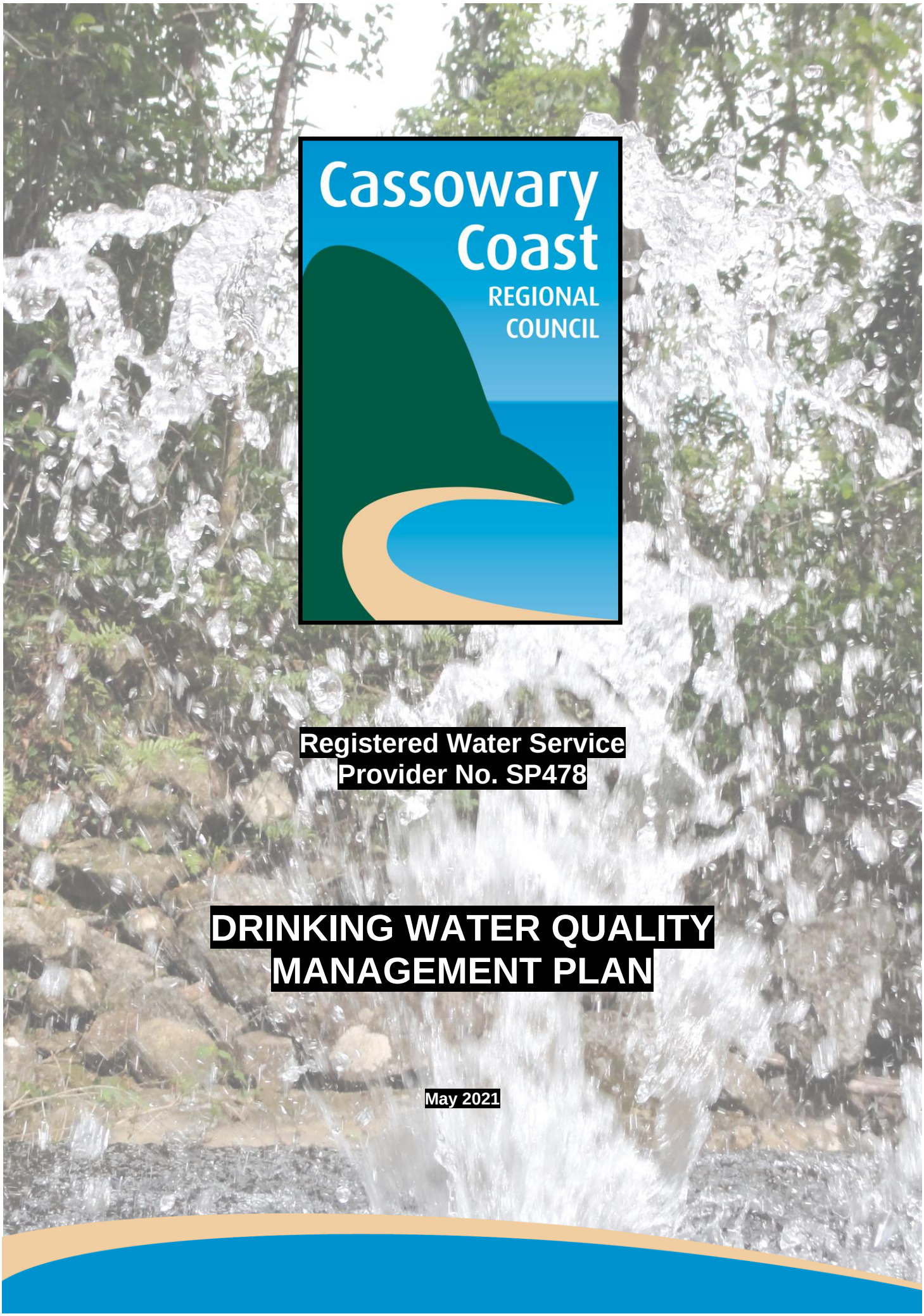

Registered Water Service Provider No. SP478

DRINKING WATER QUALITY MANAGEMENT PLAN

May 2021

Document Information:

Version	Created by	Note	Issued to	Qty	Date	Approved
ECM Doc No. 2060992	Andrew Musumeci		Ross Jennings (RJ)	1	22/10/2013	RJ DEWS
ECM Doc No. 2410540	Geoffrey Smart	Amdt 05/2016 Draft amendments	DEWS	1	29/06/2016	
ECM Doc No. 2453409	Geoffrey Smart		DEWS	1	28/11/2016	GS
ECM Doc No. 2481853	Geoffrey Smart		DEWS	1	16/03/2016	GS
ECM Doc No. 2500146	Geoffrey Smart		DEWS	1	31/05/2017	GS
ECM Doc No. 2504456	Geoffrey Smart		DEWS	1	16/06/2017	GS
ECM Doc No. 2573490	Geoffrey Smart	Updated to include Kennedy Bore	DEWS	1	17/03/2018	GS
ECM Doc No. 2878333	Geoffrey Smart	Updated to include Wheatleys Hill and Bulgun Ck intake reservoirs, chlorination facilities at Nyleta, Bulgun intake, Hyatt St and Wheatleys.	DNRME	1	16/10/2020	GS
	Geoffrey Smart	2016-2021 water quality data, complaint history, bore details.	RDMW	1	25 May 2021	GS

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Table of Contents

1. Registered Service Details

Service Provider Identification Number: **SP478**

Name: **Cassowary Coast Regional Council (CCRC)**

Contact Details:

Chief Executive Officer -	Mr. James Gott PO Box 887 Innisfail Qld 4860
Director Infrastructure Services	Mr. David Goodman (07) 404309156 David.Goodman@ccrc.qld.gov.au
Manager Water-	Mr. Geoffrey Smart (07) 4030 2276 Geoffrey.Smart@ccrc.qld.gov.au

2. Introduction

2.1 Legislative Background

This Drinking Water Quality Management Plan (DWQMP) has been prepared by CCRC to satisfy the requirements of section 95 of The *Water Supply (Safety and Reliability) Act 2008* (the Act). The objective of the DWQMP is to establish a risk based management system that the Service Provider follows to ensure the provision of drinking water to a high quality that protects public health. The Act prescribes mandatory requirements for inclusion in a DWQMP.

