5.05. ENDORSEMENT OF DRINKING WATER QUALITY MANAGEMENT PLAN (DWQMP)

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GENERAL MANAGER: Paul Hoye, General Manager Operations
DEPARTMENT: Water and Wastewater

RECOMMENDATION

It is recommended that Council endorses the Amended Drinking Water Quality Management Plan (DWQMP).

EXECUTIVE SUMMARY

The Drinking Water Quality Management Plan (DWQMP) for Douglas Shire Council (Douglas) 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 from catchment to tap.

After a recent internal audit by a qualified water auditor it became evident that it was necessary to amend the Douglas Drinking Water Quality Management Plan (DWQMP) to include capital improvements and Douglas Shire work procedures. Water staff, including the Manager Water & Wastewater and the General Manager Operations, participated in a risk assessment workshop on 15-16 July, 2015 to replace the previous risk assessment framework from 2011. Through the risk assessment process, the Water and Wastewater Branch has identified a number of risks to the Shire's drinking water schemes that require improvements over time. These are detailed in the risk assessment table, and in the risk management improvement plan. The Water and Wastewater Branch intends to use the risk management improvement program to inform capital and operational budgets in coming financial years.

The outcome of the risk workshop and subsequent development project is a more user friendly DWQMP that will provide regulatory guidance to water operational staff members on a daily basis. The draft DWQMP will be submitted to the Department of Energy and Water Supply (DEWS) for approval after endorsement by Council.

BACKGROUND

After de-amalgamation Douglas operated on the approved Cairns Regional Council DWQMP and was required to amend the plan to include only Douglas water supply schemes. The first amended Douglas DWQMP was approved by DEWS on 26 February 2015. An internal audit was initiated at the beginning of March 2015 to test the appropriateness of DWQMP. The risk management framework of 2011 was found to be inadequate to address current conditions and it was decided to engage all water staff in a risk management workshop. Recommendations followed and Douglas engaged a consultant to amend and fully review the DWQMP. The result is a new user friendly health based risk management plan that demonstrates how public health risks are managed. In addition, the plan also describes how Douglas meets the requirements of the environmental authority for the Mossman Water Treatment Plant under the *Environmental Protection Act (1994)* and Water Licences under the *Water Act 2000*.

COMMENT

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 DWQMP becomes a useful document within Douglas 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 Douglas Shire Council and the Manager 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.

PROPOSAL

The amended Douglas Shire Council DWQMP addresses all 12 Elements of the Australian Drinking Water Guidelines (ADWG) and in so doing also ensures that the requirements of the WS Act and Drinking Water Quality Management Plan Guidelines are met.

It is proposed that Council endorses the amended DWQMP before it is submitted to DEWS for approval and subsequent implementation.

FINANCIAL/RESOURCE IMPLICATIONS

Failure to comply with required standards and procedures in the DWQMP may result in harm to the community and substantial penalties.

RISK MANAGEMENT IMPLICATIONS

Council as a registered water service provider has a statutory obligation to ensure it is able to provide water services to customers. Council's reputation would suffer if it is unable to maintain service levels at prescribed standards. The DWQMP provides information on strategies and procedures on how to ensure safe drinking water for the community at all times and minimise occupational health and safety risks and risks to Council infrastructure.

SUSTAINABILITY IMPLICATIONS

Economic: It is essential to adequately maintain water infrastructure in order to provide satisfactory services in support of economic development in the 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 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.

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 2014-2019 Initiatives:

Theme 2 - Building a Sustainable Economic Base
2.1.1 - Develop management plans for all Council assets and adequately resource their implementation.

Theme 5 - Governance
5.1.2 - Implement a robust enterprise risk management culture to identify and manage potential risks.

Operational Plan 2015-2016 Actions:

WW4 - Review and amend Drinking Water Quality Management Plan (DWQMP).

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:

Asset-Owner	Meeting the responsibilities associated with owning or being the custodian of assets such as infrastructure.
Information Provider	Bringing people together to develop solutions to problems.
Regulator	Meeting the responsibilities associated with regulating activities through legislation or local law.

CONSULTATION

Internal:	Extensive internal consultation occurred during the formation of the new DWQMP. All water operational and management staff were actively involved in the internal audit, risk identification process and development of procedures.
External:	A Principal Scientist from Bligh Tanner compiled the DWQMP under project management of the Manager Water and Wastewater.

ATTACHMENTS

Attachment 1 -	Douglas Shire Council Drinking Water Quality Management Plan (DSC DWQMP)

BLIGH TANNER

DOUGLAS SHIRE COUNCIL

Drinking Water Quality Management Plan

SPID 558

DATE. September 2015

CLIENT. Douglas Shire Council

CONTACT. Manager Water and Wastewater

+ DOCUMENT CONTROL SHEET

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+ DOCUMENT
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VERSION	AUTHOR	REVIEWED	APPROVED	DATE
1	Michael Lawrence	Wouter van der Merwe		August 2015
1.1	Michael Lawrence	Wouter van der Merwe	Paul Hoye	October 2015

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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.*

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:

- Installation of turbidity meters on each UF rack, and replacement of butterfly valves (PCWST110, PCWST111)
- Replacement of the Craiglie Reservoir Roof (PCWR125)
- Bank stabilisation at the Daintree WTP (PCWST116)
- Disinfection projects throughout all schemes (PCWST112, PCWST115, PCWST118)
- Interconnect Whyanbeel and Mossman reticulation schemes (PCWR127)

These items are included in the Capital Budget for completion during 2015/2016 Financial Year.

Other items such as gas chlorination across other schemes (PCWST113 and PCWST114) and bringing additional reservoirs online (PCWST119) are already included for funding in 2016/2017 financial year.

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+ GLOSSARY

Term	Definition
ADWG	Australian Drinking Water Guidelines
CEB	Chemically enhanced backwash
CIP	Clean in place
DBPs	Disinfection by-products (including trihalomethanes)
DWQMP	Drinking Water Quality Management Plan
PDT	Pressure Decay Test
PH Act	*Public Health Act 2005*
PHU	Public Health Unit – Queensland Health
QH	Queensland Health
THM	Trihalomethanes – a subset of possible disinfection by-products
UF	Ultrafiltration
UV	Ultraviolet
WS Act	*Water Supply (Safety and Reliability) Act 2008*
WPR	Water Planning and Regulation, Department of Energy and Water Supply

DOUGLAS SHIRE COUNCIL
DRINKING WATER QUALITY MANAGEMENT PLAN

1 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 2011), and meets the regulatory requirements of the *Water Supply (Safety and Reliability) Act 2008* (WS Act).

1.1 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 Licences under the *Water Act 2000*.

1.2 Alignment of the DWQMP to ADWG and Regulatory Requirements

The Douglas Shire Council drinking water quality management plan addresses all 12 Elements of the Australian Drinking Water Guidelines (ADWG) and in so doing also ensures that the requirements of the WS Act and Drinking Water Quality Management Plan Guidelines are met.

The document is maintained by the Manager, Water and Wastewater.

Table 1 DWQMP structure

Reference	ADWG Element and Component	Water Supply Act Requirement	Location in DWQMP
Non-ADWG			
	Registered Service Details	3.5	Title pages, Section 4
Element 1: Commitment to drinking water quality management			
1A	Drinking Water Policy	Not required in DWQMP	Section 3.1
1B	Regulatory and formal requirements	Not required in DWQMP	Section 3.2
1C	Engaging stakeholders	3.6	Section 3.4
Element 2: Assessment of the Water Supply System			
2A	Water Supply System Analysis	3.6, 3.7.2	Section 4
2B	Assessment of Water Quality Data	3.7.1	Section 4.8, and Appendix
2C	Hazard Identification	3.7.2	Section 4.13
2D	Risk Assessment	3.8	Section 4.13
Element 3: Preventive measures for drinking water quality management – critical control points			
3A	Preventive Measures and Multiple Barriers	3.9.1	Section 4.4, 4.5, 4.6 and 5.
3B	Critical Control Points	3.9.1	Section 4.4, 4.5, 4.6 and 5.

Reference	ADWG Element and Component	Water Supply Act Requirement	Location in DWQMP
Element 4: Operational procedures and process control			
4	Operational Procedures	3.9.2	Sections 4.4.10, 4.5.10, 4.6.10
Element 5: Verification of Drinking Water Quality			
5	Verification monitoring plan	3.1	Section 7
Element 6: Incident and Emergency Response			
6	ERP	3.9.3	Section 8
Element 7: Employee Awareness and Training			
7	Training and awareness	3.9.1	Section 9
Element 8: Community Involvement and Awareness			
8	Community consultation strategy developed and implemented	Not explicitly required in DWQMP, but customer service standards partly address	Section 10
Element 9: Research and Development			
9	Process Validation	Not explicitly required in DWQMP	Section 11
Element 10: Documentation and Reporting			
10	Documentation and Reporting	3.9.5, 3.9.4	Section 12
Element 11: Evaluation and Audit			
11	Long term evaluation of system	WS(Act) requires regular review and audits. Not explicitly required in DWQMP	Section 13
Element 12: Review and Continual Improvement			
12A	Snr Executive review of effectiveness of management system	Not explicitly required	Section 14.2
12B	Risk Management Improvement Plan	3.9.4	Section 14.2

2 REGISTERED SERVICE DETAILS

Located in the Tropics of Australia, Douglas Shire is the only place in the world with two adjoining World Heritage listed areas: the Great Barrier Reef and the Wet Tropics – which includes the ancient rainforest of the Daintree. The Douglas Shire covers an area of 2,445km from north of Ellis Beach in the south to the Bloomfield River in the north. The economy of the Shire depends mainly on tourism, with 2 million visitors annually exploring our many natural wonders and agriculture of sugar cane farming and processing.

Douglas Shire Council is a registered water service provider, SPID 558, providing drinking water services to ~16250 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.

Figure 1 Douglas Shire Council Area and drinking water scheme locations

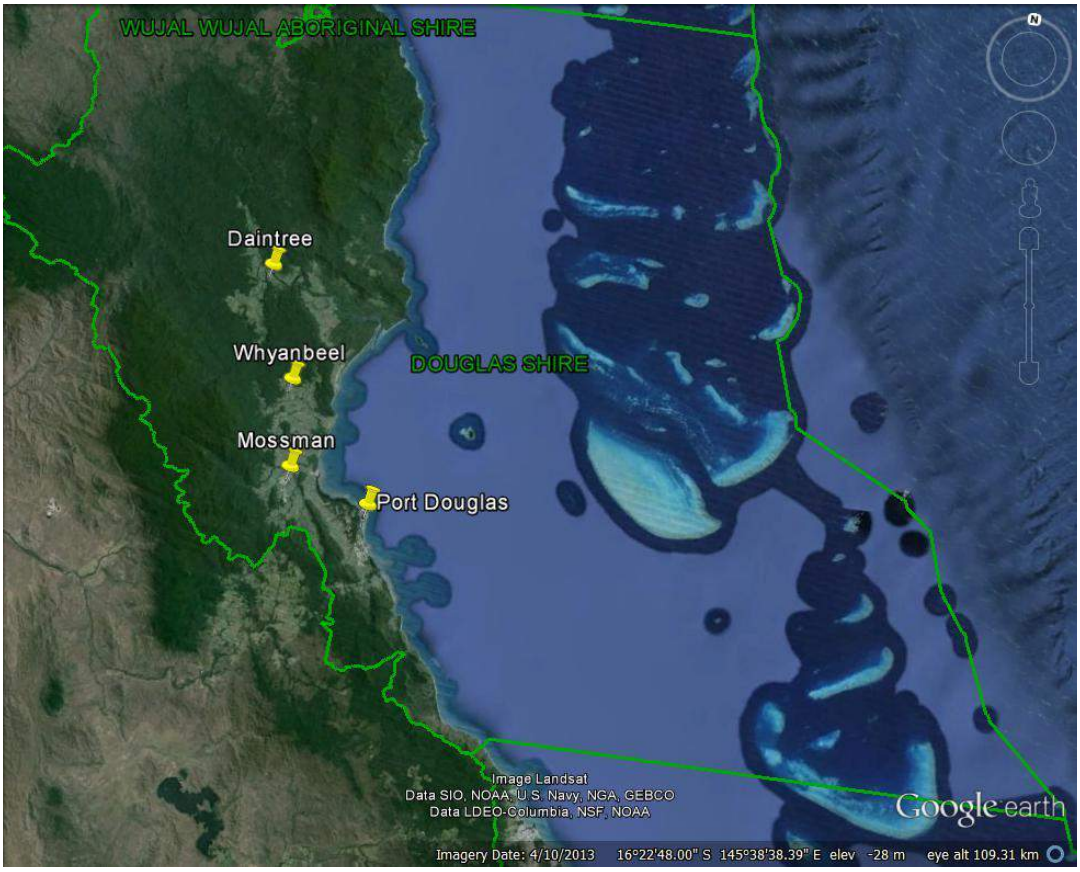

Table 2 Drinking water schemes, populations, connections and demands

Scheme Name/ Communities Served	Intake	Current			Projected in 10 years		
		Population served	Connections	Demand ML/day	Population served	Connections	Demand ML/day
Daintree	Martin Creek	87	7 (non res) 33 (res)	0.45	103	60	0.47
Mossman and Port Douglas	Rex Creek	14816	597 (non res) 5696 (res)	12.2	16036	3850	15.4
Whyanbeel	Little Falls Creek	1457	70 (non res) 579 (res)	1.7	1526	737	2.1
Dagmar Heights*	Dagmar Bore	20	10 (res)	0.005	125	25	0.015
TOTAL		**16380**	6992	14.355			17.985

*Non potable supply, not detailed further in this plan.

3 ELEMENT 1: COMMITMENT TO DRINKING WATER QUALITY

3.1 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

DOUGLAS SHIRE COUNCIL

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 Waste 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 Waste 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 Waste employees and acknowledges that corporate responsibility lies with the Water and Waste Management and ultimately the Douglas Shire Council, Chief Executive Officer.

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

Manager Responsible for Review: **Manager Water & Wastewater**

ORIGINALLY ADOPTED: 16/06/2015
CURRENT ADOPTION:
DUE FOR REVISION: 16/06/2019
REVOKED/SUPERSEDED:

1 #425995

3.2 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 3 Regulatory and formal requirements

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 2005	Sets minimum sampling frequencies for *E. coli* as a provider. Council must not provide unsafe water.
Water Act 2000	Council is licenced to extract raw water. • Rex Creek – Licence #408436 • Little Falls Creek – Licence #500313 • Daintree – Licence #408446
Environment Protection Act 1994	Water treatment is considered an environmentally relevant activity when treating >10ML/day. General obligation not to cause environmental harm. • EA Permit number EPPR01790513. DSC Ref #729266 • 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 (2002) Plumbing and Drainage Regulation (2003) Standard Plumbing and Drainage Regulation (2003)	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.

3.3 Customer and Stakeholder Engagement

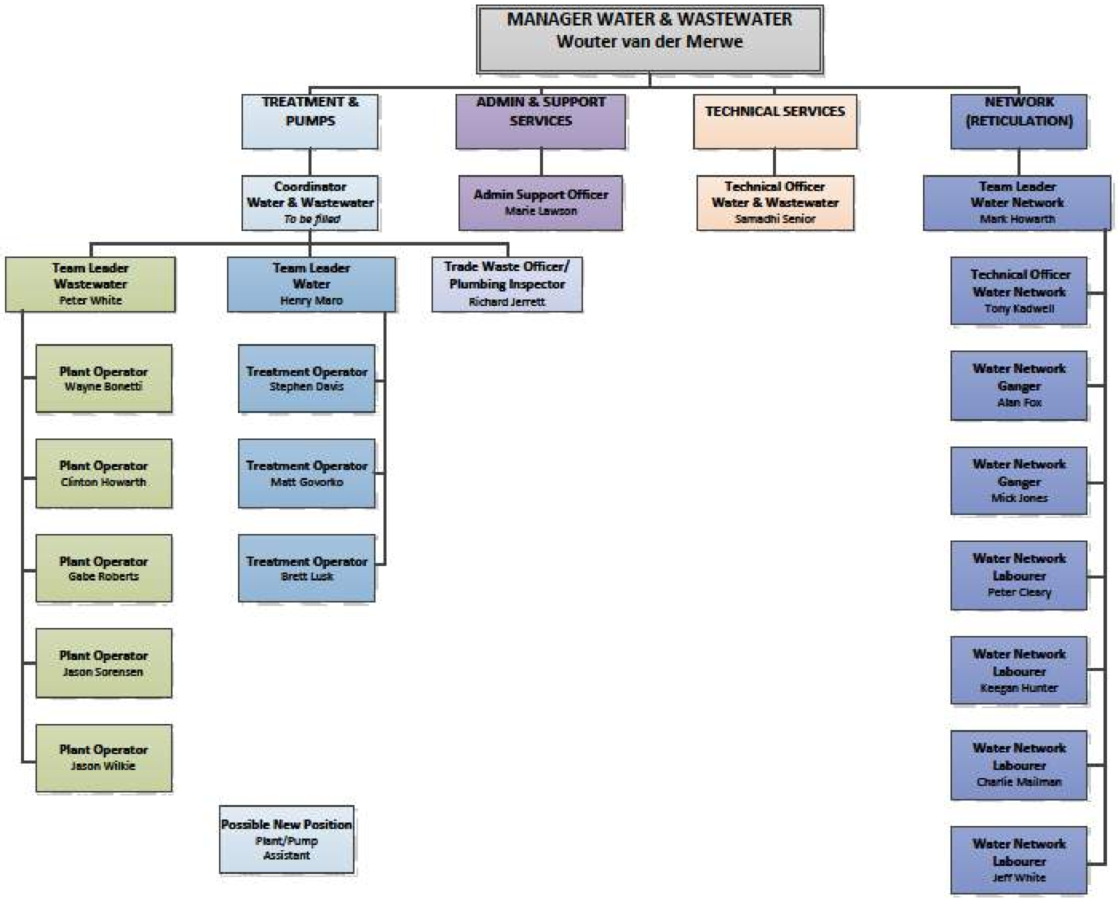
Douglas Shire Council has established customer service standards against which we are able to measure our performance. The most current version of these standards is available on our website at http://douglas.qld.gov.au/

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

3.4 Key stakeholders

Drinking water is managed in Douglas Shire Council by the Manager of Water and Wastewater, under the General Manager Operations. 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 Water and Wastewater organisational chart



External stakeholders have been categorised into different tables below. These stakeholders have some influence on the management and operation of the water services.

Table 4 Key Regulatory Stakeholders

Agency	Contact Details	Role
Water Planning and Regulation (DEWS)	1300 596 709	Regulation of drinking water, and incident reporting.
Tropical Public Health Services Cairns (Dept of 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 Heritage Protection	13 QGOV (13 74 68)	Water treatment is ERA. Discharge licenses etc.

Table 5 Key catchment stakeholders and major/ critical customers

Organisation	Contact Details	Role
Wet Tropics Management Authority	07 4241 0500	Catchment manager
Ozcare	07 4087 2805	High risk customers
Blue Care	07 4098 1126	High risk customers
Stella Maris Home for the Aged	07 4098 5946	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
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
Port Douglas State School	07 4084 3222	Vulnerable Population Customers
Port Douglas Kindergarten	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 Kidz Childcare Centre	07 4099 3392	Vulnerable Population Customers
Port Explorers	07 4099 3392	Vulnerable Population Customers
Petit Early Learning Journey	07 4237 8802	Vulnerable Population Customers
The Cubby House	07 4099 4292	Vulnerable Population Customers
Village Kids Children’s Centre Cooya Beach	07 4098 3444	Vulnerable Population Customers
Cooya Kidz Kindergarten & Early Childhood	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 Community Kindergarten	07 4098 1880	Vulnerable Population Customers
Sheraton Mirage Resort	07 4099 5888	Large Population Resort
QT Resort	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

Organisation	Contact Details	Role
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
Peppers Beach Club Port Douglas	07 4087 1000	Large Population Resort
Pullman Port Douglas Sea Temple Resort & Spa	07 4084 3500	Large Population Resort
Tourism Port Douglas / Daintree	07 4099 4588	Maintain contacts

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.

Table 6 Key suppliers

Company	Contact Details	Maintenance area
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 8555	Water Engineering, Risk Management, DWQMP preparation, Incident investigation, Review and Audits.

3.4.1 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 Manager Water and Wastewater.

4 ELEMENT 2: ASSESSMENT OF THE WATER SUPPLY SYSTEM

4.1 Catchment Characterisation

Raw water for all the Douglas Shire Council schemes is sourced from remote intakes in rugged 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.

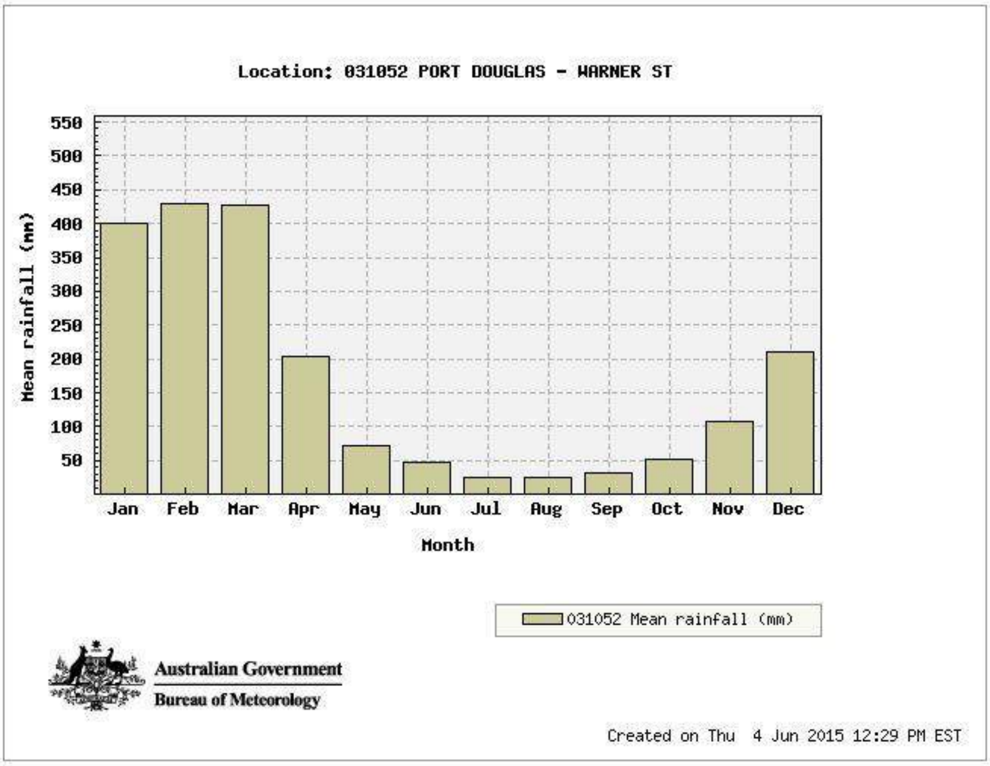
There is a prevalence of native and feral wildlife in these catchments, so microbiological hazards are the most significant for our services. During the wet season, there are regular “high turbidity” events (> 50 NTU) but these are normally short lived. There is minimal to no risk of pesticides, heavy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

The locations of the water treatment plant intakes are indicated on the image below, demonstrating the protected nature of these catchments. In this image, the blue lines indicate the catchment boundaries, and the green line is the shire boundary.

Figure 4 Location of WTPs

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

Figure 5 125 year rainfall record for Port Douglas.



Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
Mean rainfall (mm) for years 1884 to 2015	400.9	429.5	426.3	203.1	72.4	47.4	25.6	24.0	31.8	51.7	107.1	210.2	2031.5	125

As the Whyanbeel and Daintree schemes are small with relatively low water volumes extracted, there have been no occasions when raw water was unavailable. As such these schemes are considered 100% reliable.

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 number408436 expiry 30/6/2111). Water restrictions are regularly imposed during September, October and November. Douglas Shire Council has identified the need to obtain raw water from another source to supplement Rex Creek during these times (RMIP item PCWR132).

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 only 1 mg/L, we do not normally need to take any further action.

4.2 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 used in cleaning, citric acid can be used)
- Chlorination (using 1 or more of sodium hypochlorite, calcium hypochlorite and/or gas chlorination)
- UV disinfection (optional)

4.3 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 major storages and the reticulation network are conducted weekly to ensure efficient functioning of the network.

