

5.4. DRINKING WATER QUALITY MANAGEMENT PLAN REVISED VERSION

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DEPARTMENT Water and Wastewater

RECOMMENDATION

That Council endorses the 2020 revised version of the Drinking Water Quality Management Plan for Douglas Shire Council.

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 2011 (ADWG) and the *Water Supply (Safety and Reliability) Act 2008* (WS Act). The DWQMP describes the Mossman/Port Douglas, Whyanbeel and Daintree drinking water schemes operated by Douglas Shire Council from catchment to tap.

It is a legislative requirement that a water service provider reviews their DWQMP every two years. If the review identifies that minor or major changes are required in the DWQMP, then the plan shall be submitted to the regulator (Department of Regional Development, Manufacturing and Water (DRDMW), formerly DNRME) for approval.

In March 2020, Douglas Shire Council conducted a review of their DWQMP and it was identified that the Water and Wastewater Department was required to make minor amendments to the plan, requiring regulator approval. The key amendments of the DWQMP are detailed below.

BACKGROUND

Douglas Shire Council submitted an amended DWQMP application to the Department of Natural Resources, Mines and Energy (DNRME - the regulator) for approval on 13 May 2020. The key amendments included:

- Updating system details and risk assessment considerations for modifications to the following schemes.
 - Adding the backwash recovery plant at Mossman Water Treatment Plant.
 - Adding the Daintree bore and Daintree rainwater system as point sources for raw water supply for the Daintree scheme.
- Changes to monitoring and telemetry (SCADA) system.
- Include cyber security as an identified risk in the risk assessment.
- Update documented procedures, including newly created procedures.
- Update the Risk Management Improvement Plan.
- Update the verification monitoring program.

The Regulator issued an information requirement notice to obtain further information about Council's amended DWQMP, this information was submitted on 30 September 2020. The amendments in the DWQMP application were submitted in accordance with the information requirement notice issued by DNRME.

On 10 December 2020, DNRME approved Douglas Shire Council's amended DWQMP with standard conditions. See attached DWQMP revised version.

The DWQMP is openly linked to Council's Water and Wastewater Customer Service Standards in ensuring Council's level of service in supplying and delivering drinking water meets legislative compliance and does not create a public health risk.

COMMENT

Council's water treatment plant operators are essential to ensure the safe operation of water treatment plants, and in implementing the actions identified in this plan. The revision of the DWQMP was performed in consultation with the water plant operators to ensure alignment of procedures.

The DWQMP is an essential document to guide operators and management in current and future operational infrastructure requirements and performance parameters.

It is also a requirement that water treatment plant operators are aware of their environmental and operational obligations and risks associated with operating and managing water treatment plants within Douglas Shire.

PROPOSAL

The DWQMP has been approved by the Regulator, Water and Wastewater presented the amended DWQMP to the council workshop on 19 January 2021. It is proposed that Council endorses the revised version of the DWQMP and once endorsed by Council, Water and Wastewater department will notify the regulator.

FINANCIAL/RESOURCE IMPLICATIONS

The risk table within the DWQMP outlines potential risks associated with operating a potable water supply and emphasises the requirement for this management plan.

RISK MANAGEMENT IMPLICATIONS

Council as a registered water service provider has a statutory obligation to ensure it can provide water services to customers. The DWQMP provides information on strategies and procedures on how to ensure safe drinking water for the community, as well as minimising risks to council infrastructure, public health and occupational health and safety risks.

SUSTAINABILITY IMPLICATIONS

Economic: Is it essential to adequately maintain water infrastructure in order to provide satisfactory services in support of economic development within Douglas Shire.

Environmental: Failing to provide adequate and compliant water services can lead to environmental harm and breaching of licence conditions. Water treatment staff are aware that the actions they may take throughout the water treatment process may impact the World Heritage Catchments, as well as the Great Barrier Reef.

Social: The community expects fully operational and compliant water services.

CORPORATE/OPERATIONAL PLAN, POLICY REFERENCE

This report has been prepared in accordance with the following:

Corporate Plan 2019-2024 Initiatives:

Theme 3 - Leading Environmental Stewardship

Our visitors and residents deeply value the unparalleled environment in which we live. We recognise our responsibility in protecting and preserving our natural world for generations to come. We understand the strong link between the environment and the economy: they are interdependent.

Douglas Shire will be at the forefront of environmental protection by developing strategies, setting policies, and working with all stakeholders to become the envy of and to inspire locations across Australia and the World.

Goal 2 - We will implement programs that reduce and offset our environmental footprint.

Goal 3 - We will continue to build water infrastructure so that the Douglas Shire may enjoy water security and water quality.

Goal 4 - We will partner with the community to educate and monitor.

Theme 5 - Robust Governance and Efficient Service Delivery

Strong governance and financial management are the foundations of the way in which Council will conduct its business and implement the initiatives of the Corporate Plan.

Goal 2 - We will put the customer at the centre of our service delivery and process improvement as we deliver efficient and appropriate services based on community expectations.

COUNCIL'S ROLE

Council can play a number of different roles in certain circumstances and it is important to be clear about which role is appropriate for a specific purpose or circumstance. The implementation of actions will be a collective effort and Council's involvement will vary from information only through to full responsibility for delivery.

The following areas outline where Council has a clear responsibility to act:

Builder/Owner	Council makes a significant investment every year in the infrastructure that underpins the Shire through its capital works program. Council will manage its assets with appropriate frameworks and deliver its projects through robust project management.
Regulator	Council has a number of statutory obligations detailed in numerous regulations and legislative Acts. Council also makes local laws to ensure that the Shire is well governed. In fulfilling its role as regulator, Council will utilise an outcomes based approach that balances the needs of the community with social and natural justice.

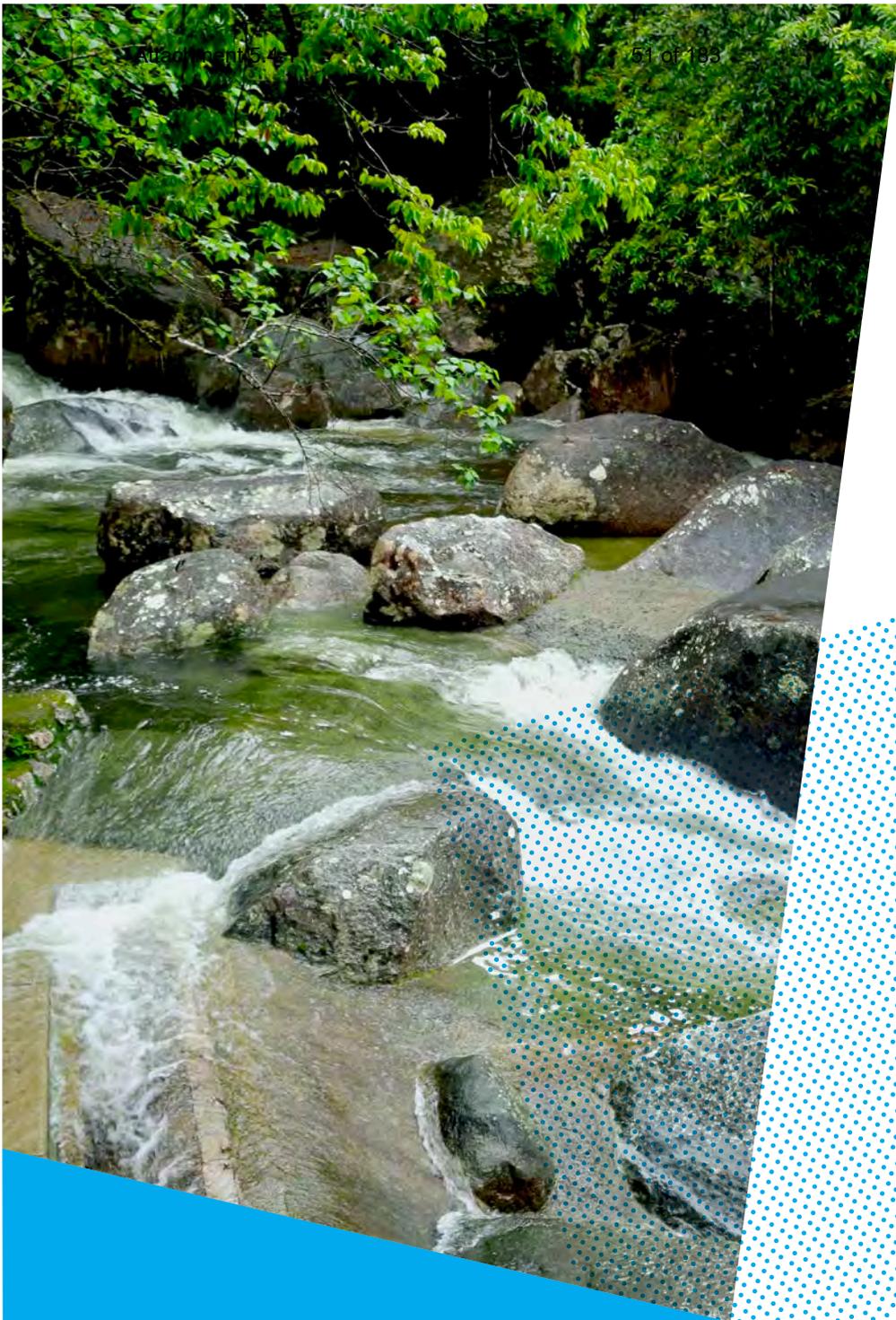
CONSULTATION

Internal: Internal consultation occurred within the Water and Wastewater department.

External: An associate director from Bligh Tanner assisted in compiling and reviewing the revised version the DWQMP.

ATTACHMENTS

1. Douglas DWQMP V 3.1 September 2020 [5.4.1 - 83 pages]



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+ DOCUMENT

'Drinking Water Quality Management Plan

+ JOB NUMBER

'2017.0720

+ PROJECT MANAGER

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Douglas Shire Council

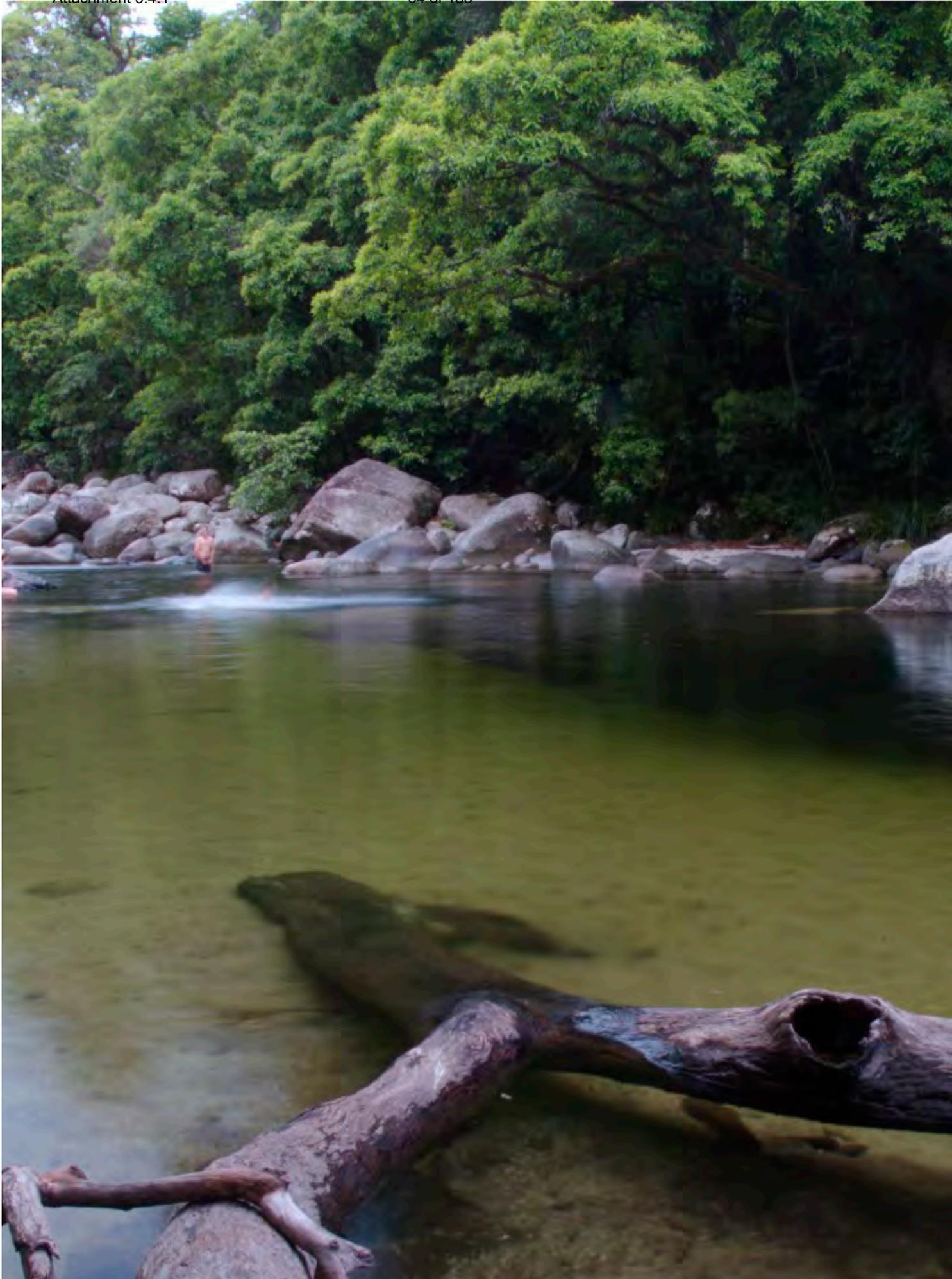
+ CLIENT CONTACT

Peter Tonkes

VERSION	AUTHOR	REVIEWED	APPROVED	DATE
1.0	Michael Lawrence	Wouter van der Merwe		August 2015
1.1	Michael Lawrence	Wouter van der Merwe	Paul Hoyer	October 2015
2.0	Michael Lawrence	Peter White		October 2017
2.1	Michael Lawrence	Peter White	Nicholas Wellwood	January 2018
3.0	Melissa Mitchell	Peter White/ Michael Lawrence	Peter Tonkes	May 2020
3.1	Melissa Mitchell	Peter White/ Michael Lawrence	Peter Tonkes	September 2020

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Figure 1 – Whyanbeel Intake

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 a number of 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, rechlorination 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	<i>Public Health Act 2005</i>
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
WS Act	<i>Water Supply (Safety and Reliability) Act 2008</i>
WPR	Water Planning and Regulation, Department of Natural Resources Mines and Energy

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 of 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 V3.3 2016), and meets the regulatory requirements of the *Water Supply (Safety and Reliability) Act 2008 (WS Act)*.

Purpose of DWQMP

The Douglas Shire Council Drinking Water Quality Management Plan (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 Licenses under the *Water Act 2000*.

Registered service details

Douglas Shire Council is a registered water service provider, SPID 558, providing drinking water services to ~15000 customers. We supply water to 4 separate schemes of which 3 are potable drinking water services covered in this DWQMP. All 3 schemes are similar in their operation. All potable schemes source water from highly protected catchments, utilising a combination of ultrafiltration 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/ Communities Served	Intake	Current**			Projected in 10 years		
		Population served	Total Connected Properties	Demand ML/annum	Population served	Total Connected Properties	Demand ML/day
Daintree	Intake Creek (Daintree Bore, Daintree Rainwater)	78	34	10.7	86	37	0.03
Daintree (untreated)*	Intake Creek	7			9		0.0003
Mossman and Port Douglas	Rex Creek	13030	5687	3881	1493	6282	11.7
Whyanbeel	Little Falls Creek	1635	711	290.1	1806	785	10.9
Dagmar Heights*	Dagmar Bore	30	13	2.1	33	14	0.006
TOTAL		14773	6445	4184.1	16864	7118	12.7

* non-potable supply. Not discussed further.

