



## RAROTONGA WATER QUALITY REPORT AUGUST 2025

### SUMMARY

Water samples were collected on Tuesday 26<sup>th</sup> August. Tides changed from low to high during sample collection. Three out of twelve streams were flowing and sampled. Juvenile fish and prawns were present in sampled streams. Seawater influence, stagnancy and no water were observed in the remaining streams, therefore could not be sampled. The table below summarize the levels of Enterococci bacteria, total suspended solids and dissolved oxygen.

Lagoon Site	Site ID	Enterococci (MPN/100ml)	Total Suspended Solids (mg/L)	Dissolved Oxygen (%)
Pouara Raiui	RAM03	<1	2.0	118
Avana Mudflats	RAM04	20	3.0	115
Paringaru	RAM05	<1	2.0	119
Tikioki Packing Shed	RAM06	<1	2.0	130
Totokoitu Station	RAM08	41	4.3	125
Papua	RAM09	<1	2.0	126
Arorangi School	RAM11	10	4.1	129
Social Centre	RAM13	<1	2.0	127
Muri Buoy	RAM16	<1	2.0	118
Betela Beach	RAM17	10	5.0	128
Avatiu	RAM18	10	3.0	136
Muri Koka	RAM19	10	4.0	122
Ngatipa	RAM20	<1	0.3	140
Matavera Outfall	RAM21	<1	2.0	123
Muri Aroko	RAM22	20	1.0	116
Tikioki	RAM23	<1	2.0	128
Papaaroa	RAM24	<1	3.0	128
Stream Site	Site ID	Enterococci (MPN/100ml)	Total Suspended Solids (mg/L)	Dissolved Oxygen (%)
Avana	RAS01	NW	NW	NW
Paringaru	RAS02	NW	NW	NW
Akapuao	RAS03	NW	NW	NW
Totokoitu	RAS04	2420	0.3	81
Betela	RAS06	1986	4.5	53
Avatiu	RAS08	NW	NW	NW
Vaiterenga	RAS10	NW	NW	NW
Areiti	RAS11	488	3.8	49
Takuvaine	RAS12	NW	NW	NW
Pouara	RAS13	NW	NW	NW
Avana Mouth	RAS14	NW	NW	NW
Papua	RAS15	NW	NW	NW



GRADING SCALE	Excellent	Very Good	Good	Poor	Very Poor	Extremely Poor
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### Lagoon:

- All sites were safe for swimming due to very good and excellent levels with low Enterococci bacteria results at <1 MPN/100mL to 41 MPN/100mL.
- Low results below 5.0 mg/L at all sites showed good to excellent levels of total suspended solids indicating clearer waters and minimal threat to coral reefs.

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- Dissolved oxygen levels were above the recommended threshold of 80% showing excellent levels at all sites.
- Temperature ranged from 24.2 degrees at Papua to 26.8 degrees at Avatiu with a mean temperature of 25.4 degrees.
- Salinity was stable ranging from 29.8 ppt at Ngatipa to 35.5 ppt at Arorangi School giving an average of 34.3 ppt.
- pH ranged from 7.92 at Paringaru to 8.21 at Matavera Outfall with a mean of 8.06.

