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# RAROTONGA WATER QUALITY DATA REPORT

January – December 2009



July 2010

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Annual Report 2009

## INSHORE AND AQUACULTURE DIVISION



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**Additional Pages:** Water Quality Report Card Rarotonga 2010 and Stream Summary 2009 data analysed

## 1. Introduction

Rarotonga the capital of the Cook Islands is rapidly developing with tourism as one of the major income earners for the country. The health of the lagoon and reef is important for the welfare of the people. It is vital that the health of the lagoon is monitored and action is taken to protect the health of the lagoon, coral reef and the people that use it. Human activities contribute to the decreased water quality, for example farming of pigs, deforestation and farming crops close to streams. The water quality monitoring programme gives an evaluation of the state of the streams and the lagoon, and can be used to identify issues that need to be addressed.

In 2003, the Ministry of Marine Resources started to monitor the Rarotonga lagoon. Measurements included temperature, dissolved oxygen, pH, salinity, nutrients, chlorophyll *a*, suspended solids and bacterial contamination to measure long term changes in water quality of the lagoon and streams.

Temperature varies seasonally and influences the occurrence and growth of aquatic plants, and animals. The solubility of dissolved oxygen (DO) is regulated by temperature however other factors also affect DO including water flow. In the water, DO is either absorbed directly from the atmosphere or is produced by algae via photosynthesis and is removed by respiration and decomposition of organic matter. The recommended minimum for DO saturation is not less than 75% saturation for oceanic waters, embayments, open coastal waters and estuaries and not less than 80% for streams (Department of Health, Clean Water Branch Hawaii 1994). Salinity varies little in most marine environments and saltwater is normally between 34ppt and 36ppt in areas away from freshwater influences (Smith 2004). Mosely *et al.* (2004) in water quality guidelines developed for Pacific Countries suggest that pH should be between 8.0 and 8.4 in lagoon type environments. The Department of Health, Clean Water Branch Hawaii (1994) pH standard for open coastal waters is between 7.6 and 8.6 and can be as low as 7.0 in areas influenced by freshwater input.

Nutrients such as nitrate and phosphate which are naturally present in seawater are essential for the growth of phytoplankton and other algae which form the base of the food web. Elevated nutrients concentration can lead to an increase in algae and aquatic plants biomass which can have detrimental impacts on the coral reef health. The guidelines for nutrient concentrations for the protection of coral reef health are 14µg/L

for dissolved inorganic nitrogen (DIN), which is made up of nitrate and ammonia ( $\text{NO}_3\text{-N} + \text{NH}_4\text{-N}$ ), and  $2.6\mu\text{g/L}$  for dissolved reactive phosphorus (DRP) (Bell 1992). The ANZECC guideline values for streams or lowland rivers that are a cause for concern in Australia tropical areas based on measured values are  $10\mu\text{g/L}$  for nitrate ( $\text{NO}_3\text{-N}$ ) and ammonia ( $\text{NH}_4\text{-N}$ ), and  $4\mu\text{g/L}$  for DRP (ANZECC 2000).

Chlorophyll *a* and total suspended solids measure phytoplankton biomass, inorganic and organic particulate material in the water respectively. Elevated concentrations of both have been shown to impact negatively on coral reef health above concentration of  $0.5\mu\text{g/L}$  and  $4\text{-}5\text{mg/L}$ , respectively (Bell, 1992).

Increased inorganic and organic materials entering lagoons are often associated with increases in bacterial numbers which can potentially disease causing organisms. Enterococci bacteria are used to indicate the potential presence of human pathogens in marine and freshwater environment. Guidelines have been developed by the World Health Organisation (WHO) for contact recreation using Enterococci numbers (Table 1). This guideline is also used for freshwater samples to evaluate the bacterial water quality of the streams as they flow directly into the lagoon and are likely to impact the bacterial water quality of the lagoon.

**Table 1: WHO Standards for Bathing Water Quality (WHO 2001).**

Category	Indicator Counts	Microbiological Assessment
A.	$\leq 40$ Enterococci / 100ml	Suitable for swimming
B.	$\geq 41$ to $\leq 200$ Enterococci / 100ml	Suitable for swimming but requires surveillance
C.	$\geq 201$ to $\leq 500$ Enterococci / 100ml	Not suitable for swimming, requires assessment
D.	$> 500$ Enterococci / 100ml	Not suitable for swimming, public warnings

This report is a Data Report summarising the findings of the water quality sampling program in 2009 and supports of the Water Quality Report Card. The Water Quality Report Card for Rarotonga 2010 is attached.

## **2. Methods**

### **2.1 Sampling**

All the water quality parameters were measured monthly for both lagoon and streams. In total there are 14 marine sites and 8 stream sites for Rarotonga (Figure 1 and Table 2 & 3). Water samples for Rarotonga were stored in the dark on ice and the samples were processed soon after sample collection.

