



DRINKING WATER QUALITY MANAGEMENT PLAN

SPID 558

Version 4.1

2022

DOUGLAS SHIRE
COUNCIL

Celebrating Our Communities

Nganamu Bubu Kunbul - Eastern Kuku Yalanji

Nganyji Paman-ku Manyjirri-l - Yirrganydji

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TABLE OF CONTENTS

Executive Summary 1

Glossary..... 2

Introduction 3

Element 1: Commitment to drinking water quality 5

Element 2: Assessment of the water supply system..... 10

Element 3: Preventive measures for drinking water quality management – Critical control points 41

Element 4: Operational procedures and process control..... 42

Element 5: Verification of drinking water quality..... 43

Element 6: Incident and emergency response..... 51

Element 7: Employee awareness and training 62

Element 8: Community involvement and awareness 62

Element 9: Research and development 63

Element 10: Documentation and reporting..... 63

Element 11: Evaluation and audit..... 66

Element 12: Review and continual improvement 69

Appendix A – Water Quality Data 2014-2022..... 71

Appendix B – Daintree Bore Details..... 76

Drinking Water Quality Management Plan

EXECUTIVE SUMMARY

The Drinking Water Quality Management Plan (DWQMP) for Douglas Shire Council is a public health-based risk management plan that meets the requirements of the Australian Drinking Water Guidelines 2016 (ADWG) and the Water Supply (Safety and Reliability) Act 2008.

The DWQMP describes the Mossman Port Douglas, Whyanbeel and Daintree drinking water schemes operated by Council from catchment to tap.

Council has undertaken a system assessment and a public health risk assessment. Through the risk assessment process, Council has identified several risks to our drinking water schemes that require improvements over time. These are detailed in the risk assessment table, and in the risk management improvement plan.

Council intends to use the risk management improvement program to inform capital and operational budgets in coming financial years.

Critical items that have been identified that require attention include:

- Connecting Cooya Beach Reservoirs, re-chlorination and pipework to the network
- Mossman alternative intake
- Implementation of smart water metering
- Investigating chlorination options for workplace health and safety reasons
- Upgrading security and disaster response at water treatment infrastructure

GLOSSARY

ADWG	Australian Drinking Water Guidelines
CCP	Critical control point
CEB	Chemically enhanced backwash
CIP	Clean in place
DBPs	Disinfection by-products (including trihalomethanes)
DWQMP	Drinking Water Quality Management Plan
LDMP	Local Disaster Management Plan (Douglas Shire Council)
OCP	Operational control point
PDT	Pressure decay test
PH Act	Public Health Act 2005
PHU	Public Health Unit – Queensland Health
PRV	Pressure relief valve
QH	Queensland Health
THM	Trihalomethanes – a subset of possible disinfection by-products
UF	Ultrafiltration
UV	Ultraviolet
The Act	Water Supply (Safety and Reliability) Act 2008
WPR	Water Planning and Regulation, Department of Regional Development, Manufacturing and Water



Figure 1. Whyanbeel intake

INTRODUCTION

Douglas Shire Council provides drinking water to customers in three drinking water schemes. The Douglas Shire Drinking Water Quality Management Plan (DWQMP) is a risk-based management plan that ensures that Council can provide all our customers in each of these schemes with safe drinking water.

The DWQMP is based on the principles of the Australian Drinking Water Guidelines 6 (NHMRC V3.7 2022) and meets the regulatory requirements of the *Water Supply (Safety and Reliability) Act 2008* (WS Act).

Purpose of DWQMP

The Douglas Shire Council DWQMP is a public health-based risk management plan that demonstrates how public health risks to our services are managed. In addition, we describe how we meet the requirements of our Environmental Authority for the Mossman water treatment plant under the *Environmental Protection Act 1994* and our water licences under the *Water Act 2000*.

Registered service details

Douglas Shire Council is a registered water service provider, SPID 558, providing drinking water services to ~15,000 customers. Council supplies water to four separate schemes, of which three are potable

drinking water services covered in this DWQMP. All three schemes are similar in their operation. All potable schemes source water from highly protected catchments, utilising a combination of membrane filtration and chlorination, with the ability to use supplemental UV disinfection.

Customers supplied non-potable water (Dagmar Heights and Daintree untreated) are sent written notification regarding water use by Council annually and are rated differently.

Table 1. Drinking water schemes, populations, and demand

Scheme name	Intake	Population Served	Current**		Projected in 10 years		
			Total connected properties	Demand ML/annum	Population served	Total connected properties	Demand ML/annum
Daintree	Intake Creek, Daintree Bore, (Daintree Rainwater)	90	49	12.6	99	54	13.9
Daintree (untreated)*	Intake Creek	12	5	0.3	12	5	0.3
Mossman and Port Douglas	Rex Creek	13319	6396	3880.7	14712	7065	4286.7
Whyanbeel	Little Falls Creek	1684	749	309.7	1860	827	342.1
Dagmar Heights*	Dagmar Bore	30	13	3.7	33	14	4.1
TOTAL		15135	7212	4207	16716	7965	4647.1

**Data as reported in KPI report 2020/21

ELEMENT 1: COMMITMENT TO DRINKING WATER QUALITY

Policy

Council is committed to consistently providing our customers within the drinking water schemes with a safe and reliable drinking water supply.

DRINKING WATER QUALITY GENERAL POLICY

INTENT

To establish a policy for the implementation and maintenance of a Drinking Water Quality Management System that is consistent with the Australian Drinking Water Guidelines.

SCOPE

This policy applies to all Water and Wastewater activities associated with the supply of drinking water to the community.

PROVISIONS

The Drinking Water Quality Management System will utilise a risk-based “catchment to tap” approach to identify and manage potential risks associated with drinking water quality.

To achieve this, in partnership with stakeholders and relevant agencies, Water and Wastewater will:

- Consider the needs and expectations of our customers, stakeholders, regulators and employees and integrate appropriate solutions into our planning to provide and maintain safe water supplies.
- Undertake regular monitoring of drinking water quality and maintain effective reporting mechanisms to provide relevant and timely information and promote confidence in the management of the water supply systems.
- Have in place appropriate contingency plans and incident response capabilities to respond to and manage water quality incidents.
- Audit and review our practices against industry standards and stakeholder expectations to continually improve our performance.
- Provide training to all relevant employees to ensure that they are aware of this policy and are involved in the implementation of our Drinking Water Quality Management System.
- Openly communicate this policy to the community to encourage public awareness.

This policy assigns responsibility for drinking water quality management to all Water and Wastewater employees and acknowledges that corporate responsibility lies with the Water and Wastewater Management and ultimately the Douglas Shire Council, Chief Executive Officer.

Regulatory and formal requirements

The following table lists the regulatory requirements that Douglas Shire Council is required to meet about the management of drinking water.

Table 2. Regulatory register

Requirement	Council obligations and how they relate to the DWQMP
Water Supply (Safety and Reliability) Act 2008	Council registered as a service provider. Service provider given powers to do certain things (e.g., disconnect customers, restrictions). Required to have an approved DWQMP and comply with the DWQMP.
Water Supply (Safety and Reliability) Regulation 2011	Required to report and respond to drinking water incidents. Plumbers are required to install water meters. Regulation currently has no impact.
Public Health Act 2005	Sets minimum sampling frequencies for <i>E. coli</i> as a provider. Council must not provide unsafe water.
Public Health Regulation 2018	
Water Act 2000	Council is licenced to extract raw water. + Rex Creek – Licence #408436 + Little Falls Creek – Licence #500313 + Daintree – Licence #408446
Environment Protection Act 1994	Water treatment is considered an environmentally relevant activity when treating >10 ML/day. General obligation not to cause environmental harm. + EA Permit number EPPR01790513. DSC Ref #868568 + Whyanbeel Development application and ERA. DSC Ref #729267 + Daintree Development application. DSC Ref #729268
Disaster Management Act 2003	Council is required to have a disaster management plan. This plan links to the Emergency Plan in this document.
Work Health and Safety Act 2011	Council must ensure safe work practices, including in the provision of drinking water.
Plumbing and Drainage Act (2018)	Council must ensure that water infrastructure work is at a particular standard. Requires plumbers to install water meters (transitional arrangements for 18 months from July 2015).
Plumbing and Drainage Regulation (2019)	
Qld Plumbing and Wastewater Code (QPW code)	The code defines how drinking water infrastructure can be constructed.
Plumbing Code of Australia	Provides additional information to QPW code.
Australian Standards	Numerous standards for plumbing, chemical handling, etc.
Wet Tropics World Heritage Protection and Management Act 1993	Water infrastructure, which is located within Wet Tropics of Queensland World Heritage Area, is maintained within Wet Tropics Permit.

Customer and stakeholder engagement

Douglas Shire Council has established customer service standards against which we are able to measure our performance. The most current version of these standards is available on our website at <http://douglas.qld.gov.au/>

In addition, when there are issues of community concern, Council undertakes community meetings to ensure that relevant information is made available.

Key stakeholders

Drinking water is managed in Douglas Shire Council by the Manager Water and Wastewater.

The following chart identifies the key internal stakeholders from within the water and wastewater group. This chart is updated by Council as required and will be updated in the DWQMP, either if there is a significant change in the structure or following the biannual review of the DWQMP.

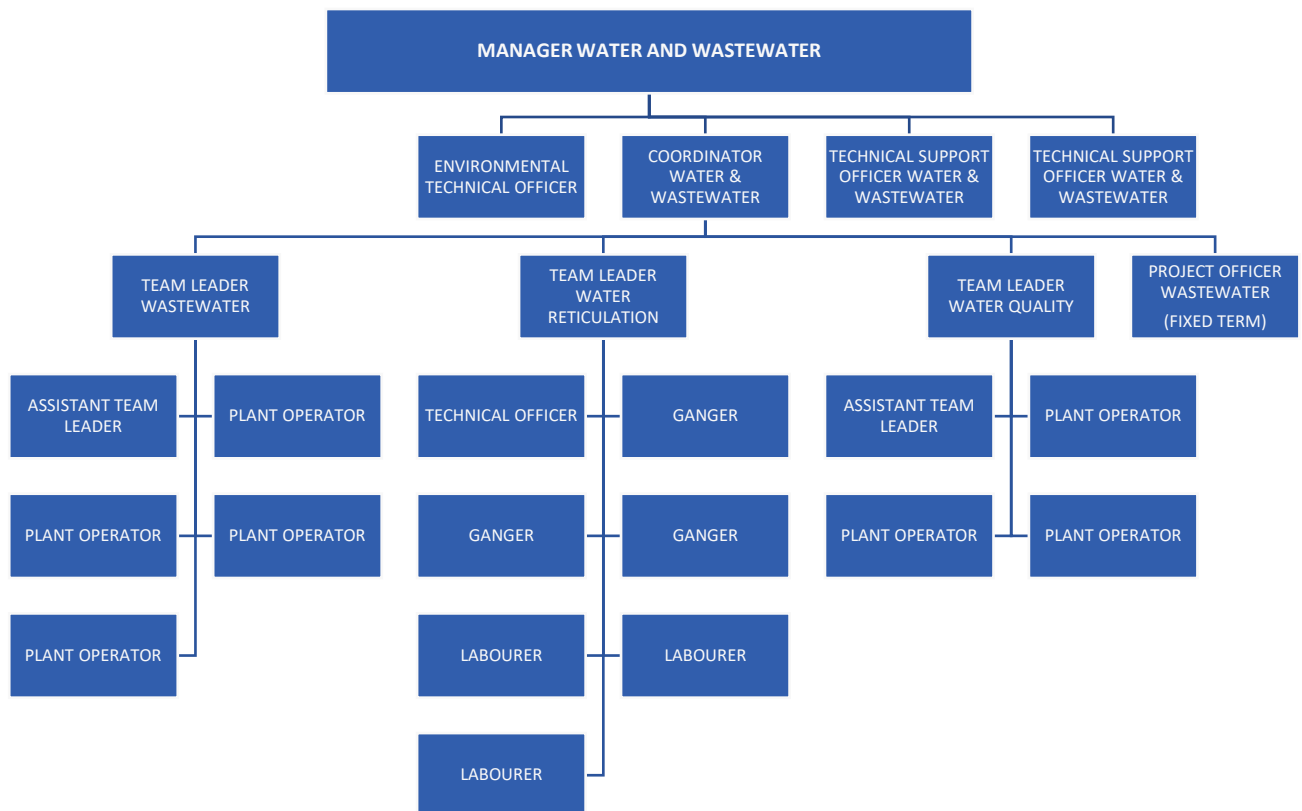


Figure 2. Water and wastewater corporate structure

External stakeholders are identified in the table below. These stakeholders have some influence on the management and operation of the water services.

Table 3. External stakeholders

Regulatory Stakeholder	Contact Details	Role
Water Supply Regulation (Regulator)	1300 596 709	Regulation of drinking water, and incident reporting
Tropical Public Health Services Cairns (Queensland Health)	4226 5555	Public health advice, assistance managing incidents
Dept of Natural Resources, Mines and Energy	13 QGOV (13 74 68)	Water quality and flow monitoring
Dept of Environment and Science	13 QGOV (13 74 68)	Water treatment is ERA. Discharge licences etc.
Wet Tropics Management Authority	07 4241 0500	Catchment manager
Ozcare	07 4087 2800	High Risk Customers
Blue Care Mossman Community Care	07 4098 1126	High Risk Customers
Douglas Shire Aged Persons Home Inc.	07 4098 8233	High Risk Customers
Douglas Shire Meals on Wheels	07 4098 1105	High Risk Customers
Mossman Multi-Purpose Health Service (Hospital)	07 4084 1200	High Risk Customers
Apunipima Cape York Health Council - Mossman Gorge Primary Health Care Centre	07 4037 7100	High Risk Customers
Bubu Bamanga Ngadimunku	07 4098 1305	Vulnerable Population Customers
C&K Mossman Community Kindergarten	07 4098 1880	Vulnerable Population Customers
C&K Port Douglas Kindergarten	07 4098 5811	Vulnerable Population Customers
Mossman Medical Centre	07 4098 1248	Vulnerable Population Customers
Port Village Medical Centre	07 4099 5043	Vulnerable Population Customers
Port Douglas Medical Centre	07 4099 5276	Vulnerable Population Customers
New Horizons for Health	07 4099 1111	Vulnerable Population Customers
Daintree State School	07 4098 6135	Vulnerable Population Customers
Goobidi Bamanga CACs Ltd	07 4098 1283	Vulnerable Population Customers
Goobidi Bamanga OSHC	07 4098 3030	Vulnerable Population Customers

Drinking Water Quality Management Plan

SPID 558

Regulatory Stakeholder	Contact Details	Role
Goodstart Early Learning Mossman	07 4098 2044	Vulnerable Population Customers
Miallo State School	07 4098 8130	Vulnerable Population Customers
Mossman State High School	07 4084 1333	Vulnerable Population Customers
Mossman State School	07 4099 9333	Vulnerable Population Customers
Petit Early Learning Journey - Port Douglas	07 4237 8802	Vulnerable Population Customers
Port Douglas State School	07 4084 3222	Vulnerable Population Customers
Port Explorers Port Douglas	07 4099 3392	Vulnerable Population Customers
Port Explorers OSHC Port Douglas State School	07 4098 5793	Vulnerable Population Customers
Port Explorers Cooya Beach	07 4098 3444	Vulnerable Population Customers
St Augustine's Primary School	07 4098 1631	Vulnerable Population Customers
Enhance (Tropical North) Family Day Care	07 4098 1831	Vulnerable Population Customers
Wonga Beach State School	07 4099 9777	Vulnerable Population Customers
Big 4 Port Douglas Glengarry Holiday Park	07 4098 5922	Large Population Resort
Mossman & Wonga Caravan Park (Council-owned)	07 4099 9418	Large Population Resort
Coconut Grove Apartments Port Douglas	07 4099 0600	Large Population Resort
Mandalay Luxury Beachfront Apartments	07 4099 0100	Large Population Resort
Oaks Resort Port Douglas	07 4099 8900	Large Population Resort
Peppers Beach Club Port Douglas	07 4087 1000	Large Population Resort
Pool Port Douglas	07 4084 3400	Large Population Resort
Port Douglas Outrigger Holiday Apartments	07 4099 5662	Large Population Resort
Pullman Port Douglas Sea Temple Resort & Spa	07 4084 3500	Large Population Resort
Ramada Resort Port Douglas	07 4030 4333	Large Population Resort
Rendezvous Reef Resort	07 4087 2790	Large Population Resort
Sheraton Grand Mirage Resort	07 4099 5888	Large Population Resort
Silkari Lagoons Port Douglas	07 4030 4666	Large Population Resort
Tourism Port Douglas & Daintree (TPDD)	07 4099 4588	Tourism Industry Contact
Douglas Chamber of Commerce	<i>via email</i>	Business Industry Contact
Bligh Tanner	07 3251 8509	Water Engineering, Risk Management, DWQMP preparation, Incident investigation, Review and Audits.
Cairns Regional Council Laboratory Services	1300 692 247	Verification sampling
Orica (Ixom)	0478 401 092	Chlorine Gas
Elite chemicals	07 4035 5699	Sodium hypochlorite, Citric acid, caustic soda.

Regulatory Stakeholder	Contact Details	Role
KSB	0429 006 895	Pumps
ABB	07 3713 9007	Online Instruments
SGS	1300 781 744	Verification sampling
Siemens	07 3332 8326	Online Instruments
Welcon Technologies	07 4976 0600	SCADA and PLC support

We liaise with these stakeholders as necessary, for example, we may contact these customers individually in the event of implementing “boil water” or “do not drink” alerts.

Customer complaints

Douglas Shire Council takes customer complaints seriously as they can provide advance warning of issues within the water network that may not yet be apparent and may alert us to environmental issues.

All customer complaints received by Council are recorded and investigated, with the officer assigned and the results of the investigation included in the record. These records are reviewed monthly by the Coordinator Water and Wastewater. Customer complaints are reported to the Regulator annually as required under the key performance indicator reporting.

ELEMENT 2: ASSESSMENT OF THE WATER SUPPLY SYSTEM

Catchment characterisation

Raw water for all the Douglas Shire Council schemes is sourced from remote intakes in rugged weathered granitic terrain, located in the Wet Tropics World Heritage Rainforest. The catchments have specific Wet Tropics legislation that defines what can be done within the catchment. As a result, there is very limited potential for any human activity within the catchment area for any of the intakes, and the catchments can therefore be considered highly protected, and at low risk of containing human pathogens than typical water sources.

There is a prevalence of native and feral wildlife in these catchments, so microbiological hazards are the most significant for our services. During the wet season, there are regular “high turbidity” events (> 50 NTU), but these are normally short lived. There is minimal to no risk of pesticides, heavy metals or other hazards in these catchments.

The locations of the water treatment plant intakes are indicated in Figure 3, demonstrating the protected nature of these catchments.

Rainfall

Rainfall in the wet tropics is typically concentrated from November to May. The rainfall averages in Figure 4 are for Port Douglas, which has the longest record, but data from Daintree, Whyanbeel and Mossman indicates a very similar pattern.

As the Whyanbeel and Daintree schemes are small with relatively low water volumes extracted, there have been no occasions when raw water volumes from Little Falls Creek or Intake Creek were unavailable. As such these schemes are considered 100% reliable. A bore pump and rainwater system have been added to the Daintree Scheme. The bore pump was installed to provide a supplementary supply of raw water to the existing raw water treatment tank at the WTP, in the event the existing intake at Intake Creek goes offline during the wet season or the flow at Intake Creek reduces below the licenced extraction limits. The rainwater system is designed to collect run-off from the Daintree Water Treatment Plant roof via guttering and feed directly into the raw water supply prior to the treatment process during rainfall events.

The Mossman/Port Douglas scheme has a much higher demand, and there have been occasions in October/November when water supply from Rex Creek becomes less reliable. Whilst we have not run out of water, Douglas Shire Council must also meet its *Water Act 2000* obligations and is obliged to maintain an environmental flow in Rex Creek per the conditions of the water licence (licence #408436). Water restrictions are regularly imposed during September, October, and November. Douglas Shire Council is currently looking to construct an intake on the Mossman River to access the additional 2,000 ML/a strategic reserve set aside in the ROP for town water supply purposes to supplement the supply for the Mossman/Port Douglas scheme.

The water quality coming from these catchments is very good. However, due to the nature of rainfall in these catchments which can be very intense, turbidity can increase from the normal values of <1 NTU to over 50 NTU, but these events are usually short-lived. At times, the raw water pH can drop below 6.5, and has been observed to be as low as 6.2. This has no impact on water treatment and improves our disinfection process. There are no other water quality issues that have been identified.

Historically, these schemes were raw water, and then were operated as UF/UV schemes. There are sometimes customer complaints related to chlorine. We investigate these complaints, but as the WTP target dose rate is typically ~1-1.5 mg/L, we do not normally need to take any further action.



