Prepared for To Tātou Vai

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Acronyms

AVG	Automatic valveless gravity filter
NES	National Environmental Services
OEMP	Operational environmental management plan
PACl	Poly Aluminium Chloride
SOP	Standard operating procedure
SS	Suspended solids
ST	Settling Tank
TTV	To Tatou Vai
WTP	Water Treatment Plant

Units

µg/L	milligrams per liter
Kg	Kilograms
E. Coli	*Escherichia coli (E. coli)* bacteria normally live in the intestines of people and animals. Most *E. coli* are harmless and actually are an important part of a healthy human intestinal tract. However, some *E. coli* are pathogenic, meaning they can cause illness, either diarrhea or illness outside of the intestinal tract. The types of *E. coli* that can cause diarrhea can be transmitted through contaminated water or food, or through contact with animals or persons. (https://www.cdc.gov/ecoli/general/index.html)

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Explanation

This supplementary plan is informed by the operational environment management plan main report. It provides for the management of environmental hazards and risks outside of the potential hazards and risks caused by the PACl. The plan covers the following:

1. Location of the Takuvaˈine Water Treatment Plant;
2. Areas where there are likely significant potential adverse environmental impacts;
3. How the Water Treatment Plant works;
4. Management of potential environmental hazards and risks; and
5. Summary of Recommendations and Monitoring Programme