2.2 Rarotonga Marine and Stream Sampling site map

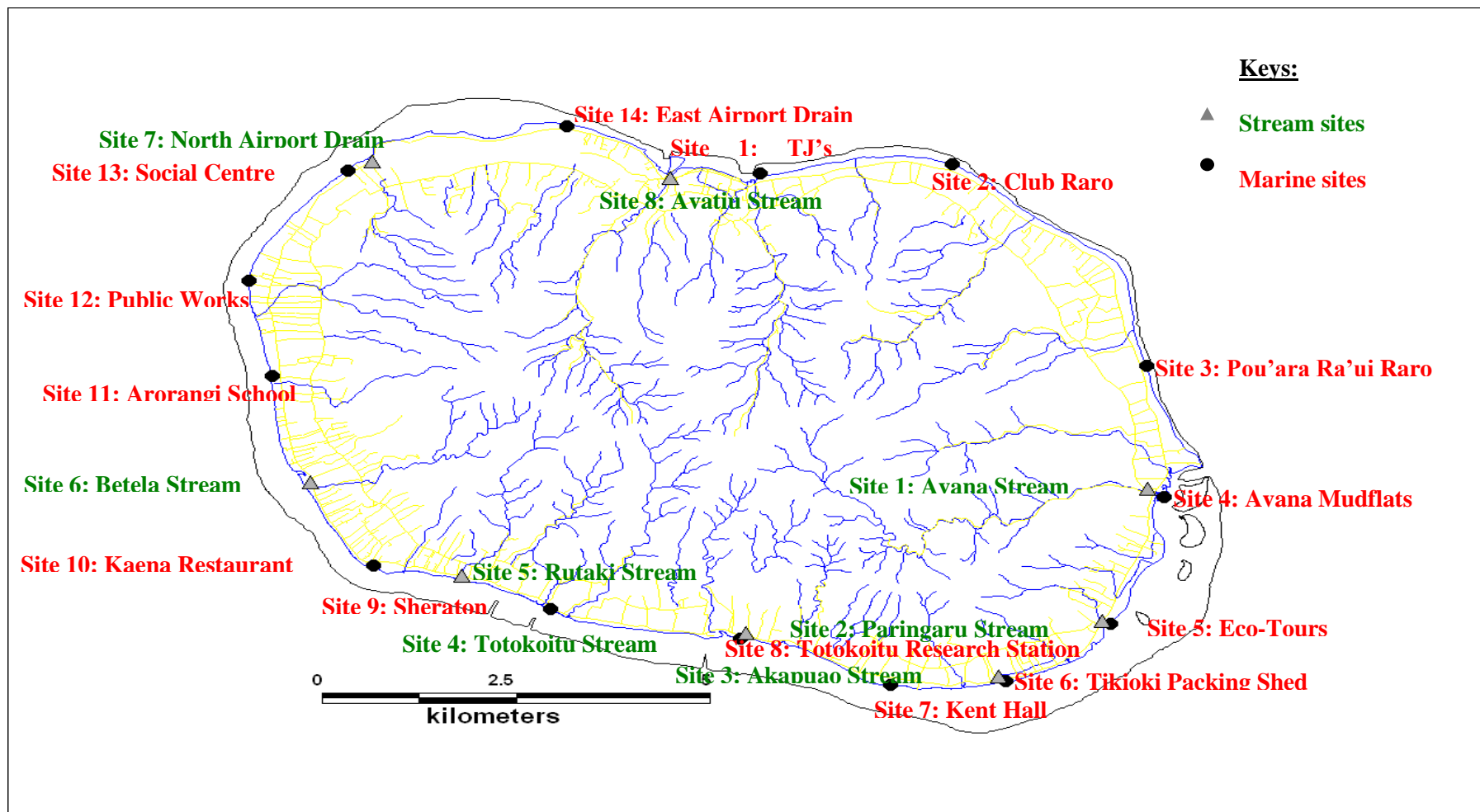


Figure 1. Lagoon and stream sites for Rarotonga



**Table 2: Rarotonga Lagoon sampling locations.**

SITE NUMBER	LOCATION	LATITUDE	LONGITUDE
1	TJ's	S21 12.308	W159 46.441
2	Club Raro	S21 04.417	W159 45.304
3	Pou'ara Ra'tui	S21 13.821	W159 43.842
4	Avana Mudflat	S21 14.864	W159 43.730
5	Eco-Tours	S21 15.856	W159 44.089
6	Tikioki Packing Shed	S21 16.314	W159 44.788
7	Kent Hall	S21 16.195	W159 45.335
8	Totokoitu Research Station	S21 15.976	W159 46.570
9	Sheraton	S21 15.744	W159 47.851
10	Kaena Restaurant	S21 15.401	W159 49.036
11	Arorangi School	S21 13.903	W159 49.723
12	Public Works	S21 13.149	W159 49.873
13	Social Centre	S21 12.285	W159 49.205
14	East Airport Drain	S21 11.932	W159 47.737

**Table 3: Rarotonga Stream sampling locations.**

SITE NUMBER	LOCATION	LATITUDE	LONGITUDE
1	Avana	S21 14.794	W159 43.835
2	Paringaru	S21 15.838	W159 44.135
3	Akapuao	S21 16.274	W159 44.836
4	Totokoitu	S21 15.938	W159 46.535
5	Rutaki	S21 15.481	W159 48.442
6	Betela	S21 14.739	W159 49.462
7	North Airport Drain	S21 12.214	W159 49.043
8	Avatiu	S21 12.342	W159 47.047

### 2.3 Physical Parameters

At each site temperature (°C), dissolved oxygen (DO), % saturation and concentration, pH, and salinity (‰) were measured using a YSI 556 Probe. The individual probes were calibrated before use in the field and measurements were made at each site at the time of sampling (Hall et al., 2007).

### 2.4 Nutrients

All water samples for nutrient analysis were filtered through a Whatman GF/F glass fibre filter into a 250ml acid washed plastic bottle. These samples were stored frozen until they were shipped on ice in chilly bins to NIWA for analysis. All nutrient

analysis were conducted using an Astoria Pacific auto-analyser 300 series with methods from the Astoria Pacific International Methods Manual (A 6/00). Nitrate were analysed by the cadmium column reduction method (Astoria 305-A177), DRP by the molybdenum blue method (Astoria 305-A204) and NH<sub>4</sub>-N by the indophenol blue method (Astoria 305-A026).

## **2.5 Chlorophyll *a* and Suspended Solids**

Samples for chlorophyll *a* and total suspended solids analysis of known volumes were filtered on to GF/F filters; chlorophyll *a* filters were frozen immediately and the suspended solid filters were dried in the oven after processing. The frozen filters for chlorophyll *a* were then analyzed later by acetone extraction and fluorometry (APHA 1998) in the MMR laboratory (Hall et al., 2007). Total suspended solids analysis followed Hall et al., (2007).

## **2.6 Bacteria**

Water samples collected for Enterococci were analysed in duplicate using membrane filtration method and placed on Enterococci agar. The volumes filtered differed depending on how clean the water was and on previous results. Enterococci plates were incubated at 37<sup>0</sup>C for 24 hours (Hall et al., 2007).

## **3. Results**

### **3.1 Missing Data**

#### **Lagoon**

There was only one missing data point in the sampling which was at East Airport Drain in the month of February. This was due to data not being stored into the YSI probe.

#### **Stream**

The pH data in November at all stream sites was omitted, due to the pH probe calibrations not being within specifications.

#### **4. Acknowledgments**

We thank Drs Julie Hall and Els Maas for both technical advice and editorial comments, Mike Crump and his team at NIWA for their technical support, and the staff of the Ministry of Marine Resources for editorial and sample collection. We are grateful to the National Environment Services for providing man power and transport during the sampling. Thanks also to the Cook Islands Meteorological Services for providing the weather and rainfall information. The Ministry of Marine Resources would also like to thank NZAid for all the funding support.

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Water Quality Database-Ministry of Marine Resources.