Figure 3. Location of intakes for the Douglas Shire Council water schemes

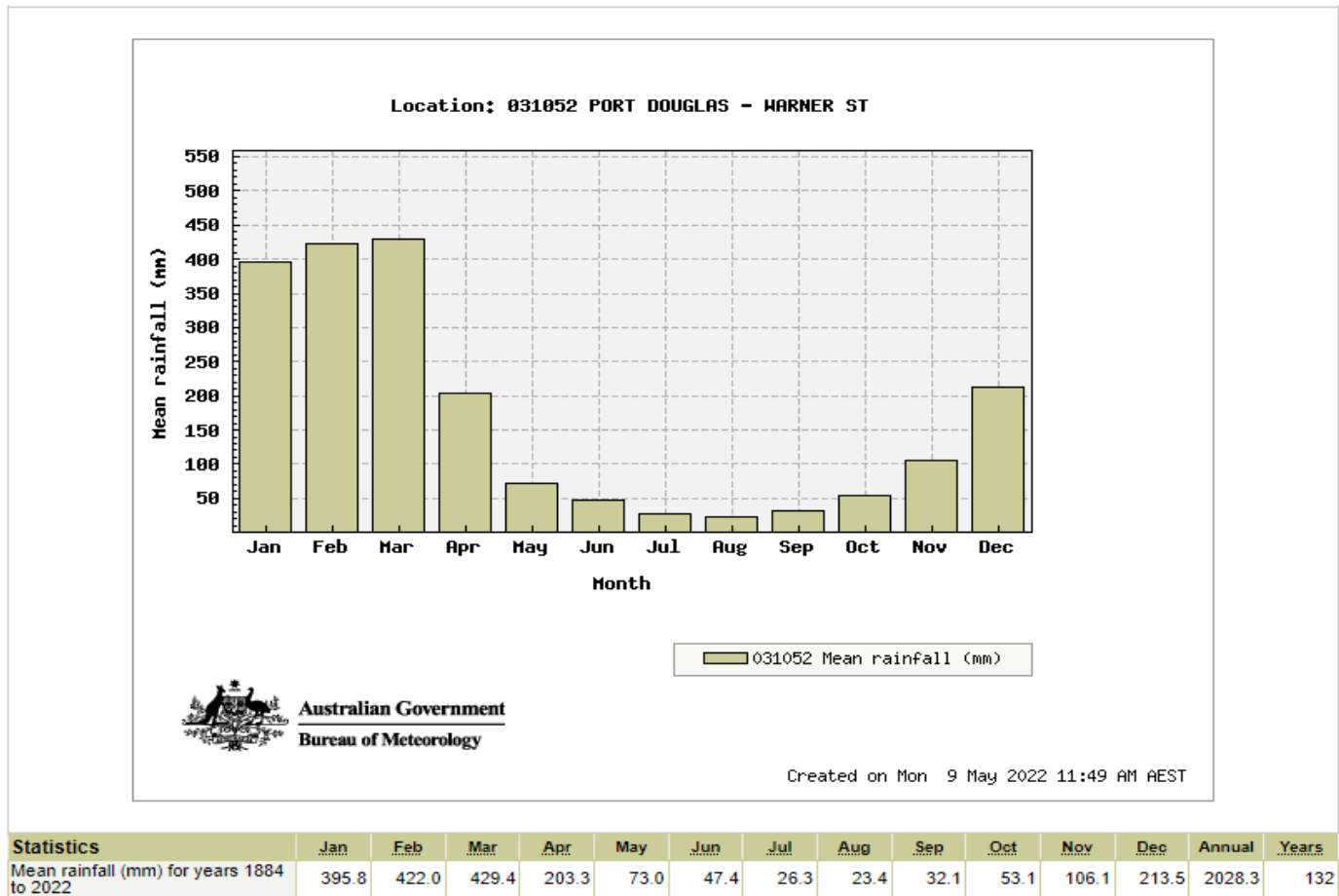


Figure 4. Rainfall data Port Douglas

Treatment overview

Mossman, Whyanbeel and Daintree Water Treatment Plants treat water from Rex Creek, Little Falls Creek and Intake Creek respectively. All treatment plants have the following process steps:

- Johnson screen
- 200-micron pre-filter
- Ultrafiltration (caustic soda and sodium hypochlorite and citric acid used in cleaning)
- Chlorination (using 1 or more of sodium hypochlorite, calcium hypochlorite and/or gas chlorination)
- The Whyanbeel WTP has a sodium carbonate pH adjustment step as the chlorine gas resulted in lower pH readings. Similar dosing may be required in the future at the Mossman WTP.

Reticulation overview

The reticulation networks for each of the three water supply schemes are ageing, have limited storage capacity and some long reticulation distances to rural areas. The length of the network and ageing infrastructure increases pH and results in reduced disinfection residual levels (or pH levels where only the hypochlorite ion is present, making disinfection less effective against ingress). Water quality testing of the reticulation network and reservoirs are conducted regularly to ensure adequate chlorination of the network.

All available data regarding asset age, type and make is available in the Authority Asset Register and is also accessible to all staff using the MapInfo Interface corporate mapping software.

Network maintenance is tracked and fed into the asset management documentation for these assets.

There are relatively high proportions of asbestos cement mains, which are slowly being phased out of the system where possible through general maintenance, emergency works, or if works are conducted and the main is identified as in need of repair. A camera, where possible, is passed up the main to look further at the condition. The actual age of many of the cast iron pipes is unknown as they were all been assigned a generic date of installation when the asset system was first started.

Mossman – Port Douglas drinking water scheme

The Mossman water treatment plant is a 30 ML/day design treatment plant, with a daily production average of 11.6 ML/day. The schematic, including bypasses is included in Figure 5. Opening bypass valves requires manual intervention, and none of these options are used in normal operation.

The water treatment plant is designed with the relevant development approval and environmental authorities in mind, such as ensuring that chemicals are appropriately banded, and stormwater cannot be contaminated by activities on site.

Intake

The Mossman water treatment plant source is located on Rex Creek.

The intake channel has been built into the rock bed, and it diverts raw water flow to a series of Johnson screens. The Johnson screens offer initial coarse filtering of the raw water prior to the raw water entering the raw water pipeline and remove solids (generally sand and leaf matter) more than 1 mm in diameter. The screens are designed to be self-cleaning but are inspected three times per week, 52 weeks per year and cleaned as required.

The water licence for Rex Creek has a nominal entitlement of 4,800 ML/year. There are maximum extraction limits based on flow. These limits are listed in the raw water operational procedure and additionally are programmed into SCADA.

Screened water feeds 6 km by gravity to the WTP through two raw water mains. The available head is more than sufficient to provide water pressure feed to operate the ultrafiltration membranes.

Turbidity is measured immediately prior to the Johnson screens and a second turbidity meter is located on the raw water main at Marrs Creek, just prior to entry into the WTP. A third meter is located at the WTP. Any of the three turbidity meters can be selected for duty to control shutdown of the WTP in the event of high turbidity.

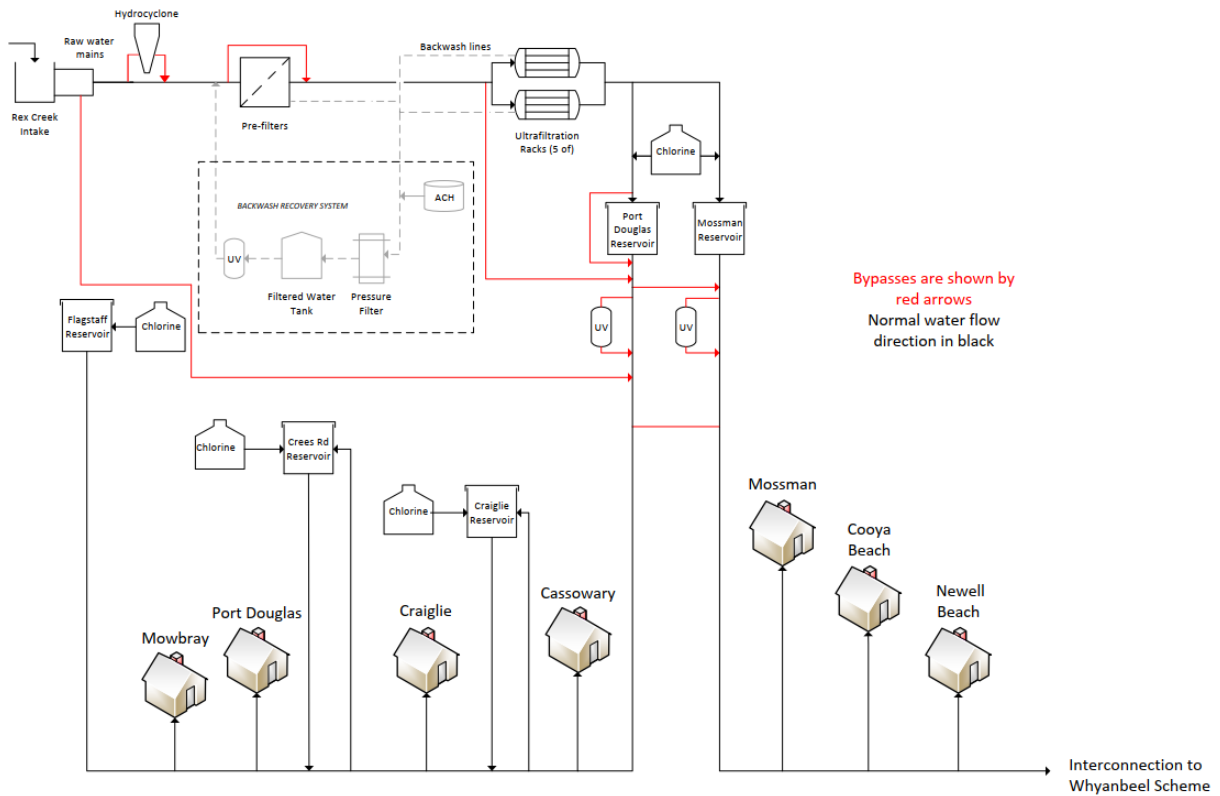


Figure 5. Catchment to tap schematic

The operational limit for raw water turbidity at the Mossman WTP is 30 NTU. Any higher than this and the plant is shut down and Team Leader authorisation is required to restart water production. The target turbidity is <20 NTU. The water treatment plant can operate at higher turbidity, e.g. in extended periods of high demand if necessary, but this comes at the expense of membrane life and increases the frequency of cleaning.

It is possible to bypass the Mossman WTP and provide raw water directly to the community. This was the original configuration of this scheme, but it is not intended to be used into the future.



Figure 6. Rex Creek intake – race is lined with stainless steel

Hydrocyclone and pre-filtration

Raw water is filtered to 200 microns through four pre-filters. The pre-filters provide a duty/ standby operation and are designed to provide raw water flow to meet 100% of the treatment plant design capacity. During high turbidity events, water is additionally passed through a hydrocyclone to remove sand. During normal operations, the hydrocyclone is bypassed.

The pre-filters are cleaned by automated backwashing using raw water (typically every 60 minutes depending on raw water turbidity). As no chemicals are used, backwash water is discharged directly to the water course. The pre-filters are removed and inspected to assess serviceability once every 12 months. It is possible to bypass the pre-filters at Mossman.

Ultrafiltration

The Mossman treatment plant uses five racks of 52 Koch polysulfone ultrafiltration membranes per rack. The membranes have a nominal size cut-off of 100,000 Daltons.

The ultrafiltration process is fully automated and includes its own main control panel which operates UF inlet/outlet valves, recirculation pumps, backwash supply pumps, a chemically-enhanced-backwash (CEB), and clean-in-place (CIP) system including chemical dosing equipment. Critical process equipment is installed with a duty/standby capacity to minimise disruptions to the water treatment process.

Operation and monitoring of the ultrafiltration treatment plants is via a PLC/SCADA system with a Citect user interface for process operation, monitoring, and alarming functions.

The cleaning of the cartridges is via an automated backwashing sequence that utilises water-only backwashing (typical frequency of 60 minutes) and CEBs with a minimum ratio of one CEB to twelve backwashes in total. The frequency of backwashing and the ratio of CEBs to water-only backwashes may be varied and is determined by the operator by observing trending values of the trans-membrane pressure (TMP) in relation to production flow set points and raw water inflow turbidity.

Currently, CEBs are programmed automatically in SCADA to occur 1 in every 12 backwash cycles. This changes operationally to maintain membrane performance.

Chemically enhanced backwashing utilises a caustic/chlorine cleaning solution which is introduced to the membrane cartridges at a pre-determined concentration, typically pH 10 and concentration of chlorine at 60 mg/L. The cartridges are allowed to soak in this solution for 400 seconds. Effectiveness of the backwashing sequence is continually monitored, and all associated parameters are recorded for reporting and operational planning purposes. CEB backwash water is directed to the sewer. Following backwashes, the membranes are rinsed prior to coming back into service.

A CIP utilises a heated cleaning solution of either citric acid pH 4 solution caustic (max pH 12) or a combined caustic/chlorine solution (pH 12, 200 mg/L). These are used to remove both organic and inorganic fouling. A CIP is typically undertaken on each rack once per month.

At the completion of a CIP the UF rack is backwashed, rinsed and tested to ensure all traces of chemicals are removed prior to placing the UF rack back into service. Testing is performed on the UF rack by means of sampling the retentate and permeate header water and conducting in house lab testing for pH and free chlorine levels. Test limit results for free chlorine <0.1 mg/L and a pH result equivalent to the raw water pH value (typically 6.5 to 7.5) must be achieved prior to placing the UF rack back into service. Additional rinse cycles can be performed to ensure test results are within defined limits.



Figure 7. UF membrane rack at Mossman/Port Douglas WTP

Backwash recovery

Pre-filter and UF water-only backwashes are recycled through backwash recovery plant and fed back into the head of works to minimise water losses across the treatment process. The backwash recovery plant is a direct filtration plant that utilises 3-5 mg/L aluminium chloralhydrate (ACH) for coagulation, pressurised sand filtration to typically <1 NTU and disinfection by UV, specified at 2-log *Cryptosporidium* reduction at 55% UVT (34.8 MJ/cm²). By utilising the backwash recovery plant, approximately 1 ML of water is recovered daily that would otherwise be lost to waste.

Membrane integrity – direct testing

Membrane integrity is evaluated every 24 hours (of elapsed production time) by undertaking an automated pressure decay test (PDT). The pressure decay test measures whether there are any breaches of the membrane greater than three microns in size. Membrane integrity is considered as a critical control point for managing the protozoa risk, and the CCP procedure, relevant to all schemes, is presented in a later section. If the UF rack fails, the integrity check it is immediately and automatically taken offline for inspection and repair.

Trending data and outcomes of the integrity check cycle are monitored to pre-determine UF cartridge maintenance/repair intervals allowing UF racks to be removed from service and repaired to avoid unexpected shutdowns on account of integrity check failure.

Nonetheless, there is sufficient production capacity of treated water that under normal demand two racks can remain offline until repaired.

Membrane integrity – indirect testing.

The permeate turbidity is monitored using individual filter rack permeate turbidity meters capable of 0.001 NTU resolution.

Where the permeate turbidity exceeds 0.15 NTU on any rack for over 15 minutes, the affected UF rack is taken offline and undergoes a PDT to determine if there is a breach of the membranes, as per the relevant CCP procedure.

The ultrafiltration racks can be bypassed – but this would not be used except in emergency situations. Permeate is directed to the clearwater reservoirs.

Chlorination

All disinfection points are operated as per the Chlorination (Primary and Re-dosing) CCP procedure. Disinfection is achieved through gas chlorination using two 920 kg chlorine gas drums as duty standby, with automated change over operation. The system uses a vacuum chlorine gas draw off injector disinfection system to chlorinate the Mossman 1.8 ML and Port Douglas 5 ML reservoirs. Current operation uses a recirculation system on each of the treated water reservoirs with a set point control mode of operation.

The target, action and critical limits for chlorine are stated in the CCP. Two critical limits ensure effective disinfection (low side) and prevent exceedances of the chemical health guideline value (high side). It is possible to bypass chlorination. This is not used under normal operation.

(Ultraviolet disinfection)

The UV units are a redundant system that are not currently operational but physically remain - they are still included on the schematic until they are physically no longer present.

Reticulation

Water is reticulated under gravity to Mossman / Port Douglas water scheme. Network maps showing sampling locations are included under Element 5. The reticulation network has the following materials and age ranges.

Table 4. Mossman/Port Douglas treated water reticulation

Scheme	Total Length (km)	% of total	Length (km)	Material	Age Range
Mossman/ Port Douglas	195	51.74	101.1	AC	1960-1989
		22.94	44.8	PVC	1940-2022
		12.62	24.7	DICL	1940-2022
		9.15	17.9	HDPE	1960-2022
		1.83	3.6	CI	1960
		1.58	3.1	DI	1960
		0.02	0.04	GI	unknown
		0.02	0.04	MSCL	unknown

The pipe material code is as follows:

AC: Asbestos Cement, CI: Cast Iron, DICL: Ductile Iron Cement Lined, GI: Galvanised Iron, MSCL: Mild Steel Cement Lined, PE: Polyethylene, PVC: Polyvinylchloride

There are two reservoirs located at the Mossman water treatment plant: the Port Douglas and Mossman reservoirs. There are two Cooya reservoirs, but these are currently not in use. It is intended to commission these reservoirs in the future. There are three reservoirs that service Port Douglas: Crees Road reservoir, the Craiglie reservoir (Hope St) and Flagstaff reservoir.

The Crees Rd, Craiglie and Flagstaff reservoirs are utilised to provide additional storage capacity for the Port Douglas scheme. All three reservoirs can be gravity fed from the Mossman WTP, but Flagstaff reservoir can additionally be fed from the Craiglie reservoir pump station or Port Douglas pump station. Outflow from the Craiglie reservoir is by the way of two pumps in a duty/standby arrangement. Outflow from the Crees Rd reservoir is gravity fed. All three reservoirs are roofed and have vermin proofing. Other operational reservoirs are in reasonable to good condition, but the vermin proofing on all reservoirs will nonetheless be sequentially and comprehensively assessed and ensured. In the case of Cassowary and Mowbray, these reservoirs are offline as their condition is poor. They will not be brought online until they are rehabilitated.

There are no areas of low pressure within the scheme, but the distribution network to Newell Beach, Cooya Beach and the extremities of the network to Cassowary and Mowbray, have relatively long detention times.

The Mossman/Port Douglas scheme and the Whyanbeel Scheme are interconnected to provide supply security to either system.

Table 5. Mossman/Port Douglas treated water reticulation

Reservoir	Capacity (ML)	Status	Material	Roofed	Vermin Proof	(Re) chlorination	Alarms
Mossman Clearwater	1.8	Active	Concrete	Y	Y	Y	Chlorine high and low level. Reservoir level.
Port Douglas Clearwater	5	Active	Concrete	Y	Y	Y	Chlorine high and low level. Reservoir level.
Cooya Beach	2	Offline	Concrete	Y	Y	N	
Cassowary	0.1	Offline	Zinc Anneal	Y	N	N	
Craiglie	10.1	Active	Concrete	Y	Y	Y	Chlorine high and low level. Reservoir level, pressure alarms for pumps, flow rate.
Flagstaff Two Reservoir	2.2	Active	Concrete	Y	Y	Y	Chlorine high and low level. Reservoir level, pressure alarms for pumps, flow rate.
Mowbray	0.125	Offline	Concrete	Y	N	N	Reservoir level
Crees Road	20	Active	Concrete	Y	Y	Y	Chlorine high and low level. Reservoir level.

Redosing

The Crees Rd, Craiglie and Flagstaff reservoirs are rechlorinated. Current upgrade of the Craiglie reservoir includes changing to an electro-chlorination redosing system. The Crees Road reservoir re-

doses with chlorine gas (two 920 kg cylinders) . The Flagstaff reservoirs has calcium hypochlorite eroders. All chlorination systems are operated within the CCP procedure set points. Future projects include a chlorination review to reduce workplace health and safety risks associated with gas chlorination.

Whyanbeel drinking water scheme

The Whyanbeel water treatment plant is a 4.7 ML/day design treatment plant, with an average flow of 900 kL/day. As the WTP capacity is <5 ML/day it is not considered an environmentally relevant activity.

Intake

The Whyanbeel intake is located on Little Falls Creek.

The intake channel has been built into the rock bed, and it diverts raw water flow to a series of Johnson screens. The Johnson screens offer initial coarse filtering of the raw water, prior to it entering the pipeline, removing all solids (generally sand and leaf matter) more than 1 mm in diameter. The screens are designed to be self-cleaning but are inspected three times per week, 52 weeks per year and cleaned as required.

Screened raw water gravity feeds (0.5 km) to the WTP through two raw water mains. At the WTP, two raw water booster pumps (duty/ standby) pump water to the ultrafiltration membranes.

Turbidity is measured using an online turbidity meter which is located at the WTP and provides the control turbidity for WTP shutdown. Operationally, the Whyanbeel WTP shuts down when raw water turbidity exceeds 5 NTU. The water treatment plant can operate at a higher turbidity (for example in extended periods of high demand) if necessary, but this comes at the expense of membrane life and increases the frequency of cleaning. As there is sufficient treated water supply, there is generally no need to operate outside this level.

The water licence for Little Falls Creek provides for an annual allocation of 630 ML. It is possible to bypass the Whyanbeel WTP and provide raw water directly to the community. This was the original configuration of this scheme, but it is not intended to be used into the future.

