Ministry of Marine Resources
TU'ANGA O TE PAE MOANA
COOK ISLANDS

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RAROTONGA WATER QUALITY REPORT
NOVEMBER 2025

SUMMARY

Water samples were collected on Tuesday 4th November. Weather was sunny with changing tides from high to low during sample collection. All twelve lagoon sites were accessible and sampled. All lagoon sites were safe for swimming. One out of eight streams were flowing and sampled. Juvenile fish were observed in sampled stream. Ebb flow and lack of water were observed at the remaining seven streams, therefore were not sampled. Summary table for Enterococci bacteria, total suspended solids and dissolved oxygen results and levels below.

Lagoon Site	Site ID	Enterococci (MPN/100ml)	Total Suspended Solids (mg/L)	Dissolved Oxygen (%)
Pouara Raui	RAM03	<1	0.3	137
Avana Mudflats	RAM04	10	1.3	110
Paringaru	RAM05	86	3.3	114
Tikioki Packing Shed	RAM06	41	2.3	125
Totokoitu Station	RAM08	<1	2.3	128
Papua	RAM09	<1	0.3	130
Arorangi School	RAM11	31	0.3	154
Social Centre	RAM13	<1	0.3	125
Muri Buoy	RAM16	<1	0.3	114
Betela Beach	RAM17	20	1.3	138
Avatiu	RAM18	<1	3.3	135
Muri Koka	RAM19	20	2.3	121
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	NW	NW	NW
Betela	RAS06	NW	NW	NW
Avatiu	RAS08	NW	NW	NW
Vaiterenga	RAS10	NW	NW	NW
Areiti	RAS11	112	12.1	47

GRADING SCALE	Excellent	Very Good	Good	Poor	Very Poor	Extremely Poor

Lagoon:

- All results were low ranging from <1 MPN/100mL to 86 MPN/100mL. Levels were very good and excellent. This indicated that the areas were safe for swimming.
- Total suspended solids results were below 5.0 mg/L, ranging from 0.3 mg/L to 3.3 mg/L with good to excellent levels at all sites indicating clearer waters and minimal threat to coral reefs.
- Dissolved oxygen levels were above the recommended threshold of 80% showing excellent levels at all sites.
- Temperature ranged from 25.8 degrees at Muri Buoy to 27.5 degrees at Arorangi School with a mean of 26.6 degrees.
- Salinity was stable ranging from 34.5 ppt at Arorangi School to 35.7 ppt at Pouara Raui, Social Centre and Muri Buoy, with a mean of 35.3 ppt.
- pH ranged from 7.90 at Paringaru to 8.08 at Pouara Raui with a mean of 7.97.

Stream:

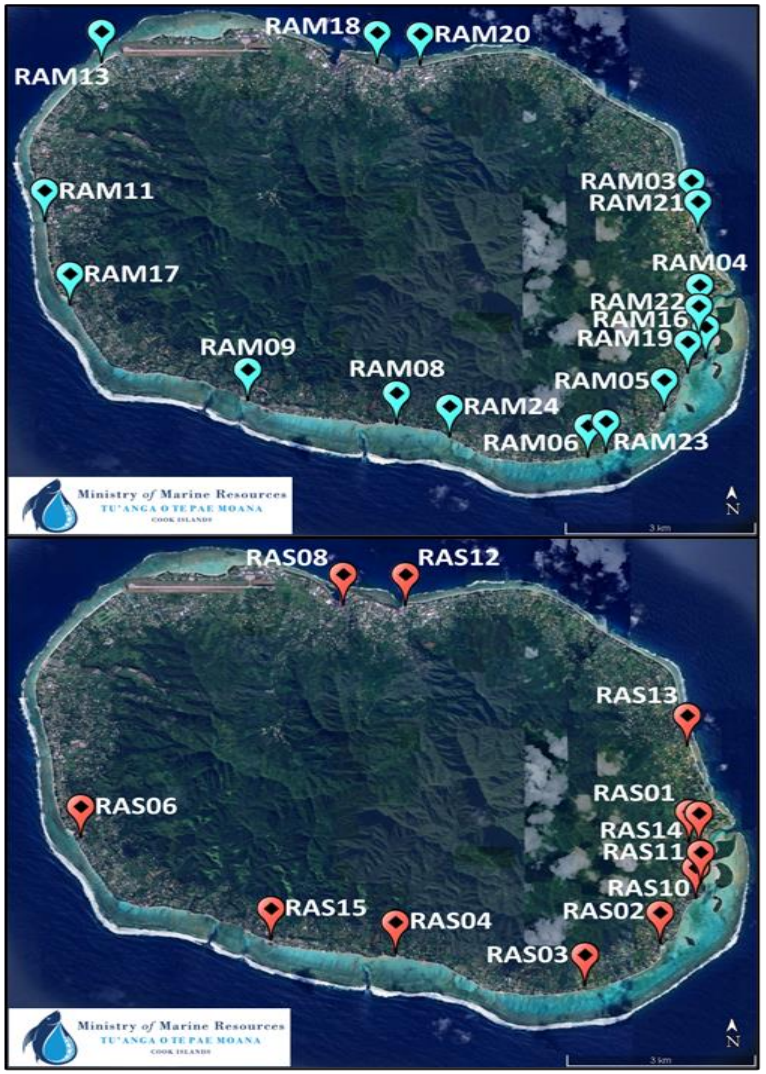
- Enterococci bacteria level was good at 112 MPN/100mL.
- Total suspended solids and dissolved oxygen levels were both very poor at 12.1 mg/L and 47%, respectively.
- Physical parameter results for temperature, salinity and pH were 24.1 degrees, 0.4 ppt and 6.21, respectively.

The monthly summary and lab study reports can be found at the end of this report. October rainfall data will be available at a later date.

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

Lagoon Site	Site ID	Jun	Jul	Aug	Sep	Oct	Nov
Pouara Raui	RAM03	<1	<1	<1	<1	10	<1
Avana Mudflats	RAM04	75	20	20	74	10	10
Paringaru	RAM05	10	75	<1	10	<1	86
Tikioki Packing Shed	RAM06	<1	134	<1	31	<1	41
Totokoitu Station	RAM08	148	63	41	20	20	<1
Papua	RAM09	10	185	<1	52	10	<1
Arorangi School	RAM11	86	109	10	31	10	31
Social Centre	RAM13	<1	<1	<1	110	<1	<1
Muri Buoy	RAM16	<1	<1	<1	<1	63	<1
Betela Beach	RAM17	187	<1	10	20	<1	20
Avatiu	RAM18	<1	<1	10	<1	<1	<1
Muri Koka	RAM19	20	20	10	<1	75	20
Ngatipa	RAM20	10	NO DATA	<1	NO DATA	<1	NO DATA
Matavera Outfall	RAM21	<1		<1		<1	
Muri Aroko	RAM22	63		20		97	
Tikioki	RAM23	10		<1		<1	
Papaaroa	RAM24	31		<1		<1	

Stream Site	Site ID	Jun	Jul	Aug	Sep	Oct	Nov
Avana	RAS01	NW	649	NW	435	NW	NW
Paringaru	RAS02	411	1203	NW	NW	NW	NW
Akapuao	RAS03	NW	>2420	NW	NW	NW	NW
Totokoitu	RAS04	816	488	2420	816	NW	NW
Betela	RAS06	308	1553	1986	NW	1046	NW
Avatiu	RAS08	109	299	NW	NW	NW	NW
Vaiterenga	RAS10	NW	>2420	NW	NW	NW	NW
Areiti	RAS11	28	>2420	488	328	58	112
Takuvaine	RAS12	NW	NO DATA	NW	NO DATA	NW	NO DATA
Pouara	RAS13	NW		NW		NW	
Avana Mouth	RAS14	NW		NW		NW	
Papua	RAS15	NW		NW		NW	