All available data regarding asset age, type, make is available from the Asset Management System Asset Life Cycle Software and is accessible to all staff using MapInfo ATGIS 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.

4.4 Mossman – Port Douglas Drinking Water Scheme

The Mossman water treatment plant is a 30 ML/d design treatment plant, with a daily production flow range from 2160 to 30000 kL/d. An overview of the overall scheme and the detailed treatment schematic are presented in

Figure 6 and

Figure 7 overleaf. Bypass options that are available for use are shown in red in Figure 7. 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 bunded, and stormwater cannot be contaminated by activities on site.

Figure 6 Mossman - Port Douglas catchment to tap schematic

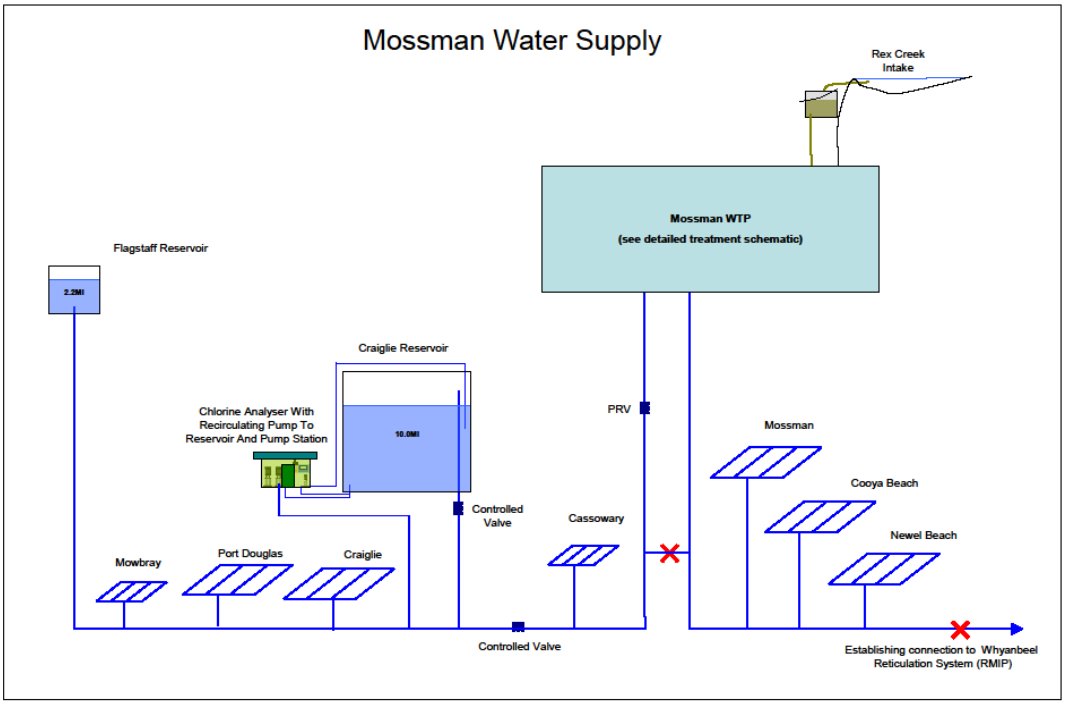
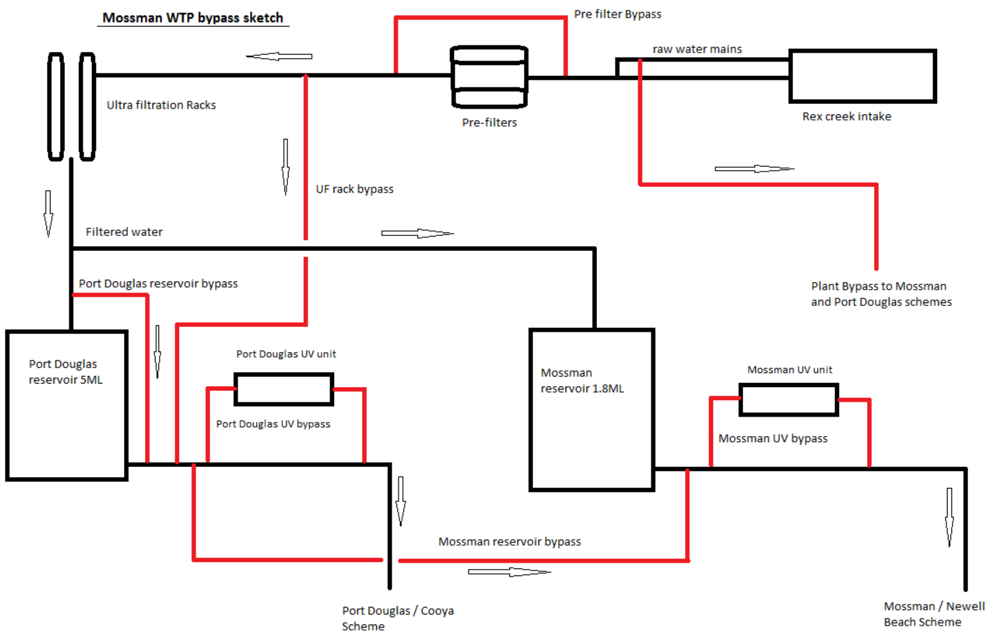


Figure 7 Mossman WTP treatment schematic



4.4.1 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. In addition, the following maximum extraction rates apply. These limits are programmed into SCADA.

Table 7 Maximum water extraction from Rex Creek

Rex Creek Flow Rate (l/s)	Maximum extraction flow rate (l/s)
≤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

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 meter can be selected for duty to control shutdown of the WTP in the event of high turbidity.

The operational limits for raw water turbidity are listed in the table below. 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, except under emergency scenarios.

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. Nonetheless, we intend to clarify this point.

Table 8 Raw water turbidity limits at Mossman WTP

Operational Monitoring		**Limits**		**Correction**		
				What		
What	Turbidity	**Alert**	20NTU	Alarm and paging to on call operator	**Who** (Responsible branch)	Operations
Purpose	to protect membranes and increase operational lifetime				**Who (action)**	Treatment Plant Operator
Where	One of 3 turbidity meters (intake, raw water main, WTP inlet)				**How**	Treatment plant operator receives alarm for auto shut off
How	Automated Turbidity meter (SCADA) alarmed and paged				**When**	Immediate
When	Continuous					
Who (responsible branch)	Operations					
Who (action)	Treatment Plant operators	**Operational Limit**	30NTU	Intake valve shut off at upper alarm limit	**Who**	Treatment Plant Operator
					How	Treatment plant operator receives alarm for auto shut off
					When	Immediate

Figure 8 Rex Creek Intake Channel – Mossman

4.4.2 Prefiltration

Raw water is further 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.

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.

4.4.3 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.

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

A 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.

4.4.4 Environmental Discharge

Discharges to the environment from the Mossman Water Treatment Plant are in accordance with our integrated environmental authority. Prefilter and UF water only backwashes are discharged directly to the creek. Chemically enhanced backwash water and clean in place waters are contaminated with chlorine (and in some cases the pH is outside of the acceptable range) and are discharged to sewer.

4.4.5 Membrane integrity – indirect 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 details are in Table 9 below. 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 and storage capacity of treated water that the rack can remain offline until it is repaired.

Table 9 Pressure Decay test CCP parameters at Mossman WTP

Operational Monitoring		Limits		Correction		
				What		
What	Membrane Integrity	**Alert**	Trend data showing increase pressure drops to implement corrective action. Upper Limit - 10kPa drop over 600 seconds	Investigate integrity trends, and schedule preventive maintenance at convenient time.	**Who** (Responsible branch)	Operations
Purpose	to ensure protozoa are removed				**Who (action)**	Treatment Plant Operators
Where	Treatment Plants				**How**	Assess on-site
How	Online SCADA (alarmed if fail and paged)				**When**	Within 48 hours
When	Once Daily for each rack					
Who (responsible branch)	Operations					
Who (action)	Treatment Plant operators	**Critical**	15 kPa pressure reduction over 600 seconds	Auto shut down. Run manual integrity check, look for leaks etc., schedule repairs	**Who**	Treatment Plant Operators
					How	Assess on-site
					When	Shut Rack down immediately. Do not put online until rectified.

4.4.6 **Membrane Integrity – direct testing.**

The permeate turbidity is currently monitored using a combined permeate turbidity meter capable of 0.001 NTU resolution.

Where the combined permeate turbidity exceeds 0.15 NTU, the UF racks in production mode are taken offline and undergo PDTs to determine if there is a breach of the membranes, as per the details in Table 10.

An improvement item has been identified to install a 0.001 NTU resolution turbidity meter on each of the 5 racks to allow monitoring of individual racks (again at 0.15 NTU, but at a 1 minute time delay). The individual turbidity meters have been ordered, and will be installed as soon as possible. This will not change the operational limits, but will ensure that the integrity of each rack is maintained.

The ultrafiltration racks can be bypassed – but this would not be used except in emergency situations.

Permeate is directed to the clear water reservoirs.

Table 10 Turbidity limits for ultrafiltration CCP at Mossman WTP

Operational Monitoring		Limits		Correction		
				What		
What	Membrane Integrity	**Alert**	> 0.1 NTU	Investigate turbidity trends, schedule operator to observe next PDT.	**Who** (Responsible branch)	Operations
Purpose	indirect continual integrity test to ensure protozoa removal				**Who (action)**	Treatment Plant Operators
Where	Treatment Plants				**How**	Assess on-site
How	Online SCADA (alarmed if fail and paged)				**When**	Within 48 hours.
When	continuous					
Who (responsible branch)	Operations					
Who (action)	Treatment Plant operators	**Critical**	> 0.15 NTU	Auto shut down. Run manual PDT, look for leaks etc., schedule repairs.	**Who**	Treatment Plant Operators
					How	Assess on-site
					When	Shut Rack down immediately. Do not put online until rectified.

4.4.7 Chlorination

Disinfection is achieved through chlorination. Current operation uses a recirculation system on each of the treated water reservoirs that doses sodium hypochlorite with a set point control mode of operation.

The target for chlorine is typically 1.0 mg/L (this can change operationally, e.g. seasonally to ensure sufficient residual in reticulation) with actions and critical limits as described below. The two critical limits ensure effective disinfection (low side) and prevent exceedances of the chemical health guideline value (high side). Critical limits do not change.

Table 11 Chlorination CCP (low) for Mossman WTP

Operational Monitoring		Limits		Correction		
				What		
What	Chlorination	Target	1 mg/L		**Who** (Responsible branch)	Operations
Purpose	Ensure effective disinfection and inactivation of bacteria and virus	**Alert**	< 0.7 mg/L	Manual retest, check calibration if different to manual check, check chemical supply, dosing lines etc. and correct problem.	**Who (action)**	Treatment Plant Operators
Where	Treatment Plants				**How**	Assess on-site
How	Online SCADA (alarmed if fail and paged)				**When**	Immediately
When	continuous					
Who (responsible branch)	Operations					
Who (action)	Treatment Plant operators	**Critical**	< 0.2 mg/L	Auto shut down. Identify cause and re-establish chlorination. Establish if non-chlorinated water provided to consumers and report to Manager.	**Who**	Treatment Plant Operators
					How	Assess on-site
					When	Automated shutdown.

Table 12 Chlorination CCP (high) at Mossman WTP

Operational Monitoring		Limits		Correction		
				What		
What	Chlorination	Target	1 mg/L		**Who** (Responsible branch)	Operations
Purpose	ensure no overdose of chlorine	**Alert**	> 2 mg/L	Manual retest, check calibration if different to manual check, re-establish correct dose rate.	**Who (action)**	Treatment Plant Operators
Where	Treatment Plants				**How**	Assess on-site
How	Online SCADA (alarmed if fail and paged)				**When**	Immediately
When	continuous					
Who (responsible branch)	Operations					
Who (action)	Treatment Plant operators	**Critical**	> 4 mg/L	Shut off chlorination. Investigate and rectify cause and report to Manager.	**Who**	Treatment Plant Operators
					How	Assess on-site
					When	Automated shutdown.

It is possible to manually chlorinate raw water and it is also possible to bypass chlorination. This is not used under normal operation.

DSC are currently replacing the sodium hypochlorite chlorination systems with gas chlorination. This system will use 2 by 920 kg chlorine gas drums and have duty standby automated change over operation. The system will utilise a set point based vacuum chlorine gas draw off injector disinfection system to chlorinate the Mossman 1.8 ML and Port Douglas 5 ML reservoirs. The gas chlorinators will dose at the same point of the treatment process, and operate at the same SCADA limits to the sodium hypochlorite systems.

We will inform the Regulator when these systems are operational, but consider that they are already described (and risk assessed) in the DWQMP.

4.4.8 Ultraviolet Disinfection

The original WTP design was for UF and UV only. UV disinfection is achieved by the use of Hanovia totally encapsulated in pipe-line UV systems. The UV systems have been designed to meet treatment plant maximum flow design capacity and achieve a minimum dose rate of 12 mJ/cm^2. This dose rate is sufficient for 3.5 log reduction of protozoa, and ~4 log reduction for most bacteria. However, the dose rate is not sufficient to provide any additional barrier for viruses.

The UV units incorporate an automated wiper system and UV intensity monitors also receive input from the corresponding flow meters to calculate the effective UV dose rate. The UV units are fully automated and can ramp output to achieve the minimum dose rate set point depending on flow conditions, water transmittance and lamp output.

The operation of the UV units is monitored via PLC/SCADA Citec systems with trending and automated alarm functions. All UV units undergo scheduled maintenance for the cleaning/ replacement of lamps and calibration checks to ensure for correct operation.

However, UV disinfection <u>is no longer considered as a CCP</u>. Further, UV actually consumes chlorine, and impacts the ability to maintain the disinfection residual. As such the UV will not be used in routine operation when this plan is approved. The UV system can be bypassed, to facilitate this. However the UV systems will remain operational and can be used if required (such as issues with chlorination/ emergencies). When UV is operational, it is operated as described in Table 13.

Table 13 UV operational parameters (when in use) for Mossman WTP

Operational Monitoring		Limits		Correction		
				What		
What	UV Unit	**Critical**	UV unit drop below 12 mJ/cm^2	Investigate cause and correct if possible, Notify Manager	**Who** (Responsible branch)	Operations
Purpose	Additional disinfection				**Who (action)**	Treatment Plant Operators
Where	Mossman WTP				**How**	alarm and pages
How	SCADA (alarmed and paged)				**When**	Immediate
When	Continuous					
Who (responsible branch)	Operations					
Who (action)	Treatment Plant operators		UV Failure		**Who**	Treatment Plant Operators
					How	alarm and pages
					When	Immediate

4.4.9 Reticulation

Water is reticulated under gravity to Mossman and Port Douglas water scheme. Network maps showing pipe diameters, locations of hydrants, and sampling locations are shown in Figure 16 to Figure 24 in Section 7.6.

The reticulation network has the following materials and age ranges.

Table 14 Mossman- Port Douglas Reticulation network details

Scheme	Total Length	% of total	Length (km)	Material	Age Range
Mossman - Port Douglas	214.5 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 2015/16. There are 2 reservoirs that service Port Douglas, including the Craiglie Reservoir (Hope St) and the Flagstaff Reservoir.

The Craiglie and Flagstaff Reservoir are utilised to provide additional storage capacity for the Port Douglas scheme. Either reservoir can be gravity fed from the Mossman WTP, but Flagstaff can additionally be fed from the Craiglie Reservoir pump station. Outflow from the Craiglie reservoir is by the way of two pumps in a duty standby arrangement.

All reservoirs are roofed and have vermin proofing, but the roof at Craiglie is in poor condition. The roof is budgeted for replacement during 2015-16.

Other reservoirs are thought to be in reasonable to good condition, but the vermin proofing on all reservoirs will nonetheless be sequentially and comprehensively assessed and ensured during 2015-16.

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.

There is an additional reservoir at Mowbray that is currently offline, but can be used in times of high demand or for cyclone preparedness. There is also a roofed and vermin proofed steel reservoir at Cassowary. This is not used in normal situations, but may be considered as cyclone preparation (for example, with manual chlorination).

Reservoirs details are summarised overleaf.

Table 15 Mossman - Port Douglas Reservoir details

Scheme	Reservoir	Capacity (ML)	Material	Roofed	Vermin Proof	(Re)chlorination	Alarms
Mossman - Port Douglas	Mossman Clearwater	1.8	Concrete	Y	Y	Y	Chlorine high and low level. Reservoir level
	Port Douglas Clearwater	5	Concrete	Y	Y	Y	Chlorine high and low level. Reservoir level
	Cooya Beach Reservoir	2	Concrete	Y	Y	N	Reservoir level
	Cassowary Reservoir	0.1	Zinc Anneal	Y	Y	N	Reservoir level
	Craiglie Reservoir	10.1	Concrete	Y	Y	Y	Chlorine high and low level. Reservoir level, Pressure alarms for pumps, flow rate.
	Flagstaff Two Reservoir	2.2	Concrete	Y	Y	chlorine tablets	Reservoir level, Pressure alarms for pumps, flow rate.
	Mowbray Reservoir	0.125	Concrete	Y	Y	N	Reservoir level

4.4.10 Redosing

The Craiglie Reservoir chlorination station is a recirculation system with continuous online monitoring, which is operated within the limits defined in the CCP table below. The redosing station uses two 70 kg chlorine gas cylinders in duty standby configuration with automated change over between cylinders. The system operates using a set point based vacuum chlorine gas draw off injector disinfection system.

Manual redosing also occurs at Flagstaff reservoir utilising Calcium hypochlorite tablets. This activity is only performed seasonally and typically during periods of low water consumption. Automated calcium hypochlorite redosing systems will be installed this financial year under budget item PCWST115.

Table 16 Craiglie Reservoir re-dosing CCP (high chlorine)

<table>
<tr><th colspan="2" rowspan="2">Operational Monitoring</th><th colspan="2" rowspan="2">Limits</th><th colspan="3">Correction</th></tr>
<tr><th>What</th><th colspan="2"></th></tr>
<tr><td>What</td><td>Chlorination</td><td>Target</td><td>1 mg/L</td><td rowspan="6">Manual retest, check calibration if different to manual check, re-establish correct dose rate.</td><td>Who (Responsible branch)</td><td>Operations</td></tr>
<tr><td>Purpose</td><td>ensure no overdose of chlorine</td><td rowspan="5">Alert</td><td rowspan="5">> 2 mg/L</td><td>Who (action)</td><td>Treatment Plant Operators</td></tr>
<tr><td>Where</td><td>Craiglie Reservoir</td><td>How</td><td>Assess on-site</td></tr>
<tr><td>How</td><td>Online SCADA (alarmed if fail and paged)</td><td rowspan="3">When</td><td rowspan="3">Immediately</td></tr>
<tr><td>When</td><td>continuous</td></tr>
<tr><td>Who (responsible branch)</td><td>Operations</td></tr>
<tr><td rowspan="3">Who (action)</td><td rowspan="3">Treatment Plant operators</td><td rowspan="3">Critical</td><td rowspan="3">> 4 mg/L</td><td rowspan="3">Shut off chlorination, manually stop pumps, and dilute with treated water. Investigate and rectify cause and report to Manager.</td><td>Who</td><td>Treatment Plant Operators</td></tr>
<tr><td>How</td><td>Assess on-site</td></tr>
<tr><td>When</td><td>Automated shutdown.</td></tr>
</table>

4.4.11 Operational Monitoring

Table 17 Operational Monitoring Mossman/ Port Douglas scheme

Parameter	Instrument	Location	Frequency	Target and Action Limits	Critical Limits	Calibration	
						Factory	in house
Rex Creek Flow	Level Pro 6100 level gauge	Rex Creek Intake	Daily	As per water licence and Table 7	4800 ML annual allocation and 370l/s maximum instantaneous extraction limit (note maximum instantaneous extraction limit decreases as intake level decreases, calculated value displayed on Citec)	annual	annual
	Raw water flow meter FT1001	Mossman WTP inlet					
Turbidity	ABB	Mossman WTP inlet	online continuous plus daily visual	<20	>30 NTU	-	2/wk.
	Greenspan	Rex Creek Intake	online continuous plus 3/week visual	can be used alternately to WTP turbidity meter		-	-
	Hach	Raw water main near Marrs Creek	online continuous plus weekly	can be used alternately to WTP turbidity meter		-	-
	ABB	Permeate turbidity	online continuous plus daily visual	-	<0.15 NTU	-	2/wk.
	Hach DR2100	WTP inlet and Treated water	2/week manual	-	used to confirm online instruments accurate	annual	monthly
Chlorine	Siemens Deplox 5	Treated Water	online continuous plus daily visual	Typically 1 mg/L with action at <0.7 and > 2 mg/L	<0.2 and > 4 mg/L	-	2/wk.
	Siemens Deplox 4	Craiglie Reservoir	online continuous plus daily visual	Typically 1 mg/L with action at <0.7 and > 2 mg/L	<0.2 and > 4 mg/L	-	2/wk.
	Hach pocket calorimeter II free chlorine	Treated water, Craiglie and Flagstaff	treated twice/week Craiglie Res 2/wk. Flagstaff 5/wk.	-	used to confirm online instruments accurate	annual	monthly
pH (CIP)	pH meter	CIP testing	following CIP	pH within 0.2 of raw water		annual	monthly

4.5 Whyanbeel Drinking Water Scheme

The Whyanbeel water treatment plant is a 4.7 ML/d design treatment plant, with a daily flow range from 1728 to 4924.8 kL/d. As the WTP is <5 ML/day it is not considered an environmentally relevant activity.

Figure 9 Whyanbeel catchment to tap schematic

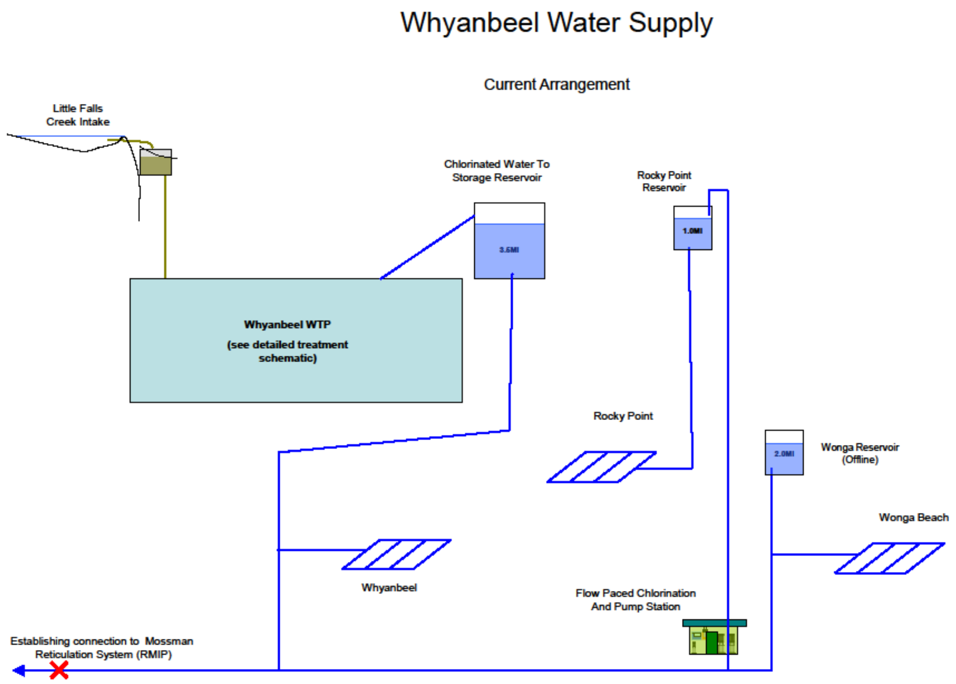
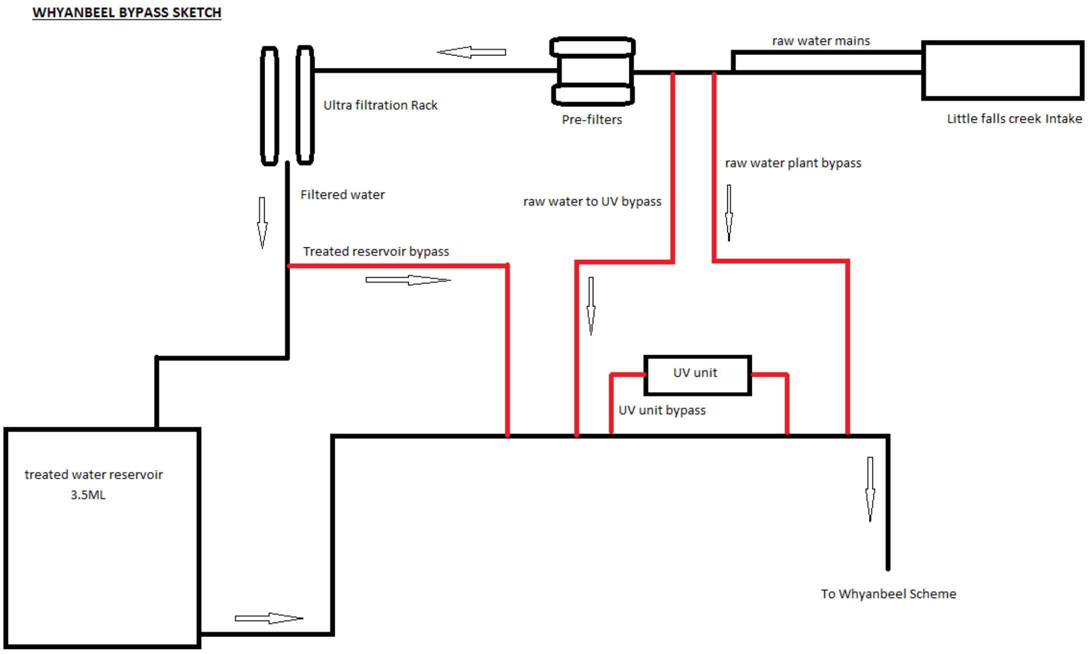


Figure 10 Whyanbeel WTP treatment schematic



4.5.1 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 licence 500313 for Little Falls Creek provides for an annual allocation of 630 ML.