** Data as reported in KPI reports 2018/2019

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.

Figure 2 – Drinking Water Policy



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

This policy is to remain in force until otherwise determined by Council.

Manager Responsible for Review: Manager Water and Wastewater

ORIGINALLY ADOPTED: 16/06/2015

CURRENT ADOPTION: 09/07/2019

DUE FOR REVISION: 09/07/2023

Regulatory and formal requirements

The following table lists the regulatory requirements that Douglas Shire Council is required to meet with regard to 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 Water Supply (Safety and Reliability) Regulation 2011	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. 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 Public Health Regulation 2018	Sets minimum sampling frequencies for <i>E. coli</i> as a provider. Council must not provide unsafe water.
Water Act 2000	Council is licensed to extract raw water. + Rex Creek - License #408436 + Little Falls Creek - License #500313 + Daintree - License #408446
Environment Protection Act 1994	Water treatment is considered an environmentally relevant activity when treating >10ML/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) Plumbing and Drainage Regulation (2019)	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).
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.

The catchment is managed under the *Wet Tropics World Heritage Protection and Management Act 1993* but this is not Councils responsibility.

Customer and stakeholder engagement

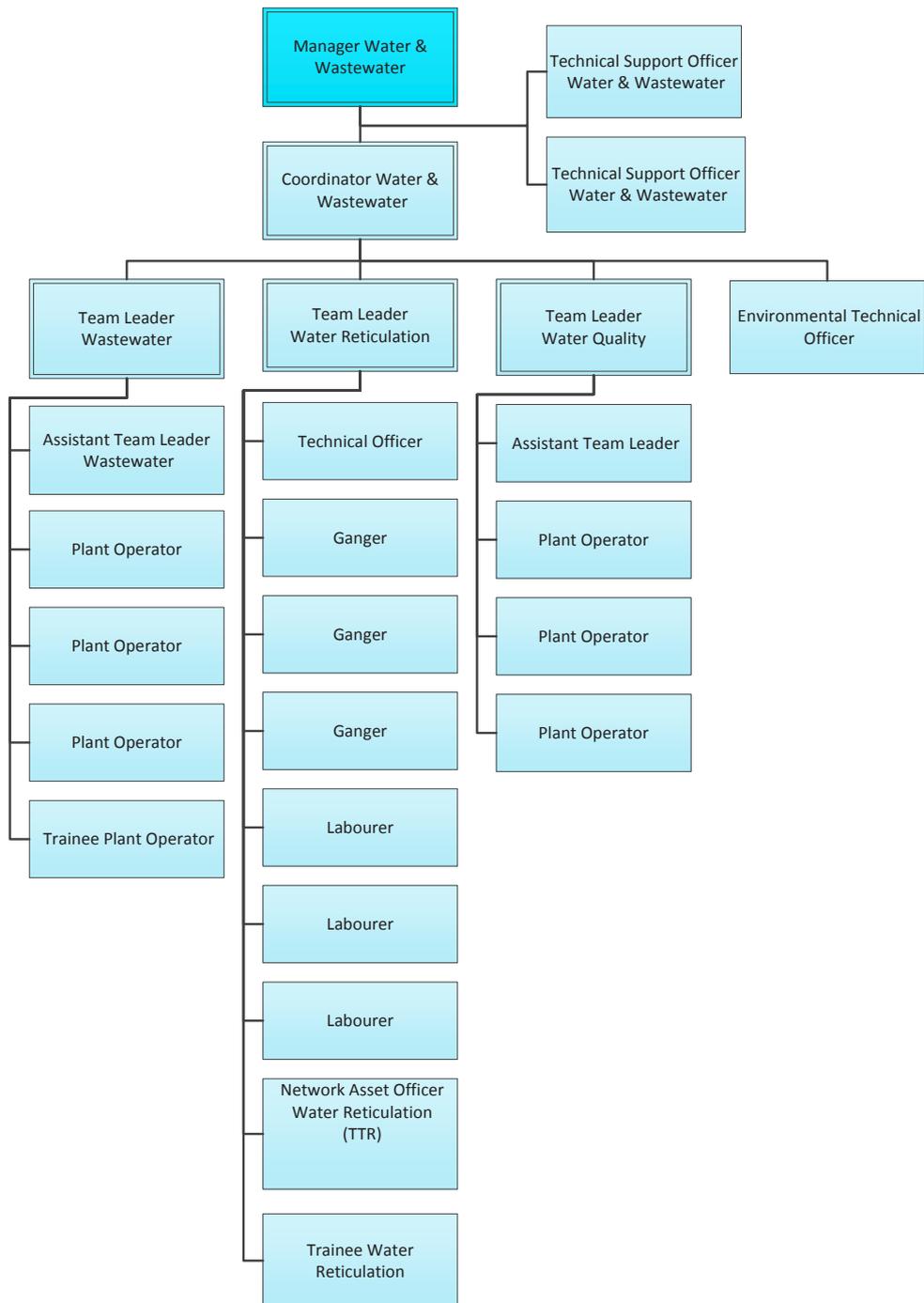
Douglas Shire Council has established customer service standards against which we are able to measure our performance. The most current version of these standards is available on our website at <http://douglas.qld.gov.au/>

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 of 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 3 – 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 Planning and 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 and Mines	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 2805	High Risk Customers
Blue Care	07 4098 1126	High Risk Customers
Douglas Shire Aged Persons Home Inc.	07 4098 8233	High Risk Customers
Meals on Wheels	07 4098 1105	High Risk Customers
Mossman Multi-Purpose Health Service (Hospital)	07 4084 1200	High Risk Customers
Apunipima Cape York	07 4037 7100	High Risk Customers
Mossman State High School	07 4084 1333	Vulnerable Population Customers
Mossman State School	07 4099 9333	Vulnerable Population Customers
St Augustine's Primary School	07 4098 1631	Vulnerable Population Customers
Bubu Bamanga Ngadimunku	07 4098 1305	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
C & K Port Douglas	07 4098 5811	Vulnerable Population Customers
Wonga Beach State School	07 4099 9777	Vulnerable Population Customers
Wonga Beach Pre School	07 4099 9713	Vulnerable Population Customers
Miallo State School	07 4098 8130	Vulnerable Population Customers
Daintree State School	07 4098 6135	Vulnerable Population Customers
Goobidi Bamanga OSHC	07 4098 3244	Vulnerable Population Customers
Goobidi Bamanga CACs Ltd	07 4098 1283	Vulnerable Population Customers
Port Explorers	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
Goodstart Early Learning Mossman	07 4098 2044	Vulnerable Population Customers
Tropical North Family Day Care	07 4098 1831	Vulnerable Population Customers
C & K Mossman Community	07 4098 1880	Vulnerable Population Customers
Sheraton Grand Mirage Resort	07 4099 5888	Large Population Resort
Oaks Resort Port Douglas	07 4099 8900	Large Population Resort
Rendezvous Reef Resort	07 4087 2790	Large Population Resort
Port Douglas Outrigger Holiday Apartments	07 4099 5662	Large Population Resort
Mandalay Luxury Beachfront Apartments	07 4099 0100	Large Population Resort
Coconut Grove Apartments Port Douglas	07 4099 0600	Large Population Resort
Ramada Resort Port Douglas	07 4030 4333	Large Population Resort

Regulatory Stakeholder	Contact Details	Role
Peppers Beach Club Port Douglas	07 4087 1000	Large Population Resort
Pullman Port Douglas Sea Temple Resort & Spa	07 4084 3500	Large Population Resort
Big 4 Port Douglas Glengarry Holiday Park	07 4098 5922	Large Population Resort
Mossman and Wonga Caravan Park (Council Owned)	0417 768 266	Large Population Resort
Douglas Chamber of Commerce	Via email	Business Industry Contact
Tourism Port Douglas / Daintree	07 4099 4588	Tourism Industry Contact
Cairns regional Council Laboratory Services	1300 692 247	Verification Monitoring
Orica (Ixom)	Gerhard Florida 0478401092	Chlorine Gas
Elite chemicals	Glenn 07 4035 5699	Sodium hypochlorite, Citric acid, caustic soda.
Koch	Mark Forbes 0288334600	Membrane Supplier
KSB	Grant Butler 0429006895	Pumps
ABB	Nilesh Patel 07 3713 9007	Online Instruments
SGS	4035 5111	Verification sampling
Siemens	Len Walder 07 3332 8326	Online Instruments
Bligh Tanner	Michael Lawrence 07 3251 8509	Water Engineering, Risk Management, DWQMP preparation, Incident investigation, Review and Audits.

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 on a monthly basis 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 to be highly protected, and at lower 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 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 rain water 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 licensed 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 as per the conditions of the water license (license number 408436 expiry 30/6/2111). Water restrictions are regularly imposed during September, October and November. Douglas Shire Council is currently looking at options for alternative intake for 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.

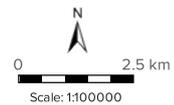
Figure 4 – Catchment and intakes for the 3 Douglas Shire Council Schemes



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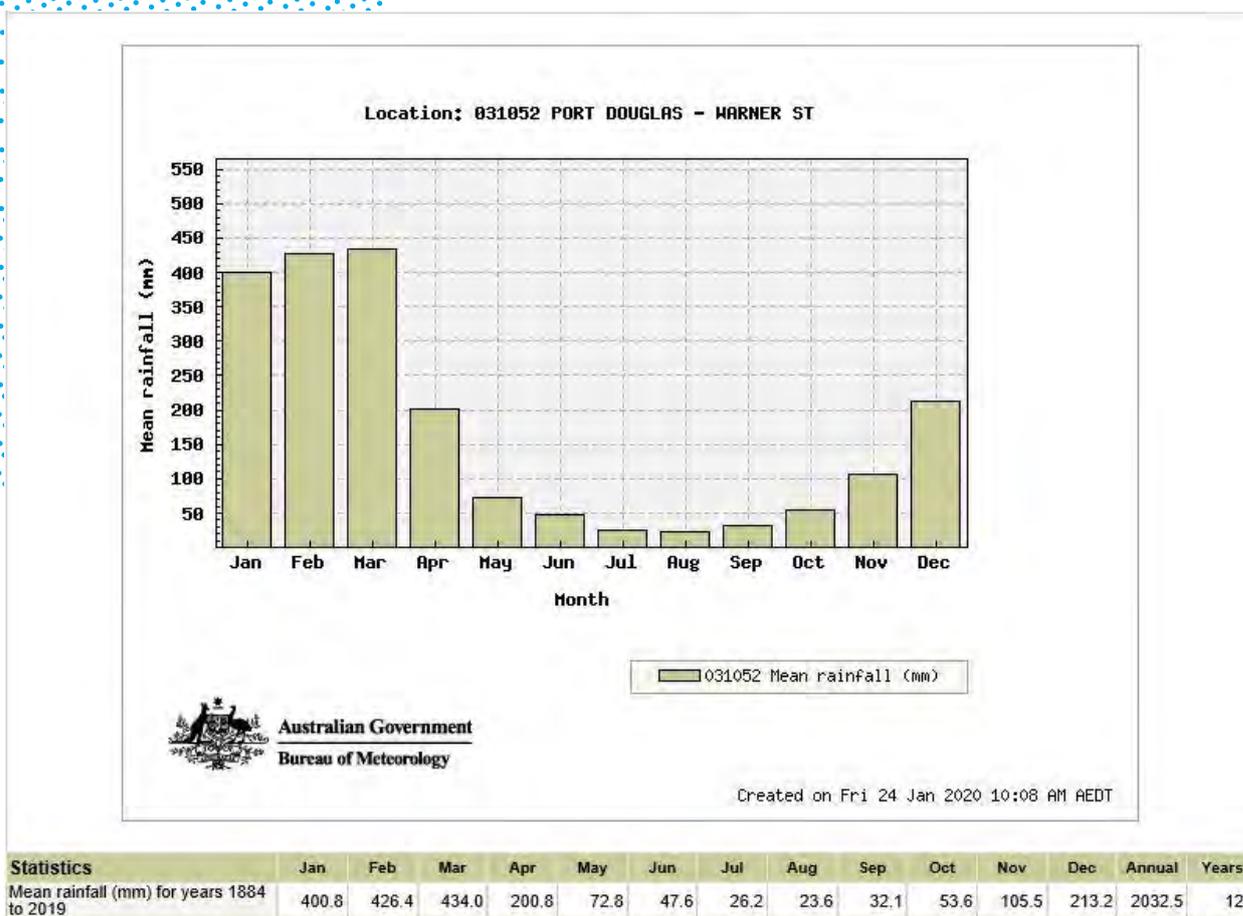
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 For more information, visit <https://qldglobe.information.qld.gov.au/info/Contact-us.html>



Figure 5 — 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 pHs. 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 weekly to ensure efficient functioning of the network.

All available data regarding asset age, type and make is available in Authority Asset Register and is also accessible to all staff using 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 concrete 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 have 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/d design treatment plant, with a daily production average of 11.6 ML/d. 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 intake is located on Rex Creek.

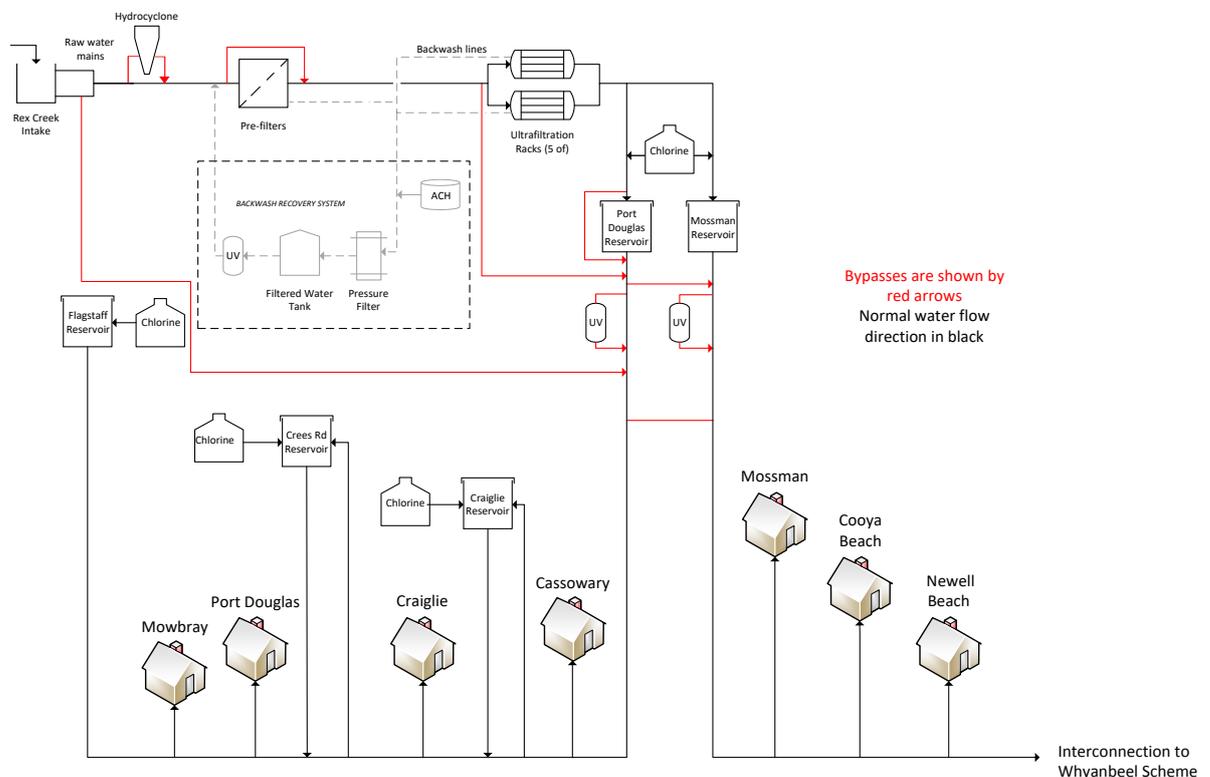
The intake channel has been built into the rock bed, and it diverts raw water flow to a series of Johnson screens. The Johnson screens offer initial coarse filtering of the raw water prior to the raw water entering the raw water pipeline and remove solids (generally sand and leaf matter) in excess of 1mm in diameter. The screens are designed to be self-cleaning but are inspected 3 times per week, 52 weeks per year and cleaned as required.

