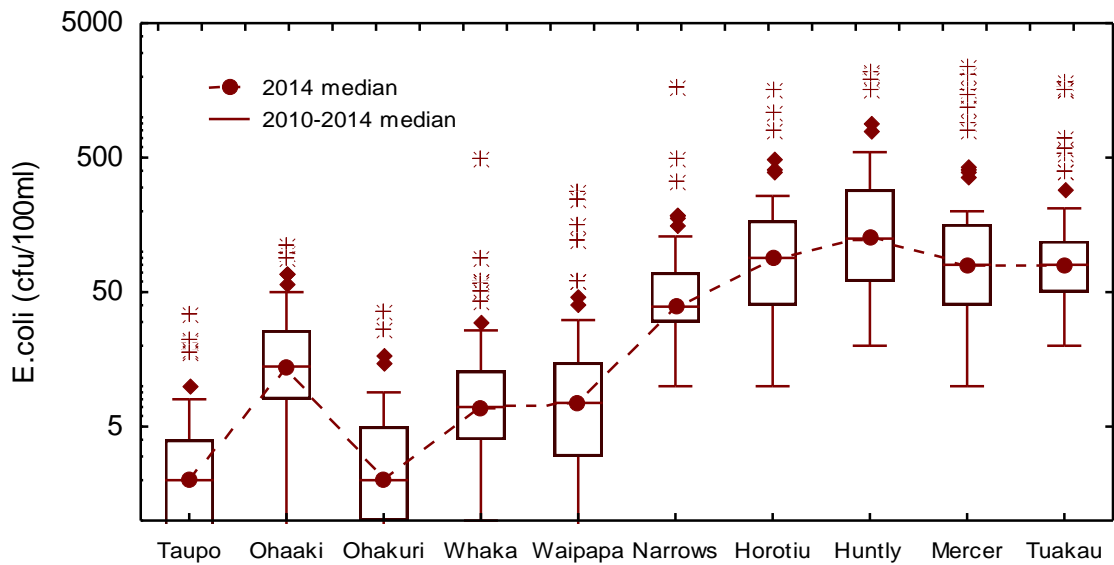
### Total Nitrogen, 2010-2014 Data



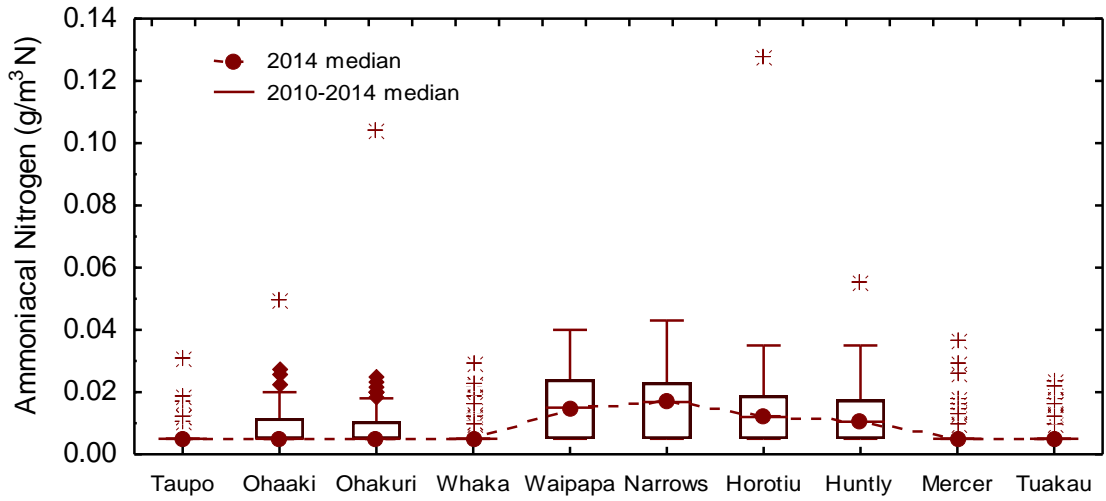
### Total Phosphorus, 2010-2014 Data



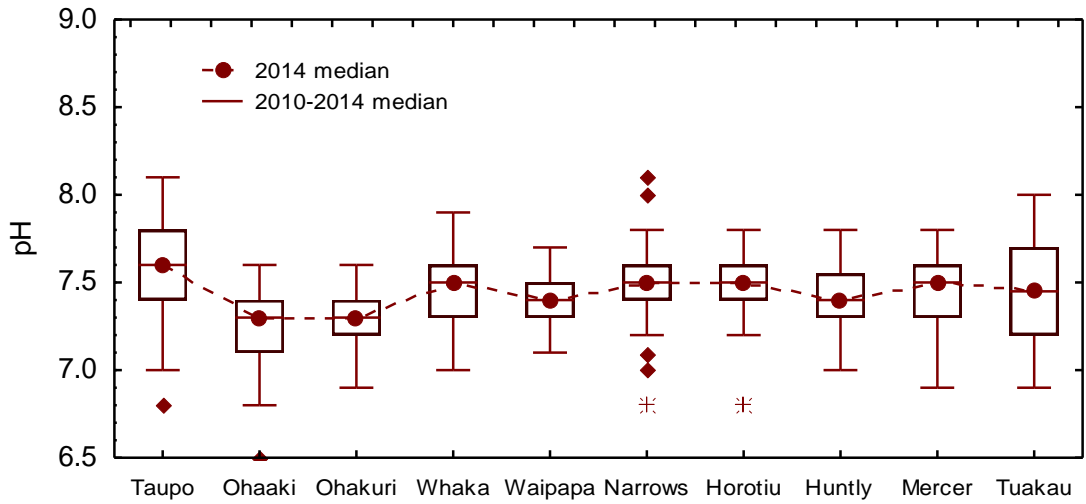
### E.coli, 2010-2014 Data



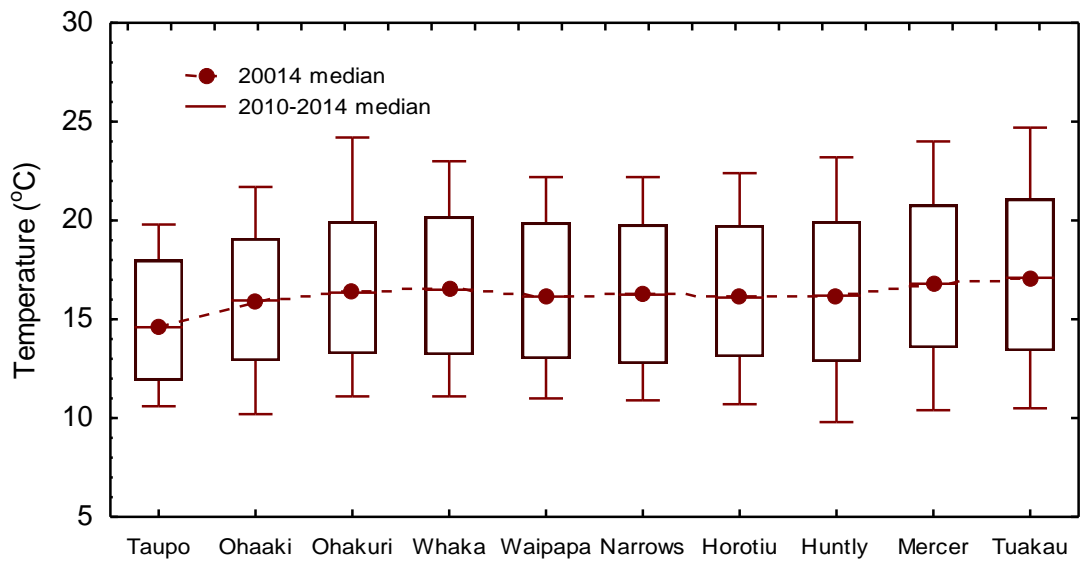
### Ammoniacal Nitrogen, 2010-2014 Data



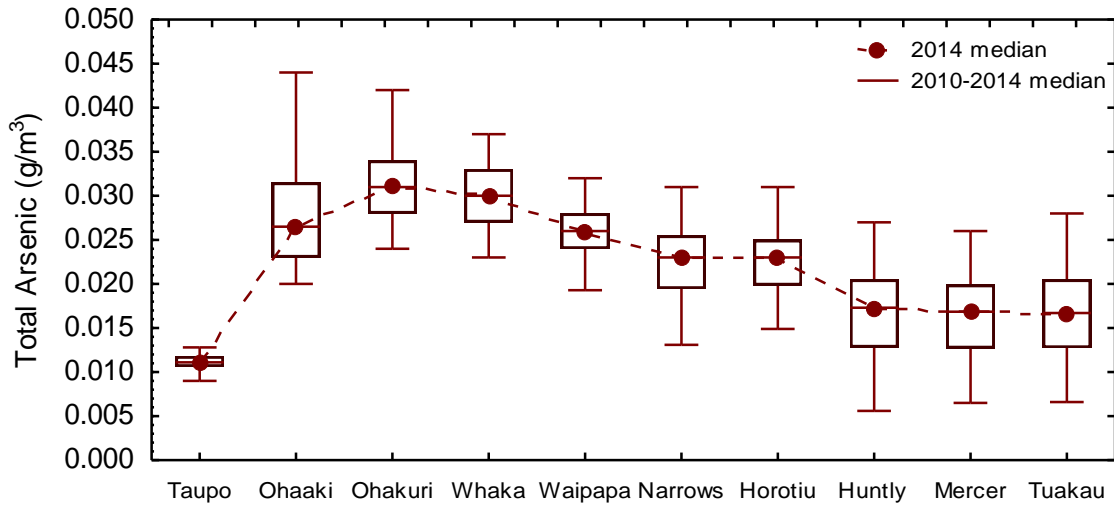
### pH, 2010-2014 Data



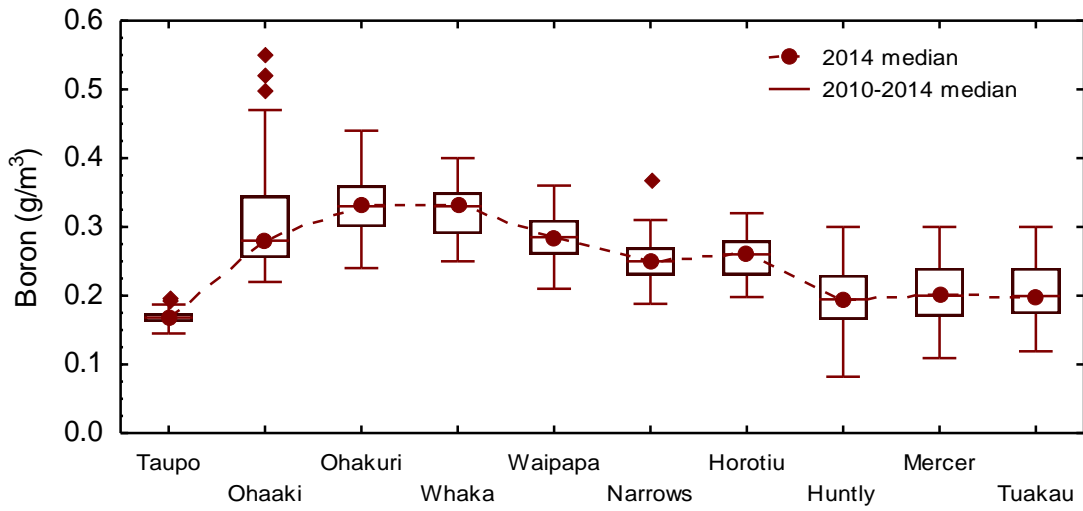
### Temperature, 2010-2014 Data



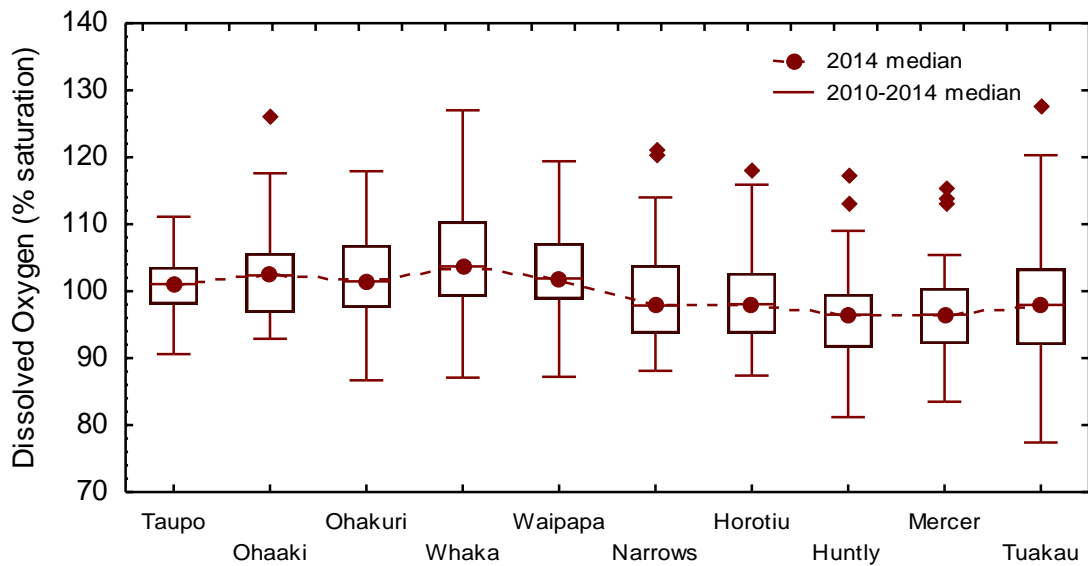
**Total Arsenic, 2010-2014 Data**



**Boron, 2010-2014 Data**



**Dissolved Oxygen, 2010-2014 Data**





**Table 3: Samples (year 2014) complying with the 'satisfactory' water quality guidelines and standards. n = 12.**

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

<sup>1</sup> 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 2014) complying with the 'excellent' water quality guidelines and standards. n = 12**

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

<sup>1</sup>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 dd/m/m/yy	TIME* hh:mm	FLOW m <sup>3</sup> /s	BDISK m	COLOR units	COND m S/m	pH units	TEMP °C	DO g/m <sup>3</sup>	PCDO %Sat	BOD5 g/m <sup>3</sup>	TURB NTU	TDS g/m <sup>3</sup>	NNN g/m <sup>3</sup>	NO3-N g/m <sup>3</sup>	NH4-N g/m <sup>3</sup>
Satisfactory Water Quality Guideline/Standard			>1.6	-	-	6.5-9	<12 (May-Sep) <20 (Oct-Apr)	>80	-	<5	-	-	-	-	<0.88

1131-127 UD = 266 m<sup>3</sup>/s (Flows from "Reids Farm")

**Waikato River at Taupo Control Gates**

7/01/2014	08:20:00	86	-	-	11.7	7.6	18.6	9.1	101.6	0.7	0.47	92	< 0.002	< 0.002	< 0.01
4/02/2014	08:47:00	230	-	-	12.0	7.6	18.8	9.3	102.8	1.6	0.47	92	< 0.002	< 0.002	< 0.01
4/03/2014	08:45:00	103	-	-	11.9	7.9	17.5	9.3	101.2	0.9	0.28	87	< 0.002	< 0.002	< 0.01
1/04/2014	08:05:00	102	-	-	11.9	8.1	18.0	9.5	102.4	0.5	0.56	90	< 0.002	< 0.002	< 0.01
6/05/2014	09:10:00	171	-	-	11.9	8.0	<u>16.6</u>	10.0	106.4	1.0	0.34	99	< 0.002	< 0.002	< 0.01
3/06/2014	09:23:00	213	-	-	11.9	7.5	<u>13.4</u>	10.0	98.2	< 0.4	0.21	87	< 0.002	< 0.002	< 0.01
1/07/2014	09:19:00	66	-	-	11.9	8.0	<u>12.5</u>	10.4	102.7	0.7	0.33	81	< 0.002	< 0.002	< 0.01
5/08/2014	09:30:00	212	-	-	12.2	7.6	11.1	11.0	104.0	0.6	0.37	89	< 0.002	< 0.002	< 0.01
2/09/2014	09:50:00	208	-	-	12.4	7.4	11.4	10.4	99.6	< 0.4	0.99	85	< 0.002	< 0.002	< 0.01
7/10/2014	08:15:00	210	-	-	11.9	7.5	11.2	10.2	97.0	0.6	0.64	88	< 0.002	< 0.002	< 0.01
4/11/2014	08:40:00	191	-	-	12.0	7.2	14.2	9.5	96.1	1.5	0.57	83	< 0.002	< 0.002	< 0.01
2/12/2014	08:15:00	101	-	-	12.2	7.7	14.9	10.4	105.9	1.1	0.62	93	< 0.002	< 0.002	< 0.01