Table 18 Maximum extraction rates from Little Falls Creek

Little Falls Creek Flow Rate (l/s)	Maximum extraction flow rate (l/s)
≤10	0
11-20	5
21-40	10
41-60	20
61-80	30
81-100	40
101-150	50
≥151	60

Table 19 Whaynbeel Raw water turbidity control point

Operational Monitoring		Limits		Correction		
				What		
What	Turbidity	Operational Limit	5 NTU	Intake valve shut off at upper alarm limit	Who (Responsible branch)	Operations
Purpose	to protect membranes and increase operational lifetime					
Where	Whyanbeel Intake				Who (action)	Treatment Plant Operator
How	Automated. Turbidity meter (SCADA) alarmed and paged				How	Treatment plant operator receives alarm for auto shut off
When	Continuous				When	**Immediately**
Who (responsible branch)	Operations					
Who (action)	Treatment Plant operators					

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, except under emergency scenarios.

Figure 11 Little Falls Creek Intake - Whyanbeel

Figure 12 Whyanbeel Intake Johnson Screen

4.5.2 **Prefiltration**

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 not possible to bypass the pre-filters at Whyanbeel.

4.5.3 **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 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 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.

Chemically Enhanced Backwashing utilises a Caustic/ Chlorine cleaning solution which is introduced to the membrane cartridges at a pre-determined concentration, typically pH 10 and concentration of chlorine at 60mg/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, 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 once per month. The concentrations for the CIP process are identical to the description in Section 4.4.3 for the Mossman WTP.

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 < 0.1mg/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.

4.5.4 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 tankered to Port Douglas under a trade waste approval.

4.5.5 Membrane integrity – indirect 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 operated as described below.

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 UF racks to be removed from service and repaired to avoid unexpected shutdowns on account of integrity check failure.

Nonetheless, there is sufficient production and storage capacity of treated water that the rack can remain offline until it is repaired

Table 20 Whyanbeel direct membrane integrity CCP.

Operational Monitoring		Limits		Correction		
				What		
What	Membrane Integrity	**Alert**	Trend data showing increase pressure drops to implement corrective action. Upper Limit - 10kPa drop 600 over seconds.	Investigate integrity trends, and schedule preventive maintenance at convenient time.	**Who** (Responsible branch)	Operations
Purpose	to ensure protozoa are removed				**Who (action)**	Treatment Plant Operators
Where	Treatment Plants				**How**	Assess on-site
How	Online SCADA (alarmed if fail and paged)				**When**	Within 48 hours
When	Once Daily for each rack					
Who (responsible branch)	Operations					
Who (action)	Treatment Plant operators	**Critical**	15 kPa pressure reduction over 600 seconds.	Auto shut down. Run manual integrity check, look for leaks etc., schedule repairs	**Who**	Treatment Plant Operators
					How	Assess on-site
					When	Shut Rack down immediately. Do not put online until rectified.

4.5.6 Membrane Integrity – direct testing.

Currently, turbidity is monitored from the treated water reservoir immediately prior to UV. An improvement item was identified to immediately move the meter to the permeate line so it provides a direct measurement of permeate turbidity. This will have been finalised prior to approval of the DWQMP. The description below refers to how this CCP will operate when the meter is moved.

The permeate turbidity is monitored using a turbidity monitor capable of 0.001 NTU resolution. Where the permeate turbidity exceeds 0.15 NTU, 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 would not be used except in emergency situations. Permeate is directed to the clear water reservoir.

Table 21 Whyanbeel indirect UF membrane integrity CCP

Operational Monitoring		Limits		Correction		
				What		
What	Membrane Integrity	**Alert**	> 0.1 NTU	Investigate turbidity trends, schedule operator to observe next PDT.	**Who** (Responsible branch)	Operations
Purpose	indirect continual integrity test to ensure protozoa removal				**Who (action)**	Treatment Plant Operators
Where	Treatment Plants				**How**	Assess on-site
How	Online SCADA (alarmed if fail and paged)				**When**	Within 48 hours.
When	continuous					
Who (responsible branch)	Operations					
Who (action)	Treatment Plant operators	**Critical**	> 0.15 NTU	Auto shut down. Run manual PDT, look for leaks etc., schedule repairs.	**Who**	Treatment Plant Operators
					How	Assess on-site
					When	Shut Rack down immediately. Do not put online until rectified.

4.5.7 Chlorination

Disinfection is achieved through chlorination. Chlorine is the only chemical that comes into contact with drinking water. Current operations use a recirculation system on the treated water 3.5 ML reservoir that doses sodium hypochlorite with a set point control mode of operation.

The target for chlorine is typically 1.0 mg/L with operator alerts at lower 0.7 mg/L and upper 2 mg/L. This target range does change operationally, for example, depending on season. There are two critical limits associated with chlorination. The operator can initiate a WTP production shutdown if the chlorine level in the clear water tank drops below 0.2 mg/L. This ensures that viruses and bacteria are deactivated. Similarly, there is a high level critical limit that is set at 4.0 mg/L to prevent high chlorine from exceeding the health guideline value.

It is possible to chlorinate raw water and it is also possible to bypass chlorination. This is not used under normal operation.

Table 22 Whyanbeel disinfection CCP (low level)

Operational Monitoring		Limits		Correction		
				What		
What	Chlorination	Target	1 mg/L	Manual retest, check calibration if different to manual check, check chemical supply, dosing lines etc. and correct problem.	**Who** (Responsible branch)	Operations
Purpose	Ensure effective disinfection and inactivation of bacteria and virus	**Alert**	< 0.7 mg/L		**Who (action)**	Treatment Plant Operators
Where	Treatment Plants				**How**	Assess on-site
How	Online SCADA (alarmed if fail and paged)				**When**	Immediately
When	continuous					
Who (responsible branch)	Operations					
Who (action)	Treatment Plant operators	**Critical**	< 0.2 mg/L	Auto shut down. Identify cause and re-establish chlorination. Establish if non-chlorinated water provided to consumers and report to Manager.	**Who**	Treatment Plant Operators
					How	Assess on-site
					When	Automated shutdown.

Table 23 Whyanbeel chlorination CCP (high)

Operational Monitoring		Limits		Correction		
				What		
What	Chlorination	Target	1 mg/L	Manual retest, check calibration if different to manual check, re-establish correct dose rate.	**Who** (Responsibility)	Operations
Purpose	ensure no overdose of chlorine	**Alert**	> 2 mg/L		**Who (action)**	Treatment Plant Operators
Where	Treatment Plants				**How**	Assess on-site
How	Online SCADA (alarmed if fail and paged)				**When**	Immediately
When	continuous					
Who (responsibility)	Operations					
Who (action)	Treatment Plant operators	**Critical**	> 4 mg/L	Shut off chlorination. Investigate and rectify cause and report to Manager.	**Who**	Treatment Plant Operators
					How	Assess on-site
					When	Auto shutdown.

DSC are currently replacing the sodium hypochlorite chlorination systems with gas chlorination. This system will use 2 by 70kg chlorine gas cylinders and have duty standby automated change over operation. The system will utilise a set point based vacuum chlorine gas draw off injector disinfection system to chlorinate the treated water reservoir. The gas chlorinator will dose at the same point of the treatment process, and operate at the same SCADA limits to the sodium hypochlorite systems. We will inform the Regulator when these systems are operational, but consider that they are already described (and risk assessed) in the DWQMP.

4.5.8 Ultraviolet Disinfection

The original WTP design was for UF and UV only. UV disinfection is achieved by the use of Hanovia totally encapsulated in pipe-line UV systems. The UV systems have been designed to meet treatment plant maximum flow design capacity and achieve a minimum dose rate of 12 mJ/cm^2. This dose rate is sufficient for 3.5 log reduction of protozoa, and ~4 log reduction for most bacteria. This dose rate is not sufficient to provide any additional barrier for viruses.

The UV units incorporate an automated wiper system and UV intensity monitors also receive input from the corresponding flow meters to calculate the effective UV dose rate. The UV units are fully automated and can ramp output to achieve the minimum dose rate set point depending on flow conditions, water transmittance and lamp output.

The operation of the UV units is monitored via PLC/SCADA Citec systems with trending and automated alarm functions. All UV units undergo scheduled maintenance for the cleaning/ replacement of lamps and calibration checks to ensure for correct operation.

However, UV disinfection is no longer considered as a CCP. Further, UV actually consumes chlorine, and impacts the ability to maintain a chlorine residual. As such the UV will not be used in routine operation when this plan is approved. The UV system is bypassed to facilitate this.

However the UV systems will remain operational and can be used if required (such as issues with chlorination/ emergencies). When UV is operational, it is operated as described in *Table 24*

Table 24 Whyanbeel UV operational conditions (when in use)

<table>
<tr><th colspan="2" rowspan="2">Operational Monitoring</th><th colspan="2" rowspan="2">Limits</th><th colspan="3">Correction</th></tr>
<tr><th>What</th><th colspan="2"></th></tr>
<tr><td>What</td><td>UV Unit</td><td rowspan="9">Critical</td><td rowspan="6">UV unit drop below 12 mJ/cm^2</td><td rowspan="9">Investigate cause and correct if possible, Notify Manager</td><td>Who (Responsible branch)</td><td>Operations</td></tr>
<tr><td>Purpose</td><td>Additional disinfection</td><td>Who (action)</td><td>Treatment Plant Operators</td></tr>
<tr><td>Where</td><td>Mossman WTP</td><td>How</td><td>alarm and pages</td></tr>
<tr><td>How</td><td>SCADA (alarmed and paged)</td><td rowspan="3">When</td><td rowspan="3">Immediate</td></tr>
<tr><td>When</td><td>Continuous</td></tr>
<tr><td>Who (responsible branch)</td><td>Operations</td></tr>
<tr><td rowspan="3">Who (action)</td><td rowspan="3">Treatment Plant operators</td><td rowspan="3">UV Failure</td><td>Who</td><td>Treatment Plant Operators</td></tr>
<tr><td>How</td><td>alarm and pages</td></tr>
<tr><td>When</td><td>Immediate</td></tr>
</table>

4.5.9 Reticulation

Water is reticulated, under gravity from the treated water reservoir to the Whyanbeel scheme. Network maps showing pipe diameters, locations of hydrants, and sampling locations are shown in Figure 25 to Figure 28 in Section 7.6. 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.

The Rocky Point reservoir receives its flow from the Whyanbeel plant Wonga beach water main via two pumps 1 duty 1 standby that pump the water to the reservoir.

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 older AC mains.

There is an improvement item to complete the connection to the Mossman Port Douglas scheme that will provide supply security to either system.

Table 25 Whyanbeel Reticulation network details

Scheme	Total Length	% of total	Length (km)	Material	Age Range
Whyanbeel	66.3	48.16	31.9	PVC	1972-2009
		42.63	28.3	AC	1972-1996
		5.08	3.37	DICL	1994
		2.74	1.82	HDPE	1972-1993
		1.39	0.92	Poly	1972

Table 26 Whyanbeel Reservoir details

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

4.5.10 Redosing

Redosing of chlorine occurs at the Rocky Point reservoir. Current operations use a recirculation system on the Rocky Point reservoir that doses sodium hypochlorite with a flow paced control mode of operation.

The target for chlorine is typically 1.0 mg/L. Operators test chlorine daily, and take corrective actions at lower 0.7 mg/L and upper 2.0 mg/L. This target range does change operationally, for example, depending on season. This is not a CCP as there is not currently online monitoring that would initiate immediate corrective actions.

The operator can instigate manual chlorine dosing of the reservoir if the chlorine level in the reservoir drops below 0.2 mg/L or instigate manual water only transfer to the reservoir to dilute potentially high chlorine levels in the event that high level critical limit set at 4.0 mg/L is reached.

This system will be replaced with an automated calcium hypochlorite system that will operate with the same limits under budget item PCWST118.

4.5.11 Operational Monitoring

Table 27 Operational Monitoring Whyanbeel Scheme

Whyanbeel

Parameter	Instrument	Location	Frequency	Target and Action Limits	Critical (or operational) Limits	Calibration	
						Factory	in house
Raw water extraction	Siemens Raw water flow meter FT1001	Inlet WTP flow meter	Continuous	As per Table 18	Total annual allocation 630 ML		
Turbidity	ABB	Whyanbeel WTP inlet	online continuous plus daily visual	<5	> 5 NTU	-	2/wk.
	ABB	Permeate turbidity	online continuous plus daily visual	-	<0.15 NTU	-	2/wk.
	Hach DR2100	WTP inlet and Treated water	2/week manual	-	used to confirm online instruments accurate	annual	monthly
Chlorine	Siemens Deplox 5	Treated Water	online continuous plus daily visual	Typically 1 mg/L with action at <0.7 and > 2 mg/L	<0.2 and > 4 mg/L	-	2/wk.
	Hach pocket calorimeter II free chlorine	Treated water and Rocky Point Res	treated twice/week Rocky Point Res 5/wk.	-	used to confirm online instruments accurate	annual	monthly
pH (CIP)	pH meter	CIP testing	following CIP	pH within 0.2 of raw water		annual	monthly

4.6 Daintree Drinking Water Scheme

The Daintree water treatment plant is a 0.49 ML/d design treatment plant, with a large daily flow range from 60.4 – 492 kL/d. The small WTP is not considered an environmentally relevant activity.

Figure 13 Daintree WTP Catchment to tap schematic

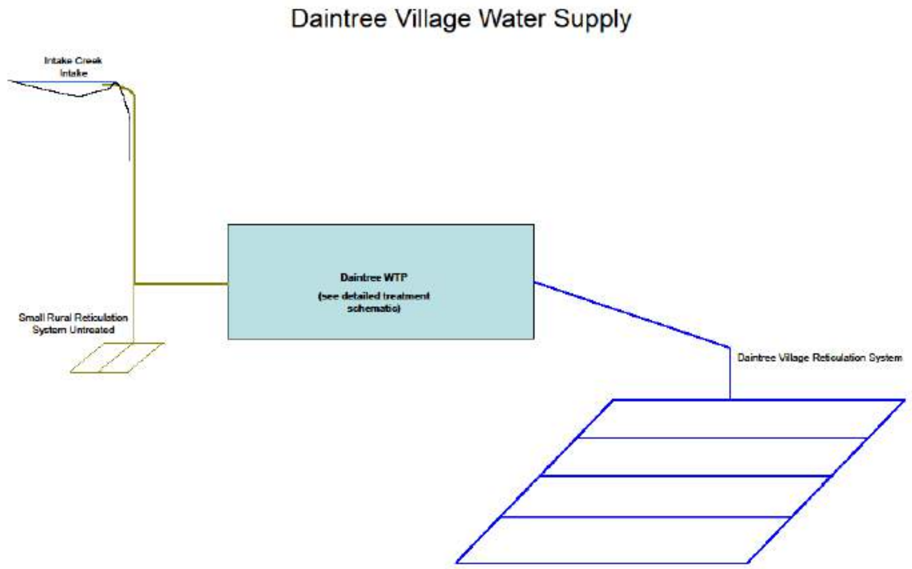
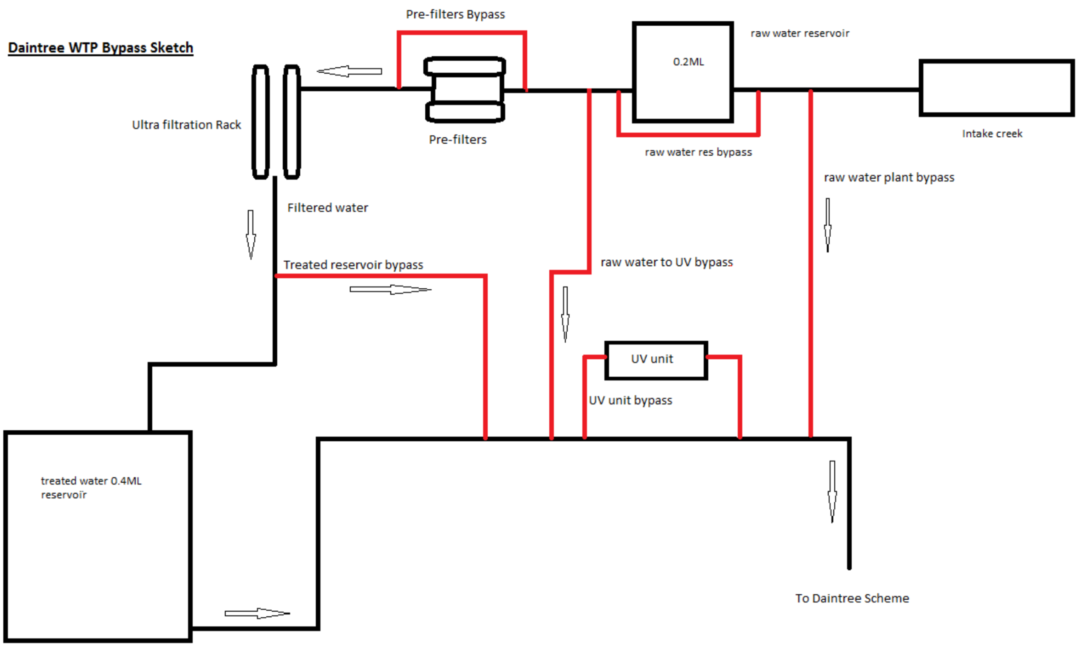


Figure 14 Daintree WTP treatment schematic



4.6.1 Intake:

The Daintree intake is located on Intake creek, and council is licenced (License # 408446) to extract a maximum of 0.3 ML/day, (80 ML annually) at a rate not exceeding 6 L/s. 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.

Table 28 Daintree Raw water turbidity operational control point

Operational Monitoring		Limits		Correction		
				What		
What	Turbidity	**Operational Limit**	5 NTU	Intake valve shut off manually at upper alarm limit.	**Who** (Responsible branch)	Operations
Purpose	to protect membranes and increase operational lifetime					
Where	Daintree Intake				**Who (action)**	Treatment Plant Operator
How	Automated. Turbidity meter (SCADA) alarmed and paged				**How**	Treatment plant operator receives alarm and attends site to shut valve
When	Continuous				**When**	As soon as able to attend WTP
Who (responsible branch)	Operations					
Who (action)	Treatment Plant operators					

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.

4.6.2 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.

4.6.3 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.

4.6.4 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 40 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 < 0.1mg/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.

4.6.5 Membrane integrity – indirect 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 details are included under Element 3.

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 UF racks to be removed from service and repaired to avoid unexpected shutdowns on account of integrity check failure.

Nonetheless, there is sufficient production and storage capacity of treated water that the rack can remain offline until it is repaired.

Table 29 Daintree UF Membrane direct integrity CCP

<table>
<tr><th colspan="2" rowspan="2">Operational Monitoring</th><th colspan="2" rowspan="2">Limits</th><th colspan="3">Correction</th></tr>
<tr><th>What</th><th colspan="2"></th></tr>
<tr><td>What</td><td>Membrane Integrity</td><td rowspan="6">Alert</td><td rowspan="6">Trend data showing increase pressure drops to implement corrective action. Upper Limit - 10kPa drop 600 over seconds.</td><td rowspan="6">Investigate integrity trends, and schedule preventive maintenance at convenient time.</td><td>Who (Responsible branch)</td><td>Operations</td></tr>
<tr><td>Purpose</td><td>to ensure protozoa are removed</td><td>Who (action)</td><td>Treatment Plant Operators</td></tr>
<tr><td>Where</td><td>Treatment Plants</td><td>How</td><td>Assess on-site</td></tr>
<tr><td>How</td><td>Online SCADA (alarmed if fail and paged)</td><td rowspan="3">When</td><td rowspan="3">Within 48 hours</td></tr>
<tr><td>When</td><td>Once Daily for each rack</td></tr>
<tr><td>Who (responsible branch)</td><td>Operations</td></tr>
<tr><td rowspan="3">Who (action)</td><td rowspan="3">Treatment Plant operators</td><td rowspan="3">Critical</td><td rowspan="3">15 kPa pressure reduction over 600 seconds.</td><td rowspan="3">Auto shut down. Run manual integrity check, look for leaks etc., schedule repairs</td><td>Who</td><td>Treatment Plant Operators</td></tr>
<tr><td>How</td><td>Assess on-site</td></tr>
<tr><td>When</td><td>Shut Rack down immediately. Do not put online until rectified.</td></tr>
</table>

4.6.6 Membrane Integrity – direct testing.

The treated water reservoir turbidity is monitored using a turbidity monitor capable of 0.001 NTU resolution. In order to ensure membrane integrity, an improvement item will see this meter being moved to the permeate line, and will be operated as described below. It is expected that this will be in place prior to the approval of this plan.

Where the permeate turbidity exceeds 0.15NTU, the UF rack is taken offline and undergoes a PDT to determine if there is a breach of the membranes.

Table 30 Daintree ultrafiltration indirect integrity CCP

Operational Monitoring		Limits		Correction		
				What		
What	Membrane Integrity	**Alert**	> 0.1 NTU	investigate turbidity trends, schedule operator to observe next PDT	**Who** (Responsible branch)	Operations
Purpose	indirect continual integrity test to ensure protozoa removal				**Who (action)**	Treatment Plant Operators
Where	Treatment Plants				**How**	Assess on-site
How	Online SCADA (alarmed if fail and paged)				**When**	Within 48 hours.
When	continuous					
Who (responsible branch)	Operations					
Who (action)	Treatment Plant operators	**Critical**	> 0.15 NTU	Auto shut down. Run manual PDT, look for leaks etc., schedule repairs	**Who**	Treatment Plant Operators
					How	Assess on-site
					When	Shut Rack down immediately. Do not put online until rectified.

The ultrafiltration rack can be bypassed – but this would not be used except in emergency situations. Permeate is directed to the clear water reservoir.

4.6.7 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 for chlorine is typically 1.0 mg/L with operator alerts at lower 0.7 mg/L and upper 2.0 mg/L. This target range does change operationally, for example, depending on season. There are two critical limits associated with chlorination. The operator can initiate a WTP production shutdown if the chlorine level in the clear water tank drops below 0.2 mg/L. This ensures that viruses and bacteria are deactivated. Similarly, there is a high level critical limit that is set at 4.0 mg/L to prevent high chlorine from exceeding the health guideline value.

It is possible to manually chlorinate raw water and it is also possible to bypass chlorination. This is not used under normal operation.

DSC are currently replacing the sodium hypochlorite chlorination systems at each WTP with gas chlorination. The Daintree system will use 2 by 70kg chlorine gas cylinders and have duty standby automated change over operation. The system will utilise a set point based vacuum chlorine gas draw off injector disinfection system to chlorinate the treated water reservoir. The gas chlorinator will dose at the same point of the treatment process, and operate at the same SCADA limits to the sodium hypochlorite systems. We will inform the Regulator when these systems are operational, but consider that they are already described (and risk assessed) in the DWQMP.