Under the Water License for Rex Creek, DSC has a nominal entitlement of 4800 ML from Rex Creek. There are maximum extraction limits based on flow. These limits are listed in the raw water operational procedure and additionally programmed into SCADA.

Screened water gravity feeds (6 km) to the WTP through 2 raw water mains. The available head is 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 prior to entry to 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 6 – Catchment to tap Schematic



The operational limits for raw water turbidity are listed in the OCP. The water treatment plant can operate at higher turbidities (for example in extended periods of high demand) if absolutely necessary, but this comes at the expense of membrane life, and increases the frequency of cleaning. As such the limits below may change as required.

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.

At times the raw water from Rex Creek has a low pH that falls below 6.5. The backwash water quality in these scenarios is also below 6.5. However, as the backwash discharge pH is identical to the raw water pH, it is not considered that there can be any environmental impact.

Hydrocyclone and Prefiltration

Raw water is filtered to 200 microns through 4 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 5 racks of 52 Koch polysulfone ultrafiltration membranes per rack. The membranes have a nominal size cut-off of 100000 Daltons.

The Ultra Filtration process is fully automated and includes its own main control panel which operates UF inlet/outlet valves, recirculation pumps, backwash supply pumps, a Chemical 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 Ultra filtration treatment plants is via a PLC/SCADA system with a Citec 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 chemically enhanced backwashing (CEB's) with a minimum ratio of one CEB to twelve backwashes in total. The frequency of backwashing and the ratio of CEB's to water only backwashes may be varied and is determined by the operator by observing trending values of the Trans-Membrane Pressure (TMP's) 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

Figure 7 — Ultrafiltration Rack at Mossman/Port Douglas WTP

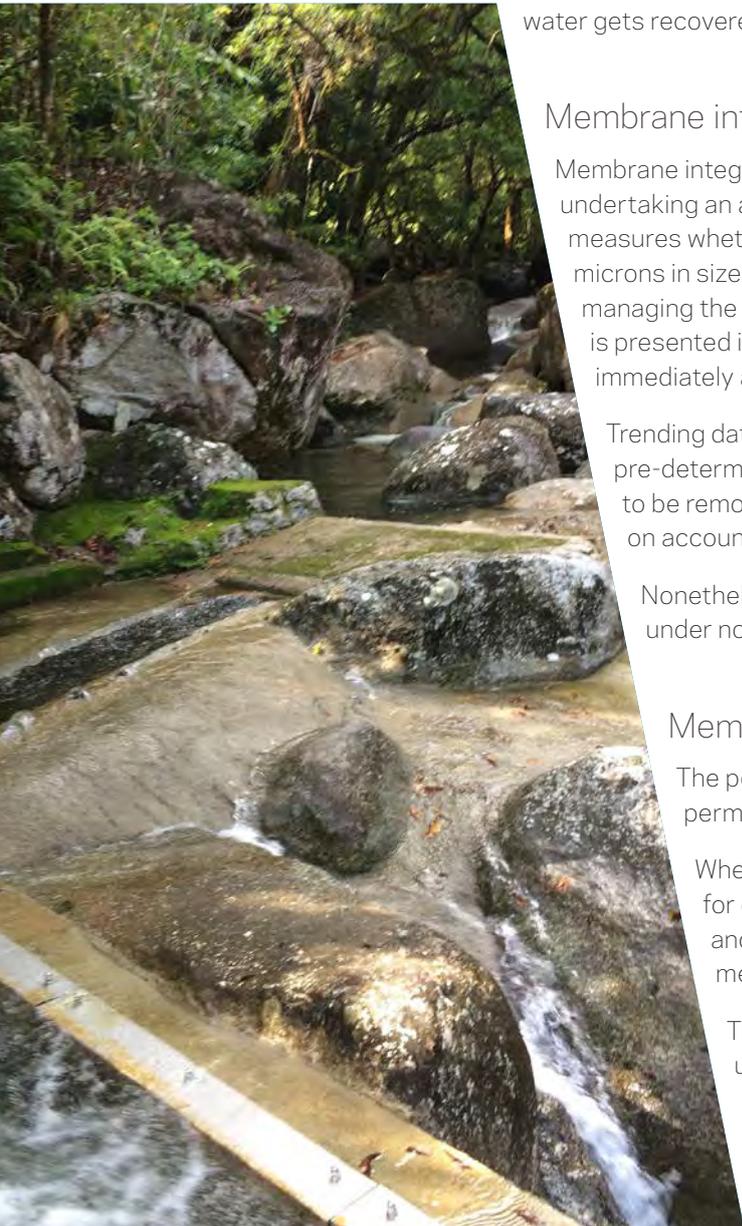
pH 10 and concentration of chlorine at 60 mg/L. The cartridges are allowed to soak in this solution for 400 seconds. Effectiveness of the backwashing sequence is continually monitored and all associated parameters are recorded for reporting and operational planning purposes. CEB backwash water is directed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

A clean in place (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.

Backwash Recovery

Prefilter and UF water only backwashes are recycled through backwash recovery plant and fed back into the head of works to recover water and reduce water intake from Rex Creek. The backwash recovery plant is a direct filtration plant that utilises 3-5 mg/L aluminum chlorohydrate (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 gets recovered daily.



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 3 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 off line 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 2 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 clear water reservoirs.

Figure 8 – Rex Creek Intake - race is lined with Stainless Steel

Chlorination

All disinfection points are operated as per the Chlorination (Primary and Re-dosing) CCP procedure. Disinfection is achieved through gas chlorination using 2 by 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. The 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 and 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	% of total	Length (km)	Material	Age Range
Mossman - Port Douglas	185 km	51.74	111	AC	1960-1997
		22.94	49.2	PVC	1940-2010
		12.62	27.1	DICL	1940-2009
		9.15	19.6	HDPE	1960-2008
		1.83	3.93	CI	1960
		1.58	3.39	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 Concrete lined, Poly: Polyethylene, PVC: Polyvinylchloride

There are 2 reservoirs located at the Mossman water 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 3 reservoirs that service Port Douglas, including 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 reservoir can be gravity fed from the Mossman WTP, but Flagstaff 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 and the 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 and Cooya Beach represents a relatively long detention time. Cassowary and Mowbray also have long detention times.

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

Table 5 — Reservoir Details - Mossman/Port Douglas Scheme

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	20ML	Active	Concrete	Y	Y	Y	Chlorine high and low, Reservoir Level.

Redosing

The Crees Rd, Craiglie, Rocky Point and Flagstaff Reservoirs are rechlorinated. Current upgrade of the Craiglie reservoir includes changing to an electro chlorination redosing system. The Crees Road Reservoir redoses with chlorine gas (two 920 kg cylinders). The Rocky Point and Flagstaff reservoirs have calcium hypochlorite eroders. All rechlorination 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/d design treatment plant, with an average flow of 900 kL/d. As the WTP is <5 ML/day it is not considered an environmentally relevant activity.

Intake

The Whyanbeel intake is located on Little Falls Creek.

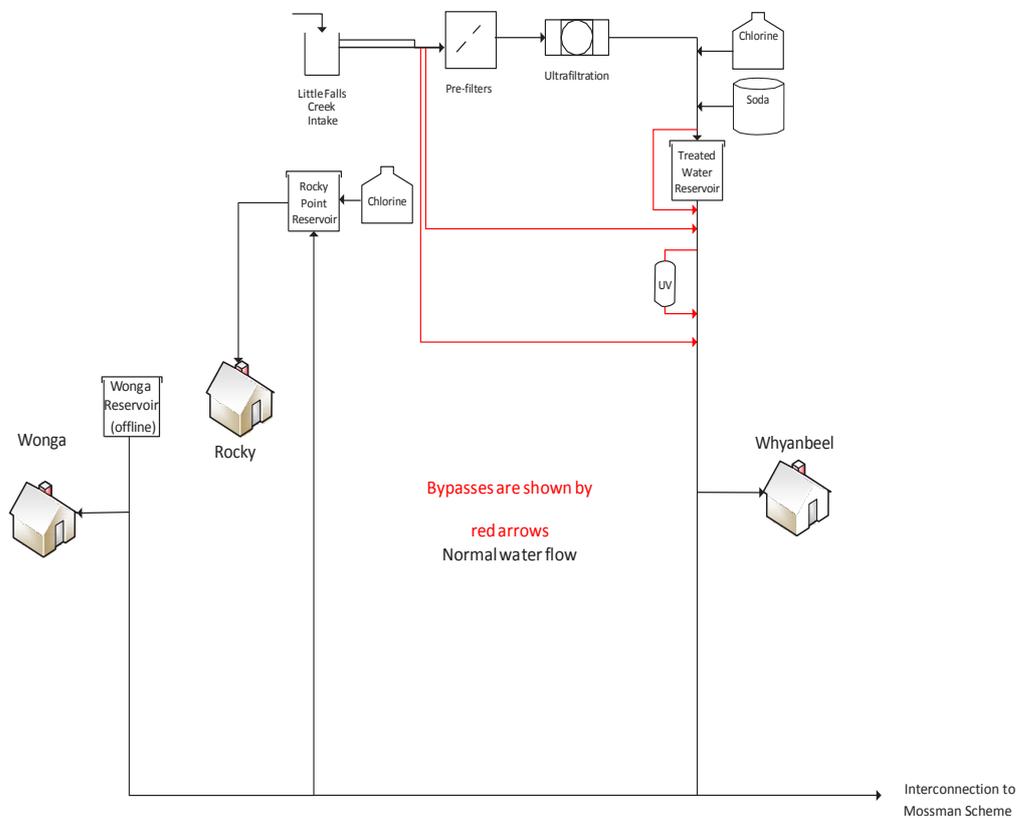
The intake channel has been built into the rock bed, and it diverts raw water flow to a series of Johnson screens. The Johnson screens offer initial coarse filtering of the raw water prior to the raw water entering the raw water pipeline and removing all solids (generally sand and leaf matter) in excess of 1 mm in diameter. The screens are designed to be self-cleaning but are inspected 3 times per week, 52 weeks per year and cleaned as required.

Screened water gravity feeds (0.5 km) to the WTP through two raw water mains. At the WTP, 2 raw water booster pumps (1 duty 1 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 higher turbidity's (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 license 500313 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 9 – Whyanbeel WTP Schematic



Prefilters 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 1 rack of 36 Koch polysulfone ultrafiltration membrane cartridges with a nominal size cut-off of 100000 Daltons.

The Ultra Filtration process at Whyanbeel 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 cutoff 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 prefilter backwash, and water only backwash water is discharged to the creek. Chemically enhanced backwash 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 off line 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 clear water reservoir.

Chlorination

Disinfection is achieved by gas chlorination (2*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. The 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	% of total	Length (km)	Material	Age Range
Whyanbeel	73.9 km	53.45	39.5	PVC	1972-2019
		38.29	28.3	AC	1972-1996
		4.56	3.37	DICL	1994
		2.46	1.82	HDPE	1972-1993
		1.24	0.92	Poly	1972

The Rocky Point reservoir receives its flow from the Whyanbeel treatment plant via two pumps, 1 duty 1 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 <600kPa.

There are 2 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 10 — Whyanbeel Clearwater Reservoir



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/d design treatment plant, with an average flow range of 100 kL/d. The small WTP is not considered an environmentally relevant activity.

Intake:

The Daintree intake is located on Intake creek, and council is licensed (License # 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 15mm. 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 200KL which then feeds 2 raw water booster pumps 1 duty 1 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 turbidity's (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 are 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. The bore water has low pH and alkalinity that may require pH adjustment if the bore is used as the sole water source, however this is not the intent.

In general the expectation is that once commissioned, the bore will supplement 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 of time.

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 and gutters and also 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 1 rack with 6 available positions for Koch polysulfone ultrafiltration membrane cartridges with a nominal size cut-off of 100000 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 Ultra Filtration process is fully automated and includes its own main control panel which operates UF inlet/outlet valves, recirculation pumps, backwash supply pumps and a Chemical Enhanced Backwashes (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 Ultra filtration treatment plants is via a PLC/SCADA system with a Citec 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 60 minutes. The frequency of backwashing is determined by the operator by observing trending values of the Trans-Membrane Pressure (TMP's) 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 CIP's are performed with the waste water being collected in the chemical holding tank then pumped out and transported by road tanker to the Port Douglas waste water plant.

A clean in place (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.

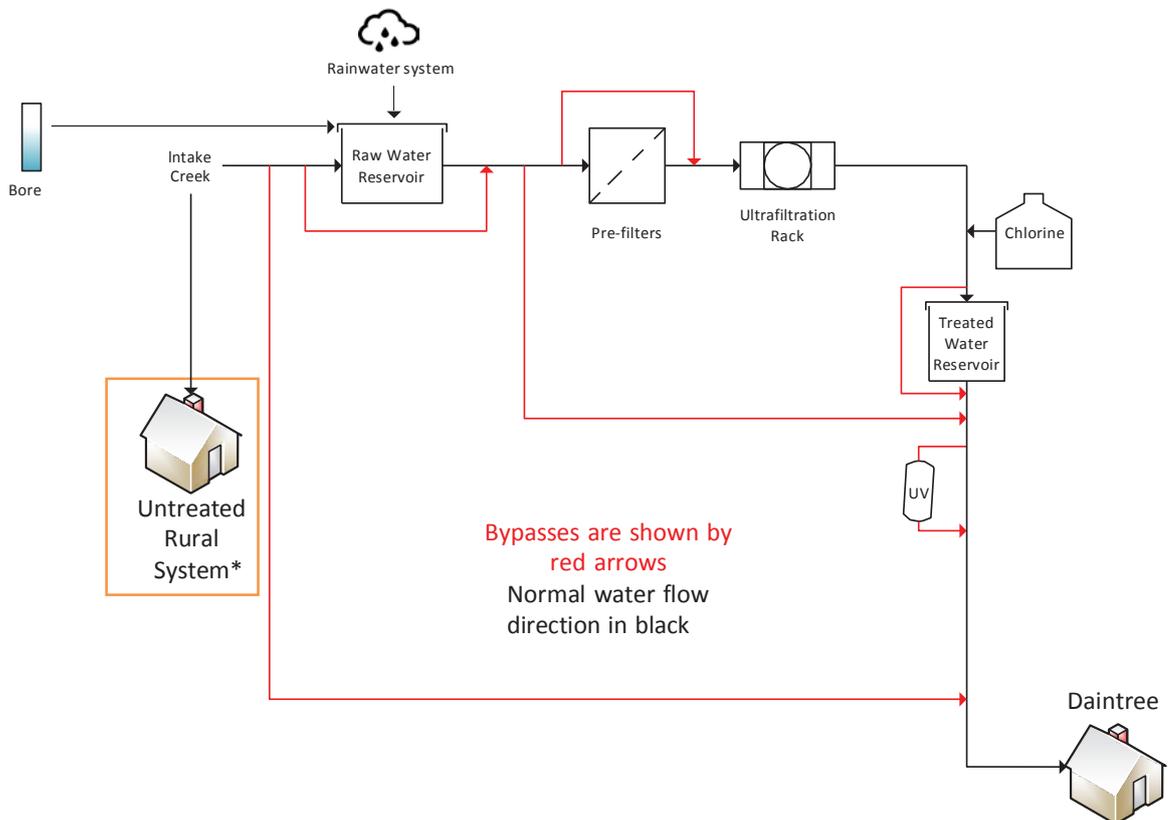
Membrane integrity – direct testing

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.