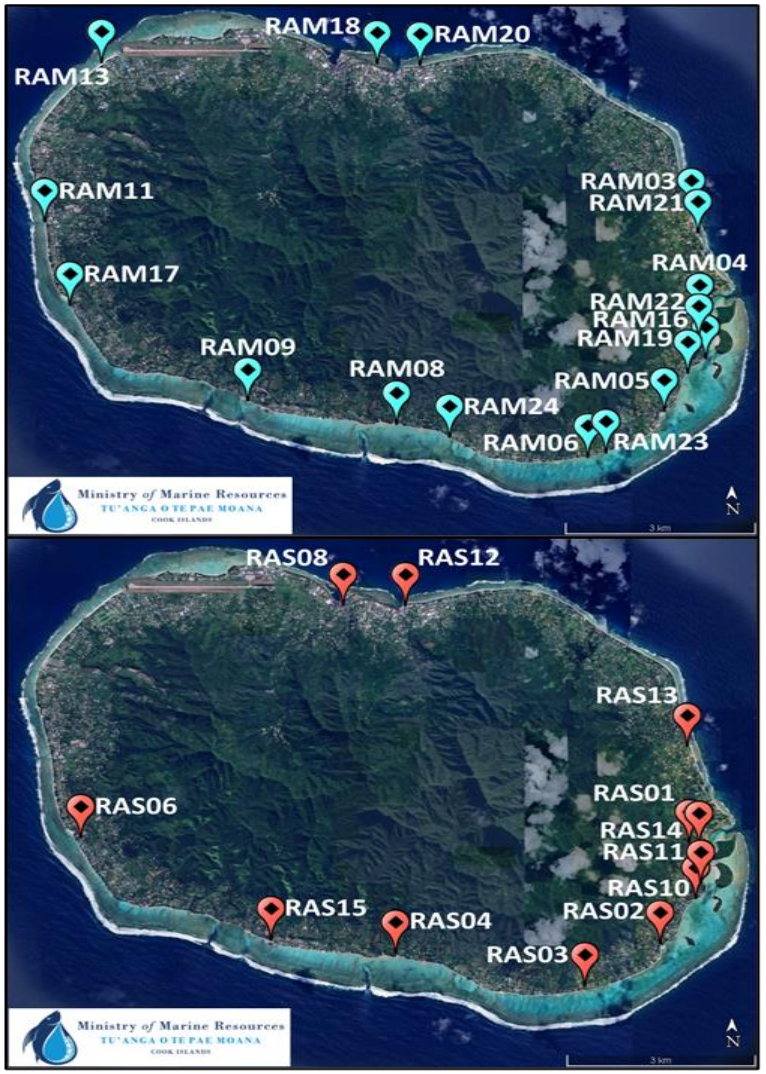


GRADING SCALE			REFERENCE
Excellent	A	< 41	WHO 2021
Very Good	B	41 ≥ 100	Guidelines on
Good	C	101 ≥ 200	Recreational
Poor	D	201 ≥ 350	Water Quality for
Very Poor	E	351 ≥ 500	Coastal and Fresh
Extremely Poor	F	> 500	Waters.

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

Lagoon Sampling Site	Site ID	Jun	Jul	Aug	Sep	Oct	Nov
Pouara Raui	RAM03	0.3	1.3	2.0	2.6	0.4	0.3
Avana Mudflats	RAM04	1.5	0.6	3.0	2.0	0.4	1.3
Paringaru	RAM05	1.6	2.9	2.0	1.9	1.9	3.3
Tikioki Packing Shed	RAM06	1.6	1.3	2.0	2.2	0.3	2.3
Totokoitu Station	RAM08	4.7	33.3	4.3	16.7	1.3	2.3
Papua	RAM09	2.4	7.8	2.0	10.1	0.3	0.3
Arorangi School	RAM11	1.0	6.8	4.1	7.4	1.3	0.3
Social Centre	RAM13	3.3	1.9	2.0	3.9	0.3	0.3
Muri Buoy	RAM16	0.3	0.5	2.0	0.3	0.3	0.3
Betela Beach	RAM17	2.0	25.2	5.0	5.6	0.3	1.3
Avatiu	RAM18	1.0	17.9	3.0	0.3	2.3	3.3
Muri Koka	RAM19	1.0	0.5	4.0	1.3	2.3	2.3
Ngatipa	RAM20	1.0	NO DATA	0.3	NO DATA	1.3	NO DATA
Matavera Outfall	RAM21	1.0		2.0		2.3	
Muri Aroko	RAM22	1.0		1.0		0.3	
Tikioki	RAM23	1.0		2.0		0.3	
Papaaroa	RAM24	1.4		3.0		1.3	