Table 31 Daintree disinfection CCP (low)

Operational Monitoring		Limits		Correction		
				What		
What	Chlorination	Target	1 mg/L	Manual retest, check calibration if different to manual check, check chemical supply, dosing lines etc. and correct problem.	**Who** (Responsible branch)	Operations
Purpose	Ensure effective disinfection and inactivation of bacteria and virus	**Alert**	< 0.7 mg/L		**Who (action)**	Treatment Plant Operators
Where	Treatment Plants				**How**	Assess on-site
How	Online SCADA (alarmed if fail and paged)				**When**	Immediately
When	continuous					
Who (responsible branch)	Operations					
Who (action)	Treatment Plant operators	**Critical**	< 0.2 mg/L	Auto shut down. Identify cause and re-establish chlorination. Establish if non-chlorinated water provided to consumers and report to Manager.	**Who**	Treatment Plant Operators
					How	Assess on-site
					When	Automated shutdown.

Table 32 Daintree chlorination CCP (high)

Operational Monitoring		Limits		Correction		
				What		
What	Chlorination	Target	1 mg/L	Manual retest, check calibration if different to manual check, re-establish correct dose rate.	**Who** (Responsibility)	Operations
Purpose	ensure no overdose of chlorine	**Alert**	> 2 mg/L		**Who (action)**	Treatment Plant Operators
Where	Treatment Plants				**How**	Assess on-site
How	Online SCADA (alarmed if fail and paged)				**When**	Immediately
When	continuous					
Who (responsibility)	Operations					
Who (action)	Treatment Plant operators	**Critical**	> 4 mg/L	Shut off chlorination. Investigate and rectify cause and report to Manager.	**Who**	Treatment Plant Operators
					How	Assess on-site
					When	Auto shutdown.

4.6.8 Ultraviolet Disinfection

The original WTP design was for UF and UV only. UV disinfection is achieved by the use of Hanovia totally encapsulated in pipe-line UV systems. The UV systems have been designed to meet treatment plant maximum flow design capacity and achieve a minimum dose rate of 12 mJ/cm^2. This dose rate is sufficient for 3.5 log reduction of protozoa, and ~4 log reduction for most bacteria. This dose rate is not sufficient to provide any additional barrier for viruses.

The UV units incorporate an automated wiper system and UV intensity monitors also receive input from the corresponding flow meters to calculate the effective UV dose rate. The UV units are fully automated and can ramp output to achieve the minimum dose rate set point depending on flow conditions, water transmittance and lamp output.

The operation of the UV units is monitored via PLC/SCADA Citec systems with trending and automated alarm functions. All UV units undergo scheduled maintenance for the cleaning/ replacement of lamps and calibration checks to ensure for correct operation.

However, UV disinfection is no longer considered as a CCP. Further, UV actually consumes chlorine, and impacts the ability to maintain a chlorine residual. As such the UV will not be used in routine operation when this plan is approved. The UV system can be bypassed, to facilitate this.

Table 33 Daintree UV operational conditions (when in use)

Operational Monitoring		Limits		Correction		
				What		
What	UV Unit	**Critical**	UV unit drop below 12 mJ/cm^2	Investigate cause and correct if possible, Notify Manager	**Who** (Responsible branch)	Operations
Purpose	Additional disinfection				**Who (action)**	Treatment Plant Operators
Where	Mossman WTP				**How**	alarm and pages
How	SCADA (alarmed and paged)				**When**	Immediate
When	Continuous					
Who (responsible branch)	Operations					
Who (action)	Treatment Plant operators		UV Failure		**Who**	Treatment Plant Operators
					How	alarm and pages
					When	Immediate

4.6.9 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. Over the past 6 months, DSC has gradually increased the chlorine dose to the 1 mg/L target, which is translating into detectable residuals at the Shire Hall. There is great sensitivity in this community to chemicals in their water supplies, so changes are made slowly so as to acclimatise the consumers without resulting in increased opposition to chlorination.

Network maps showing pipe diameters, locations of hydrants, and sampling locations are shown in Figure 29 and Figure 30 in Section 7.6.

Table 34 Daintree Reticulation network details

Scheme	Total Length	% of total	Length (km)	Material	Age Range
Daintree	4.4 km	53.72	2.36	HDPE	unknown
		46.28	2.04	AC	unknown

Table 35 Daintree Reservoir details

Scheme	Reservoir	Capacity (ML)	Material	Roofed	Vermin Proof	(Re)chlorination	Alarms
Daintree	Daintree Clearwater	0.4	Concrete	Y	Y	Y	Chlorine high and low level. Duty pump start/stop Reservoir level.

4.6.10 Operational Monitoring

Table 36 Operational Monitoring Daintree Scheme

Daintree

Parameter	Instrument	Location	Frequency	Target and Action Limits	Critical Limits	Calibration	
						Factory	in house
Turbidity	ABB	Daintree WTP inlet	online continuous plus daily visual	<5	> 5 NTU	-	2/wk.
	ABB	Permeate turbidity	online continuous plus daily visual	-	<0.15 NTU	-	2/wk.
	Hach DR2100	WTP inlet and Treated water	2/week manual	-	used to confirm online instruments accurate	annual	monthly
Chlorine	Siemens Deplox 5	Treated Water	online continuous plus daily visual	Typically 1 mg/L with action at <0.7 and >2 mg/L	< 0.2 and > 4 mg/L	-	2/wk.
	Hach pocket calorimeter II free chlorine	Treated water	treated 2/week	-	used to confirm online instruments accurate	annual	monthly
pH (CIP)	pH meter	CIP testing	following CIP	pH within 0.2 of raw water		annual	monthly

4.7 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.

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 *Naeglaria* 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 μg/L, which is well below the ADWG health guideline value. Future THM monitoring will be moved to the furthest extents of the reticulation network, and if a similar pattern emerges, we may discontinue THM monitoring altogether.

Of note, with over 1262 *E. coli* samples, only 2 post treatment samples were positive. 1 in the Flagstaff reservoir in Dec 2014 and 1 in the Mossman Post UV sample in March 2015. Both these 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.

4.8 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.

4.9 Definitions

The tables below define the likelihood, consequence and uncertainty.

Table 37 Consequence definitions

Consequence	Descriptor
Catastrophic	Potential acute health impact, significant community illness (> 4 people) expected
Major	Potential acute health impact, no community illness expected
Moderate	Repeated breach of chemical health guideline value
Minor	Isolated breach of chemical health guideline value, or widespread occurrence of parameter above aesthetic guideline
Insignificant	Potential isolated occurrence of aesthetic parameter above guideline value.

Table 38 Likelihood definitions

Likelihood	Descriptor
Almost Certain	Occurs more often than once per week
Likely	Occurs more often than once per month, and up to once per week
Possible	Occurs more often than once per year, and up to once per month
Unlikely	Occurs more often than once every 5 years, and up to once per year
Rare	Occurs less than once every 5 years

Table 39 Uncertainty definitions

Uncertainty Level	Descriptor
Certain	The processes involved are thoroughly understood and supported by extensive on site knowledge, and/or high frequency (weekly or better) water quality data.
Confident	The processes involved are well understood and supported by extensive operational experience, 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.
Estimate	The process is reasonably well understood, and is supported by some water quality data.
Unreliable	The process is not well understood, and there is little to no water quality data.

4.10 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 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.

4.11 Public Health Risk Matrix

The public health risk matrix used in this plan is detailed below.

Table 40 Public Health Risk Matrix

Public Health Risk Matrix					
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost Certain	Medium 6	High 10	High 15	Extreme 20	Extreme 25
Likely	Medium 5	Medium 8	High 12	High 16	Extreme 20
Possible	Low 3	Medium 6	Medium 9	High 12	High 15
Unlikely	Low 2	Low 4	Medium 6	Medium 8	High 10
Rare	Low 1	Low 2	Low 3	Medium 5	Medium 6

As stated above, Council considers all medium and low risks to be acceptable.

4.12 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 below.

Table 41 Water supply system and hazard identification team

Participant	Position	Water industry/ Risk management experience
Paul Hoye	General Manager Operations	22 years, Previously an EHO, food safety auditor, HACCP training. 20 years in DSC
Wouter van der Merwe	Manager Water and Wastewater	30 years water industry, 18 months in DSC. Formal risk training.
Henry Maro	Team Leader Water Treatment	20 water industry, with 8 years at DSC. Cert 3 in water and wastewater, risk assessments undertaken previously
Samadhi Senior	Technical Officer Water and Wastewater.	5 years in council/ water, risk assessment
Mark Howarth	Team Leader, Water Reticulation	37 years with council/ water. Risk assessment experience.
Matt Govorko	Water Operator	10 years water industry, DSC. Cert 3, council risk assessments.
Steve Davis	Water Operator	4 years DSC and water industry, Cert 3, council risk assessments
Tony Kadwell	Technical Officer	28 years, Cert 3 Reticulation. Previous risk training
Michael Lawrence - Bligh Tanner	Facilitator	10 years in water industry, formal ADWG training, water quality management systems auditor.

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 overleaf.

Table 42 Hazard Identification - All schemes

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.	protected catchment, chlorination (UV)
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	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	Almost Certain	High 15	Confident		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		nil required
Hydrocarbons	Chemical	illegal disposal of fuel etc.	Moderate	Rare	Low 3	Confident	Single issue on lot at Wonga beach - but potential to leach through mains.	nil required
Iron	Chemical	natural geology, sediment	Minor	Unlikely	Low 4	Reliable		raw water intake CCP, UF
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, if identified it is immediately replaced.	old mains replacement program
Manganese	Chemical	natural geology	Moderate	Rare	Low 3	Reliable		raw water intake CCP, UF
Pesticides	Chemical	limited use in catchment	Moderate	Rare	Low 3	Reliable		nil required
Scaling	Chemical	tds or organics in raw water	Minor	Likely	Medium 8	Confident		CIPs and CEBs.
Taste and odour	Chemical	algae blooms	Minor	Unlikely	Low 4	Confident		UF
Taste and odour	Chemical	regrowth in reticulation	Minor	Likely	Medium 8	Confident		
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
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
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		raw water intake CCP, UF
Turbidity	Physical	sloughing of biofilm, resuspension of sediment in reservoirs/mains	Minor	Possible	Medium 6	Reliable		mains flushing program, stable disinfection regime

Hazard	Type of Hazard	Sources of Hazard	Unmitigated Risk			Uncertainty	Comments	Treatment Barrier/s
			Consequence	Likelihood	Risk			
Radioactivity	Radiological	Natural geology	Moderate	Rare	Low 3	Confident		nil required
Failure of supply	Whole of System	drought (Mossman/ Port Douglas)	Catastrophic	Unlikely	High 10	Reliable		investigating alternate source
Failure of supply	Whole of System	drought	Catastrophic	Rare	Medium 6	Reliable		
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	
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.	
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 interlinkages
Operator error	Whole of System	untrained/ overworked/ mistake	Catastrophic	Almost Certain	Extreme 25	Confident		staff training
Sabotage/ Terrorism	Whole of System	Any chemical or microbiological hazard	Catastrophic	Possible	High 15	Estimate		Regular inspections, security fencing, security contract.
WTP fire	Whole of System	electrical fire	Catastrophic	Rare	Medium 6	Reliable		

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. Where previous documents are present, but outdated and not used, we have indicated that there is no current procedure, but will develop one within the current financial year. 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 43 Mitigated Risk assessment - all schemes

Process Step	Hazardous Event	Hazards managed by same barriers	Unmitigated Risk	Primary preventive measure	Other Preventive Measures	Mitigated			Uncertainty	Comments	CCP?				Documented Procedure	Risk Management Improvements		
						Consequence	Likelihood	Risk			Q1	Q2	Q3	Y/N		Immediate	2015/16 FY	16/17 FY or later
Catchment	Present in catchment - animals	bacteria and virus	Extreme 25	disinfection	(UV)	Catastrophic	Rare	Medium 6	Certain	considered as whole of treatment in absence of failure					SCADA			
	Present in catchment - animals	protozoa	Extreme 25	uf	(UV)	Catastrophic	Rare	Medium 6	Confident	considered as whole of treatment in absence of failure					SCADA			
	Storm events	loss of supply due to high turbidity	High 10	raw water turbidity trigger		Catastrophic	Rare	Medium 6	Confident	considered as whole of treatment in absence of failure					SCADA			
Raw Water Feed	Raw water main break	Failure of supply	High 10	multiple intakes Mossman	mains break procedure	Catastrophic	Rare	Medium 6	Confident	network operators have extensive experience mitigating lack of formal procedure					CRC mains break procedure available, needs to be updated			
	Blocked Johnson screen	Failure of supply	High 10	Intake checked daily	Sufficient treated water capacity to last 1 day.	Catastrophic	Rare	Medium 6	Reliable	Screens block in flood events; Daintree access depends on river conditions, but can operate for 3 days without access.	Y	N	N	N	required			
	Raw water UF feed pump failure (Daintree/ Whyanbeel)	Failure of supply	High 10	1 day supply treated water, spares available	duty standby	Catastrophic	Rare	Medium 6	Certain	spare pumps available on site					SCADA alarms on reservoir levels			
	Loss of Raw water reservoir at Daintree due to subsidence	Failure of supply	High 10	stabilisation works are scheduled		Catastrophic	Unlikely	High 10	Estimate	Not happened, but eroding slope requires remediation. Activate DMP							Budget item PCWST116 Daintree WTP bank stabilisation next to raw water reservoir.	
	Blocked prefilters	Failure of supply	High 10	duty standby prefilter operation		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.					SCADA raw water deviation alarm on UF allows identification.			
	turbidity above limit	turbidity	High 10	raw water turbidity trigger	UF	Minor	Rare	Low 2	Confident	running plant without prefilters ultimately can lead to blocked UF and loss of supply	Y	Y	N	N	OCP in plan			
Ultrafiltration	loss of integrity	Protozoa, turbidity	Extreme 25	24 hr PDT	continuous turbidity monitoring	Catastrophic	Unlikely	High 10	Confident	Mossman WTP butterfly valves have been leaking causing failures in PDT even when membrane thought to be intact.	Y	Y	Y	Y	PDT CCP		Budget item PCWST111: MWTP UF racks integrity test associated valve replacement: Replace all the old butterfly valves (on each UF rack) associated with the integrity test pressurisation system.	
	loss of integrity	Protozoa, turbidity	Extreme 25	continuous turbidity monitoring	24 hr PDT	Catastrophic	Unlikely	High 10	Confident	Mossman turbidity currently combined - hence sensitivity for failure of a single rack is reduced	Y	Y	Y	Y	Turbidity CCP		Budget item PCWST110 - install turbidity meters to each rack.	
	loss of integrity	Protozoa, turbidity	Extreme 25	continuous turbidity monitoring	24 hr PDT	Catastrophic	Unlikely	High 10	Confident	on treated turbidity, not permeate at Daintree and Whyanbeel	Y	Y	Y	Y	Turbidity CCP		Move turbidity meter to permeate rather than treated water.	
	membrane scaling reducing plant capacity	reduced supply	Medium 8	regular backwashes, including CEB/ CIP as required		Minor	Possible	Medium 6	Reliable	Whyanbeel WTP dosing system can have issues.					TMP monitored high-high alarm for each rack.		Budget item PCWST117 Renewal of chemical dosing system for CIP and CEB.	
Disinfection	overdose	Chlorine	High 15	alerts at 2 mg/L, critical at 4 mg/L (dosing system shutdown)		Moderate	Rare	Low 3	Confident		Y	Y	Y	Y	high CCP			

Process Step	Hazardous Event	Hazards managed by same barriers	Unmitigated Risk	Primary preventive measure	Other Preventive Measures	Mitigated			Uncertainty	Comments	CCP?				Documented Procedure	Risk Management Improvements		
						Consequence	Likelihood	Risk			Q1	Q2	Q3	Y/N		Immediate	2015/16 FY	16/17 FY or later
	insufficient dose	bacteria/virus	Extreme 25	disinfection		Catastrophic	Rare	Medium 6	Confident	1 spare pump shared across schemes. Gas chlorination projects will make more dosing pumps available as spares.	Y	Y	Y	Y	low ccp			
	chemical breakdown	chlorate	High 12	nil currently		Moderate	Likely	High 12	Reliable	WHO 0.8 mg/L, potential 0.3 mg/L guideline							Budget item PCWST112 Change Mossman WTP to gas chlorine (2*920 kg cylinders).	
	chemical breakdown	chlorate	High 12	nil currently		Moderate	Likely	High 12	Reliable									Budget item PCWST113 Whyanbeel Gas chlorination project
	chemical breakdown	chlorate	High 12	nil currently		Moderate	Likely	High 12	Reliable									Budget item PCWST114 Daintree Gas chlorination project
	ineffective disinfection due to turbidity	bacteria	High 10	UF		Catastrophic	Rare	Medium 6	Certain	UF shutdown at 0.15 NTU, unlikely to ever exceed 1 NTU					turbidity CCP for UF			
UV	low dose	Protozoa	Extreme 25	UF	UV	Catastrophic	Rare	Medium 6	Confident	If UF operating, UV is a redundant barrier. Risk prior to UV is mitigated and already medium 6.	N	Y	N	N	not a ccp, but procedure in DWQMP			
		bacteria	Extreme 25	UF/ chlorination	UV	Catastrophic	Rare	Medium 6	Confident	UF removes some bacteria, and chlorination is more effective with sufficient CT at these plants	N	Y	N	N	not a ccp, but procedure in DWQMP			
	reduces chlorine effectiveness	bacteria	Extreme 25	chlorination alert at 0.7 mg/L, critical at 0.2 mg/L	UV	Catastrophic	Rare	Medium 6	Confident	Dose rate is normally sufficient to compensate for this demand, but increases the risk of lower than desired chlorine concentration. UV is both unnecessary, and potentially counterproductive					chlorination CCP			
Treated water storage/ Reservoirs	Ingress into reservoirs	bacteria/virus	Extreme 20	primary disinfection, redosing at Craiglie		Catastrophic	Rare	Medium 6	Confident	Integrity of Craiglie Roof compromised, but compensated for by disinfection barrier.	Y	N	N	N	required		Budget item PCWR125 replace Craiglie Reservoir roof	
	Ingress into reservoirs	Protozoa	Extreme 20	Integrity at Craiglie		Catastrophic	Likely	Extreme 20	Estimate	Craiglie roof compromised	Y	N	N	N	required		Budget item PCWR125 replace Craiglie Reservoir roof	
	Ingress into reservoirs	Protozoa	Extreme 20	Integrity and sealing		Catastrophic	Possible	High 15	Estimate	Requires continual attention. No removal process for protozoa post WTP.	Y	N	N	N	required	develop a reservoir inspection program	Budget item PCWR124 eliminate any potential ingress into reservoir, seal vertical sheeting to abutment, repair/replace sheeting, water proof hatches	PCWR124 continues.
	Ingress into reservoirs	bacteria/virus	Extreme 20	primary disinfection, hypo dosing at Rocky Point		Catastrophic	Rare	Medium 6	Confident	Telemetry and alarming essential	Y	N	N	N	required		Budget item PCWST118 Investigate Gas v Hypo at Rocky Point, and include telemetry and alarms.	
	Ingress into reservoirs	bacteria/virus	Extreme 20	primary disinfection, manual redosing at Flagstaff Res		Catastrophic	Rare	Medium 6	Confident	Redosing at Flagstaff is manual using chlorine tablets. Daily site visits	Y	N	N	N	required		Budget item PCWST115 Gas chlorination project Flagstaff Reservoir.	
	Ingress into reservoirs	bacteria/virus	Extreme 20	primary disinfection, no redosing (Cooya, Wonga)		Catastrophic	Unlikely	High 10	Reliable	Note Cooya Reservoir currently not in use - will be commissioned under WR3	Y	N	N	N	required			Budget item PCWST119 gas chlorination project Stage 2 Cooya Res. 2 70 kg gas systems, telemetry.

Process Step	Hazardous Event	Hazards managed by same barriers	Unmitigated Risk	Primary preventive measure	Other Preventive Measures	Mitigated			Uncertainty	Comments	CCP?				Documented Procedure	Risk Management Improvements		
						Consequence	Likelihood	Risk			Q1	Q2	Q3	Y/N		Immediate	2015/16 FY	16/17 FY or later
	Ingress into reservoirs	bacteria/virus	Extreme 20	primary disinfection, no redosing		Catastrophic	Unlikely	High 10	Estimate	Mowbray, Cassowary - are offline and not normally used. Manual dosing would be required to ensure safe water	Y	N	N	N	required	not required as these are not normally used		
	ingress of amoeba	amoeba	High 12	disinfection as above items	integrity	Major	Rare	Medium 5	Reliable	reservoirs consistently above 0.5 mg/L	Y	N	N	N	CCP for chlorine			
Reticulation	ingress of contaminated water	bacteria/virus	Extreme 20	network pressure, residual disinfection, mains break procedure		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	Y	N	N	N	formalise flushing		Budget item PCWR127 Upgrade of mains Newell Beach.	
	ingress of contaminated water	protozoa	Extreme 20	network pressure, mains break procedure		Catastrophic	Rare	Medium 6	Reliable	procedure emphasised, toolbox talk reminders	Y	N	N	N	CRC mains break procedure available, needs to be updated			
	Power failure	Failure of supply	High 15	Power supply generally robust. Many areas gravity fed.		Catastrophic	Rare	Medium 6	Confident	Craiglie main area at risk - however, power outages are rare, and not normally long duration						provide provision to be able to use generator if required, identify source of generator		
	increasing pH impacting residual disinfection	bacteria/virus	Extreme 20	network pressure, reservoir integrity, mains break procedure	replacement of AC mains	Catastrophic	Unlikely	High 10	Reliable	While pH increases, there needs to be a concurrent contamination event for this to actually result in the adverse outcome.							Budget item PCWR128 replacement of ageing AC mains	Identify priority areas for AC main replacement (Cooya possibly next?) PCWR128
	change in flow rate, reservoir run low, disturbing sediment in pipe	turbidity	Medium 6			Minor	Unlikely	Low 4	Confident	Very low turbidity, and reticulation network has low HPC counts. Not a common occurrence.								
	long water age	DBPs	High 12	Low organics in source water, effective removal, low chlorine doses		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.					managed by ensuring UF and chlorination effective			
	backflow	protozoa	Extreme 20	system integrity, backflow prevention on new installations		Catastrophic	Unlikely	High 10	Estimate	Port Douglas all replaced, other areas do have old meters than may not have backflow prevention					need to develop			Long term meter replacement strategy
Redosing	overdose	chlorine	High 15	alerts at 2mg/L, critical at 4 mg/L (redosing shutdown)		Moderate	Unlikely	Medium 6	Reliable	Craiglie	Y	Y	Y	Y	CCP on monitored reservoir			
Redosing	overdose	chlorine	High 15	alerts at 2mg/L, critical at 4 mg/L (redosing shutdown)		Moderate	Unlikely	Medium 6	Reliable	Flagstaff/Rocky Point	Y	N	Y	Y	Required, but not CCP. Is OCP.			
	insufficient dose	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	Catastrophic	Rare	Medium 6	Confident	Craiglie	N	Y	N	N	documented in OCPs			
	insufficient dose	bacteria/virus	Extreme 20	disinfection daily inspects	Primary disinfection provides residual in most cases.	Catastrophic	Unlikely	High 10	Confident	Flagstaff, Rocky Point					documented in OCPs		PCWST115 and PCWST118	