1131-105 UD = 264 m<sup>3</sup>/s (Flows from Ohaaki Bridge Recorder, +/- 20%)

**Waikato River at Ohaaki Br**

7/01/2014	08:59:00	92	9.0	55.0	16.5	7.2	<u>20.5</u>	8.3	96.2	0.9	0.62	121	0.033	0.033	< 0.01
4/02/2014	09:37:00	204	3.5	65.0	14.0	7.1	<u>20.7</u>	8.7	98.7	1.3	0.63	109	0.018	0.018	< 0.01
4/03/2014	09:58:00	83	4.2	47.5	17.5	7.3	<u>20.0</u>	8.4	96.1	1.0	0.72	119	0.028	0.027	0.01
1/04/2014	08:59:00	100	2.9	45.0	17.0	7.5	19.6	8.6	94.9	0.8	0.84	128	0.038	0.037	< 0.01
6/05/2014	09:56:00	126	4.0	55.0	15.9	7.6	<u>17.2</u>	10.1	107.9	1.0	0.51	124	0.046	0.045	0.02
3/06/2014	10:03:00	131	6.2	50.0	14.9	7.3	<u>13.8</u>	10.7	105.1	0.5	0.43	111	0.040	0.040	< 0.01
1/07/2014	10:10:00	108	2.5	52.5	15.7	7.4	<u>15.0</u>	9.5	98.6	0.7	0.83	109	0.057	0.056	0.03
5/08/2014	10:20:00	151	3.2	50.0	14.6	7.5	11.9	12.0	114.1	0.8	1.38	102	0.029	0.029	< 0.01
2/09/2014	10:40:00	172	4.8	65.0	14.8	7.2	<u>12.7</u>	11.0	102.6	0.7	0.82	102	0.027	0.027	< 0.01
7/10/2014	08:55:00	183	4.4	50.0	14.6	7.3	12.1	10.7	103.1	1.0	0.78	107	0.021	0.021	< 0.01
4/11/2014	09:20:00	133	3.0	-	13.4	7.3	14.7	9.5	96.4	1.2	0.84	92	0.042	0.042	< 0.01
2/12/2014	09:05:00	111	4.0	47.5	18.1	7.4	16.1	9.8	102.1	1.1	0.71	131	0.028	0.028	< 0.01

1131-107 UD = 320 m<sup>3</sup>/s (Flows from Ohakuri Dam - Total)

**Waikato River at Ohakuri Tailrace Br**

7/01/2014	09:59:00	212	2.3	42.5	17.8	7.4	<u>21.8</u>	9.1	107.2	1.3	0.92	130	0.006	0.005	< 0.01
4/02/2014	10:26:00	300	2.9	40.0	15.6	7.2	<u>21.8</u>	9.0	104.8	1.1	1.06	121	0.032	0.032	< 0.01
4/03/2014	10:55:00	232	2.1	40.0	15.8	7.4	<u>20.1</u>	8.8	100.8	1.0	0.87	113	0.014	0.014	< 0.01
1/04/2014	09:46:00	242	2.1	57.5	17.7	7.4	19.5	9.2	101.3	0.6	0.72	132	0.029	0.029	< 0.01
6/05/2014	10:42:00	197	3.8	50.0	18.6	7.4	<u>17.1</u>	9.3	99.0	0.9	0.93	154	0.144	0.142	0.02
3/06/2014	10:50:00	215	3.1	47.5	16.2	7.2	<u>13.7</u>	10.2	99.3	0.4	0.52	118	0.107	0.106	< 0.01
1/07/2014	10:53:00	226	2.8	47.5	16.4	7.4	<u>13.6</u>	10.0	100.0	0.9	0.72	115	0.116	0.114	< 0.01
5/08/2014	11:00:00	292	2.4	50.0	17.2	7.5	<u>12.8</u>	11.2	107.7	1.3	1.50	122	0.115	0.114	< 0.01
2/09/2014	11:40:00	210	3.0	65.0	17.0	7.3	<u>13.1</u>	10.7	104.7	0.7	0.66	120	0.096	0.095	< 0.01
7/10/2014	09:45:00	280	2.3	42.5	18.0	7.4	13.4	10.1	99.4	0.9	1.15	118	0.106	0.103	< 0.01
4/11/2014	10:05:00	239	1.8	-	18.1	7.4	15.9	10.1	99.6	1.4	1.63	129	0.073	0.070	< 0.01
2/12/2014	10:05:00	164	1.9	45.0	15.6	7.6	17.4	10.1	111.3	1.9	1.32	119	0.003	0.003	< 0.01

1131-147 UD = 305 m<sup>3</sup>/s (Flows from Whakamaru Dam - Total)

**Waikato River at Whakamaru Tailrace**

7/01/2014	10:45:00	225	2.1	35.0	16.8	7.7	<u>21.2</u>	10.1	109.7	1.0	1.2	126	0.050	0.048	< 0.01
4/02/2014	11:32:00	257	2.0	40.0	17.1	7.3	<u>21.8</u>	10.1	102.1	1.6	1.5	137	0.037	0.036	< 0.01
4/03/2014	11:48:00	223	3.0	42.5	15.6	7.6	<u>20.2</u>	10.1	102.6	1.6	1.0	112	0.022	0.021	< 0.01
1/04/2014	10:33:00	189	2.2	35.0	17.5	7.4	19.6	10.1	102.3	1.2	1.0	134	0.055	0.054	< 0.01
6/05/2014	11:30:00	207	2.2	40.0	18.5	7.4	<u>16.9</u>	10.1	96.2	0.9	0.8	150	0.210	0.210	< 0.01
3/06/2014	11:32:00	243	3.4	47.5	16.0	7.3	<u>13.7</u>	10.1	99.2	0.4	0.6	129	0.163	0.162	< 0.01
1/07/2014	11:38:00	108	2.4	40.0	16.6	7.5	<u>13.2</u>	10.1	103.1	0.8	1.0	117	0.179	0.177	< 0.01
5/08/2014	11:30:00	302	2.2	55.0	15.9	7.6	11.6	10.1	109.6	0.8	1.1	118	0.143	0.143	< 0.01
2/09/2014	12:25:00	225	1.8	42.5	16.6	7.5	<u>12.7</u>	10.1	106.7	1.1	1.2	118	0.121	0.120	< 0.01
7/10/2014	10:30:00	267	2.3	42.5	17.7	7.7	13.8	10.1	102.3	0.9	1.4	128	0.119	0.117	< 0.01
4/11/2014	10:45:00	247	1.8	-	17.5	7.7	16.2	10.1	102.7	1.6	1.5	133	0.062	0.060	< 0.01
2/12/2014	10:50:00	263	2.5	45.0	16.1	7.8	17.1	10.1	108.6	1.7	1.3	125	0.004	0.004	< 0.01

Note: < = less than the value stated

UD = upper decile flow (long-term record 1995-2014 inclusive)

\*New Zealand Standard Time

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

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

TKN g/m <sup>3</sup>	TN g/m <sup>3</sup>	DRP g/m <sup>3</sup>	TP g/m <sup>3</sup>	CL g/m <sup>3</sup>	AS g/m <sup>3</sup>	B g/m <sup>3</sup>	LI g/m <sup>3</sup>	A340F /cm	A440F /cm	ENT cfu/100mL	FC cfu/100mL	Ecoli cfu/100mL	CHLA g/m <sup>3</sup>	DOC g/m <sup>3</sup>	TOC g/m <sup>3</sup>
-	<0.5	-	<0.04	-	<0.01	<0.3	-	-	-	<77	-	<550	<0.02		
0.07	0.07	<0.004	0.006	7.7	<u>0.010</u>	0.16	0.038	<0.002	<0.002	5	6	6	<0.003	0.5	0.6
0.07	0.07	<0.004	0.006	7.9	<u>0.011</u>	0.17	0.044	<0.002	<0.002	<1	2	2	<0.003	1.0	0.9
0.14	0.14	<0.004	0.007	7.7	<u>0.011</u>	0.17	0.039	<0.002	<0.002	19	4	4	<0.003	1.4	1.3
0.08	0.08	<0.004	0.014	8.2	<u>0.011</u>	0.17	0.041	<0.002	<0.002	11	5	4	<0.003	1.0	0.9
0.05	0.05	<0.004	0.006	7.5	<u>0.011</u>	0.16	0.036	0.002	<0.002	2	6	6	<0.003	0.6	0.7
0.06	0.06	<0.004	0.004	8.0	<u>0.012</u>	0.18	0.043	<0.002	<0.002	5	1	1	<0.003	0.6	0.8
<0.05	0.03	<0.004	0.005	7.5	<u>0.011</u>	0.16	0.039	<0.002	<0.002	2	4	4	<0.003	0.8	0.9
0.05	0.05	<0.004	0.006	8.0	<u>0.012</u>	0.17	0.042	<0.002	<0.002	<1	1	1	<0.003	1.8	1.7
0.06	0.06	<0.004	<0.004	8.1	<u>0.012</u>	0.17	0.044	<0.002	<0.002	<1	<1	<1	<0.003	0.7	0.9
0.08	0.08	<0.004	0.006	7.8	<u>0.012</u>	0.19	0.043	<0.002	<0.002	1	1	1	<0.003	1.3	1.2
0.10	0.10	<0.004	0.008	7.4	<u>0.012</u>	0.18	0.043	<0.002	<0.002	<1	1	1	<0.003	1.7	2.5
<0.05	0.03	<0.004	0.004	8.2	<u>0.013</u>	0.18	0.044	<0.002	<0.002	3	8	8	<0.003	0.9	1.0
0.08	0.11	0.008	0.014	19.0	<u>0.028</u>	<u>0.33</u>	0.102	0.003	<0.002	7	11	11	<0.003	0.9	0.9
0.10	0.12	0.005	0.008	13.0	<u>0.022</u>	0.24	0.074	0.003	<0.002	14	14	14	<0.003	0.8	0.9
0.09	0.12	0.008	0.013	22.0	<u>0.029</u>	<u>0.47</u>	0.121	0.005	<0.002	21	22	22	<0.003	1.1	0.9
0.09	0.13	0.007	0.011	22.0	<u>0.032</u>	<u>0.39</u>	0.119	0.004	<0.002	10	14	13	<0.003	0.7	0.9
0.09	0.14	0.008	0.012	17.8	<u>0.033</u>	<u>0.31</u>	0.091	0.005	<0.002	21	25	25	<0.003	0.6	1.2
0.10	0.14	0.010	0.010	15.7	<u>0.027</u>	<u>0.30</u>	0.090	0.003	<0.002	<10	<1	<1	<0.003	0.6	0.6
0.11	0.17	0.008	0.015	15.7	<u>0.022</u>	<u>0.31</u>	0.082	0.005	<0.002	37	50	50	<0.003	0.8	0.9
0.07	0.10	0.006	0.010	13.6	<u>0.024</u>	0.25	0.076	0.002	<0.002	7	15	15	<0.003	1.0	0.8
0.07	0.10	0.005	0.007	14.0	<u>0.023</u>	0.26	0.078	<0.002	<0.002	5	3	3	<0.003	1.1	1.0
0.13	0.15	0.005	0.011	14.9	<u>0.025</u>	0.28	0.084	<0.002	<0.002	2	22	20	<0.003	0.9	0.8
0.17	0.21	0.006	0.011	10.8	<u>0.020</u>	0.22	0.061	0.003	<0.002	5	27	25	<0.003	1.2	1.0
<0.05	0.05	0.008	0.012	24.0	<u>0.041</u>	<u>0.41</u>	0.138	<0.002	<0.002	<1	8	8	<0.003	0.7	1.1
0.15	0.16	<0.004	0.016	21.0	<u>0.031</u>	<u>0.36</u>	0.120	0.005	<0.002	3	1	1	0.004	1.2	1.1
0.10	0.13	0.011	0.016	15.6	<u>0.028</u>	0.28	0.095	0.005	<0.002	<1	4	1	0.003	1.1	1.1
0.16	0.17	0.007	0.015	17.3	<u>0.028</u>	<u>0.31</u>	0.093	0.005	<0.002	7	<1	<1	0.004	2.4	2.6
0.08	0.11	0.006	0.017	22.0	<u>0.032</u>	<u>0.36</u>	0.124	0.005	<0.002	20	2	1	0.008	0.9	1.1
0.09	0.23	0.016	0.022	22.0	<u>0.036</u>	<u>0.35</u>	0.115	0.008	<0.002	5	4	4	<0.003	0.7	0.9
0.07	0.18	0.012	0.016	17.8	<u>0.028</u>	<u>0.32</u>	0.107	0.005	<0.002	10	<1	<1	<0.003	0.7	0.9
0.09	0.21	0.012	0.017	16.9	<u>0.027</u>	0.30	0.100	0.005	<0.002	10	3	3	<0.003	1.0	0.9
0.13	0.25	0.010	0.020	18.8	<u>0.028</u>	<u>0.33</u>	0.107	0.005	<0.002	<10	5	5	0.003	1.2	1.3
0.09	0.19	0.009	0.017	18.1	<u>0.029</u>	<u>0.32</u>	0.106	0.003	<0.002	2	<1	<1	0.005	1.0	1.0
0.11	0.22	0.009	0.022	21.0	<u>0.032</u>	<u>0.39</u>	0.136	0.005	<0.002	6	6	6	0.006	1.4	1.2
0.21	0.28	0.008	0.024	21.0	<u>0.036</u>	<u>0.36</u>	0.131	0.004	<0.002	1	4	4	0.006	1.3	1.1
0.07	0.07	0.006	0.020	14.9	<u>0.027</u>	0.30	0.089	0.002	<0.002	2	1	1	0.006	0.9	1.2
0.16	0.21	0.010	0.024	19.4	<u>0.033</u>	<u>0.32</u>	0.111	0.007	<0.002	15	7	6	0.007	1.4	1.6
0.24	0.28	0.007	0.019	19.1	<u>0.033</u>	0.33	0.125	0.006	<0.002	11	24	24	0.008	1.4	1.7
0.13	0.15	0.006	0.017	17.2	<u>0.028</u>	0.29	0.091	0.005	<0.002	12	3	3	0.016	1.1	1.0
0.12	0.18	0.007	0.021	22.0	<u>0.030</u>	<u>0.36</u>	0.127	0.006	<0.002	8	3	3	0.008	0.7	0.8
0.09	0.30	0.018	0.023	23.0	<u>0.035</u>	<u>0.35</u>	0.125	0.009	<0.002	4	10	10	0.004	1.1	1.3
0.09	0.25	0.016	0.019	17.7	<u>0.026</u>	<u>0.30</u>	0.107	0.006	<0.002	2	6	6	0.004	0.8	0.8
0.11	0.29	0.014	0.022	17.8	<u>0.025</u>	0.29	0.099	0.014	0.003	26	60	50	0.005	2.0	2.2
0.06	0.20	0.008	0.016	16.5	<u>0.023</u>	0.27	0.095	0.007	<0.002	4	26	26	0.006	1.6	1.3
0.09	0.21	0.008	0.015	18.1	<u>0.027</u>	<u>0.31</u>	0.108	0.005	<0.002	<1	2	2	0.012	1.0	1.2
0.13	0.25	0.006	0.022	21.0	<u>0.030</u>	<u>0.37</u>	0.127	0.007	<0.002	1	3	3	0.012	1.3	1.1
0.20	0.26	0.006	0.023	21.0	<u>0.033</u>	<u>0.35</u>	0.129	0.007	<0.002	2	18	18	0.008	1.4	1.2
0.12	0.12	0.005	<u>0.041</u>	17.2	<u>0.028</u>	<u>0.34</u>	0.110	0.003	<0.002	4	2	2	0.006	0.7	1.4

Note: < = less than the value stated  
UD = upper decile flow (long-term record 1994-2014 inclusive)