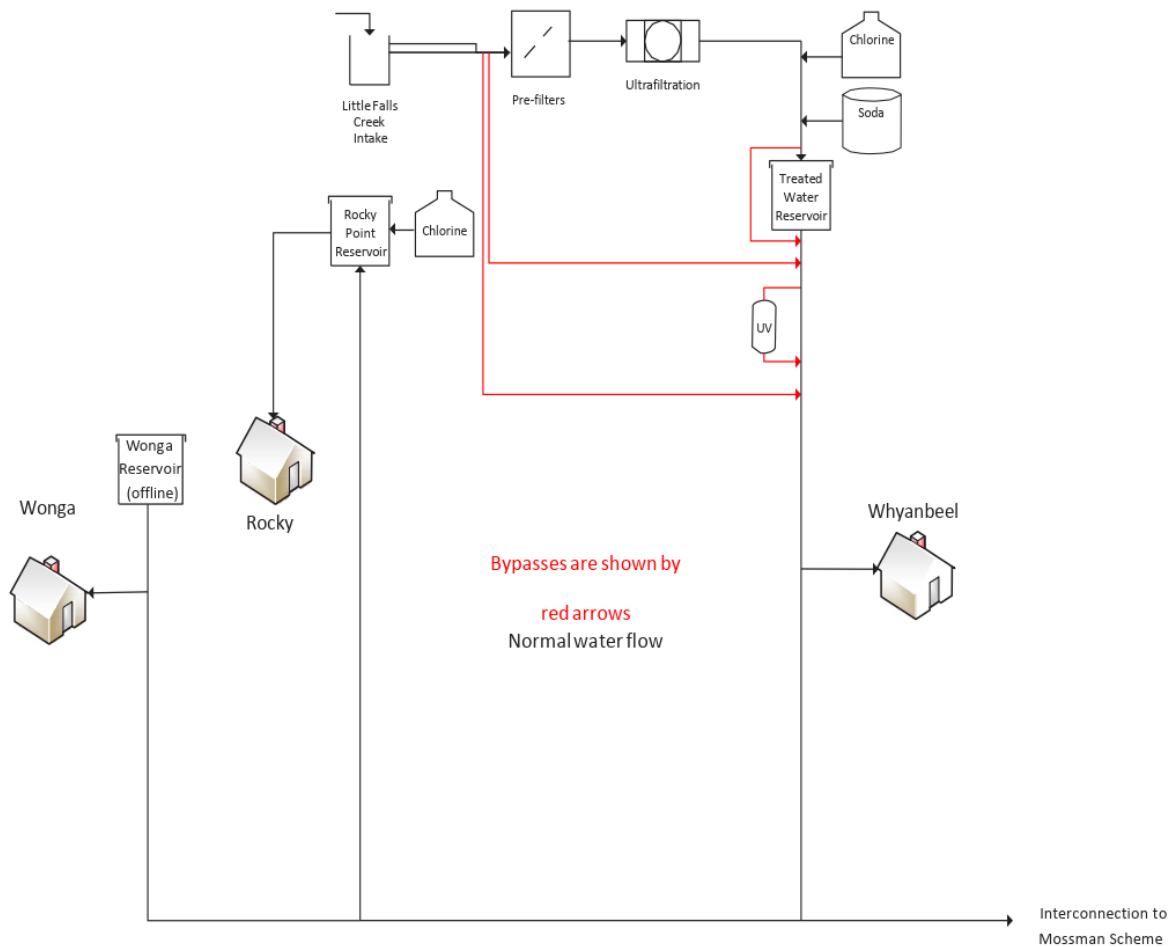


Figure 8. Whyanbeel WTP schematic

Pre-filtration

Pre-filters are operated in the same manner as described for Mossman WTP. It is not possible to bypass the pre-filters at Whyanbeel.

Ultrafiltration

The treatment plant uses one rack of 36 Koch polysulfone ultrafiltration membrane cartridges with a nominal size cut-off of 100,000 Daltons.

The ultrafiltration process at Whyanbeel WTP is identical to the Mossman WTP with the exception that the single rack and greater storage volume of treated water allow the plant to operate with a raw water turbidity cut-off of 5 NTU rather than 30 NTU.

Environmental discharge

Whilst the Whyanbeel WTP is not an environmentally relevant activity, Douglas Shire Council still has an obligation not to cause general environmental harm. As such, we ensure that only uncontaminated pre-filter backwash, and water only backwash water is discharged to the creek. CEB and CIP waters are stored onsite and transported by trucks to Port Douglas under a trade waste approval.

Membrane integrity – direct testing

Membrane integrity is evaluated every 24 hours in accordance with the CCP procedure. If the UF rack fails, the integrity check it is immediately taken offline for inspection and repair.

Trending data and outcomes of the integrity check cycle are monitored to pre-determine UF cartridge maintenance/repair intervals allowing preventive maintenance to occur as appropriate. Nonetheless, there is sufficient production and storage capacity of treated water that the rack can normally remain offline until it is repaired.

Membrane integrity – indirect testing

The permeate turbidity is monitored and managed in accordance with the CCP procedure. Where the permeate turbidity exceeds 0.15 NTU for over 15 minutes, the UF rack is taken offline and undergoes a PDT to determine if there is a breach of the membranes.

The ultrafiltration rack can be bypassed – but this is not intended to be used. Permeate is directed to the clearwater reservoir.

Chlorination

Disinfection is achieved by gas chlorination (two 70 kg chlorine gas cylinders) configured as duty/standby with automated switchover in accordance with the CCP procedure. The system utilises a set point-based vacuum chlorine gas draw off injector disinfection system to chlorinate the treated water reservoir.

The target, action and critical limits for chlorine are stated in the CCP. Two critical limits ensure effective disinfection (low side) and prevent exceedances of the chemical health guideline value (high side).

pH adjustment

Sodium carbonate is dosed to increase the pH and increase alkalinity of the treated water. 15% batched sodium carbonate solution is dosed (Deplox 5 analyser, set point control) at ~0.03 ml/L to increase the pH in accordance with the OCP procedure.

(Ultraviolet disinfection)

The UV unit is a redundant system that is not currently operational but physically remains.

Reticulation

Water is reticulated, under gravity from the treated water reservoir to the Whyanbeel scheme. Network maps showing sampling locations are shown in Element 5. There is one operational reservoir at Rocky Point. There is an additional reservoir available at Wonga Beach, which is normally offline. (This reservoir is vermin proofed and roofed – and will be brought online when demand requires it, or for contingency in cyclones). It is intended to install a recirculation chlorination system at this reservoir in the future.

Table 6. Whyanbeel reticulation

Scheme	Total Length (km)	% of total	Length (km)	Material	Age Range
Whyanbeel	72.9	53.45	39.0	PVC	1972-2022
		38.29	27.9	AC	1972-1989
		4.56	3.3	DICL	1994-2022
		2.46	1.8	HDPE	1972-2022
		1.24	0.9	Poly	1973-2022

The Rocky Point reservoir receives its flow from the Whyanbeel treatment plant via two pumps, duty/standby, that pump the water to the reservoir. Wonga Beach is fed by gravity from the WTP.

There are no areas of low pressure in Whyanbeel, and PRVs are used to reduce pressures to <600 kPa.

There are two mains from Whyanbeel to Wonga Beach – a higher pressure main feeds to Rocky Point and a lower pressure feed to Wonga Beach. There are closed interconnections between the mains, with PRVs in place to protect the lower-class mains.

Whyanbeel water scheme and Mossman/Port Douglas water scheme are interconnected to provide supply security to either system.



Figure 9. Whyanbeel clearwater reservoir

Table 7. Reservoir details – Whyanbeel scheme

Reservoir	Capacity (ML)	Status	Material	Roofed	Vermin Proof	(Re) chlorination	Alarms
Whyanbeel Clearwater	3.5	Active	Concrete	Y	Y	Y	Chlorine high and low level. Reservoir Level.
Rocky Point Reservoir	1	Active	Concrete	Y	Y	Y	Chlorine high and low level. Duty pump start/stop. Reservoir Level.
Wonga Beach Reservoir	2	Offline	Concrete	Y	Y	N	Reservoir level

Redosing

Redosing of chlorine occurs at the Rocky Point reservoir. Current operations use a recirculation system on the Rocky Point reservoir that doses using calcium hypochlorite eroders with set point operation. Redosing is operated in accordance with the CCP procedure.

Daintree drinking water scheme

The Daintree water treatment plant is a 0.49 ML/day design treatment plant, with an average flow range of 100 kL/day. The small WTP is not considered an environmentally relevant activity.

Intake:

The Daintree intake is located on Intake Creek, and Council is licenced (Licence #408446) to extract a maximum of 0.3 ML/day, (80 ML annually). Council may not take water if the flow downstream of the intake is less than 5 L/s.

The intake channel has been built into the rock bed and it diverts raw water flow to a coarse screen with a hole size of approximately 15 mm. The screen offers initial coarse filtering of the raw water prior to the raw water entering the raw water pipeline and removes sticks and leaf matter. The screen is inspected once per week (more if required and accessible) and cleaned as required.

Screened water gravity feeds (4.0 km) to the WTP through one raw water main. The available head is sufficient to provide feed water to the Daintree WTP raw water reservoir (200 kL) which then feeds two raw water booster pumps, duty/standby, that pump water to the ultrafiltration membranes.

Turbidity is measured using an online turbidity meter which is located at the WTP and provides the control turbidity for WTP shutdown.

The current turbidity limit is 5 NTU. The water treatment plant can operate at higher turbidities (for example in extended periods of high demand) if necessary, but this comes at the expense of membrane life, and increases the frequency of cleaning.

It is possible to bypass the Daintree WTP and provide raw water directly to the community. This was the original configuration of this scheme, but it is not intended to be used into the future, except under emergency scenarios. Daintree water supply has the Daintree bore and Daintree rainwater system as

alternate supplies for this scheme. Both supplies will be added to the raw water reservoir, and all treatment processes will remain identical.

Contingency bore

Daintree groundwater bore is used as a contingency water source for water security during drought conditions, or when the Intake Creek is unavailable (e.g., damaged in adverse weather events). Bore construction details in Appendix B. Pumping tests indicate that the bore should sustainably yield 4.5 L/s. Water quality testing for a full range of standard water analysis and 19 metals (total and dissolved) do not indicate that there is any parameter of concern (most parameters are near the instrument detection limit). The results are presented in Appendix B. A calcite filter is installed after the bore to maintain acceptable pH and alkalinity. In general, the expectation is that once commissioned, the bore supplements the Intake Creek supply. The bore water line has an automated scour system that will flush the raw water line and maintain water quality prior to the reservoir in situations when the bore has not been utilised for a period.

Daintree rainwater system

Daintree rainwater system is used as a contingency water source during adverse heavy rainfall events. Rainwater catchment is set on the Daintree WTP roof and feeds into the raw water tank. Rainwater supply is only available during rain events. Rainwater has minimal risks to the water quality and thus can be defined as protected water source. The area has minimal traffic and no industrial emissions. However, a microbial risk is present due to wildlife and lack of integrity of constructed rainwater catchment may cause chemical hazards. Due to these risks, the rainwater system requires frequent maintenance of the roof catchment. Maintenance includes gutter guard inspections and maintenance, cleaning of roof, gutters and onsite vegetation removal. Additionally, the rainwater system is equipped with a first flush system, which assists with cleaning.

Raw water reservoir

Raw water enters the raw water reservoir. This tank detains the water and allows sediment to settle, reducing the turbidity load to the WTP. The raw water tank is cleaned annually to prevent sediment build up.

Pre-filtration

Raw water is further filtered to 200 microns through pre-filters. The pre-filters run continuously and are cleaned by automated backwashing (typically every 10 minutes depending on raw water turbidity) to ensure constant feed of raw water to the treatment plants. The pre-filters are arranged in banks to provide a duty/standby operation and are designed to provide raw water flow to meet 100 % of the treatment plant design capacity.

The pre-filters are removed and inspected to assess serviceability once every 12 months. Backwash water supply is from the raw water supply and is directed back to the water course. It is possible to bypass the pre- filters at Daintree.

Ultrafiltration

The treatment plant uses one rack with six available positions for Koch polysulfone ultrafiltration membrane cartridges with a nominal size cut-off of 100,000 Daltons. The number of cartridges used

can be changed depending on operational requirements and demand. The Daintree water treatment has a maximum design capacity of 0.49 ML per day.

The ultrafiltration process is fully automated and includes its own main control panel which operates UF inlet/outlet valves, recirculation pumps, backwash supply pumps, CEB and CIP system including chemical dosing equipment. Critical process equipment is installed with a duty/standby capacity to minimise disruptions to the water treatment process.

Operation and monitoring of the ultrafiltration treatment plants is via a PLC/SCADA system with a Citect user interface for process operation, monitoring and alarming functions.

The cleaning of the cartridges is via an automated backwashing sequence that utilises water only backwashing typically required every 40 minutes. The frequency of backwashing is determined by the operator by observing trending values of the trans-membrane pressures (TMPs) in relation to production flow set points and raw water inflow turbidity.

Currently, no CEBs are performed at Daintree due to the discharge being to the Daintree River. Only CIPs are performed with the wastewater being collected in the chemical holding tank then pumped out and transported by road tanker to the Port Douglas wastewater treatment plant.

A CIP utilises a heated cleaning solution of either citric acid, caustic, or a combined caustic/chlorine solution. These are used to remove both organic and inorganic fouling. A CIP is typically undertaken on the rack twice per month.

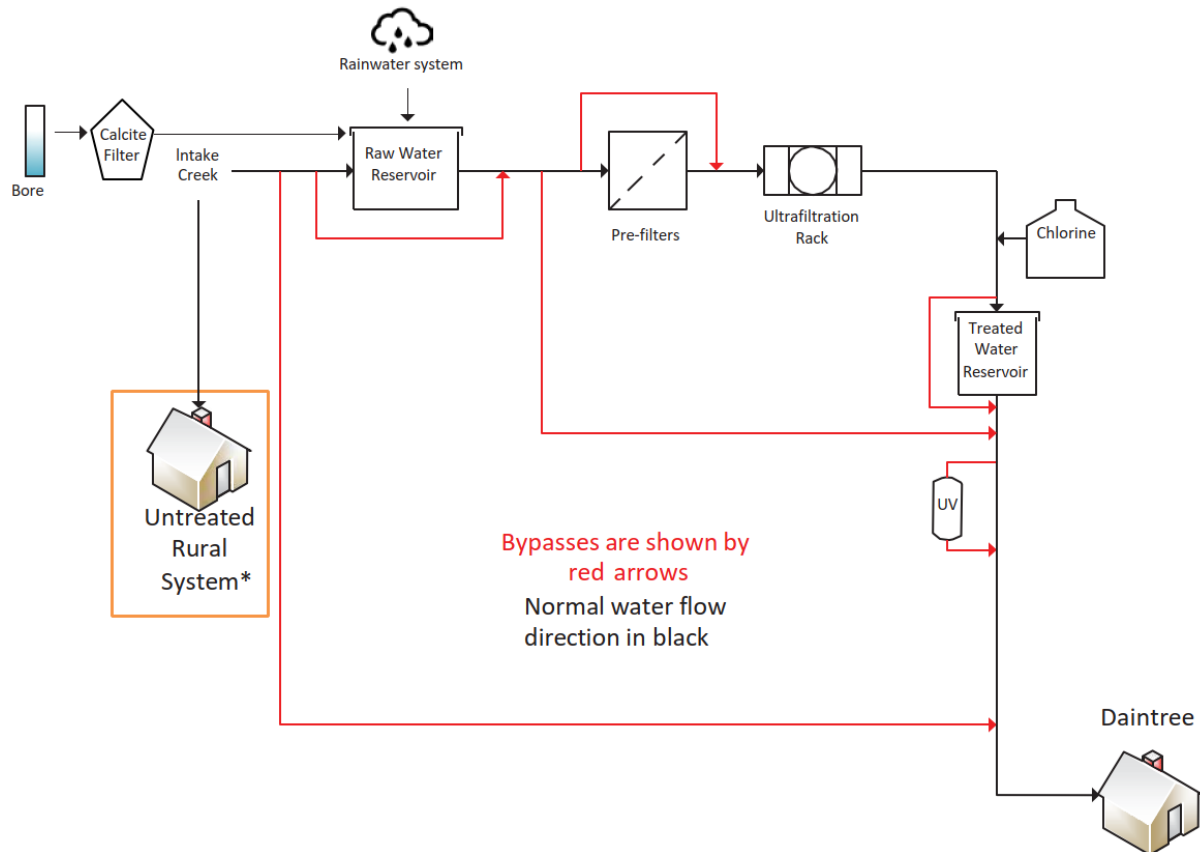
At the completion of a CIP, the UF rack is backwashed and rinsed and tested to ensure all traces of chemicals are removed prior to placing the UF rack back into service. Testing is performed on the UF rack by means of sampling the retentate and permeate header water and conducting in house lab testing for pH and free chlorine levels. Test limit results for free chlorine <0.1 mg/L and a pH result equivalent to the raw water pH value (typically 6.5 to 7.5) must be achieved prior to placing the UF rack back into service. Additional rinse cycles can be performed to ensure test results are within defined limits.

Membrane integrity – direct testing

Membrane integrity is evaluated every 24 hours (of elapsed production time) by undertaking an automated pressure decay test (PDT). Membrane integrity monitored and managed in accordance with the CCP procedure.

Membrane integrity – indirect testing.

The treated water reservoir turbidity is monitored using a turbidity monitor capable of 0.001 NTU resolution and managed in accordance with the CCP procedure.



*Non-potable supply

Figure 10. Daintree WTP schematic

Chlorination

Disinfection is achieved through chlorination. Current operations use a recirculation system on the treated water 400 kL reservoir that doses sodium hypochlorite with a set point control mode of operation.

The target, action and critical limits for chlorine are stated in the CCP. Two critical limits ensure effective disinfection (low side) and prevent exceedances of the chemical health guideline value (high side).

(Ultraviolet disinfection)

The UV unit is a redundant system that is not currently operational, but it physically remains.

Reticulation

Water is reticulated, under gravity to the Daintree scheme directly from the 400 kL treated water reservoir at the plant – there are no additional reservoirs.

There is a relatively low turnover in this scheme, in the past this has led to low chlorine residuals in the reticulation system. When chlorine residual reduces below 0.2 mg/L, mains are flushed until the chlorine residual is above 0.2 mg/L. There is great sensitivity in this community to chemicals in their water supplies, so if changes are made, changes are made slowly so as to acclimatise the consumers

without resulting in increased opposition to chlorination. Network maps showing sampling locations are under Element 5.

Water quality data

Douglas Shire Council undertakes water quality testing of raw, treated, (reservoirs) and reticulation. Data has been statistically analysed, and a summary of the available data (in some cases since 2008) has been presented in Appendix A. The Drinking Water Quality Management Plan report is the normal method by which our data is reported publicly.

In addition to the parameters identified in those tables, Council has previously also undertaken testing to inform the management of the water supplies. For example, we have undertaken monitoring for Cryptosporidium and Giardia in the raw water, with infrequent low level positive detections that demonstrate their presence in the catchment. Similarly, we have undertaken testing for Naegleria in the reservoirs, but have not detected this pathogen. Given the focus on operational monitoring ensuring the effectiveness of treatment barriers, we no longer consider it necessary or cost effective to continue to monitor for these pathogens. Rather, we emphasise the optimal operation of our treatment barriers.

Council has also undertaken monitoring for disinfection by-products within the reservoirs. The highest level detected was at Rocky Point reservoir, with only 150 mg/L, which is well below the ADWG health guideline value. Of note, with over 5,300 *E. coli* samples (2014-2019), three post-treatment samples were positive - one in the Flagstaff reservoir in Dec 2014, one in the Mossman post-UV sample in March 2015 and a May 2016 sample at Cooya. All three samples were collected in very adverse weather conditions and are thought to be the result of contamination of the samples, rather than reflecting the water quality at the time. Incidents that occurred prior to chlorination of these schemes are no longer considered relevant.

Water quality data in general indicates that the treatment processes are very effective at reducing or eliminating hazards.

Risk methodology

Douglas Shire Council has adopted a risk methodology based on the “Preparing a Drinking Water Quality Management Plan Supporting Information, September 2010” documentation provided by the Queensland Water Supply Regulator.

There are some minor differences to the published version in that the consequence descriptor for catastrophic has been quantified, and the uncertainty descriptors tailored to reflect the data availability in these schemes.

Public Health Risk Matrix and Definitions

The public health risk matrix used for the risk assessment is presented below. Medium and Low risks are acceptable - High and Extreme risks should be reduced by implementing risk improvement actions.