2.2 Service Provider Commitment

CCRC have developed a customer service charter complete with customer service standards. This Charter documents Council's commitment to water consumers to provide a consistent high quality water supply within prescribed standards of quality, flow, pressure and consistent operation. This DWQMP is referenced in the charter as Council's management system for quality control of the water supply system. A copy of Council's Customer Service Charter can be located on the Cassowary Coast Regional Council web site. (http://www.cassowarycoast.qld.gov.au/customer-service-charter-and-customer-service-standards)

2.3 Service Provider Schemes

CCRC have four water supply schemes: Innisfail; Nyleta, Tully and Cardwell. These schemes supply water to approximately 25,050 people in urban and rural areas stretching from Innisfail in the north to Cardwell in the south. The extent of the water serviced areas of the four schemes is shown in Figure 2.0 and general details of the scale of each scheme are included in Table 2.0.

The reticulated water network for the Innisfail scheme (Innisfail and surrounds) is sourced from the Johnstone River and treated at a treatment plant using a process of upflow clarification, filtration and disinfection. The major communities serviced in the Innisfail scheme include the towns of Innisfail and South Johnstone.

The Nyleta scheme services the communities of Silkwood, El Arish, Kurramine Beach, Bingil Bay and Mission Beach. The water supply for this scheme is sourced primarily from Nyleta Ck with some additional supply from a bore near Jurs Ck. A new intake facility at South Liverpool Ck, Nyleta was completed in 2017. The high quality of the Nyleta Ck water source allows a minimal treatment process for this scheme consisting of course filtration and disinfection.

The Tully scheme supplies reticulated water to the major communities of Tully, Wongaling, South Mission Beach and Tully Heads. There are two water sources for this scheme, Bulgan Ck and Boulder Ck. Bulgan Ck is primarily used to supply the coastal communities of Wongaling and South Mission. Boulder Ck primarily supplies Tully and Tully Heads. Both water sources are located in Wet Tropics Rainforest areas north- west of Tully. The source water is a very high quality and treatment consists of course filtration and disinfection.

The Cardwell scheme supplies water to the township of Cardwell and surrounding rural residential properties. The water source for Cardwell is Meunga Ck in the forested foothills behind Cardwell. Water sourced from this creek is of a high quality and requires only course filtration and disinfection. A groundwater bore at Ellerbeck Road Kennedy supplements the water supply scheme in the event of a turbidity event in Meunga Ck.

The catchments of the four scheme areas are shown in Figure 2.1.