1. Where is the Takuvaʻine Water Treatment Plant?

Figure 1 - Location of Rarotonga's Water Treatment Plants with Takuvaʻine in red

2. Takuva'ine Water Treatment Plant – Areas where there are likely significant potential adverse environmental impacts.

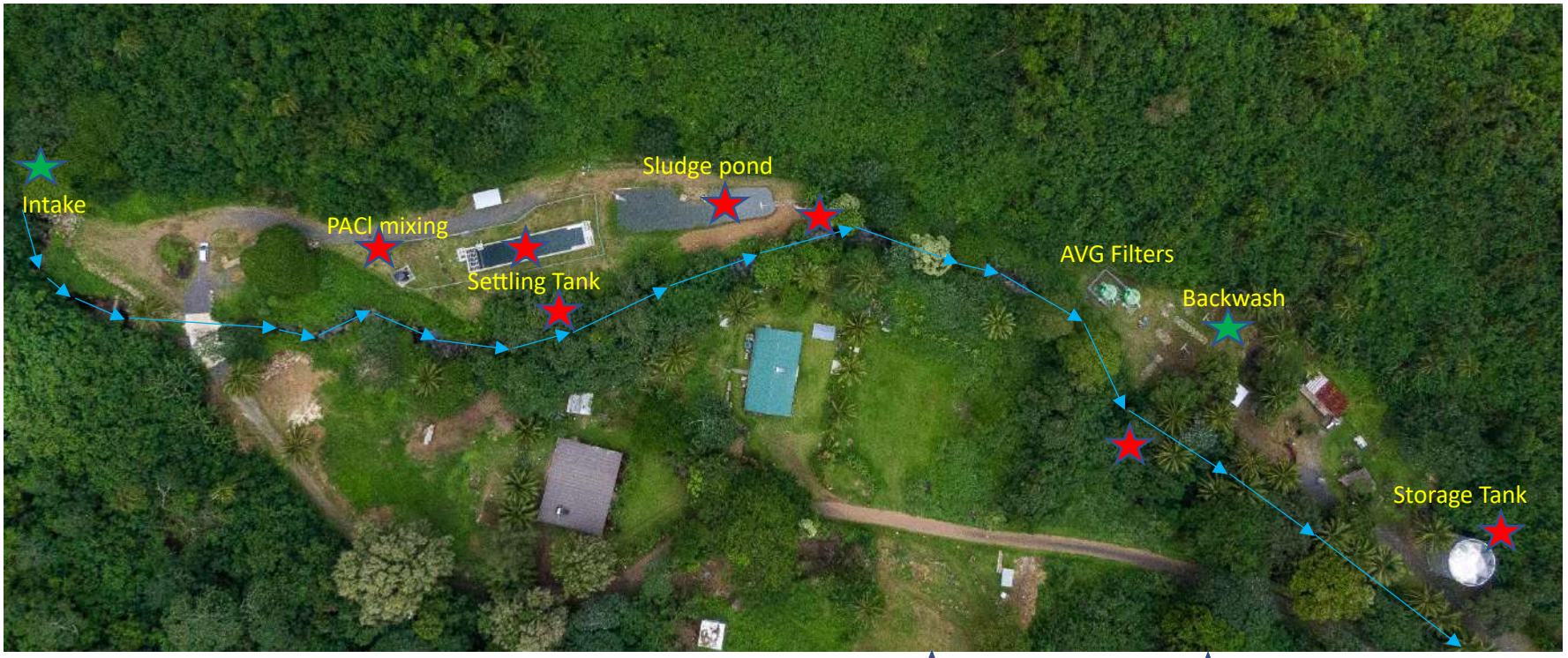
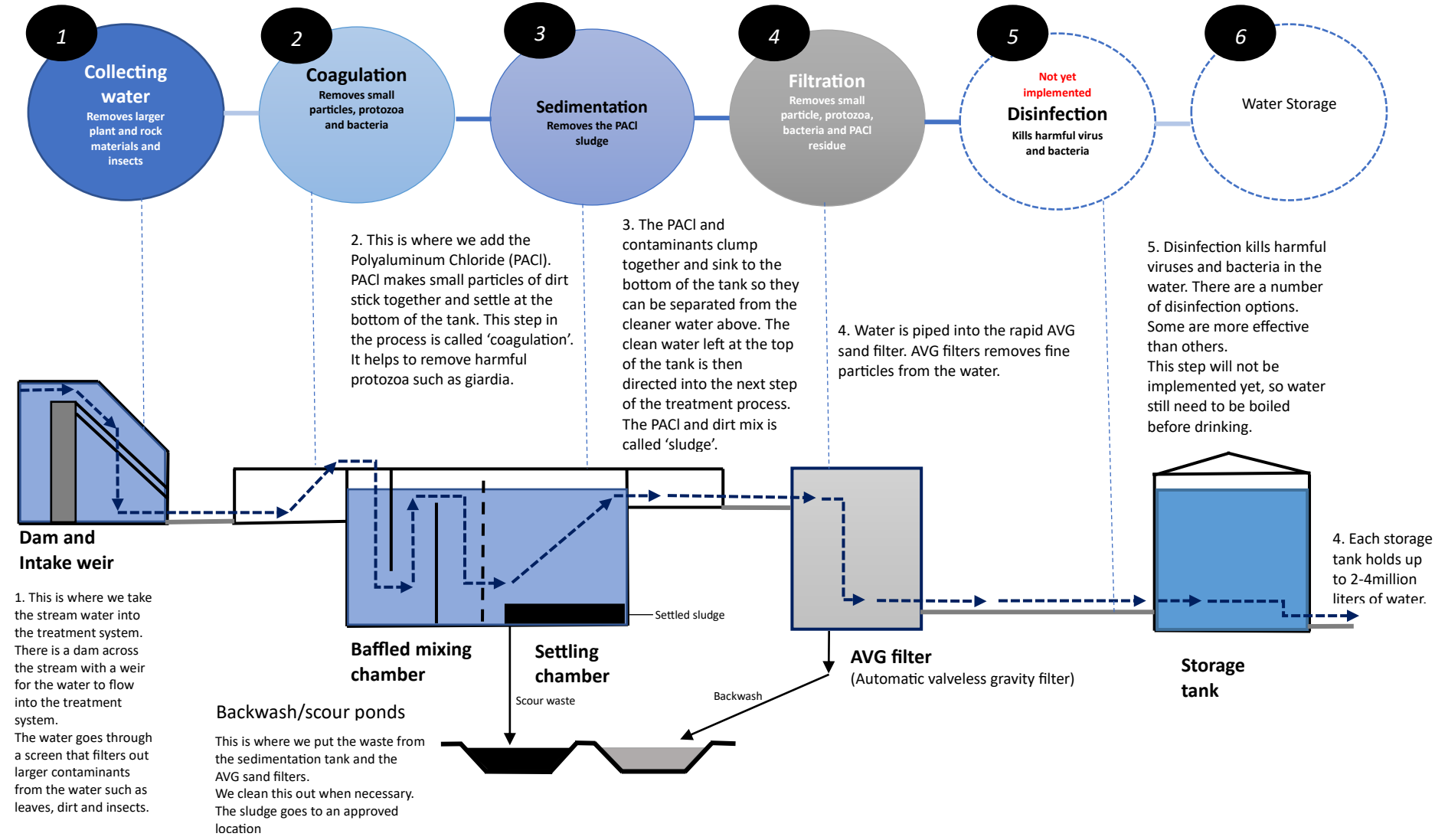