**Stream:**

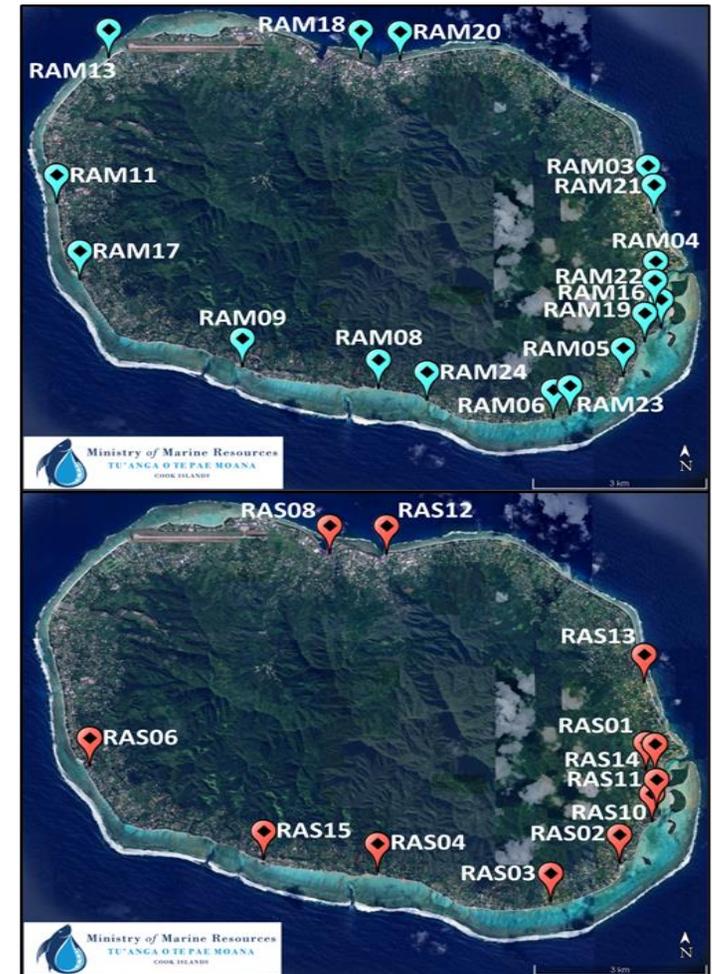
- Enterococci bacteria ranged from very poor levels with 488 MPN/100mL at Areiti to extremely poor levels with 1986 MPN/100mL at Betela and 2420 MPN/100mL at Totokoitu.
- Levels of total suspended solids were good to excellent with results less than 5.0 mg/L at all sites.
- Good levels of dissolved oxygen at 81% was recorded at Totokoitu. Betela and Areiti had poor levels at 53% and 49%, respectively.
- Temperature ranged from 22.5 degrees at Totokoitu to 23.3 degrees at Areiti, giving an average of 22.8 degrees.
- Salinity readings were stable, ranging from 0.1 ppt at Betela to 0.4 ppt at Areiti with an average of 0.2 ppt.
- pH readings ranged from 6.74 at Areiti to 7.06 at Totokoitu, mean pH of 6.88.

The monthly summary reports, lab study reports and rainfall data can be found at the end of this report.

**1. ENTEROCOCCI BACTERIAL COUNTS - RAROTONGA - Most Probable Number of Enterococci per 100 mL (MPN/100mL)**

Lagoon Site	Site ID	Mar	Apr	May	Jun	Jul	Aug
Pouara Raui	RAM03	20	<1	10	<1	<1	<1
Avana Mudflats	RAM04	97	10	160	75	20	20
Paringaru	RAM05	<1	135	10	10	75	<1
Tikioki Packing Shed	RAM06	<1	<1	10	<1	134	<1
Totokoitu Station	RAM08	156	30	<1	148	63	41
Papua	RAM09	158	63	10	10	185	<1
Arorangi School	RAM11	51	10	10	86	109	10
Social Centre	RAM13	<1	<1	<1	<1	<1	<1
Muri Buoy	RAM16	31	10	10	<1	<1	<1
Betela Beach	RAM17	63	74	<1	187	<1	10
Avatiu	RAM18	<1	<1	160	<1	<1	10
Muri Koka	RAM19	63	20	10	20	20	10
Ngatipa	RAM20	NO DATA	NO DATA	20	10	NO DATA	<1
Matavera Outfall	RAM21			<1	<1		<1
Muri Aroko	RAM22			20	63		20
Tikioki	RAM23			<1	10		<1
Papaaroa	RAM24			<1	31		<1