YSI 556 MPS Multi Probe System Operations Manual. YSI Incorporated

## 6. Appendix 1.

### 6.1 Water Quality data lagoon sites.

Location	Date	Site Number	Temp (°C)	Salinity (ppt)	DOSat (%)	DO (mg/L)	pH	DRP (µg/L)	NH4-N (µg/L)	NO3-N (µg/L)	Extracted (Chl a (µg/L))	TSS (mg/L)	VSS (mg/L)	Enterococci (Count/100ml)
TJ's	13-Jan-09	1	26.5	34.6	97.5	6.5	7.8	5	2	0.5	0.27	1.9	0.9	27
TJ's	10-Feb-09	1	27.4	35.8	111.7	7.2	8.1	4	1	2	0.32	3.8	0.5	14
TJ's	3-Mar-09	1	28.2	35.6	101.6	6.5	8.3	26	21	9	0.42	5.2	0.8	7
TJ's	7-Apr-09	1	27	35.2	110.4	7.2	8.4	10	11	22	0.26	4.3	0.6	1900
TJ's	5-May-09	1	25.5	35.3	99.4	6.7	8.4	3	13	7	0.25	1.9	0.7	8
TJ's	3-Jun-09	1A	24.7	34.9	114	7.8	8.3	7	13	18	0.32	6.3	1	4
TJ's	3-Jun-09	1B						6	9	7	0.31	7.4	1.3	3
TJ's	1-Jul-09	1	24.5	35.4	125.4	8.5	8.1	6	8	0.5	0.19	0.9	0.4	14
TJ's	12-Aug-09	1A	20.5	34.9	147	10.8	8.6	7	10	0.5	0.11	0.6	0.3	0
TJ's	12-Aug-09	1B						4	9	3	0.11	0.3	0.3	0
TJ's	1-Sep-09	1	21.5	35.3	114.9	8.3	8.3	5	7	4	0.34	1.6	0.5	3
TJ's	13-Oct-09	1A	23.7	35.6	121.3	8.4	8.2	5	7	3	0.1	0.3	0.3	4
TJ's	13-Oct-09	1B						8	7	2	0.05	0.3	0.3	2
TJ's	3-Nov-09	1	23	35.7	103.9	7.3	8.4	10	3	9	0.19	6.4	1.1	30
TJ's	1-Dec-09	1	24.8	35.6	120.3	8.2	8.2	4	3	0.5	0.14	1	0.1	0
Club Raro	13-Jan-09	2	26.5	35.8	99.1	6.5	7.8	2	2	0.5	0.35	3	0.8	4
Club Raro	10-Feb-09	2	27.4	35.7	105.7	6.8	8.2	4	2	4	0.35	11.5	1.5	3
Club Raro	3-Mar-09	2A	28.1	35.2	101.4	6.5	8.3	3	5	0.5	0.56	7.7	0.5	0
Club Raro	3-Mar-09	2B						2	6	0.5	0.5	3.2	0.5	0
Club Raro	7-Apr-09	2A	27.1	35.2	109.9	7.2	8.5	2	5	0.5	0.28	12	1.7	1075
Club Raro	7-Apr-09	2B						4	5	2	0.58	9.7	0.8	1395
Club Raro	5-May-09	2A	24.9	34.9	99.9	6.8	8.4	3	12	3	0.32	3.2	0.7	9
Club Raro	5-May-09	2B						4	13	15	0.36	3.8	0.6	10
Club Raro	3-Jun-09	2	24.5	34.7	108.8	7.4	8.2	3	11	13	0.2	9.1	2	56
Club Raro	1-Jul-09	2	24.2	35.6	112.9	7.7	8.4	4	8	19	0.3	2.3	0.8	84
Club Raro	12-Aug-09	2	20.7	35.0	106.1	7.8	8.5	6	8	23	0.21	0.7	0.3	116

Location	Date	Site Number	Temp (°C)	Salinity (ppt)	DOSat (%)	DO (mg/L)	pH	DRP (µg/L)	NH4-N (µg/L)	NO3-N (µg/L)	Extracted (Chl a (µg/L))	TSS (mg/L)	VSS (mg/L)	Enterococci (Count/100ml)
Club Raro	1-Sep-09	2A	21.3	35.7	112.9	8.1	8.4	8	7	8	0.23	1.8	1.8	45
Club Raro	1-Sep-09	2B						4	7	4	0.31	3.3	0.6	71
Club Raro	13-Oct-09	2	23.7	35.6	119.7	8.3	8.2	3	6	1	0.16	4.4	4.4	53
Club Raro	3-Nov-09	2	22.9	35.7	107.9	7.6	8.4	4	8	8	0.39	6.5	1.3	13
Club Raro	1-Dec-09	2	24.8	35.6	113.3	7.7	8.2	3	3	7	0.27	3	0.5	10
Pou'ara Ra'ui	13-Jan-09	3	26.5	27.0	97.8	6.8	8	6	4	21	1.15	1.1	0.8	1185
Pou'ara Ra'ui	10-Feb-09	3A	27.7	35.7	118.9	7.7	8.3	2	4	3	0.39	3	0.9	0
Pou'ara Ra'ui	10-Feb-09	3B						2	2	2	0.4	3.4	0.5	0
Pou'ara Ra'ui	3-Mar-09	3	29.3	34.0	140	8.9	8.4	8	22	2	0.56	1.1	0.5	4
Pou'ara Ra'ui	7-Apr-09	3	27.2	33.1	118.4	7.8	8.5	3	8	2	0.53	1.4	0.8	31
Pou'ara Ra'ui	5-May-09	3	22.9	34.5	101.8	7.2	8.4	10	24	2	0.98	1.7	0.7	194
Pou'ara Ra'ui	3-Jun-09	3	24	33.8	117.3	8.1	8.3	4	17	3	0.65	8.7	1.8	3
Pou'ara Ra'ui	1-Jul-09	3	25.8	35.5	168.6	11.2	8.5	7	14	21	0.88	0.8	0.6	30
Pou'ara Ra'ui	12-Aug-09	3	19.2	35.9	131	9.8	8.8	6	9	9	0.61	0.8	0.4	31
Pou'ara Ra'ui	1-Sep-09	3	21.8	35.7	130.3	9.3	8.6	4	11	17	0.51	2	0.4	53
Pou'ara Ra'ui	13-Oct-09	3	24.5	35.8	160.1	10.9	8.4	8	11	26	0.8	3.5	0.1	46
Pou'ara Ra'ui	3-Nov-09	3	23.2	35.6	121.2	8.4	8.4	10	8	4	0.27	0.8	0.1	28
Pou'ara Ra'ui	1-Dec-09	3	26.1	35.6	134.6	8.9	8.3	6	15	16	0.3	0.6	0.4	5
Avana Mudflat	13-Jan-09	4	25.7	30.4	73.4	5	7.9	6	12	11	0.47	3.5	1	184
Avana Mudflat	10-Feb-09	4	27.2	35.5	85.5	5.6	8.1	5	12	9	0.7	2.3	0.8	192
Avana Mudflat	3-Mar-09	4	28.5	26.1	96.7	6.5	8.2	14	17	43	0.53	3.8	1.1	35
Avana Mudflat	7-Apr-09	4A	27.4	33.4	99.9	6.6	8.5	14	13	179	1.04	13	2.8	66
Avana Mudflat	7-Apr-09	4B						15	10	173	1.14	14.7	3.1	49
Avana Mudflat	5-May-09	4	25.1	31.7	92.9	6.4	8.5	5	7	0.5	0.6	7.4	3	29
Avana Mudflat	3-Jun-09	4	23.6	31.6	93.6	6.6	8.2	5	12	0.5	0.96	20.8	5	60
Avana Mudflat	1-Jul-09	4A	25	33.7	122.5	8.4	8.4	5	2	1	0.24	1	0.6	4
Avana Mudflat	1-Jul-09	4B						10	4	1	0.29	1.5	0.8	3
Avana Mudflat	12-Aug-09	4	19.4	32.8	102.2	7.7	8.6	2	2	1	0.33	3.6	0.7	84
Avana Mudflat	1-Sep-09	4	20.7	34.1	106	7.8	8.4	2	8	2	0.22	1.5	0.5	4
Avana Mudflat	13-Oct-09	4	23.9	32.9	101.8	7.1	8.4	6	12	19	0.33	1.2	1.2	15