Stream Sampling Site	Site ID	Jun	Jul	Aug	Sep	Oct	Nov
Avana	RAS01	NW	1.0	NW	0.7	NW	NW
Paringaru	RAS02	0.3	2.7	NW	NW	NW	NW
Akapuao	RAS03	NW	5.0	NW	NW	NW	NW
Totokoitu	RAS04	0.3	0.3	0.3	4.4	NW	NW
Betela	RAS06	3.1	2.5	4.5	NW	4.0	NW
Avatiu	RAS08	1.4	2.0	NW	NW	NW	NW
Vaiterenga	RAS10	NW	4.0	NW	NW	NW	NW
Areiti	RAS11	7.3	68.8	3.8	36.7	25.0	12.1
Takuvaine	RAS12	NW	NO DATA	NW	NO DATA	NW	NO DATA
Pouara	RAS13	NW		NW		NW	
Avana Mouth	RAS14	NW		NW		NW	
Papua	RAS15	NW		NW		NW	

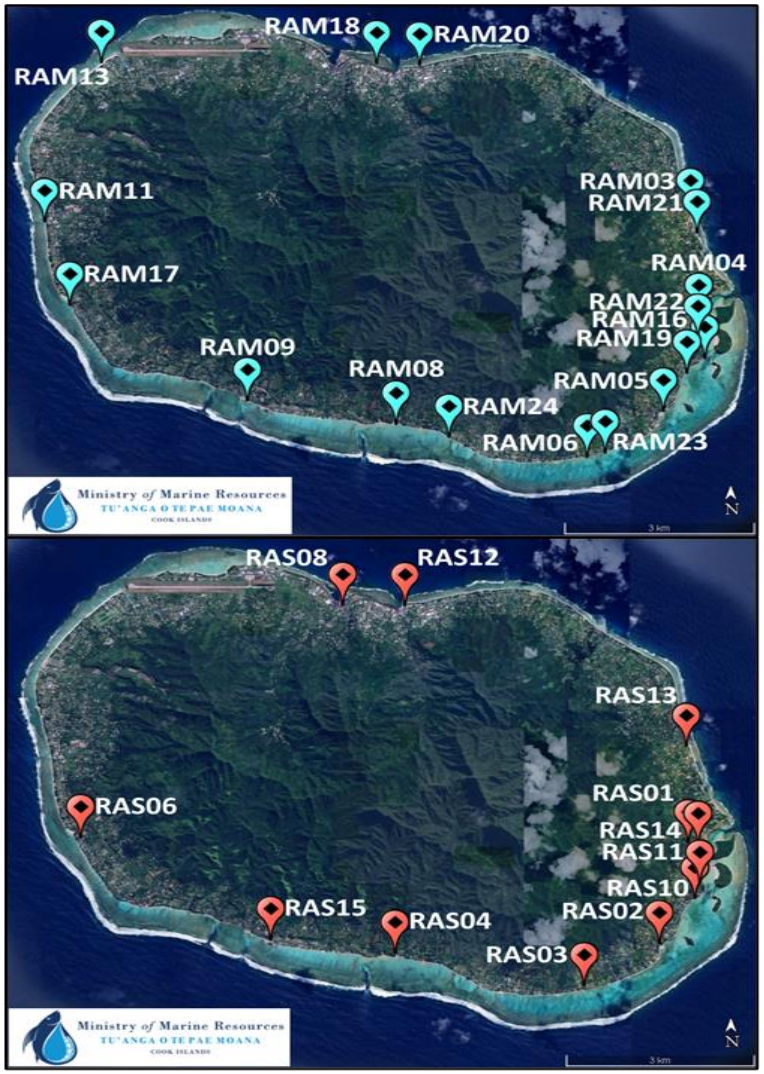


GRADING SCALE			REFERENCE
Excellent	A	< 1.0	Bell 1992, total suspended solids recommended limit is ≤5mg/L for healthy coral reef.
Very Good	B	1.0 ≥ 2.5	
Good	C	2.5 ≥ 5.0	
Poor	D	5 ≥ 10	
Very Poor	E	10 ≥ 20	
Extremely Poor	F	> 20	