Stream Site	Site ID	Mar	Apr	May	Jun	Jul	Aug
Avana	RAS01	1733	NW	378	NW	649	NW
Paringaru	RAS02	>2420	NW	921	411	1203	NW
Akapuao	RAS03	>2420	NW	649	NW	>2420	NW
Totokoitu	RAS04	>2420	NW	NW	816	488	2420
Betela	RAS06	>2420	416	980	308	1553	1986
Avatiu	RAS08	NW	NW	461	109	299	NW
Vaiterenga	RAS10	>2420	NW	>2420	NW	>2420	NW
Areiti	RAS11	613	830	NW	28	>2420	488
Takuvaine	RAS12	NO DATA	NO DATA	NW	NW	NO DATA	NW
Pouara	RAS13			NW	NW		NW
Avana Mouth	RAS14			NW	NW		NW
Papua	RAS15			NW	NW		NW
				NW	NW		NW



GRADING SCALE			REFERENCE
Excellent	A	< 41	WHO 2021 Guidelines on Recreational Water Quality for Coastal and Fresh Waters.
Very Good	B	41 ≥ 100	
Good	C	101 ≥ 200	
Poor	D	201 ≥ 350	
Very Poor	E	351 ≥ 500	
Extremely Poor	F	> 500	

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## 2. TOTAL SUSPENDED SOLIDS - RAROTONGA - Milligrams per Litre (mg/L)

Lagoon Sampling Site	Site ID	Mar	Apr	May	Jun	Jul	Aug
Pouara Raui	RAM03	1.0	1.7	3.3	0.3	1.3	2.0
Avana Mudflats	RAM04	2.0	4.7	0.5	1.5	0.6	3.0
Paringaru	RAM05	3.0	6.8	5.5	1.6	2.9	2.0
Tikioki Packing Shed	RAM06	4.0	4.7	3.0	1.6	1.3	2.0
Totokoitu Station	RAM08	3.0	7.1	5.6	4.7	33.3	4.3
Papua	RAM09	3.0	4.7	0.3	2.4	7.8	2.0
Arorangi School	RAM11	5.0	12.6	2.3	1.0	6.8	4.1
Social Centre	RAM13	3.0	5.4	1.3	3.3	1.9	2.0
Muri Buoy	RAM16	1.0	5.2	1.3	0.3	0.5	2.0
Betela Beach	RAM17	2.0	7.0	0.3	2.0	25.2	5.0
Avatiu	RAM18	3.0	4.2	5.4	1.0	17.9	3.0
Muri Koka	RAM19	4.0	1.9	2.7	1.0	0.5	4.0
Ngatipa	RAM20	NO DATA	NO DATA	2.3	1.0	NO DATA	0.3
Matavera Outfall	RAM21			4.3	1.0		2.0
Muri Aroko	RAM22			1.3	1.0		1.0
Tikioki	RAM23			2.3	1.0		2.0
Papaaroa	RAM24			1.3	1.4		3.0

Stream Sampling Site	Site ID	Mar	Apr	May	Jun	Jul	Aug
Avana	RAS01	3.1	NW	1.0	NW	1.0	NW
Paringaru	RAS02	6.1	NW	6.7	0.3	2.7	NW
Akapuao	RAS03	4.5	NW	5.0	NW	5.0	NW
Totokoitu	RAS04	8.7	NW	NW	0.3	0.3	0.3
Betela	RAS06	6.3	3.7	3.7	3.1	2.5	4.5
Avatiu	RAS08	NW	NW	1.0	1.4	2.0	NW
Vaiterenga	RAS10	8.8	NW	3.3	NW	4.0	NW
Areiti	RAS11	2.1	30.9	NW	7.3	68.8	3.8
Takuvaine	RAS12	NO DATA	NO DATA	NW	NW	NO DATA	NW
Pouara	RAS13			NW	NW		NW
Avana Mouth	RAS14			NW	NW		NW
Papua	RAS15			NW	NW		NW



GRADING SCALE			REFERENCE
Excellent	A	< 1.0	Bell 1992, total suspended solids recommended limit is ≤5mg/L for healthy coral reef.
Very Good	B	1.0 ≥ 2.5	
Good	C	2.5 ≥ 5.0	
Poor	D	5 ≥ 10	
Very Poor	E	10 ≥ 20	
Extremely Poor	F	> 20	