\*New Zealand Standard Time

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

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

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

**1131-143** UD = 370 m<sup>3</sup>/s (Flows from Waipapa Dam - Total)

**Waikato River at Waipapa Tailrace**

7/01/2014	11:24:00	267	2.5	37.5	15.8	7.5	<u>20.9</u>	10.1	101.3	1.0	1.1	126	0.138	0.135	0.01
4/02/2014	12:12:00	304	1.6	40.0	17.0	7.3	<u>21.8</u>	10.1	111.2	1.3	1.2	138	0.092	0.089	0.02
4/03/2014	12:30:00	220	2.1	40.0	16.0	7.2	<u>20.0</u>	10.1	109.4	1.5	1.4	117	0.111	0.108	0.02
1/04/2014	11:13:00	212	1.9	47.5	17.2	7.1	19.8	10.1	102.2	0.4	0.8	135	0.138	0.136	0.02
6/05/2014	12:20:00	213	2.1	42.5	17.2	7.3	<u>16.6</u>	10.1	98.8	0.9	0.8	139	0.300	0.290	0.01
3/06/2014	12:06:00	280	2.4	40.0	15.5	7.3	<u>13.6</u>	10.1	98.3	<0.4	0.7	124	0.220	0.220	<0.01
1/07/2014	12:10:00	163	<u>1.0</u>	35.0	14.6	7.4	<u>12.8</u>	10.1	105.5	0.8	2.3	106	0.270	0.270	0.01
5/08/2014	12:10:00	271	2.2	47.5	16.7	7.6	11.4	10.1	108.2	1.2	1.3	126	0.240	0.240	<0.01
2/09/2014	12:56:00	237	1.8	42.5	15.7	7.5	<u>12.5</u>	10.1	106.5	1.0	1.6	115	0.210	0.200	<0.01
7/10/2014	11:10:00	287	1.8	40.0	16.4	7.6	14.0	10.1	105.9	0.8	1.7	126	0.210	0.200	<0.01
4/11/2014	11:25:00	248	1.9	-	16.4	7.5	16.0	10.1	98.9	0.8	1.7	114	0.147	0.145	0.01
2/12/2014	11:30:00	270	2.2	42.5	16.5	7.7	17.1	10.1	102.3	1.6	1.4	134	0.112	0.111	0.02

**1131-328** UD = 372 m<sup>3</sup>/s (Flows from Karapiro Dam - Total)

**Waikato River at Narrows Boat Ramp**

8/01/2014	08:17:00	157	2.0	40.0	15.1	7.5	<u>20.4</u>	10.1	97.8	1.1	2.5	122	0.176	0.173	0.02
5/02/2014	07:00:00	181	<u>1.5</u>	27.5	17.0	7.6	<u>20.9</u>	10.1	101.6	1.2	1.7	139	0.103	0.101	0.02
5/03/2014	08:00:00	157	1.8	40.0	15.8	7.6	<u>20.2</u>	10.1	88.1	1.0	1.8	124	0.104	0.101	0.02
2/04/2014	07:25:00	146	2.5	37.5	15.9	7.4	19.5	10.1	92.0	1.3	1.5	126	0.095	0.092	0.03
7/05/2014	08:55:00	154	2.5	37.5	16.9	7.2	<u>16.6</u>	10.1	100.7	0.8	1.3	139	0.320	0.320	0.02
4/06/2014	09:00:00	167	1.8	40.0	17.0	7.3	<u>13.2</u>	10.1	97.1	1.0	1.3	136	0.350	0.350	0.02
2/07/2014	09:05:00	234	<u>1.1</u>	35.0	15.4	7.7	<u>12.1</u>	10.1	95.2	0.6	3.2	128	0.560	0.550	0.02
6/08/2014	08:20:00	180	1.9	37.5	16.4	7.3	11.5	10.1	103.1	1.1	1.7	134	0.500	0.500	<0.01
4/09/2014	09:00:00	234	3.5	-	15.7	7.7	<u>12.3</u>	10.1	101.4	1.2	1.4	122	0.260	0.260	<0.01
8/10/2014	07:35:00	195	<u>1.0</u>	25.0	15.3	8.1	12.6	10.1	104.1	1.3	<u>6.0</u>	117	0.230	0.230	<0.01
5/11/2014	07:40:00	169	<u>1.3</u>	37.5	16.8	7.6	16.1	10.1	104.1	1.4	2.8	123	0.184	0.181	0.02
3/12/2014	07:52:00	165	2.6	40.0	16.6	7.8	16.2	10.1	103.1	1.5	1.4	130	0.210	0.200	0.03

**1131-69** UD = 376 m<sup>3</sup>/s (Flows from Hamilton - Bridge Street Bridge)

**Waikato River at Horotiu Br**

8/01/2014	09:00:00	170	<u>1.5</u>	40.0	14.9	7.4	<u>21.5</u>	10.1	97.0	1.2	2.6	116	0.106	0.103	<0.01
5/02/2014	07:40:00	253	<u>1.4</u>	35.0	16.9	7.7	<u>20.8</u>	10.1	103.0	0.4	1.6	140	0.099	0.097	0.01
5/03/2014	08:45:00	159	1.8	40.0	16.1	7.5	19.8	10.1	88.1	1.2	2.0	126	0.123	0.120	<0.01
2/04/2014	08:20:00	148	<u>1.5</u>	35.0	16.1	7.5	19.4	10.1	94.4	1.4	1.7	132	0.132	0.129	0.01
7/05/2014	09:45:00	166	1.7	32.5	17.0	7.4	<u>16.7</u>	10.1	99.4	0.7	1.8	128	0.350	0.350	0.01
4/06/2014	10:00:00	185	1.6	40.0	17.1	6.8	<u>13.5</u>	10.1	96.1	0.7	1.4	134	0.390	0.390	0.02
2/07/2014	09:55:00	234	<u>0.9</u>	35.0	15.8	7.5	<u>12.0</u>	10.1	94.6	1.0	4.2	132	0.660	0.660	0.02
6/08/2014	09:17:00	215	<u>1.6</u>	35.0	16.6	7.4	11.4	10.1	103.8	1.1	1.7	142	0.530	0.530	<0.01
4/09/2014	09:40:00	198	3.5	-	16.0	7.6	<u>12.0</u>	10.1	107.8	1.2	2.0	122	0.270	0.270	<0.01
8/10/2014	08:15:00	222	<u>0.9</u>	27.5	15.2	7.8	13.2	10.1	100.5	1.6	4.5	96	0.191	0.188	<0.01
5/11/2014	08:20:00	192	<u>1.1</u>	35.0	17.0	7.7	15.9	10.1	103.7	1.8	3.6	131	0.188	0.184	0.01
3/12/2014	09:10:00	163	1.9	37.5	17.4	7.4	17.8	10.1	100.1	1.6	3.6	134	0.220	0.220	<0.01

**1131-77** UD = 564 m<sup>3</sup>/s (Flows from Huntly Power Station Recorder)

**Waikato River at Huntly-Tainui Br**

8/01/2014	09:32:00	229	<u>1.3</u>	40.0	14.5	7.3	<u>22.2</u>	10.1	99.1	1.3	4.6	112	0.148	0.146	<0.01
5/02/2014	08:30:00	309	<u>0.7</u>	35.0	16.9	7.5	<u>22.1</u>	10.1	88.8	1.4	3.5	134	0.056	0.054	<0.01
5/03/2014	09:20:00	185	<u>1.2</u>	40.0	16.0	7.3	19.1	10.1	82.6	3.7	2.5	123	0.070	0.070	<0.01
2/04/2014	09:10:00	169	<u>1.4</u>	32.5	16.1	7.6	19.7	10.1	104.7	0.9	1.8	130	0.192	0.189	0.01
7/05/2014	10:30:00	223	<u>1.1</u>	30.0	16.1	7.4	<u>16.4</u>	10.1	101.9	1.0	3.7	117	0.440	0.430	<0.01
4/06/2014	10:50:00	291	<u>1.2</u>	40.0	15.8	7.3	<u>12.9</u>	10.1	96.0	0.6	4.4	121	0.700	0.700	0.02
2/07/2014	10:40:00	505	<u>0.3</u>	27.5	12.5	7.2	11.9	10.1	88.4	1.2	<u>40.0</u>	105	1.100	1.090	0.02
6/08/2014	09:47:00	419	<u>0.6</u>	27.5	13.6	7.2	11.6	10.1	97.9	1.2	<u>13.7</u>	107	1.030	1.020	0.01
4/09/2014	10:10:00	314	2.6	-	14.8	7.3	<u>12.5</u>	10.1	105.8	1.0	4.8	112	0.500	0.500	<0.01
8/10/2014	08:55:00	327	<u>0.7</u>	27.5	13.8	7.7	13.5	10.1	99.1	1.5	<u>9.0</u>	84	0.430	0.420	<0.01
5/11/2014	09:05:00	309	<u>0.9</u>	32.5	14.4	7.4	16.2	10.1	99.9	1.5	<u>8.3</u>	116	0.330	0.330	<0.01
3/12/2014	10:15:00	223	<u>1.3</u>	35.0	15.5	7.6	18.8	10.1	96.1	1.3	4.0	127	0.320	0.320	<0.01

Note: < = less than the value stated

UD = upper decile flow (long-term record 1995-2014 inclusive)

\*New Zealand Standard Time

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

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

TKN g/m <sup>3</sup>	TN g/m <sup>3</sup>	DRP g/m <sup>3</sup>	TP g/m <sup>3</sup>	CL g/m <sup>3</sup>	AS g/m <sup>3</sup>	B g/m <sup>3</sup>	LI g/m <sup>3</sup>	A340F /cm	A440F /cm	ENT cfu/100mL	FC cfu/100mL	E coli cfu/100mL	CHLA g/m <sup>3</sup>	DOC g/m <sup>3</sup>	TOC g/m <sup>3</sup>
-	<0.5	-	<0.04	-	<0.01	<0.3	-	-	-	<77	-	<550	<0.02		
0.13	0.27	0.016	0.024	17.1	<u>0.025</u>	0.27	0.088	0.010	<0.002	4	8	8	0.010	1.3	1.5
0.14	0.23	0.014	0.026	18.7	<u>0.031</u>	<u>0.32</u>	0.114	0.009	0.003	2	3	3	0.006	1.3	1.6
0.12	0.23	0.017	0.033	16.5	<u>0.024</u>	0.28	0.085	0.010	0.004	30	5	5	0.004	1.2	1.2
0.12	0.26	0.014	0.023	21.0	<u>0.025</u>	<u>0.31</u>	0.109	0.008	<0.002	2	5	5	0.006	1.2	1.4
0.13	0.43	0.024	0.032	21.0	<u>0.026</u>	0.29	0.100	0.013	0.003	10	7	7	0.003	1.0	1.4
0.09	0.31	0.018	0.023	17.0	<u>0.023</u>	0.28	0.097	0.007	<0.002	16	1	1	0.004	1.2	1.1
0.17	0.44	0.018	0.032	15.5	<u>0.020</u>	0.23	0.083	0.015	0.003	59	210	160	0.004	2.0	2.2
0.07	0.31	0.014	0.024	17.8	<u>0.022</u>	0.27	0.095	0.010	<0.002	<1	4	4	0.008	1.3	1.6
0.14	0.35	0.011	0.020	16.5	<u>0.023</u>	0.27	0.092	0.007	<0.002	1	<1	<1	0.011	1.2	1.4
0.17	0.38	0.008	0.028	18.8	<u>0.024</u>	<u>0.31</u>	0.105	0.009	<0.002	1	1	1	0.009	1.3	1.6
0.14	0.29	0.012	0.026	18.6	<u>0.028</u>	0.29	0.107	0.009	0.002	5	47	41	0.009	1.4	1.2
0.12	0.23	0.013	0.038	18.9	<u>0.029</u>	0.30	0.103	0.008	<0.002	<1	7	7	0.003	1.8	1.6
0.22	0.40	0.014	0.029	15.5	<u>0.023</u>	0.21	0.068	0.013	0.002	<u>240</u>	130	110	0.010	1.2	1.7
0.17	0.27	0.010	0.024	19.1	<u>0.029</u>	0.28	0.100	0.010	0.002	47	70	60	0.008	1.8	1.6
0.20	0.30	0.014	0.024	17.0	<u>0.024</u>	0.27	0.085	0.008	<0.002	54	20	20	0.005	1.2	1.2
0.14	0.24	0.008	0.024	17.2	<u>0.023</u>	0.25	0.086	0.008	<0.002	<u>140</u>	38	36	0.008	1.3	1.5
0.11	0.43	0.022	0.028	19.6	<u>0.022</u>	0.26	0.085	0.013	0.003	20	21	17	<0.003	1.1	1.5
0.17	<u>0.52</u>	0.021	0.030	19.0	<u>0.020</u>	0.26	0.094	0.010	0.002	30	38	32	0.004	1.1	1.5
0.20	<u>0.76</u>	0.030	<u>0.044</u>	16.4	<u>0.017</u>	0.23	0.081	0.023	0.004	<u>110</u>	80	70	0.004	2.6	3.3
0.14	<u>0.64</u>	0.023	0.033	18.4	<u>0.018</u>	0.25	0.088	0.017	0.004	29	500	500	0.004	1.8	2.1
0.14	0.40	0.011	0.020	16.6	<u>0.018</u>	0.25	0.083	0.012	<0.002	11	34	26	0.019	1.7	2.1
0.29	<u>0.52</u>	0.004	0.029	16.4	<u>0.020</u>	0.23	0.085	0.011	<0.002	11	26	26	<u>0.021</u>	1.2	1.9
0.18	0.36	0.010	0.027	18.8	<u>0.024</u>	0.27	0.089	0.011	0.002	19	47	37	0.012	1.5	1.6
0.15	0.36	0.018	0.034	18.8	<u>0.025</u>	0.28	0.101	0.011	<0.002	13	33	33	0.004	2.2	2.0
0.18	0.29	0.010	0.031	14.8	<u>0.022</u>	0.21	0.071	0.012	0.002	<u>130</u>	170	150	0.005	1.6	1.7
0.19	0.29	0.009	0.024	18.9	<u>0.029</u>	0.28	0.107	0.011	0.002	11	40	40	0.010	1.6	1.5
0.18	0.30	0.013	0.026	17.2	<u>0.025</u>	0.27	0.086	0.008	<0.002	<u>460</u>	60	60	0.007	1.9	1.7
0.16	0.29	0.010	0.025	17.2	<u>0.024</u>	0.25	0.086	0.009	<0.002	43	90	90	0.007	1.6	1.4
0.12	0.47	0.026	0.037	19.6	<u>0.023</u>	0.26	0.091	0.012	0.003	100	100	100	<0.003	1.0	1.1
0.12	<u>0.51</u>	0.025	0.036	19.3	<u>0.022</u>	0.29	0.102	0.010	<0.002	60	60	60	0.003	1.0	1.8
0.23	<u>0.89</u>	0.040	<u>0.062</u>	16.7	<u>0.017</u>	0.21	0.074	0.028	0.005	<u>150</u>	260	260	0.004	3.0	3.3
0.12	<u>0.65</u>	0.027	<u>0.041</u>	18.7	<u>0.018</u>	0.26	0.085	0.018	0.005	48	100	100	0.003	1.8	2.0
0.12	0.39	0.017	0.025	16.6	<u>0.019</u>	0.24	0.085	0.010	<0.002	30	100	70	0.019	1.3	1.6
0.31	<u>0.50</u>	0.008	<u>0.044</u>	16.6	<u>0.020</u>	0.24	0.086	0.014	<0.002	11	27	27	0.017	1.7	2.6
0.24	0.43	0.012	0.040	18.6	<u>0.026</u>	0.28	0.090	0.011	<0.002	35	90	80	0.013	1.7	1.7
0.13	0.35	0.018	<u>0.044</u>	19.2	<u>0.025</u>	0.27	0.099	0.012	<0.002	37	70	70	0.006	1.7	2.0
0.21	0.36	0.014	0.032	14.4	<u>0.018</u>	0.19	0.058	0.017	0.003	56	220	180	0.006	1.7	2
0.20	0.26	0.009	0.032	19.0	<u>0.027</u>	0.29	0.096	0.014	0.003	<u>210</u>	190	160	0.014	1.7	2.0
0.15	0.22	0.004	0.030	17.1	<u>0.021</u>	0.25	0.077	0.011	0.002	<u>290</u>	260	260	0.008	3.8	3.6
0.15	0.34	0.016	0.028	17.7	<u>0.021</u>	0.23	0.077	0.012	0.002	25	45	45	0.006	1.4	1.6
0.16	<u>0.60</u>	0.027	0.034	18.3	<u>0.018</u>	0.21	0.068	0.017	0.003	110	150	130	0.003	1.1	1.8
0.16	<u>0.86</u>	0.023	0.040	16.2	<u>0.014</u>	0.19	0.065	0.016	0.003	50	60	60	0.006	1.5	1.6
0.47	<u>1.57</u>	0.020	<u>0.079</u>	11.9	0.006	0.08	0.024	0.030	0.005	<u>1000</u>	1600	<u>1600</u>	0.003	3.3	5.2
0.31	<u>1.34</u>	0.021	<u>0.065</u>	13.8	0.008	0.13	0.040	0.037	0.007	<u>280</u>	800	<u>800</u>	<0.003	3.2	4.2
0.21	<u>0.71</u>	0.019	0.033	15.4	<u>0.013</u>	0.18	0.059	0.018	0.003	26	60	60	0.018	2.8	3.8
0.30	<u>0.73</u>	0.012	<u>0.052</u>	14.6	<u>0.012</u>	0.15	0.052	0.017	0.003	70	110	100	0.014	2.1	2.6
0.24	<u>0.57</u>	0.016	<u>0.049</u>	15.1	<u>0.015</u>	0.19	0.057	0.020	0.004	40	440	310	0.013	1.9	2.1
0.15	0.47	0.022	<u>0.045</u>	17.1	<u>0.018</u>	0.21	0.073	0.019	0.003	9	50	30	<0.003	1.8	1.8