Process Step	Hazardous Event	Hazards managed by same barriers	Unmitigated Risk	Primary preventive measure	Other Preventive Measures	Mitigated			Uncertainty	Comments	CCP?				Documented Procedure	Risk Management Improvements		
						Consequence	Likelihood	Risk			Q1	Q2	Q3	Y/N		Immediate	2015/16 FY	16/17 FY or later
					Small top-up													
System Wide	SCADA/ telemetry failure	Protozoa	Extreme 25	Treated water in system.		Catastrophic	Unlikely	High 10	Reliable	Cyclone Oswald knocked out communications, version not fully supported as outdated. If long term, may need to consider DMP.							Budget item PCWST120 Upgrade SCADA to new version of CITEC. PCWST121, PCWST122, PCWST123 telemetry and switching improvements also associated with these communication upgrades	PCWST123 improving telemetry over 2 years.
	Demand exceeds supply	Limited supply	Extreme 25	Asset planning		Catastrophic	Unlikely	High 10	Reliable	Mossman Port Douglas scheme - Planning over next 10 years to ensure risk is low					asset management plan			Budget item PCWST126 Commission Cooya reservoir. Include valves, telemetry, and vermin proofing
	Demand exceeds supply	Limited supply	Extreme 25	Asset planning		Catastrophic	Unlikely	High 10	Reliable	Mossman Port Douglas scheme					asset management plan		Budget item PCWR131 Develop Crees Rd Reservoir site	Continue PCWR131
	WTP Fire	Failure of supply	Medium 6	Can provide raw water with BWA.		Catastrophic	Rare	Medium 6	Reliable	would need to activate disaster plan								
	Drought (Mossman)	Failure of supply	High 10	Restrictions leading to Wet season	seeking alternate source	Catastrophic	Unlikely	High 10	Estimate	Drought frequency increasing and population increasing. Has not happened but becoming more likely							Budget item PCWR132 Water supply security - investigate, design and possibly implement alternate supply source	Continue PCWR132
	Flood	Failure of supply	High 10	Generally only impacts raw water quality		Catastrophic	Rare	Medium 6	Reliable	Can operate WTP at higher turbidities if necessary - will increase backwash frequency and impact capacity.					DMP			
	Flood	Failure of supply	High 10	Daintree Intake		Catastrophic	Unlikely	High 10	Reliable	Floods have previously damaged intake.							Budget item PCWR130 install 2 hydrants and 2 sluice valves to improve raw water supply security.	
	landslip Daintree intake	Failure of supply	High 15	Daintree Intake		Catastrophic	Unlikely	High 10	Estimate	Would use plunge pool for supply in interim. T piece in main to facilitate this.							Budget item PCWR130 install 2 hydrants and 2 sluice valves to improve raw water supply security.	
	Cyclone	Failure of supply	High 15	DMP	interconnection of Mossman and Whyanbeel schemes	Catastrophic	Unlikely	High 10	Reliable	Activate DMP if WTP knocked out completely (e.g. Daintree). Otherwise use interconnection.					business continuity plan and hazard checklists		Budget item PCWR127 improve interconnection to improve supply security.	
	operator error	any	Extreme 25	training, experience, mentoring		Catastrophic	Unlikely	High 10	Estimate	Look at National Certification framework for operator training.					HR training register	Formalise Water operations professional development.	develop procedures listed as required	
	accidental use of bypass	protozoa and bacteria	Extreme 25	Valves identified as permanently closed, tagged out.		Catastrophic	Rare	Medium 6	Confident	Need to ensure all closed valves are tagged, and consider what valves need locking out.					develop bypass procedures			
	loss of knowledge	All	Extreme 25			Catastrophic	Possible	High 15		develop mentoring system, capture assets in GIS system						Formalise Water operations professional development. Ground truth GIS.	local government structure plan	

5 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 previous

Figure 15 Critical Control Point decision tree

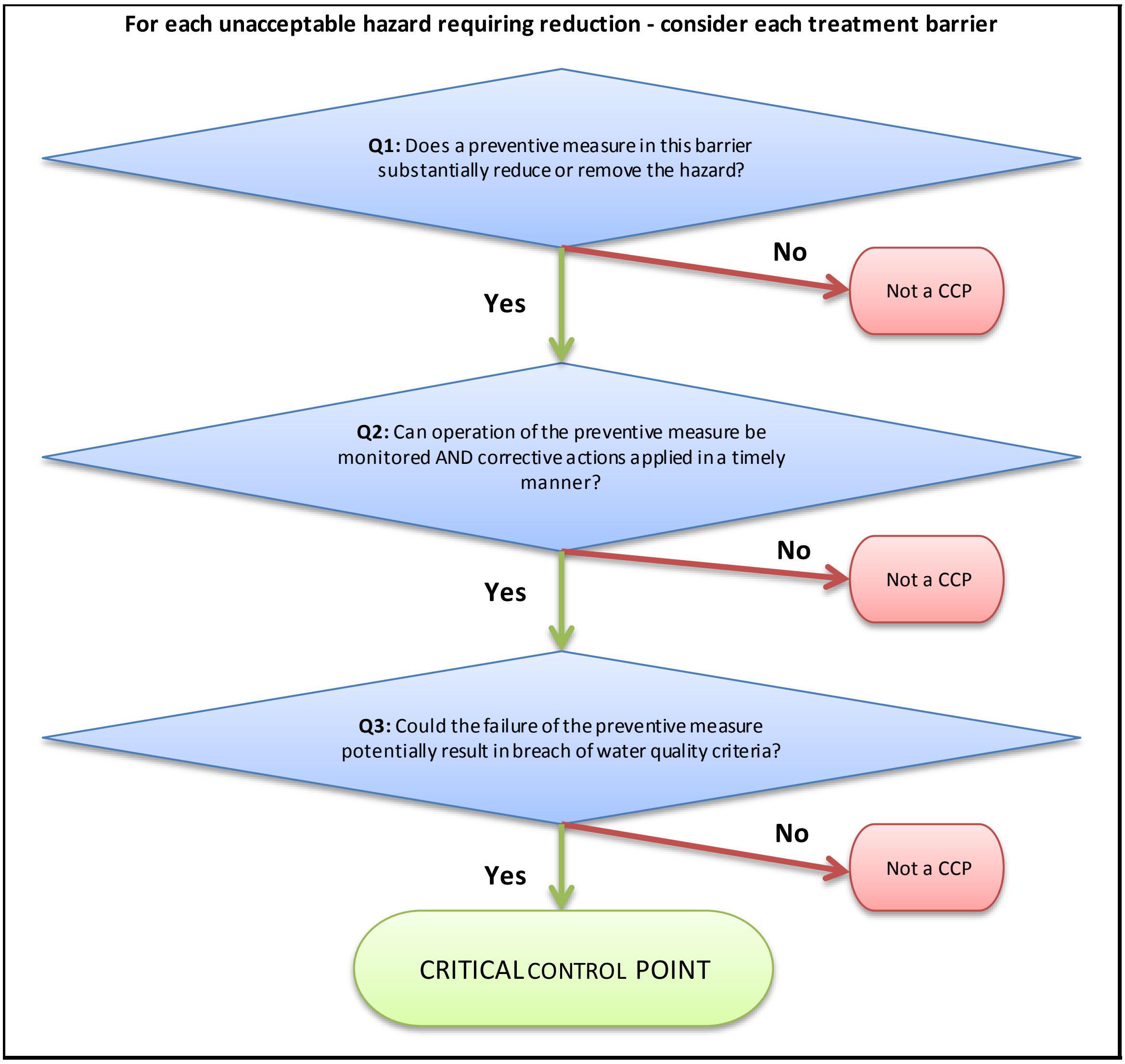


Table 44 Critical Control Point decisions

Critical Control Point decisions						
Barrier	**Hazard**	**Q1**	**Q2**	**Q3**	**CCP for hazard?**	**Comment**
Johnston Screens	Turbidity	Yes	No	No	No	Cannot monitor in timely manner - know when it is likely, but reactive.
Raw Water Abstraction	Turbidity	Yes	Yes / No	No	No	Turbidity measurement at source and WTP. Control at WTP inlet. (Daintree Q2 No: manual shutoff)
Ultrafiltration	Protozoa	Yes	Yes	Yes	Yes	PDT (direct integrity testing) is a CCP
	Protozoa	Yes	Yes	Yes	Yes	Online continuous turbidity (indirect integrity test) is a CCP
Chlorination	Bacteria	Yes	Yes	Yes	Yes	Low level chlorine critical limit for this CCP
	Virus	Yes	Yes	Yes	Yes	Low level chlorine critical limit for this CCP
	Chlorine	Yes	Yes	Yes	Yes	High level chlorine critical limit for this CCP
UV disinfection	Protozoa	No	Yes	No	No	If UF operating correctly, there should not be a protozoa load
	Bacteria	No	Yes	No	No	If chlorination operating correctly, there is no bacterial load
Reservoir chlorination Craiglie	Chlorine	Yes	Yes	Yes	Yes	High level chlorine critical limit for this CCP
Reservoir chlorination Flagstaff/ Rocky Point	Chlorine	Yes	No	Yes	Yes	lack of online monitoring means this is not a CCP yet
Reservoir integrity	Bacteria	Yes	No	No	No	Bacteria not always present, even if breach of integrity. Can monitor chlorine, but not integrity.
	Protozoa	Yes	No	No	No	Protozoa not always present even with integrity breach, cannot monitor anything.
Reticulation integrity	Protozoa	Yes	No	No	No	Protozoa not always present even with integrity breach, cannot monitor anything.
	Bacteria	Yes	No	No	No	Cannot react in timely manner to prevent ingress. Possible to breach water quality, but only in conjunction with low disinfection

6 ELEMENT 4: OPERATIONAL PROCEDURES AND PROCESS CONTROL

Operational procedures, where possible are 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.

The critical limits are included in the scheme descriptions in Section 4 as they are more easily accessible to operators in this format.

6.1.1 Corrective Actions

Corrective actions are undertaken as defined in the CCP tables. Where manual tests indicate that water quality is outside the 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 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.

6.1.2 Equipment Capability and Maintenance

Online instruments are calibrated and maintained according to the operational monitoring tables as described in section 4. The calibration details are recorded in hard copy at the WTPs.

7 ELEMENT 5: VERIFICATION OF DRINKING WATER QUALITY

7.1 Purpose and Principles

Verification monitoring is an essential element for Council to verify that the water delivered to our customers is of high quality and safe. Verification monitoring is predominantly undertaken by the Technical Officer, Water and Wastewater, or when that person is on leave, one of the WTP operators.

Whilst there are regulatory requirements to take *E. coli* samples at a certain frequency and these requirements are met, this is not the driver of the verification monitoring program. The purpose of this sampling program is to identify any water quality problems and ensure that they are rectified promptly and appropriately managed into the future.

Sampling locations include raw, treated, reservoir and reticulation samples. This ensures that the samples are representative of the water received by customers, and targets higher risk locations. The full list of sites is included in Table 47. We sample each of the sections of the reticulation network to ensure that we have provided safe water.

7.2 Monitoring Parameters

There are regulatory requirements under the *Public Health Regulation 2005* (Schedule 3A) that specify the minimum monitoring frequency for *Escherichia coli (E. coli)* and fluoride. Daily fluoride monitoring is required under the Public Health Regulation for providers who add fluoride. However, as DSC no longer adds fluoride no monitoring is required.

7.3 *E. coli*

E. coli monitoring frequency for the service provider is prescribed under the *Public Health Regulation 2005* (Schedule 3A). Douglas Shire Council undertakes extensive sampling well above our legal requirements. The frequency of sampling is identified in the following table. The Water Quality officer undertakes the sampling, and analysis, and reports results above the water quality criteria immediately to the Manager Water and Wastewater.

Table 45 E. coli monitoring frequency per scheme

Scheme	Population	Required *E. coli* frequency (Public Health Regulation)*	DSC sampling
Douglas Shire Council	16239	1/ week plus 3/ month (88 total samples)	~1250/year
Mossman-Port Douglas	14670	1/ week plus 2/ month	~15/week
Whyanbeel	1443	1/ week	~7/ week plus 1/qtr.
Daintree	86	1/ month	~3/week plus 1/qtr.

*The Public Health Regulation only requires monitoring on a provider, not scheme, basis.

7.4 Chemical monitoring

Table 24 identifies the parameters that are monitored, and their locations (treatment, reservoirs, reticulation).

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 ageing AC mains that appear to be the cause of the increasing pH in reticulation. Similarly, by monitoring for turbidity, iron and manganese, and alkalinity, we can observe changes in the reticulation network over time.

Table 46 Verification monitoring for Douglas Shire Council

	Week 1	Week 2	Week 3	Week 4	Quarterly
Reticulation	Colour, pH, Temp, Chlorine Residual, Turbidity, *E.coli*, Total coliforms, HPC, Cu, Fe, Mn	pH, Temp, Chlorine Residual, *E.coli* & Total coliforms	pH, Temp, Chlorine Residual, *E.coli* & Total coliforms	pH, Temp, Chlorine Residual, *E.coli* & Total coliforms	
Reservoir	Alkalinity, pH, Chlorine Residual, *E. coli*, Total coliforms, HPC, Chlorite	pH, Temp, Chlorine Residual, *E.coli* & Total coliforms	pH, Temp, Chlorine Residual, *E.coli* & Total coliforms	pH, Temp, Chlorine Residual, *E.coli* & Total coliforms	
Treatment	Alkalinity, pH, Chlorine Residual, *E. coli*, Total coliforms, HPC,	pH, Temp, Chlorine Residual, *E.coli* & Total coliforms	pH, Temp, Chlorine Residual, *E.coli* & Total coliforms	pH, Temp, Chlorine Residual, *E.coli* & Total coliforms	
Raw				pH, Temp, Turbidity, EC	Alkalinity, Ca, Cl, Colour, Salts, EC, F, Hard, Mg, pH, K, Si02, Na, S04, Turbidity, *E. coli*, ICPMS-Fe, Mn, TDS, TON, TN, Ammonia,

Analyses by External Lab (NATA)

Analyses by Douglas Shire Colilert-18 Lab

7.5 Event Based and Investigative Monitoring

Douglas Shire Council will also initiate water quality sampling if there are events likely to impact on water quality. As previously stated, we are discontinuing sampling for *Naeglaria*, and for *Cryptosporidium* and *Giardia*. We accept that these pathogens represent real risks, however, by ensuring the effectiveness of the UF barrier and retaining a disinfection residual in reservoirs and throughout the network, these risks are managed appropriately.

Similarly, we are now moving the THM monitoring from the reservoirs, where more than 2 years of quarterly data has typically resulted in ~100 μg/L with a maximum of 150 μg/L. We will commence summer monitoring at sample points at the extremities of the reticulation network in each scheme. This is considered investigative monitoring, and the ongoing analysis for THMs will depend on the results. For example, we will increase monitoring if THM results are consistently above 200 μg/L, but equally will cease sampling if results are consistently below 200 μg/L.

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 section 7.6.1.

7.5.1 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**.

7.6 Scheme by Scheme monitoring locations

Table 47 Sampling locations

Mossman	**Raw**	**Treatment**	**Reservoir**	**Retic**
Mossman Intake				
Cassowary – Bunn's Corner				
Cooya Beach - Bouganvillea St (cnr Cooya Beach Rd)				
Cooya Beach - Northern End - Boat Ramp				
Craiglie - Reef Park Reservoir				
Craiglie - Teamsters Park				
Flagstaff - Reservoir No. 2 Pump Station Tap				
Four Mile Beach - Barrier Street				
Four Mile Beach - Esplanade				
Mossman - Davis Park in front of Church				
Mossman - Showgrounds near Ticket Box				
Mossman T/P (Mossman Reservoir) - Post UV				
Mossman T/P (Port Reservoir) - Post UV				
Mowbray – Connolly Road				
Newell Beach - Esplanade - T-Intersection				
Newell Beach - Jetty - Corner Tap (Croc Sign)				
Port Douglas - Rex Smeal Park				
Whyanbeel	**Raw**	**Treatment**	**Res**	**Retic**
Whyanbeel Intake				
Rocky Point Pump Station				
Rocky Point Reservoir				
Whyanbeel - Post UV				
Wonga Beach - Bells Park				
Wonga Beach - Marlin Drive Bus Shelter				
Wonga Beach Reservoir - North Tap				
Daintree	**Raw**	**Treatment**	**Res**	**Retic**
Daintree Intake				
Daintree - Post UV				
Daintree - Shire Hall				

Sampling locations are identified in the following maps overleaf

In the following figures, the small filled dark blue circles represent fire hydrants, the large unfilled blue circles represent reservoirs, and crosses represent gate valves (blue are open, red are closed). Brown items represent private water infrastructure.

Blue lines indicate the water mains, with bold lines = 300mm plus, thin lines 99-300mm, and dotted lines < 99mm.

Figure 16 Mossman - Port Douglas water supply scheme extends from Newell in the North to Mowbray in the South