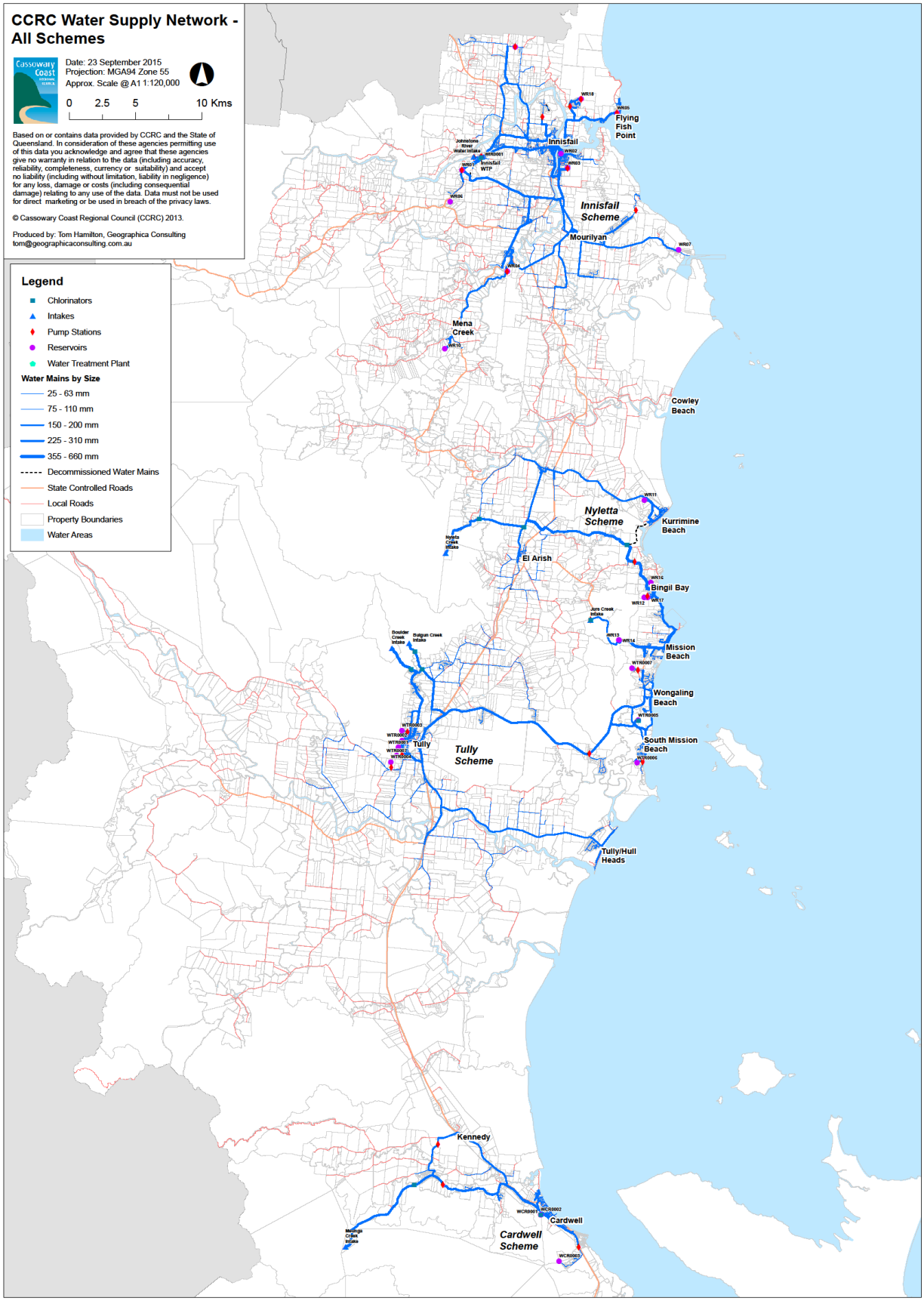
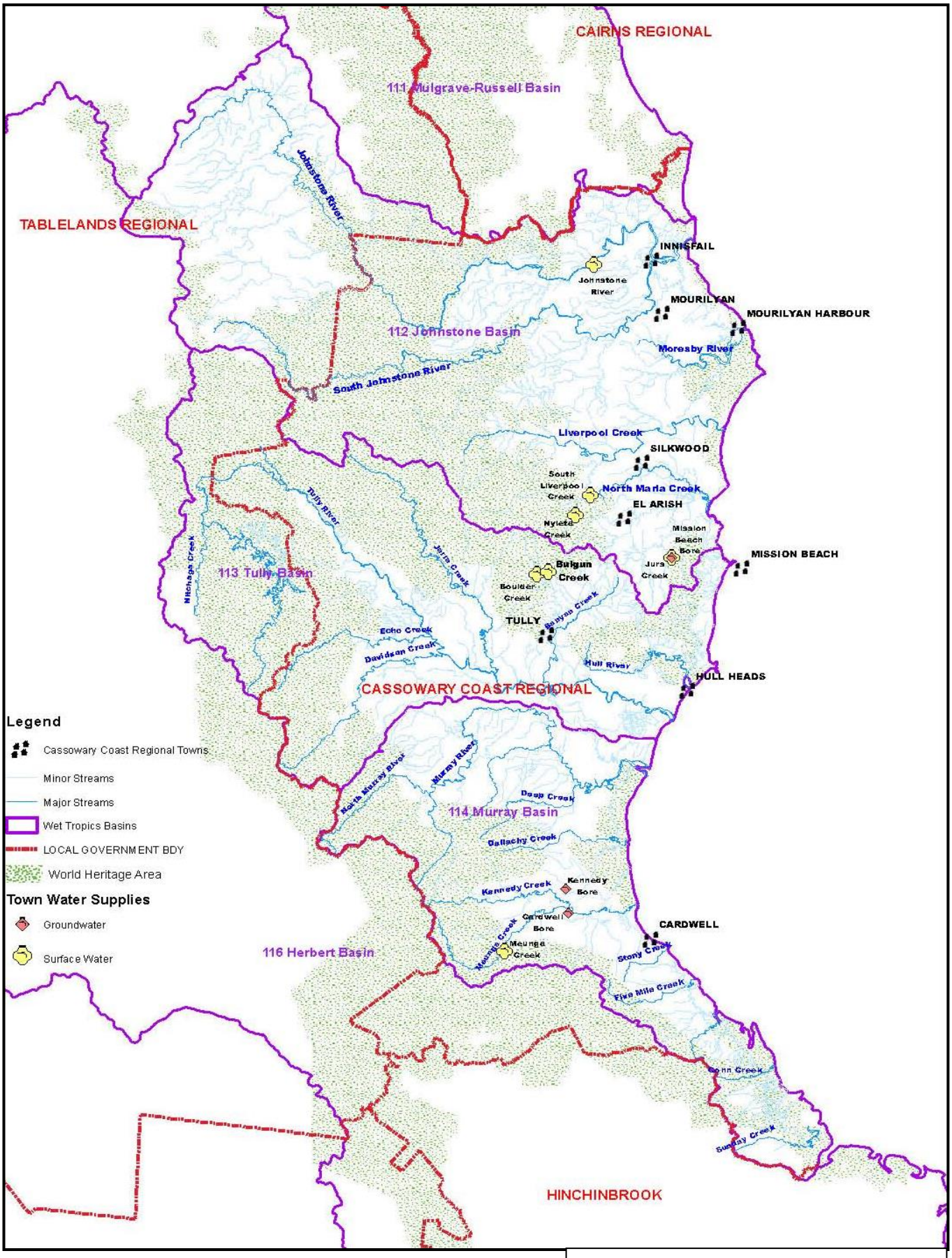


Figure 2.0: CCRC Water Supply Schemes



c/o DERM North Region South Johnstone

Figure 2.1: Catchment Map

Scheme Name	Communities Served	2010/2011 *(SWIM)*				2019/2020 *(SWIM)*				Projected for 2025			
		Pop'n [1]	Connections [1]	Total supplied ML/yr *Total Water Lost ML/yr* *Demand ML/d [3]*	Total Supply L/per/day *Lost L/per/day*	Pop'n [1]	Connections [1]	Total supplied ML/yr *Total Lost ML/yr [5]* *Demand ML/d [3]*	Total Supply L/per/day *Lost L/per/day*	Pop'n [2]	Connections [4]	Total supplied ML/yr *Total Lost ML/yr* *Demand ML/d [3]*	Total L/person /day *Lost L/person /day*
Innisfail	Innisfail; Daradgee; Wangan; Flying Fish Point; Mourilyan area; Sth Johnstone; Mena Creek; and small commun'ties	13300	5860	2660 *953* *7.28*	548 *196*	12,149	6115	2827 *1291* *7.75*	637 *291*	**12394**	**6238**	**2261** ***452*** **6.20**	**500 (target)** ***100 (target)***
Nyleta	Silkwood, El Arish, Kurrimine Beach, Bingil Bay, Mission Beach	3930	1714	572.8 *146* *1.57*	399 *102*	3835	2214	809 *239* *2.22*	578 *170*	**4091**	**2362**	**746** ***149*** **2.04**	**500 (target)** ***100 (target)***
Tully	Tully, Silky Oak, Euramo, Tully Heads, Hull Heads, Feluga, South Mission Beach Wongaling Beach	7490	3168	2100.9 *975* *5.78*	768 *357*	7109	3725	1778 *608* *4.87*	685 *234*	**7365**	**3857**	**1344** ***269*** **3.68**	**500 (target)** ***100 (target)***
Cardwell	Cardwell, Caruchan, Kennedy	2210	966	631.6 *247* *1.73*	783 *306*	1956	1123	523 *141* *1.43*	733 *197*	**2015**	**1157**	**368** ***74*** **1.01**	**500 (target)** ***100 (target)***

Table 2.0: CCRC water supply scheme details.