Table 8. Risk matrix

Public Health Risk Matrix	Consequence	Insignificant	Minor	Moderate	Major	Catastrophic
Likelihood		<i>Isolated aesthetic exceedance, little operational disruption</i>	<i>Local aesthetic exceedance, potential isolated breach of chemical health parameter</i>	<i>Widespread aesthetic exceedance, or repeated breaches of chronic health guidelines</i>	<i>Potential acute health impact, no outbreak expected</i>	<i>Potential acute health impact, declared outbreak likely</i>
Almost Certain	<i>Occurs daily to weekly</i>	Medium 6	High 10	High 15	Extreme 20	Extreme 25
Likely	<i>1-4 occurrences per month</i>	Medium 5	Medium 8	High 12	High 16	Extreme 20
Possible	<i>1-11 occurrences per year</i>	Low 3	Medium 6	Medium 9	High 12	High 15
Unlikely	<i>1 occurrence per 1-5 years</i>	Low 2	Low 4	Medium 6	Medium 8	High 10
Rare	<i><1 occurrence per 5 years</i>	Low 1	Low 2	Low 3	Medium 5	Medium 6

Table 9. Uncertainty descriptors

Uncertainty Level	Uncertainty descriptor
Certain	The processes involved are thoroughly understood and supported by very extensive on-site knowledge covering multiple drought and flood cycles, and/or high frequency (weekly or better) water quality monitoring data.
Confident	The processes involved are well understood and supported by extensive on-site knowledge of more than one drought and flood cycle, and/or monthly water quality data
Reliable	There is a good understanding of the process which is supported by quarterly water quality data and operational experience that covers drought and flood years.
Estimate	The process is reasonably well understood, and data covers seasonal and drought and flood cycles.
Unreliable	The process is not well understood, and water quality data does not cover seasonal variations for drought and flood years.

Methodology

The entire risk assessment process is conducted over three stages. These include

1. Hazard identification, Unmitigated
2. Risk assessment, and
3. Mitigated risk assessment.

As Douglas Shire Council has three schemes with a very similar treatment train, the risk assessment was undertaken for all three schemes simultaneously but considering any individual differences.

The relevant hazards were identified from previous versions of the DWQMP, water quality data, incident history, known water quality issues, and experience of the hazard identification team. The hazards that were considered are listed in the unmitigated risk assessment table in the following section.

After a hazard is identified, the likely sources were identified. This sometimes resulted in the identification of specific schemes where the hazard was significantly different to another. Where this is the case, the different schemes were considered separately for their unmitigated public health risk (the same hazard is identified on multiple lines).

For each hazard, an unmitigated risk was determined by first determining the consequence of the hazard, and then considering the likelihood that the hazard would result in that consequence. The unmitigated risk assumes that a person consumes the water with the hazard present and no treatment in place. (In some cases, such as overdose of treatment chemicals, this simplistic definition is broadened to assume that the hazard is introduced to the water supply with no further control measures after the hazard has been introduced).

The consequence definitions are adhered to strictly, such that any hazards that could result in an acute health risk (for example pathogens), must have either a major or catastrophic consequence. On the contrary, parameters with chronic health risks, such as manganese or trace level pesticides, will have either minor or moderate consequences. The ADWG does not provide guidance on acute chemical risks, and none have been identified in this process.

Once the consequence and likelihood were assigned, the Public Health Risk was determined using the matrix in the next section. An uncertainty is also assigned to demonstrate the level of confidence in the assessment.

Douglas Shire Council considers that a Public Health Risk of medium or below is acceptable. If an unmitigated risk was determined to be low, this was not carried forward to a mitigated risk assessment. Hazards with unmitigated risks of medium or above are generally carried forward to the scheme specific risk assessments, detailed in the individual scheme-based plans.

For the mitigated risk assessment, the hazards and the sources of the hazards/ hazardous events are then separated out to consider where in the treatment process that the hazard can eventuate as a risk. This is done to examine failure modes for individual process elements. Where a hazard is present, the preventive measures that are intended to minimise the risk are identified.

The effectiveness of the identified measure, given the hazardous event is then assessed. Where an unmitigated risk is unacceptable, and reduced, the operational procedure used to manage the risk is identified. Again, an uncertainty is assigned. If the mitigated risk remains unacceptable, or there is no operational procedure, a risk management improvement item was identified.

Hazard identification and risk assessment

A hazard identification team was assembled in June 2015 to identify the hazards that are present across any or all schemes. Members of this team were also involved in the water supply system description and analysis. Following agreement on the hazards that are present, the unmitigated risks were evaluated. The hazard identification team that was involved in this process is detailed in the table overleaf.

During the Hazard identification workshop, available raw water quality data, and operational knowledge was used to inform the workshop conclusions.

An unmitigated risk was then assigned for each hazard, considering any differences in types of schemes that may change the unmitigated risk rating. The hazard identification and unmitigated risk assessment is presented in the following pages.

Risk reviews

Following an audit in 2021, and a DWQMP review in 2022, we conducted a desktop review of the completed RMIP actions, updated the current risks, and identified risk improvement items that had either been deferred or have been recently added to the infrastructure programs.

The risk register was updated to ensure the mitigated risk column reflects 2022 risks, with the 2020 risk being captured in an historical reference column. Similarly, comments have been updated.

The RMIP (the final columns of the risk register) has similarly been updated to remove items that have been completed, and to include those relevant items that are required to mitigate unacceptable risks. The relevant unmitigated risks above are passed forward to the scheme by scheme mitigated risk assessment. In this case, relevant generally means that the hazard is present for that type of scheme, with an unmitigated risk of medium or above. Low risks identified above are not considered further, as they are not considered to pose a public health risk within the timeframe for plan review where these outcomes will be revisited.

Some asset management issues have been included as whole of system risks (failure of supply in Mossman/Port Douglas due to drought). In these cases, we have been very conservative in the application of the likelihood as the consequence of loss of supply is so severe. For example, whilst it may be rare that we are unable to supply the Mossman/Port Douglas scheme, we have assessed the likelihood as “unlikely”. This is partially to differentiate from the Daintree and Whyanbeel schemes, but also because we believe it essential for supply security to develop an alternate water source in this scheme.

As stated above, following determination of the mitigated risk, we identified if we have a robust implemented documented procedure for that process that ensure that the measures are effective. As appropriate, we have also assessed and documented whether the barrier was a critical control point. This is described more fully in the following section.

Table 10. Risk assessment participants

Participants	Position	Relevant Workshop	Water Industry/Risk Management Experience
Paul Hoye	General Manager Operations	2015	22 years, Previously an EHO, food safety auditor, HACCP training. 20 years in DSC
Wouter van der Merwe	Manager Water and Wastewater	2015	30 years water industry. Formal risk training.
Henry Maro	Team Leader Water Treatment	2015, 2017 and 2020	25 water industry, with 14 years at DSC. Cert 3 in water and wastewater. Multiple risk assessments.
Samadhi Senior	Technical Officer Water and Wastewater	2015	5 years in Council/ water, risk assessment experience
Mark Howarth	Team Leader Water Reticulation	2015	37 years with Council/ water. Risk assessment experience.
Matt Govorko	Water Operator	2015	10 years water industry, DSC. Cert 3, Council risk assessments.
Steve Davis	Water Operator	2015	4 years DSC and water industry, Cert 3, Council risk assessments
Tony Kadwell	Technical Officer	2015 and 2020	28 years, Cert 3 Reticulation. Previous risk training
Michael Lawrence	Bligh Tanner - Facilitator	2015, 2017, 2020 and 2022	>15 years in water industry, formal ADWG training, water quality management systems auditor.
Nicholas Wellwood	General Manager Operations	2017	Engineer, 30 years in water industry, formal risk training
Peter White	Coordinator Water and Wastewater	2017, 2020 and 2022	17 years in Council in water and wastewater, risk assessment experience
Marie Lawson	Administration Officer Water and Wastewater	2017	12 years in DSC, initial drinking water risk assessment
Peter Tonkes	Manager Water and Wastewater	2020	1 year in Council Water and Wastewater management
Ada Pasanen	Environmental Technical Officer	2020 and 2022	5 years in Council water and wastewater compliance management
Mitchell Simpson	Team Leader Water Reticulation	2020 and 2022	3 years in Council Water and Wastewater management
John Petherbridge	Assistant Team Leader Water Quality	2020 and 2022	6 years in Council Water and Wastewater management
Jason Wilkie	Team Leader Wastewater	2020	10 years in Council Water and Wastewater management
Melissa Mitchell	Environmental Technical Officer	2020	<1 year in Council Water and Wastewater compliance management. 17 years in DSC
Jonathan Ward	Manager Water and Wastewater	2022	Registered Professional Engineer. 30+ years water industry experience, 16 years in Local Government.

Table 11. Unmitigated risks

Hazard	Type of Hazard	Sources of Hazard	Unmitigated Risk			Uncertainty	Comments	Treatment Barrier/s
			Consequence	Likelihood	Risk			
Bacteria/Virus	Biological	Native animals in catchment, ineffective disinfection	Catastrophic	Almost Certain	Extreme 25	Certain	More likely than protozoa, but low risk of human-human pathogenic forms. Zoonotic disease more likely. Risk is same for Daintree Rainwater system as for other catchments. Risk is lower for Daintree Bore but captured under this unmitigated risk score.	Protected catchment, UF, chlorination.
Bacteria/Virus	Biological	Ingress into reservoirs/water mains, insufficient residual disinfection	Catastrophic	Likely	Extreme 20	Confident	Reservoir integrity requires constant attention to ensure that this is managed.	Reservoir integrity, residual disinfection, redosing, mains break procedures.
Cyanobacteria	Biological	algal bloom	Minor	Rare	Low 2	Confident	Shaded intakes, high relief in the catchment, constant flow. Will not build up.	Protected catchment.
Protozoa	Biological	Native animals in catchment, ineffective UF.	Catastrophic	Almost Certain	Extreme 25	Confident	Possible, but high concentrations of human pathogenic forms not considered likely. Risk is same for Daintree rainwater system as for other catchments. Risk is lower for Daintree bore but captured under this unmitigated risk score.	Protected catchment, UF.
Protozoa	Biological	Ingress into reservoirs/water mains	Catastrophic	Likely	Extreme 20	Reliable	Possible, but high concentrations of human pathogenic forms not considered likely.	Protected catchment, UF.
Amoeba (<i>Naegleria, Acanthamoeba</i> etc)	Biological	Ingress into reservoirs/water mains, insufficient residual disinfection.	Major	Possible	High 12	Estimate	if present likely impact to only single person.	residual disinfectant, mains repair procedure.
Chlorate	Chemical	Chemical breakdown	Moderate	Likely	High 12	Confident	Currently no guideline value, but Qld Health have set a limit of 0.8 mg/l. Council limiting use of hypochlorite solutions.	Moved to gas chlorination at all large WTPs.
Chlorine	Chemical	Chemical overdose.	Moderate	Possible	Medium 9	Confident	Can potentially occur due to equipment failure, operator error or due to sabotage/terrorism.	SCADA control of dosing.
DBPs	Chemical	Elevated organics and long detention times.	Moderate	Likely	High 12	Reliable	Low organic loading and tight membranes reduce formation potential.	UF, stable water, low doses of chlorine, multiple redosing points in longer reticulation systems.
Heavy metals	Chemical	Natural geology	Moderate	Rare	Low 3	Reliable	Acknowledged that metals exist in groundwater naturally.	Monitoring as per the verification monitoring program. Investigative monitoring of Daintree bore before being brought online.
Hydrocarbons	Chemical	Illegal disposal of fuel, etc.	Moderate	Rare	Low 3	Confident	Single issue on lot at Wonga beach - but potential to leach through mains.	Nil required.
Iron	Chemical	Natural geology, sediment.	Minor	Unlikely	Low 4	Reliable	Acknowledged that Iron exists in the natural environment	Raw water intake CCP, UF. Monitoring as per the verification monitoring program.
Lead	Chemical	Pipework	Moderate	Possible	Medium 9	Reliable	Some lead joints in old pipework (Mossman gorge intake). Not believed to be any service connection lead left, when identified it is replaced.	Old mains replacement program.
Manganese	Chemical	Natural geology.	Moderate	Rare	Low 3	Reliable	Acknowledged that Manganese exists in the natural environment.	Raw water intake CCP, UF. Monitoring as per the verification monitoring program.
Pesticides	Chemical	Limited use in catchment.	Moderate	Rare	Low 3	Reliable	Land management activities generally occur downstream of the intake locations within the catchment.	Nil required.
Scaling	Chemical	TDS or organics in raw water.	Minor	Likely	Medium 8	Confident	Catchment characteristics and natural geology influence TDS values and organics in raw water.	CIPs and CEBs.
Taste and odour	Chemical	Algae blooms.	Minor	Unlikely	Low 4	Confident	Catchment characteristics, including high relief, constant flow and shaded intakes reduces risk of build-up.	UF
Taste and odour	Chemical	Regrowth in reticulation.	Minor	Likely	Medium 8	Confident	More likely to occur in longer reticulation systems.	Mains flushing program, stable disinfection program.
Alkalinity	Chemical	potential change in ratio of surface runoff to springs.	Minor	Unlikely	Low 4	Reliable	Change in alkalinity appears to drive pH change in AC mains.	Nil - but affects water stability in reticulation.

Hazard	Type of Hazard	Sources of Hazard	Unmitigated Risk			Uncertainty	Comments	Treatment Barrier/s
			Consequence	Likelihood	Risk			
High pH	Chemical	Interaction with AC mains.	Minor	Almost Certain	High 10	Confident	As pH increases in AC mains, residual disinfection becomes less effective.	Long-term replacement of AC mains. Monitoring per the verification monitoring program.
Low pH	Chemical	Naturally occurring, chlorine gas	Minor	Almost Certain	High 10	Reliable	Annual pH drop at end of dry season typically < 6.5. Addition of chlorine gas may lower pH further - Whyanbeel has required pH adjustment as a result. Mossman WTP may require in future, but acceptable pH to date.	Sodium carbonate dosing at Whyanbeel, monitoring of operation at Mossman to identify if this is also required. Calcite filter installed after Daintree bore. Monitoring per the verification monitoring program.
Colour	Physical	Naturally occurring	Minor	Possible	Medium 6	Confident		Raw water intake CCP, UF.
Temperature	Physical	Seasonal	Minor	Likely	Medium 8	Certain	Chlorine consumption, regrowth.	Nil required.
Turbidity	Physical	Rainfall events	Minor	Almost Certain	High 10	Certain	High turbidity events are managed through early warning alarm system to reduce damaging treatment plant infrastructure.	Raw water intake CCP, hydrocyclone, pre-filters, UF.
Turbidity	Physical	Sloughing of biofilm, resuspension of sediment in reservoirs/mains	Minor	Possible	Medium 6	Reliable		Mains flushing program, stable disinfection regime.
Radioactivity	Radiological	Natural geology	Moderate	Rare	Low 3	Confident	Radioactivity occurs in the natural environment.	Nil required.
Failure of supply	Whole of System	Drought	Catastrophic	Unlikely	High 10	Reliable	Changing climatic conditions provide unpredictable water supply.	Investigating alternate source for Mossman/Port Douglas scheme. Daintree scheme has alternative supplies available.
Failure of supply	Whole of System	Landslide at raw water intake (Daintree)	Catastrophic	Possible	High 15	Estimate	Likely able to put pump in plunge pool for raw water supply. Daintree bore and Daintree rainwater system in place as contingency water supplies	Regular inspections and monitoring of the intake. Inflow trends and alarms on SCADA. Secondary supplies available.
Failure of supply	Whole of System	Flood/repeated storms resulting in WTP shutdown	Catastrophic	Unlikely	High 10	Reliable	Successive storms have shut down production twice in 10 years to the point of being unable to treat enough water to supply consumers.	Build system capacity and reticulation inter-linkages.
Failure of supply	Whole of System	Cyclone	Catastrophic	Possible	High 15	Confident		Generators, cyclone preparedness plans, DMP.
Failure of supply	Whole of System	Loss of power	Catastrophic	Possible	High 15	Confident	Port Douglas worst area, others can be gravity fed under most circumstances	
Reduced supply	Whole of System	Demand exceeds capacity	Catastrophic	Almost Certain	Extreme 25	Reliable	This is based off longer term considerations - so while we currently have sufficient capacity, if nothing is done, demand may exceed capacity by 2025.	Build system capacity and reticulation inter-linkages.
Operator error	Whole of System	Untrained/overworked/mistake	Catastrophic	Almost Certain	Extreme 25	Confident	Technical equipment requires skilled operational staff and continual training.	Staff training.
Sabotage/Terrorism/Cyber security incident	Whole of System	Any chemical or microbiological hazard	Catastrophic	Possible	High 15	Estimate	Council recognises ongoing security assessments are mandatory. This includes cyber security measures.	Regular inspections, security fencing, security contract.
WTP fire	Whole of System	Electrical fire	Catastrophic	Rare	Medium 6	Reliable	Electrical fire risks exist	Regular inspections. Smoke alarms connected to SCADA system.

Table 12. Mitigated Risk Assessment Summary

Process Step	Hazardous Event	Hazards Managed by Same Barriers	Unmitigated Risk	Primary Preventive Measure	Other Preventive Measures	Mitigated			Uncertainty	Comments	Y/N	Documented Procedure	Risk Management Improvement Plan 2022		
						Consequence	Likelihood	Risk					2021/22	Proposed 2022/23	2023/24 or beyond
Catchment	Present in catchment - animals	Bacteria and virus	Extreme 25	Disinfection	UF (Bacteria). Promote and support efforts to control feral animal activity in the water supply catchment.	Catastrophic	Rare	Medium 6	Certain		N	SCADA			
	Present in catchment - animals	Protozoa	Extreme 25	UF	Promote and support efforts to control feral animal activity in the water supply catchment.	Catastrophic	Rare	Medium 6	Confident		N	SCADA			
	Storm events	Loss of supply due to high turbidity	High 10	Raw water turbidity trigger		Catastrophic	Rare	Medium 6	Confident		N	SCADA			
Raw Water Feed	Raw water main break	Failure of supply	High 10	Internal conditions assessments carried out frequently. Spare reticulation equipment and fittings available for repairs.	Treated water storage has been increased in Mossman/Port Douglas scheme. Daintree scheme has alternative raw water supplies.	Catastrophic	Rare	Medium 6	Confident	Rex Creek raw water main engineering conditions assessment carried out in 2019.	N	SOP and BCP			
	Blocked Johnson screen (Rex Creek)	Failure of supply	High 10	Rex Creek intake allows self-cleaning of Johnson screens. All intakes checked regularly.	Treated water storage has been increased in Mossman/Port Douglas scheme.	Catastrophic	Rare	Medium 6	Reliable	Johnson screens can block in flood events.	N	SOP			
	Raw water UF feed pump failure (Daintree/Whyanbeel)	Failure of supply	High 10	Regular maintenance and checks of pumps.	Duty and standby pumps.	Catastrophic	Rare	Medium 6	Certain	Spare pumps available.	N	SCADA alarms on reservoir levels			
	Loss of raw water reservoir at Daintree due to subsidence.	Failure of supply	High 10	Stabilisation works completed	Sufficient treated water capacity to last 13 days in Daintree. Spare pumps available.	Catastrophic	Rare	Medium 6	Reliable	Stabilisation completed in 2017. Continue to observe for any other signs of erosion on site.	N				
	Daintree Bore pump failure	Failure of supply	High 10	Other raw water sources available	Sufficient treated water capacity to last 13 days in Daintree.	Catastrophic	Rare	Medium 6	Reliable	Daintree Bore is currently used as a contingency supply.	N				
	Blocked pre-filters	Failure of supply	High 10	Duty standby pre-filter operation	WTPs set offline during high turbidity events. Sufficient treated water capacity.	Catastrophic	Rare	Medium 6	Confident	Running plant without pre-filters ultimately can lead to blocked UF and loss of supply.	N	SCADA raw water deviation alarm on UF allows identification.			
	Turbidity above limit	Turbidity	High 10	Raw water turbidity trigger	UF	Minor	Rare	Low 2	Confident	Turbidity levels monitored using early warning alarm system to reduce impacts to treatment plant infrastructure.	Y	SCADA, turbidity CCPs, SOP			
Ultrafiltration	Loss of integrity	Protozoa, turbidity	Extreme 25	24-hr PDT	Continuous turbidity monitoring.	Catastrophic	Rare	Medium 6	Confident	Ongoing maintenance and replacement as required.	Y	SCADA and turbidity CCPs, SOP			