### 3. DISSOLVED OXYGEN - RAROTONGA - Percent (%)

Lagoon Sampling Site	Site ID	Mar	Apr	May	Jun	Jul	Aug
Pouara Raui	RAM03	97	107	125	129	137	118
Avana Mudflats	RAM04	78	93	110	114	101	115
Paringaru	RAM05	74	100	115	118	102	119
Tikioki Packing Shed	RAM06	88	108	123	126	119	130
Totokoitu Station	RAM08	88	104	127	118	119	125
Papua	RAM09	97	109	125	124	125	126
Arorangi School	RAM11	92	116	132	131	131	129
Social Centre	RAM13	94	113	130	126	124	127
Muri Buoy	RAM16	82	90	114	113	104	118
Betela Beach	RAM17	92	108	130	122	121	128
Avatiu	RAM18	95	118	116	154	134	136
Muri Koka	RAM19	95	95	118	115	101	122
Ngatipa	RAM20	NO DATA	NO DATA	119	122	NO DATA	140
Matavera Outfall	RAM21			123	131		123
Muri Aroko	RAM22			114	115		116
Tikioki	RAM23			119	131		128
Papaaroa	RAM24			127	123		128

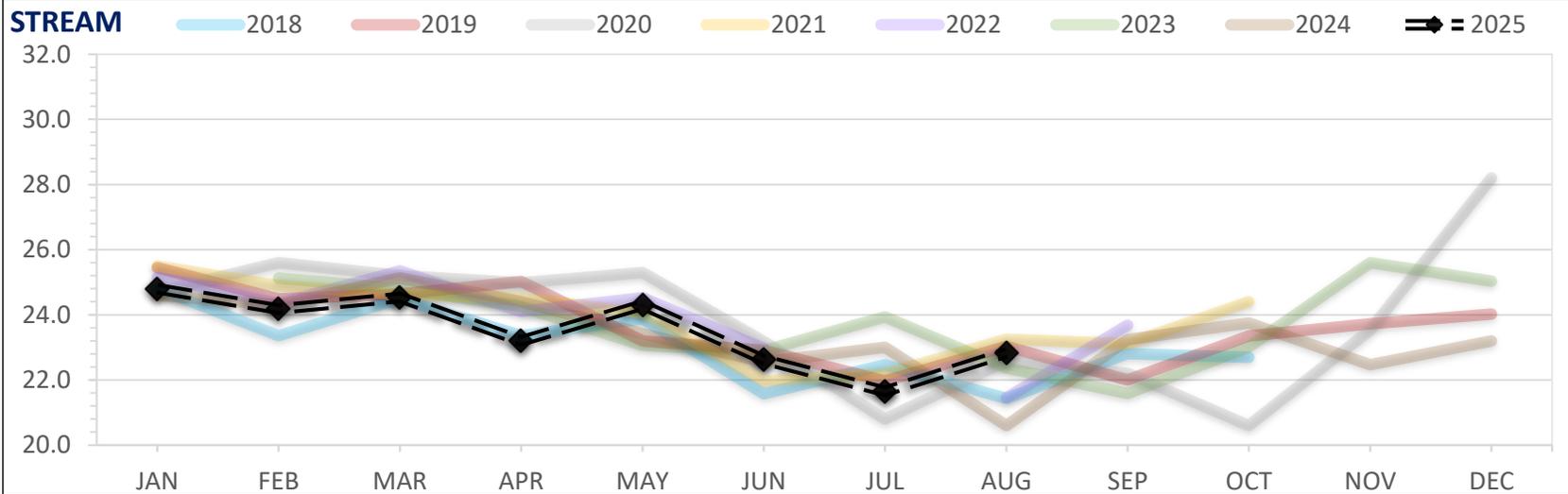