Figure 2 - Takuvaine Water Treatment Plant where there is risk of PACl getting into the environment and where there is potential risk to the Plant from the environment.

Note: Areas of risk from PACl is addressed in the main OEMP Report.

3. How the WTP work?

Figure 3 - How the Takuvaine Water Treatment Plant Work (Source: TTV sign boards at each WTP)



4. Management of Environmental Hazards and Risks

All hazards and risks are identified and using the risk assessment methodology attached as Appendix 1, the color code mean. Red = Very High Risk, Brown = High Risk, Yellow = Medium Risk, Blue = Low Risk and Green = Very Low Risk.

Area of Risk (What they are and level of risk)	**Potential Impacts**	**Mitigation Strategy**	**Monitoring Parameter**	**Monitoring Programme**	**Responsibility**	**Staff and equipment Requirement**	**Oversight**
The result of long-term accumulation of organic material behind the weir during low water flow IC = Minor P = Low	-. Increased dissolved organic carbon behind the weir at the Intake - can contribution to increased dissolved organic carbon in the water which can influence the solubility level of aluminum in the water.	**Short term** + keep the area behind immediately behind the weir at the intake free of accumulated organic debris + Check twice weekly	- Accumulation of organic debris behind the weir especially during low water flow.	+ Keep an eye out for accumulation especially during times of low water flow. + Increase rotting smell of vegetation in the water. + Check twice weekly	+ Operator (s)	+ Operator (s) + 4 the more the better.	+ Supervisor
Increased E. Coli at Source. IC = Moderate P = High	- E. Coli from insects, geckos, skinks, bats, chickens, rats and dogs E. Coli stored on leaf detritus that is broken down and released into the water when it floods. - Adverse impact on the water quality. - Increase sludge in settling pond.	**Short term** + Keep intake free of accumulated organic detritus. + Check twice weekly **Long term** + Ongoing water testing + Awareness activities through the Tourism sector.	- E. Coli level	+ Continue with water testing programme. + Manage use of trek trail across the island.	+ Operator (s) + TTV laboratory staff + Tourism sector and Public Health.	+ Operator (s) + TTV laboratory	+ Supervisor
Increase suspended solids IC = Moderate P = Medium	- Adverse impact on the water quality. - increase sludge in settling pond.	+ Keep vegetation along lower slopes short. + Eliminate invasive species, e.g., pīpī-vai, rau-māniota and kākā. + Regular inspection of inner stream for overgrowth.	- Suspended solid level	+ Continue with water testing programme	+ Operator (s) + TTV laboratory staff	+ Operator (s) + 4 the more the better.	+ Supervisor
Removal of debris from behind weir. IC = Moderate P = Medium	- Erosion in the catchment area. - May increase slips in the catchment area.	**Short term** + Develop SOP for controlled release of materials downstream.	- SOP - Debris deposits and volume of deposits.	+ Daily check + After major rainfall.	+ Operator (s) + Supervisor	+ Removal from the weir by contractor, T&M Heather.	+ Manager + Supervisor

Area of Risk (What they are and level of risk)	**Potential Impacts**	**Mitigation Strategy**	**Monitoring Parameter**	**Monitoring Programme**	**Responsibility**	**Staff and equipment Requirement**	**Oversight**
	- Increase sediment entering WTP.	+ Controlled release of material downstream. **Long term** + Request for NES approval for controlled release of material downstream. + Investigate and construct silt trap options further inland of the intake and weir to minimize erosion.	- When debris level is critical and after major rainfall. - Volume of material released.			+ Supervisor to be present.	