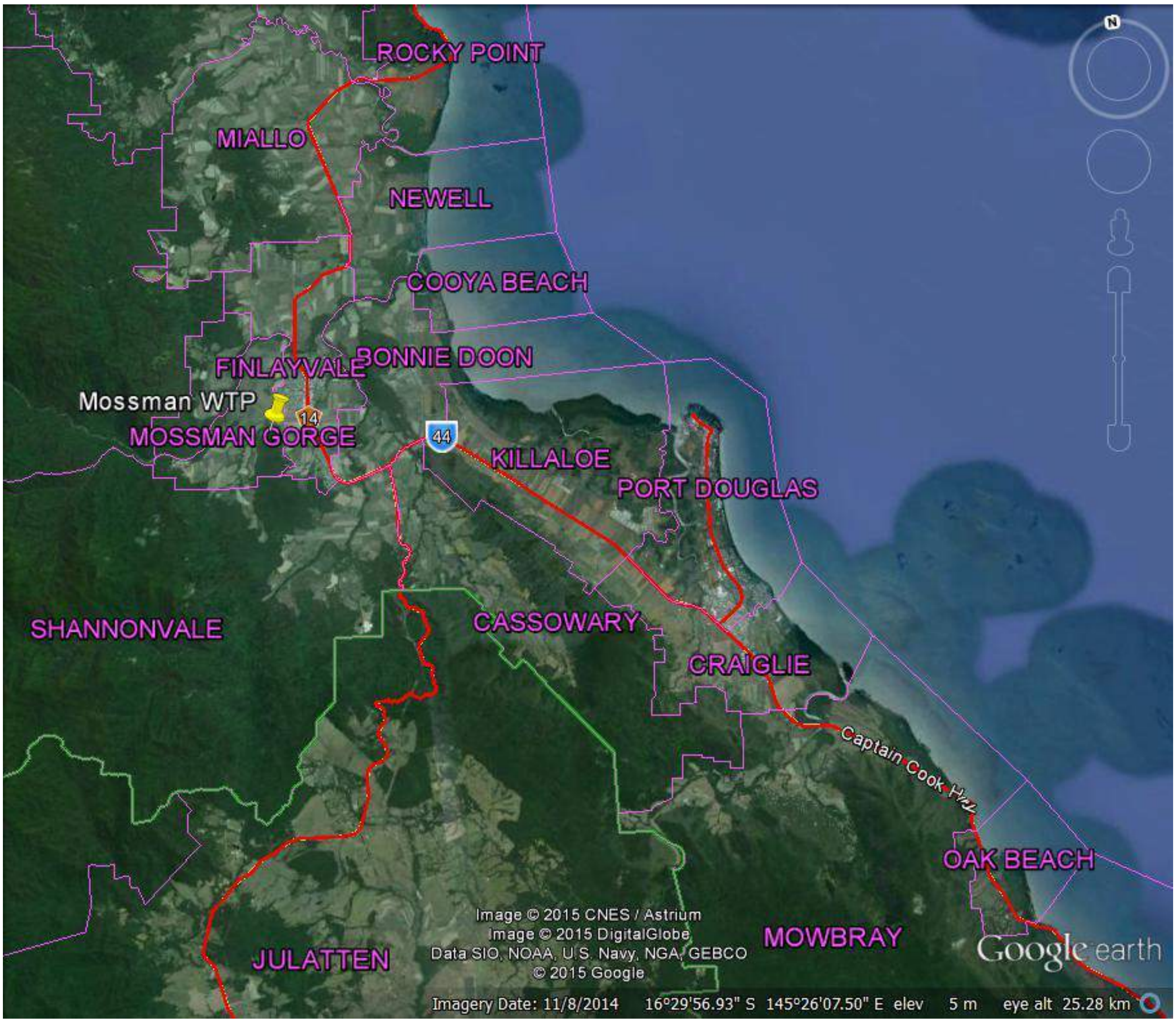


Figure 17 Water sampling locations near Mossman WTP

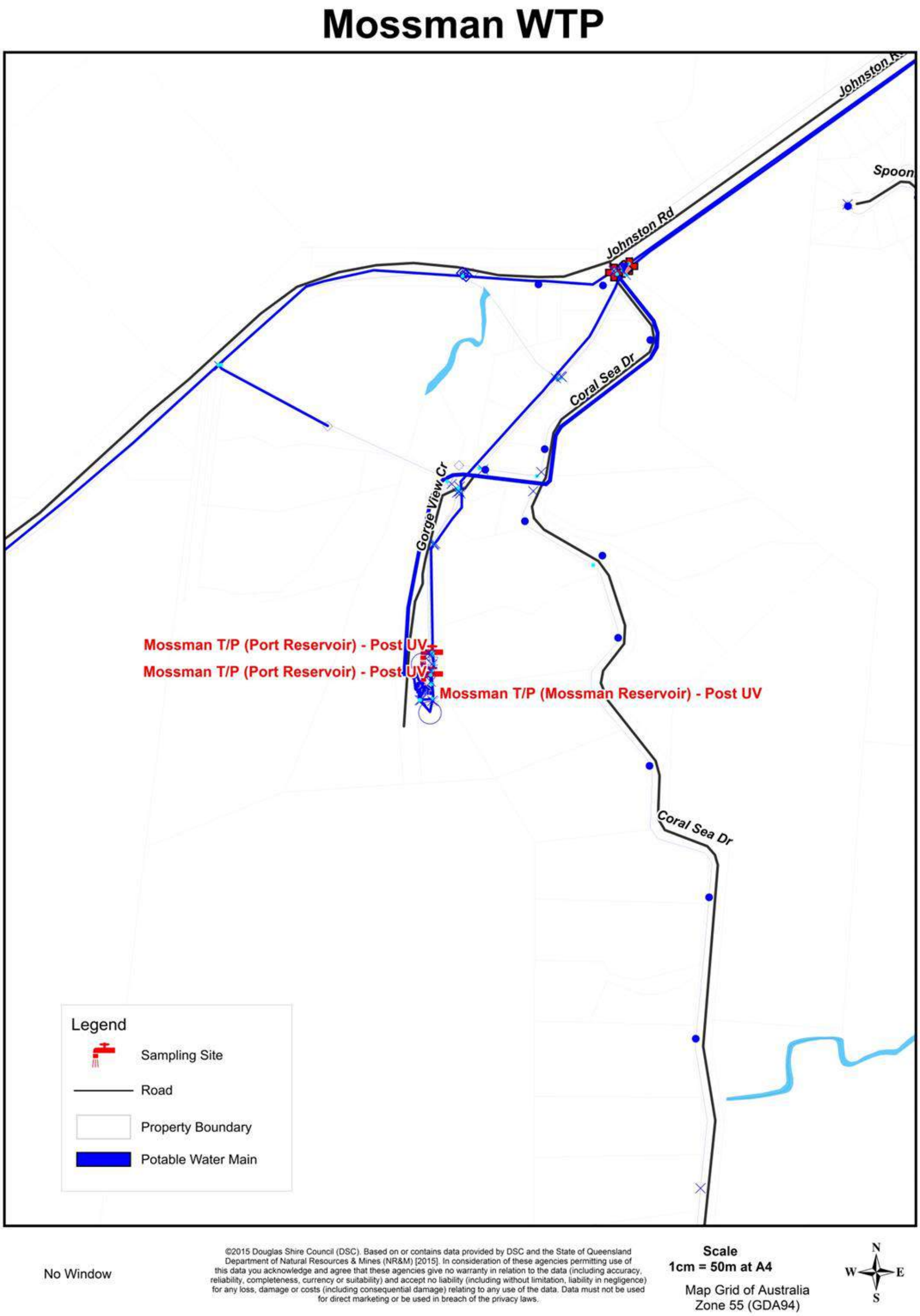


Figure 18 Water Sampling Locations at Mossman

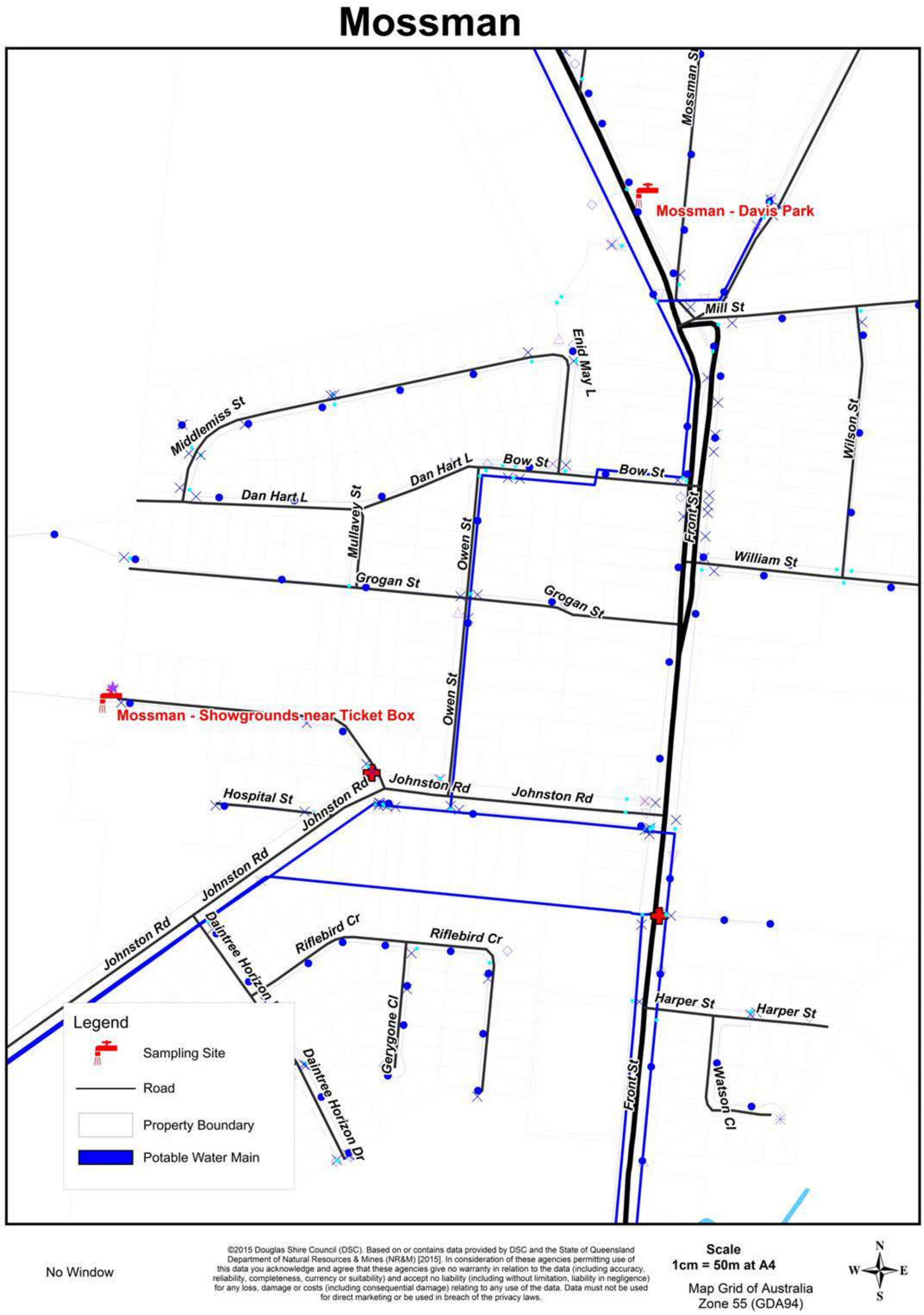


Figure 19 Water Sampling Locations at Cooya Beach

Figure 20 Water Sampling Locations at Newell Beach

Figure 21 Water Sampling Locations at Cassowary

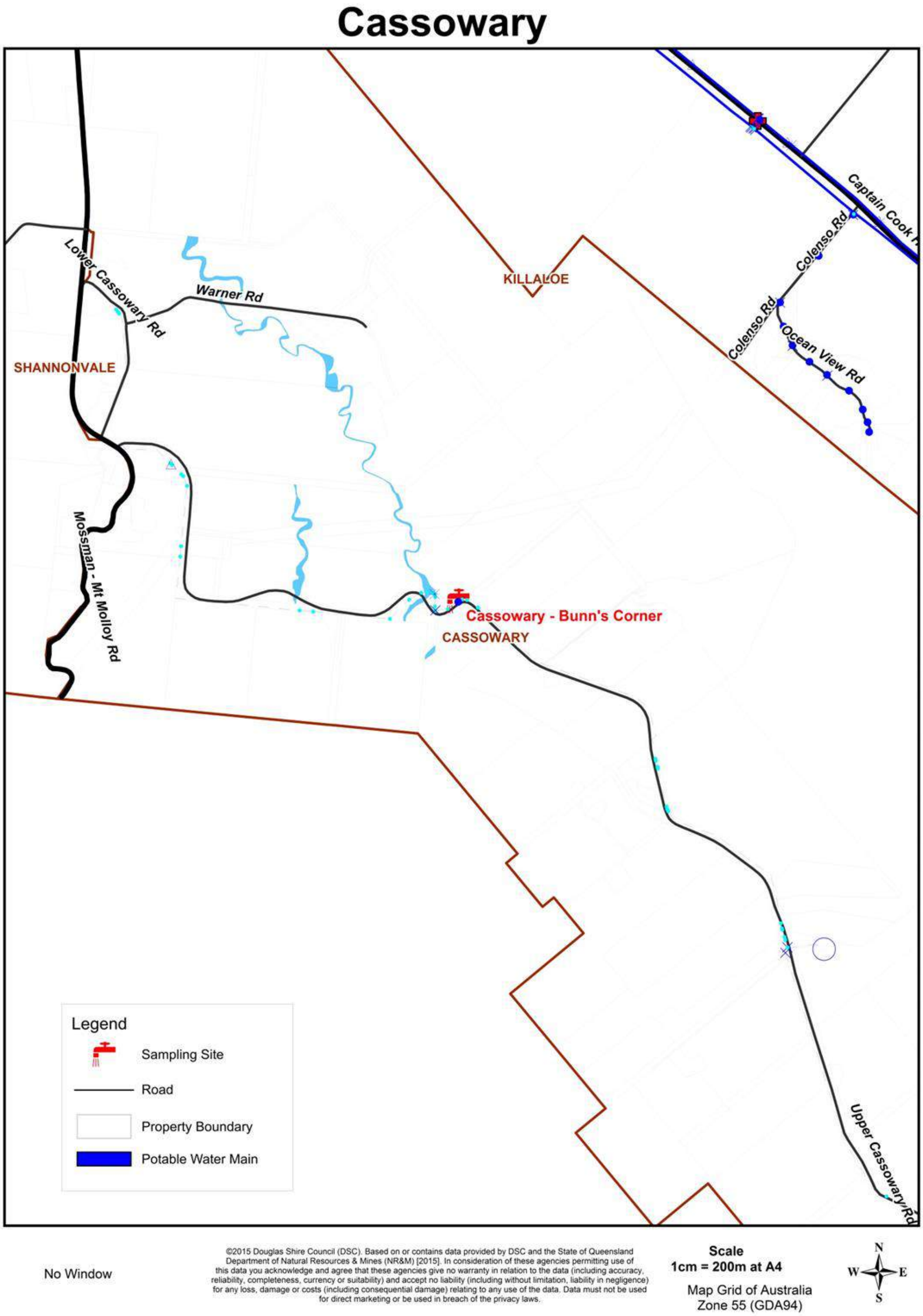


Figure 22 Water Sampling Locations at Port Douglas

Figure 23 Water Sampling Locations at Craiglie

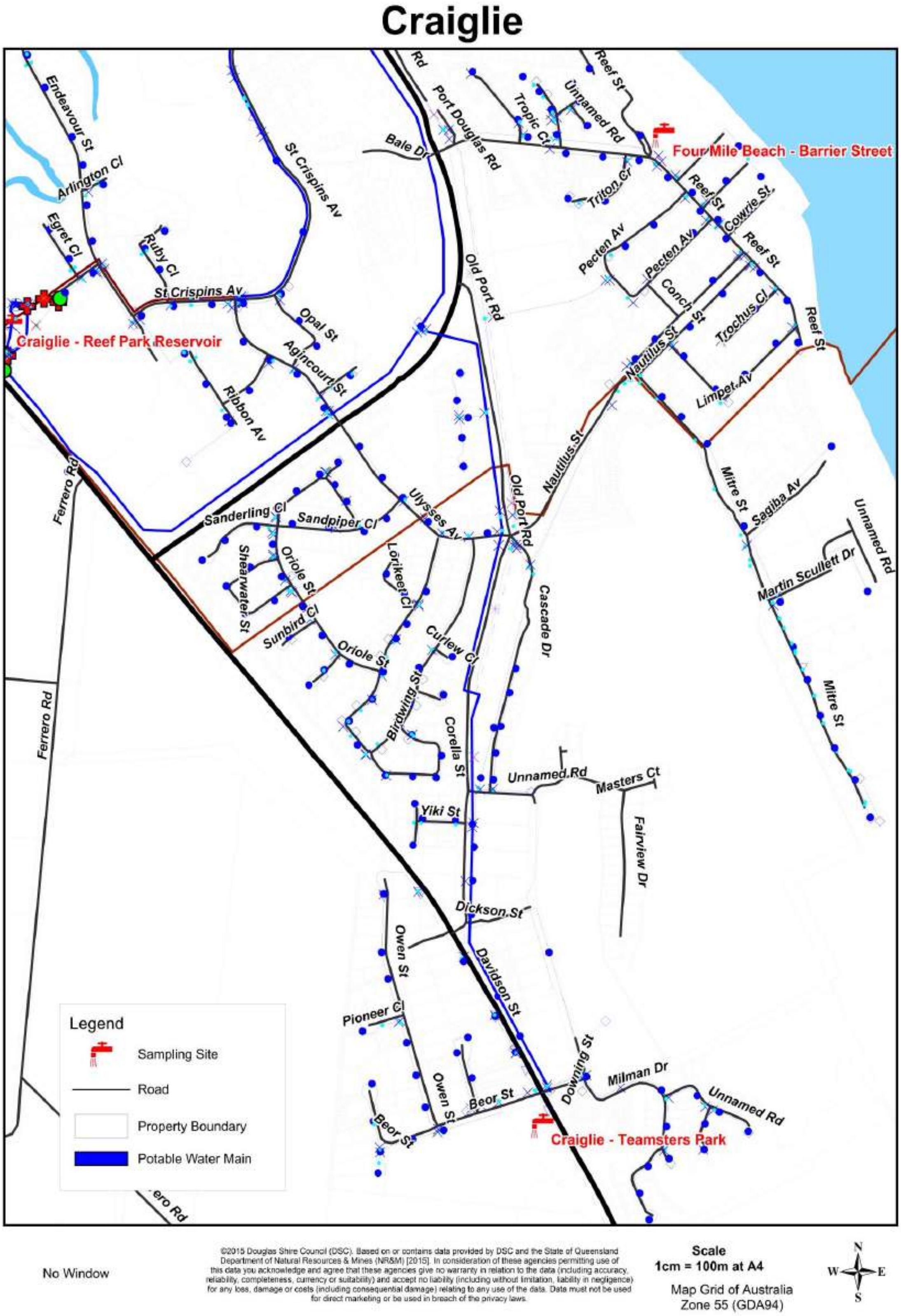
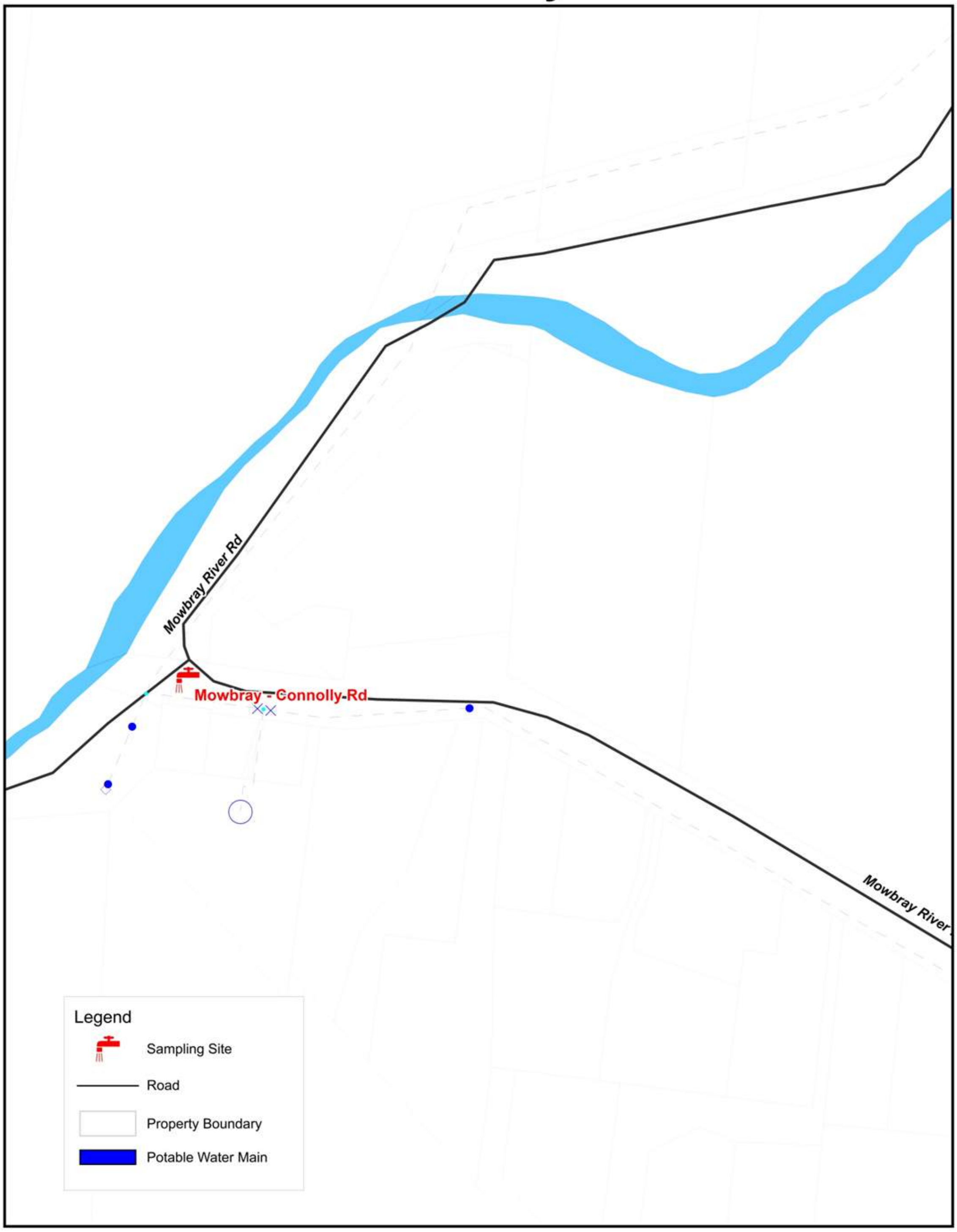


Figure 24 Water Sampling Locations at Mowbray

Mowbray



No Window

Scale
1cm = 40m at A4

Map Grid of Australia
Zone 55 (GDA94)