Figure 11 – Daintree WTP Schematic



Chlorination

Disinfection is achieved through chlorination. Current operations use a recirculation system on the treated water 400KL 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. The two critical limits ensure effective disinfection (low side) and prevent exceedances of the chemical health guideline value (high side).

(Ultraviolet disinfection)

The UV units are 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 400KL 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, DSC 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.

DSC 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 5300 *E. coli* samples (2014-2019), 3 post treatment samples were positive. 1 in the Flagstaff reservoir in Dec 2014 and 1 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
			Isolated aesthetic exceedence - little operational disruption	Local aesthetic exceedence, potential isolated breach of chemical health parameter	Widespread aesthetic exceedences, or repeated breaches of chronic health guidelines	Potential acute health impact, no outbreak expected	Potential acute health impact, declared outbreak likely
Likelihood							
Almost Certain	Occurs daily to weekly		Medium 6	High 10	High 15	Extreme 20	Extreme 25
Likely	1-4 occurrences per month		Medium 5	Medium 8	High 12	High 16	Extreme 20
Possible	1-11 occurrences per year		Low 3	Medium 6	Medium 9	High 12	High 15
Unlikely	1 occurrence per 1-5 years		Low 2	Low 4	Medium 6	Medium 8	High 10
Rare	<1 occurrence per 5 years		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,
2. Unmitigated risk assessment, and
3. Mitigated risk assessment.

As Douglas Shire Council has 3 schemes with a very similar treatment train, the risk assessment was undertaken for all 3 schemes simultaneously, but taking into account 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 the audit in 2017, and again for the review in 2020, 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 2020 risks, with the 2017 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 actually 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 2015 and 2017

Participant	Position	Relevant workshop	Water Industry/ Risk Management Experience
Paul Hoye	General Manager Operations (2015)	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 and 2020	>15 years in water industry, formal ADWG training, water quality management systems auditor.
Nicholas Wellwood	General Manager Operations (2017)	2017	Engineer, 30 years in water industry, formal risk training
Peter White	Coordinator Water and Wastewater	2017 and 2020	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	3 years in council water and wastewater compliance management
Mitchell Simpson	Team Leader Water Reticulation	2020	1 year in Council Water & Wastewater management
John Pethbridge	Assistant Team Leader Water Quality	2020	4 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

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 (Naeglaria, Acanthamoeba 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 not a guideline value, and phasing out hypochlorite solutions.	Moving to gas chlorination
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 issues on private properties - 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 buildup.	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
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 as 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 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. Monitoring as 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, UF

Attachment 5.4.1 Hazard	Type of Hazard	Sources of Hazard	Unmitigated Risk 88 of 183			Uncertainty	Comments	Treatment Barrier/s
			Consequence	Likelihood	Risk			
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 (Mossman/ Port Douglas)	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, this is the case over 3-5 years.	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

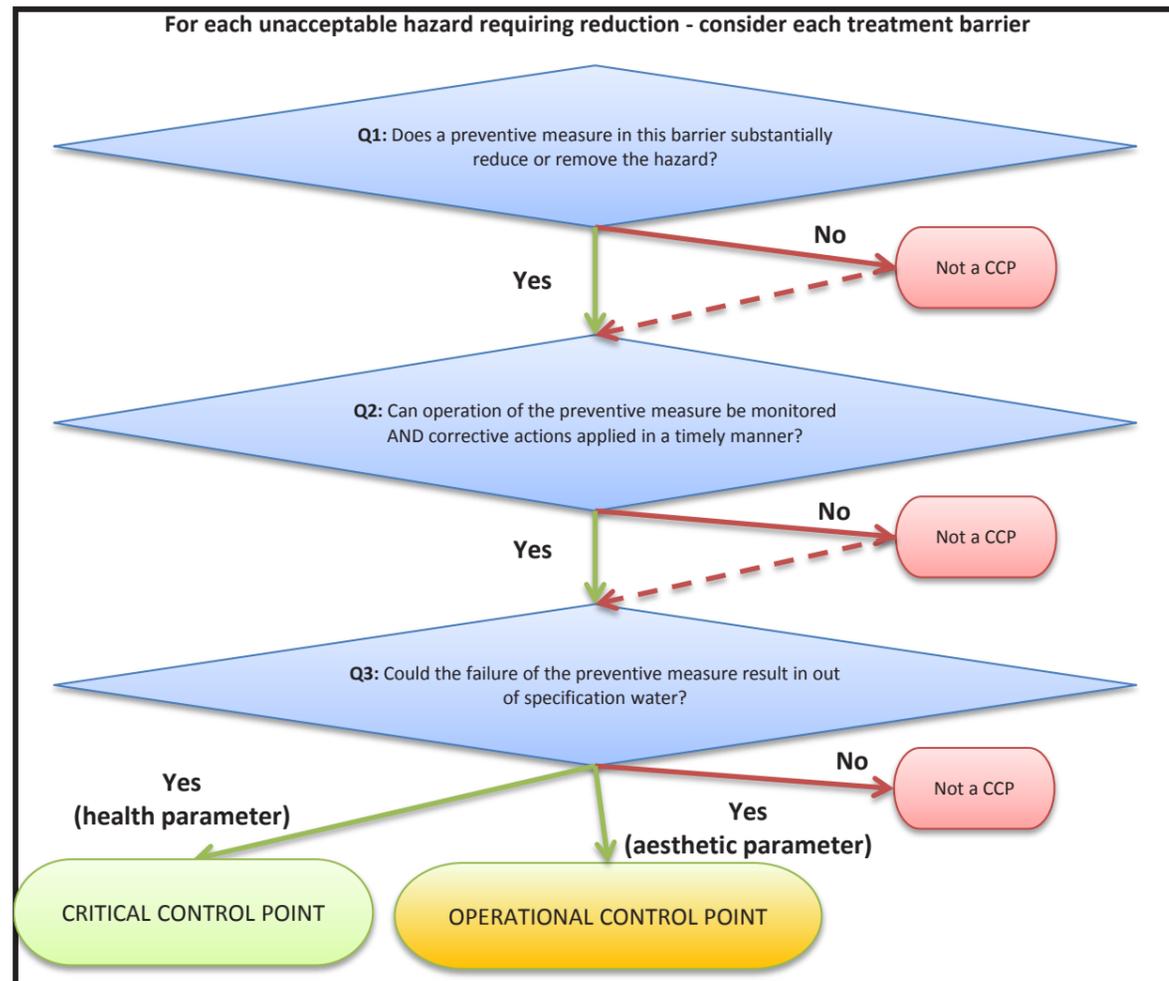
Process Step	Hazardous Event	Hazards managed by same barriers	Unmitigated Risk	Primary preventive measure	Other Preventive Measures	2017 Risk	Mitigated			Uncertainty	Previous Comments 2015/2017	Comments 2020	CCP?	Documented Procedure	Risk Management Improvement Plan 2020		
							Consequence	Likelihood	Risk				Y/N		2019/20	Proposed 2020/21 FY	2021/22 FY or beyond
Catchment	Present in catchment - animals	Bacteria and virus	Extreme 25	Disinfection	UF (Bacteria)	Medium 6	Catastrophic	Rare	Medium 6	Certain	considered as whole of treatment in absence of failure	Risk reviewed. No change. Mitigated risks considered same for Daintree Rainwater and bore system.		SCADA			
	Present in catchment - animals	Protozoa	Extreme 25	UF		Medium 6	Catastrophic	Rare	Medium 6	Confident	considered as whole of treatment in absence of failure	Risk reviewed. No change		SCADA			
	Storm events	Loss of supply due to high turbidity	High 10	Raw water turbidity trigger		Medium 6	Catastrophic	Rare	Medium 6	Confident	considered as whole of treatment in absence of failure	Risk reviewed. No change		SCADA			
Raw Water Feed	Raw water main break	Failure of supply	High 10	Two raw delivery mains from Rex Ck. System capacity has improved storage	spare reticulation equipment and fittings available for repairs	Medium 6	Catastrophic	Rare	Medium 6	Confident	network operators have extensive experience mitigating lack of formal procedure	SOP created and continuous operator training in place. Daintree Scheme has alternative water supplies.		Developed water mains SOP and BCP			
	Blocked Johnson screen	Failure of supply	High 10	Rex Creek intake allows self cleaning of Johnson screens. All intakes checked regularly.	spare reticulation equipment and fittings available for repairs	Medium 6	Catastrophic	Rare	Medium 6	Reliable	Screens block in flood events, Daintree access depends on river conditions, but can operate for 3 days without access.	Daintree bore and Daintree rainwater system in place as contingency water supplies for Daintree Scheme. Mossman Scheme intake built to allow more self cleaning.	N	Required	Project to line remaining area of race and angle Johnston screens to allow more self cleaning		
	Raw water UF feed pump failure (Daintree/ Whyanbeel)	Failure of supply	High 10	Regular maintenance and checks of pumps.	duty standby	Medium 6	Catastrophic	Rare	Medium 6	Certain	spare pumps available	New pumps installed. Risk reviewed. No change.		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	Medium 6	Catastrophic	Rare	Medium 6	Reliable	Stabilisation completed in 2017. Continue to observe for any other signs of erosion on site.	No observed degradation in the slope stability. Continue monitoring, Daintree Bore Pump and rainwater system in place as contingency water supplies for Daintree scheme					
	Loss of raw water Daintree Bore due to bore pump failure	Failure of supply	High 10		Sufficient treated water capacity to last 13 days in Daintree.	Medium 6	Catastrophic	Rare	Medium 6	Reliable		Contingency supply					
	Blocked prefilters	Failure of supply	High 10	Duty standby pre-filter operation	WTPs set offline during high turbidity events. Sufficient treated water capacity.	Medium 6	Catastrophic	Rare	Medium 6	Confident	Running plant without prefilters ultimately can lead to blocked UF and loss of supply. Mossman automatically increases backwash frequency based on turbidity.	Johnson screen replaced at Rex Creek, race lining completed, raw water scour valves inspection		SCADA raw water deviation alarm on UF allows identification.			
	Turbidity above limit	Turbidity	High 10	Raw water turbidity trigger	UF	Low 2	Minor	Rare	Low 2	Confident	running plant without prefilters ultimately can lead to blocked UF and loss of supply	Monitor turbidity levels, using early warning alarm system to reduce impacts of treatment plant infrastructure	N	SCADA and Turbidity CCPs	Review SOP's		
Ultrafiltration	Loss of integrity	Protozoa, turbidity	Extreme 25	24 hr PDT	Continuous turbidity monitoring	Medium 6	Catastrophic	Rare	Medium 6	Confident	Butterfly valves replaced, and spares now kept. CCP being adhered to strictly	Ongoing maintenance and replacement as required	Y	SCADA and Turbidity CCPs	Review SOP's		
	Loss of integrity	Protozoa, turbidity	Extreme 25	Continuous turbidity monitoring	24 hr PDT	Medium 6	Catastrophic	Rare	Medium 6	Confident	turbidity meters on individual racks, 15 minute delay to match draft HBT guidance.	Risk reviewed. No change	Y	Turbidity CCP			
	Membrane scaling reducing plant capacity	Reduced supply	Medium 8	Regular backwashes, including CEB/ CIP as required		Medium 6	Minor	Possible	Medium 6	Reliable	Whyanbeel WTP dosing system can have issues.	Regular backwashes including CEB/CIP as required		TMP monitored, and recorded high-high alarm for each rack.			
ph Adjustment (Whyanbeel)	pH < 6.5	Low pH, corrosion	High 10	Sodium carbonate dosing		Low 4	Minor	Unlikely	Low 4	Confident	Whyanbeel Sodium Carbonate dosing system installed late 2017	Risk reviewed. No change	N	pH Adjustment OCP, SOP			
Disinfection	Overdose	Chlorine	High 15	Alerts at 2 mg/L, critical at 4 mg/L (dosing system shutdown)		Low 3	Moderate	Rare	Low 3	Confident			Y	High CCP, SOP			

Attachment 5.4.1																	
Process Step	Hazardous Event	Hazards managed by same barriers	Unmitigated Risk	Primary preventive measure	Other Preventive Measures	2017 Risk	Mitigated			90 of 183 Uncertainty	Previous Comments 2015/2017	Comments 2020	CCP? Y/N	Documented Procedure	Risk Management Improvement Plan 2020		
							Consequence	Likelihood	Risk						2019/20	Proposed 2020/21 FY	2021/22 FY or beyond
	Insufficient dose	Bacteria/virus	Extreme 25	Disinfection		Medium 6	Catastrophic	Rare	Medium 6	Confident		Two recirculation pumps (duty/standby) at each chlorination system.	Y	Low CCP SOP			
	Chemical breakdown (Mossman/Port Douglas/Whyanbeel)	Chlorate	High 12	Gas currently installed at most dosing points		Medium 9	Moderate	Possible	Medium 9	Reliable	WHO 0.8 mg/L, potential 0.3 mg/L guideline	Gas chlorine installed at most dosing points. Craiglie Reservoir upgrade includes electro chlorination system.					
	Chemical breakdown (Daintree)	Chlorate	High 12	currently use recommended best practices for management of sodium hypochlorite solution to reduce chlorate	Multiple times turnover of stock within 12 week period	Medium 9	Moderate	Possible	Medium 9	Reliable	Daintree to continue to use sodium hypochlorite until guideline value changes.	Commence investigative monitoring to confirm level of risk			Commence investigative monitoring in Daintree scheme.	Research alternative disinfection methods to reduce chlorate formation.	
	Ineffective disinfection due to turbidity	Bacteria	High 10	UF		Medium 6	Catastrophic	Rare	Medium 6	Certain	UF shutdown at permeate turbidity of 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	Primary disinfection, redosing at Craiglie		Medium 6	Catastrophic	Rare	Medium 6	Confident		Craiglie roof reconstructed	N				
	Ingress into reservoirs (Craiglie)	Protozoa	Extreme 20	Integrity at Craiglie		Extreme 20	Catastrophic	Rare	Medium 6	Confident	Repairs undertaken to rectify hatch. Still some holes in roof. On hold whilst Crees Road reservoir being constructed. Roof to be replaced after Crees Road online.	Craiglie roof reconstructed	N				
	Ingress into reservoirs (all others)	Protozoa	Extreme 20	Integrity and sealing		Medium 6	Catastrophic	Rare	Medium 6	Estimate	Reservoir inspection program is now in place. Have sealed Flagstaff, Rocky Point and Whyanbeel.	Risk reviewed, no change.	N	SOP			
	Ingress into reservoirs (Rocky Point)	Bacteria/virus	Extreme 20	Primary disinfection, hypo dosing at Rocky Point		Medium 6	Catastrophic	Rare	Medium 6	Confident	Telemetry and alarming essential. Regular site visits.	Risk reviewed, no change.	N	SOP			
	Ingress into reservoirs (Flagstaff)	Bacteria/virus	Extreme 20	Primary disinfection, Hypo dosing at Flagstaff Res		Medium 6	Catastrophic	Rare	Medium 6	Confident	Calcium hypochlorite dosing. Telemetry and alarming essential. Regular site visits.	Risk reviewed, no change.	N	SOP			
	Ingress into reservoirs (Cooya Beach)	Bacteria/virus	Extreme 20	Primary disinfection, no redosing (Cooya)		High 10	Catastrophic	Unlikely	High 10	Reliable	Water supply assessment to be undertaken to determine if reservoirs should be brought online	Design review undertaken	N	Required when reservoir operational	Not required as reservoir is not normally used		
	Ingress into reservoirs (Wonga, Mowbray, Cassowary)	Bacteria/virus	Extreme 20	Primary disinfection, no redosing		High 10	Catastrophic	Unlikely	High 10	Estimate	Wonga Mowbray, Cassowary - are offline and not normally used. Manual dosing would be required to ensure safe water	Water supply assessment revealed that redosing at Wonga, Mowbray, Cassowary reservoir is currently not required as these reservoirs are not normally. Investigate requirements to bring Wonga Beach Reservoir online.	N	Required when reservoir operational	Condition assessment on Wonga Reservoir to bring online		
	Ingress of amoeba	Amoeba	High 12	Disinfection as above items	Integrity	Medium 5	Major	Rare	Medium 5	Reliable	Reservoir chlorine levels consistently above 0.5 mg/L		N	CCP for chlorine			
Reticulation	Ingress of contaminated water	Bacteria/virus	Extreme 20	Network pressure, residual disinfection, mains break procedure		Medium 6	Catastrophic	Rare	Medium 6	Confident	HPC counts low across all schemes, and while Daintree residual can be low, there have been very few issues with water quality. Requires vigilance		N	SOP	Review of SOP		
	Ingress of contaminated water	Protozoa	Extreme 20	network pressure, mains break procedure		Medium 6	Catastrophic	Rare	Medium 6	Reliable	procedure emphasised, toolbox talk reminders		N	SOP	Review of SOP		
	Power failure	Failure of supply	High 15	Power supply generally robust. Many areas gravity fed.		Medium 6	Major	Rare	Medium 5	Confident	Craiglie main area at risk - however, power outages are rare, and not normally long duration	Generators available. Generators are on automatic start up in case of power failure. All areas can be gravity fed from reservoirs					
	change in flow rate, reservoir run low, disturbing sediment in pipe	turbidity	Medium 6			Low 4	Minor	Unlikely	Low 4	Confident	Very low turbidity, and retic network has low HPC counts. Not a common occurrence.						