Table 2.0 Notes:

1) Tabulated data is sourced from annual reports to DEWS (swim). Connection numbers exclude vacant connections. No equivalent population is assigned to non residential or other connections. This inflates the per capita water consumption from measures used by other authorities

2) Population growth in all regions over the past couple of years is quite low with highest growth being in the Nyleta catchment reflecting moderate increases in Mission Beach. The population projections for 2025 have been revised down considerably from earlier versions of the DWQMP. T **T**

Actual growth rates based on connection data from 2017 to 2020 are outlined in table 2.1 below.

	Growth Rate
Innisfail Scheme	0.3%
Nyleta Scheme	1.3%
Tully Scheme	0.7%
Cardwell Scheme	0.5%

Table 2.1: Growth trends based on connections

The growth trends adopted for the 2025 projections (from the 2020 population) are summarised in Table 2.2 below.

	Growth Rate
Innisfail Scheme	0.4%
Nyleta Scheme	1.3%
Tully Scheme	0.7%
Cardwell Scheme	0.6%

Table 2.2: Adopted growth trends.

3) Total volumes of water supplied includes lost water. Consumption (litres per person per day) includes the lost water.

4) The 2018 DWQMP adopted per person consumption figures of 450-400L/person/day. Progress towards achieving these targets has been slow and notwithstanding strategies to reduce the volume of lost water, this 2020 version of the DWQMP has increased the target consumptions to 500L/person/day. Water loss targets remain as stretch targets.

5) Lost water is assumed to be current annual real losses reported in the SWIM

2.4 Format of DWQMP

This DWQMP follows the requirements of the DWQMP Guideline prepared by the Department of Natural Resources Mines and Energy. Separate chapters are provided in this DWQMP to describe the details of each water supply scheme. Each chapter includes a description of the scheme extents and key infrastructure; the quality of the source water; the treatment processes and the quality of the treated water.

Appendices are provided with this DWQMP that contain the details of the Innisfail Water Treatment Plant, risk assessments undertaken for each scheme, an incident response manual, improvement plans, a sampling manual and quality and critical control points.

2.5 Key Stakeholders

2.5.1 CCRC Internal

The organisational chart for the Water Section is outlined in Figure 2.2 and functional responsibilities are listed in Table 2.3.

The Water Section comprises of three main sections, Engineering, Treatment and Construction and Maintenance. The Manager Water has the overall responsibility for all functions associated with the Water business, but delegates the various aspects of its management to the sections that can do so most expertly and cost-effectively. This is reflected in the organisational structure of the branch. The Manager Water reports to the Director Infrastructure Services who in turn reports directly to the Chief Executive Officer.

Table 2.3 - Functional responsibilities

Manager Water (MW)	The person responsible to the Director Infrastructure Services (DIS) for delivery of CCRC's Water Business. This includes all asset management, treatment, planning and design, construction and maintenance related functions.
Engineer Water (EW)	The person responsible to the MW fulfilling the Asset owner/ specifier role. This role is the primary technical support engineer for all planning and design activities including system modelling. The EW assists the MW with program development and delivery, branch wide budgets, planning; and capital works. A number of staff report to the EW and the EW is responsible for managing the work and performance of those staff.
Coordinator Treatment (CT)	The person responsible to the MW for the operation of Council's water and sewerage treatment plants, all intake facilities and all disinfection facilities. This person directs the activities of all operators in their role to ensure compliance with all relevant legislation associated with water quality and waste water treatment.
Coordinator Water Reticulation (CWR)	The person responsible to the MW for the maintenance of all existing civil, mechanical and electrical assets (other than at treatment plants). This person directs the activities of Councils plumbing, mechanical and electrical trades personnel to ensure the water supply system remains in an operational state. Responsible for the coordination of the Water Section Branch day labour force. Responsible for all construction activities undertaken by day labour.
Technical Officer Water Planning(TOPR)	The person responsible to the EW for all planning and reporting functions associated with water supply and sewage treatment. This person assists with forward works plans and assists with the preparation of reporting for water regulator.

Program Planner Water	This person is responsible for maintaining water sections asset register, managing as constructed information, managing asset condition information, developing asset renewal and maintenance programs.
Supervisor Mechanical Maintenance (SME)	The person responsible to the CWR for all mechanical and electrical maintenance. This person is responsible for the implementation and completion of CCRC's water mechanical maintenance programs and assistance in the delivery of minor capital works programs.
Supervisor Water (Tully) (SW)	The person responsible to the CWR for the supervision of Councils operational plumbing and labour force in the southern area.
Supervisor Water (Innisfail) (SW)	The person responsible to the CWR for the supervision of Councils operational plumbing and labour force in the northern area.
Supervisor Capital Works	The person responsible to the CWR for delivery of the water mains renewal capital program. Supervises Council's capital works (mains) plumbing and labour work force.
Treatment Plant Operators (TOP)	The person/s responsible for the daily operation of the treatment plants. Responsible for the monitoring of reservoirs in system. Responsible for disinfection systems and quality testing. This person reports to the CT and ensures all environmental licences and drinking water guidelines are met.
Treatment Systems Attendant (TSO)	The person responsible to the CT for the sampling and operations of council non treated water schemes. This person does not operate a conventional treatment plant however is responsible for the monitoring an operations of the schemes disinfection systems.
Trade Waste Officer (TWO)	The person responsible to the EW for the implementation and enforcement of CCRC's Trade Waste Environmental Management Plan and related policy. This person also is responsible for the implementation and administration of the Council Backflow Prevention programme.
Manager Asset Engineering (MAE)	Person responsible to the DW for the strategic management of Councils assets. This role encompassed responsibly over CCRC's Civil design and Survey Sections.
Director Infrastructure Service (DIS)	The person responsible to the CEO for the overall management of the CCRC's Infrastructure Services Department consisting of Fleet and Plant, Engineering Services, Asset management and Water Section.
Chief Executive Officer	Responsible for all functions of the CCRC.
Elected Councillors and Mayor	Approve budgets and resourcing, decide fees and charges, endorse policy and plans.