Location	Date	Site Number	Temp (°C)	Salinity (ppt)	DOSat (%)	DO (mg/L)	pH	DRP (µg/L)	NH4-N (µg/L)	NO3-N (µg/L)	Extracted (Chl a (µg/L))	TSS (mg/L)	VSS (mg/L)	Enterococci (Count/100ml)
Avana Mudflat	3-Nov-09	4A	23	35.4	88.5	6.2	8.4	5	12	21	0.19	1.6	0.9	3
Avana Mudflat	3-Nov-09	4B						4	8	20	0.19	2.1	0.8	3
Avana Mudflat	1-Dec-09	4A	24.8	35.2	101.3	6.9	8.1	2	12	14	0.28	1.9	0.5	0
Avana Mudflat	1-Dec-09	4B						4	7	29	0.22	2	0.3	0
Eco Tours	13-Jan-09	5	26.7	34.2	81.3	5.4	7.9	9	7	6	0.48	1.7	0.6	31
Eco Tours	10-Feb-09	5	28.2	35.0	60.7	3.9	8	3	7	8	1.09	3.9	0.7	0
Eco Tours	3-Mar-09	5	30.1	32.7	106.1	6.7	8.1	9	8	7	1.52	13.4	2.8	40
Eco Tours	7-Apr-09	5	27.7	33.7	78.8	5.1	8.4	1	3	9	2.16	6	1	40
Eco Tours	5-May-09	5	25.2	34.0	87.5	5.9	8.3	9	7	29	0.4	5.3	1.7	5
Eco Tours	3-Jun-09	5	23.7	33.4	92.2	6.5	8.2	19	7	146	0.5	11.5	2.9	61
Eco Tours	1-Jul-09	5	24.5	33.8	107.7	7.4	8.4	0.5	2	1	4.68	2.5	1.1	2
Eco Tours	12-Aug-09	5A	19.7	34.9	99.9	7.4	8.5	2	10	12	0.32	3.1	3.1	4
Eco Tours	12-Aug-09	5B						0.5	3	2	0.27	2.6	0.4	3
Eco Tours	1-Sep-09	5A	20.7	35.1	102.4	7.5	8.4	0.5	3	6	0.41	2.9	0.5	5
Eco Tours	1-Sep-09	5B						0.5	4	5	0.39	3	0.7	27
Eco Tours	13-Oct-09	5A	24.4	32.4	96.9	6.7	8.2	1	23	7	0.68	4.3	4.3	10
Eco Tours	13-Oct-09	5B						8	18	21	0.86	4.4	0	10
Eco Tours	3-Nov-09	5	23.1	35.1	99.8	7	8.3	5	14	12	0.17	3.2	1.1	5
Eco Tours	1-Dec-09	5	25.6	34.1	98.4	6.6	7.9	0.5	13	16	0.47	5.5	1.2	26
Tikioki Packing Shed	13-Jan-09	6	26.4	32.4	81.3	5.5	7.9	3	3	22	0.56	1.9	0.5	118
Tikioki Packing Shed	10-Feb-09	6	28.4	35.4	91.2	5.8	8.1	4	2	8	1.06	7	1.7	0
Tikioki Packing Shed	3-Mar-09	6	27.7	31.2	97.1	6.4	8.2	3	4	22	1.07	6.3	3.2	7
Tikioki Packing Shed	7-Apr-09	6	27.2	34.8	95.4	6.2	8.6	0.5	3	7	1.04	5.7	0.5	20
Tikioki Packing Shed	5-May-09	6	25.4	34.8	86.9	5.9	8.4	5	8	30	0.53	8	1.5	15
Tikioki Packing Shed	3-Jun-09	6A	24.2	34.1	97.6	6.7	8.2	16	5	46	0.67	13.4	3.9	21
Tikioki Packing Shed	3-Jun-09	6B						4	5	58	0.57	14	3.3	17
Tikioki Packing Shed	1-Jul-09	6A	24.5	34.1	109.2	7.5	8.5	0.5	7	8	0.5	1.9	1	10
Tikioki Packing Shed	1-Jul-09	6B						4	14	20	0.66	1.4	0.7	4
Tikioki Packing Shed	12-Aug-09	6	20.5	34.7	103	7.6	8.6	9	18	35	0.38	2	0.1	16
Tikioki Packing Shed	1-Sep-09	6	20.6	34.8	106.5	7.8	8.4	2	4	9	0.42	1.5	1.5	0



Location	Date	Site Number	Temp (°C)	Salinity (ppt)	DOSat (%)	DO (mg/L)	pH	DRP (µg/L)	NH4-N (µg/L)	NO3-N (µg/L)	Extracted (Chl a (µg/L))	TSS (mg/L)	VSS (mg/L)	Enterococci (Count/100ml)
Tikioki Packing Shed	13-Oct-09	6	23.6	34.7	107.1	7.4	8.3	3	0.5	9	0.75	5	0	0
Tikioki Packing Shed	3-Nov-09	6	22.9	34.8	94.9	6.7	8.4	1	2	6	0.42	4.8	1.8	2
Tikioki Packing Shed	1-Dec-09	6	24.7	35.3	107.3	7.3	8.1	5	9	18	0.05	3.3	0.5	0
Kent Hall	13-Jan-09	7	26	35.3	78.9	5.3	7.9	15	15	32	0.25	0.6	0.4	2
Kent Hall	10-Feb-09	7A	28.6	35.3	90.1	5.7	8.1	7	3	15	0.58	5.3	1	0
Kent Hall	10-Feb-09	7B						7	3	26	0.55	4.3	0.9	5
Kent Hall	3-Mar-09	7	27.6	35.1	89.1	5.8	8.1	16	0.5	22	0.52	3.5	0.6	6
Kent Hall	7-Apr-09	7	27.8	34.6	94.7	6.1	8.6	8	0.5	33	0.42	4.2	0.7	54
Kent Hall	5-May-09	7	25.8	34.3	87.6	5.9	8.4	10	0.5	32	0.32	4.7	1.3	15
Kent Hall	3-Jun-09	7A	24.5	32.4	93.2	6.5	7.9	16	2	19	0.39	9.6	2.2	43
Kent Hall	3-Jun-09	7B						6	0.5	21	0.36	9.1	1.9	37
Kent Hall	1-Jul-09	7	24.2	34.5	99	6.8	8.4	3	1	23	0.23	1	0.4	5
Kent Hall	12-Aug-09	7	20.3	34.7	95.6	7.1	8.5	5	3	29	0.19	1.7	0.2	2
Kent Hall	1-Sep-09	7	20.4	34.9	103.4	7.6	8.4	8	0.5	42	0.27	1.4	0.5	0
Kent Hall	13-Oct-09	7	23.4	34.6	103.7	7.2	8.3	0.5	3	9	0.49	1	1	2
Kent Hall	3-Nov-09	7	23	35.5	96.7	6.8	8.4	4	5	7	0.12	5.1	1.1	2
Kent Hall	1-Dec-09	7	23.9	35.1	101.4	7	8	3	2	8	0.23	2.2	0.9	6
Totokoitu Research	13-Jan-09	8A	26.6	33.0	83.2	5.6	8	2	3	6	0.24	0.8	0.5	37
Totokoitu Research	13-Jan-09	8B						11	22	8	0.43	2.1	0.7	27
Totokoitu Research	10-Feb-09	8	28.1	35.6	86.2	5.5	8.1	6	0.5	12	0.4	4.1	1.1	24
Totokoitu Research	3-Mar-09	8	28.6	28.7	128.1	8.5	8.2	16	5	12	0.67	3.2	0.6	8
Totokoitu Research	7-Apr-09	8	27.3	33.7	104.1	6.8	8.6	10	6	25	0.69	6.4	0.8	45
Totokoitu Research	5-May-09	8	25.8	32.6	93.9	6.4	8.4	5	10	112	0.98	6.7	1.9	25
Totokoitu Research	3-Jun-09	8	23.8	29.6	98.6	7	8.1	8	3	78	0.76	21	5.6	4550
Totokoitu Research	1-Jul-09	8	25.1	23.3	120.6	8.7	8.2	17	12	23	2.55	1.1	0.5	182
Totokoitu Research	12-Aug-09	8	19.5	33.3	105.5	8	8.6	7	4	14	0.43	1.7	0.4	12
Totokoitu Research	1-Sep-09	8	20.3	35.4	108.9	8	8.5	9	4	32	0.17	0.4	0	11
Totokoitu Research	13-Oct-09	8A	24.1	30.8	106.7	7.5	8.3	4	4	6	0.78	9.1	0.6	26
Totokoitu Research	13-Oct-09	8B						16	3	33	0.73	10.8	1.3	19
Totokoitu Research	3-Nov-09	8A	23.2	35.1	101.7	7.1	8.4	9	5	34	0.41	10.4	2.4	10