Attachment 5.4.1																	
Process Step	Hazardous Event	Hazards managed by same barriers	Unmitigated Risk	Primary preventive measure	Other Preventive Measures	2017 Risk	Mitigated			91 of 183 Uncertainty	Previous Comments 2015/2017	Comments 2020	CCP?	Documented Procedure	Risk Management Improvement Plan 2020		
							Consequence	Likelihood	Risk				Y/N		2019/20	Proposed 2020/21 FY	2021/22 FY or beyond
	long water age	DBPs	High 12	Low organics in source water, effective removal, low chlorine doses		Low 2	Minor	Rare	Low 2	Confident	Low level detections in reservoirs justifies a reduction in sampling for THMs in verification monitoring program. Will do investigative sampling at far ends of reticulation.	Targeted sampling of likely worst case situations. Detections all low level that do not raise concerns that this is an issue in any scheme		SOP			
	backflow - e.g. from customer meters or standpipes	protozoa	Extreme 20	system integrity, backflow prevention on new installations		High 10	Catastrophic	Unlikely	High 10	Estimate	Port Douglas all replaced, other areas do have old meters than may not have backflow prevention	Audit has been undertaken to ensure all valves tested as per schedule. Installations are being initiated as required. Some standpipe locations are uncontrolled, not sufficiently monitored and enforced. Ongoing.		Required Asset Management Plan	Backflow devices installed on standpipes available for hire. Review SOP	Long term meter replacement strategy. Set water extraction points within Shire.	
Redosing	Overdose (Craiglie/ Crees Rd)	chlorine	High 15	alerts at 2mg/L, critical at 4 mg/L (redosing shutdown)		Medium 6	Moderate	Unlikely	Medium 6	Reliable		Risk reviewed, no change.	Y	CCP on monitored reservoir			
Redosing	Overdose (Flagstaff/Rocky Point)	chlorine	High 15	alerts at 2mg/L, critical at 4 mg/L (redosing shutdown)		Medium 6	Moderate	Unlikely	Medium 6	Reliable		Risk reviewed, no change.	Y	Required, but not CCP. Is OCP.			
	insufficient dose (Craiglie/ Crees Rd)	bacteria/virus	Extreme 20	disinfection alarms at 0.7 and critical 0.2 mg/L	primary disinfection provides residual in most cases. Small top-up.	Medium 6	Catastrophic	Rare	Medium 6	Confident		Risk reviewed, no change.	N	Documented in OCPs			
	insufficient dose (Flagstaff/ Rocky Point)	bacteria/virus	Extreme 20	disinfection daily inspects	primary disinfection provides residual in most cases. Small top-up.	High 10	Catastrophic	Rare	Medium 6	Confident	Flagstaff and Rocky point have calcium hypochlorite eroders in place.	Flagstaff and Rocky point have calcium hypochlorite eroders in place.		Documented in OCPs			
System Wide	SCADA/ telemetry failure/ Cyber attack	Protozoa	Extreme 25	treated water in system.		High 10	Catastrophic	Rare	Medium 6	Reliable	Cyclone Oswald knocked out communications, version not fully supported as outdated. If long term, may need to consider DMP.	CITEC all upgraded across all plants		BCP & Cyber security arrangement and planning	Engage consultant to review current cyber security practices		
	Demand exceeds supply	Limited supply	Extreme 25	Asset planning		High 10	Catastrophic	Unlikely	High 10	Reliable	Mossman Port Douglas scheme - Planning over next 10 years to ensure risk is low	Larger Whyanbeel / Mossman interconnection being designed. Water supply assessment to determine need to bring old reservoirs online etc.		Asset management plan and BCP	Mossman/Port Douglas Scheme and Whyanbeel Scheme interconnection replaced		
	Demand exceeds supply	Limited supply	Extreme 25	Asset planning		High 10	Catastrophic	Unlikely	High 10	Reliable	Mossman Port Douglas scheme	Reservoir at Crees Road operational. Design review undertaken for bringing Cooya Beach reservoir online.		Asset management plan and BCP		Install rechlorination at Cooya Beach Reservoir	
	WTP Fire	Failure of supply	Medium 6	Can provide raw water with BWA.		Medium 6	Catastrophic	Rare	Medium 6	Reliable	Would need to activate disaster plan			LDMP & BCP			
	Drought (Mossman)	Failure of supply	High 10	Restrictions leading to Wet season	seeking alternate source	Medium 6	Catastrophic	Rare	Medium 6	Estimate	Whyanbeel Mossman connection to be installed within 6 months - supply not likely to be impacted in this timeframe, and resilience after will be increased.	Whyanbeel Mossman interconnection finalized. Alternative intake options being reviewed				Alternative intake	
	Drought (Daintree Rainwater)	Failure of supply	High 10	Use alternate supply		Low 2	Minor	Rare	Low 2	Estimate		Intended to supplement Intake Creek.					
	Flood	Failure of supply	High 10	Generally only impacts raw water quality		Medium 6	Catastrophic	Rare	Medium 6	Reliable	Can operate WTP at higher turbidities if necessary - will increase backwash frequency and impact capacity.			LDMP & BCP			
	Flood	Failure of supply	High 10	Daintree Intake		High 10	Catastrophic	Rare	Medium 6	Reliable	Access to intake improved, alternate supply bore is being commissioned	Access to intake improved, alternate supply bore commissioned, rainwater system in place		BCP			
	Landslip Daintree intake	Failure of supply	High 15	Daintree Intake		High 10	Catastrophic	Rare	Medium 6	Estimate	Access to intake improved, alternate supply bore is being commissioned	Access to intake improved, alternate supply bore commissioned, rainwater system in place		BCP			

Attachment 5.4.1							Mitigated			92 of 183	Previous Comments 2015/2017	Comments 2020	CCP?	Documented Procedure	Risk Management Improvement Plan 2020			
Process Step	Hazardous Event	Hazards managed by same barriers	Unmitigated Risk	Primary preventive measure	Other Preventive Measures	2017 Risk	Consequence	Likelihood	Risk	Uncertainty			Y/N		2019/20	Proposed 2020/21 FY	2021/22 FY or beyond	
	Cyclone	Failure of supply	High 15	DMP	interconnection of Mossman and Whyanbeel schemes	High 10	Catastrophic	Unlikely	Medium 6	Reliable		Activate DMP if WTP knocked out completely (eg Daintree). Otherwise use interconnection.	Mossman/Port Douglas and Whyanbeel Scheme interconnection replaced.		Business continuity plan and hazard checklists			
	operator error	any	Extreme 25	training, experience, mentoring		High 10	Catastrophic	Unlikely	High 10	Estimate		Look at National Certification framework for operator training.			HR training register		Ongoing training as required	
	accidental use of bypass	protozoa and bacteria	Extreme 25	valves identified as permanently closed, tagged out.		Medium 6	Catastrophic	Rare	Medium 6	Confident		Need to ensure all closed valves are tagged, and consider what valves need locking out.	Valves are tagged out, but could still accidentally be opened. Locking out or reducing access to be considered.			More securely lock out bypass to prevent accidental use.		
	loss of knowledge	All	Extreme 25	Ensure all staff know the correct record keeping procedures		High 15	Catastrophic	Possible	High 15	Estimate		Develop mentoring system, capture assets in GIS system	GIS system evaluations ongoing		Asset Management Plan	GIS system evaluations ongoing		
	Cyber threat/ Attack	All	Extreme 25	Cyber security safeguards	Staff Training		Catastrophic	Unlikely	High 10	Reliable			Review current cyber security		BCP and Cyber Security Arrangements and Planning	Engage consultant to review current cybersecurity measures	Internal upgrade of water and wastewater networks and systems	
	Chemicals Unavailable	Bacteria and Viruses	Extreme 25	Operational planning	UF		Catastrophic	Rare	Medium 6	Confident			3 months supply of chemicals (and other critical consumables)		BCP			

Table 13 – CCP Decision Tree



Raw Water Operational Procedure - Whyanbeel WTP



What is measured

Raw Water Turbidity

Where or how is it measured

Turbidity at any of intake, raw water main or WTP inlet.
Measured online by online turbidity meters

What is the control point

WTP Inlet

What are the hazards

Turbidity

Record Keeping

SCADA records

Adjustment Limit
Turbidity > 20 NTU
Extraction at License

Target
Turbidity < 5 NTU
Extraction within license

- + Shut down plant at 20 NTU
 - + Check supply volumes to ensure that there is sufficient treated water supply
 - + If treated water supply is low, contact Team Leader
 - + Do not restart unless authorised by Team Leader or raw water turbidity is < 20 NTU
 - + If plant required to operate, reduce production as low as possible to retain adequate supply
- + If extraction is at license limit contact Manager
 - + Consider need to implement water restrictions to comply with extraction license
 - + Do not operate above extraction limits without written authorisation from Co-ordinator or Manager

- + Operator receives alarm and paging
 - + Consider weather event and treated water volumes
 - + If appropriate reduce plant flow or cease production
 - + If treated water volumes are low or demand high, continue to treat water
- + Extraction limits to be monitored manually.
 - + Adjust plant production to ensure extraction is below license limits

Water License Extraction Limits

Little Falls Creek Flow Rate (L/s)	Maximum Extraction Rate (L/s)
≤10	0
11-20	5
21-40	10
71-80	20
61-80	30
81-100	40
101-150	50
>151	60

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Raw Water Operational Procedure - Mossman WTP



What is measured

Raw Water Turbidity

Where or how is it measured

Turbidity at any of intake, raw water main or WTP inlet.
Measured online by online turbidity meters

What is the control point

WTP Inlet

What are the hazards

Turbidity

Record Keeping

SCADA records

Adjustment Limit
Turbidity > 30 NTU
Extraction at License

Target
Turbidity <20 NTU
Extraction within license

- + Shut down plant at 30 NTU
- + Do not restart unless authorised by Team Leader or raw water turbidity is <30 NTU
- + If plant required to operate, reduce production as low as possible to retain adequate supply
- + If extraction is at license limit contact Manager
- + Consider need to implement water restrictions to comply with extraction license
- + Do not operate above extraction limits without written authorisation from Co-ordinator or Manager

- + Operator receives alarm and paging
- + Consider weather event and treated water volumes
- + If appropriate reduce plant flow or cease production
- + If treated water volumes are low or demand high, continue to treat water
- + Extraction limits to be monitored online.
- + Adjust plant production to ensure extraction is below license limits

Water License Extraction Limits

≤50	0
51-60	5
61-70	15
71-80	20
81-100	30
101-120	50
121-140	70
141-160	80
161-200	100
201-250	125
251-300	150
301-350	175
351-400	200
401-450	225
541-500	250
501-550	275
551-600	300
601-650	325
651-700	350
701-739	370
>740	370

DOCUMENT	935212
VERSION	2.2
APPROVED	MGR WATER AND WASTEWATER
DATE	05/20

Raw Water Operational Procedure Daintree WTP



What is measured

Raw Water Turbidity

Where or how is it measured

Turbidity at any of intake, raw water main or WTP inlet.
Measured online by online turbidity meters

What is the control point

WTP Inlet

What are the hazards

Turbidity

Record Keeping

SCADA records

Adjustment Limit
Turbidity > 20 NTU
Extraction at License

Target
Turbidity < 5 NTU
Extraction within license

- + Shut down plant at 20 NTU
 - + Check supply volumes to ensure that there is sufficient treated water supply
 - + If treated water supply is low, contact Team Leader
 - + Do not restart unless authorised by Team Leader or raw water turbidity is < 5 NTU
 - + If plant required to operate, reduce production as low as possible to retain adequate supply
- + If extraction is at license limit contact Manager
 - + Consider need to implement water restrictions to comply with extraction license
 - + Do not operate above extraction limits without written authorisation from Co-ordinator or Manager

- + Operator receives alarm and paging
 - + Consider weather event and treated water volumes
 - + If appropriate reduce plant flow or cease production
 - + If treated water volumes are low or demand high, continue to treat water
- + Extraction limits to be monitored manually
 - + Adjust plant production to ensure extraction is below license limits

Water License Extraction Limits

≤5	0
>5	6
Maximum Daily Volume	0.3 ML
Maximum Annual Volume	80 ML

DOCUMENT NO.	953212
VERSION	2.2
APPROVED	MGR WATER AND WASTEWATER
DATE	05/20

Direct Membrane Integrity Pressure Decay Test Critical Control Point Procedure



What is measured

Pressure decay

Where or how is it measured

Automated PDT program run every 24 hours of filter rack operation

What is the control point

Membrane Filter Racks

What are the hazards

Pathogens, turbidity

Record Keeping

SCADA records of PDTs, manually record results of tests on daily operational sheet and in operational data spreadsheet

Critical Limit
> 1.5 kpa/min

Adjustment Limit
> 1 kpa/min

Target Criterion
< 1 kpa/min

- + Automatic shut down of failed UF rack
- + Follow all adjustment procedures as appropriate
- + Review reservoir levels (SCADA) to determine if community can be supplied from existing storage until situation is resolved
- + Check that Turbidity Critical Limit was continually met since previous passed PDT - if so, no action required.
- + If turbidity CCP was also compromised, Environmental Technical Officer (or Water operator) to arrange daily water quality monitoring at treated water reservoir for:
 1. pH
 2. turbidity
 3. E. coli
 4. Total and free chlorine

- + Report breach to Coordinator Water and Wastewater on CCP reporting form
- + If situation cannot be resolved, and rack must be brought online to ensure continuity of supply Coordinator Water and Wastewater or Manager Water and Wastewater to;
 - + Provide written direction to Water Treatment Operators or Team Leader
 - + Contact Regulator on 1300 596 709 if required
- + Manager Water and Wastewater to determine corrective action/incident management if required. This may include actions such as:
 1. Restart plant under increased monitoring conditions and increased chlorine
 - OR
 2. Restart plant with boil water alert

- + Take rack offline
- + Conduct manual PDT and observe for signs of bubbles
- + If bubbles observed mark with electrical tape to signal need for maintenance/ repair
- + Note the estimated number of leaking straws on the UF rack repair sheet and provide to Team Leader
- + If no, or minimal bubbles are observed, this may be an indication of leaking valves/ pipework. Conduct full system check of relevant valves and pipework.
- + Fix any identified leaks if possible, or report on UF rack repair sheet and keep rack offline
- + On receipt of UF rack repair sheets, Team Leader to schedule repairs as appropriate

- + Racks can only be returned to service if the PDT result on a manual or automatic test is < 1 kpa/min
- + Provide weekly report to Coordinator Water and Wastewater indicating which racks have exceeded PDT limits, and repairs that were required/ need to replace spare parts.