3. DISSOLVED OXYGEN - RAROTONGA - Percent (%)

Lagoon Sampling Site	Site ID	Jun	Jul	Aug	Sep	Oct	Nov
Pouara Raui	RAM03	129	137	118	181	127	137
Avana Mudflats	RAM04	114	101	115	109	120	110
Paringaru	RAM05	118	102	119	120	136	114
Tikioki Packing Shed	RAM06	126	119	130	125	128	125
Totokoitu Station	RAM08	118	119	125	122	128	128
Papua	RAM09	124	125	126	131	126	130
Arorangi School	RAM11	131	131	129	125	140	154
Social Centre	RAM13	126	124	127	127	133	125
Muri Buoy	RAM16	113	104	118	96	118	114
Betela Beach	RAM17	122	121	128	126	135	138
Avatiu	RAM18	154	134	136	165	142	135
Muri Koka	RAM19	115	101	122	113	123	121
Ngatipa	RAM20	122	NO DATA	140	NO DATA	137	NO DATA
Matavera Outfall	RAM21	131		123		127	
Muri Aroko	RAM22	115		116		119	
Tikioki	RAM23	131		128		127	
Papaaroa	RAM24	123		128		129	

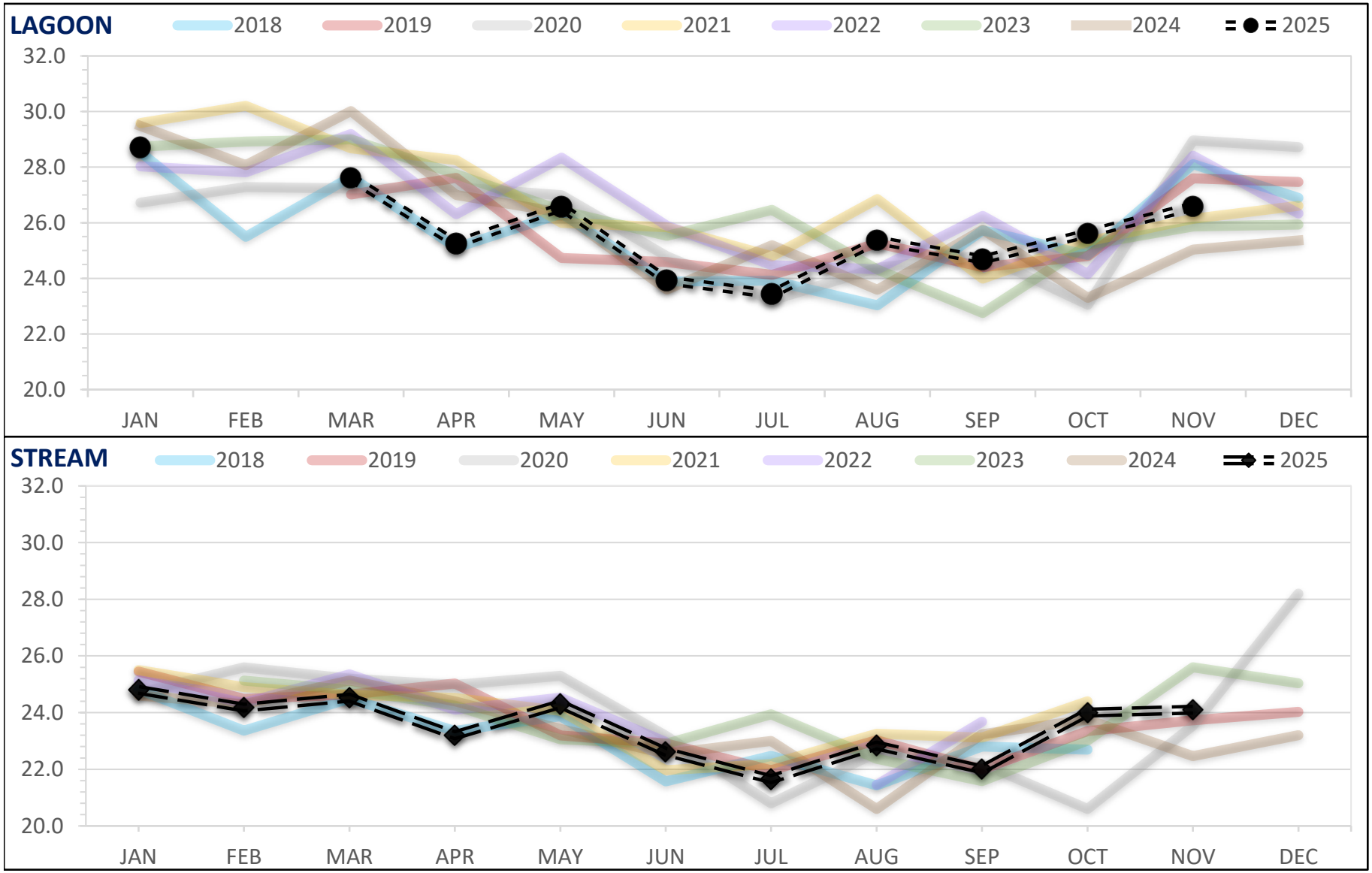
Stream Sampling Site	Site ID	Jun	Jul	Aug	Sep	Oct	Nov
Avana	RAS01	NW	95	NW	76	NW	NW
Paringaru	RAS02	74	79	NW	NW	NW	NW
Akapuao	RAS03	NW	61	NW	NW	NW	NW
Totokoitu	RAS04	99	95	81	ND	NW	NW
Betela	RAS06	97	91	53	NW	79	NW
Avatiu	RAS08	99	91	NW	NW	NW	NW
Vaiterenga	RAS10	NW	62	NW	NW	NW	NW
Areiti	RAS11	75	64	49	62	55	47
Takuvaine	RAS12	NW	NO DATA	NW	NO DATA	NW	NO DATA
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	