Note: < = less than the value stated

UD = upper decile flow (long-term record 1995-2014 inclusive)

\*New Zealand Standard Time

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

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

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

1131-91 UD = 654 m<sup>3</sup>/s (Flows from Mercer Bridge Recorder)

**Waikato River at Mercer Br**

8/01/2014	10:21:00	227	-	-	14.7	7.6	<u>23.0</u>	10.1	101.7	1.6	<u>7.2</u>	114	0.120	0.119	< 0.01
5/02/2014	09:30:00	292	-	-	16.8	7.8	<u>21.9</u>	10.1	96.2	1.5	3.8	124	0.060	0.059	< 0.01
5/03/2014	12:00:00	191	-	-	16.2	7.6	<u>20.2</u>	10.1	96.5	1.8	3.9	122	0.064	0.062	< 0.01
2/04/2014	10:15:00	169	-	-	16.2	7.5	<u>20.9</u>	10.1	97.1	1.4	3.2	128	0.184	0.182	< 0.01
7/05/2014	11:35:00	221	-	-	16.7	7.4	<u>17.5</u>	10.1	104.5	0.8	<u>5.1</u>	123	0.420	0.420	< 0.01
4/06/2014	11:30:00	299	-	-	16.8	6.9	<u>13.4</u>	10.1	96.6	0.7	<u>6.9</u>	127	0.680	0.680	< 0.01
2/07/2014	11:15:00	564	-	-	15.5	7.2	<u>12.9</u>	10.1	87.8	1.0	<u>15.9</u>	125	1.000	0.990	0.01
6/08/2014	11:05:00	455	-	-	15.3	7.2	<u>12.2</u>	10.1	100.3	1.5	<u>15.7</u>	128	0.900	0.890	< 0.01
4/09/2014	10:50:00	362	-	-	16.3	7.6	<u>13.0</u>	10.1	101.4	1.5	<u>15.0</u>	118	0.460	0.460	< 0.01
8/10/2014	09:35:00	350	-	-	15.0	7.6	13.7	10.1	98.0	1.5	<u>17.0</u>	96	0.370	0.370	< 0.01
5/11/2014	10:05:00	337	-	-	15.7	7.6	16.9	10.1	101.7	1.7	<u>10.3</u>	112	0.290	0.290	< 0.01
3/12/2014	11:15:00	260	-	-	16.2	7.7	19.1	10.1	100.6	1.5	<u>6.5</u>	126	0.290	0.290	< 0.01

1131-133 UD = 654 m<sup>3</sup>/s (Flows from Mercer Bridge Recorder)

**Waikato River at Tuakau Br**

8/01/2014	11:19:00	223	<u>0.5</u>	40.0	14.8	7.7	<u>23.2</u>	10.1	103.7	1.6	<u>8.5</u>	117	0.127	0.126	< 0.01
5/02/2014	12:15:00	288	<u>0.6</u>	32.5	17.0	7.9	<u>24.0</u>	10.1	112.0	0.5	3.7	125	0.010	0.009	< 0.01
5/03/2014	12:55:00	199	<u>0.9</u>	42.5	16.3	7.9	<u>20.2</u>	10.1	104.4	1.6	3.2	125	0.041	0.038	< 0.01
2/04/2014	10:50:00	166	<u>1.4</u>	32.5	16.2	7.5	<u>21.3</u>	10.1	98.2	2.0	3.3	121	0.187	0.185	< 0.01
7/05/2014	12:03:00	220	<u>0.7</u>	30.0	16.8	7.5	<u>17.7</u>	10.1	105.3	1.2	<u>5.8</u>	121	0.420	0.420	< 0.01
4/06/2014	12:00:00	298	<u>0.9</u>	40.0	16.7	7.2	<u>13.4</u>	10.1	95.9	0.9	<u>6.9</u>	132	0.680	0.670	< 0.01
2/07/2014	12:00:00	563	<u>0.4</u>	27.5	15.8	7.2	<u>12.0</u>	10.1	85.8	1.5	<u>17.3</u>	129	0.960	0.960	0.02
6/08/2014	11:30:00	455	<u>0.4</u>	25.0	15.2	7.2	<u>12.3</u>	10.1	96.1	1.4	<u>22.0</u>	113	0.890	0.880	< 0.01
4/09/2014	11:20:00	361	<u>0.7</u>	-	15.9	7.6	<u>13.1</u>	10.1	104.3	1.8	<u>12.1</u>	120	0.420	0.420	< 0.01
8/10/2014	10:10:00	356	<u>0.5</u>	25.0	15.0	7.6	14.2	10.1	100.6	1.6	<u>11.0</u>	94	0.320	0.310	< 0.01
5/11/2014	11:35:00	359	<u>0.6</u>	27.5	15.8	7.3	17.3	10.1	101.0	1.7	<u>9.9</u>	121	0.310	0.310	< 0.01
3/12/2014	11:44:00	258	<u>1.0</u>	30.0	16.3	7.8	<u>20.1</u>	10.1	102.7	1.6	<u>7.0</u>	130	0.270	0.270	< 0.01

Note: < = less than the value stated

UD = upper decile flow (long-term record 1995-2014 inclusive)

\*New Zealand Standard Time

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

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

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

0.26	0.38	0.009	0.034	14.9	<u>0.016</u>	0.18	0.056	0.017	0.003	10	51	51	0.011	1.7	2.5
0.20	0.26	0.008	0.036	18.5	<u>0.025</u>	0.27	0.091	0.013	0.003	20	100	100	0.017	1.5	1.8
0.24	0.30	0.006	0.026	17.5	<u>0.022</u>	0.25	0.078	0.010	< 0.002	36	20	20	0.016	1.7	2.1
0.18	0.36	0.013	0.036	17.2	<u>0.022</u>	0.24	0.079	0.010	< 0.002	21	38	37	0.011	1.3	1.7
0.19	<u>0.61</u>	0.020	0.037	18.5	<u>0.019</u>	0.23	0.071	0.016	0.003	31	80	40	0.006	1.1	1.8
0.19	<u>0.87</u>	0.018	0.040	17.6	<u>0.015</u>	0.22	0.071	0.016	0.003	2	50	40	0.003	1.8	2.2
0.38	<u>1.38</u>	0.018	<u>0.055</u>	14.7	0.008	0.11	0.033	0.036	0.006	<u>280</u>	230	200	0.005	4.2	5.1
0.39	<u>1.29</u>	0.024	<u>0.067</u>	16.3	<u>0.011</u>	0.16	0.053	0.038	0.008	<u>380</u>	800	<u>800</u>	0.003	3.7	5.0
0.28	<u>0.74</u>	0.008	0.037	16.2	<u>0.012</u>	0.17	0.052	0.031	0.005	70	140	130	<u>0.026</u>	1.5	1.8
0.38	<u>0.75</u>	0.006	<u>0.064</u>	15.7	<u>0.013</u>	0.16	0.052	0.021	0.003	15	60	50	<u>0.027</u>	2.7	3.7
0.31	<u>0.60</u>	0.014	<u>0.057</u>	16.6	<u>0.019</u>	0.21	0.066	0.021	0.003	8	40	10	0.017	1.7	2.3
0.16	0.45	0.018	<u>0.043</u>	17.9	<u>0.019</u>	0.22	0.076	0.023	0.004	< 1	49	49	0.006	3.0	2.5

0.35	0.48	0.009	0.037	15.0	<u>0.017</u>	0.19	0.057	0.017	0.003	53	80	80	0.020	1.6	3.1
0.21	0.22	0.005	0.033	18.7	<u>0.028</u>	0.29	0.100	0.012	0.002	11	30	20	<u>0.024</u>	1.8	1.7
0.21	0.25	0.006	0.028	17.5	<u>0.021</u>	0.25	0.081	0.010	< 0.002	52	40	40	0.019	1.6	1.8
0.18	0.37	0.013	0.033	17.6	<u>0.020</u>	0.24	0.079	0.008	< 0.002	17	47	47	0.014	1.4	1.6
0.18	<u>0.60</u>	0.020	0.036	19.2	<u>0.019</u>	0.24	0.073	0.015	0.003	24	90	60	0.005	1.3	2.0
0.21	<u>0.89</u>	0.023	<u>0.046</u>	17.7	<u>0.015</u>	0.23	0.077	0.017	0.004	< 1	50	50	0.006	1.6	2.9
0.56	<u>1.52</u>	0.020	<u>0.061</u>	15.7	0.010	0.14	0.041	0.040	0.007	<u>280</u>	390	390	0.008	4.7	5.6
0.39	<u>1.28</u>	0.018	<u>0.073</u>	16.1	<u>0.011</u>	0.15	0.049	0.042	0.008	<u>460</u>	700	<u>700</u>	0.009	3.9	5.3
0.29	<u>0.71</u>	0.008	<u>0.044</u>	16.5	<u>0.013</u>	0.19	0.060	0.027	0.004	30	80	60	<u>0.030</u>	2.6	3.3
0.32	<u>0.64</u>	0.006	<u>0.056</u>	16.2	<u>0.013</u>	0.18	0.056	0.025	0.004	8	50	40	<u>0.038</u>	2.8	2.8
0.28	<u>0.59</u>	0.012	<u>0.055</u>	16.7	<u>0.016</u>	0.21	0.063	0.026	0.004	7	80	60	0.017	2.4	2.8
0.15	0.42	0.016	<u>0.042</u>	18.4	<u>0.017</u>	0.22	0.072	0.023	0.004	3	26	26	0.008	2.2	2.7

Note: < = less than the value stated

UD = upper decile flow (long-term record 1995-2014 inclusive)

\*New Zealand Standard Time

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

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

## 3.2 Waikato River Monitoring Programme

### Bathing Season Microbiological Survey

#### Summary Statistics

#### Comparison with Water Quality Standards

#### Parameter Graph

#### Raw Data

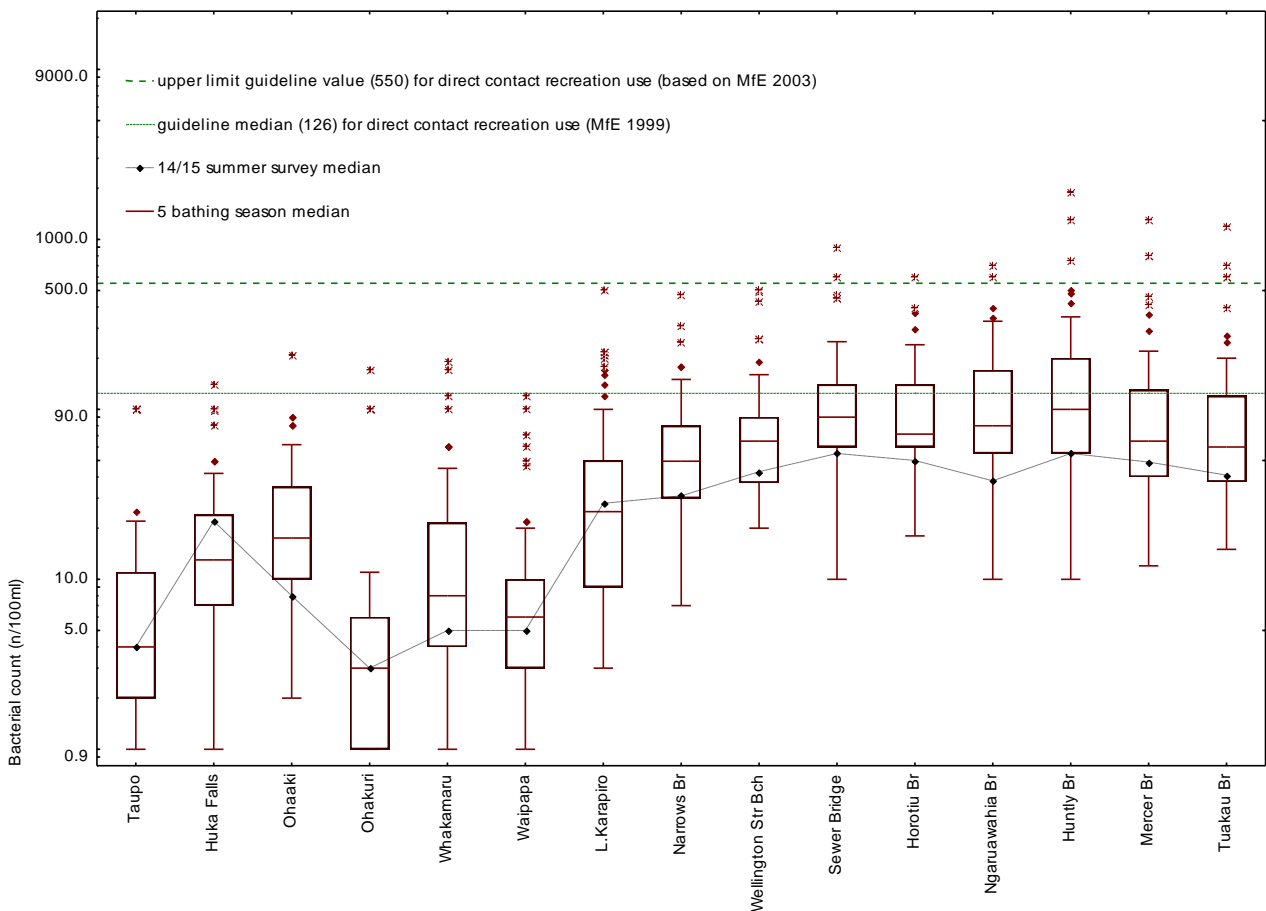
Table 5: Bathing Season Statistics of E. coli Bacteria.