- + Record results of each pressure decay test in daily operational sheet
- + Enter results in operational monitoring spreadsheet and check trends for any increasing trend or sudden jump in pressure decay
- + If increasing trend or jump, consider scheduling a manual PDT to observe for leaks if time permits.
- + If manual PDT undertaken, take actions as per adjustment limit actions above
- + Record observations in plant diary so other operators are aware of actions that have been taken

The action and critical limits are based on demonstrating that the ultrafiltration membranes achieve a 3.0 log reduction of *Cryptosporidium* under the proposed Health Based Targets Framework.

DOCUMENT	953212
VERSION	2.2
APPROVED	MGR WATER AND WASTEWATER
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Indirect Membrane Integrity Permeate Turbidity Critical Control Point Procedure



What is measured	Where or how is it measured	What is the control point	What are the hazards	Record Keeping
Individual rack permeate turbidity	Continuous online turbidity and weekly manual grab samples	Membrane Filter Racks	Pathogens, turbidity	SCADA records. Manually record grab sample results on daily operational sheet and in operational data spreadsheet

Critical Limit
> 0.15 NTU

Immediate for grab sample, or with 15 minute delay for online monitoring

Adjustment Limit
> 0.1 NTU

Immediate for grab sample, or with 15 minute delay for online monitoring

Target Criterion
< 0.1 NTU

- + Automatic shut down of failed UF rack
 - + Follow all adjustment procedures as appropriate
 - + Review reservoir levels (SCADA) to determine if community can be supplied from existing storage until situation is resolved
 - + If rack did not shut down automatically after 15 minute delay, and water with >0.15 NTU may have entered reticulation, Environmental Technical Officer (or Water operator) to arrange daily water quality monitoring at treated water reservoir for:
 1. pH
 2. turbidity
 3. E. coli
 4. Total and free chlorine
- + Report breach to Coordinator Water and Wastewater on CCP reporting form
 - + If situation cannot be resolved, and rack must be brought online to ensure continuity of supply Coordinator Water and Wastewater or Manager Water and Wastewater to;
 - + Provide written direction to Water Treatment Operators or Team Leader
 - + Contact Regulator on 1300 596 709 if required
 - + Manager Water and Wastewater to determine corrective action/incident management if required. This may include actions such as:
 1. Restart plant under increased monitoring conditions and increased chlorine

OR

 2. Restart plant with boil water alert

- + Take rack offline
 - + Review reservoir levels (SCADA) to determine if community can be supplied from existing storage until situation is resolved
 - + Take manual permeate turbidity sample to confirm result
 - + If significantly different, clean and recalibrate turbidity meter and resample
 - + If grab sample confirms value is close to or exceeds 0.1 NTU, conduct manual PDT and observe for signs of bubbles
 - + If bubbles observed mark with electrical tape to signal need for maintenance/ repair
 - + Note the estimated number of leaking straws on the UF rack repair sheet and provide to Team Leader
- + If no, or minimal bubbles are observed, this may be an indication of leaking valves/ pipework. Conduct full system check of relevant valves and pipework.
 - + Fix any identified leaks if possible, or report on UF rack repair sheet and keep rack offline
 - + On receipt of UF rack repair sheets, Team Leader to schedule repairs as appropriate
 - + Racks may be returned to service if the PDT result on a manual or automatic test is < 1 kpa/ min and turbidity is <0.1 NTU
 - + If rack does not pass, and water supply security is of concern, immediately complete CCP reporting form and send to Coordinator Water and Wastewater of General Manager Operations.
 - + Provide weekly report to Coordinator Water and Wastewater indicating which racks have exceeded PDT limits, and repairs that were required/ need to replace spare parts.

- + Record results of manual grab sample in daily operational sheet
- + Enter results in operational monitoring spreadsheet and check trends
- + Ensure turbidity meters are maintained (cleaned and calibrated) as per normal schedule
- + Record any observations in plant diary

The action and critical limits are based on demonstrating that the ultrafiltration membranes achieve a 3.0 log reduction of *Cryptosporidium* under the proposed Health Based Targets Framework.

DOCUMENT NO.	953212
VERSION	2.2
APPROVED	MGR WATER AND WASTEWATER
DATE	05/20

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pH adjustment - Whyanbeel Operational Control Point Procedure



What is measured pH in recirculation line from Whyanbeel Reservoir	Where or how is it measured Continuous online monitoring at WTP, weekly grab samples	What is the control point Soda Ash Dosing system	What are the hazards Chlorine sensitive pathogens	Record Keeping SCADA records, grab sample in daily operational monitoring sheet and spreadsheet
--	--	--	---	---

Operational Limit
pH <6 or > 7.5

Adjustment Limit
pH < 6.5 or > 7

Target Criterion
pH 6.5-7

- + Automatic alarms (shut down of soda ash dosing at high pH)
- + Follow all adjustment procedures as appropriate
- + Do not restart Soda Ash Dosing until the cause of the overdose has been rectified.
- + Report exceedence to Coordinator Water and Wastewater on CCP reporting form
- + if pH < 6, re-establish soda ash dosing
- + if pH > 7.5 cease dosing and allow low pH water to reduce the pH of the reservoir - but normal operation can continue
- + If pH > 9, report an incident to Regulator as disinfection may be compromised

- + Immediate manual retest
- + Check online instrument calibration
- + If pH <6.5 Check chemical supply and all dosing lines (e.g. for blockages or leaks), and if dosing system operating correctly, increase dose rate
- + if pH > 7, reduce soda ash dose rate
- + Review previous chlorine results as recorded on operational check sheet
- + Notify Team Leader Water Quality
- + Record actions in plant diary
- + Report actions to Coordinator Water and Wastewater in weekly report

- + Plant visual inspection, including checking soda ash dosing system.
- + Normal dose rate is 0.03 mL/L of 15% soda ash (sodium carbonate)
- + Equipment checks and chemical volume
- + WTP water sampling and testing
- + weekly grab sample (compare to online instrument)
- + Record results in operational sheet and spreadsheet
- + Instrument maintenance and calibration as required

DOCUMENT NO.	953212
VERSION	2.2
APPROVED	MGR WATER AND WASTEWATER
DATE	05/20

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Chlorination (Primary and Re-dosing) Critical Control Point Procedure



What is measured	Where or how is it measured	What is the control point	What are the hazards	Record Keeping
Free chlorine in treated water reservoir and reticulation network reservoirs	Continuous online monitoring at WTPs Craiglie, Rocky Point and Flagstaff Reservoirs, weekly manual grab samples	Chlorine dosing system	Chlorine sensitive pathogens	SCADA records, grab sample in daily operational monitoring sheet and spreadsheet

Critical Limit
< 0.2 mg/L or > 4.5 mg/L
online for > 15 min

Adjustment Limit
< 0.7 mg/L or > 2 mg/L
online for > 15 min

Target Criterion
1.0 - 1.5 mg/L

- + Automatic alarms
 - + Follow all adjustment procedures as appropriate
 - + Check reservoir chlorine levels to ensure within adjustment limit
 - + Consider need to adjust target at Reservoirs or need to manually dose reservoirs
 - + On breach of low level critical limit, Environmental Technical Officer (or Water Operator) to arrange water quality monitoring at reticulation sampling locations for:
 1. pH
 2. turbidity
 3. E. coli
 4. Total and free chlorine
 - + On breach of high level critical limit, Environmental Technical Officer (or Water operator) to arrange water quality monitoring at reticulation sampling locations for:
 1. Total and free chlorine
- + Report breach to Coordinator Water and Wastewater on CCP reporting form
 - + If situation cannot be resolved, Coordinator Water and Wastewater or Manager Water and Wastewater to;
 - + Provide written direction to Water Treatment Operators or Team Leader
 - + Contact Regulator on 1300 596 709 if required
 - + Manager Water and Wastewater to determine corrective action/incident management if required. This may include actions such as:
 1. Consider need to take reservoir offline

OR

 2. Calculate chlorine contact time in conjunction with UF operation to inform need to consider issuing boil water alert

- + Immediate manual retest
 - + Check online instrument calibration
 - + Check chemical supply and all dosing lines (e.g. for leaks)
 - + Resolve any identified issue
 - + Review previous chlorine results as recorded on operational check sheet
 - + Notify Team Leader Water Quality
 - + Record actions in plant diary
- + Report actions to Coordinator Water and Wastewater in weekly report

- + Plant visual inspection, including checking chlorine dosing system.
- + Equipment checks and chemical volume (e.g. weight of cylinders, remaining liquid or solid)
- + WTP water sampling and testing
- + weekly grab sample (compare to online instrument)
- + Record results in operational sheet and spreadsheet
- + Instrument maintenance and calibration as required

DOCUMENT NO.	953212
VERSION	2.3
APPROVED	MGR WATER AND WASTEWATER
DATE	09/20

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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	Feb-20
Inspection and Maintenance of Intakes - All Water Intakes	#908590	Manager Water and Wastewater	Sep-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
Craigie Water Reservoir chlorine Gas Dosing Facility Safety and Emergency Management Plan	#861398	Manager Water and Wastewater	May-19
Council Metered Standpipes conditions of hire and use	#819971	Manager Water and Wastewater	Jun-19
Approved Extraction Points	#819972	General Manager Operations	Jul-17
DSC Operational Business Continuity Sub-Plan for Water and Wastewater	#948661	Manager Water and Wastewater	May-20
Local Disaster Management Plan	#884641	CEO	Dec-18

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 regularly to ensure that the reservoirs are intact and that any points of ingress are repaired.
- 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.

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 reservoirs, or the water treatment plant.

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.

PHR Requirement:

The PHR is a provider based requirement based on population. The minimum requirement under the PHR is based on Douglas Shire having a population of 16544. The PHR requires 1 *E. coli* sample per week for populations above 5000, with an additional monthly *E. coli* sample required for every 5000 people that exceed 5000 population. For a population of 16544, the minimum requirement is 1 per week and 2 per month, or a grand total of 76 *E. coli* samples.

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 produced 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 8 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 and Mn.

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 (external samples taken in lieu of internal samples on that week). We sample every week of the year, alternating between the identified sample locations.

The parameters monitored allow DSC 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.

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. As stated in the previous DWQMP, this was a trigger point to cease THM sampling.

In 2020/21 we will commence investigative monitoring of chlorate in the Daintree scheme to determine baseline concentrations. Monitoring will initially occur quarterly. Monitoring will be undertaken 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.

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:

Table 15 – Verification Monitoring Locations

Mossman/Port Douglas (pop < 15000)	Raw	Reservoir	Retic
Mossman Intake	Monthly		
Cassowary – Bunn’s Corner			Alternate weeks
Cooya Beach - Northern End - Boat Ramp			Alternate weeks
Craiglie - Reef Park Reservoir		Monthly	
Flagstaff - Reservoir No. 2 Pump Station Tap		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		Monthly	
Whyanbeel (pop < 5000)	Raw	Reservoir	Retic
Whyanbeel Intake	Monthly		
Rocky Point Pump Station			Alternate weeks
Rocky Point Reservoir		Monthly	
Wonga Beach - Bells Park			Alternate weeks
Daintree (pop < 1000)	Raw	Reservoir	Retic
Daintree Raw Water	Monthly		
Daintree Bore	Monthly		
Daintree Rainwater	Monthly when possible		
Daintree - Shire Hall			Alternate weeks
TOTAL	<i>48 - not counted to PHR requirement as raw water</i>	48	244

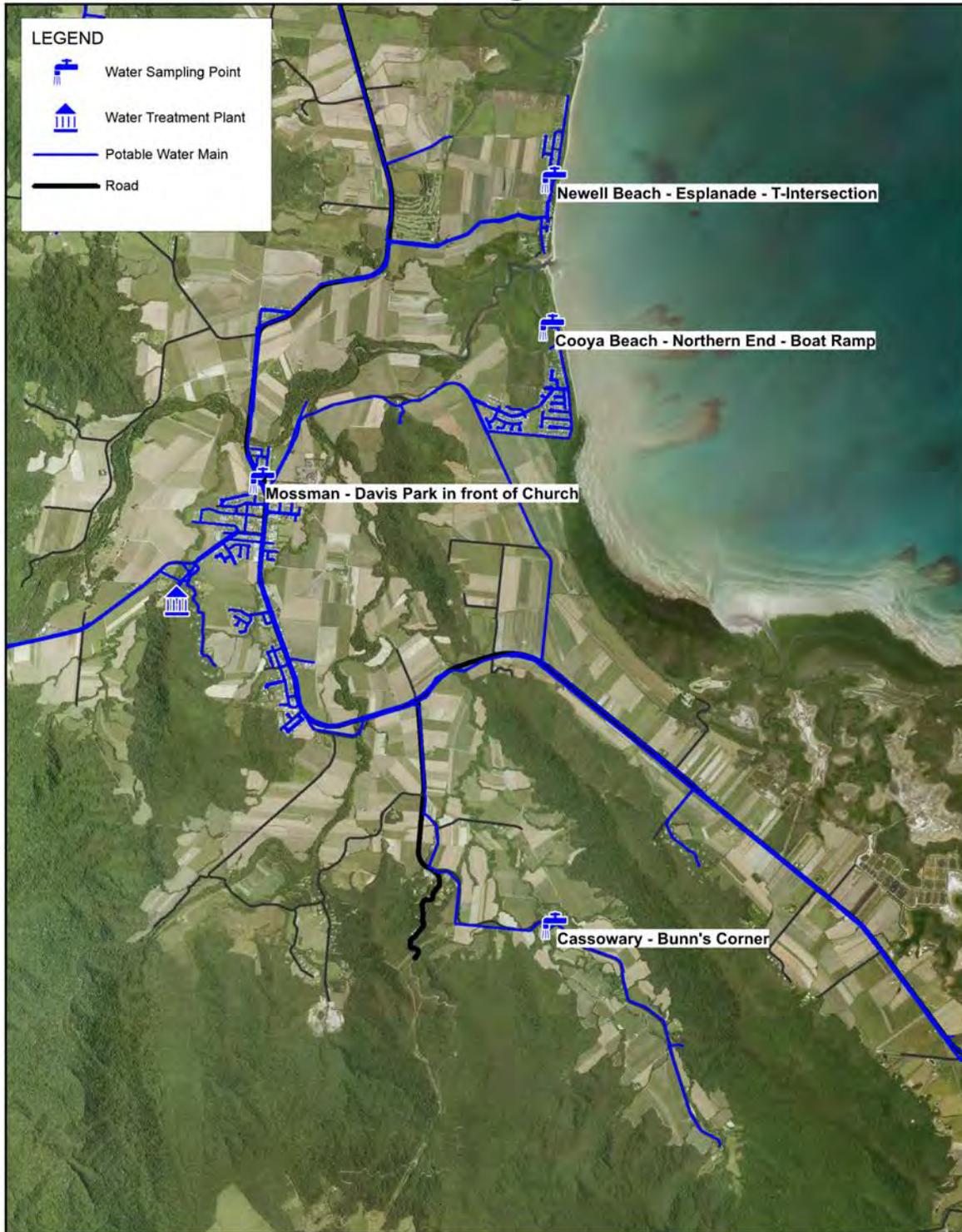
Alternate Weeks - in Whyanbeel means that samples are taken weekly, alternating between the 2 Retic sites. In Daintree, samples are taken every 2 weeks at the Shire Hall. In Mossman/Port Douglas, each site is sampled in every two week period, with samples taken for at least 2 sites every week. Monthly samples are additional to this.