5. Summary of Recommendations and Monitoring Programme

The following are recommended actions to improve the operation and effective management of this WTP.

There are two areas around the WTP that requires attention but are not priority areas. These are the protection of the north side of the settling tank as it is close to the stream, and the sheltered nature of the sludge ponds. Recommendations are provided for them to help deal with it in the long term.

Increase E. Coli, like with all WTPs, the threat from human presence can be managed through stringent laws to prevents additional risk to the system from people using the walking trek and also continuing to plant taro in the catchment area.

It is important to investigate further ways to reduce the workload involved in the removing of debris from behind the weir. Removing the debris will also help prevent the accumulation of organic materials behind the weir.

The following are recommended strategies for each area identified as medium to high risk.

Hazards and Risks	**Recommendations**	**Monitoring Programme**
Increased E. Coli at Source.	+ Keep intake free of accumulated organic detritus. + Check twice weekly + Ongoing water testing + Awareness activities through the Tourism sector	+ Continue with water testing programme. + Manage use of trek trail across the island.

Hazards and Risks	Recommendations	Monitoring Programme
Increase suspended solids	+ Keep vegetation along lower slopes short. + Eliminate invasive species, e.g., pīpī-vai, rau-māniota and kākā. + Regular inspection of inner stream for overgrowth.	+ Continue with water testing programme
Removal of debris from behind weir.	+ Develop SOP for controlled release of materials downstream. + Request for NES approval for controlled release of material downstream. + Investigate and construct silt trap options further inland of the intake and weir to minimize erosion.	+ Revised SOP + Measure volume of deposits. + Remove debris when debris level is critical and after heavy rain in Takuvaine. + Measure volume of material released. + Daily check

6. Appendices

6.1 Risk Assessment Methodology Used

The assessment of risks involved for each hazard is provided below in Tables 1 and 2.

Table 1 Level of risk impact and probability

Risk Criteria	Definition of Rating	Score
Impact (I)	**A:** Extent – The area over which the impact will be experienced	Local = 1; Island = 2; and National = 3
	B: Intensity – The magnitude of the impact, i.e., whether the impact will result in minor, moderate, major or catastrophic environmental, social and economic (including human health) changes	Low = 1; Medium = 2; and High = 3
	C: Duration – The time frame over which the impact will be experienced and its reversibility.	Short Term – 1; Mid Term – 2; and Long Term – 3
Impact Consequences (Combined Score): Minor 3 – 4; Moderate 5 – 6; Major 7 – 8; Massive 9 – 10.		
Probability (P) – Likelihood of the impact occurring	Improbable - Unlikely to occur during project lifetime	1
	Possible - May occur during project lifetime 20%-60% chance of occurring	2
	Probable - Likely to occur during the project lifetime >60-90% chance of occurring	3
	Highly probable - Highly likely to occur, or likely to occur more than once during project lifetime	4

Table 2 Matrix showing overall significance of the impact as a combination of the consequences and probability rating

		Probability of Occurrence			
		Improbable	Possible	Probable	Highly Probable
Consequences of Impact	Minor	Very Low	Very Low	Low	Low
	Moderate	Low	Low	Medium	Medium
	Major	Medium	Medium	High	High
	Catastrophic	High	High	Very High	Very High

6.2 To Tatou Vai (TTV) Water Treatment Plant (WTP) Operator's Daily Check List (Source: TTV Treatment Division)

Date WTP	Sludge Level (%)	Bulk Tank (%)	Dose Rate (mg/L or g/m^3)	Intake (NTU)	ST (NTU)	Post AVG (NTU)	Reservoir (NTU)	Flow Rate (L/Sec)	Reservoir (KPA)	Comments

Notes: PACl storage tank (how full it is in %), PACl header tank (Float valve and arm), the sludge level in the settling tank (from bottom of tank to mid-way level in %), adjusting the dosing level of PACl (in mg/L), Intake (NTU), Sediment tank (Float valve arm at the NTU), Post AVG (NTU), RES (NTU) Flow rate (L/sec)