The contact details of the key staff as noted above are listed in Incident Response Manual.

2.5.2 External Stakeholders

External stakeholders are divided into 4 categories: Statutory; Customers, Key Suppliers and Other. The Table 2.4 below outlines the key external stakeholders.

Statutory	**Relationship with DWQMP**
Department of Regional Development, Manufacturing and Water	Queensland Water Supply Regulator
Department of Natural Resources, Mines and Energy (DNRME)	Water allocations, weirs, management of water quality in Johnstone River
Department of Environment and Science (DES)	Environmental compliance. Licencing of any environmental relevant activity. Intakes in National Parks
Queensland Health	Public Health,(E.coli incidents),Testing laboratory
Workplace Health and Safety Queensland (WHSQ)	Workplace safety
Wet Tropics Management Authority	Intakes in Wet Tropics Management Area
Customers	
All serviced properties.	CCRC is responsible to supply all serviced properties in accordance with DWQMP and customer service charter.
Hospitals	Extra reticulation supply redundancy, notifications for water outages.
Businesses with backflow prevention devices	Register and manage.
Other	
QWRAP	Regional partnering with adjoining water authorities.
Qld Water Directorate	Advisory and advocacy service to member water authorities. SWIM, SWIM Local,
Welcon Technologies Pty Ltd	Service provider for Council's SCADA systems.
Chemical Suppliers	
Elite Coogee Chemicals	Sodium Hypochlorite supplier
Water Treatment Services	Chemical Supplier for Council's Innisfail Water Treatment Plant

Table 2.4: External Stakeholders.

2.6 SCADA Implantation

Since 2013, capital works budgets had been allowing for the deployment of SCADA to key water infrastructure as a major risk mitigation measure in line with the 2013 DWQMP (ECM Doc # 2265542). Outlined below in Table 2.5 is an extract of the improvement plan initiatives documented in the 2013 DWQMP.

In February 2015 Council endorsed a strategy report entitled Water Supply and Sewerage Services SCADA Strategy (ECM Doc # 2267722). This document outlined a program of work and funding requirements to allow all key water and sewerage infrastructure to be connected to SCADA by the end of the 2019/2020 year. The implementation in 2016 of the *Historian* SCADA data management and reporting system allows staff to access all data and report trends and statistics.

In 2015 Council established a service level agreement with Welcon Technologies Pty Ltd. This agreement covers scheduled SCADA maintenance activities; unscheduled activities and callouts; software upgrades and project specific services. This agreement provides Council with some certainty that is has adequate support with the operations of its expanding SCADA network.

By 2020, Council had completed deployment of SCADA to all key water infrastructure and had successfully transitioned to GEOSCADA. This software allows staff and operators to have ready SCADA access of the status of all water facilities on their digital devices.

Table 2.5: 2013 DWQMP Improvement Plans SCADA Summary.

IP Number	Description	Proposed Action			Programmed	
		Interim	Short Term	Long Term	Start	Finish
IP-6 - SCADA Implementation	Implementation of SCADA monitoring at critical sites based on risk to the quality of water within the designated scheme. SCADA will assist with the operational monitoring of equipment and provide data for Capture and Analysis of the system to be used to minimise both likelihood and consequences	Investigation of suitability of current technology and feasibility of system.	Develop a funded program that enable all high risk sites to be prioritised. Install trial system on critical infrastructure and monitor.	Install SCADA to sites in accordance with the program	Interim 2011 Short Term 2013 Long Term 2014	2013 2015 2020
IP-20 - Turbidity Monitoring Equipment	Installation of Turbidity monitoring equipment to evaluate turbid events and develop a suitable management strategy of these events	Investigate and trial monitoring equipment	Develop a funded program for the installation of selected equipment	Evaluate data and investigate strategies for dealing with turbid water events	Interim 2012 Short Term 2013 Long Term 2013	2013 2013 2017

IP-23 - Disinfection systems improvements	The implementation of a stable disinfection system with redundancy and automated adjustment of dose rate based on flow and changes in turbidity	Design and specify system configuration	Allocate funding for trial site and install system	Monitor system and install at all other required locations	Interim 2012 Short Term 2012 Long Term 2013	2012 2013 2017