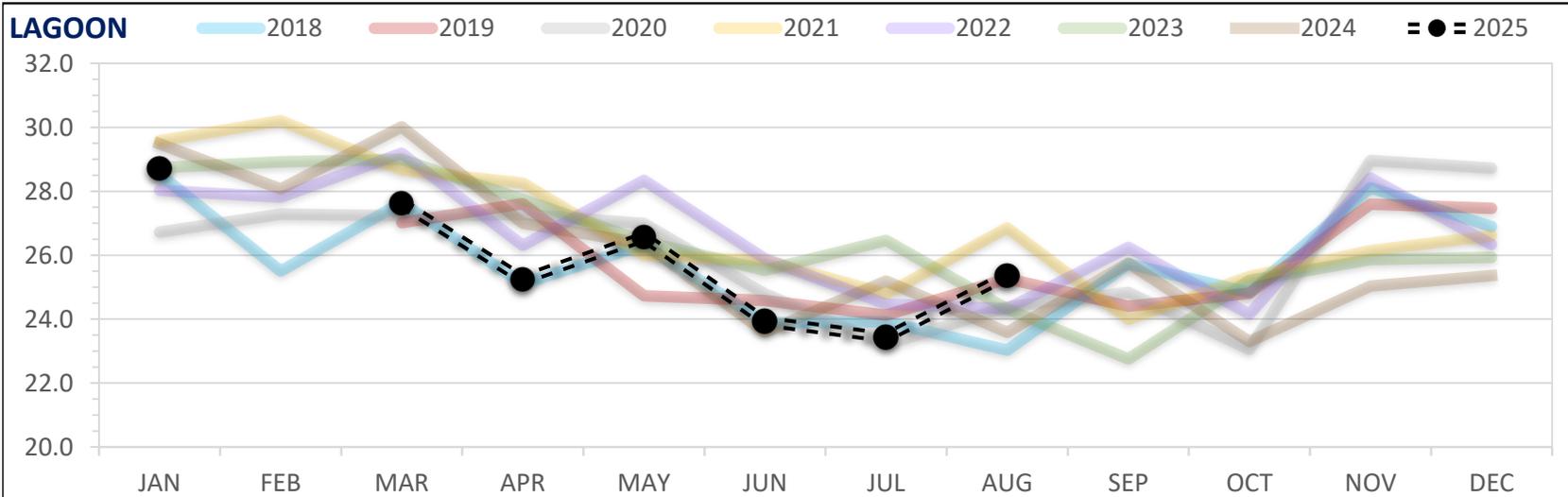
Stream Sampling Site	Site ID	Mar	Apr	May	Jun	Jul	Aug
Avana	RAS01	92	NW	82	NW	95	NW
Paringaru	RAS02	64	NW	93	74	79	NW
Akapuao	RAS03	36	NW	61	NW	61	NW
Totokoitu	RAS04	94	NW	NW	99	95	81
Betela	RAS06	75	55	72	97	91	53
Avatiu	RAS08	NW	NW	82	99	91	NW
Vaiterenga	RAS10	35	NW	43	NW	62	NW
Areiti	RAS11	25	53	NW	75	64	49
Takuvaine	RAS12	NO DATA	NO DATA	NW	NW	NO DATA	NW
Pouara	RAS13			NW	NW		NW
Avana Mouth	RAS14			NW	NW		NW
Papua	RAS15			NW	NW		NW



GRADING SCALE			REFERENCE
Excellent	A	>95	Department of Health, Clean Water Branch Hawaii 1994: Dissolved oxygen recommended limit is ≥75% saturation for oceanic waters, embayments, open coastal waters & estuaries; ≥80% saturation for streams.
Very Good	B	90 ≥ 95	
Good	C	80 ≥ 90	
Poor	D	60 ≥ 80	
Very Poor	E	40 ≥ 60	
Extremely Poor	F	< 40	