Location Name	BATHING SEASON MEDIAN					5 Season
	06/07	08/09	10/11	12/13	14/15	Median
Taupo Gates	2	3	8	6	4	4
Huka Falls	8	13	15	9	22	13
Ohaaki Bridge	16	41	19	18	8	18
Ohakuri Tailrace Br	2	3	3	3	3	3
Whakamaru Tailrace	6	10	18	8	5	8
Waipapa Tailrace	6	6	7	6	5	6
Lake Karapiro Boatramp	8	25	45	30	28	28
Narrows Br	55	83	60	34	31	55
Wellington Street Beach	84	80	80	43	43	80
Sewer Br Alandale	100	120	130	70	55	100
Horotiu Br	150	120	110	64	50	110
Ngaruawahia Br	140	120	240	65	38	120
Huntly-Tainui Br	150	160	160	75	55	150
Mercer Br	85	115	160	48	49	85
Tuakau Br	50	105	80	41	41	50
Waipa River (Ngaruawahia Br)	90	130	100	52	50	90
Port Waikato Beach (Maraetai Bay)	44	50	20	22	19	22



**Table 6: Year 2014/15 Bathing Season E. coli survey results complying with the “Satisfactory” and “Excellent” Water Quality Guidelines. n = 13 (except \* where n = 12).**

HUMAN USES - RECREATION				
Location Name	SATISFACTORY		EXCELLENT	
	<i>E. coli</i>	<i>E. coli</i>	<i>E. coli</i>	<i>E. coli</i>
	Samples < 550	Median <126	Samples < 55	Median <23
Taupo Gates	13	Y	13	Y
Huka Falls	12*	Y*	10*	Y*
Ohaaki Bridge	13	Y	13	Y
Ohakuri Tailrace Br	13	Y	13	Y
Whakamaru Tailrace	13	Y	12	Y
Waipapa Tailrace	13	Y	12	Y
Lake Karapiro Boatramp	12*	Y*	10*	N*
Narrows Br	13	Y	9	N
Wellington Street Beach	12*	Y*	8*	N*
Sewer Br Alandale	12*	Y*	6	N*
Horotiu Br	13	Y	7	N
Ngaruawahia Br	12*	Y*	9*	N*
Huntly-Tainui Br	13	Y	7	N
Mercer Br	13	Y	9	N
Tuakau Br	13	Y	9	N
Waipa River (Ngaruawahia Br)	12*	Y*	7*	N*
Port Waikato Beach (Maraetai Bay)	11*	Y*	10*	Y*



**Figure 2: E. coli - five bathing season data**



# References

- Tulagi A 2014. Waikato River water quality monitoring programme data report 2013. Waikato Regional Council Technical Report 2014/31. Hamilton, Waikato Regional Council
- Tulagi A 2013. Waikato River water quality monitoring programme data report 2012. Waikato Regional Council Technical Report 2013/12. Hamilton, Waikato Regional Council
- Vant B 2013. Trends in river water quality in the Waikato region, 1993-2012. Waikato Regional Council Technical Report 2013/20, Hamilton, Waikato Regional Council
- Wilson B, Vant B, Huser B 1998. Waikato River water quality monitoring programme data report 1997. Environment Waikato Technical Report 1998/6. Hamilton, Waikato Regional Council

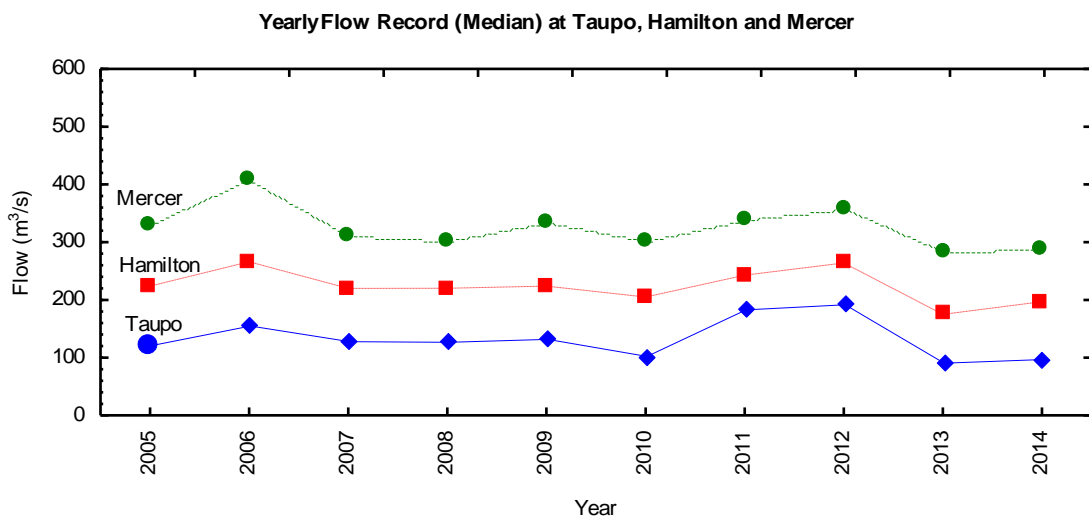
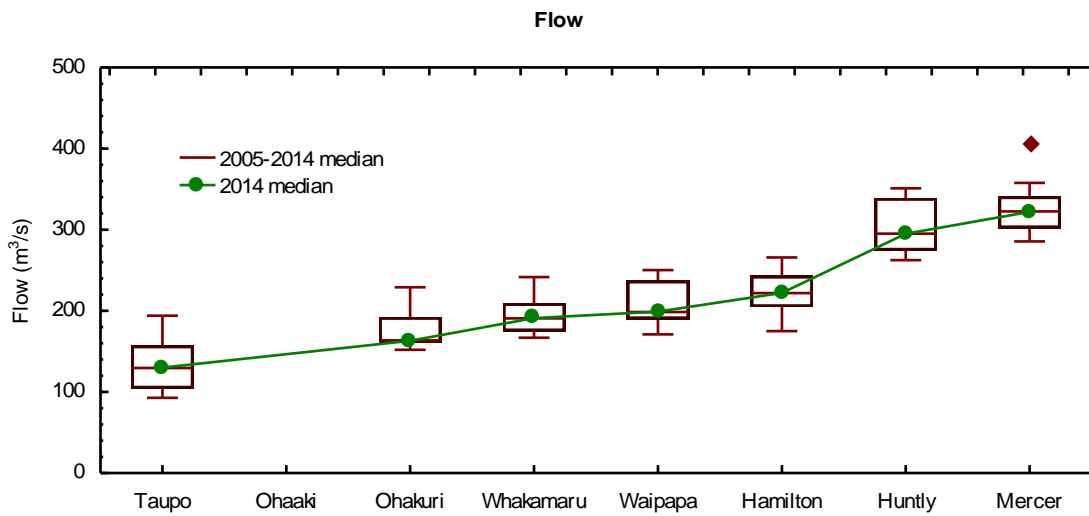
# Appendix I:

## Flow Information

Location	DISTANCE	FLOW RATE+ (m <sup>3</sup> /s)										10 YEAR
	km	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Median
Taupo	4.2	123	157	130	129	134	104	185	194	93	99	130
Ohakuri	75.8	152	184	157	163	162	192	225	229	163	163	163
Whakamaru	105.0	175	208	178	186	196	209	242	232	168	167	191
Waipapa	126.1	200	237	190	211	194	198	250	245	175	171	199
Hamilton	211.5	224	266	220	220	224	205	243	264	175	197	222
Huntly	246.5	*293	*351	*278	274	*302	*297	339	345	266	263	295
Mercer	286.3	332	409	313	302	334	*304	*341	*358	*286	290	322
Waitapu Stm	46.6	3.6	3.8	2.8	3.0	2.7	3.3	3.8	3.5	2.5	2	3
Waipa River	232.7	48	62	34	43	53	41	61	62	47	58	50