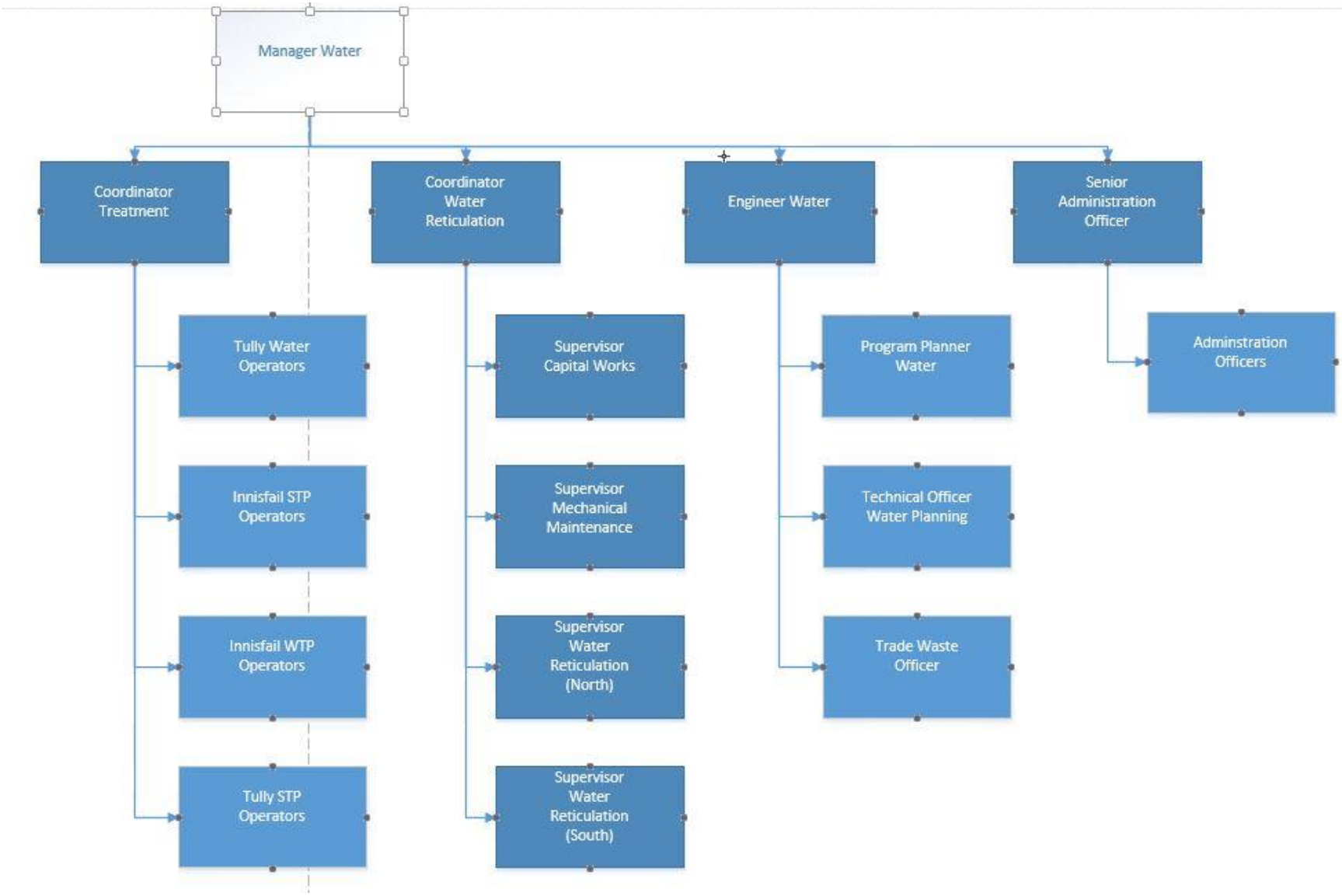


Figure 2.2: The organisational chart for the Water Section (Excludes operational staff such as plumbers, fitters, labourers)

SECTION 3

INNISFAIL WATER SUPPLY SCHEME

MAY 2021

3. Innisfail Scheme Details of Infrastructure

3.1 Source Details

The Johnstone River Catchment includes the Johnstone (North) River and South Johnstone River and is located in the Wet Tropics region in North Queensland covering an area of 2,300km^2. It is one of the wettest catchments in Australia, sometimes receiving over 5,000mm of rainfall per year. The (North) Johnstone River flows from the Atherton Tablelands over the Great Dividing Range through Wooroonooran National Park eventually meeting the ocean approximately one kilometre downstream of Innisfail. The towns of Malanda and Milla Milla are situated adjacent to tributaries.

The climate of this catchment can be described as tropical with distinctive wet and dry seasons. The average annual rainfall for Innisfail is 3,490mm with majority of rain fall from the months of December to April.

Figure 3.0: Innisfail Average Annual Rainfall (BoM).

Summary statistics for all years Information about climate statistics

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	507.3	590.1	662.2	456.3	302.2	188.5	137.6	115.8	85.9	87.8	158.9	262.6	3558.1
Lowest	20.6	59.8	87.4	31.0	13.8	9.9	4.8	0.0	0.0	0.0	0.0	9.8	1775.1
5th %ile	86.5	157.2	203.7	110.4	75.9	34.4	28.1	8.1	1.0	2.3	13.9	31.8	2338.1
10th %ile	139.1	248.2	225.1	154.7	95.2	43.9	38.0	20.7	5.2	6.0	23.6	40.8	2575.3
Median	446.6	495.1	622.9	407.2	264.1	161.7	114.2	94.2	63.8	62.3	109.9	178.1	3490.2
90th %ile	988.6	1019.8	1140.7	777.6	548.1	385.2	252.9	238.4	211.4	183.2	347.5	521.9	4760.1
95th %ile	1142.7	1167.0	1243.8	1030.8	665.4	405.2	286.7	318.6	255.5	284.6	597.5	758.1	4931.4
Highest	1581.6	1515.2	1650.5	1652.5	1063.0	527.4	505.7	536.0	426.2	497.5	997.2	1303.6	5894.9

Upstream of the Innisfail Water Treatment Plant is the North Johnstone gauging station, Tung oil. In 2014, the Queensland Government, Department of Science, Information Technology, Innovation and the Arts completed a statistical study of water quality in a number of Far North Queensland river systems including the Johnstone River. The data provided in the report Wet Tropics water quality statistics for high and base flow conditions includes information relevant to Council's Johnstone River intake including catchment characteristics, river flow rates at the nearby Tung oil gauging station and variability on water quality parameters such as total suspended solids and nutrients for high and base flow conditions. The intake for the Innisfail reticulation scheme is located on the Johnstone River (North) approximately 2km downstream of the Tung oil gauging station and 16.6 km upstream of the confluence with the South Johnstone River.