#### 4. AVERAGE TEMPERATURE - RAROTONGA - Degrees Celcius (°C)

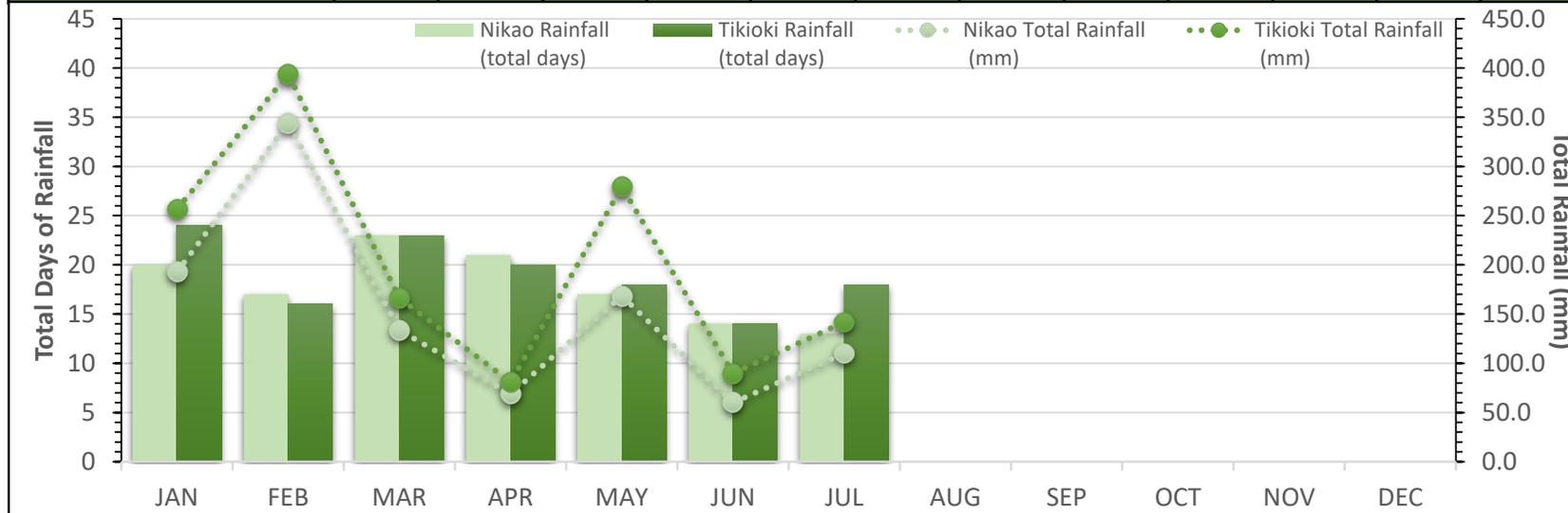
2025	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Lagoon	28.7	ND	27.6	25.2	26.6	23.9	23.4	25.4				
Stream	24.8	24.2	24.5	23.2	24.3	22.6	21.7	22.8				



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## 5. RAROTONGA RAINFALL - NIKAO & TIKIOKI - Total Rainfall (mm) & Total Days of Rainfall

Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
<b>Nikao Total Rainfall (mm)</b>	192.6	344.3	133.6	68.8	168.3	60.0	110.2					
<b>Nikao Rainfall (total days)</b>	20	17	23	21	17	14	13					
<b>Nikao Highest 1-Day (mm)</b>	37.4	72.5	43.0	10.6	28.5	19.1	80.6					
<b>Nikao Highest 1-Day (date)</b>	9th	13th	3rd	2nd	24th	16th	6th					
<b>Tikioki Total Rainfall (mm)</b>	256.6	393.6	166.4	80.8	279.2	89.8	141.8					
<b>Tikioki Rainfall (total days)</b>	24	16	23	20	18	14	18					
<b>Tikioki Highest 1-Day (mm)</b>	83.8	94.4	53.6	13.0	67.8	48.0	79.6					
<b>Tikioki Highest 1-Day (date)</b>	9th	20th	30th	6th	15th	16th	6th					