+Rating curve errors mean estimates of flow are  $\pm 8\%$

\*Historical flow data updated due to rating changes from updated data received

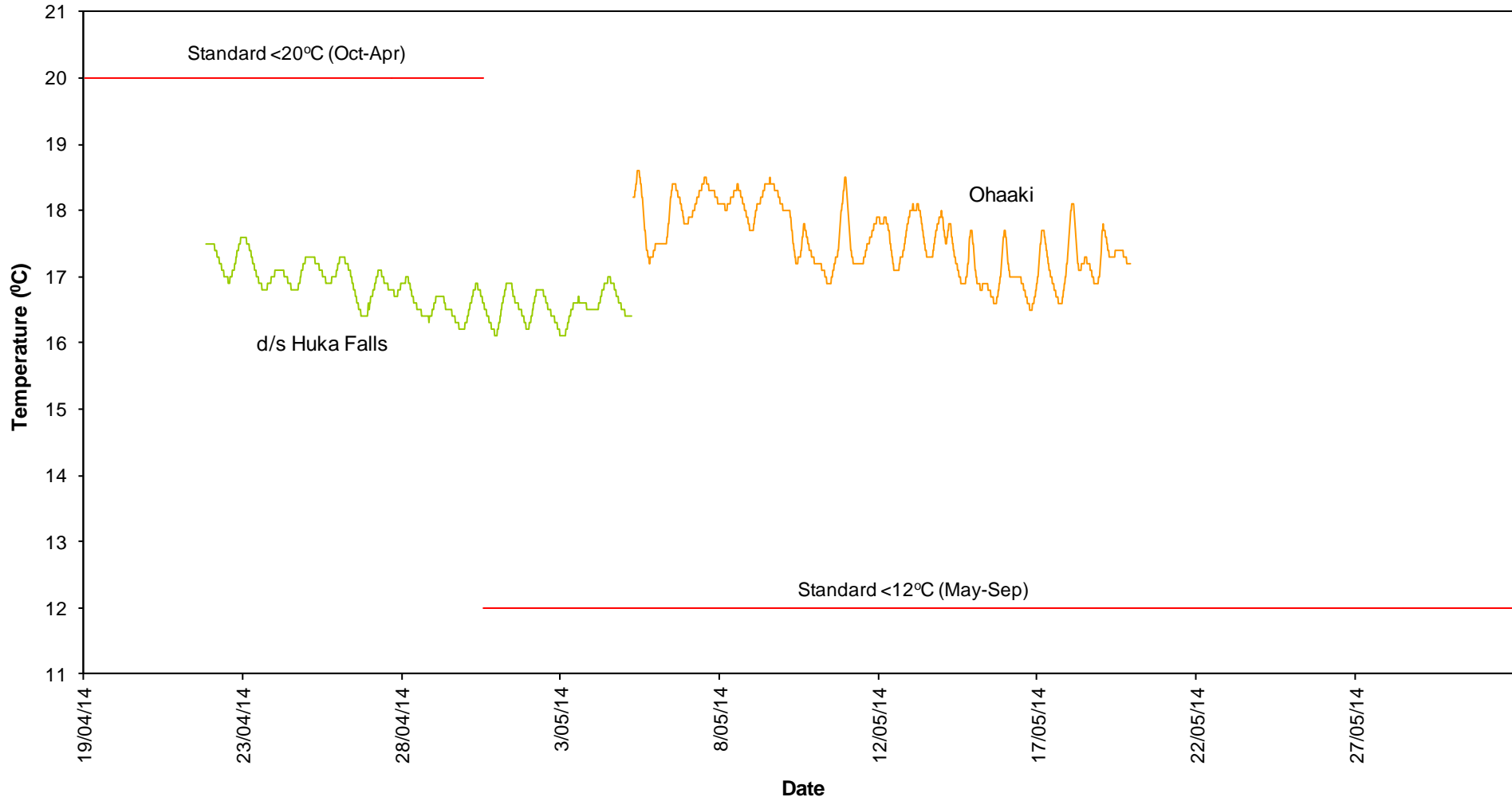


# **Appendix II**

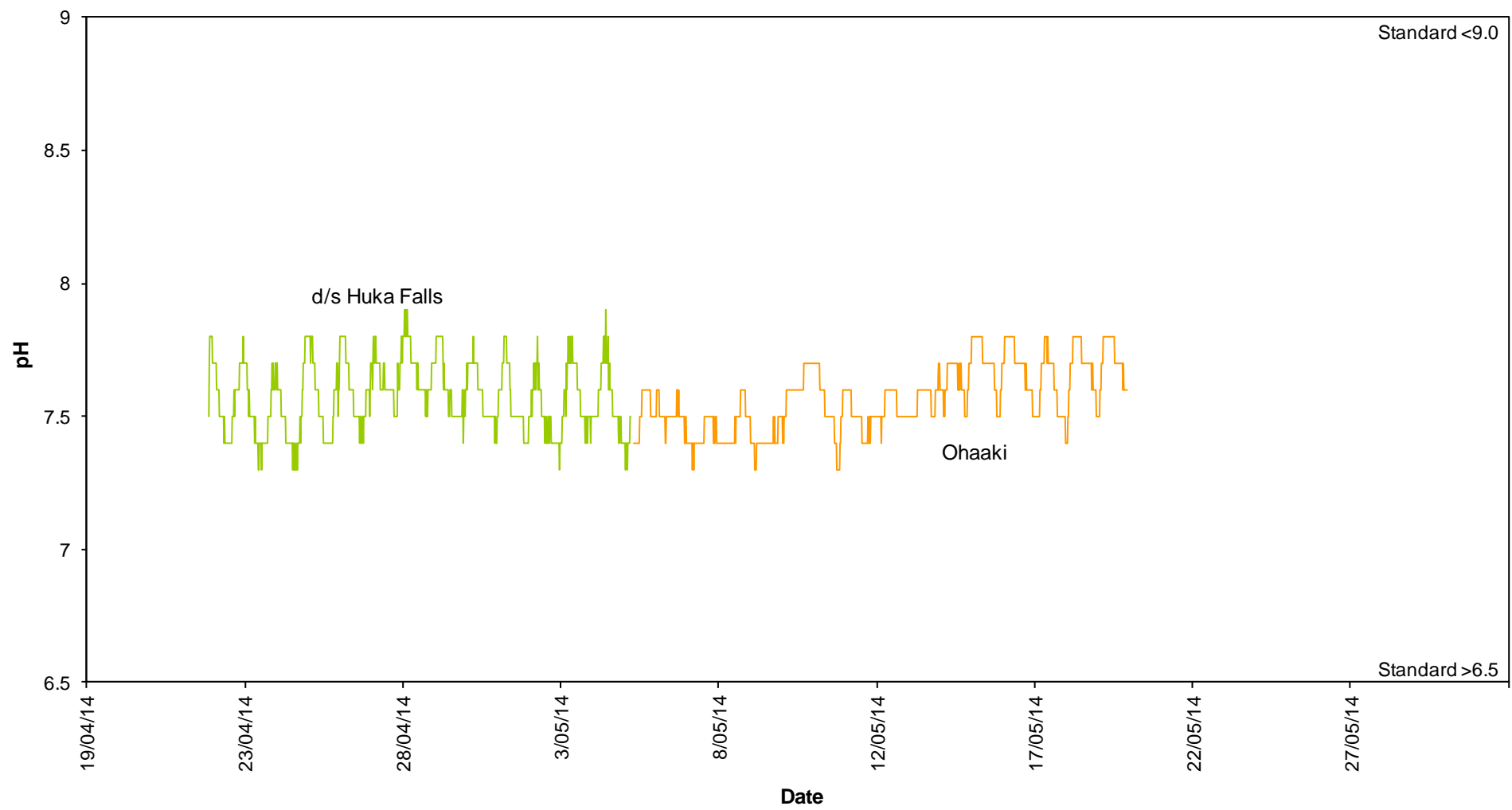
## **Datasonde deployments**

### **Diurnal variation of selected water quality parameters**

### Temperature: Upper Waikato (April - May)

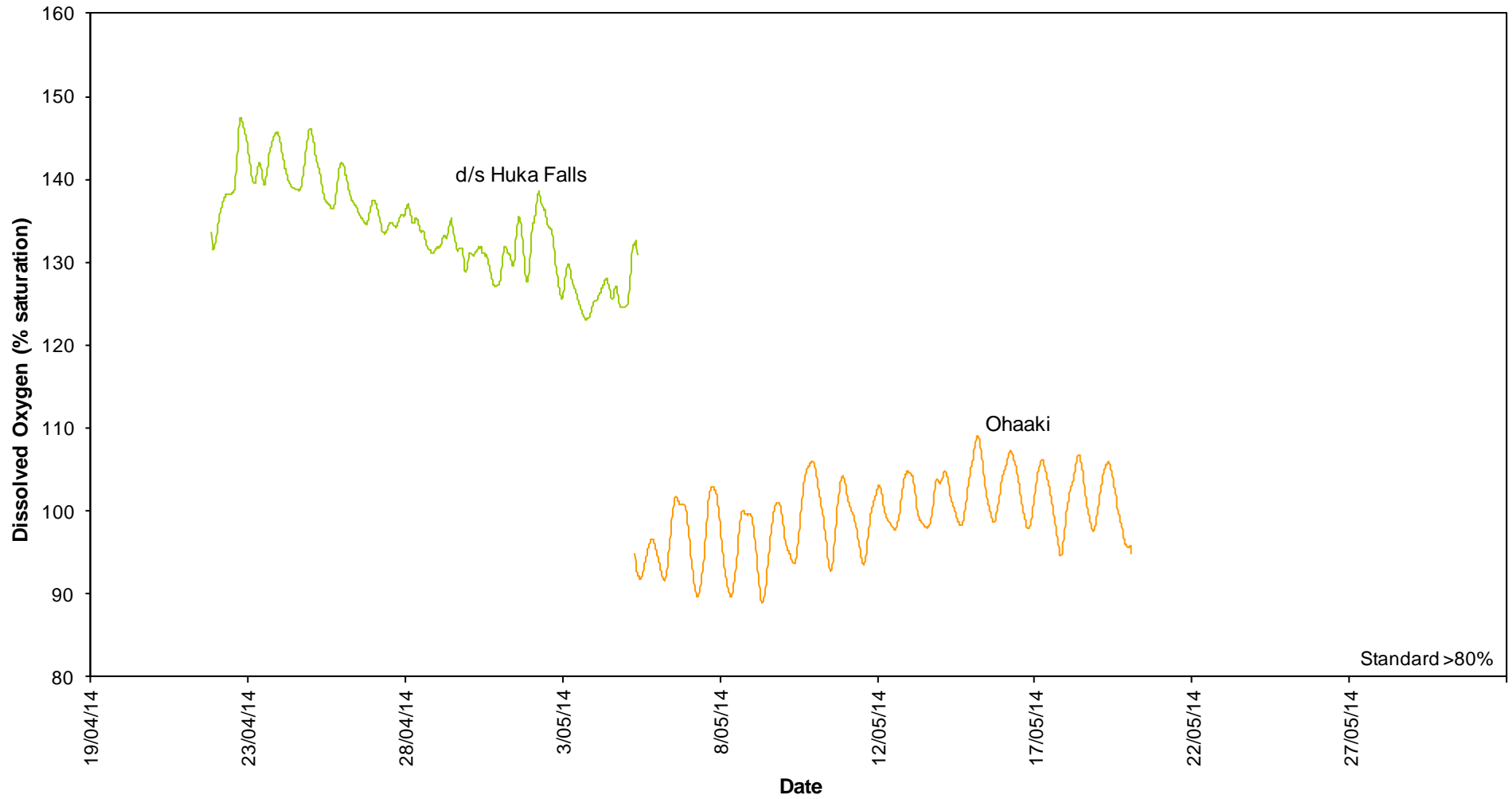


### pH: Upper Waikato (April - May)

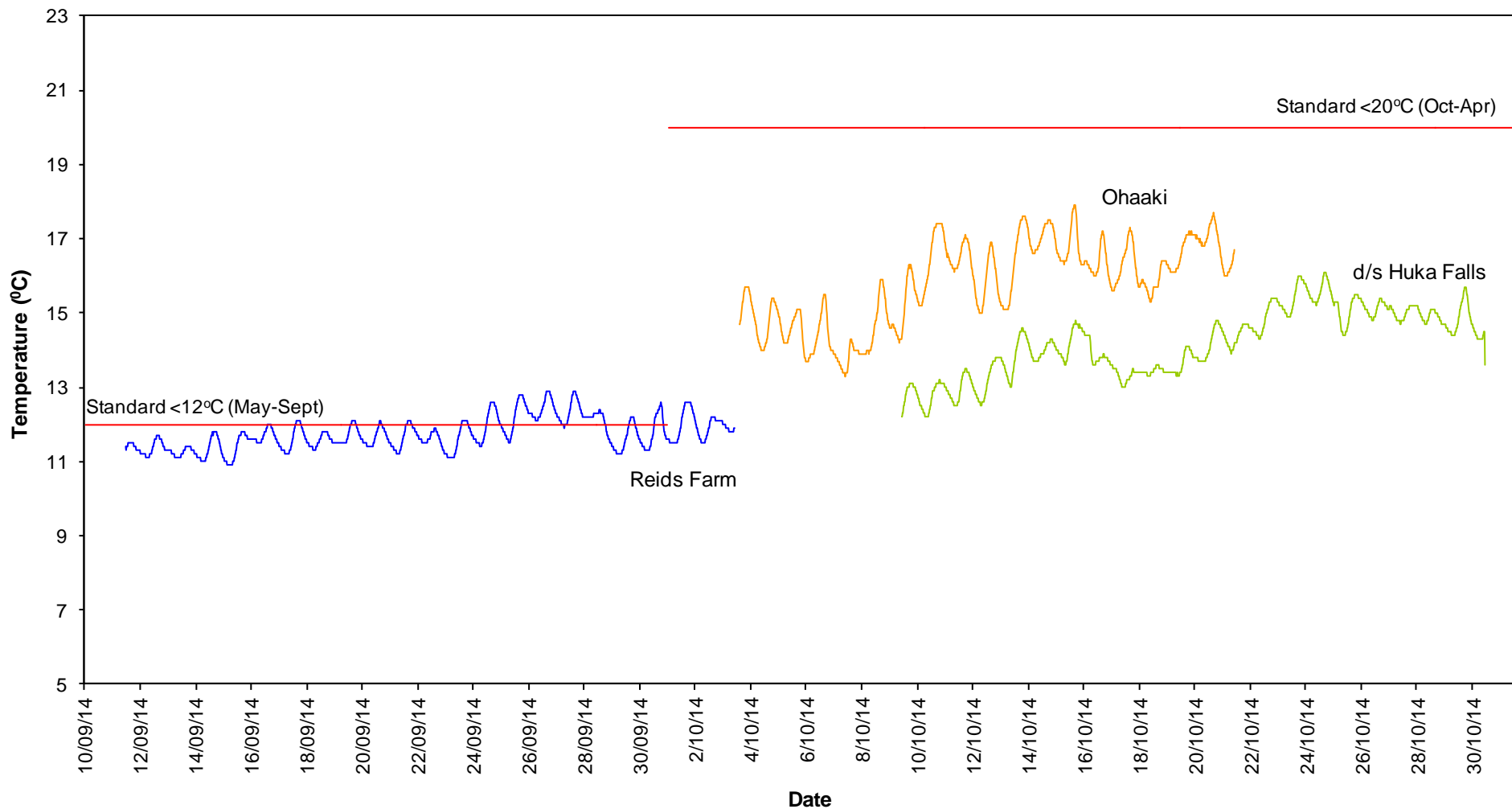




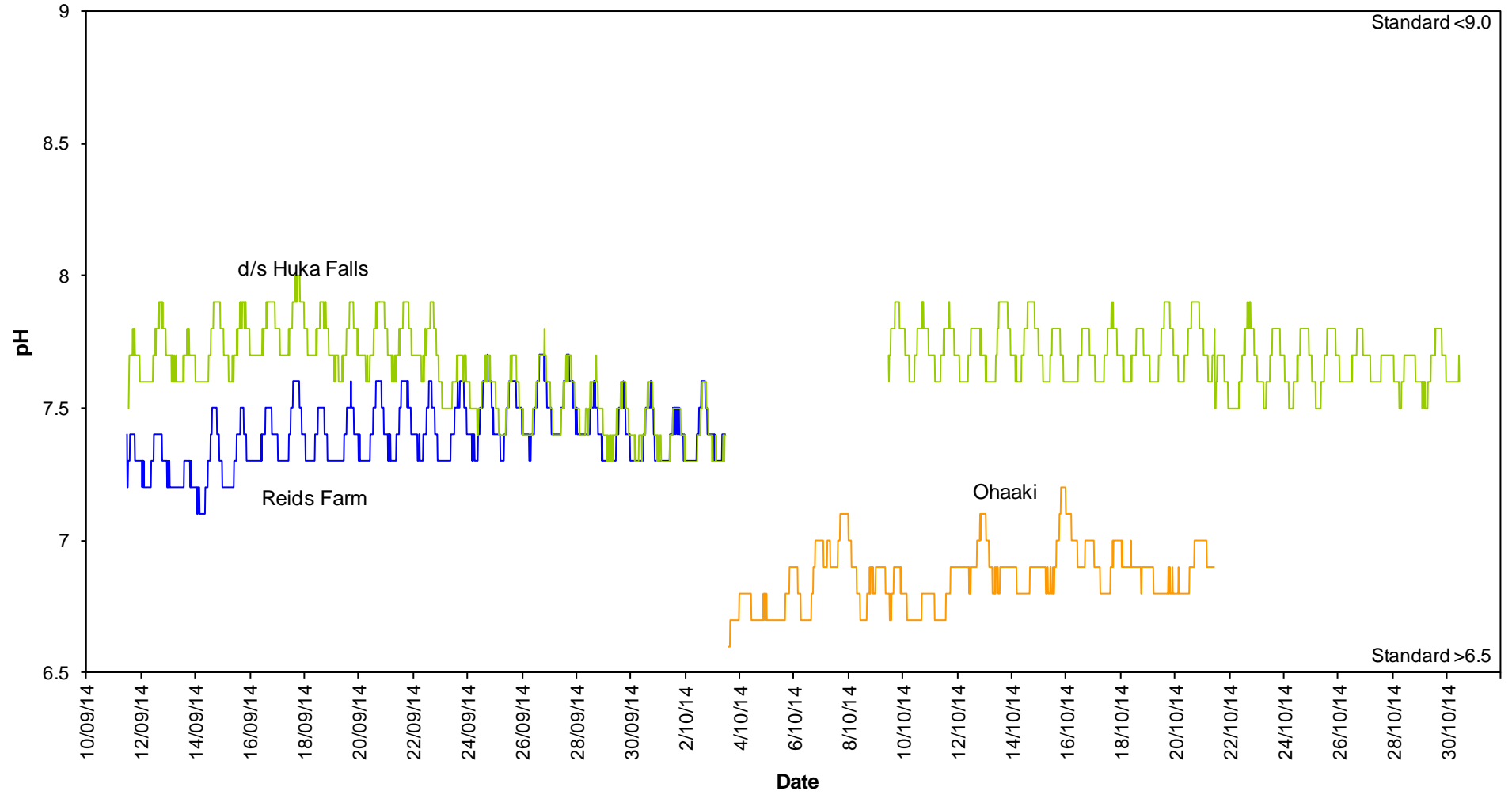
### Dissolved Oxygen, % saturation: Upper Waikato (April - May)



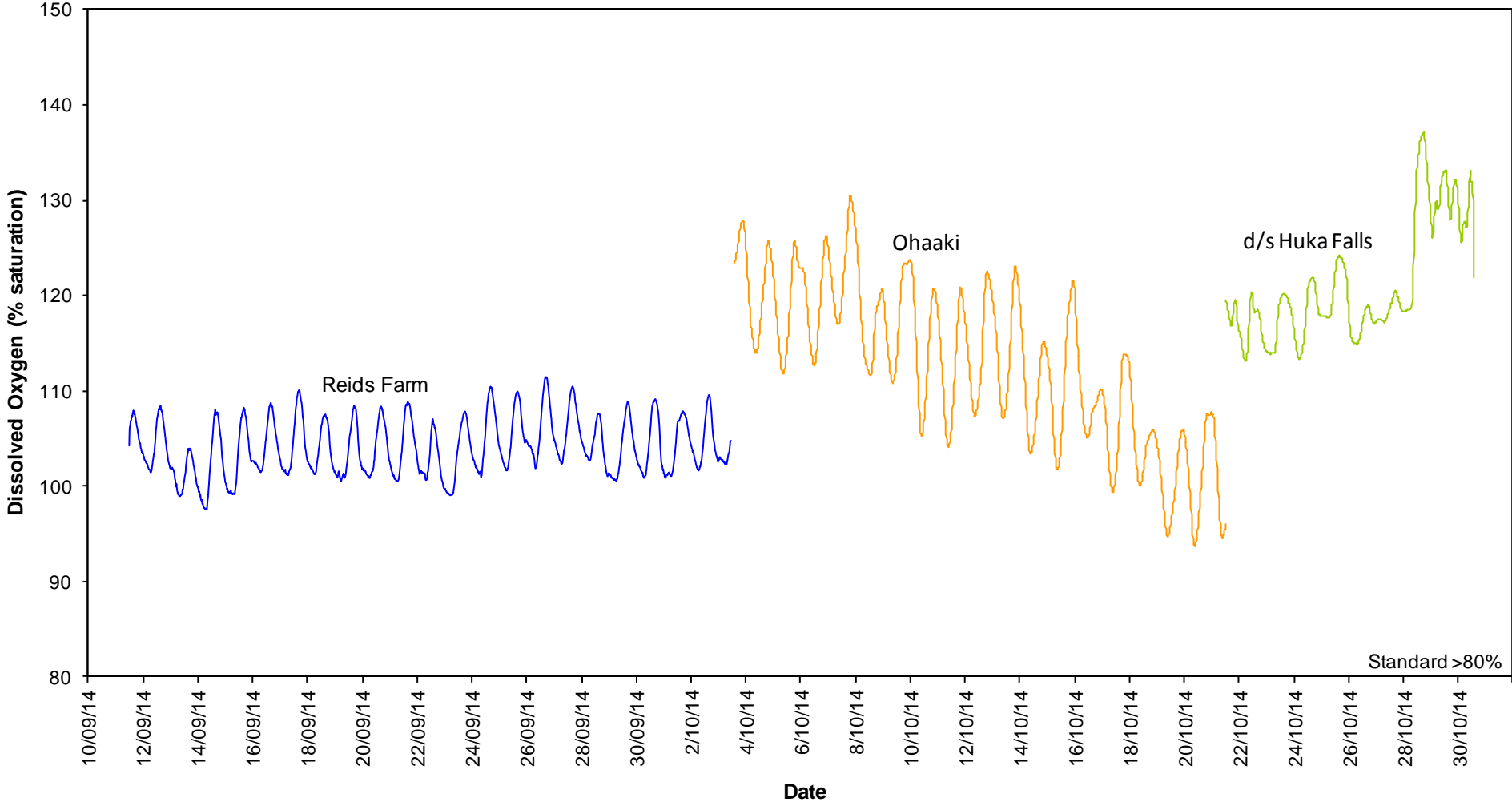
### Temperature: Upper Waikato (September to October)



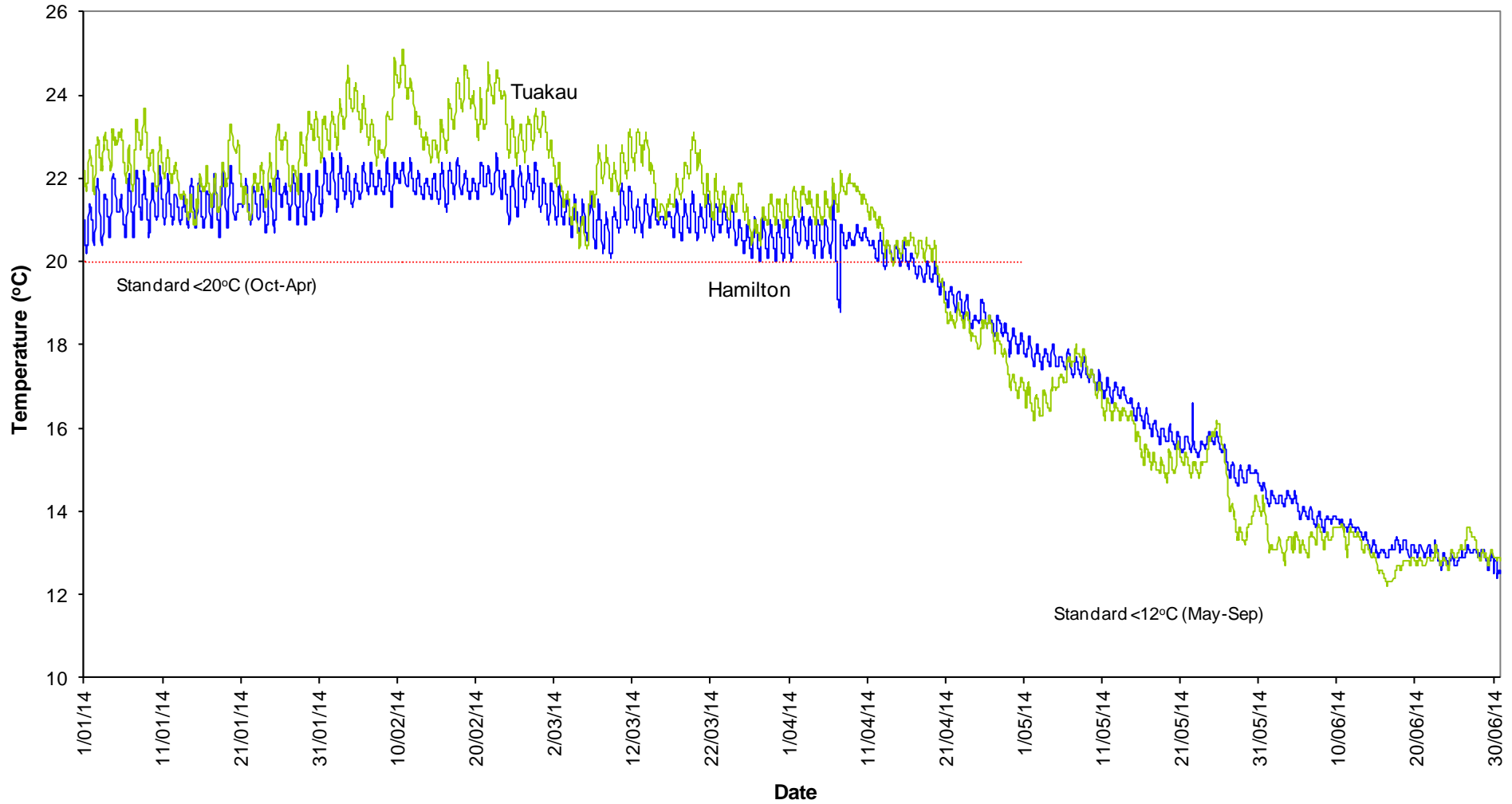
### pH: Upper Waikato (September to October)