In this way each scheme meets the PHR in its own right, well above minimum requirements.

Quality Assurance

At least every 3 months, duplicate *E. coli* samples will be 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 12 – Mossman sampling locations

Mossman - Port Douglas drinking water scheme



Figure 13 – Port Douglas sampling locations

Whyanbeel drinking water scheme

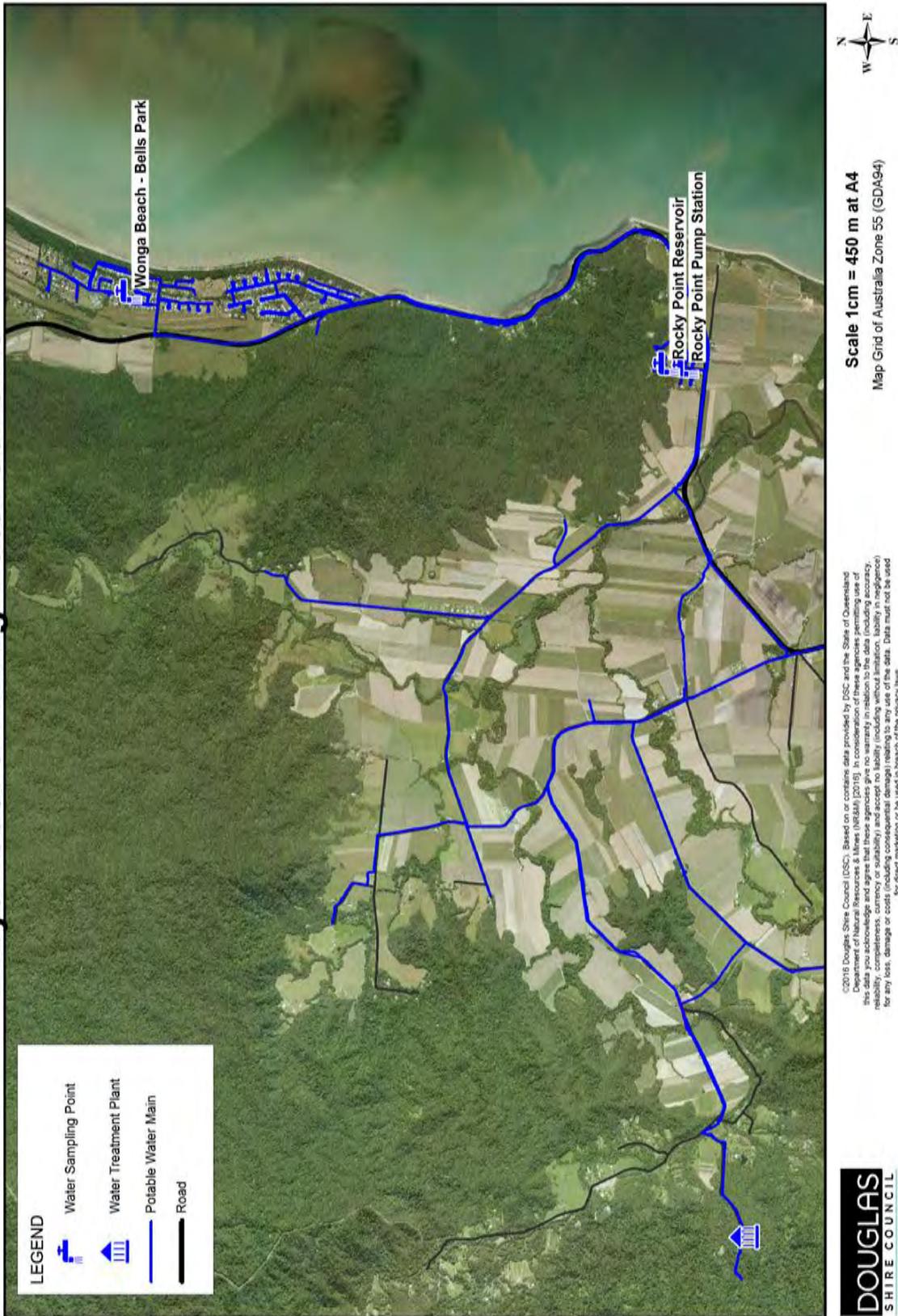


Figure 14 — Whyanbeel sampling locations

Daintree drinking water scheme



Figure 15 – 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 16 – 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 17 – 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 water related aspects</p> <p>Consider what community notification is needed (if any) e.g. 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 functioning effectively.</p>	<p>Notify Manager Water and Wastewater Notify Regulator of any reportable incidents immediately (within 3 hours).</p> <p>Ensure all control measures identified in the DWQMP are functioning effectively</p> <p>Commence investigation</p> <p>Arrange for re-samples to be taken (where 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) e.g. 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 where required</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 functioning effectively.</p> <p>Check and act upon operations and maintenance records and procedures.</p>	<p>Notify Team Leader Water. Quality. Review operations and maintenance records for anomalies</p> <p>Commence investigation to determine cause, if not identifiable through operational records</p> <p>Investigate immediate remediation actions</p> <p>Increase operational monitoring frequency where required</p>	<p>Operations and maintenance records and procedures.</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 Critical Control Point 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 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 DSC 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 3 hours of becoming aware of the incident (3 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 activate the Disaster Management Plan/ a Disaster is declared by the State Government.

This requires coordination across DSC departments and requires external resourcing and support from agencies, such as Queensland Fire and Emergency Services, Department of Natural Resources Mines and Energy, 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 Local Disaster Management Group (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.

Example incident responses

The following flow charts demonstrate the Douglas Shire Council Incident Response for *E. coli* or chemical health exceedances.

Douglas Shire Council has also developed Boil Water Alert and Do Not Drink Alert templates, and are developing a communication strategy to best ensure these Alerts are disseminated as soon as possible in the event that they are required. Example templates follow (document number 460573)

E. coli Response Process and Decision Tree

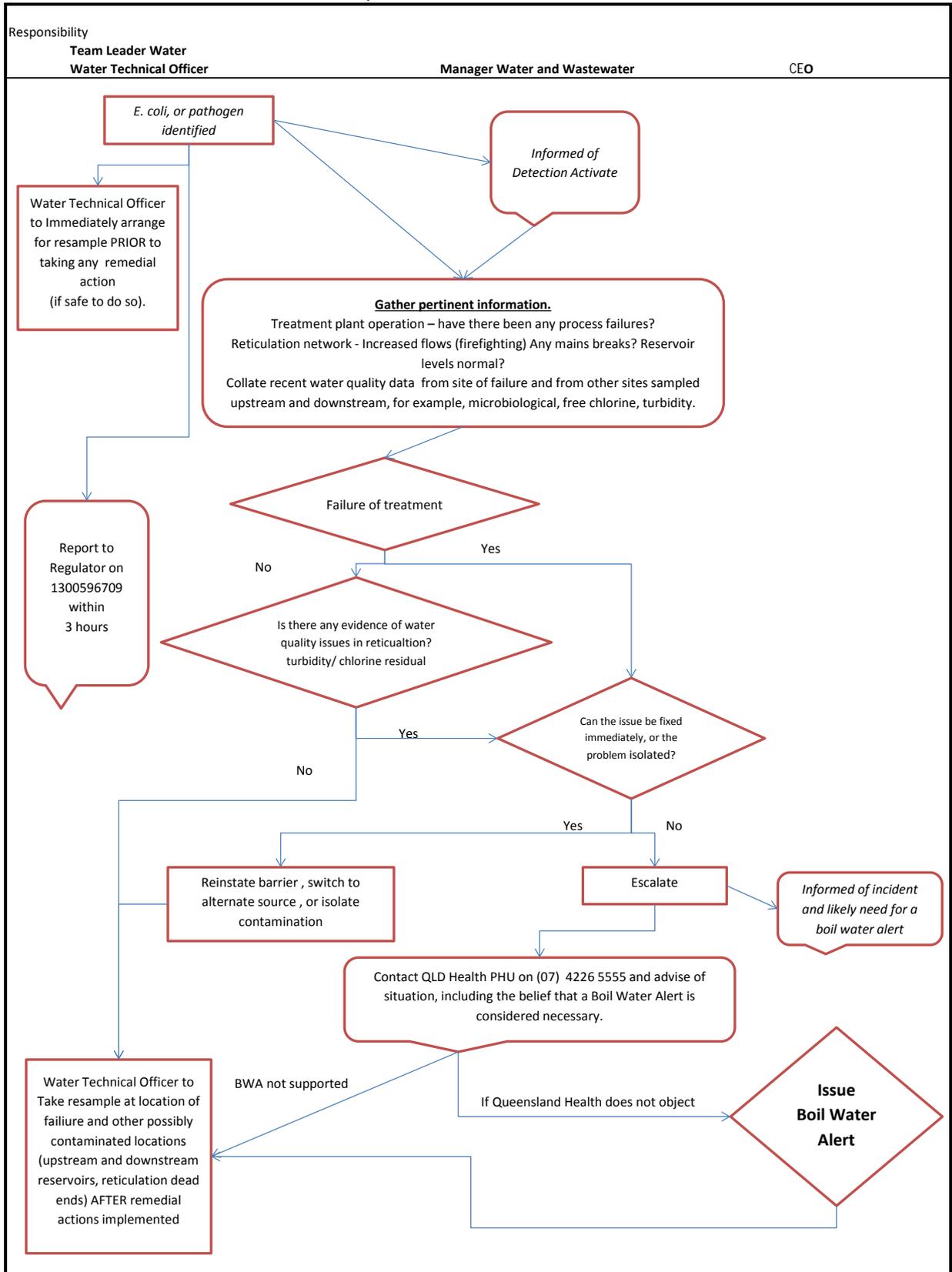
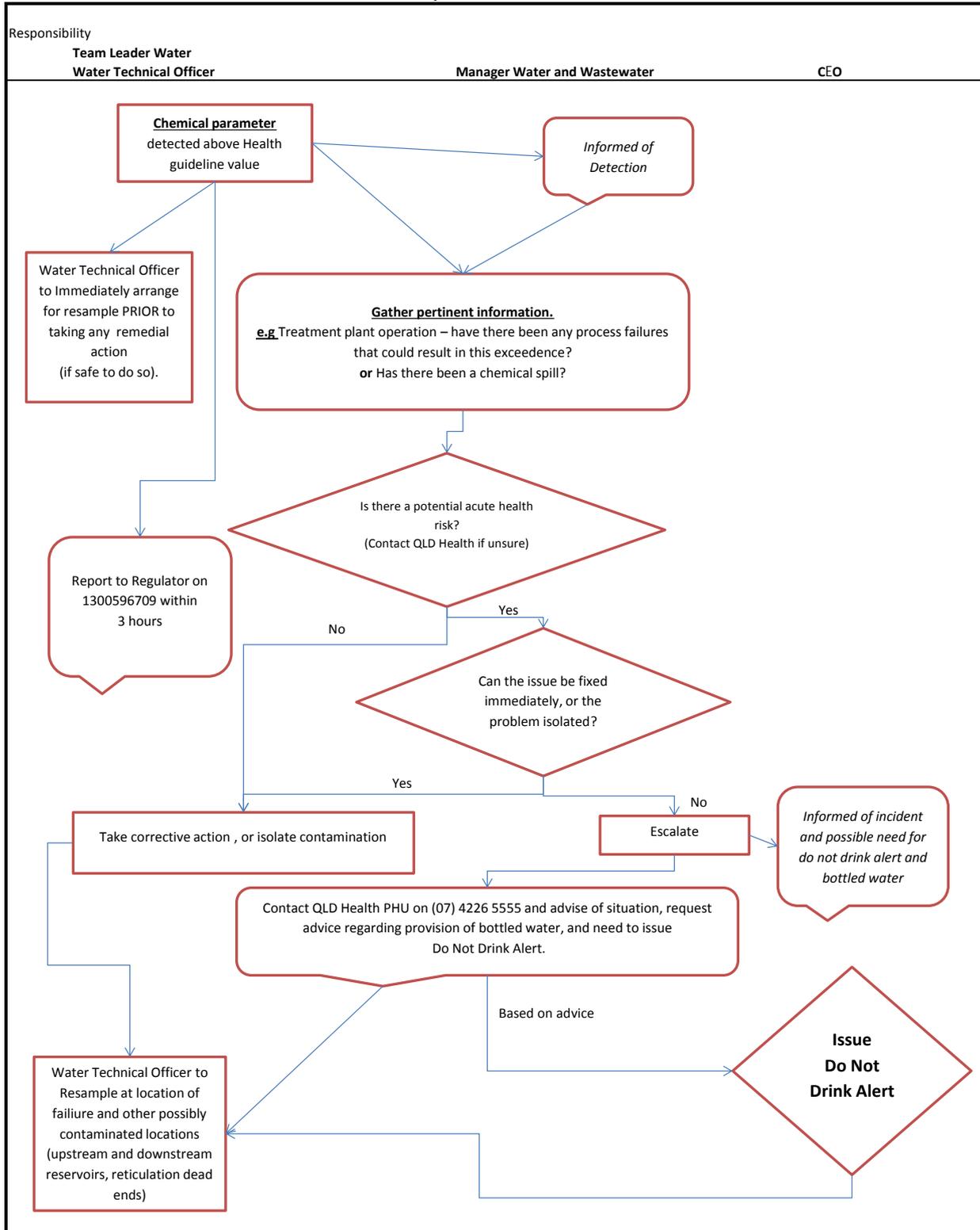


Figure 17 – Chemical exceedence response protocol

Chemical Parameter Response Process and Decision Tree



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. In an effort to engage operators, much of the development of these plans was done in conjunction with operators. It is intended that the drinking water quality management plan 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 of 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 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 a number of 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 on the basis of 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 of 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 Technical Officer Water and Wastewater and signed off by the Manager. The Manager Water and

Wastewater also reports quarterly to Councilors 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 Critical Control Point 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 & 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 & 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's retains the systems integrator (Welcon) whom specialise in Water & 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 & 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 have 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 & 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 & 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 & Wastewater system.

Background to Councils Systems

Council maintains 3 water treatment plants. All are 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 server to allow for high levels of redundancy.

Physical Security

CCTV has been installed at all sites, as a deterrent & 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 4 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 and visa versa. Only the minimum number of IP addresses and port 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.

Routine Maintenance, Backup & Restoration of Services

Routine Maintenance

Quarterly on site visits are performed by Welcon during which software upgrades / patching is performed, as well as checking system performance & hardware operation. SCADA software updates for security vulnerabilities are very rare. The risk to council from SCADA software vulnerabilities is considered low as there is not 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 resides have been configured with redundancy in mind e.g. RAID disk arrays. Council SCADA systems are backed up quarterly by the council's systems integrator (Welcon). Backups include the Programmable Logic Controllers 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 4 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 Drinking water quality management plan 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 4 years. The next audit is expected to be conducted by June 2021.

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 drinking water quality management plan report will be prepared as per the guideline, and will be published on Councils 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 drinking water quality management plan 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, DSC will undertake actions as soon as practical. Otherwise, items are identified as occurring in particular financial years, as this aligns with Council 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 Councilors.