Figure 25 Whaynbeel water supply scheme - from Rocky Point to Wonga Beach

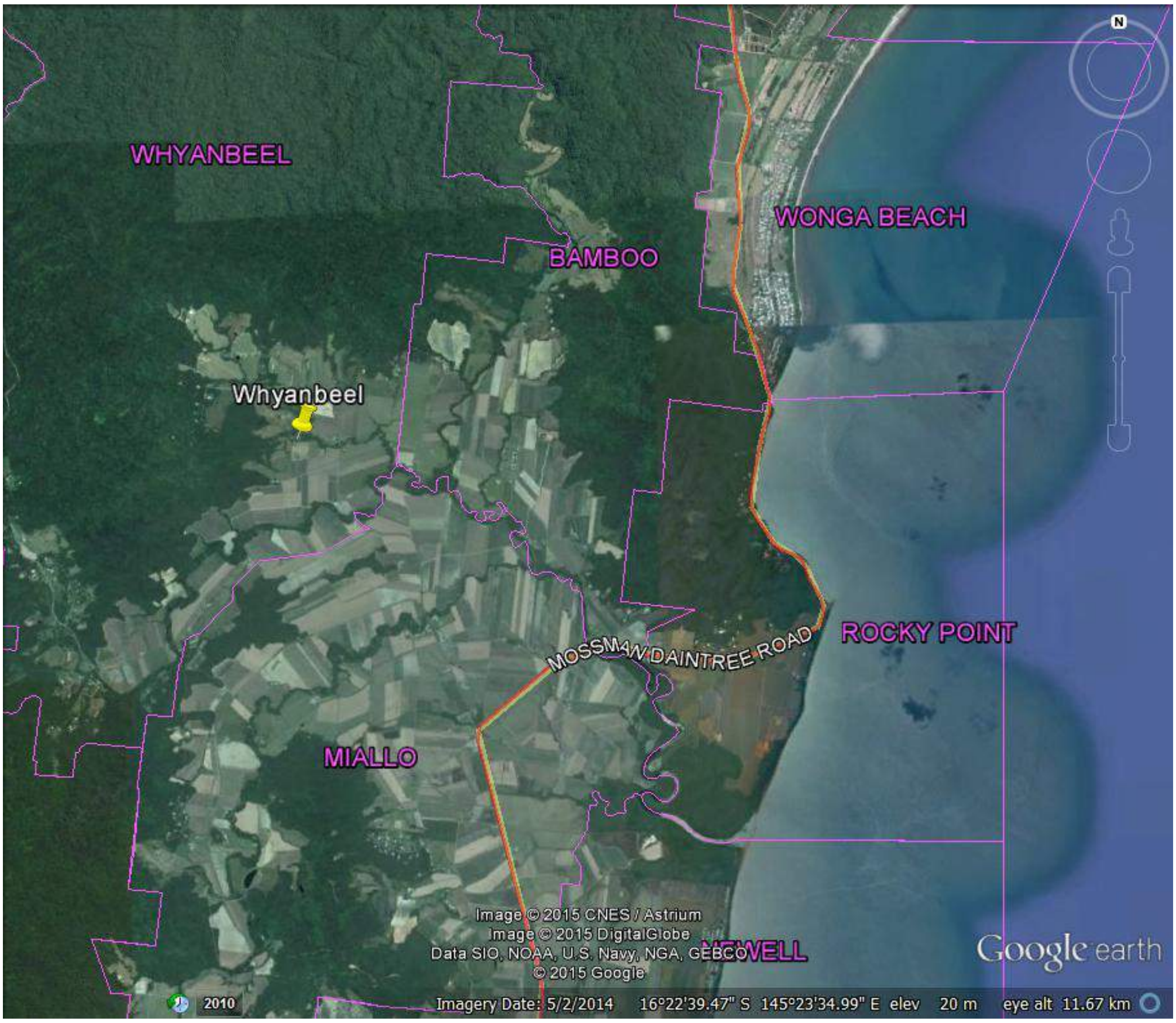


Figure 26 Water Sampling Locations at Whyabeel WTP

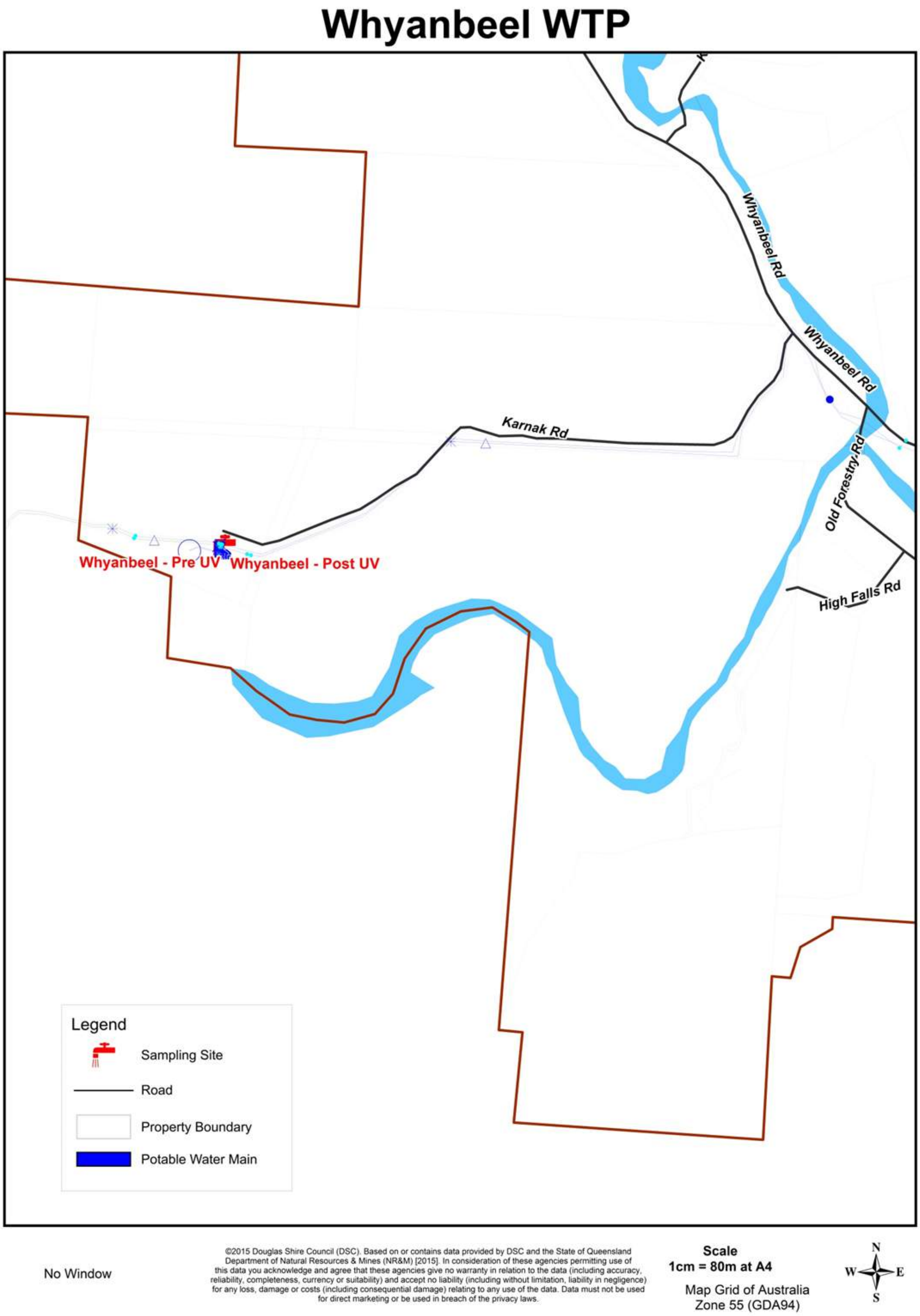


Figure 27 Water Sampling Locations at Rocky Point

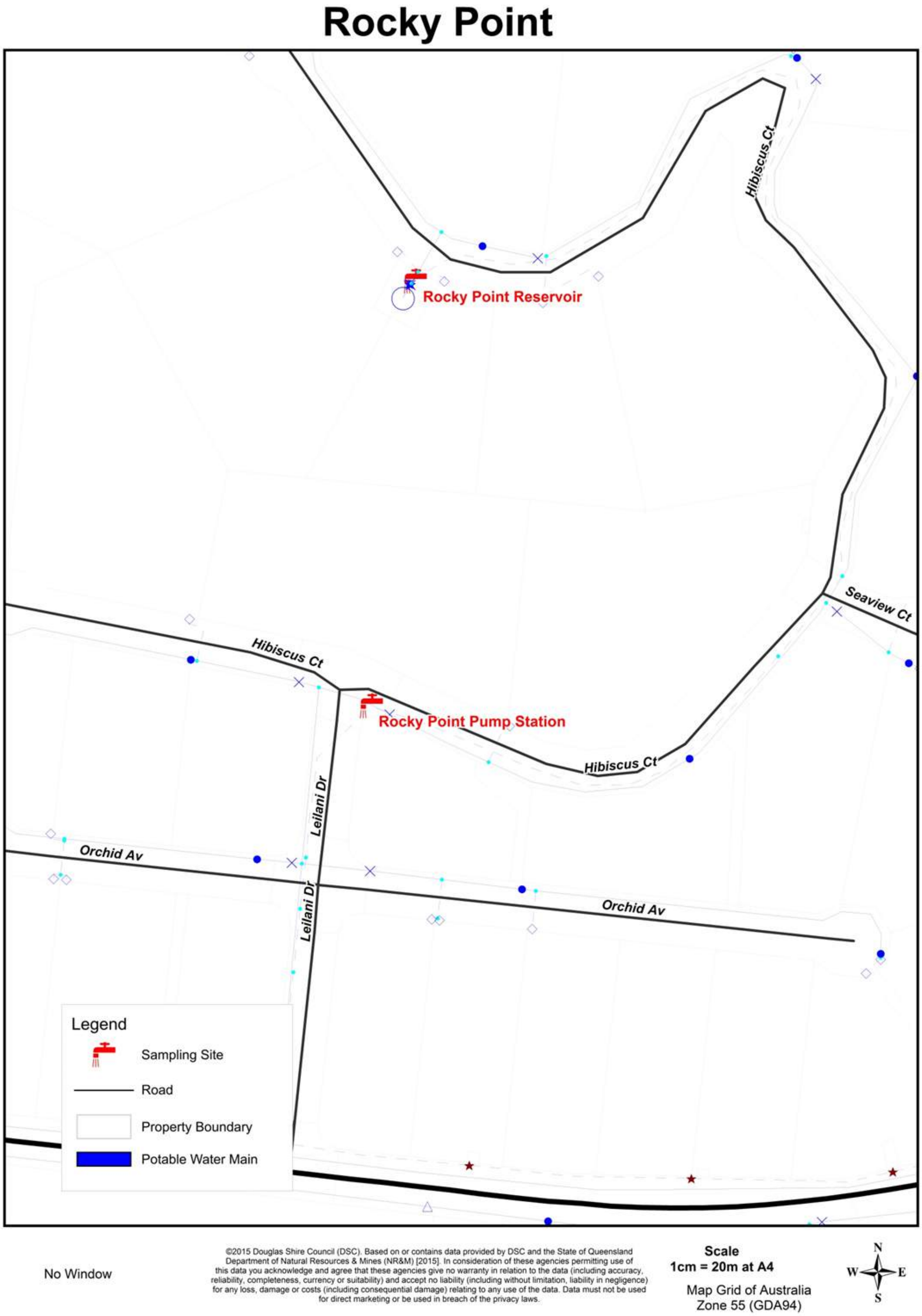
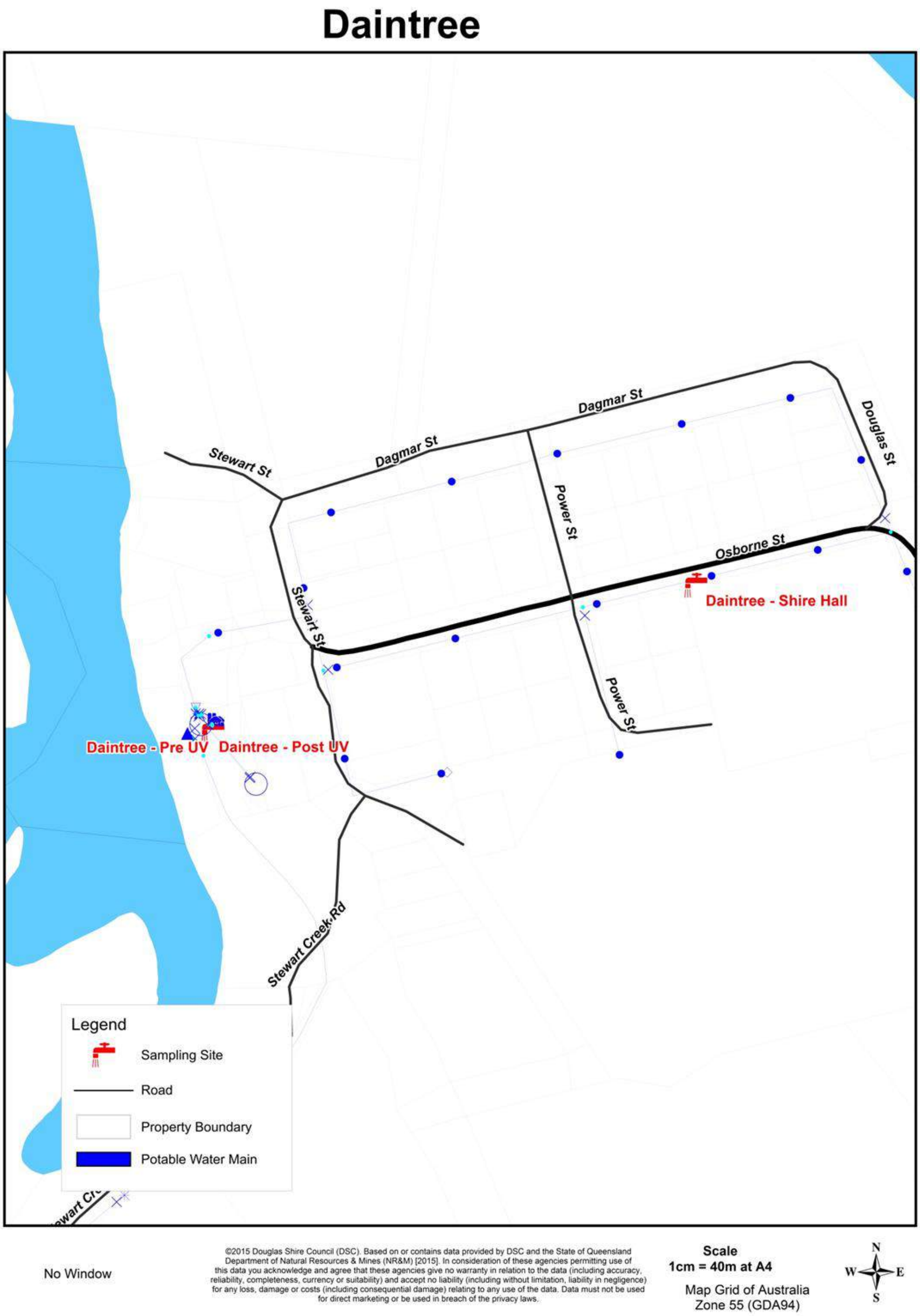


Figure 28 Water Sampling Locations at Wonga Beach

Figure 29 Daintree Village overview

Figure 30 Water Sampling Locations in Daintree



8 ELEMENT 6: INCIDENT AND EMERGENCY RESPONSE

Levels of Incident are as defined below:

- Declared Disaster
- Reportable Incidents and Emergencies
- Operational Action

Table 48 Management of incidents and emergencies

Alert Level	Description	Key management response(s)	Position(s) responsible
Declared Disaster	• Declared disaster. Examples include a cyclone.	Activate disaster management plan.	CEO
Reportable 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. • Environmental Incident	Activate incident response plan. Ensure all control measures identified in the DWQMP are functioning effectively.	Manager Water and Wastewater Team Leader Water, Technical Officer Water and Wastewater
Operational Action	• Exceed operational limit • Potential environmental issue 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, WTP Operators

Table 49 Incident and emergency summary of actions

Alert Level	Key management response(s)	Brief summary of actions	Documented Plans & Procedures
Declared Disaster	Activate disaster management plan.	• Notify CEO • Coordinate internal notification, investigation and response of water related aspects • Consider what community notification is needed (if any) e.g. do not drink alert, boil water alert or bottled/emergency water distribution • Notify WPR of escalation from incident/event or of standalone emergency as soon as practicable	Disaster management plan.
Reportable Incidents and Emergencies	Ensure all barriers identified in the DWQMP are functioning effectively.	• Notify Manager Water and Wastewater • Notify WPR of any reportable incidents immediately (within 3 hours). • (Notify EHP – environmental incident) • Ensure all control measures identified in the DWQMP are functioning effectively • Immediately Resample • Commence investigation • Implement appropriate immediate remediation actions, (this may include hand dosing reservoirs, flushing of mains, or isolation of affected areas) • Consider what community notification is needed (if any) e.g. do not drink alert, boil water alert or bottled/emergency water distribution • Review associated laboratory reports and operational records • In case of customer complaints, coordinate investigation and resolution, including obtaining water samples where required • Take remedial actions, and then take another resample to demonstrate effectiveness of actions.	DWQMP
Operational Action	Ensure all operational steps identified in the DWQMP are functioning effectively. Check and act upon operations and maintenance records and procedures.	• Notify Team Leader Water. • Review operations and maintenance records for anomalies • Commence investigation to determine cause, if not identifiable through operational records • Investigate immediate remediation actions • Increase operational monitoring frequency where required	DWQMP. Routine monitoring

8.1 Operational Action

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

Issues at this level are normally identified through operational monitoring.

Corrective actions will be taken e.g. according to the operational procedures identified in this plan. Exceedance of a critical limit does not automatically escalate to the next level if the water quality criteria are not breached.

8.2 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 Manager 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 overleaf.

Incidents at this level are reportable to the Queensland Water Supply Regulator. We 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 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.

8.3 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 Department of Emergency Services, Department of Energy and Water Supply, Department of Health, local disaster management groups, emergency responders like QFRS, 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, and will report directly to the Coordinator of the LDMG on water requirements.

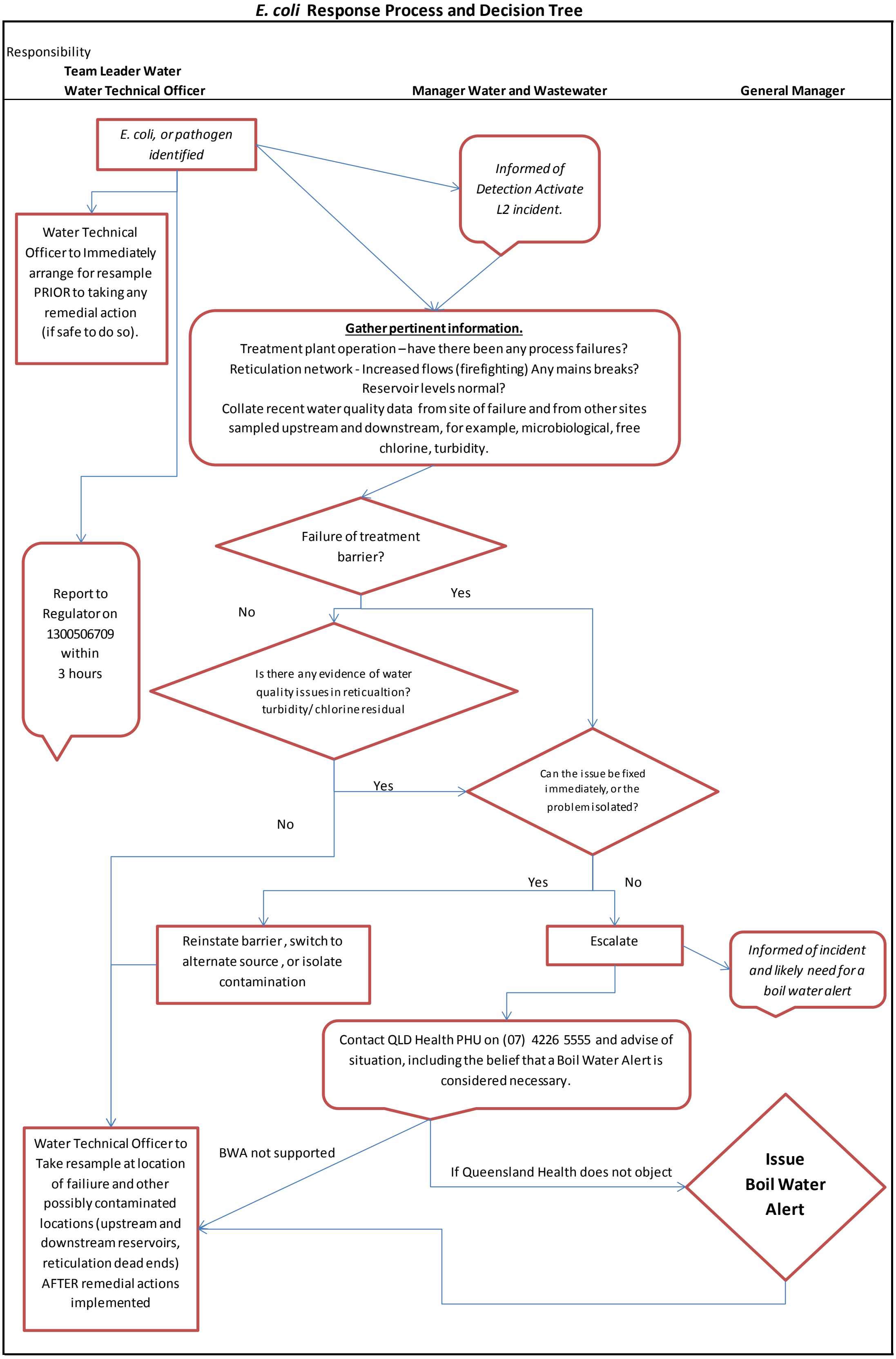
While every effort will be made to continue to implement the Drinking Water Quality Management Plan, Disaster Management actions may take precedence. Every effort will be made to keep WPR informed of the situation as soon as practicable.

8.4 Example incident responses

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

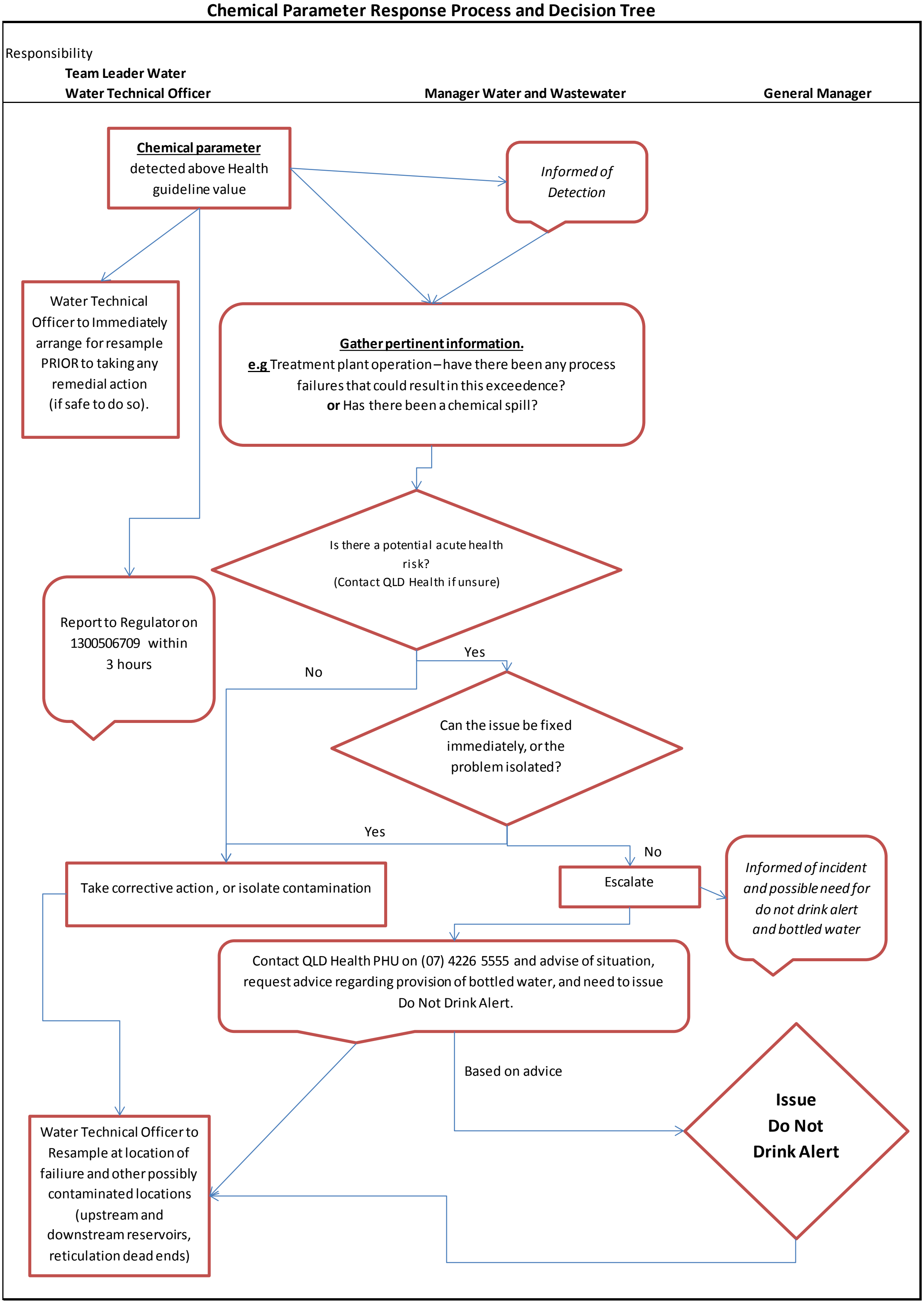
8.4.1 Detection of *E. coli*

Figure 31 E. coli response



8.4.2 Detection of chemical parameter

Figure 32 Detection of chemical parameter above ADWG response



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 (MagiQ document number 460573)

Figure 33 Draft Boil Water Alert Template

DOUGLAS SHIRE COUNCIL

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,
- Making baby formula,
- Making ice or,
- 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.

Figure 34 Draft Do Not Drink Alert Template

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.

(Contact person?)

9 ELEMENT 7: EMPLOYEE AWARENESS AND TRAINING

9.1 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 Manager 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.

9.2 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 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.

Douglas Shire Council maintains a list of the relevant qualifications and certifications of operational staff, and intends to further formalise training programs. For example, we are aware of the industry push towards the National Certification Framework for Water Treatment Plant Operators, and will investigate obtaining the appropriate units of competency for all operational staff over the next 2 year DWQMP review period. This is consistent with the intent of the draft guidance note just released by the Regulator. Specific environmental training may also be considered.

10 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.

11 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.

It is intended that in the long term, as the drinking water quality management plan becomes embedded into normal activities that more focus can be placed on this element.

12 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.

12.1 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 Councillors on all water matters.

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

12.2 Procedures

A number of procedures were previously developed when Douglas Shire Council was part of the amalgamated Council and were identified in the previous version of the DWQMP. The procedures were not specific to these schemes, are not implemented as described, and are therefore no longer considered appropriate. So, whilst some provide a good starting point for the development of new procedures, we have taken the position that any procedure that is outdated or incorrect should be rewritten.

SOPs will be developed and adopted for all new processes (e.g. gas chlorination) prior to implementation of the new process. It is intended that all procedures will be reviewed on a 4 yearly basis, or more frequently if the need for updates are identified.

Operational Procedures and CCPs are primarily documented through this plan, and are also embedded within the SCADA system.

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

13 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.

13.1 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

13.2 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.

13.2.1 Regulatory Audits.

There is a regulatory requirement to audit the DWQMP, in accordance with the approval of the DWQMP. The frequency is currently every 4 years. Douglas Shire Council has not yet been required to undertake a regulatory audit. When a regulatory audit is conducted, it shall be undertaken in as required. The audit timetable was recently changed to align with the wider Far North Queensland Regional Organisation of Councils, and it is expected that this audit date will remain.

13.2.2 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 requirements

Table 50 Auditing Framework

Audit Type	Frequency	Report submitted to
External	• As required by the Regulator	• Council management • Qld Water Supply Regulator

13.2.3 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.

14 ELEMENT 12 REVIEW AND CONTINUAL IMPROVEMENT

14.1 Review

There is a regulatory requirement to review the DWQMP biannually. However, as this DWQMP has evolved following de-amalgamation from Cairns Regional Council, we have previously undertaken reviews at a higher frequency to ensure that the DWQMP suits our operations.

The current review and amendment of the DWQMP has been conducted following an internal audit of our DWQMP that identified areas for improvement.

Council will also trigger reviews if, after consultation with the regulator, are considered to be significant enough to require a DWQMP amendment.

14.2 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 risk assessment, and have been collated here.

The items have been prioritised according to budget cycles. Where an item is required immediately, DSC will undertake as soon as practical. Otherwise, items are identified as occurring in the 15/16 or 16/17 financial years. Items in the 15/16 financial year have been approved in the Council budget, and will proceed. Some items are also budgeted for in 16/17, but other items may not be approved and may not occur in 16/17. Where items are included in the 16/17 improvement plan, it is the intent to, at a minimum, propose the item in that financial year’s budget.

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 General Manger, Operations are intimately involved in developing the budget, and communicating it to the Council Executive and the Councillors.

The current council is aware of how the DWQMP is developed, and the linkages of capital works projects to identified risks. It is the intent of Douglas Shire Council to ensure that the incoming Council in 2016 is equally well informed of how the DWMQP drives the Capital works program, such that drinking water maintains the necessary focus to ensure that we can continue to deliver safe drinking water.

Table 51 Risk Management Improvement Items

RMIP Reference	Hazardous Event	Hazards managed by same barriers	Unmitigated Risk	Primary preventive measure	Risk	Documented Procedure	Risk Management Improvements			Expected Risk when completed
							Immediate	2015/16 FY	16/17 FY or later	
DWQMP Doc	Raw water main break	Failure of supply	High 10	multiple intakes Mossman	Medium 6	CRC mains break procedure available, needs to be updated				Medium 6
DWQMP Doc	Blocked Johnson screen	Failure of supply	High 10	Intake checked daily	Medium 6	Procedure, including preparing for storm events required.				Medium 6
PCWST116	Loss of Raw water reservoir at Daintree due to subsidence	Failure of supply	High 10	stabilisation works are scheduled	High 10			Budget item PCWST116 Daintree WTP bank stabilisation next to raw water reservoir.		Medium 6
PCWST111	loss of integrity	Protozoa, turbidity	Extreme 25	24 hr PDT	High 10	PDT CCP		Budget item PCWST111: MWTP UF racks integrity test associated valve replacement: Replace all the old butterfly valves (on each UF rack) associated with the integrity test pressurisation system.		Medium 6
PCWST110	loss of integrity	Protozoa, turbidity	Extreme 25	continuous turbidity monitoring	High 10	Turbidity CCP		Budget item PCWST110 - install turbidity meters to each rack.		Medium 6
Dain 1*	loss of integrity	Protozoa, turbidity	Extreme 25	continuous turbidity monitoring	High 10	Turbidity CCP		Move turbidity meter to permeate rather than treated water.		Medium 6
Whyanbeel 1*	loss of integrity	Protozoa, turbidity	Extreme 25	continuous turbidity monitoring	High 10	Turbidity CCP		Move turbidity meter to permeate rather than treated water.		Medium 6
PCWST117	membrane scaling reducing plant capacity	reduced supply	Medium8	regular backwashes, including CEB/ CIP as required	Medium 6	TMP monitored, high-high alarm for each rack.		Budget item PCWST117 Renewal of chemical dosing system for CIP and CEB.		Medium 6
PCWST112	chemical breakdown	chlorate	High 12	nil currently	High 12			Budget item PCWST112 Change Mossman WTP to gas chlorine (2*920 kg cylinders).		Low 3
PCWST113	chemical breakdown	chlorate	High 12	nil currently	High 12				Budget item PCWST113 Whyanbeel Gas chlorination project	Low 3
PCWST114	chemical breakdown	chlorate	High 12	nil currently	High 12				Budget item PCWST114 Daintree Gas chlorination project	Low 3
PCWR125 DWQMP Doc	Ingress into reservoirs	bacteria/virus	Extreme 20	primary disinfection, redosing at Craiglie	Medium 6	Reservoir inspection program plus check sheets required	develop a reservoir inspection program	Budget item PCWR125 replace Craiglie Reservoir roof		Medium 6
WR2 DWQMP Doc	Ingress into reservoirs	Protozoa	Extreme 20	Integrity at Craiglie	Extreme 20	Reservoir inspection program plus check sheets required	develop a reservoir inspection program	Budget item WR2 replace Craiglie Reservoir roof		Medium 6