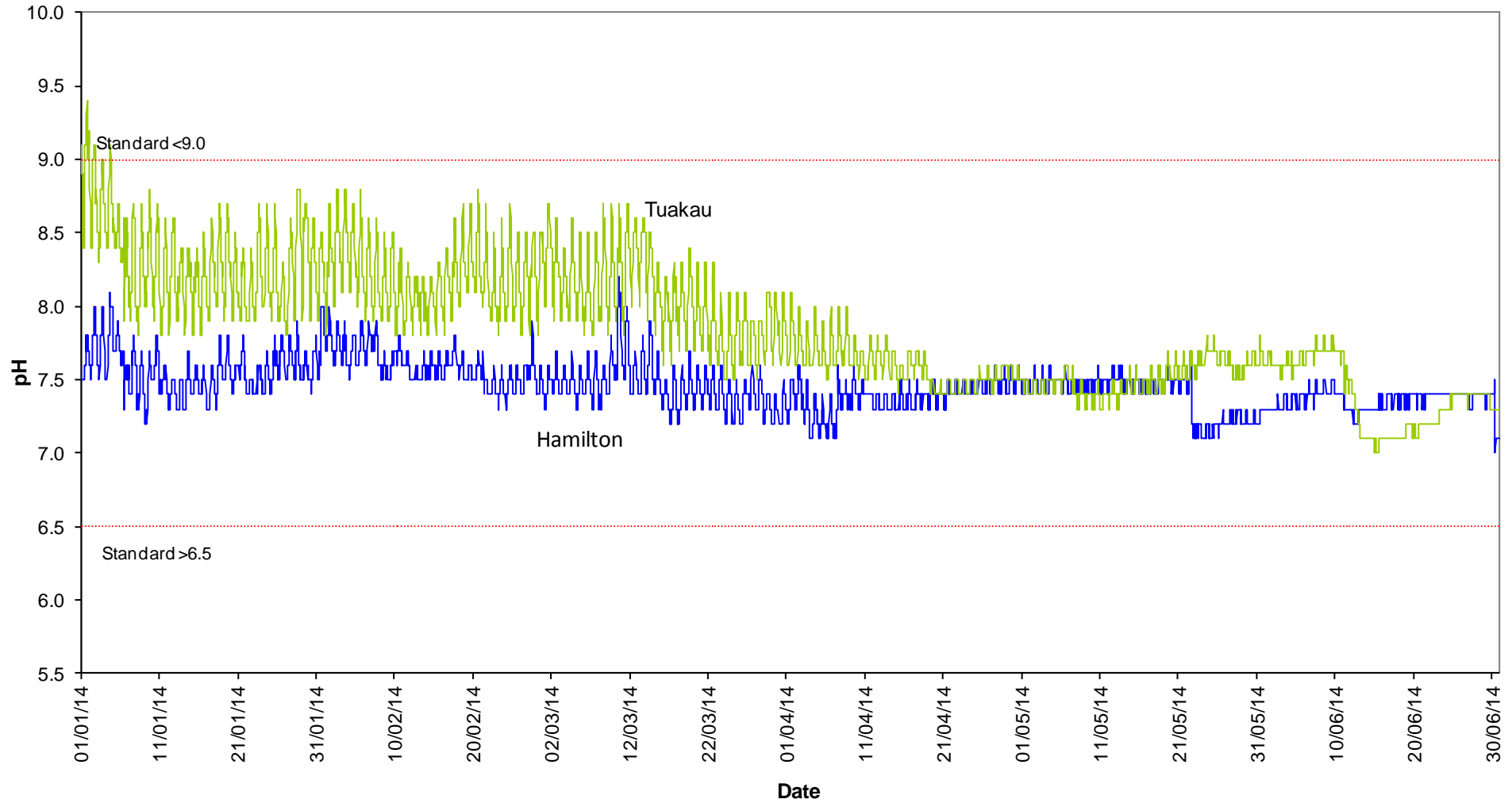
Dissolved Oxygen, % saturation: Upper Waikato (September to October)



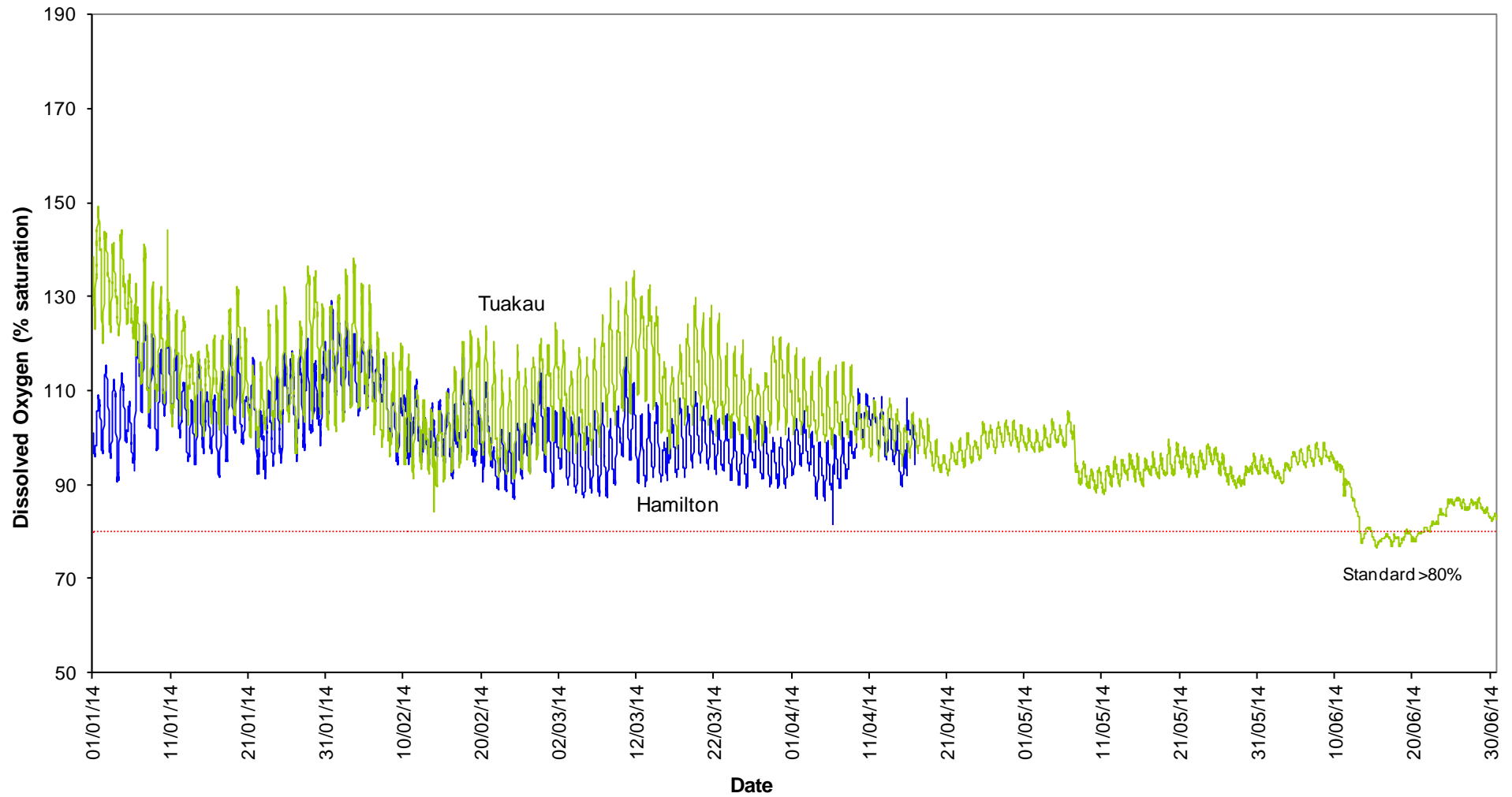
### Temperature: Lower Waikato (January-June)



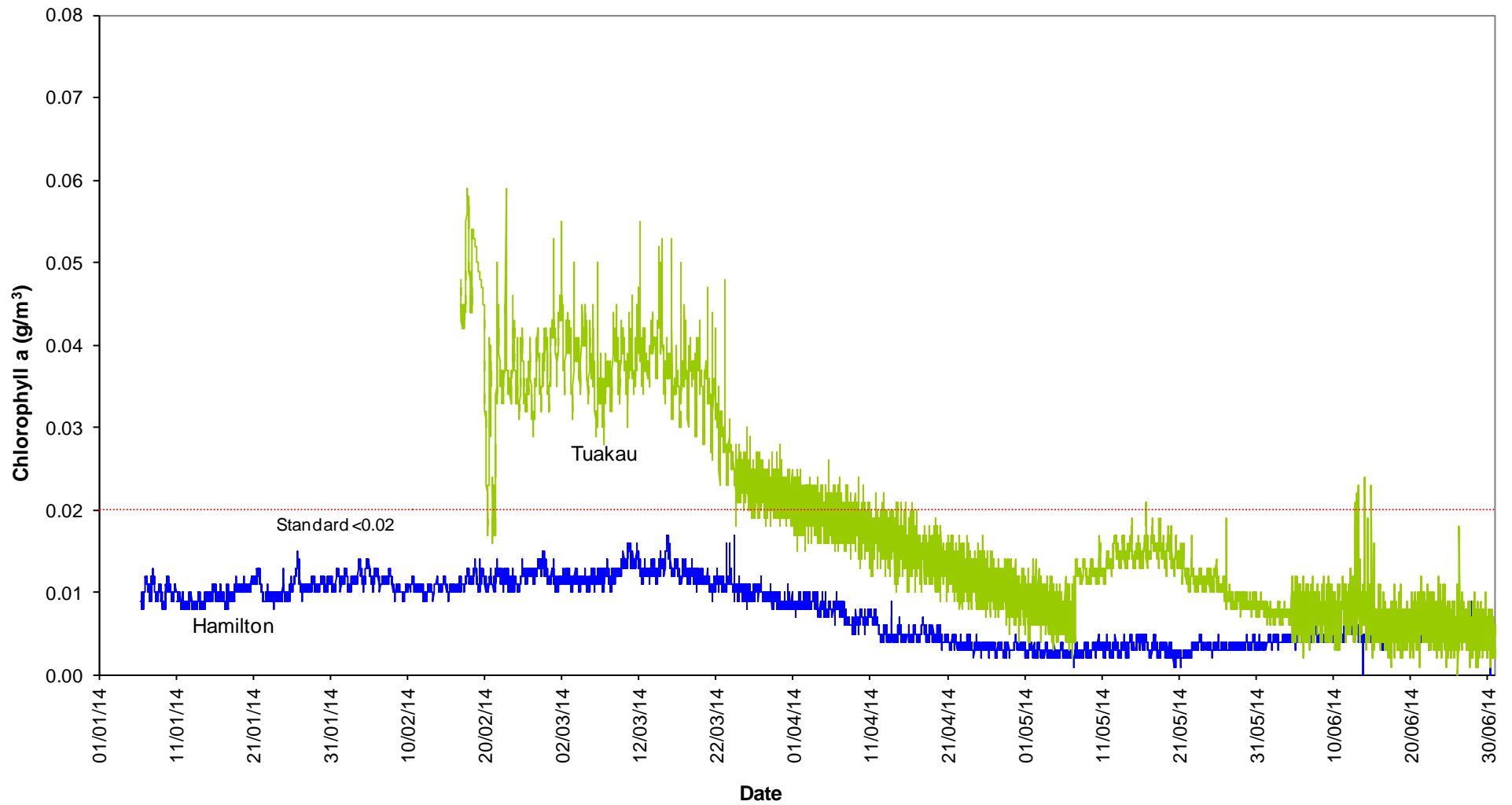
### pH: Lower Waikato (January - June)