Location	Date	Site Number	Temp (°C)	Salinity (ppt)	DOSat (%)	DO (mg/L)	pH	DRP (µg/L)	NH4-N (µg/L)	NO3-N (µg/L)	Extracted (Chl a (µg/L))	TSS (mg/L)	VSS (mg/L)	Enterococci (Count/100ml)
Totokoitu Research	3-Nov-09	8B						12	3	73	0.23	7.7	1.2	5
Totokoitu Research	1-Dec-09	8A	24.3	34.7	105.7	7.3	8	3	6	7	0.52	6.2	1	3
Totokoitu Research	1-Dec-09	8B						4	7	9	0.48	5.3	0.8	7
Sheraton	13-Jan-09	9A	26.5	34.7	88.1	5.8	8	3	3	5	0.2	1.6	0.8	63
Sheraton	13-Jan-09	9B						4	7	2	0.28	1.8	0.6	32
Sheraton	10-Feb-09	9	28.2	34.7	87.5	5.6	8	4	4	19	0.28	1.8	0.4	14
Sheraton	3-Mar-09	9	27.6	26.6	99.9	6.8	8.2	3	4	0.5	0.37	0.8	0.8	2
Sheraton	7-Apr-09	9A	27.1	34.2	108.4	7.1	8.6	9	8	22	0.29	2.6	0.5	9
Sheraton	7-Apr-09	9B						9	8	0.5	0.24	5.6	1.1	10
Sheraton	5-May-09	9	25.8	33.0	90.8	6.1	8.5	7	6	8	0.28	0.4	0.3	14
Sheraton	3-Jun-09	9	24.4	34.2	98.6	6.8	8.1	5	9	16	0.29	7.9	0.9	18
Sheraton	1-Jul-09	9	24.7	32.7	115.6	8	8.5	11	6	27	0.05	0.4	0.4	0
Sheraton	12-Aug-09	9	20.9	34.4	101.4	7.4	8.5	7	3	11	0.15	0.6	0.3	0
Sheraton	1-Sep-09	9	21.6	34.9	111.8	8	8.4	5	6	13	0.12	0.7	0.5	1
Sheraton	13-Oct-09	9	23.7	34.1	109.3	7.6	8.3	3	2	4	0.43	4	0.2	25
Sheraton	3-Nov-09	9	23.2	35.5	113	7.9	8.4	15	4	42	0.19	3.2	0.5	2
Sheraton	1-Dec-09	9	23.8	35.5	111.9	7.7	8.1	12	3	66	0.26	1.7	0.6	6
Kaena Restaurant	13-Jan-09	10A	26.5	34.3	93.5	6.2	8	3	6	2	0.62	7.8	1.3	101
Kaena Restaurant	13-Jan-09	10B						3	3	2	0.86	6.5	0.6	84
Kaena Restaurant	10-Feb-09	10	28.2	35.5	115.3	7.4	8.2	6	3	1	0.2	1.8	0.4	0
Kaena Restaurant	3-Mar-09	10A	27.4	34.8	93.9	6.1	8	2	4	8	0.22	0.6	0.3	17
Kaena Restaurant	3-Mar-09	10B						0.5	8	6	0.22	0.5	0.3	20
Kaena Restaurant	7-Apr-09	10	27.3	30.6	111.9	7.5	8.6	1	3	1	0.05	1.5	0	4
Kaena Restaurant	5-May-09	10	26.1	35.1	91.5	6.1	8.5	3	7	8	0.19	1.8	0.6	1
Kaena Restaurant	3-Jun-09	10	24.1	34.3	96.6	6.7	8.1	6	7	11	0.35	7.3	0.2	45
Kaena Restaurant	1-Jul-09	10	24.2	35.4	114.5	7.8	8.5	7	8	5	0.05	0.5	0.5	13
Kaena Restaurant	12-Aug-09	10	21.5	35.4	101.3	7.3	8.5	9	6	12	0.11	0.5	0	2
Kaena Restaurant	1-Sep-09	10	21.8	35.3	104	7.4	8.4	7	7	11	0.16	0.7	0.2	66
Kaena Restaurant	13-Oct-09	10	23.7	35.1	104.9	7.3	8.4	8	5	25	0.25	2.4	2.4	37
Kaena Restaurant	3-Nov-09	10	23.3	35.5	103.2	7.2	8.5	6	4	9	0.14	2.7	0.4	0

Location	Date	Site Number	Temp (°C)	Salinity (ppt)	DOSat (%)	DO (mg/L)	pH	DRP (µg/L)	NH4-N (µg/L)	NO3-N (µg/L)	Extracted (Chl a (µg/L))	TSS (mg/L)	VSS (mg/L)	Enterococci (Count/100ml)
Kaena Restaurant	1-Dec-09	10	23.7	35.3	104.9	7.3	8.1	3	4	6	0.18	1.7	0.5	300
Arorangi School	13-Jan-09	11	27.2	34.2	94.1	6.2	8.1	2	6	6	0.66	8.2	1.4	74
Arorangi School	10-Feb-09	11	27.8	35.7	114.6	7.4	8.2	7	6	28	0.48	5.7	1	8
Arorangi School	3-Mar-09	11	26.3	32.9	91.7	6.2	8	5	4	26	0.44	2.5	0.4	20
Arorangi School	7-Apr-09	11	27.5	30.6	121.8	8.1	8.6	1	5	3	0.44	16.5	4.3	20
Arorangi School	5-May-09	11A	25.6	33.1	98.3	6.7	8.4	7	4	3	0.39	7	7	36
Arorangi School	5-May-09	11B						2	5	2	0.29	1.3	0.4	29
Arorangi School	3-Jun-09	11	24.9	34.3	101.2	6.9	8.2	10	4	4	0.7	8	0.4	43
Arorangi School	1-Jul-09	11A	25	33.6	138	9.4	8.6	3	2	4	0.12	0.5	0.8	30
Arorangi School	1-Jul-09	11B						3	0.5	7	0.53	0.5	0.4	41
Arorangi School	12-Aug-09	11	19.52	32.5	119.6	9.1	8.6	5	38	10	0.16	0.6	0.4	8
Arorangi School	1-Sep-09	11	22.6	34.5	144.1	10.2	8.5	10	6	23	0.18	0.3	0.1	0
Arorangi School	13-Oct-09	11	24.3	34.6	117	8	8.4	10	6	60	0.82	6.7	6.7	7
Arorangi School	3-Nov-09	11	23.5	35.1	117	8.1	8.5	11	8	47	0.25	4.4	0.8	6
Arorangi School	1-Dec-09	11A	23.5	34.7	104.8	7.3	8.1	5	1	31	0.69	5.5	1.2	53
Arorangi School	1-Dec-09	11B						5	3	17	0.73	4.6	0.8	46
Public Works	13-Jan-09	12	27.2	35.8	97.8	6.4	8	17	7	12	0.47	11.6	1.3	33
Public Works	10-Feb-09	12A	28.2	35.3	126	8.1	8.3	20	6	14	0.61	21.8	1.3	4
Public Works	10-Feb-09	12B						10	5	16	0.58	22.1	2.3	2
Public Works	3-Mar-09	12A	25.9	30.1	96.9	6.6	8	5	4	7	0.41	2.8	0.7	6
Public Works	3-Mar-09	12B						16	4	58	0.31	3.5	0.5	3
Public Works	7-Apr-09	12	27.3	33.9	118.8	7.8	8.6	14	4	58	0.22	2.6	0.4	69
Public Works	5-May-09	12	25.9	32.8	101.6	6.9	8.5	4	6	4	0.19	1.1	0.2	5
Public Works	3-Jun-09	12	24.9	34.2	103.6	7.1	8.3	3	6	3	0.61	9.2	2	89
Public Works	1-Jul-09	12	24.9	32.5	131	9	8.6	4	5	10	0.15	0.6	0.5	0
Public Works	12-Aug-09	12	20.44	34.1	113	8.3	8.5	4	3	10	0.15	1.6	0.3	0
Public Works	1-Sep-09	12	23.1	34.9	128.4	9	8.4	7	6	8	0.13	0.7	0.1	0
Public Works	13-Oct-09	12	24.3	31.4	108.6	7.6	8.3	9	5	28	0.2	14	0.4	37
Public Works	3-Nov-09	12	23.4	34.9	110	7.7	8.4	7	5	11	0.14	6.8	1	4
Public Works	1-Dec-09	12	23.4	34.6	107.1	7.5	8.1	7	2	16	0.38	7.6	1.3	113