Report Date: 29.08.2025		RAROTONGA LAB STUDY REPORT – AUGUST				Lab Report No.: 08L5279 – 08L5298		
SAMPLE DESCRIPTION								
Date Samples Collected:		Name of Sample:	Collected By:	Submitted By:	Time of Receipt:	Physical Description:		Quantity Per Site Received:
Tuesday 26 <sup>th</sup> August		Marine	NES		12:40PM	Clear		2.5L
		Stream	MMR		10:45AM	Clear and slightly turbid		
Study No.		1	2	3	4	5	6	7
SITE ID	LAB ID	Enterococci (MPN/100ml)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	pH	Total Suspended Solids (mg/L)
MARINE								
RAM03	08L5279	<1	25.6	35.3	118.0	7.90	8.20	2.0
RAM04	08L5280	20	25.4	33.6	114.9	7.79	7.98	3.0
RAM05	08L5281	<1	25.7	33.5	119.0	8.03	7.92	2.0
RAM06	08L5282	<1	25.4	34.5	130.4	8.81	8.07	2.0
RAM08	08L5283	41	24.5	34.3	125.3	8.60	8.06	4.3
RAM09	08L5284	<1	24.2	34.7	126.1	8.66	8.06	2.0
RAM11	08L5285	10	25.8	35.5	128.7	8.57	8.12	4.1
RAM13	08L5286	<1	26.2	35.4	127.4	8.43	8.05	2.0
RAM16	08L5287	<1	24.8	34.7	118.0	8.03	8.01	2.0
RAM17	08L5288	10	24.9	34.8	127.9	8.69	8.05	5.0
RAM18	08L5289	10	26.8	35.1	136.4	8.96	8.17	3.0
RAM19	08L5290	10	25.7	34.8	121.5	8.14	8.03	4.0
RAM20	08L5291	<1	25.3	29.8	140.3	9.74	8.02	0.3
RAM21	08L5292	<1	25.9	35.3	123.0	8.20	8.21	2.0
RAM22	08L5293	20	25.0	34.7	115.8	7.85	7.98	1.0
RAM23	08L5294	<1	25.3	34.6	128.1	8.65	8.00	2.0
RAM24	08L5295	<1	24.7	31.9	127.6	8.84	8.04	3.0
STREAM								
RAS04	08L5296	2420	22.5	0.2	81.3	7.03	7.06	0.3
RAS06	08L5297	1986	22.7	0.1	52.5	4.53	6.85	4.5
RAS11	08L5298	488	23.3	0.4	48.5	4.13	6.74	3.8
Study Method		IDEXX Enterolert*	YSI Manual	YSI Manual	YSI Manual	YSI Manual	YSI Manual	MMR Lab Manual Water Quality Monitoring V5
Recommended Limit		Ref. Comments	Ref. Comments	Ref. Comments	Ref. Comments	Ref. Comments	Ref. Comments	Ref. Comments

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## Abbreviation

NL: Not Listed, MPN: Most Probable Number, cfu: Colony Forming Unit, mL: milli Litre, FAU: Formazin Attenuation Unit, NTU: Nephelometric Turbidity Unit, ppt: Parts Per Thousand, DB: Designated Bathing Beach, MB: Moderate Use of Bathing, LB: Light Use of Bathing, IB: Infrequent Use of Bathing  
NA: Not Available, however data will be available at a later date; ND: No Data due to equipment failure or logistics problems or time delay or methodology problem or combination of all; NW: No Water, stream dry or water stagnant or water level too low for sample collection or water dirty/murky.