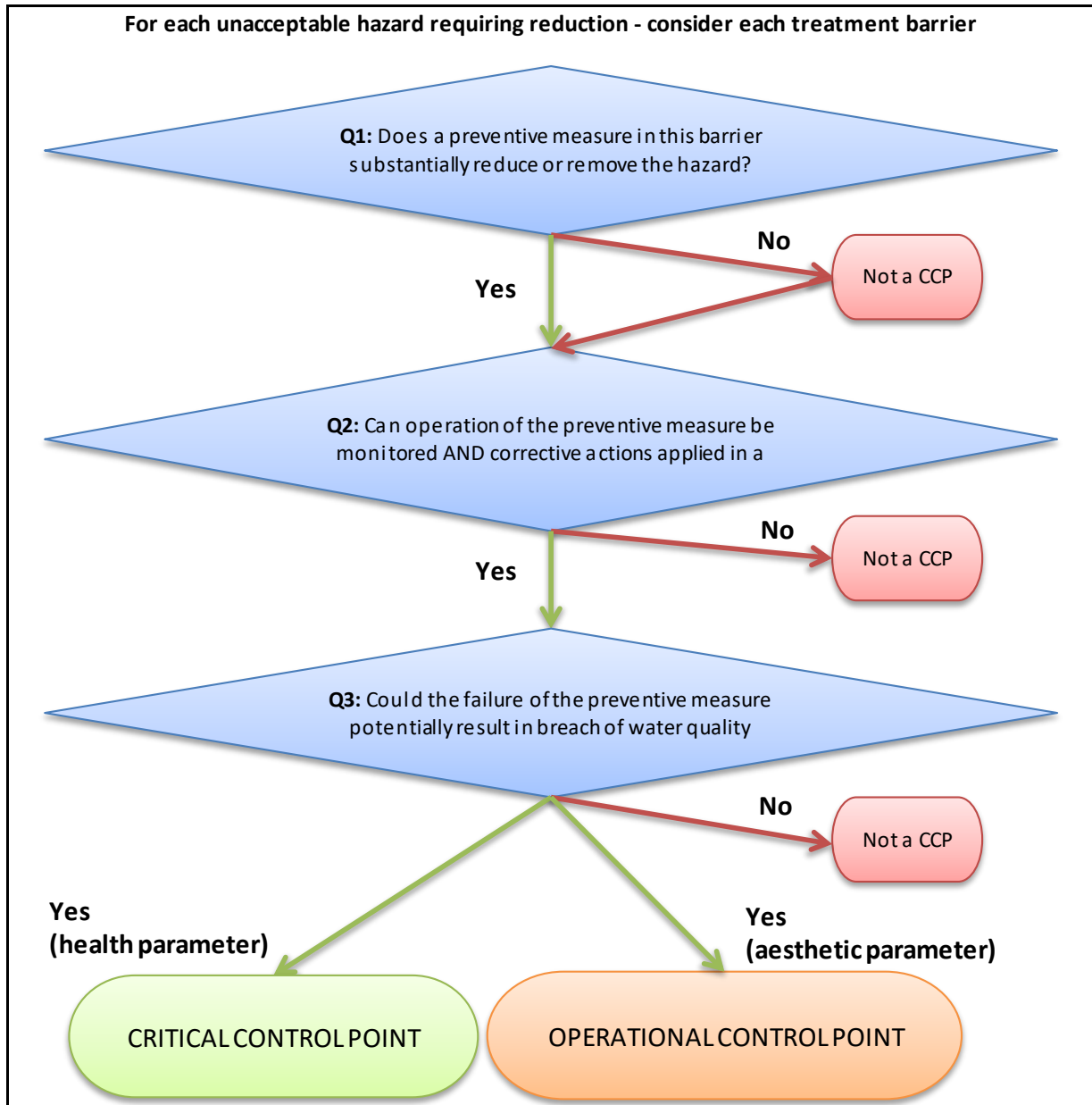
Process Step	Hazardous Event	Hazards Managed by Same Barriers	Unmitigated Risk	Primary Preventive Measure	Other Preventive Measures	Mitigated			Uncertainty	Comments	Y/N	Documented Procedure	Risk Management Improvement Plan 2022		
						Consequence	Likelihood	Risk					2021/22	Proposed 2022/23	2023/24 or beyond
	Loss of integrity	Protozoa, turbidity	Extreme 25	Continuous turbidity monitoring.	24 hr PDT	Catastrophic	Rare	Medium 6	Confident		Y	Turbidity CCP			
	Membrane scaling reducing plant capacity	Reduced supply	Medium 8	Regular backwashes, including CEB/CIP as required.		Minor	Possible	Medium 6	Reliable		N	TMP monitored, high-high alarm for each rack.			
	Membrane availability	Reduced supply	Extreme 25	Staged approach to replace UF system.		Major	Unlikely	Medium 8	Confident	Existing Koch UF membranes and replacement parts unavailable. Existing UF systems need to be replaced with new UF system.	N		Replace Mossman WTP pre-filters to prolong life of current UF membranes	Begin UF replacement program at Mossman WTP	Begin UF replacement program at Whyanbeel WTP and Daintree WTP
Low pH (Whyanbeel)	pH < 6.5	Low pH, corrosion	High 10	Sodium carbonate dosing.	Online pH monitoring at Whyanbeel WTP. In situ pH monitoring within reticulation system	Minor	Unlikely	Low 4	Confident	Whyanbeel Sodium Carbonate dosing system installed late 2017.	N	SCADA, pH adjustment OCP, SOP			
Low pH (Daintree)	pH < 6.5	Low pH, corrosion	High 10	Calcite filter after Daintree bore.	In situ pH monitoring within reticulation system	Minor	Unlikely	Low 4	Confident	Low pH from Daintree bore water supply has been identified as a potential issue.	N	pH adjustment OCP, SOP			
Disinfection	Overdose	Chlorine	High 15	Alerts at 2 mg/L, critical at 4 mg/L (dosing system shutdown).		Moderate	Rare	Low 3	Confident		Y	High CCP, SOP			
	Insufficient chlorine dose	Bacteria/virus	Extreme 25	Online chlorine monitoring at dosing points.	Two recirculation pumps (duty/standby) at each chlorination system	Catastrophic	Rare	Medium 6	Confident		Y	Low CCP, SOP			
	Chemical breakdown (Mossman/Port Douglas and Whyanbeel)	Chlorate	High 12	Gas chlorination currently installed at all dosing points.	Low organics in source water	Moderate	Unlikely	Low 4	Confident	Queensland Health guideline value 0.8 mg/L	N				
	Chemical breakdown (Daintree)	Chlorate	High 12	Continuous turnover of sodium hypochlorite solution to reduce product age.	Low organics in source water. Investigative chlorate monitoring in reticulation network completed; all results under 0.8 mg/L.	Moderate	Possible	Medium 9	Reliable	Queensland Health guideline value 0.8 mg/L	N				
	Ineffective disinfection due to turbidity	Bacteria	High 10	UF		Catastrophic	Rare	Medium 6	Certain	UF shutdown at 0.15 NTU, unlikely to ever exceed 1 NTU	Y	Turbidity CCP for UF			
Treated water storage/Reservoirs	Ingress into reservoirs	Bacteria/virus	Extreme 20	All active reservoirs inspected and maintained regularly and after storm events.	Primary disinfection at water treatment plants, redosing at reservoirs.	Catastrophic	Rare	Medium 6	Confident	Craigie reservoir refurbished in 2020.	Y	Chlorination CCP			

Process Step	Hazardous Event	Hazards Managed by Same Barriers	Unmitigated Risk	Primary Preventive Measure	Other Preventive Measures	Mitigated			Uncertainty	Comments	Y/N	Documented Procedure	Risk Management Improvement Plan 2022		
						Consequence	Likelihood	Risk					2021/22	Proposed 2022/23	2023/24 or beyond
	Ingress into reservoirs	Protozoa	Extreme 20	All active reservoirs inspected and maintained regularly and after storm events.		Catastrophic	Rare	Medium 6	Confident	Craiglie reservoir refurbished in 2020.	N				
	Ingress into reservoirs	Amoeba	High 12	All active reservoirs inspected and maintained regularly.	Primary disinfection at water treatment plants, redosing at reservoirs.	Major	Rare	Medium 5	Reliable	Reservoir chlorine levels consistently above 0.5 mg/L.	Y	CCP for chlorine			
	Storage capacity	Insufficient treated water storage	Extreme 20	Storage capacity increased by building Crees Rd reservoir.	Continuous reservoir inspection program.	Major	Rare	Medium 5	Reliable	Design completed to bring Cooya Beach reservoirs online. Includes chlorine redosing.	N				Cooya Beach reservoirs to be brought online
Reticulation	Ingress of contaminated water	Bacteria/virus	Extreme 20	Network pressure, residual disinfection, mains break procedure		Catastrophic	Rare	Medium 6	Confident		Y	SOP, CCP for chlorine			
	Ingress of contaminated water	Protozoa	Extreme 20	Network pressure, mains break procedure		Catastrophic	Rare	Medium 6	Reliable		N	SOP			
	Power failure	Failure of supply	High 15	Power supply generally robust with automatic start up generators at water treatment plants. Many areas gravity fed from reservoirs.		Major	Rare	Medium 5	Confident		N				
	Change in flow rate disturbing sediment in pipe	Turbidity	Medium 6	Mains flushing as required		Minor	Unlikely	Low 4	Confident		N				
	Long water age	DBPs	High 12	Low organics in source water, effective filtration, low chlorine doses.	High water demand in Mossman/Port Douglas scheme.	Minor	Rare	Low 2	Confident		N	SOP			
	Backflow - e.g. from customer meters or standpipes	Contamination	Extreme 20	Backflow register maintained for all commercial properties.	Backflow devices installed on all standpipes.	Catastrophic	Unlikely	High 10	Estimate		N	Backflow register			Design and install designated water filling stations within Shire.
Redosing	Overdose	Chlorine	High 15	Alerts at 2 mg/L, critical at 4.5 mg/L (redosing shutdown).		Moderate	Unlikely	Medium 6	Reliable		Y	CCP			

Process Step	Hazardous Event	Hazards Managed by Same Barriers	Unmitigated Risk	Primary Preventive Measure	Other Preventive Measures	Mitigated			Uncertainty	Comments	Y/N	Documented Procedure	Risk Management Improvement Plan 2022		
						Consequence	Likelihood	Risk					2021/22	Proposed 2022/23	2023/24 or beyond
	Insufficient dose	Bacteria/virus	Extreme 20	Disinfection alarms at 0.7 and critical at 0.2 mg/L.	Primary disinfection provides residual in most cases. Small top-up at reservoirs.	Catastrophic	Rare	Medium 6	Confident		Y	CCP			
System Wide	SCADA/telemetry failure/Cyber attack	Protozoa	Extreme 25	Regular SCADA backups.		Catastrophic	Rare	Medium 6	Reliable	Consultant reviewed current cyber security practices	N	BCP and cyber security arrangement and planning			
	Demand exceeds supply	Limited supply	Extreme 25	Asset planning	Water restrictions and water education implemented.	Catastrophic	Unlikely	High 10	Reliable	Alternative water supplies have been investigated for Mossman/Port Douglas scheme. Daintree scheme has contingency water supplies.	N	Asset management plan and BCP.			Mossman River intake construction
	WTP Fire	Failure of supply	Medium 6	Can provide raw water with Boil Water Alert.		Catastrophic	Rare	Medium 6	Reliable	Would need to activate LDMP and BCP.	N	LDMP and BCP			
	Drought (Mossman)	Failure of supply	High 10	Restrictions leading to dry season	Construct Mossman River intake to access additional water allocation.	Catastrophic	Rare	Medium 6	Estimate	Finalise design of Mossman River intake, Mossman WTP UV Upgrade to apply for grant funding	N				Mossman River intake construction
	Drought (Daintree)	Failure of supply	High 10	Use alternative supply		Minor	Rare	Low 2	Estimate	Daintree scheme has contingency water supplies.	N				
	Flood	Failure of supply	High 10	Sufficient treated water storage	Daintree scheme has alternative raw water sources.	Catastrophic	Rare	Medium 6	Reliable	Floods can impact access to intakes.	N	BCP			
	Landslip Daintree intake	Failure of supply	High 15	Sufficient treated water storage	Daintree scheme has alternative raw water sources.	Catastrophic	Rare	Medium 6	Estimate	Access to Daintree intake improved.	N	BCP			
	Cyclone	Failure of supply	High 15	Treated water storage at various locations.	Interconnection of Mossman/Port Douglas and Whyanbeel schemes.	Catastrophic	Rare	Medium 6	Reliable		N	LDMP, BCP			
	Operator error	Any	Extreme 25	Training, experience, mentoring.		Catastrophic	Unlikely	High 10	Estimate		N	HR training register.			
	Accidental use of bypass	Protozoa, bacteria and virus	Extreme 25	Bypass valves identified as permanently closed and tagged out.	Operator training	Catastrophic	Rare	Medium 6	Confident		N	SOP			
	Loss of knowledge	All	Extreme 25	Ensure all staff know the correct record keeping procedure.	Assets captured in GIS system	Catastrophic	Possible	High 15	Estimate		N	Asset management plan			
	Cyber threat/Attack	All	Extreme 25	Cyber security safeguards and continuous improvements.	Staff training	Catastrophic	Unlikely	High 10	Reliable	Consultant reviewed current cyber security practices with recommended actions.	N	BCP and cyber security arrangements and planning.			

Process Step	Hazardous Event	Hazards Managed by Same Barriers	Unmitigated Risk	Primary Preventive Measure	Other Preventive Measures	Mitigated			Uncertainty	Comments	Y/N	Documented Procedure	Risk Management Improvement Plan 2022		
						Consequence	Likelihood	Risk					2021/22	Proposed 2022/23	2023/24 or beyond
	Chemicals Unavailable	Bacteria and viruses	Extreme 25	Operational planning to ensure sufficient chemical stock levels available.	UF	Catastrophic	Rare	Medium 6	Confident		N	BCP			

Table 13. CCP decision tree



ELEMENT 3: PREVENTIVE MEASURES FOR DRINKING WATER QUALITY MANAGEMENT – CRITICAL CONTROL POINTS

For hazards that are unacceptable without treatment, but acceptable following treatment using a robust barrier, the process was assessed to determine whether the process was a critical control point. This is included in the risk register on the previous pages. The CCP decision tree in Table 14 was used to determine CCPs.

The actual CCP procedures were included in the preceding pages.

ELEMENT 4: OPERATIONAL PROCEDURES AND PROCESS CONTROL

Operational monitoring is based off the OCP and CCP procedures. Where possible these procedures are directly embedded into the SCADA system. This removes some of the risk that the procedure is not implemented as the SCADA system will send pages and alarms to operators or shut down processes automatically.

Corrective actions

Corrective actions are undertaken as defined in the OCP/ CCP tables. Where manual tests indicate that water quality is outside the OCP/ CCP action limits, the benchtop instruments are recalibrated, and the sample retested. If the sample still fails, the online instrumentation is recalibrated.

Breaches of action limits always result in operators taking the appropriate actions to bring the process back within normal operational limits, and reporting to the Team Leader as per the CCP procedures and the incident and emergency response plan.

If a critical limit is breached, the CCP actions are implemented, and the Manager Water and Wastewater is informed as soon as possible. This is defined as an operational action under the incident and emergency response plan but may be escalated to a reportable incident if necessary.

Equipment capability and maintenance

Online instruments are calibrated and maintained according to manufacturer specifications. Calibrations are also conducted when operators identify differences between online and benchtop instruments.

Other procedures

Other procedures related to drinking water management are listed in the following table.

Table 14. Relevant procedures

Procedure	Document Number	Approved	Date
Water Main Breaks SOP	#954212	Manager Water and Wastewater	Apr-21
Inspection and Maintenance of Intakes - All Water Intakes	#908590	Manager Water and Wastewater	Aug-19
Raw Water Turbidity Monitoring	#907879	Manager Water and Wastewater	May-19
Ultrafiltration Cartridge Fibre Repair	#934107	Manager Water and Wastewater	Dec-19
Mossman WTP - Ultrafiltration Plant CIP	#919172	Manager Water and Wastewater	Sep-19
Whyanbeel WTP - Ultrafiltration Plant CIP	#919205	Manager Water and Wastewater	Sep-19
Daintree WTP - Ultrafiltration Plant CIP	#934100	Manager Water and Wastewater	Dec-19
Whyanbeel WTP - pH Adjustment	#919175	Manager Water and Wastewater	Sep-19
Chlorination (Primary and Re-dosing)	#907844	Manager Water and Wastewater	May-19
Treated Water Turbidity Monitoring - Water Treatment Plants	#909201	Manager Water and Wastewater	Jun-19
Accidental Bypass	#810989	Manager Water and Wastewater	May-22
Mossman WTP - Chlorine Gas Dosing Facility Safety and Emergency Management Plan	#861547	Manager Water and Wastewater	May-19

Procedure	Document Number	Approved	Date
Council Metered Standpipes conditions of hire and use	#819971	Manager Water and Wastewater	Aug-21
DSC Operational Business Continuity Sub- Plan for Water and Wastewater	#948661	Manager Water and Wastewater	May-20
Local Disaster Management Plan	#1039350	CEO	Sept-21

ELEMENT 5: VERIFICATION OF DRINKING WATER QUALITY

Purpose and principles

Verification monitoring has been comprehensively reviewed and altered on the following basis.

Demonstrating a safe supply

- CCPs – the CCPs are in place to ensure that the ultrafiltration membranes are intact. This is done by two complimentary CCPs, the indirect (continuous turbidity) and direct (pressure decay test) limits ensure at least 3-log reduction of Cryptosporidium and allow credit to be claimed for bacterial and viral reduction.
- Chlorination CCP is then in place to ensure that any remaining bacteria and viruses are inactivated.
- If the chlorination CCP is breached on the low critical limit, a stated action is to undertake additional *E. coli* sampling.

As the chlorination CCP applies at the WTP (ensuring a primary kill) and is duplicated in the reticulation reservoirs, there is continuous online monitoring of chlorine residuals. As such, if the plants are operated with the CCPs within the target ranges, we have high confidence that the water supply is safe.

Supporting programs

1. Reservoir inspections are undertaken at least every 6 months, usually pre and post wet season, to ensure the integrity of the structures and to check run-off and vermin proofing. A procedure has been developed and a checklist is completed during each inspection. Any points of ingress or other damage recorded on the checklist. The completed checklist is sent to the Coordinator Water and Wastewater who programs necessary repairs with priority based on the risk to the integrity of the water supply.
2. Network operations have a routine flushing program that ensures that the primary mains into the reticulation zones are regularly flushed. This is typically monthly in each zone. Mains are flushed until the chlorine residual is above 0.2 mg/L.
3. Operators undertake regular reticulation chlorine testing in the reticulation network and initiate ad-hoc flushing when the residual is <0.2 mg/L.

Routine monitoring programs

As chlorine residual is used as the mechanism to ensure safe water, *E. coli* testing is not likely to result in positive tests at the water treatment plants. Therefore, WTP *E. coli* samples are no longer considered necessary, except when investigating an incident.

Similarly, reservoirs have SCADA alarms for action and critical limits, and are operated under the same chlorination CCP as at the WTPs. Again, these are not considered as high priorities to monitor as frequently as previously.

Instead, the focus is to ensure that the individual reticulation zones are monitored regularly with monthly sampling at the reservoirs. The number of sampling sites has been reduced to one per reticulation zone rather than the previous 2-3.

Public Health Regulation (PHR) requirement

PHR Schedule 3A sets the standards for frequency of sampling based on the population of the water provider. The Australian Bureau of Statistics lists the population of Douglas Shire 12,445 (based on 2021 census), although the population can increase considerably at peak tourist times. The PHR requires 1 *E. coli* sample per week for populations above 5,000, with an additional monthly *E. coli* sample for every 5,000 people that exceed 5,000 population. For a population of 12,445, the minimum requirement is one per week and two per month, or a total of 76 *E. coli* samples per year. Based on the current sampling program we are collecting over 400 *E. coli* samples per year (351 on drinking water, 65 on raw/intake water and 26 on a non-potable water source), using a combination of internal and NATA testing.

Schedule 3A also sets the value that must be met per sample as well as the annual value. *E. coli* results are presented in Appendix A.

Sampling locations

The sampling locations for each scheme are shown on maps in the following pages. The table opposite indicates the frequency of monitoring. The monitoring locations are chosen to be representative of the water delivered to customers (reservoirs) or to identify problems (end of reticulation zones). The balance of sites ensures we can demonstrate we produce safe drinking water.

External laboratory samples and parameters

- Raw water is monitored quarterly for Alkalinity, Ca, Colour, EC, F, Hardness, Mg, pH, K, Silica, Na, SO₄, turbidity, Fe, Mn, Pb, Cu, TDS, TON, TN, NH. Daintree Bore has additional testing for total and dissolved Fe, Pb that occurs eight times a year.
- Monthly samples are taken from reservoir locations for Alkalinity, pH, and *E. coli*. Mossman discharge is monitored monthly for BOD.
- Reticulation samples are analysed monthly for colour, pH, *E. coli*, Cu, Fe, Pb, Mn and turbidity.
- In 2020/21, we commenced investigative monitoring of chlorate in the Daintree scheme to determine baseline concentrations. Monitoring is conducted quarterly across seasons to capture whether there is increased breakdown in summer due to temperature effects or winter due to less chemical turnover. If results are consistently below 0.5 mg/L the need to continue monitoring will be reconsidered. The results so far are presented in the table below. All testing is undertaken by a NATA-accredited laboratory.

Sample site	Sample date	Test	QH limit	Result	Units
Daintree Shire Hall	2/12/2020	Chlorate	0.8	0.012	mg/L

Sample site	Sample date	Test	QH limit	Result	Units
Daintree Shire Hall	24/02/2021	Chlorate	0.8	0.635	mg/L
Daintree - Shire Hall	2/06/2021	Chlorate	0.8	0.248	mg/L
Daintree - Shire Hall	20/10/2021	Chlorate	0.8	0.19	mg/L
Daintree - Shire Hall	15/12/2021	Chlorate	0.8	0.586	mg/L
Daintree - Shire Hall	9/03/2022	Chlorate	0.8	0.417	mg/L
Daintree - Shire Hall	1/06/2022	Chlorate	0.8	0.24	mg/L

Internal testing and parameters

Raw water is sampled monthly for *E. coli*.