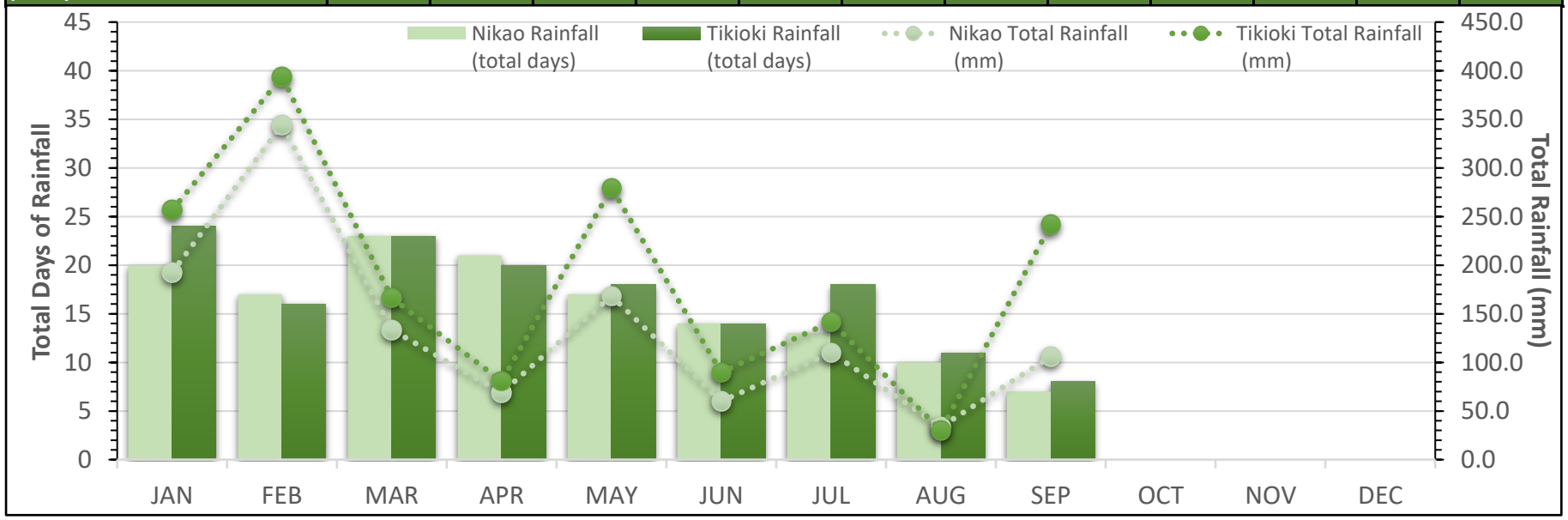
4. AVERAGE TEMPERATURE - RAROTONGA - Degrees Celcius (˚C)