RMIP Reference	Hazardous Event	Hazards managed by same barriers	Unmitigated Risk	Primary preventive measure	Risk	Documented Procedure	Risk Management Improvements			Expected Risk when completed
							Immediate	2015/16 FY	16/17 FY or later	
PCWR124 DWQMP Doc	Ingress into reservoirs	Protozoa	Extreme 20	Integrity and sealing	High 15	Reservoir inspection program plus check sheets required	develop a reservoir inspection program	Budget item PCWR124 eliminate any potential ingress into reservoir, seal vertical sheeting to abutment, repair/replace sheeting, water proof hatches	PCWR124 continues.	Medium 6
PCWST118 DWQMP Doc	Ingress into reservoirs	bacteria/virus	Extreme 20	primary disinfection, hypo dosing at Rocky Point	Medium 6	Reservoir inspection program plus check sheets required	develop a reservoir inspection program	Budget item PCWST118 Investigate Gas v Hypo at Rocky Point, and include telemetry and alarms.		Medium 6
PCWST115 DWQMP Doc	Ingress into reservoirs	bacteria/virus	Extreme 20	primary disinfection, manual redosing at Flagstaff Res	Medium 6	Reservoir inspection program plus check sheets required	develop a reservoir inspection program	Budget item PCWST115 Gas chlorination project Flagstaff Reservoir.		Medium 6
PCWST119 DWQMP Doc	Ingress into reservoirs	bacteria/virus	Extreme 20	primary disinfection, no redosing (Cooya, Wonga)	High 10	Reservoir inspection program plus check sheets required	develop a reservoir inspection program		Budget item PCWST119 gas chlorination project Stage 2 Cooya Res. 2 70 kg gas systems, telemetry.	Medium 6
PCWR127 DWQMP Doc	ingress of contaminated water	bacteria/virus	Extreme 20	network pressure, residual disinfection, mains break procedure	Medium 6	formalise flushing		Budget item PCWR127 Upgrade of mains Newell Beach.		Medium 6
DWQMP Doc	ingress of contaminated water	protozoa	Extreme 20	network pressure, mains break procedure	Medium 6	CRC mains break procedure available, needs to be updated				Medium 6
Port 1*	Power failure	Failure of supply	High 15	Power supply generally robust. Many areas gravity fed.	Medium 6		provide provision to be able to use generator if required, identify source of generator			Medium 6
PCWST114	increasing pH impacting residual disinfection	bacteria/virus	Extreme 20	network pressure, reservoir integrity, mains break procedure	High 10			Budget item PCWR128 replacement of ageing AC mains	Identify priority areas for AC main replacement (Cooya possibly next?) PCWR128	Medium 6
DWQMP Doc Retic 1	backflow	protozoa	Extreme 20	system integrity, backflow prevention on new installations	High 10	need to develop			Long term meter replacement strategy	Medium 6
PCWST115 and PCWST118	insufficient dose	bacteria/virus	Extreme 20	disinfection daily inspects	High 10	documented in OCPs		PCWST115 and PCWST118		Medium 6

RMIP Reference	Hazardous Event	Hazards managed by same barriers	Unmitigated Risk	Primary preventive measure	Risk	Documented Procedure	Risk Management Improvements			Expected Risk when completed
							Immediate	2015/16 FY	16/17 FY or later	
PCWST120, PCWST121, PCWST122, PCWST123	SCADA/ telemetry failure	Protozoa	Extreme 25	Treated water in system.	High 10			Budget item PCWST120 Upgrade SCADA to new version of CITEC. PCWST121, PCWST122, PCWST123 telemetry and switching improvements also associated with these communication upgrades	PCWST123 improving telemetry over 2 years.	Medium 6
PCWR126	Demand exceeds supply	Limited supply	Extreme 25	Asset planning	High 10	asset management plan			Budget item PCWR126 Commission Cooya reservoir. Include valves, telemetry, and vermin proofing	Medium 6
PCWR131	Demand exceeds supply	Limited supply	Extreme 25	Asset planning	High 10	asset management plan		Budget item PCWR131 Develop Crees Rd Reservoir site	Continue PCWR131	Medium 6
PCWR132	Drought (Mossman)	Failure of supply	High 10	Restrictions leading to Wet season	High 10			Budget item PCWR132 Water supply security - investigate, design and possibly implement alternate supply source	Continue PCWR132	Medium 6
PCWR130	Flood	Failure of supply	High 10	Daintree Intake	High 10			Budget item PCWR130 install 2 hydrants and 2 sluice valves to improve raw water supply security.		Medium 6
PCWR130	landslip Daintree intake	Failure of supply	High 15	Daintree Intake	High 10			Budget item PCWR130 install 2 hydrants and 2 sluice valves to improve raw water supply security.		Medium 6
PCWR127	Cyclone	Failure of supply	High 15	DMP	High 10	business continuity plan and hazard checklists		Budget item PCWR127 improve interconnection to improve supply security.		Medium 6
Training 1 DWQMP Doc	operator error	any	Extreme 25	training, experience, mentoring	High 10	HR training register	Formalise Water operations professional development.	develop procedures listed as required		Medium 6
DWQMP Doc	accidental use of bypass	protozoa and bacteria	Extreme 25	Valves identified as permanently closed, tagged out.	Medium 6	develop bypass procedures				Medium 6
Training 1	loss of knowledge	All	Extreme 25		High 15		Formalise Water operations professional development. Ground truth GIS.	local government structure plan		Medium 6

"*" these improvements were not identified in the 2015-16 capital budget, and will be completed if possible under the operating budget. They may however be delayed until the following year.

15 APPENDIX A – WATER QUALITY DATA (2008-2015)

15.1 Mossman Water Quality Data (Reticulation, Reservoirs, Treatment and Raw)

Reticulation

E. coli Retic	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	<1	<1	<1	<1
Max	-	-	-	<1	<1	1	<1
Min	-	-	-	<1	<1	<1	<1
Count	-	-	-	537	526	522	524
95th %ile	-	-	-	<1	<1	<1	<1

Chlorine Retic	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	0.33	0.31	0.41	0.45	0.62	0.54	0.61
Max	1.4	3.9	1.1	1.9	2.4	1.2	1.2
Min	0.1	0.01	0.01	0.01	<0.10	<0.10	<0.10
Count	18	653	514	536	526	472	522
5th %ile							<0.10
95th %ile	0.97	0.7	0.8	0.9	1	0.92	0.92

pH Retic	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	8.7	8.6	8.5	8.2	7.9	7.7	7.64
Max	9.9	9.6	9.7	9.6	9.4	9.2	9.6
Min	5.9	6.3	7.2	7.2	7.1	6.8	6.6
Count	519	533	522	537	526	490	525
95th %ile	9.5	9.4	9.3	9	8.6	8.6	8.48

Colour Retic	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	3.8	2.7	1.9	1.6	1.8	1.3	<1
Max	65	46	13	4.5	8.4	5.3	5
Min	1.1	1	1	<1	<1	<1	<1
Count	493	311	219	537	526	486	71
95th %ile	6.2	4.9	3.1	2.8	3.4	4	5

Turbidity Retic	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	0.32	0.6	0.25	0.1	0.1	0.1	<0.10
Max	16	31	3.1	1	5.7	0.3	2
Min	0.1	0.1	0.1	<0.10	<0.10	<0.10	<0.10
Count	270	232	135	537	526	494	208
95th %ile	0.85	1.25	0.63	0.2	0.2	0.2	0.1

Iron Retic	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	<0.05	0.05	0.03	<0.02
Max	-	-	-	<0.17	0.51	0.09	0.11
Min	-	-	-	<0.05	<0.02	<0.02	<0.02
Count	-	-	-	253	505	349	71
95th %ile	-	-	-	<0.05	0.09	0.07	<0.02

Manganese Retic	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	0.001	<0.01	0.02	<0.01
Max	-	-	-	0.025	0.02	0.03	<0.01
Min	-	-	-	<0.001	<0.01	<0.01	<0.01
Count	-	-	-	253	505	349	71
95th %ile	-	-	-	0.004	0.02	0.03	<0.01

E. coli Reservoir	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	<1	<1	<1	<1
Max	-	-	-	<1	<1	<1	1
Min	-	-	-	<1	<1	<1	<1
Count	-	-	-	106	105	104	106
95th %ile	-	-	-	<1	<1	<1	<1

Chlorine Reservoir	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	0.85	0.65	0.48	0.64	0.77	0.73	0.72
Max	1.1	1.9	0.93	1.9	2.8	1.4	1.21
Min	0.7	0.01	0.01	0.03	<0.10	<0.10	<0.10
Count	8	103	97	106	105	96	103
5th %ile							0.17
95th %ile	1.03	1	0.8	1.51	1.2	1.2	1.18

pH Reservoir	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	8.2	8.2	8.3	8.2	7.7	7.5	7.5
Max	9.2	9.5	9.5	9.3	8.7	8.5	8.5
Min	6.9	7	7.4	7.1	7.1	7	6.4
Count	56	90	98	106	105	90	105
95th %ile	9	9.4	9.4	9.1	8.5	8	8.21

Iron Reservoir	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	0.07	0	0	<0.05	-	-	-
Max	0.09	0	0	<0.05	-	-	-
Min	0.05	0	0	<0.05	-	-	-
Count	2	0	0	14	-	-	-
95th %ile	0.08	0	0	<0.05	-	-	-

Manganese Reservoir	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	0	0	0	<0.001	-	-	-
Max	0	0	0	<0.001	-	-	-
Min	0	0	0	<0.001	-	-	-
Count	2	0	0	14	-	-	-
95th %ile	0	0	0	<0.001	-	-	-

E. coli Treatment	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	<1	<1	<1	<1
Max	-	-	-	<1	<1	<1	1
Min	-	-	-	<1	<1	<1	<1
Count	-	-	-	157	168	153	156
95th %ile	-	-	-	<1	<1	<1	<1

Chlorine Treatment	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	0.91	1	0.91	0.9
Max	-	-	-	2.2	2.6	1.3	1.13
Min	-	-	-	0.2	0.38	0.34	0.085
Count	-	-	-	137	113	89	102
95th %ile	-	-	-	1.38	1.3	1.2	1.04

pH Treatment	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	7.2	7.2	7.1	7.3
Max	-	-	-	7.7	8.5	7.3	7.92
Min	-	-	-	6.6	6.9	6.9	6.5
Count	-	-	-	137	113	92	113
95^{th} %ile	-	-	-	7.5	7.4	7.2	7.8

Iron Treatment	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	<0.05	-	-	-
Max	-	-	-	<0.05	-	-	-
Min	-	-	-	<0.05	-	-	-
Count	-	-	-	13	-	-	-
95^{th} %ile	-	-	-	<0.05	-	-	-

Manganese Treatment	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	<0.001	-	-	-
Max	-	-	-	<0.001	-	-	-
Min	-	-	-	<0.001	-	-	-
Count	-	-	-	13	-	-	-
95^{th} %ile	-	-	-	<0.001	-	-	-

E. coli Raw	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	45	46	9	14
Max	-	-	-	>100	>100	12	37
Min	-	-	-	5	3	6	4
Count	-	-	-	4	5	4	5
95^{th} %ile	-	-	-	94	>100	12	34

Colour Raw	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	14.4	7.3	5.8	10.2
Max	-	-	-	27	8.8	7.2	15
Min	-	-	-	4.4	5.7	3.3	5.5
Count	-	-	-	4	5	4	3
95^{th} %ile	-	-	-	25.4	8.7	7.1	14.5

pH Raw	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	7.1	7.1	7.1	6.84
Max	-	-	-	7.2	7.2	7.3	7.1
Min	-	-	-	6.9	6.9	6.9	6.5
Count	-	-	-	4	5	4	16
95th %ile	-	-	-	7.2	7.2	7.3	7.1

Iron Raw	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	0.082	0.03	0.02	0.013
Max	-	-	-	0.094	0.05	0.024	0.036
Min	-	-	-	<0.05	<0.02	<0.02	<0.02
Count	-	-	-	4	5	4	3
95th %ile	-	-	-	0.093	0.05	0.023	0.033

Manganese Raw	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	0.002	<0.01	<0.01	<0.01
Max	-	-	-	0.004	<0.01	<0.01	<0.01
Min	-	-	-	0.001	0.001	<0.01	<0.01
Count	-	-	-	4	5	4	3
95th %ile	-	-	-	0.004	<0.01	<0.01	<0.01

Turbidity Raw	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	1.5	0.6	0.4	0.5
Max	-	-	-	2.5	1.1	0.6	5.3
Min	-	-	-	0.4	0.3	0.3	0.1
Count	-	-	-	4	5	4	17
95th %ile	-	-	-	2.5	1	0.6	2.02

15.2 Whyanbeel water quality data: Reticulation, Reservoirs, Treat and Raw.

E. coli Retic	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	<1	<1	<1	<1
Max	-	-	-	<1	1	7	<1
Min	-	-	-	<1	<1	<1	<1
Count	-	-	-	162	209	154	160
95th %ile	-	-	-	<1	<1	<1	<1

Chlorine Retic	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	0.16	0.31	0.41	0.47	0.29	0.38	0.36
Max	0.4	2.6	4.4	8.2	1	1.9	1.25
Min	0.1	0.01	0.01	<0.10	<0.10	<0.10	<0.10
Count	7	233	208	162	209	146	157
5th %ile							<0.10
95th %ile	0.34	0.94	1.3	1.4	0.6	0.8	0.92

pH Retic	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	8.2	8.2	8.6	8	8.1	7.7	7.69
Max	10	10	10.1	9.4	9.7	8.9	9.31
Min	5.9	6.9	6.9	7	7.2	7.1	6.5
Count	168	212	211	162	209	144	159
95th %ile	9.9	9.6	9.6	9.2	9.3	8.7	9.01

Colour Retic	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	3.3	2.3	1.4	1.8	2.5	1.3	<1
Max	8.1	16	2.5	13	21	3.9	1.4
Min	1.3	1.1	1	<1	<1	<1	<1
Count	120	92	42	162	156		38
95th %ile	6	3.6	2.1	3.2	4.6	3	1.1

Turbidity Retic	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	0.25	0.28	0.15	0.2	<0.10	0.1	<0.10
Max	0.9	4.6	0.4	3.2	4.9	0.8	0.2
Min	0.1	0.1	0.1	<0.10	<0.10	<0.10	<0.10
Count	22	59	51	162	156	145	62
95th %ile	0.69	0.61	0.25	0.4	0.3	0.3	<0.10

Iron Retic	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	0	0.11	0.07	0.11	0.09	0.05	<0.02
Max	0	0.21	0.09	0.47	0.7	0.17	0.053
Min	0	0.06	0.06	<0.05	<0.02	<0.02	<0.02
Count	0	8	4	75	150	108	24
95th %ile	0	0.19	0.09	0.3	0.22	0.1	0.047

Manganese Retic	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	0	0	0	0.001	<0.01	0.02	<0.01
Max	0	0	0	0.02	0.03	0.03	<0.01
Min	0	0	0	<0.001	<0.01	<0.01	<0.01
Count	0	8	21	75	150	108	24
95^{th} %ile	0	0	0	0.01	0.01	0.03	<0.01

E. coli Reservoir	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	<1	<1	<1	<1
Max	-	-	-	<1	<1	3	<1
Min	-	-	-	<1	<1	<1	<1
Count	-	-	-	110	49	85	52
95^{th} %ile	-	-	-	<1	<1	<1	<1

Chlorine Reservoir	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	0.15	0.31	0.34	0.29	0.33	0.23	0.71
Max	0.2	2.8	0.8	3	1.4	1.8	1.49
Min	0.1	0.01	0.02	<0.10	<0.10	<0.10	<0.10
Count	2	49	51	110	49	84	51
5^{th} %ile							<0.10
95^{th} %ile	0.2	0.7	0.61	0.6	0.74	0.56	1.08

pH Reservoir	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	8	7.2	0	8.4	7.4	7.9	7.13
Max	9.2	7.8	0	10	8	9.6	7.58
Min	7	6.9	0	7	7.2	7.1	6.6
Count	39	51	0	110	49	77	52
95^{th} %ile	9	7.6	0	9.9	7.8	9.1	7.43

Iron Reservoir	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	0.34	0	0	<0.05	-	-	-
Max	0.55	0	0	0.09	-	-	-
Min	0.13	0	0	<0.05	-	-	-
Count	2	0	0	14	-	-	-
95^{th} %ile	0.53	0	0	<0.05	-	-	-

Manganese Reservoir	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	0	0	0	0.002	-	-	-
Max	0	0	0	0.004	-	-	-
Min	0	0	0	<0.001	-	-	-
Count	6	1	0	14	-	-	-
95th %ile	0	0	0	0.003	-	-	-

E. coli Treatment	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	<1	<1	<1	<1
Max	-	-	-	<1	<1	<1	<1
Min	-	-	-	<1	<1	<1	<1
Count	-	-	-	87	53	100	106
95th %ile	-	-	-	<1	<1	<1	<1

Chlorine Treatment	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	0.88	0.92	0.83	0.96
Max	-	-	-	1.5	2	1.3	1.34
Min	-	-	-	0.48	0.27	0.36	0.67
Count	-	-	-	54	53	49	51
5th %ile							0.69
95th %ile	-	-	-	1.24	1.2	1.1	1.12

pH Treatment	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	6.6	7	7.1	7	7	7	7.1
Max	6.9	7.5	7.5	7.4	7.4	7.2	8.56
Min	6.4	6.5	6.7	6.7	6.8	6.8	6.3
Count	31	56	53	53	53	47	64
95th %ile	6.8	7.3	7.3	7.2	7.2	7	7.58

Iron Treatment	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	<0.05	-	-	-
Max	-	-	-	<0.05	-	-	-
Min	-	-	-	<0.05	-	-	-
Count	-	-	-	6	-	-	-
95th %ile	-	-	-	<0.05	-	-	-

Manganese Treatment	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	<0.001	-	-	-
Max	-	-	-	<0.001	-	-	-
Min	-	-	-	<0.001	-	-	-
Count	-	-	-	6	-	-	-
95th %ile	-	-	-	<0.001	-	-	-

E. coli Raw	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	44	54	44	52
Max	-	-	-	>100	>100	130	>100
Min	-	-	-	16	6	14	12
Count	-	-	-	3	4	4	4
95th %ile	-	-	-	92	>100	113	97

Colour Raw	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	15.3	12.4	8.6	11.2
Max	-	-	-	20	17	9.2	15
Min	-	-	-	7	8.6	7.2	8.7
Count	-	-	-	3	4	4	3
95th %ile	-	-	-	19.9	16.4	9.2	14.5

pH Raw	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	6.7	-	6.7	6.6	6.7	6.6	6.54
Max	6.7	-	6.9	6.7	6.8	6.7	7
Min	6.7	-	6.4	6.5	6.5	6.4	6.1
Count	3	-	9	3	4	4	18
95th %ile	6.7	-	6.9	6.7	6.8	6.7	6.99

Iron Raw	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	0.085	0.06	0.03	0.03
Max	-	-	-	0.117	0.12	0.032	0.04
Min	-	-	-	<0.05	0.03	0.027	0.02
Count	-	-	-	3	4	4	3
95th %ile	-	-	-	0.114	0.11	0.03	0.04

Manganese Raw	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	0.002	<0.01	<0.01	<0.01
Max	-	-	-	0.003	<0.01	<0.01	<0.01
Min	-	-	-	0.001	0.001	<0.01	<0.01
Count	-	-	-	3	4	4	3
95th %ile	-	-	-	0.003	<0.01	<0.01	<0.01

Turbidity Raw	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	1.4	0.9	0.6	0.36
Max	-	-	-	2.8	2.2	0.7	2.8
Min	-	-	-	0.4	0.5	0.3	<0.1
Count	-	-	-	3	4	4	18
95th %ile	-	-	-	2.6	1.9	0.7	1.19

15.3 Daintree Water Quality Data (Reticulation, Treatment and Raw)

E. coli Retic	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	<1	<1	<1	<1
Max	-	-	-	<1	<1	<1	<1
Min	-	-	-	<1	<1	<1	<1
Count	-	-	-	55	51	50	54
95th %ile	-	-	-	<1	<1	<1	<1

Chlorine Retic	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	0.3	0.13	0.12	0.17	0.2	0.2
Max	-	1.6	0.3	0.3	0.4	0.37	0.71
Min	-	0.01	0.01	<0.10	<0.10	<0.10	<0.10
Count	-	45	53	55	51	50	53
5th %ile							<0.10
95th %ile	-	0.9	0.28	0.25	0.31	0.36	0.62

pH Retic	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	7.6	7.7	7.7	7.8	7.7	7.7	7.46
Max	8.3	8.2	7.9	9	7.9	8	7.9
Min	7.3	7.4	7.3	7.5	7.5	7.3	6.75
Count	57	53	55	55	51	48	54
95th %ile	7.8	7.9	7.9	8.3	7.8	7.8	7.74

Colour Retic	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	3.6	3.3	1.5	<1	<1	1.3	<1
Max	7.4	15	3.8	2.1	1.8	2.1	4.1
Min	1.1	1.1	1	<1	<1	<1	<1
Count	54	47	29	55	51	48	13
95th %ile	6	7.5	3.3	1.3	1	1.8	1.64

Turbidity Retic	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	0.1	0.54	0.18	0.1	0.1	0.1	0.11
Max	0.1	2.5	0.6	0.2	0.6	0.3	0.6
Min	0.1	0.1	0.1	<0.10	<0.10	<0.10	<0.10
Count	1	37	32	55	51	50	21
95th %ile	0.1	1.34	0.49	0.2	0.2	0.2	0.4

Iron Retic	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	0	0.11	0.07	<0.05	<0.02	<0.02	0.03
Max	0	0.21	0.09	<0.05	0.03	0.02	0.11
Min	0	0.06	0.06	<0.05	<0.02	<0.02	<0.02
Count	0	8	4	55	49	37	8
95th %ile	0	0.19	0.09	<0.05	0.02	<0.02	0.08

Manganese Retic	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	0	0	0	<0.001	<0.01	<0.01	<0.01
Max	0	0	0	<0.001	0.01	<0.01	<0.01
Min	0	0	0	0.001	<0.01	<0.01	<0.01
Count	0	8	21	55	49	37	8
95th %ile	0	0	0	<0.001	<0.01	<0.01	<0.01

E. coli Treatment	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	<1	<1	<1	<1
Max	-	-	-	<1	<1	<1	<1
Min	-	-	-	<1	<1	<1	<1
Count	-	-	-	107	106	103	104
95th %ile	-	-	-	<1	<1	<1	<1

Chlorine Treatment	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	0.67	0.31	0.28	0.28	0.33	0.5
Max	-	4.6	0.5	0.5	0.62	0.51	0.98
Min	-	0.14	0.19	<0.10	<0.10	<0.10	0.1
Count	-	53	54	87	54	49	51
5th %ile	-						0.29
95th %ile	-	1.88	0.41	0.4	0.47	0.43	0.85

pH Treatment	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	7.3	7.5	7.5	7.5	7.5	7.6	7.4
Max	7.6	7.8	8.6	7.7	8.2	7.7	8.3
Min	7	7.2	7.2	7.2	7.4	7.4	6.93
Count	31	54	53	87	54	48	66
95th %ile	7.6	7.7	7.6	7.6	7.6	7.7	7.69

Iron Treatment	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	<0.05	-	-	-
Max	-	-	-	<0.05	-	-	-
Min	-	-	-	<0.05	-	-	-
Count	-	-	-	6	-	-	-
95th %ile	-	-	-	<0.05	-	-	-

Manganese Treatment	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	<0.001	-	-	-
Max	-	-	-	<0.001	-	-	-
Min	-	-	-	<0.001	-	-	-
Count	-	-	-	6	-	-	-
95th %ile	-	-	-	<0.001	-	-	-

E. coli Raw	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	-	52	89	66	39
Max	-	-	-	>100	>100	160	88
Min	-	-	-	27	72	23	10
Count	-	-	-	4	5	4	3
95th %ile	-	-	-	92	>100	144	81

Colour Raw	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	3.6	3.2	1.5	38.6	13.6	14.3	12
Max	7.4	15	3.8	>70	19	24	15
Min	1.1	1.1	1	5.9	9.2	5.3	10
Count	54	47	29	4	5	4	3
95th %ile	6	7.4	3.3	>70	18.4	22.5	14.6

pH Raw	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	7.4	-	7.3	7.4	7.5	7.5	7.37
Max	7.4	-	7.3	7.5	7.7	7.6	7.6
Min	7.3	-	7.1	7.2	7.3	7.3	7.2
Count	3	-	9	4	5	4	3
95th %ile	7.4	-	7.3	7.5	7.7	7.6	7.57

Iron Raw	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	0.16	0.37	0.19	0.162	0.176
Max	-	-	0.25	0.67	0.28	0.28	0.28
Min	-	-	0.11	0.13	0.14	0.098	0.1
Count	-	-	6	4	5	4	3
95th %ile	-	-	0.24	0.65	0.27	0.264	0.267

Manganese Raw	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	0	0.007	0.008	<0.01	<0.01
Max	-	-	0.01	0.017	0.01	<0.01	<0.01
Min	-	-	0	0.001	0.003	<0.01	<0.01
Count	-	-	6	4	5	4	3
95th %ile	-	-	0.01	0.015	0.01	<0.01	<0.01

Turbidity Raw	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Avg	-	-	1.56	13.6	1.4	1.4	0.8
Max	-	-	2.7	45	2.9	2.6	1.2
Min	-	-	0.9	0.6	0.9	0.7	0.6
Count	-	-	9	4	5	4	3
95th %ile	-	-	2.58	39.4	2.6	2.4	1.14