Reticulation samples are tested for pH, chlorine, and *E. coli* (Colilert) as indicated in the table opposite. We sample every week of the year, alternating between the identified sample locations.

The parameters monitored allow Council to observe trends in water quality throughout the schemes and has (in the example of changing pH) led to the replacement of aging AC mains that result in increasing pH in reticulation. Similarly, by monitoring for iron, manganese, lead, copper, and alkalinity, we can observe changes in the reticulation network over time. Turbidity monitoring alerts the water maintenance team of any damage/ingress to reticulation pipework and triggers and investigation.

Event based and investigative monitoring

Douglas Shire Council will also initiate investigative water quality sampling if there are events likely to impact on water quality.

For example, Council undertook investigative THM monitoring under the previous DWQMP, and all results were consistently below 200 mg/L (refer to Appendix A for results of the monitoring). As stated in the previous DWQMP, this was a trigger point to cease THM sampling.

If there are events that occur in the catchment or reticulation network, we will undertake monitoring to identify the cause of the issues, and take actions as described in the incident response plan.

Response to exceedance

Where any exceedance of the water quality criteria is identified, this activates the incident and emergency plan, and is immediately treated as a Reportable incident or emergency. We will report events as required under the conditions of approval of the DWQMP.

Scheme-by-scheme monitoring locations

Sampling locations are identified in the following table and maps:

Mossman/Port Douglas (pop < 15000)	Raw	Reservoir	Retic
Mossman Intake	Monthly		
Cassowary - Bunns Corner			Alternate weeks
Cooya Beach - Northern End - Boat Ramp			Alternate weeks

Drinking Water Quality Management Plan

SPID 558

Craiglie - Reef Park Reservoir		Monthly	
Flagstaff - Reservoir		Monthly	
Four Mile Beach - Barrier Street			Monthly
Four Mile Beach - Esplanade			Alternate weeks
Mossman - Davis Park in front of Church			Alternate weeks
Mowbray - Connolly Road			Monthly
Newell Beach - Esplanade - T-Intersection			Alternate weeks
Crees Road Reservoir		Monthly	
Whyanbeel (pop < 5000)	Raw	Reservoir	Retic
Whyanbeel Intake	Monthly		
Rocky Point - Hibiscus Ct			Alternate weeks
Rocky Point Reservoir		Monthly	
Wonga Beach - Esplanade			Alternate weeks
Daintree (pop < 1000)	Raw	Reservoir	Retic
Daintree Raw Water	Monthly		
Daintree Bore	Monthly		
Daintree Rainwater	Monthly when raining		
Daintree - Shire Hall			Alternate weeks
TOTAL	48 - not counted to PHR requirement as raw water	48	244

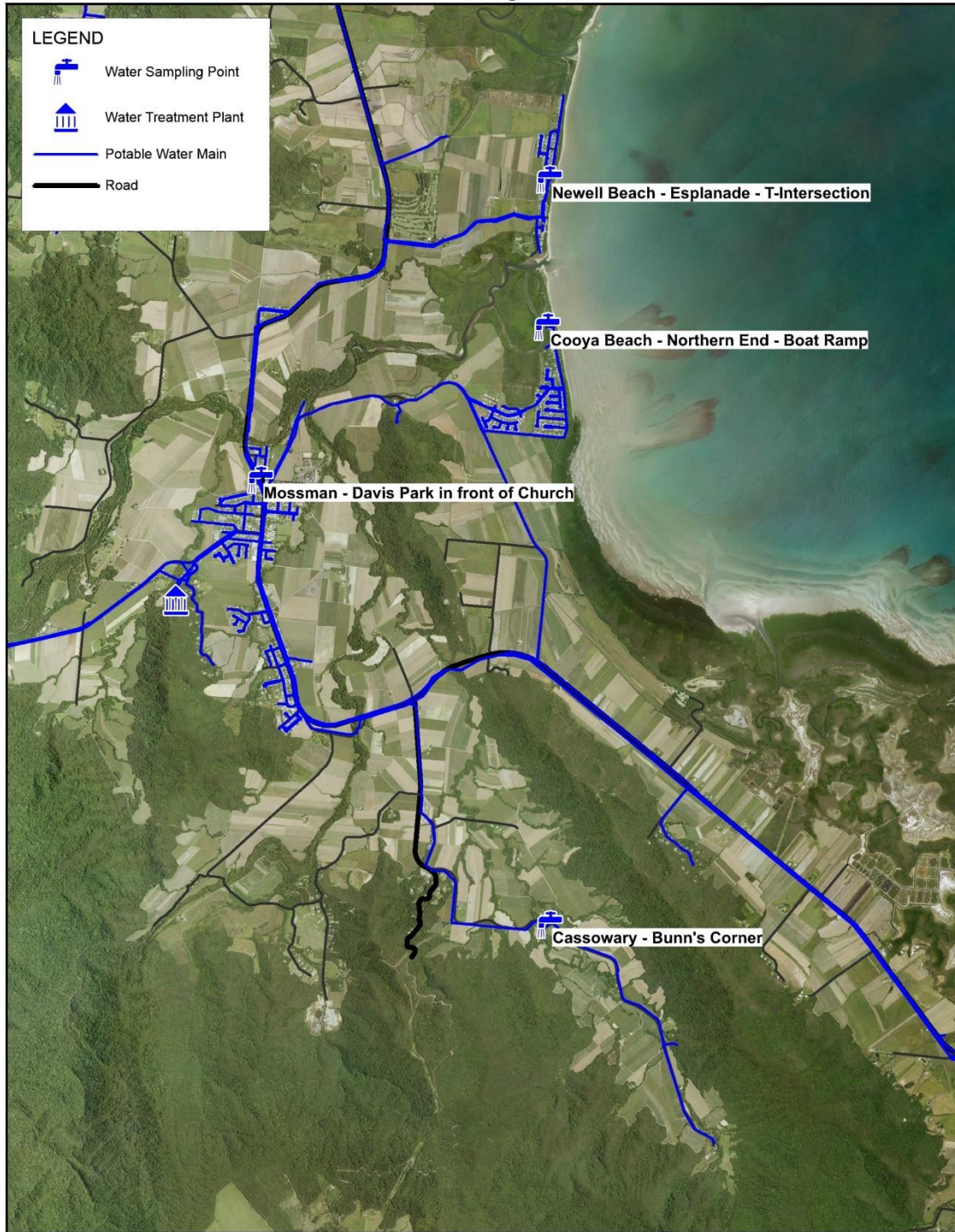
Alternate Weeks - in Whyanbeel means that samples are taken weekly, alternating between the two Retic sites of Wonga Beach and Rocky Point Hibiscus Ct. In Daintree, samples are taken every two weeks at the Shire Hall. In Mossman/Port Douglas, each site is sampled in every two-week period, with samples taken for at least two sites every week. Monthly samples are additional to this.

In this way each scheme meets the PHR, well above minimum requirements.

Quality assurance

Monthly duplicate *E. coli* samples are taken from 4 sites and tested internally (Colilert) to compare with the external *E. coli* samples.

Mossman drinking water scheme



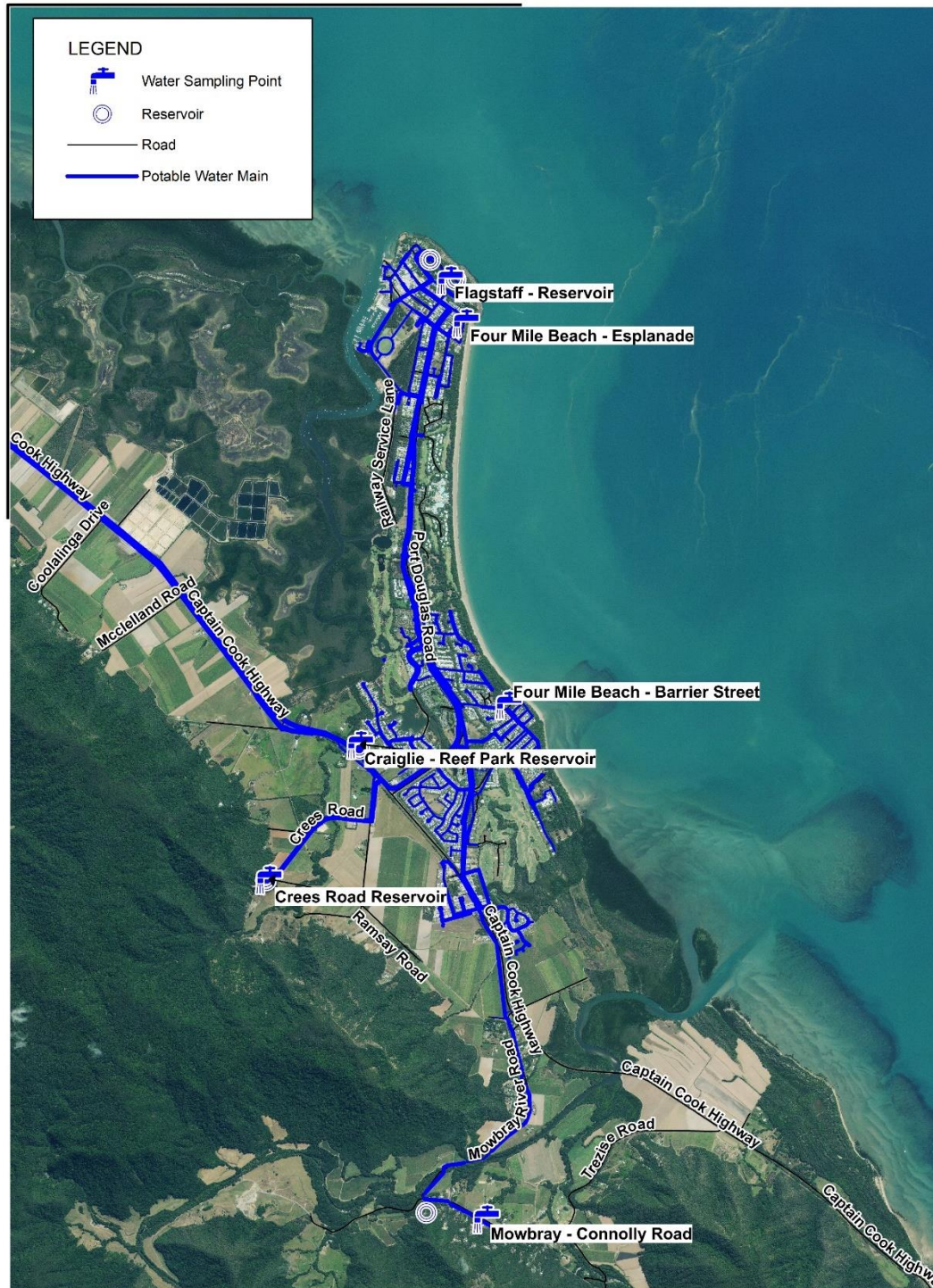
©2017 Douglas Shire Council (DSC). Based on or contains data provided by DSC and the State of Queensland Department of Natural Resources & Mines (NR&M) [2017]. In consideration of these agencies permitting use of this data you acknowledge and agree that these agencies give no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accept no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for direct marketing or be used in breach of the privacy laws.

Scale
1cm = 600 m at A4
Map Grid of Australia
Zone 55 (GDA94)



Figure 11. Mossman sampling locations

Mossman/Port Douglas drinking water scheme



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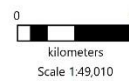


Figure 12. Port Douglas sampling locations

Whyanbeel drinking water scheme

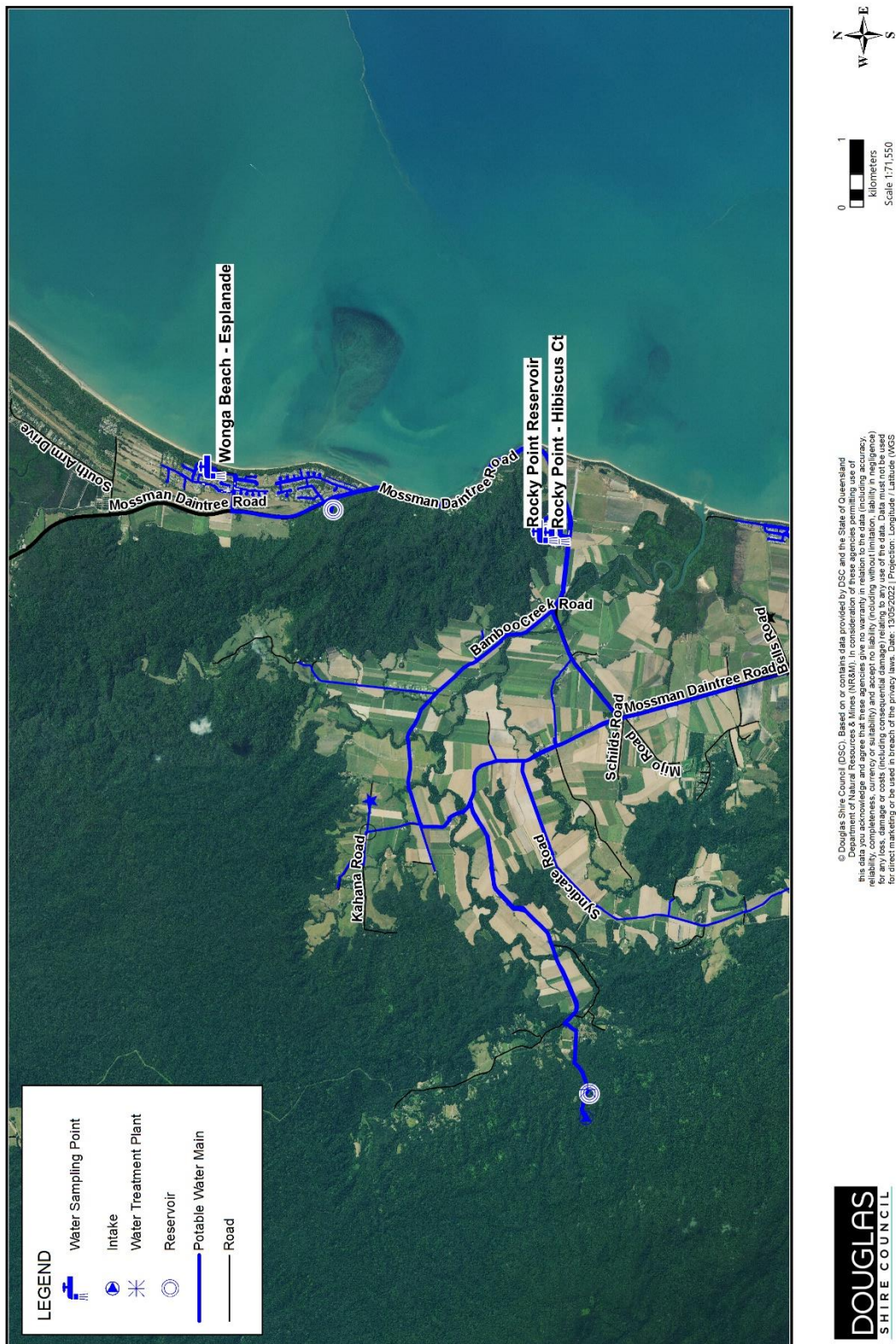
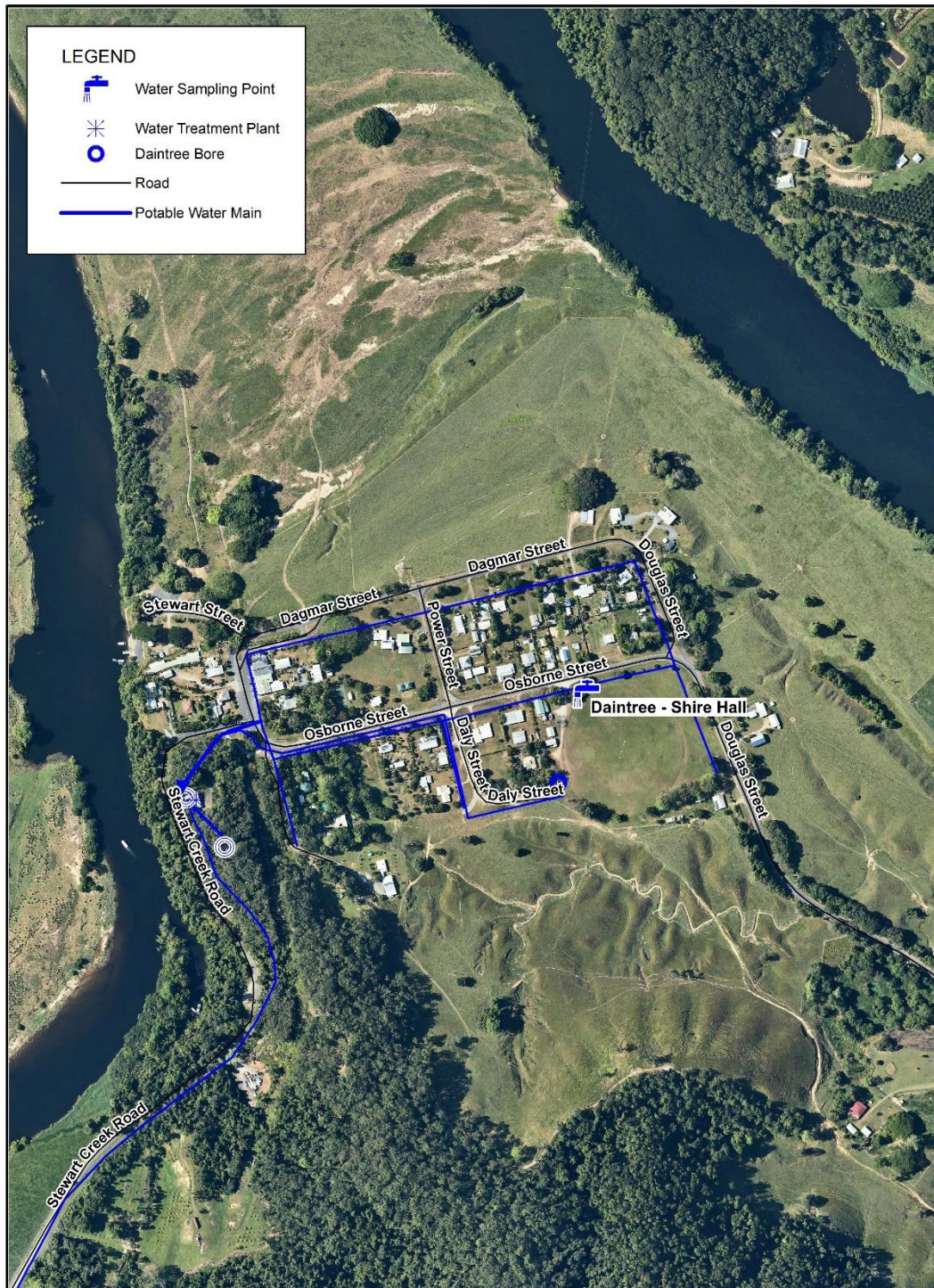


Figure 13. Whyanbeel sampling locations

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Daintree drinking water scheme



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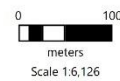


Figure 14. Daintree sampling locations

ELEMENT 6: INCIDENT AND EMERGENCY RESPONSE

Levels of Incident are as defined below:

- High – Declared Disaster
- Medium – Incidents and Emergencies
- Low – Operational Action

Table 15. Emergency response levels

Alert Level	Description	Key management response(s)	Position(s) responsible
High: Declared Disaster	Declared disaster. Examples include a cyclone or a significant flood.	Activate disaster management plan.	CEO
Medium: Incidents and Emergencies	Exceedance of ADWG health guideline value Outbreak of waterborne disease Detection of a parameter with no water quality criteria that may have an adverse effect on public health An event which is beyond the ability of DSC to control and may have an adverse effect on public health. Loss of water supply for >6 hours. Cyber Security Incident likely to impact ability to supply safe drinking water.	Activate incident response plan. Ensure all control measures identified in the DWQM Plan are functioning effectively.	Coordinator Water and Wastewater Team Leader Water Quality Environmental Technical Officer Water and Wastewater
Low: Operational Action	Exceed operational limit Exceed critical limit, but not ADWG Health Guideline. Effectively managed by the water treatment team undertaking operational actions in line with our DWQMP.	Ensure all barriers are functioning effectively. Check and act upon operations and maintenance records and procedures. Take appropriate actions to rectify situation.	Team Leader Water Quality WTP operators

Table 16. Summary of emergency responses

Alert Level	Key management response(s)	Brief summary of actions	Documented Plans & Procedures
<p>High: Declared Disaster</p>	<p>Activate disaster management plan.</p>	<p>Notify CEO</p> <p>Coordinate internal notification, investigation and response of waterrelated aspects</p> <p>Consider what community notification is needed (if any) <u>e.g.</u> do not drink alert, boil water alert or bottled/emergency water distribution</p> <p>Notify Regulator of escalation from incident/event or of standalone emergency as soon as practicable</p>	<p>Disaster management plan.</p>
<p>Medium: Incidents and Emergencies</p>	<p>Activate incident response plan.</p> <p>Ensure all barriers identified in the DWQMP are functioningeffectively.</p>	<p>Notify Manager Water and WastewaterNotify Regulator of any reportable incidents immediately (within 3 hours).</p> <p>Ensure all control measures identified inthe DWQMP are functioning effectively</p> <p>Commence investigation Arrange for re-samples to be taken (<u>where</u> required)</p> <p>Implement appropriate immediate remediation actions, (this may include hand dosing reservoirs, flushing of mains,or isolation of affected areas)</p> <p>Consider what community notification is needed (if any) <u>e.g.</u> do not drink alert, boil water alert or bottled/emergency water distribution</p> <p>Review associated laboratory reports and operational records</p> <p>In case of customer complaints, coordinate investigation and resolution, including obtaining water samples whererequired</p>	<p>Incident response plan (this document)</p> <p>DSC DWQMP</p>
<p>Low: Operational Action</p>	<p>Ensure all operational steps identified in the DWQMP are functioningeffectively.</p> <p>Check and act upon operations and maintenance records and procedures.</p>	<p>Notify Team Leader Water. Quality. Review operations and maintenancerecords for anomalies</p> <p>Commence investigation to determinecause, if not identifiable through operational records</p> <p>Investigate immediate remediationactions</p> <p>Increase operational monitoringfrequency where required</p>	<p>Operations and maintenance records andprocedures.</p> <p>DSC DWQMP.</p> <p>Routine monitoring</p>

Operational actions

At this level, operational actions are required to manage the issue and prevent escalation.