## Comments

1. Temperature<sup>#</sup>  
Subtropical regions (south of Cape Canaveral and Tampa Bay, Florida, and Hawaii).  
Short-term Max. 32.2°C, Max. True daily mean 29.4°C (average of 24-hourly temperature reading).  
Temperature is the measure of warmth and coldness, reported as an average and measured in degrees celcius (°C).
2. pH  
Changes to pH can be caused by a range of potential water quality problems (e.g., low values due to acid sulphate runoff). pH values are also related to soil geology and may be naturally low or high (in limestone areas). High pH values can also be caused temporarily when high rates of photosynthesis by aquatic plants (including algae) lead to a decrease in carbon dioxide, and therefore a decrease in carbonic acid in the water.
3. Salinity  
A measure of the amount of dissolved salts in the water, and therefore an indicator of salinity. Excess salinity in freshwater streams occurs as a result of excess soil salinity, which may be caused by excess land clearing and changes to the groundwater table. Salinity is reported as parts per thousand (ppt).
4. Dissolved Oxygen<sup>^</sup>  
DO levels indicate how much oxygen is in the water. Low DO levels indicate an abnormal disturbance in the ecosystem such as an algal bloom. DO is measured in percentage (%).  
Low DO: 3.5 mg/L at 26C leads to 100% mortality of *Acipenser oxyrhincus*  
2.7 mg/L at 19C leads to 22% mortality of *Acipenser oxyrhincus*  
<3.7 mg/L Demersal finfish biomass diminishes  
<3.5 mg/L Species richness diminishes  
Below 2 mg/L infaunal species migrate to sediment surface and epifaunal species move to better aerated water.  
Oxygen is essential for life processes of most aquatic organisms. Many aquatic organisms will suffocate if there is insufficient oxygen in the water.
5. Suspended Solids<sup>@</sup>  
Settleable and suspended solids should not reduce the depth of the compensation point for photosynthetic activity by more than 10% from the seasonably established norm for aquatic life. Total suspended solids (TSS) are non-living (inorganic) such as silt and mud; and organic matter such as animal and plant material found in the water. The presence of large amounts of particles are responsible for creating the murky appearance of dirty water and can quickly kill coral reefs. TSS is measured in milligrams per litre (mg/L).
6. Turbidity  
Water clarity (the degree of light penetration) is important as aquatic plants depend on light to photosynthesize and produce oxygen. Large amounts of sediment in a water body can also smother benthic organisms. Suspended solid results are interactive and interdependent with turbidity. Expert interpretation needed. Turbidity is measured as FAU.
7. Enterococci<sup>β</sup>  
The presence of bacteria Enterococci *sp* is monitored as an indicator of human and animal waste pollution. The higher the numbers of Enterococci bacteria present in a sample, the greater the amount of faecal pollution in the water. Bacteria count is measured in Most Probable Number of Enterococci cells per 100mL of sample (MPN/100mL).
8. Nutrients (Nitrate, Nitrite, Ammonia, Phosphate)  
High nutrient concentrations in a water body (eutrophication) may lead to excessive weed and algal growth. Excess nutrients enter a water body through several means, including discharge of treated sewage, storm water, and in run-off from land, for example as fertiliser, animal waste, or decaying plant matter.
9. Chlorophyll-a  
Chlorophyll-a is a pigment found in green plants, including aquatic plant. Measuring the amount of chlorophyll-a in the water therefore indicates the amount of green algae present in the water. High concentrations of algae (algal blooms) may harm other aquatic organisms, either through the production of toxins, reduction of available light through covering the water surface, or by using all available oxygen during respiration at night. Chlorophyll-a is measured in micrograms per litre (µg/L).
10. Rainfall  
Rarotonga: daily rainfall data is provided by the Cook Islands Meteorological Service.  
Aitutaki: daily rainfall data is recorded by MMR Staff (Aitutaki Marine Research Centre – AMRC) at Amuri and by Rowan Strickland at Vaipae.  
Rainfall is measured in millimetres (mm) and reported as an average per month, total number of days that had no rainfall and the highest amount of rainfall in 1-day.

<sup>#</sup>EPA Quality Criteria for Water Gold Book 1986

<sup>^</sup>EPA Ambient Aquatic Life Water Quality Criteria for DO (Saltwater): Cape Cod to Cape Hatteras Nov 2000

<sup>@</sup>EPA Quality Criteria for Water Red Book 1976

<sup>β</sup>WHO Guidelines on Recreational Water Quality for Coastal and Fresh Waters 2021

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