Location	Date	Site Number	Temp (°C)	Salinity (ppt)	DOSat (%)	DO (mg/L)	pH	DRP (µg/L)	NH4-N (µg/L)	NO3-N (µg/L)	Extracted (Chl a (µg/L))	TSS (mg/L)	VSS (mg/L)	Enterococci (Count/100ml)
Social Centre	13-Jan-09	13	27.5	35.8	95.1	6.2	8.1	12	6	14	0.41	12.8	0.8	23
Social Centre	10-Feb-09	13	28.1	34.3	108.9	7	8.2	6	4	13	0.37	14.3	1.7	38
Social Centre	3-Mar-09	13	27.2	35.3	98.1	6.4	8.1	12	4	5	0.22	0.8	0.1	13
Social Centre	7-Apr-09	13	27.7	34.6	109.6	7.1	8.6	8	1	7	0.05	1	0	0
Social Centre	5-May-09	13	25.5	35.3	95.4	6.4	8.4	4	3	7	0.24	2.9	0.9	6
Social Centre	3-Jun-09	13	25	34.3	105.5	7.2	8.1	4	5	5	0.32	5.4	0.4	18800
Social Centre	1-Jul-09	13	25.2	35.5	118.7	8	8.5	8	3	15	0.15	0.9	0.6	5
Social Centre	12-Aug-09	13	21.28	35.5	107.4	7.7	8.5	6	3	17	0.05	0.8	0.3	4
Social Centre	1-Sep-09	13A	22.9	35.6	115.4	8.1	8.4	3	2	3	0.19	2.3	0.5	35
Social Centre	1-Sep-09	13B						3	4	2	0.12	1.2	0.3	37
Social Centre	13-Oct-09	13	25.2	35.6	117.1	7.9	8.2	2	4	3	0.17	4.6	1.1	12
Social Centre	3-Nov-09	13	23.8	35.7	104	7.2	8.5	0.5	4	3	0.27	15.7	2.2	25
Social Centre	1-Dec-09	13	23.4	35.5	102.9	7.1	8	0.5	4	1	0.21	3.2	0.5	43
East Airport Drain	13-Jan-09	14	27.8	33.9	100.1	6.5	8	0.5	5	1	0.63	7.6	1.1	81
East Airport Drain	10-Feb-09	14						2	4	3	0.51	8.9	1.1	6
East Airport Drain	3-Mar-09	14	27.2	34.2	117.4	7.7	8.2	2	2	5	0.5	1.8	0.3	79
East Airport Drain	7-Apr-09	14	29.1	32.8	145.1	9.3	8.6	7	4	14	0.58	5	0.8	34
East Airport Drain	5-May-09	14A	27.5	28.8	112.5	7.6	8.6	3	4	6	0.55	1.7	0.8	64
East Airport Drain	5-May-09	14B						3	5	13	0.55	1.4	0.5	56
East Airport Drain	3-Jun-09	14	25.1	33.6	151.6	10.3	8.3	9	4	31	0.72	7.1	0.8	16
East Airport Drain	1-Jul-09	14	26.9	32.8	162.2	10.8	8.5	6	3	6	0.47	2.3	0.9	16
East Airport Drain	12-Aug-09	14A	22.66	35.4	126.9	8.9	8.5	2	3	3	0.14	0.4	0.1	0
East Airport Drain	12-Aug-09	14B						4	3	4	0.16	0.3	0.3	0
East Airport Drain	1-Sep-09	14	23	34.6	136.3	9.6	8.5	13	4	21	0.26	1.4	0.4	44
East Airport Drain	13-Oct-09	14	25.5	35.5	144.5	9.7	8.3	17	4	26	0.16	0.7	0.7	145
East Airport Drain	3-Nov-09	14A	23.6	35.7	115	8	8.6	7	3	13	0.34	4.7	1.1	3
East Airport Drain	3-Nov-09	14B						2	3	3	0.35	5	1.4	2
East Airport Drain	1-Dec-09	14	23.6	35.5	117.1	8.1	8	0.5	4	3	0.31	2.7	0.4	5