Issues at this level are identified by implementation of the CCP Procedures. Corrective actions will be taken according to the specific CCP - either at the adjustment or at the critical limit.

Exceedance of a critical limit does not automatically escalate a CCP response to the next incident and emergency level if the water quality criteria are not breached.

Reportable incident or emergency

At this level, there is a potential for an adverse public health impact (or environmental harm).

These issues are identified through either operational or verification monitoring of the processes and water quality, or where there has been a significant widespread treatment or reticulation network failure resulting in the loss (or likely loss) of water supply for a period >6 hours. When identified, these issues are escalated as required.

In general, the Team Leader Water Quality still manages the incident, but in close consultation with the Coordinator Water and Wastewater.

Appropriate corrective actions will be identified and implemented as soon as practicable to minimise the effect of the incident.

Flow charts indicating Council actions to detections of exceedances of water quality criteria are included in the following pages.

Incidents at this level are reportable to the Regulator. Douglas Shire Council will inform the Regulator within three hours of becoming aware of the incident (three hours allows sufficient time to investigate the cause of the incident and commence corrective actions as soon as possible). Advice may be directly sought from Queensland Health if we believe expert health advice is required.

Resampling: A resample will be arranged immediately (prior to corrective actions) for any parameter where the initial sample did not meet the ADWG health guideline value and another sample taken when corrective actions have been implemented.

Declared disaster

The CEO and the Coordinator of the Local Disaster Management Group (LDMG) activate the Disaster Management Plan/ a Disaster is declared by the State Government.

This requires coordination across Council departments and requires external resourcing and support from agencies, such as Queensland Fire and Emergency Services, Department of Regional Development, Manufacturing and Water, Department of Health, local disaster management groups, emergency responders like Fire and Rescue and Police.

When a Disaster Management Group is stood up, drinking water quality management actions will be taken as necessary to respond to the requirements of the Disaster Coordinator. The Manager Water and Wastewater is a core member of the LDMG and will report directly to the Coordinator of the LDMG on water requirements.

While every effort will be made to continue to implement the Drinking Water Quality Management Plan, Disaster Management actions may take precedence. Every effort will be made to keep the Regulator informed of the situation as soon as practicable.

E. coli Response Process and Decision Tree

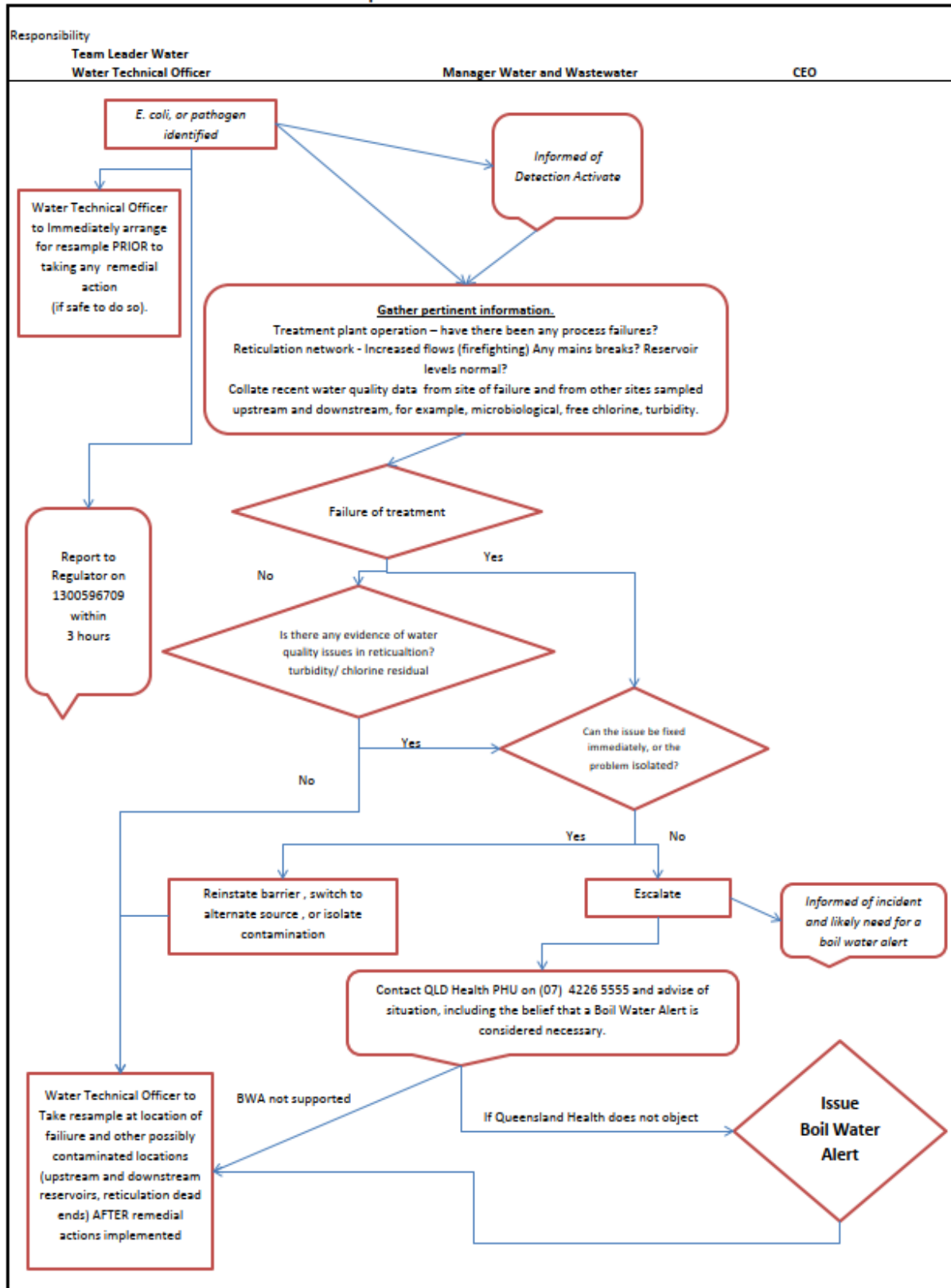


Figure 15. E coli response protocol

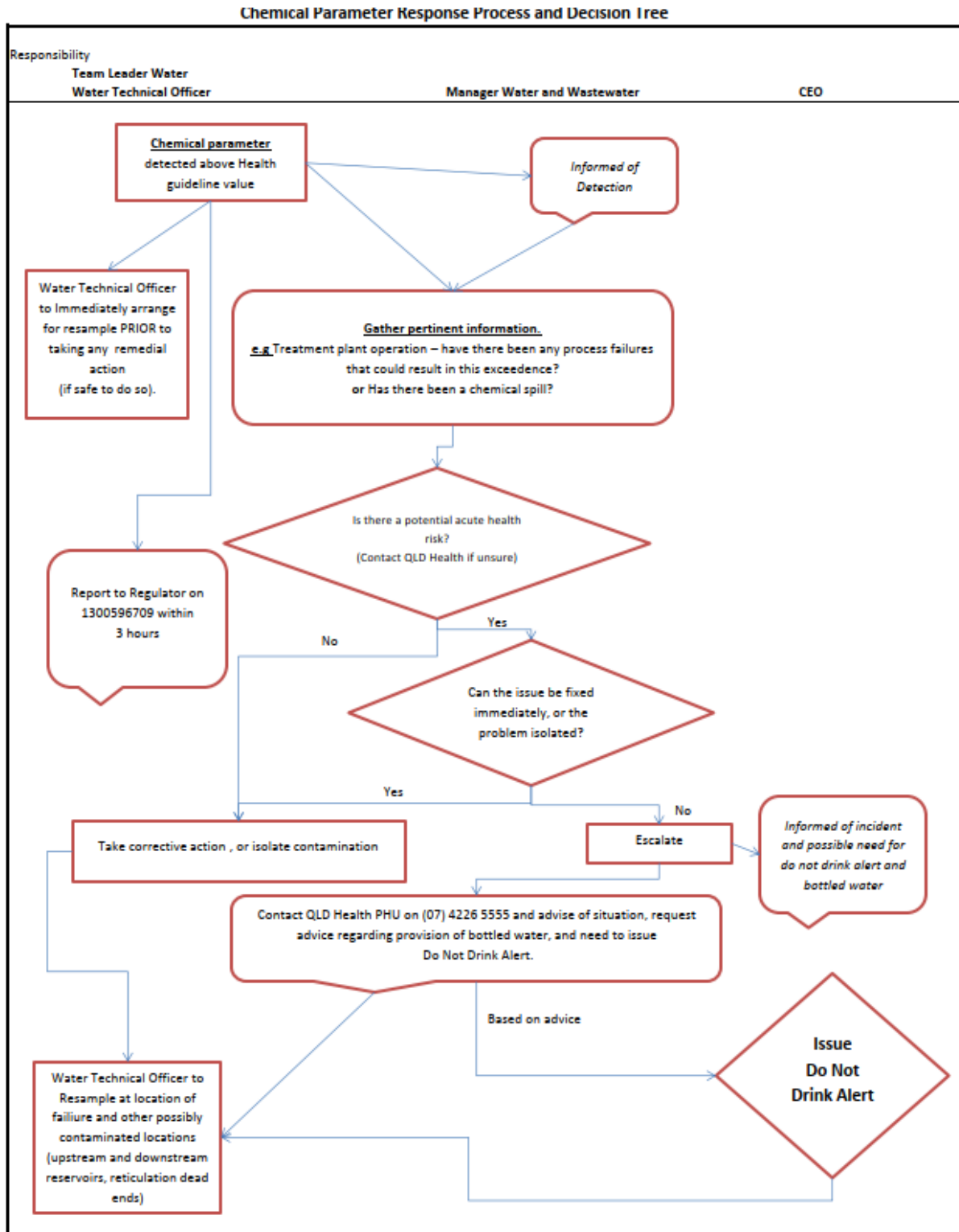


Figure 16. Chemical exceedance response protocol



Precautionary Boil Water Alert
DATE IN EFFECT

Douglas Shire Council advises that consumers in << **Delete any areas that are DEFINITELY not affected** Daintree, Whyanbeel, Rocky Point, Wonga Beach, Cassowary, Mowbray, Craiglie, Port Douglas, Mossman, Cooya Beach, Newell Beach, >> should boil all drinking water until further notice.

The water treatment plant is unable to operate normally at this time.
(OR INSERT OTHER REASON)

As a precaution you are advised that water used for consumption should be brought to the boil (for example in a kettle). Water should be transferred to a clean container with a lid and refrigerated or allowed to cool before use.

Boiled or bottled water should be used for:

- Drinking,
- Preparing or cooking food or drinks,
- Washing raw foods such as fruit and vegetables
- Making baby formula,
- Preparing beverages and making ice,
- Brushing teeth,
- Babies and toddlers should be sponge bathed,
- Children should take boiled or bottled water to school.

Be careful to avoid being scalded when handling hot water.

Dishes can be washed in a dishwasher, or can be washed in hot soapy water and dried before using.

Residents can continue to shower and wash clothes as normal.

Douglas Shire Council is working hard to fix the problem.

Further information has been published on Councils website.



Boil Water Alert - *Cryptosporidium (or Giardia)* contamination
DATE IN EFFECT

Douglas Shire Council advises that consumers in << **Delete any areas that are DEFINITELY not affected** Daintree, Whyanbeel, Rocky Point, Wonga Beach, Cassowary, Mowbray, Craiglie, Port Douglas, Mossman, Cooya Beach, Newell Beach, >> should boil all drinking water until further notice.

Regular monitoring has detected the presence of *Cryptosporidium / Giardia* in your water supply. These organisms may cause gastrointestinal disease.

Anyone with symptoms such as diarrhoea, abdominal pain, slight fever or vomiting should contact their doctor.

As a precaution you are advised that water used for consumption should be brought to the boil (for example in a kettle). Water should be transferred to a clean container with a lid and refrigerated or allowed to cool before use.

Boiled or bottled water should be used for:

- Drinking,
- Preparing or cooking food or drinks,
- Washing raw foods such as fruit and vegetables
- Making baby formula,
- Preparing beverages and making ice,
- Brushing teeth,
- Babies and toddlers should be sponge bathed,
- Children should take boiled or bottled water to school.

Be careful to avoid being scalded when handling hot water.

Dishes can be washed in a dishwasher, or can be washed in hot soapy water and dried before using.

Residents can continue to shower and wash clothes as normal.

Special care is advisable for certain consumers at this time - these include: people with severely weakened immune systems (the immunosuppressed), individuals receiving dialysis treatment, and aged individuals.

Please contact your doctor or 13 HEALTH for more information.

Douglas Shire Council is working hard with Queensland Health to fix the problem as soon as possible.

Further information has been published on Councils website.



Lifting of Boil Water Alert
DATE IN EFFECT

Douglas Shire Council advises that consumers in << **Delete any areas that are DEFINITELY not affected** Daintree, Whyanbeel, Rocky Point, Wonga Beach, Cassowary, Mowbray, Craiglie, Port Douglas, Mossman, Cooya Beach, Newell Beach, >> no longer need to boil their water.

Please run your internal drinking water taps for 5 minutes prior to ceasing boiling water to ensure that any water remaining in your household pipes has been removed.

We apologise for the inconvenience and thank you for your understanding.



DO NOT DRINK ALERT
DATE IN EFFECT

Douglas Shire Council advises that consumers in << **Delete any areas that are DEFINITELY not affected** Daintree, Whyanbeel, Rocky Point, Wonga Beach, Cassowary, Mowbray, Craiglie, Port Douglas, Mossman, Cooya Beach, Newell Beach, >> to DO NOT DRINK tapwater until further notice.

Douglas Shire Council is concerned that the water supply may have been contaminated with (WHAT). And that the water supply may not be safe for consumption.

If you have consumed the water and are feeling unwell, contact your family doctor or Queensland Health on 13 HEALTH.

Bottled will be provided at:

LOCATION
and TIME

OR

Drinking water will be available for collection at:

LOCATION
and TIME

Douglas Shire Council is working hard with Queensland Health to fix the problem.

Further information has been published on Councils website.



Boil Water Alert – detection of *E. coli*
DATE IN EFFECT

Douglas Shire Council advises that consumers in << **Delete any areas that are DEFINITELY not affected** Daintree, Whyanbeel, Rocky Point, Wonga Beach, Cassowary, Mowbray, Craiglie, Port Douglas, Mossman, Cooya Beach, Newell Beach, >> should boil all drinking water until further notice.

Regular monitoring has detected the presence of *E. coli* bacteria in your water supply. *E. coli* itself is generally not harmful but its presence in drinking water does indicate that the water supply *could be* contaminated with organisms that could cause gastrointestinal disease.

As a precaution you are advised that water used for consumption should be brought to the boil (for example in a kettle). Water should be transferred to a clean container with a lid and refrigerated or allowed to cool before use.

Boiled or bottled water should be used for:

- Drinking,
- Preparing or cooking food or drinks,
- Washing raw foods such as fruit and vegetables,
- Making baby formula,
- Preparing beverages and making ice,
- Brushing teeth,
- Babies and toddlers should be sponge bathed,
- Children should take boiled or bottled water to school.

Be careful to avoid being scalded when handling hot water.

Dishes can be washed in a dishwasher, or can be washed in hot soapy water and dried before using.

Residents can continue to shower and wash clothes as normal.

Douglas Shire Council is working hard with Queensland Health to fix the problem.

Further information has been published on Councils website.

ELEMENT 7: EMPLOYEE AWARENESS AND TRAINING

Employee awareness

Water treatment operators are essential to ensure the safe operation of water treatment plants, and in implementing the actions identified in this plan. To engage operators, much of the development of these plans was done in conjunction with operators. It is intended that the DWQMP becomes a useful document within Council that is implemented by the operators, but equally used by managers to demonstrate the need for change and justify budgetary expenditure. It is an expectation of Council and the Coordinator Water and Wastewater that this plan is understood and implemented by relevant staff.

An additional requirement is that staff are aware of their environmental obligations. As such, this plan includes details of how staff are to ensure that they do not cause general environmental harm, nor act contrary to our integrated environmental authority.

Water treatment staff are aware of the actions that they may take at the water treatment plant intakes and into the World Heritage catchment and are also aware that discharges can impact on the Great Barrier Reef.

Employee training

Plant operators and Network (reticulation system) operators were instrumental in developing and reviewing this plan. Operators ensured that the scheme description and operational details were correct and actively participated in the risk workshop. In so doing, this ensured that they are familiar with the plan and their requirements under the plan.

Internal training for operational staff is conducted by way of Toolbox Talks. These are short group information sessions that ensure staff know their responsibilities and are made aware of any changes that affect their daily work processes and tasks.

All plant operators have Cert III in Water Operations. Assistant trainees are currently completing their Cert IIIs consistent with the National Certification Framework for water treatment operators. Douglas Shire Council maintains a list of the relevant qualifications and certifications of operational staff. It is the intent to ensure that all operators maintain competency in the appropriate units applicable to Douglas Shire Council. In addition, specific environmental training may also be considered.

ELEMENT 8: COMMUNITY INVOLVEMENT AND AWARENESS

Council is aware of the importance of keeping our customers informed of significant issues, and significant improvements. Council has engaged with our customers directly, through community meetings, and continues to update the information on our website to provide information. Council clearly states the level of service that customers can expect through our published customer service standards.

Other information is provided at <http://douglas.qld.gov.au>

Specific water related issues are included in our Council alerts. Council encourages two-way communication and includes relevant contact details on our webpage.

ELEMENT 9: RESEARCH AND DEVELOPMENT

Council undertakes several activities that can be considered as research and development. For example, the testing, validation, and optimisation of new equipment prior to placing it into service.

Council recognises that there is further scope to formalise activities such as the validation of existing barriers. This may become essential if the ADWG adopts microbiological health-based targets.

Health based target initial assessment

The catchment (World Heritage Protected Area with minimal or no human activity) is conservatively rated as a Category 2 catchment based on elevated E. coli results in raw water.

The CCPs for these schemes ensure that we can claim the maximum allowable log reductions for ultrafiltration, and 4-log reduction for bacteria and viruses from chlorination. UV may not be necessary (except in Whyanbeel where, if UF had to be operated outside of the PDT CCP as there is only one rack, if the turbidity was <1 NTU, UV would compensate).

This will be further explored if health-based targets are required to be assessed under the Queensland legislative requirements.

ELEMENT 10: DOCUMENTATION AND REPORTING

There are numerous elements of documentation and reporting that are essential to the safe management of the drinking water supply.

Record keeping

Primarily, Douglas Shire Council uses a system called MagiQ to manage documents and records. This is essentially the same as the previous InfoExpert documentation system. MagiQ has the capability to 'publish' versions to ensure staff members only access the approved and up to date version of documents, there is also the capability to track the history of access to a document in the event of changes being made without prior approval. Records can also have comments within the version field to allow updates and review to be tracked against the version changes.

Douglas Shire Council has Administration Instructions dealing with record keeping and security. There is also a manual available regarding how to use the MagiQ system.

All documents in MagiQ are accessible by management, team members and other internal staff. A copy of the latest version and the relevant documents that apply to their work are available in hard copy, for example, on notice boards within the depot and plants.

Records, and as developed, procedures are saved into MagiQ where they receive a unique document number.

In addition to the MagiQ system, there are other methods in which records are collected and stored. At the water treatment plants, daily sheets are manually filled out to record operational parameters, and these are stored in hard copy at the WTP. WTP monthly and quarterly reports are provided to the Manager Water and Wastewater electronically and are captured in MagiQ.