Dominant land uses include beef and dairy pastures, sugarcane, bananas, pawpaw's and other small crops, with the majority of the remaining area being World Heritage listed tropical rain forest (963km2). Figure 3.1 below shows the land uses Johnstone River catchments.

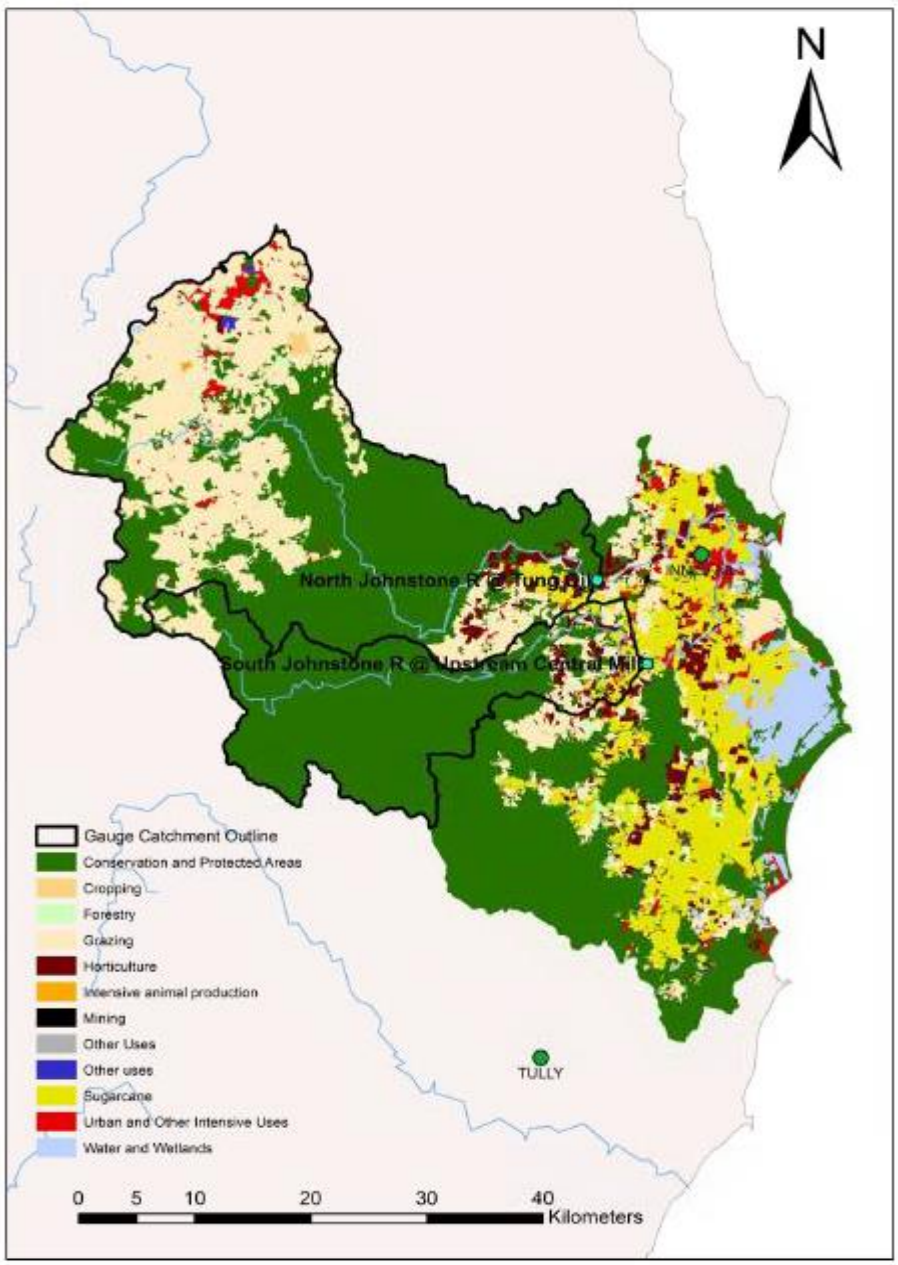


Figure 3.1: Johnstone River Catchment & Land Use.

(Source: Wet Tropics water quality ststistics for high and base flow conditions, April 2014, Dept of Science, Information technology, Innovation and the Arts)

Table 3.0 below shows the extent of agricultural uses in the catchment. Information from the Australian Bureau of Statistics 2008-09.

Table 3.0

AGRICULTURAL LAND USE AND SELECTED PRACTICES		
Total Catchment area	Ha	232,950
Holdings in the catchment	No	706
Land used mainly for agricultural production	Ha	58,845
Land area over which herbicides were used	Ha	21,812
Fertiliser applied	Tonnes	72,336

Pollution data collected for the Wet Tropics water quality study showed that the Johnstone River had some of the lowest pollution levels of rivers sampled in the Wet Tropics region. Details of the pollution levels in high flow and base flow conditions are outlined in Figure 3.2. High flow conditions are characterised by having flow rates in the upper 10% of flow rate incidences. Base flow conditions range from 90% flow conditions being greater (near nil flow) to 10% of flow conditions being greater.

Figure 3.2: Johnstone River High Flow.