## 7. Appendix 2.

### 7.1 Water Quality data stream sites

Location	Date	Site Number	Temp (°C)	Salinity (ppt)	DOSat (%)	DO (mg/L)	pH	DRP (µg/L)	NH4-N (µg/L)	NO3-N(µg/L)	TSS (mg/L)	VSS (mg/L)	Enterococci (Count/100ml)
Avana	13-Jan-09	1	27.3	0.2	94.8	7.5	7.9	46	7	124	0.7	0.7	7050
Avana	10-Feb-09	1A	26.1	18.2	89.0	6.2	8.0	21	9	10	6.4	0.9	1490
Avana	10-Feb-09	1B						30	12	20	4.9	4.9	1762
Avana	03-Mar-09	1	26.7	17.4	102.8	7.5	8.0	41	7	33	2.5	1.3	470
Avana	07-Apr-09	1	25.3	4.2	103.8	10.0	7.3	31	15	42	0.9	0.4	4050
Avana	05-May-09	1	23.6	0.2	84.2	7.1	7.7	38	9	98	0.3	0.3	1005
Avana	03-Jun-09	1	22.9	0.1	96.8	8.3	8.2	44	14	42	1.1	0.1	1660
Avana	01-Jul-09	1	23.3	0.8	93.7	8.0	7.4	37	4	45	0.6	0.1	243
Avana	12-Aug-09	1	20.5	1.6	104.5	9.1	7.4	38	12	54	0.8	0.1	775
Avana	01-Sep-09	1	20.7	0.3	98.3	8.5	7.7	29	9	66	0.3	0.3	1255
Avana	13-Oct-09	1A	22.3	0.1	101.1	7.6	7.7	35	5	20	0.4	0.0	950
Avana	13-Oct-09	1B						33	3	17	0.3	0.0	890
Avana	03-Nov-09	1	24.1	9.1	91.6	8.4		30	4	4	3.1	1.4	625
Avana	01-Dec-09	1	25.6	3.7	110.7	11.1	7.4	36	8	7	1.9	0.7	440
Paringaru	13-Jan-09	2	25.5	0.1	66.1	5.4	6.9	30	23	234	1.9	1.2	2050
Paringaru	10-Feb-09	2	25.6	0.2	68.9	5.7	7.7	11	29	123	2.0	1.4	675
Paringaru	03-Mar-09	2	24.4	0.4	38.4	3.3	7.8	9	328	38	2.8	1.9	3300
Paringaru	07-Apr-09	2	25.9	0.2	79.5	7.3	7.7	8	43	303	1.4	0.6	855
Paringaru	05-May-09	2	25.9	0.3	144.8	11.8	8.3	13	24	303	0.3	0.3	465
Paringaru	03-Jun-09	2A	24.5	0.2	56.6	4.7	8.2	6	22	125	3.7	1.4	1090
Paringaru	03-Jun-09	2B						7	25	157	1.5	0.6	1380
Paringaru	01-Jul-09	2	24.8	0.0	109.0	9.0	7.5	2	18	418	1.9	0.8	710
Paringaru	12-Aug-09	2A	19.9	1.9	100.6	3.7	7.9	42	13		3.4	1.0	1545
Paringaru	12-Aug-09	2B						20	38	340	2.8	1.0	1440
Paringaru	01-Sep-09	2	24.2	0.2	101.7	1.9	7.5	9	26	489	2.6	0.4	175
Paringaru	13-Oct-09	2	25.0	0.2	92.2	3.7	7.9	12	15	486	6.1	1.0	3950
Paringaru	03-Nov-09	2	25.1	0.2	102.1	0.7		10	16	12	3.7	1.0	330

Location	Date	Site Number	Temp (°C)	Salinity (ppt)	DOSat (%)	DO (mg/L)	pH	DRP (µg/L)	NH4-N (µg/L)	NO3-N(µg/L)	TSS (mg/L)	VSS (mg/L)	Enterococci (Count/100ml)
Paringaru	01-Dec-09	2	28.0	0.2	142.2	7.8	7.9	12	13	71	3.6	1.7	35
Akapuao	13-Jan-09	3A	25.1	0.1	85.5	7.1	7.4	22	103	153	7.5	3.3	35600
Akapuao	13-Jan-09	3B						28	107	154	7.7	4.8	32000
Akapuao	10-Feb-09	3	25.8	0.2	41.6	3.4	7.5	9	75	53	10.0	4.0	1850
Akapuao	03-Mar-09	3A	23.2	0.5	32.0	2.7	7.9	21	340	79	4.1	1.9	530
Akapuao	03-Mar-09	3B						21	347	84	3.0	1.8	530
Akapuao	07-Apr-09	3A	27.6	0.2	90.8	8.8	7.6	15	56	79	5.3	1.5	1490
Akapuao	07-Apr-09	3B						15	55	81	7.0	2.1	1265
Akapuao	05-May-09	3	22.3	0.1	71.5	6.2	7.8	13	64	163	9.4	2.9	4250
Akapuao	03-Jun-09	3A	23.8	0.3	15.7	1.3	8.1	5	1130	19	5.9	0.8	4500
Akapuao	03-Jun-09	3B						5	1120	16	6.3	1.2	5250
Akapuao	01-Jul-09	3	24.2	0.1	44.8	3.8	7.3	3	33	83	41.9	12.8	4000
Akapuao	12-Aug-09	3	18.6	0.3	39.8	8.9	7.2	22	37	310	6.7	3.0	1375
Akapuao	01-Sep-09	3	20.2	0.2	21.1	7.6	7.0	8	76	33	1.8	1.8	9050
Akapuao	13-Oct-09	3	24.1	0.2	44.2	7.8	7.8	9	88	153	3.9	0.4	6150
Akapuao	03-Nov-09	3	23.7	22.0	9.7	6.7		8	309	87	8.8	3.2	9950
Akapuao	01-Dec-09	3	*	*	*	*	*	*	*	*	*	*	*
Totokoitu	13-Jan-09	4	24.6	0.1	84.3	7.0	7.6	81	10	29	1.2	0.7	6450
Totokoitu	10-Feb-09	4	24.0	0.1	89.8	7.6	7.8	75	13	33	0.7	0.7	1275
Totokoitu	03-Mar-09	4	22.6	0.1	82.7	7.2	7.7	52	27	33	1.7	0.5	1465
Totokoitu	07-Apr-09	4A	24.2	0.1	104.1	10.7	7.4	56	13	20	1.1	0.6	1325
Totokoitu	07-Apr-09	4B						51	13	20	1.3	0.1	890
Totokoitu	05-May-09	4	22.5	0.1	81.8	7.1	7.9	54	11	21	0.9	0.8	1440
Totokoitu	03-Jun-09	4	22.8	0.1	84.8	7.3	8.4	45	2	29	1.6	0.9	4550
Totokoitu	01-Jul-09	4A	22.8	0.1	87.8	7.6	7.5	15	16	43	0.9	0.1	1180
Totokoitu	01-Jul-09	4B						14	13	42	1.1	0.8	1540
Totokoitu	12-Aug-09	4	18.5	0.1	94.8	4.7	7.7	23	22	32	1.2	0.3	1315
Totokoitu	01-Sep-09	4A	19.7	0.1	83.5	3.7	7.3	45	16	27	0.9	0.1	1240
Totokoitu	01-Sep-09	4B						24	15	27	0.3	0.3	1110
Totokoitu	13-Oct-09	4	21.9	0.1	89.2	2.1	8.2	35	8	23	0.8	0.8	2050
Totokoitu	03-Nov-09	4A	21.9	0.1	76.5	5.2		24	18	17	2.2	1.2	1600
Totokoitu	03-Nov-09	4B						29	22	34	2.8	1.3	1805