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

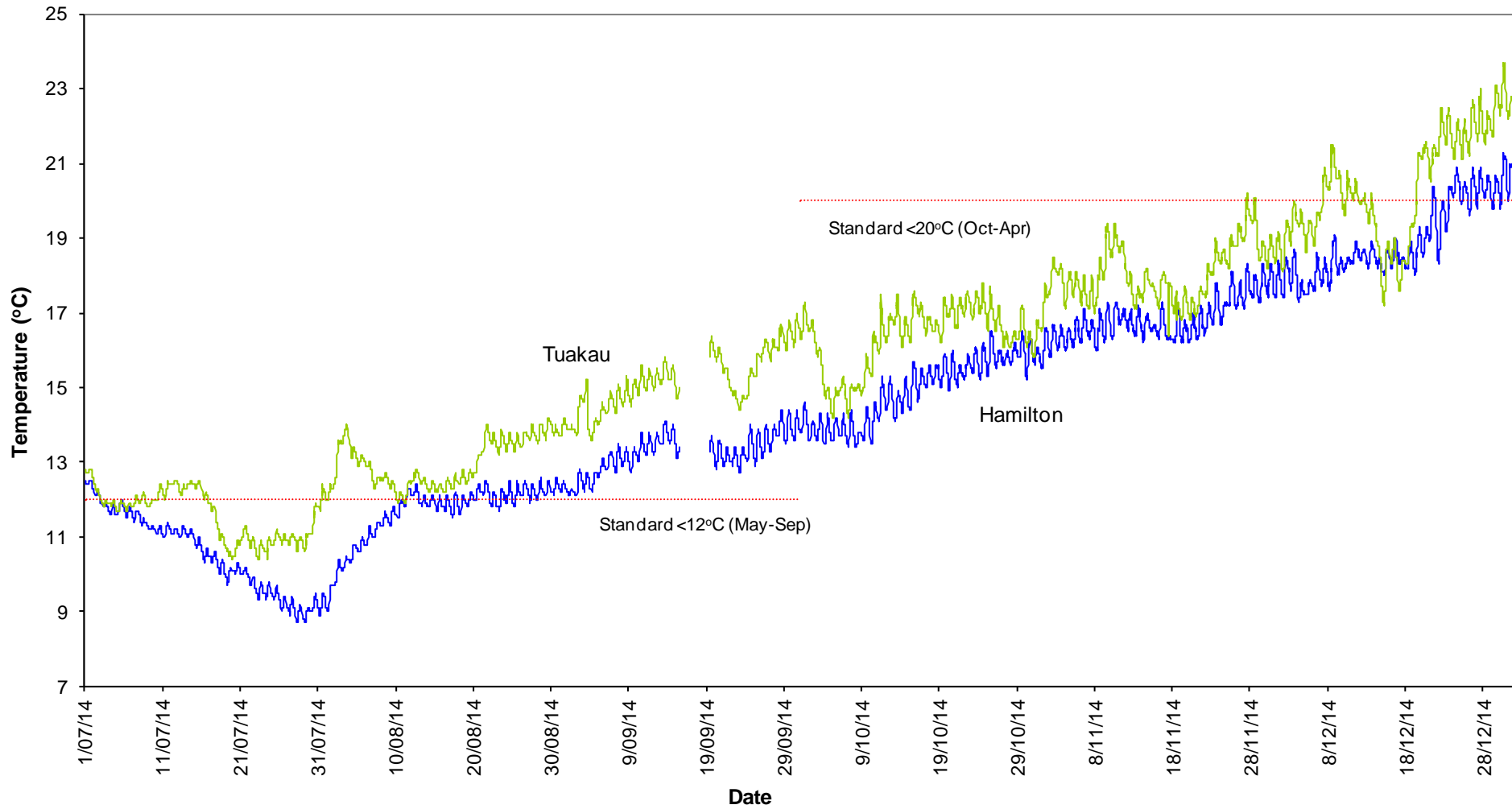


### Chlorophyll a: Lower Waikato (January- June)

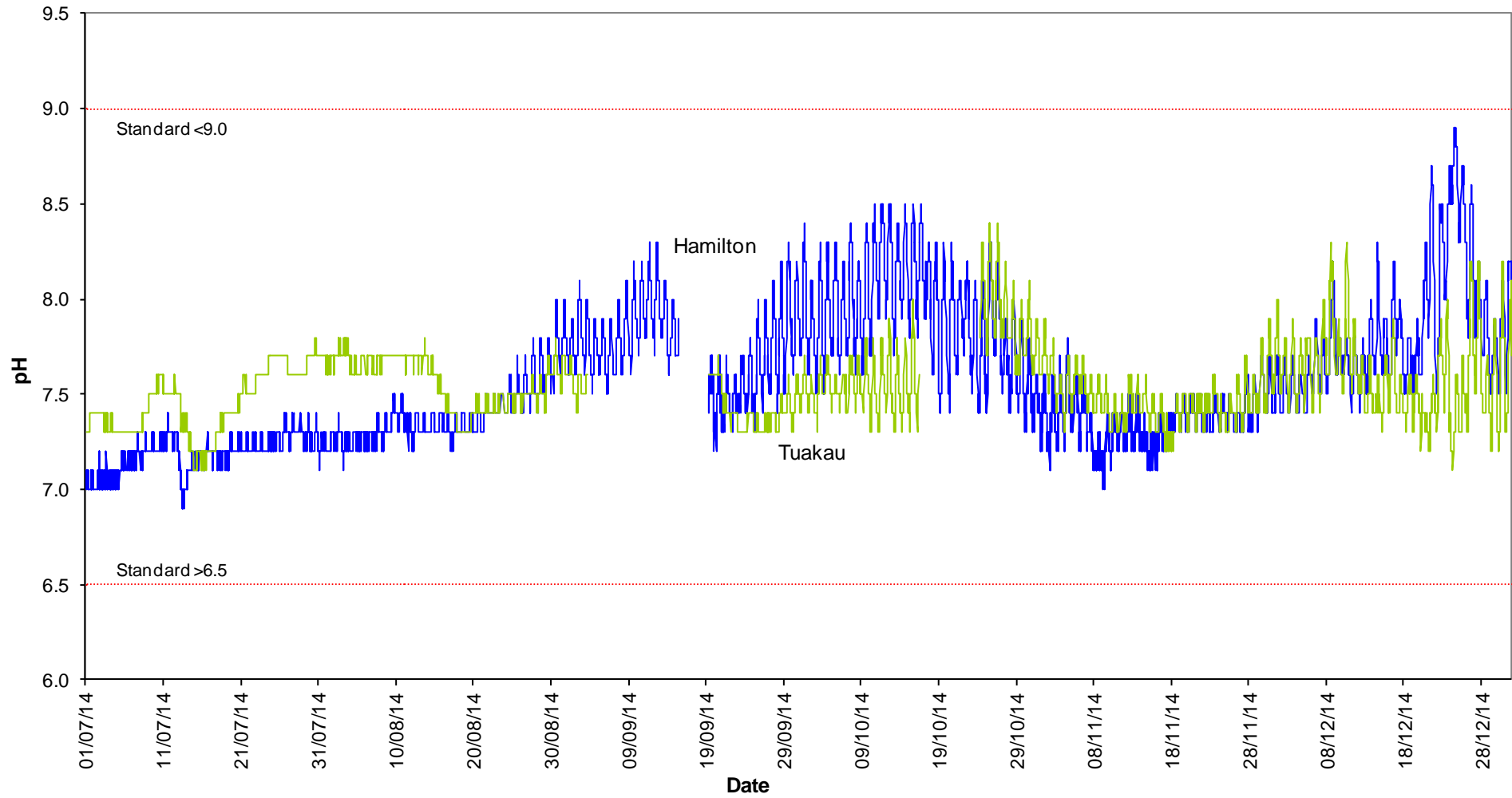




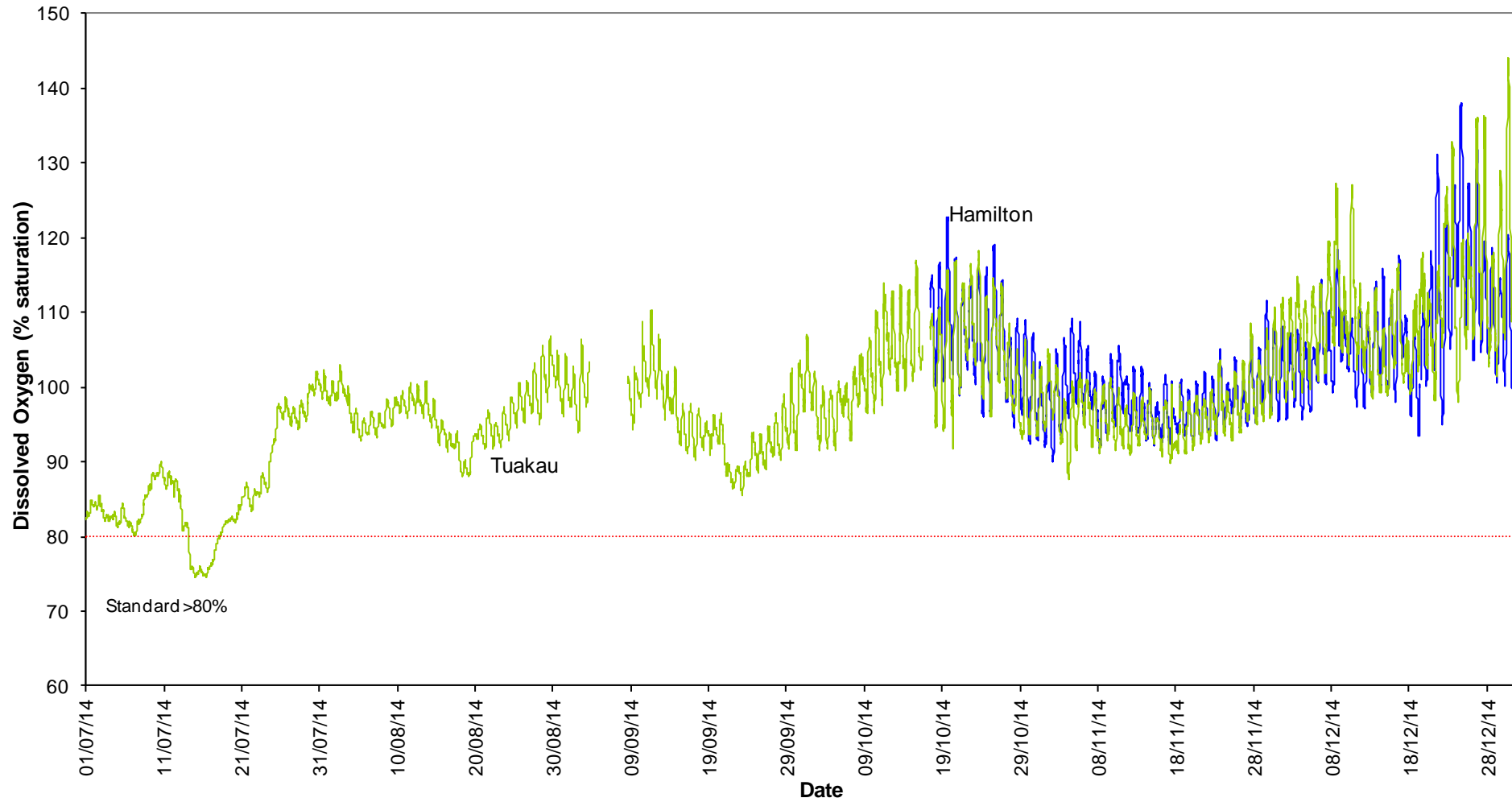
### Temperature: Lower Waikato (July-December)



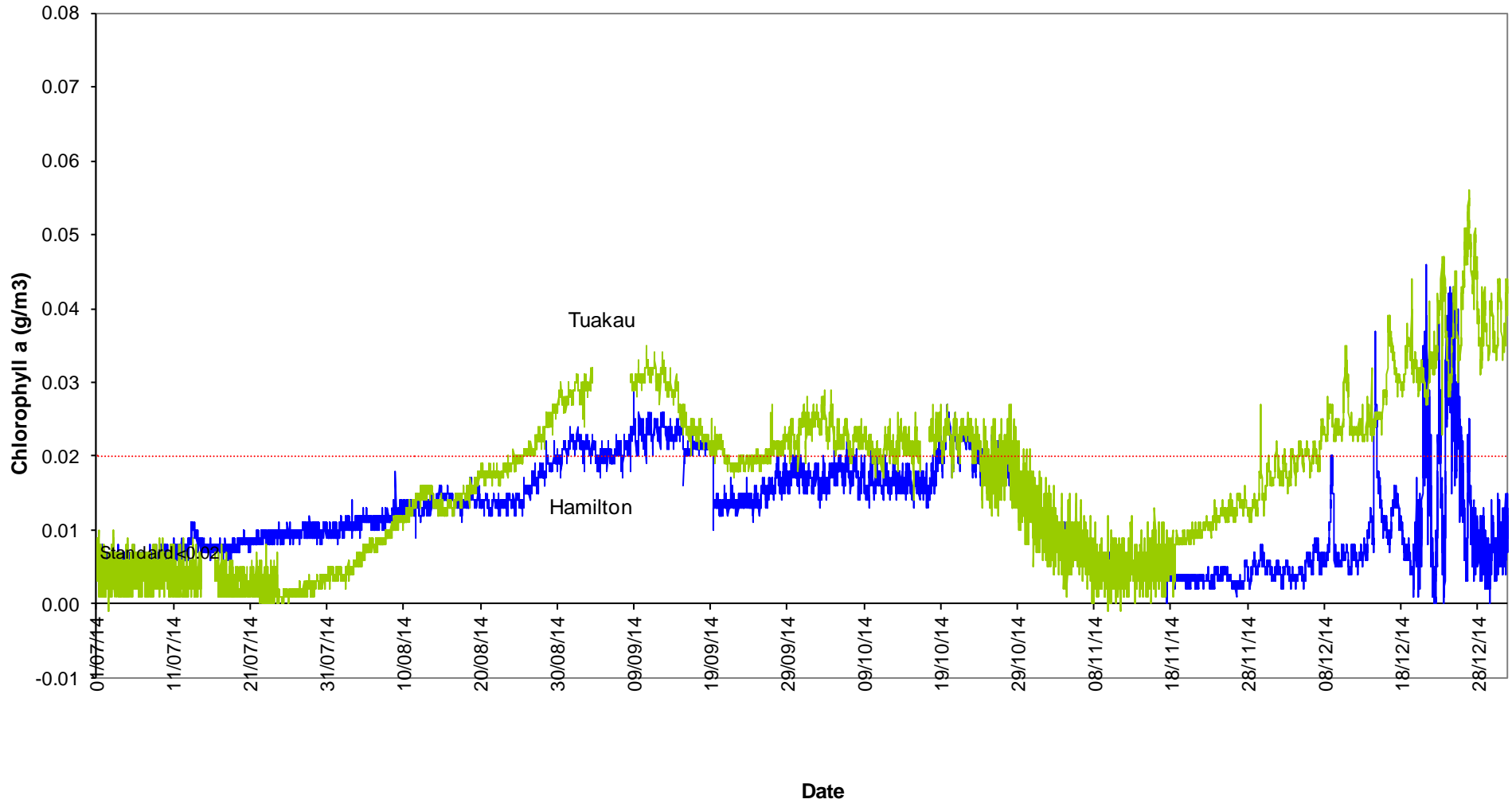
### pH: Lower Waikato (July - December)



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



### 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 <sup>1</sup>	Comments <sup>2</sup>
<b>Dissolved oxygen</b>	- requirement for aquatic life	DO (conc.)	routine (field)
	- indicator of organic pollution	DO (%sat.)	routine (field)
	- indicator of photosynthesis (plant growth)		
<b>Temperature</b>	- indicator of biological activity	Temperature	routine (field)
	- requirement for aquatic life		
	- mixing processes		
	- modelling studies (e.g. nutrient uptake)		
<b>Conductivity</b>	- indicator of total salts dissolved in water	Conductivity	routine
	- indicator for geothermal input	TDS	routine
<b>pH</b>	- aquatic life protection	pH	routine
	- indicator of industrial discharges, mining		
<b>Clarity</b> - 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		
<b>Colour</b> - 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	
<b>Nutrients (N and P) chlorophyll a</b>	- enrichment, excessive plant growth	NO <sub>3</sub> -N+NO <sub>2</sub> -N	routine
	- nutrient limitation for plant/algal growth	NH <sub>4</sub> -N,TKN DRP, TP, Chl a	
<b>Geothermal contaminants</b>	- indicators of geothermal inflows	Cl, Li, B, As	routine
	- aquatic life protection (ecotoxicity)		
	- drinking water (human health aspects)		
<b>Organic carbon</b>	- indicator of organic pollution	BOD <sub>5</sub>	routine
	- catchment characteristics	TOC/DOC	routine
<b>Faecal bacteria</b> - E. coli - enterococci - faecal coliforms	- indicator of pollution with faecal matter	E. Coli	routine
	- disease risk for swimming etc.	ENT	routine
		FC	routine

<sup>1</sup> see the page 49 for the meaning of the abbreviations.

<sup>2</sup> 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 <sup>3</sup>	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 <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).
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 <sup>3</sup>	Ministry for the Environment (1992).
Arsenic	<0.01 g/m <sup>3</sup>	Ministry of Health (2001).
Boron	<1.4 g/m <sup>3</sup>	Ministry of Health (2001).

## Waikato River monitoring programme - water quality parameters and analytical methods

Id <sup>1</sup>	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 3125 B / USEPA 200B
B	Boron	ICP-MS, APHA method 3125 B
BDISK	Black disk	Field measurement, horizontal water transparency (20mm, 60mm, 100mm, 200mm disk) in river
BOD <sub>5</sub>	Biochemical oxygen Demand (5 day)	Incubation 5 days at 20°C, DO-meter, No nitrification inhibitor added, unseeded, APHA method 5210 B
CHLA	Chlorophyll a	Acetone extraction. Spectroscopy. APHA method 10200 H (modified)
Cl	Chloride	Filtered sample. Ferric thiocyanate colorimetry, Discrete analyser. APHA method 4500 ClE (modified)
COLOUR	Colour	Field measurement, Munsell colour patches
COND	Conductivity	Lab Meter @ 25°C. APHA method 2510B
DO	Dissolved oxygen	Field measurement (Hach DO meter, model HQ 30d)
DO (% Sat)	Dissolved oxygen (percent saturation)	Field measurement (Hach DO meter, model HQ 30d)
DOC	Dissolved organic Carbon	Filtration, acidification, purging to remove inorganic C, persulphate oxidation, IR detection. APHA method 5310 C (modified)
DRP	Dissolved reactive Phosphorus	Filtration, Molybdenum Blue Colorimetry. Discrete analyser. APHA 4500 PE (modified)
E. coli	Escherichia coli	Membrane Filtration (mFC Agar) confirmation by MUG Agar. APHA method 9222 G
ENT	Enterococci bacteria	Membrane Filtration (mE Agar) confirmation by EIA Agar. APHA method 9230 C
FC	Faecal coliforms	Membrane Filtration (mFC Agar). APHA method 9222 D
Flow	Flow – instantaneous	Calculated from rating curve ± 8%
Li	Lithium	ICP-MS, method APHA 3125 B
NH <sub>4</sub> -N	Ammoniacal Nitrogen (Total)	Filtration, Phenol/Hypochlorite Colorimetry. Discrete analyser. APHA method 4500-NH <sub>3</sub> F (modified).
NNN	Nitrite/Nitrate Nitrogen	Automated Cadmium reduction. Flow injection analyser. APHA method 4500 – NO <sub>3</sub> -I (modified)
NO <sub>3</sub> -N	Nitrate nitrogen	Calculation: (Nitrate-N + Nitrite -N) – Nitrite - N
pH	pH	Lab Meter @ 25°C. APHA method 4500-H <sup>+</sup> B
TDS	Total dissolved solids	Filtration, gravimetric. APHA 2540 C (modified)
TEMP	Temperature	Field measurement (Hach DO meter, model HQ 30d)
TKN	Total Kjeldahl-Nitrogen	Acid digestion. Phenol/Hypochlorite colorimetry. Discrete analyser. APHA method 4500-N <sub>org</sub> D (modified), 4500 NH <sub>3</sub> F (modified)
TOC	Total Organic Carbon	Acidification, purging to remove inorganic C, persulphate oxidation, IR detection. APHA method 5310 C (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-P B & E (modified), corrected values to take into account possible interference from arsenic present in the sample.
TURB	Turbidity	Turbidity Meter Hach 2100N. APHA method 2130 B

<sup>1</sup> 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, 22<sup>nd</sup> Edition, 2012, APHA, AWWA, WEF

ICP-MS = Inductively Coupled Plasma – Mass Spectroscopy