Continuous online operational data is captured and stored by the SCADA system. The current system retains 12 months of data to allow operators to look at annual trends and archives all older data.

Verification monitoring data is entered weekly into MagiQ, and quarterly and annual reports are prepared by the Environmental Support Officer Water and Wastewater and signed off by the Manager. The Manager Water and Wastewater also reports quarterly to Councillors on all water matters.

All records are kept in accordance with Public Records Act requirements.

Procedures

The key procedures for the safe operation of the Douglas Shire Council drinking water schemes are the CCP Procedures. These procedures identify the daily tasks of the operators, and the action and critical responses that are required to prevent a barrier from going out of control.

Reporting processes are the responsibility of the Team Leader Water Quality and Environmental Technical Officer and signed off by the Manager Water and Wastewater.

Cyber security

In 2015, the Queensland Audit department undertook an in depth look into Council ICT environment and operations. This included the water and wastewater systems. As a result, systems and controls were enhanced to reach the current state, as described below.

An example of the work undertaken at that time is the virtual partitioning of Council's network, such that water and wastewater systems cannot see / talk to the general voice and data network on which administrative systems and users sit. Thus, a malware infection in one system does not affect the operation and cannot move from one network to the other.

Council retains the systems integrator (Welcon) who specialise in water and wastewater systems and in particular the SCADA (Supervisory Control And Data Acquisition) computer systems Council uses to manage its plants. Welcon are primarily responsible for the configuration and maintenance of the SCADA system, as they do for many shires in FNQ. Given the current controls and systems design Council regards the water and wastewater systems to be at low risk of a cyber-attack. The controls and protections are described in overview below.

Improvement planning an opportunities

As cyber security risks continue to broaden and deepen, Council has made additional enhancements to its business systems ICT environment and data networks. The business systems ICT environment and data networks were considered first for upgrades, given the closed and partitioned nature of the water and wastewater network / systems, i.e. the water and wastewater systems are less open to attack.

During the financial year 2020-21, Council intends to plan the rollout of further protections for the water and wastewater systems. This is likely to take the form of rolling out several of the same technology / systems used in the Business systems ICT environment and data networks. An example of such a system would be intrusion detection clients on all computers in the water and wastewater system.

Background to Council's systems

Council maintains three water treatment plants, all managed using SCADA monitoring and control software. Council staff are responsible for the day-to-day activity, while Welcon assist with event escalation, maintenance, and troubleshooting.

None of the water treatment plants can be manually operated. However, all the water treatment plants have water reservoirs and therefore can operate for periods of hours to days without SCADA automation.

At the Mossman WTP manual control, whilst achieving full plant performance, is not possible without the use of the SCADA systems. The SCADA software is configured in a hot standby configuration/architecture on two separate servers to allow for high levels of redundancy.

Current protections

Physical Security

CCTV has been installed at all sites, as a deterrent and to assist police investigating break-ins. No break-ins have occurred in the last 6 years. Water treatment plants are secured by physical locks and keys – both to the site and the control room.

eSecurity

User Access

Access to SCADA systems can be performed remotely or by access to the servers themselves. Depending upon how access is performed up to four levels of authentication / password protection is required. All external access into any of the SCADA networks is secure.

Firewall and Server protections

Council's firewall has been configured to support the partitioning of Council's network as described earlier. So, SCADA defined users only see the SCADA network. Only the minimum number of IP addresses and ports are permitted by the firewall to / from the SCADA network. The firewall runs an intrusion prevention module, which in addition to sending alarms and notifications, can cut off traffic if tolerances are triggered. This provides protection for common attacks such as Denial of Service. The servers have virus scanners on them. All USB ports on computers are physically locked with commercial port blockers to prevent unauthorised USB flash drives being inserted.

Cyber security incidents/breaches

The Queensland government has a dedicated Cyber Security Unit (CSU) which assists agencies and to keep them secure from cyber-attacks. The CSU has an agreement with Local Government to provide cyber security services including access to the Queensland Government Information Security Virtual Response Team (QGISVRT). Any cyber security incident or breach will be reported to the QGISVRT (see details below):

Queensland Government Information Security Virtual Response Team (QGISVRT)

Phone: - 07 3215 3951

Email: - qgisvrt@qld.gov.au

Website: - [Cyber Security | Queensland Government Enterprise Architecture \(qgcio.qld.gov.au\)](https://www.qld.gov.au/cyber-security)

Cyber incidents/breaches must also be reported to the Regulator.

Routine maintenance, backup and restoration of services

Routine maintenance

Quarterly on-site visits are performed by Welcon where the system performance and hardware operation are checked and any required software upgrades/patching is performed. SCADA software updates for security vulnerabilities are very rare. The risk to Council from SCADA software vulnerabilities is considered low as there is no external integrations – all of Council’s SCADA systems operate in a closed network. Traffic in and out of this closed network is tightly managed via the firewall and VPN tunnels.

Backup and restore/rebuild

The servers where the application and data reside have been configured with redundancy in mind, e.g. RAID disk arrays. Council’s SCADA systems are backed up quarterly by Council’s systems integrator. Backups include the Programmable Logic Controllers (PLCs) and SCADA configurations. While data in these systems is transient, the configurations seldom change. The backups allow for reconfiguration/reinstallation of any failed part of the system.

The backups are kept on the SCADA servers onsite, as well as within Welcon’s secure storage network. Data is transferred using secure VPN tunnels. The Welcon storage network consists of four geographically separated online copies, plus weekly offline backups. Welcon has policies around password expiry and complexity to safeguard client’s data.

Previous experience has shown that a SCADA server can be rebuilt/restored to normal operation within 24 hours. Staff within Welcon have access to client data. Each Welcon staff member has signed the appropriate non-disclosure/probity agreements.

ELEMENT 11: EVALUATION AND AUDIT

Long-term evaluation of water quality results and audit of the drinking water quality management are required to determine whether preventive strategies are effective and whether they are being implemented appropriately. These reviews enable performance to be measured against objectives and help to identify opportunities for improvement.

Long-term evaluation of results

Water quality has been assessed as part of the risk assessment process and will continue to be reviewed on an annual basis and prior to reviews, budgeting process and strategic planning process. Annual water quality summaries will be included in the DWQMP report, and this data used to inform future reviews of the DWQMP. The long-term evaluation of results will include:

- Critical control point performance
- Water quality data results
- Incident history and response
- Levels of service
- Actions against the improvement plan

Audits

Auditing is the systematic evaluation of activities and processes to confirm that objectives are being met. It includes assessment of the implementation and capability of management systems. Auditing provides valuable information on those aspects of the systems that are effective, as well as identifying opportunities for improvement.

Regulatory audits

There is a regulatory requirement to audit the DWQMP with the latest date for the audit identified in the Information Notice for the Decision approving the DWQMP. The frequency is currently every four years.

A DWQMP audit was completed in June 2021 by a consultant from Water Futures Pty Ltd, who are Exemplar Global certified drinking water quality management system auditors. The auditor submitted the audit report to the Regulator in June 2021. The purpose of the audit was to:

- Audit the monitoring and performance data provided to the regulator under the plan.
- Assess the service provider’s compliance with the plan; and
- Assess the relevance of the plan in relation to the provider’s drinking water service.

No non-conformances with the Act were noted during the audit. However, several opportunities for improvement (OFIs) were identified during the audit and these have been included in DWQMP risk management process. The audit noted that the Council had made excellent progress within the audit period with respect to reducing risks and innovating in water quality management. Table 17. provides a summary of results presented against auditable elements.

Table 17. Summary of DWQMP audit results

Topic area	Compliance
Audit topic	Summary of compliance status
Verify accuracy of monitoring and performance data communicated to DRDMW	
Verification monitoring	Compliant
Operational monitoring	Compliant
Additional monitoring and performance data (if any) as provided in the Annual Report	Not applicable
Assessment of compliance with the DWQMP	
Implementation of all preventive measures for managing hazards and hazardous events (including those applied in the distribution/reticulation network).	<p>Compliant</p> <p>As OFIs, Council may wish to consider:</p> <ul style="list-style-type: none"> • Promoting and supporting efforts to control feral animal activity in the water supply catchment.

	<ul style="list-style-type: none"> Removing treatment process bypasses, or putting in place measures such as tags, locks and double-block-and-bleed, or similar protection, to prevent bypasses due to valve failure, leakage, or mis-operation.
Implementation of operational and maintenance procedures (including instrument calibration), including availability and currency of the procedures.	<p>Compliant</p> <p>As OFIs, Council may wish to consider:</p> <ul style="list-style-type: none"> Developing means of safely inspecting treated water storage reservoirs regularly and after high wind events to provide early warning of the opportunity for potential runoff or vermin ingress. Setting defined tolerances for acceptable discrepancies between online and benchtop results for critical limit monitoring instruments.
Implementation of the process for managing incidents and emergencies including reporting requirements to the Regulator.	Compliant
Implementation of the operational (including CCPs, as relevant) and verification monitoring programs.	Compliant
Implementation of the risk management improvement program	Compliant
Maintaining records using the systems as described	Compliant
Assessment of compliance with DWQMP conditions	
Reporting incidents in relation to events that are beyond the control of the service provider and have the potential to impact public health and for failing to meet water quality criteria as defined in the approval notice, and whether preventative measures taken were adequate to control the hazard.	Compliant
Undertaking regular reviews at the frequency specified in the approval notice.	Compliant
The provision and conditions in the approval notice.	Compliant

Internal audits

Douglas Shire Council may also undertake internal audits periodically to satisfy ourselves that we are consistently and demonstrably providing safe water. Where an internal audit is undertaken, the audit outcomes will not be provided to the regulator or made public. Internal audits may address any aspect of drinking water management, for example:

- Implementation of CCPs and responses to exceedances

- Progress against the improvement plan
- Record keeping
- Data collection and management, including reporting requirement
- Creation of an SOP.

Drinking water quality management plan report

The DWQMP report will be prepared per the guideline and will be published on Council's website to provide customers information on our service.

ELEMENT 12: REVIEW AND CONTINUAL IMPROVEMENT

Review

There is a regulatory requirement to review the DWQMP biannually. The current review and amendment of the DWQMP has been conducted following the external audit of our DWQMP, even though the audit noted no non-conformances.

Council may review more frequently if we believe the DWQMP needs to be updated.

Continual improvement – risk management improvement plan

The purpose of the DWQMP is to identify and manage risks to the services. Improvements are continually being made to water treatment plants and include both larger items identified in the risk management improvement program, and smaller changes to operation or monitoring.

Where Council identifies improvements that can be made, they are implemented. As improvements are intended to reduce the risks to the schemes, this is good management practice. Over time, this will result in slight differences between the management plan and actual operations. This should be expected.

Where outcomes of the scheme-by-scheme risk assessments resulted in mitigated risks that were above medium, risk management improvement items have been identified.

These are listed in the final 3 columns of the mitigated risk assessment tables.

The items have been prioritised according to budget cycles. Where an item is required immediately, Council will undertake actions as soon as practical. Otherwise, items are identified as occurring in particular financial years, as this aligns with Council's budget cycles.

Note: items in the risk management improvement program are indicative of an action that would be suitable to manage the risk. Where alternative measures can be introduced that will similarly result in a reduction of the risk, these alternate actions may take the place the identified items.

As stated, the RMIP informs the capital and operational works planning process. This is done by using the risk assessment and its outcomes and deciding upon the appropriate actions to minimise risks into the future.

The Manager Water and Wastewater and the Coordinator Water and Wastewater are intimately involved in developing the budget and communicating it to the Council Executive and the Councillors.

The current Council is aware of how the DWQMP is developed, and the linkages of capital works projects to identified risks. It is the intent of Douglas Shire Council to continue to engage with Councillors to ensure that the risk management improvement items are prioritised. However, this is dependent on the Council, and their decisions regarding budget allocation. Where Council does not approve budget items, they will be revisited as required, but may not occur in the stated timeframe. Nonetheless, Council is committed to delivering safe drinking water.

APPENDIX A – WATER QUALITY DATA 2014-2022

Mossman treated water – WTP, reservoirs and reticulation

Parameter	No of samples taken	Max	Average	Min	ADWG Health Guideline	No of samples exceeding ADWG
Alkalinity (mg/L)	304	22	7	<5		0
Colour (PCU)	881	6.5	<5	<5		0
Copper (mg/L)	885	0.368	0.007	<0.001	2	0
Free Chlorine (mg/L)	3775	2.1	0.7	<0.1	5	0
Iron (mg/L)	863	0.43	0.008	<0.005		0
Lead (mg/L)	729	0.004	<0.001	<0.001	0.01	0
Manganese (mg/L)	863	0.012	<0.0002	<0.0002	0.5	0
pH (pH unit)	4373	10.4	7.3	5.4		0
<i>E.coli</i> (MPN/100ml or CFU/100ml)	4150	1*		<1	Ann value nil found in 98% of samples	0

- Total of 3 samples registered 1 (10/12/2014, 18/3/2015, 24/5/2016 – repeat NATA testing <1).

Mossman raw

Parameter	No of samples taken	Max	Average	Min
Alkalinity (mg/L)	31	12	5	<5
Calcium (mg/L)	31	0.7	0.5	0.4
Colour (PCU)	34	15	5.5	<5
Electrical Conductivity (uS/cm)	131	142	30	20
Fluoride (mg/L)	31	0.03	<0.1	0.02
Hardness (mg CaCO ₃ /L)	31	3.1	2.7	2
Magnesium (mg/L)	31	0.4	0.3	0.28
pH (pH unit)	175	7.8	6.9	6.1
Potassium (mg/L)	31	1.1	0.87	0.08
Sodium (mg/L)	31	4.6	3.9	3
Sulphate (mg/L)	31	1.8	1	0.08
Turbidity (NTU)	167	25	0.9	<0.1
Iron (mg/L)	31	0.8	0.04	0.002
Manganese (mg/L)	31	0.03	0.001	<0.005
Total Dissolved Solids (mg/L)	30	44	30	21
Total Nitrogen (mg/L)	29	0.18	0.09	<0.05
Ammonia (mg/L)	29	0.008	<0.005	<0.005
<i>E.coli</i> (MPN/100ml or CFU/100ml)	82	238.2	21.6	1

Whyanbeel treated water – WTP, reservoirs and reticulation

Parameter	No of samples taken	Max	Average	Min	ADWG Health Guideline	No of samples exceeding ADWG
Alkalinity (mg/L)	142	17	9.7	5		0
Colour (PCU)	239	5	<5	<1		0
Copper (mg/L)	239	0.033	0.004	<0.001	2	0
Free Chlorine (mg/L)	1226	2.2	0.7	<0.1	5	0
Iron (mg/L)	239	0.07	0.01	<0.005		
Lead (mg/L)	200	0.001	<0.0005	<0.0005	0.01	
Manganese (mg/L)	239	0.0007	<0.005	<0.005	0.5	
pH (pH unit)	1438	9.3	7.6	4.9		
<i>E.coli</i> (MPN/100ml or CFU/100ml)	1416	<1		<1	Ann value nil found in 98% of samples	0

Whyanbeel raw

Parameter	No of samples taken	Max	Average	Min
Alkalinity (mg/L)	31	8	<5	<5
Calcium (mg/L)	31	0.5	0.4	0.3
Colour (PCU)	34	15	8.1	<5
Electrical Conductivity (uS/cm)	87	104	27	19
Fluoride (mg/L)	31	0.1	<0.02	<0.02
Hardness (mg CaCO ₃ /L)	31	3	2.4	2
Magnesium (mg/L)	31	0.44	0.36	0.3
pH (pH unit)	131	7.8	6.5	5.8
Potassium (mg/L)	31	0.9	0.7	0.5
Sodium (mg/L)	31	4.3	3.5	2.8
Sulphate (mg/L)	31	1.9	1	0.7
Turbidity (NTU)	127	15	0.6	<0.1
Iron (mg/L)	31	0.08	0.03	0.003
Manganese (mg/L)	31	0.001	<0.005	<0.005
Total Dissolved Solids (mg/L)	30	330	34	<0.5
Total Nitrogen (mg/L)	27	0.25	0.1	<0.05
Ammonia (mg/L)	27	0.08	<0.005	<0.005
<i>E.coli</i> (MPN/100ml or CFU/100ml)	78	1203.3	78.1	2

Daintree treated water – Water treatment and reticulation

Parameter	No of samples taken	Max	Average	Min	ADWG Health Guideline	No of samples exceeding ADWG
Alkalinity (mg/L)	48	39	24	5		0
Colour (PCU)	97	8	<5	<5		0
Copper (mg/L)	97	0.27	0.013	0.001	2	0
Free Chlorine (mg/L)	499	1.68	0.7	<0.1	5	0
Iron (mg/L)	97	0.202	0.011	<0.005		0
Lead (mg/L)	81	0.005	<0.0005	<0.0005	0.01	0
Manganese (mg/L)	97	0.03	<0.005	<0.0002	0.5	0
pH (pH unit)	578	8.9	7.6	6.6		0
<i>E.coli</i> (MPN/100ml or CFU/100ml)	4150	1*		<1	Ann value nil found in 98% of samples	0

Daintree raw – intake

Parameter	No of samples taken	Max	Average	Min
Alkalinity (mg/L)	31	45	22	12
Calcium (mg/L)	31	3.3	2.3	1.2
Colour (PCU)	34	45	10	<5
Electrical Conductivity (uS/cm)	91	146	80	50
Fluoride (mg/L)	31	0.06	0.02	<0.1
Hardness (mg CaCO ₃ /L)	31	20	15	9
Magnesium (mg/L)	31	2.8	2.1	1.4
pH (pH unit)	96	7.7	7	5.6
Potassium (mg/L)	31	2.2	1.3	0.9
Sodium (mg/L)	31	11	9.1	7
Sulphate (mg/L)	31	2.4	1.7	<1
Turbidity (NTU)	88	52	2.5	0.2
Iron (mg/L)	31	0.4	0.2	0.078
Manganese (mg/L)	31	0.009	<0.005	0.0008
Total Dissolved Solids (mg/L)	30	77	62	4
Total Nitrogen (mg/L)	27	0.29	0.15	<0.05
Ammonia (mg/L)	27	0.01	<0.005	<0.005
<i>E.coli</i> (MPN/100ml or CFU/100ml)	82	770	63.1	1

Daintree raw – bore

Parameter	No of samples taken	Max	Average	Min
Alkalinity (mg/L)	15	8	4	2.7
Calcium (mg/L)	16	0.34	0.2	0.1
Colour (PCU)	18	3.5	<5	<1
Electrical Conductivity (uS/cm)	52	76	47	37
Fluoride (mg/L)	12	<0.1	<0.02	<0.02
Hardness (mg CaCO ₃ /L)	14	6	4	3
Magnesium (mg/L)	12	0.97	0.8	0.7
pH (pH unit)	66	7.4	5.2	4.2
Potassium (mg/L)	14	1.1	0.9	0.5
Sodium (mg/L)	16	6.2	5.5	4.9
Sulphate (mg/L)	12	1.8	1.6	1.2
Turbidity (NTU)	51	6	0.7	<0.1
Iron (mg/L)	42	0.665	0.096	0.005
Manganese (mg/L)	23	0.0279	0.0075	0.0046
Lead (mg/L)	42	0.01	0.0027	<0.0005
Total Dissolved Solids (mg/L)	14	47	39	16
Total Nitrogen (mg/L)	11	0.75	0.53	0.36
Ammonia (mg/L)	13	<0.02	<0.005	<0.005
<i>E.coli</i> (MPN/100ml or CFU/100ml)	46	15	5.77	<1

Daintree raw – rainwater system

Parameter	No of samples taken	Max	Average	Min
Alkalinity (mg/L)	5	7	<1.5	<1.5
Calcium (mg/L)	5	0.35	0.15	<0.1
Colour (PCU)	5	6.9	2.5	<1
Electrical Conductivity (uS/cm)	12	186.4	41	1.5
Fluoride (mg/L)	5	<0.1	<0.02	<0.02
Hardness (mg CaCO ₃ /L)	4	4.3	2	<1
Magnesium (mg/L)	5	0.83	0.3	<0.05
pH (pH unit)	13	6.5	5.9	5.3
Potassium (mg/L)	5	0.39	0.16	<0.015
Sodium (mg/L)	5	6.1	2.5	<0.05
Sulphate (mg/L)	4	2.1	<1	<1
Turbidity (NTU)	11	2	0.8	0.03
Iron (mg/L)	5	0.006	<0.015	<0.015
Manganese (mg/L)	5	0.0048	0.0021	0.0003
Total Dissolved Solids (mg/L)	3	21	14	2.5
Total Nitrogen (mg/L)	3	0.12	0.07	<0.1
Ammonia (mg/L)	3	<0.02	<0.02	<0.02
<i>E.coli</i> (MPN/100ml or CFU/100ml)	9	1732.9	284.1	6.3

THM investigation results – 2014 - 2018

Parameter	No of samples taken	Max	Average	Min
THM Chloroform (ug/L)	132	160	49.1	<0.5
THM Bromodichloromethane (ug/L)	132	16	6.2	<0.5
THM Bromoform	132	<1.0	0.5	<0.5

APPENDIX B – DAINTREE BORE DETAILS

Bore 00241