Location	Date	Site Number	Temp (°C)	Salinity (ppt)	DOSat (%)	DO (mg/L)	pH	DRP (µg/L)	NH4-N (µg/L)	NO3-N(µg/L)	TSS (mg/L)	VSS (mg/L)	Enterococci (Count/100ml)
Totokoitu	01-Dec-09	4A	23.4	0.1	91.4	4.5	7.5	18	17	26	1.0	0.6	1060
Totokoitu	01-Dec-09	4B						27	15	22	0.5	0.5	1045
Rutaki	13-Jan-09	5	26.8	0.2	46.4	3.7	7.2	90	4	26	1.9	0.7	9550
Rutaki	10-Feb-09	5	25.8	0.2	62.8	4.3	7.8	50	21	23	0.3	0.3	1910
Rutaki	03-Mar-09	5A	23.9	0.6	28.6	2.4	8.2	36	36	26	1.6	0.4	930
Rutaki	03-Mar-09	5B						37	36	25	1.1	0.6	1490
Rutaki	07-Apr-09	5	25.2	0.1	98.7	9.9	7.4	70	4	4	0.3	0.2	785
Rutaki	05-May-09	5A	21.8	0.1	90.3	7.9	7.6	78	8	9	1.5	0.5	1490
Rutaki	05-May-09	5B						69	7	9	1.6	0.3	1640
Rutaki	03-Jun-09	5	23.1	0.2	36.9	3.2	8.4	122	32	320	2.2	0.5	18500
Rutaki	01-Jul-09	5	22.7	0.2	52.2	4.5	7.7	12	4	43	0.9	0.5	1065
Rutaki	12-Aug-09	5	21.1	0.7	52.8	5.7	7.8	125	21	10	2.0	1.0	1545
Rutaki	01-Sep-09	5A	20.8	0.3	41.1	5.5	7.3	25	3	0.5	2.4	0.9	580
Rutaki	01-Sep-09	5B						29	3	2	1.5	0.1	565
Rutaki	13-Oct-09	5	23.1	0.6	24.2	6.7	8.5	50	7	76	0.6	0.6	575
Rutaki	03-Nov-09	5A	*	*	*	*	*	*	*	*	*	*	*
Rutaki	03-Nov-09	5B	*	*	*	*	*	*	*	*	*	*	*
Rutaki	01-Dec-09	5	*	*	*	*	*	*	*	*	*	*	*
Betela	13-Jan-09	6	26.5	0.2	63.6	5.1	7.5	69	8	104	1.1	0.6	5200
Betela	10-Feb-09	6	25.4	0.1	66.6	5.5	7.5	50	10	31	1.9	1.0	1945
Betela	03-Mar-09	6	22.9	0.1	46.5	4.0	7.6	39	13	17	1.0	1.0	3150
Betela	07-Apr-09	6	25.3	0.1	99.0	10.3	7.1	37	24	49	3.3	0.9	11300
Betela	05-May-09	6A	24.7	0.2	46.8	3.9	7.4	30	16	55	2.4	0.1	1710
Betela	05-May-09	6B						38	16	55	1.6	0.4	1535
Betela	03-Jun-09	6	23.4	0.1	73.6	6.3	8.1	29	9	74	1.7	0.1	2500
Betela	01-Jul-09	6	22.8	0.1	75.5	6.5	7.2	14	13	93	2.8	1.2	1630
Betela	12-Aug-09	6	19.0	0.1	61.3	9.3	7.2	25	9	12	0.4	0.4	1290
Betela	01-Sep-09	6	19.8	0.1	60.0	15.9	7.3	20	18	43	2.1	1.1	6900
Betela	13-Oct-09	6A	22.9	0.1	78.1	14.5	7.7	22	8	50	1.2	0.0	5050
Betela	13-Oct-09	6B						28	8	50	2.0	0.4	5100
Betela	03-Nov-09	6	22.3	0.1	59.7	6.4		18	12	32	3.5	1.6	1150
Betela	01-Dec-09	6A	23.3	0.1	52.8	11.7	7.2	26	22	8	5.8	1.8	2700

Location	Date	Site Number	Temp (°C)	Salinity (ppt)	DOSat (%)	DO (mg/L)	pH	DRP (µg/L)	NH4-N (µg/L)	NO3-N(µg/L)	TSS (mg/L)	VSS (mg/L)	Enterococci (Count/100ml)
Betela	01-Dec-09	6B						27	22	8	3.6	3.6	3650
North Airport Drain	13-Jan-09	7A	24.8	1.0	108.7	9.0	7.3	30	3	307	4.3	1.3	3200
North Airport Drain	13-Jan-09	7B						33	3	306	5.6	1.7	2800
North Airport Drain	10-Feb-09	7	29.6	25.8	118.4	7.9	8.0	13	25	41	8.9	2.8	790
North Airport Drain	03-Mar-09	7	24.6	0.3	53.5	4.4	7.5	4	3	95	3.9	2.1	155
North Airport Drain	07-Apr-09	7	25.7	0.3	81.8	7.7	7.6	22	30	127	5.0	2.1	278
North Airport Drain	05-May-09	7	24.9	0.2	48.2	4.0	7.5	18	13	223	1.0	0.4	1255
North Airport Drain	03-Jun-09	7	24.6	0.6	114.8	9.5	8.3	2	11	33	3.5	1.2	1250
North Airport Drain	01-Jul-09	7A	25.9	0.3	124.3	10.1	8.2	3	0.5	4	1.8	1.2	208
North Airport Drain	01-Jul-09	7B				8.6		2	3	10	1.0	0.2	161
North Airport Drain	12-Aug-09	7A	17.9	0.3	98.1	5.7	7.9	4	5	2	1.0	0.4	103
North Airport Drain	12-Aug-09	7B						3	7	1	1.5	0.7	125
North Airport Drain	01-Sep-09	7	20.4	0.2	176.0	8.0	8.2	3	0.5	13	1.1	0.1	100
North Airport Drain	13-Oct-09	7	30.8	0.3	194.6	13.8	8.6	4	6	25	15.3	3.3	70
North Airport Drain	03-Nov-09	7	25.3	18.4	86.9	3.6		15	11	8	35.9	9.6	495
North Airport Drain	01-Dec-09	7	27.3	0.3	147.5	4.3	8.1	2	6	2	8.5	3.6	130
Avatiu	13-Jan-09	8	26.3	0.2	81.4	6.6	7.4	99	12	156	13.7	5.0	3050
Avatiu	10-Feb-09	8A	26.4	0.3	130.7	10.7	8.2	81	7	16	6.0	1.0	1930
Avatiu	10-Feb-09	8B						76	4	16	8.5	2.8	1930
Avatiu	03-Mar-09	8	26.7	5.0	87.0	6.7	7.9	67	30	11	3.2	3.2	1005
Avatiu	07-Apr-09	8	24.5	0.2	85.9	8.3	7.8	85	6	46	0.7	0.3	1555
Avatiu	05-May-09	8	22.9	0.1	87.6	7.5	7.8	86	9	178	0.8	0.1	1305



Location	Date	Site Number	Temp (°C)	Salinity (ppt)	DOSat (%)	DO (mg/L)	pH	DRP (µg/L)	NH4-N (µg/L)	NO3-N(µg/L)	TSS (mg/L)	VSS (mg/L)	Enterococci (Count/100ml)
Avatiu	03-Jun-09	8	24.2	0.5	67.3	5.6	8.3	19	14	7	1.8	0.8	760
Avatiu	01-Jul-09	8	23.6	0.1	101.2	9.3	7.6	19	7	16	4.0	2.2	480
Avatiu	12-Aug-09	8	19.6	1.4	62.6	8.8	7.5	68	6	4	4.2	1.7	1835
Avatiu	01-Sep-09	8	20.3	0.2	88.2	8.8	7.6	37	3	5	0.9	0.9	845
Avatiu	13-Oct-09	8	25.6	0.2	168.4	7.3	8.6	27	5	4	1.4	0.2	205
Avatiu	03-Nov-09	8	24.3	5.1	44.3	8.9		79	4	31	1.1	1.1	1675
Avatiu	01-Dec-09	8	24.9	7.7	54.8		7.4	219	7	0.5	5.1	4.2	1180

\* No water in stream