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 Councilors 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 2014-2020

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)	240	22	7	<5		0
Chlorite (mg/L)	163	0.16	<0.05			0
Colour (PCU)	688	5	<5			0
Copper (mg/L)	692	0.37	0.01		2	0
Free Chlorine (mg/L)	3369	2.1	0.7	<0.1	5	0
Iron (mg/L)	692	0.43	0.01			0
Lead (mg/L)	558	0.00	<0.001	<0.001	0.01	0
Manganese (mg/L)	692	0.01	<0.005		0.5	0
pH (pH unit)	3706	10.06	7.4	5.4		0
THM (ug/L)	130	170	54		250	0

Mossman Raw

Parameter	No of samples taken	Max	Average	Min
Alkalinity (mg/L)	24	12	5	<5
Calcium (mg/L)	24	0.7	0.5	0.4
Colour (PCU)	27	15	5	<5
Electrical Conductivity (uS/cm)	69	142	33	20
Fluoride (mg/L)	24	0.03	<0.1	<0.1
Hardness (mg CaCO ₃ /L)	24	3	2.7	2
Magnesium (mg/L)	24	0.4	0.3	0.29
pH (pH unit)	113	7.8	6.9	6.2
Potassium (mg/L)	24	1	0.9	0.08
Silica (mg/L)	39	15	9.3	4.2
Sodium (mg/L)	24	4.6	3.9	3
Sulphate (mg/L)	24	1.8	1	0.08
Turbidity (NTU)	109	25	0.8	<0.5
Iron (mg/L)	24	0.04	0.02	0.01
Manganese (mg/L)	24	<0.005	<0.005	<0.005
Total Dissolved Solids (mg/L)	22	42	30	21
Total Oxidised Nitrogen (mg/L)	19	0.12	0.04	<0.05
Total Nitrogen (mg/L)	20	0.18	0.09	<0.05
Ammonia (mg/L)	20	0.01	<0.005	<0.005

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)	118	17	9.35	<5		0
Chlorite (mg/L)	84	0.5	0.1	<0.05		0
Colour (PCU)	187	5	<5	<1		0
Copper (mg/L)	187	0.03	0.01	<0.001	2	0
Free Chlorine (mg/L)	1065	2.2	0.7	0.01	5	0
Iron (mg/L)	187	0.07	0.02	<0.005		0
Lead (mg/L)	148	0.00	0.00	<0.0005	0.01	0
Manganese (mg/L)	187	<0.005	<0.005		0.5	0
pH (pH unit)	1222	9.31	7.52	4.85		0
THM (ug/L)	117	150	43	<0.5	250	0

Whyanbeel Raw

Parameter	No of samples taken	Max	Average	Min
Alkalinity (mg/L)	82	8	5.1	1.6
Calcium (mg/L)	25	0.5	0.38	0.3
Colour (PCU)	28	15	9.9	<5
Electrical Conductivity (uS/cm)	57	103.9	27.5	18.9
Fluoride (mg/L)	25	0.1	<0.02	<0.02
Hardness (mg CaCO ₃ /L)	25	3	2.4	2
Magnesium (mg/L)	25	0.44	0.35	0.3
pH (pH unit)	100	7.8	6.5	5.8
Potassium (mg/L)	25	0.9	0.66	0.5
Silica (mg/L)	37	11	6.1	1.9
Sodium (mg/L)	25	4.3	3.4	2.8
Sulphate (mg/L)	25	1.9	1	0.7
Turbidity (NTU)	99	15	0.88	0.1
Iron (mg/L)	25	0.04	0.03	0.00
Manganese (mg/L)	25	<0.010	<0.005	0.00
Total Dissolved Solids (mg/L)	21	330	41.4	<0.5
Total Oxidised Nitrogen (mg/L)	20	0.22	0.08	<0.01
Total Nitrogen (mg/L)	21	0.25	0.12	<0.05
Ammonia (mg/L)	21	0.08	0.02	<0.005

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)	47	39	23	<5		0
Chlorite (mg/L)	39	0.05	<0.05	<0.05		0
Colour (PCU)	70	8	5.9	<1		0
Copper (mg/L)	70	0.27	0.02	0.00	2	0
Free Chlorine (mg/L)	245	1.4	0.58	0.01	5	0
Iron (mg/L)	70	0.11	0.01	<0.008		0
Lead (mg/L)	54	0.01	0.00	<0.001	0.01	0
Manganese (mg/L)	70	<0.005	<0.005		0.5	0
pH (pH unit)	276	8.85	7.72	6.7		0
THM (ug/L)	10	110	57	23		0

Daintree Raw - Intake

Parameter	No of samples taken	Max	Average	Min
Alkalinity (mg/L)	82	55	23.6	<5
Calcium (mg/L)	25	3.3	2.22	1.2
Colour (PCU)	28	45	13.3	4.1
Electrical Conductivity (uS/cm)	53	146	78	53
Fluoride (mg/L)	25	<0.1	<0.1	<0.1
Hardness (mg CaCO ₃ /L)	25	20	14	9
Magnesium (mg/L)	25	2.8	2.1	1.4
pH (pH unit)	56	7.7	7	6.4
Potassium (mg/L)	25	1.9	1.2	0.9
Silica (mg/L)	40	29	19.5	9.2
Sodium (mg/L)	25	11	9	7
Sulphate (mg/L)	25	2.4	1.6	1.2
Turbidity (NTU)	52	52	2.5	0.4
Iron (mg/L)	25	0.4	0.17	0.09
Manganese (mg/L)	25	<0.010	0.01	<0.005
Total Dissolved Solids (mg/L)	21	77	61	4
Total Oxidised Nitrogen (mg/L)	19	0.22	0.1	<0.05
Total Nitrogen (mg/L)	21	0.29	0.16	<0.05
Ammonia (mg/L)	21	0.01	0.01	<0.005

Daintree Raw - Bore

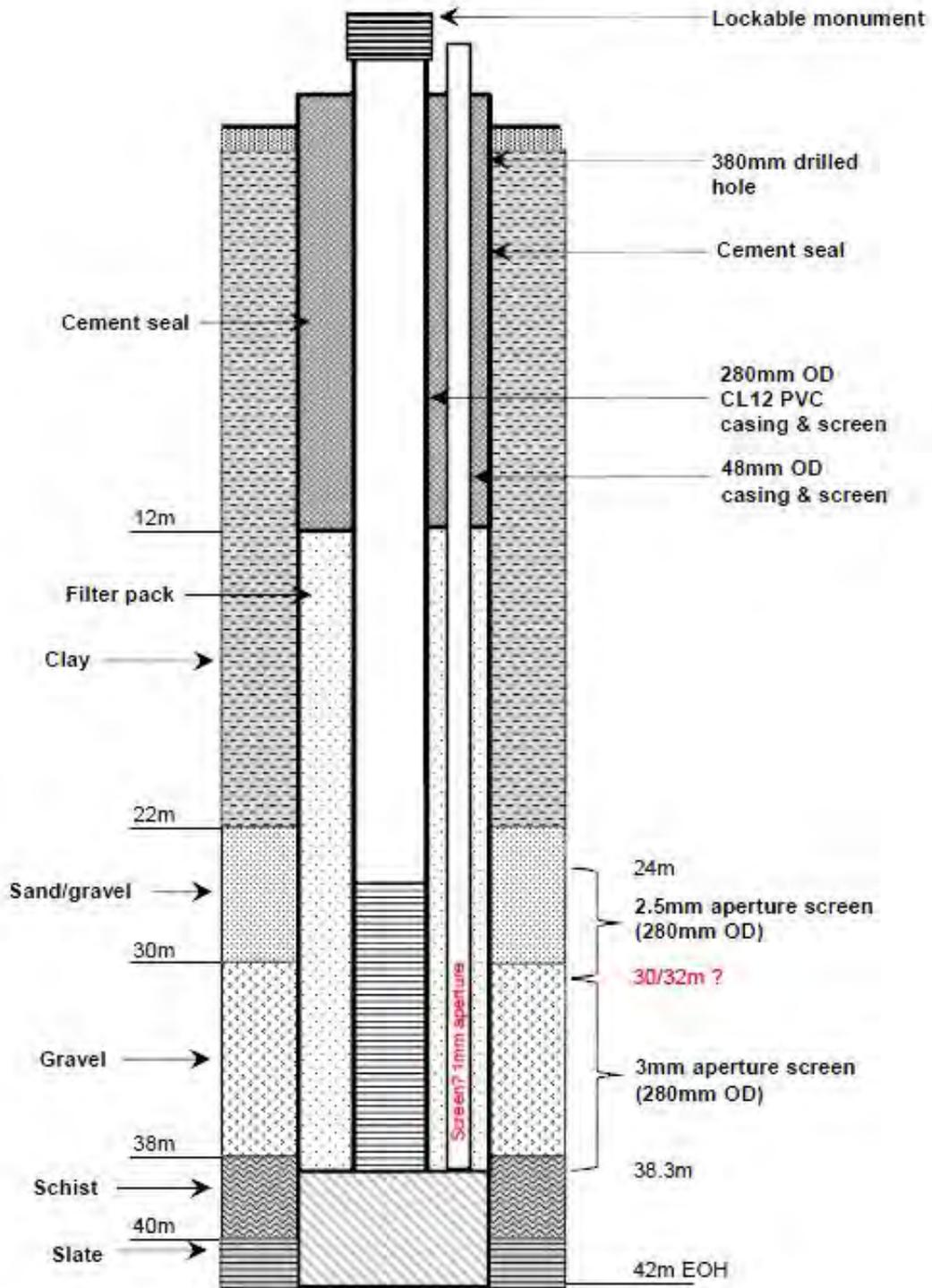
Parameter	No of samples taken	Max	Average	Min
Alkalinity (mg/L)	27	8	6.3	2.7
Calcium (mg/L)	10	0.3	0.21	0.1
Colour (PCU)	10	<5	<5	<1
Electrical Conductivity (uS/cm)	22	75.8	47.4	37
Fluoride (mg/L)	6	<0.1	<0.1	<0.02
Hardness (mg CaCO ₃ /L)	8	6	4	3
Magnesium (mg/L)	10	1.2	0.9	0.7
pH (pH unit)	32	7.4	5.3	4.7
Potassium (mg/L)	10	1.1	0.9	0.8
Silica (mg/L)	9	16	13	7
Sodium (mg/L)	10	5.8	5.2	4.9
Sulphate (mg/L)	6	1.2	1.5	1.8
Turbidity (NTU)	23	0.9	0.4	<0.1
Iron (mg/L)	34	0.05	0.02	<0.005
Manganese (mg/L)	21	0.03	0.01	<0.005
Total Dissolved Solids (mg/L)	8	47	37	16
Total Oxidised Nitrogen (mg/L)	3	0.76	0.65	0.61
Total Nitrogen (mg/L)	2	0.46	0.41	0.36
Ammonia (mg/L)	7	<0.02	<0.02	<0.005

Daintree Raw - Rainwater System

Parameter	No of samples taken	Max	Average	Min
Alkalinity (mg/L)	5	7	<5	<5
Calcium (mg/L)	2	0.2	<0.1	<0.1
Colour (PCU)	2	<5	<5	
Electrical Conductivity (uS/cm)	7	94.8	29	<1
Fluoride (mg/L)	2	<0.1	<0.1	
Hardness (mg CaCO ₃ /L)	1	2	2	
Magnesium (mg/L)	2	<0.05	<0.05	
pH (pH unit)	6	5.9	5.8	5.6
Potassium (mg/L)	2	0.2	0.11	0.03
Sodium (mg/L)	2	2.3	1.2	<0.05
Sulphate (mg/L)	1	<1	<1	
Turbidity (NTU)	5	2	0.8	0.4
Iron (mg/L)	2	<0.008	<0.008	
Manganese (mg/L)	2	<0.005	<0.005	

Appendix B - Daintree Bore Details

Bore 00241



Analytes	Unit	ADWG (2011)		Detection Limit	Sample start	Sample end
		Health	Aesthetic		CE124583 R0	CE124648 R0
Water quality parameters						
Total Dissolved Solids Dried at 175-185°C	mg/L			10	35	16
Electrical conductivity at 25°C	µS/cm			2	41	46
pH			6.5 - 8.5	0.1	5.9	6.2
Total Hardness as CaCO ₃	mg/L		200	1	4	6
Bicarbonate Alkalinity as CaCO ₃	mg/L			5	6	8
carbonate Alkalinity as CaCO ₃	mg/L			5	<5	<5
Hydroxide Alkalinity as CaCO ₃	mg/L			5	<5	<5
Total Alkalinity	mg/L			5	6	8
Turbidity	NTU			0.5	<0.5	<0.5
Nutrients and Pathogens						
Nitrate Nitrogen (NO ₃ as N)	mg/L	50		0.005	0.74	1.2
Nitrite Nitrogen (NO ₂ as N)	mg/L	3		0.005	<0.005	<0.005
Ammonia Nitrogen (NH ₃ as N)	mg/L		0.5	0.005	<0.005	<0.005
E.coli	MPN/100mL			1	<1	<1
Total Coliforms	MPN/100mL			1	76	3
Heterotrophic Plate Count (HPC) at 35 °C	CFU/mL			1	170	<10
Dissolved Metals						
Aluminium	mg/L		0.2	0.005	0.008	0.01
Arsenic	mg/L	0.01		0.003	<0.003	<0.003
Barium	mg/L	2		0.005	0.032	0.04
Beryllium	mg/L	0.06		0.0001	0.0003	0.0004
Boron	mg/L	4		0.005	<0.005	<0.005
Cadmium	mg/L	0.002		0.0001	<0.0001	<0.0001
Chromium	mg/L	0.05		0.001	0.0011	<0.0010
Cobalt	mg/L			0.001	0.002	0.002
Copper	mg/L	2	1	0.001	0.002	<0.001
Iron	mg/L		0.3	0.005	<0.005	<0.005
Lead	mg/L	0.01		0.001	<0.001	<0.001
Manganese	mg/L	0.5	0.1	0.005	0.007	0.01
Mercury	mg/L	0.001		0.00005	<0.00005	<0.00005
Molybdenum	mg/L	0.05		0.001	<0.001	<0.001
Nickel	mg/L	0.02		0.001	0.001	0.001
Selenium	mg/L	0.01		0.003	<0.003	<0.003
Strontium	mg/L			0.005	0.005	0.008
Vanadium	mg/L			0.001	<0.001	<0.001
Zinc	mg/L		3	0.005	<0.005	0.007
Total Metals						
Aluminium	mg/L		0.2	0.005	0.012	0.014
Arsenic	mg/L	0.01		0.003	<0.003	<0.003
Barium	mg/L	2		0.005	0.032	0.041
Beryllium	mg/L	0.06		0.0001	0.0003	0.0004
Boron	mg/L	4		0.005	<0.005	<0.005
Cadmium	mg/L	0.002		0.0001	<0.0001	<0.0001
Chromium	mg/L	0.05		0.001	0.001	<0.001
Cobalt	mg/L			0.001	0.002	0.002
Copper	mg/L	2	1	0.001	0.001	<0.001
Iron	mg/L		0.3	0.005	0.005	<0.005
Lead	mg/L	0.01		0.001	<0.001	<0.001
Manganese	mg/L	0.5	0.1	0.005	0.007	0.01
Mercury	mg/L	0.001		0.00005	<0.00005	<0.00005
Molybdenum	mg/L	0.05		0.001	<0.001	<0.001
Nickel	mg/L	0.02		0.001	0.001	0.002
Selenium	mg/L	0.01		0.003	<0.003	<0.003
Strontium	mg/L			0.005	0.005	0.008
Vanadium	mg/L			0.001	<0.001	<0.001
Zinc	mg/L		3	0.005	<0.005	0.007
Dissolved Ions						
Calcium	mg/L			0.2	<0.2	0.3
Magnesium	mg/L			0.1	0.9	1.2
Potassium	mg/L			0.1	0.8	1.1
Sodium	mg/L			0.5	5.3	5.1
Total Ions						
Calcium	mg/L			0.1	0.2	0.3
Magnesium	mg/L			0.1	0.9	1.2
Potassium	mg/L			0.1	0.8	1.1
Sodium	mg/L			0.5	5.4	5.1

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