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	24.7	25.6	26.6	
Stream	24.8	24.2	24.5	23.2	24.3	22.6	21.7	22.8	22.0	24.0	24.1	



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
Nikao Total Rainfall (mm)	192.6	344.3	133.6	68.8	168.3	60.0	110.2	33.7	106.1	NA		
Nikao Rainfall (total days)	*20*	*17*	*23*	*21*	*17*	*14*	*13*	*10*	*7*	*NA*		
Nikao Highest 1-Day (mm)	37.4	72.5	43.0	10.6	28.5	19.1	80.6	15.2	50.6	NA		
Nikao Highest 1-Day (date)	*9th*	*13th*	*3rd*	*2nd*	*24th*	*16th*	*6th*	*7th*	*18th*	*NA*		
Tikioki Total Rainfall (mm)	256.6	393.6	166.4	80.8	279.2	89.8	141.8	30.2	241.8	NA		
Tikioki Rainfall (total days)	*24*	*16*	*23*	*20*	*18*	*14*	*18*	*11*	*8*	*NA*		
Tikioki Highest 1-Day (mm)	83.8	94.4	53.6	13.0	67.8	48.0	79.6	15.4	145.0	NA		
Tikioki Highest 1-Day (date)	*9th*	*20th*	*30th*	*6th*	*15th*	*16th*	*6th*	*6th*	*15th*	*NA*		



Report Date: 07.11.2025		RAROTONGA LAB STUDY REPORT – NOVEMBER			Lab Report No.: 11L5363 – 11L5375		
SAMPLE DESCRIPTION							
Date Samples Collected:	Name of Sample:	Collected By:	Submitted By:	Time of Receipt:	Physical Description:		Quantity Per Site Received:
Tuesday 4th November	Marine	MMR		11:55am	Clear		2.5L
	Stream			10:30am	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 / 11L5363	<1	27.1	35.7	136.6	8.90	8.08	0.3
RAM04 / 11L5364	10	26.2	34.8	109.6	7.28	7.93	1.3
RAM05 / 11L5365	86	26.2	35.1	114.1	7.57	7.90	3.3
RAM06 / 11L5366	41	26.5	35.2	124.8	8.23	7.97	2.3
RAM08 / 11L5367	<1	26.8	35.0	128.0	8.41	7.96	2.3
RAM09 / 11L5368	<1	26.5	35.6	130.0	8.55	7.99	0.3
RAM11 / 11L5369	31	27.5	34.5	153.8	10.01	8.01	0.3
RAM13 / 11L5370	<1	27.1	35.7	124.7	8.12	7.97	0.3
RAM16 / 11L5371	<1	25.8	35.7	113.9	7.58	7.95	0.3
RAM17 / 11L5372	20	26.5	35.5	138.4	9.11	7.98	1.3
RAM18 / 11L5373	<1	26.7	35.1	134.9	8.87	7.97	3.3
RAM19 / 11L5374	20	26.1	35.3	121.1	8.04	7.93	2.3
STREAM							
RAS11 / 11L5375	112	24.1	0.4	46.7	3.92	6.21	12.1
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

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[#]
   Subtropical regions (south of Cape Canaveral and Tampa Bay, Florida, and Hawaii).
   Short-term Max. 32.2^{o}C, Max. True daily mean 29.4^{o}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^
   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[@]
   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[β]
   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.

[#]EPA Quality Criteria for Water Gold Book 1986
^EPA Ambient Aquatic Life Water Quality Criteria for DO (Saltwater): Cape Cod to Cape Hatteras Nov 2000
[@]EPA Quality Criteria for Water Red Book 1976
[β]WHO Guidelines on Recreational Water Quality for Coastal and Fresh Waters 2021