Table 11 80th, 50th and 20th percentile values and summary information for parameters during high flow conditions at the North Johnstone River at Tung Oil (gauging station 112004A) and North Johnstone River at Old Bruce Hwy Bridge (Goondi) (gauging station 1120049) sites

112004A and 1120049	North Johnstone River at Tung Oil and North Johnstone River at Old Bruce Hwy Bridge (Goondi)								Base flow cut off ($m^{-3}s^{-1}$)	31.58
	Total Suspended Solids (mg/L)	Particulate Nitrogen (mg/L)	Total Nitrogen (mg/L)	Oxidised Nitrogen (mg/L)	Ammonia Nitrogen (mg/L)	Dissolved Organic Nitrogen (mg/L)	Total Phosphorus (mg/L)	Filterable Reactive Phosphorus (mg/L)	Dissolved Organic Phosphorus (mg/L)	Particulate Phosphorus (mg/L)
80th %ile	82	0.53	0.788	0.193	0.009	0.16	0.192	0.01	0.012	0.17
50th %ile	25	0.15	0.43	0.152	0.006	0.1	0.06	0.008	0.01	0.05
20th %ile	10	0.06	0.31	0.119	0.005	0.064	0.03	0.006	0.005	0.01
No. of samples	190	189	189	188	188	189	188	188	189	189
Start Date	1/07/2005	1/07/2005	1/07/2005	1/07/2005	1/07/2005	1/07/2005	1/07/2005	1/07/2005	1/07/2005	1/07/2005
End Date	1/07/2013	1/07/2013	1/07/2013	1/07/2013	1/07/2013	1/07/2013	1/07/2013	1/07/2013	1/07/2013	1/07/2013

Table 10 80th, 50th and 20th percentile values and summary information for parameters during base flow conditions at the North Johnstone River at Tung Oil (gauging station 112004A) and North Johnstone River at Old Bruce Hwy Bridge (Goondi) (gauging station 1120049) sites

112004A and 1120049	North Johnstone River at Tung Oil and North Johnstone River at Old Bruce Hwy Bridge (Goondi)								Base flow cut off ($m^{-3}s^{-1}$)	31.58
	Total Suspended Solids (mg/L)	Particulate Nitrogen (mg/L)	Total Nitrogen (mg/L)	Oxidised Nitrogen (mg/L)	Ammonia Nitrogen (mg/L)	Dissolved Organic Nitrogen (mg/L)	Total Phosphorus (mg/L)	Filterable Reactive Phosphorus (mg/L)	Dissolved Organic Phosphorus (mg/L)	Particulate Phosphorus (mg/L)
80th %ile	7	0.072	0.274	0.086	0.010	0.155	0.026	0.009	0.008	0.021
50th %ile	3	0.04	0.19	0.056	0.005	0.085	0.01	0.007	0.005	0.01
20th %ile	1.4	0.032	0.167	0.009	0.003	0.060	0.007	0.002	0.005	0.005
No. of samples	11	11	11	11	11	11	11	11	11	11
Start Date	1/07/2005	1/07/2005	1/07/2005	1/07/2005	1/07/2005	1/07/2005	1/07/2005	1/07/2005	1/07/2005	1/07/2005
End Date	1/07/2013	1/07/2013	1/07/2013	1/07/2013	1/07/2013	1/07/2013	1/07/2013	1/07/2013	1/07/2013	1/07/2013

Various State, Local Government Departments and Community Conservation Groups are active in the Johnstone catchment area and endeavouring to improve the environmental health of the river system and reducing sediment.

Council's sampling and testing of the raw water includes a far wider spectrum of tests. The typical suite of tests is shown in Figure 3.3. In addition the Health Department also undertake a range of tests for the presence of herbicides and pesticides. In relation to raw water quality and pesticide levels, over the many years of testing there have not been any exceedances of ADWG Health Guidelines.

Figure 3.3: Typical Suite of Tests - Standard Water Analysis (QLD Health).

Client Reference : **1001**
Date Sampled : **11-May-2016**
Sample Source : **River**
Sample Point : **Innisfail WTP raw water,Innisfail sccheme**
Further Information: : **North Johnston River**

Submitting Authority : **Cassowary Coast Reg Council - Innisfail**
Reason for Analysis : **Human Consumption**
Water Treatment : **Untreated**

Method		Units	Result	Guidelines ** Health	Guidelines ** Aesthetic
18320	Conductivity @ 25°C	µs/cm	51		
18226	pH	at 22°C	7.06		6.5 - 8.5
18209	Total Hardness*	mg $CaCO_3$/L	12		200
18209	Temporary Hardness*	mg $CaCO_3$/L	12		
18208	Alkalinity*	mg $CaCO_3$/L	14		
18209	Residual Alkalinity*	meq/L	0.1		
18195	Silica	mg/L	14		80
18209	Total Dissolved Ions*	mg/L	33		
18209	Total Dissolved Solids*	mg/L	38		600
18206	True Colour	Hazen	5		15
18212	Turbidity	NTU	2		5
18209	pH Sat.* (calc. for $CaCO_3$)		9.9		
18209	Saturation Index*		-2.9		
18209	Mole Ratio*		2.8		
18209	Sodium Absorpt. Ratio*		0.6		
18209	Figure of Merit Ratio*		1.2		

Method		Units	Result	Guidelines ** Health	Guidelines ** Aesthetic
	CATIONS				
18195	Sodium	mg/L	4		180
18195	Potassium	mg/L	0.7		
18195	Calcium	mg/L	2.0		
18195	Magnesium	mg/L	1.7		
18209	Hydrogen*	mg/L	0.0		
	ANIONS				
18209	Bicarbonate*	mg/L	18		
18209	Carbonate*	mg/L	0.0		
18209	Hydroxide*	mg/L	0.0		
18204	Chloride	mg/L	5.3		250
18204	Fluoride	mg/L	< 0.05	1.5	
18204	Nitrate	mg/L	0.5	50	
18204	Sulphate	mg/L	< 1	500	250
	OTHER DISSOLVED ELEMENTS				
18195	Iron	mg/L	0.08		0.3
18195	Manganese	mg/L	<0.01	0.5	0.1
18195	Zinc	mg/L	0.02		3
18195	Aluminium	mg/L	<0.05		0.2
18195	Boron	mg/L	<0.02	4	
18195	Copper	mg/L	<0.03	2	1

Notes: * parameter is derived from calculation.
** Australian Drinking Water Guidelines 2011 (ADWG) Health and Aesthetic Values
'-' not determined

Lab use Only: TE 131.00 TC 0.44 TA 0.47 Imb 0.02 A I/C 0.47

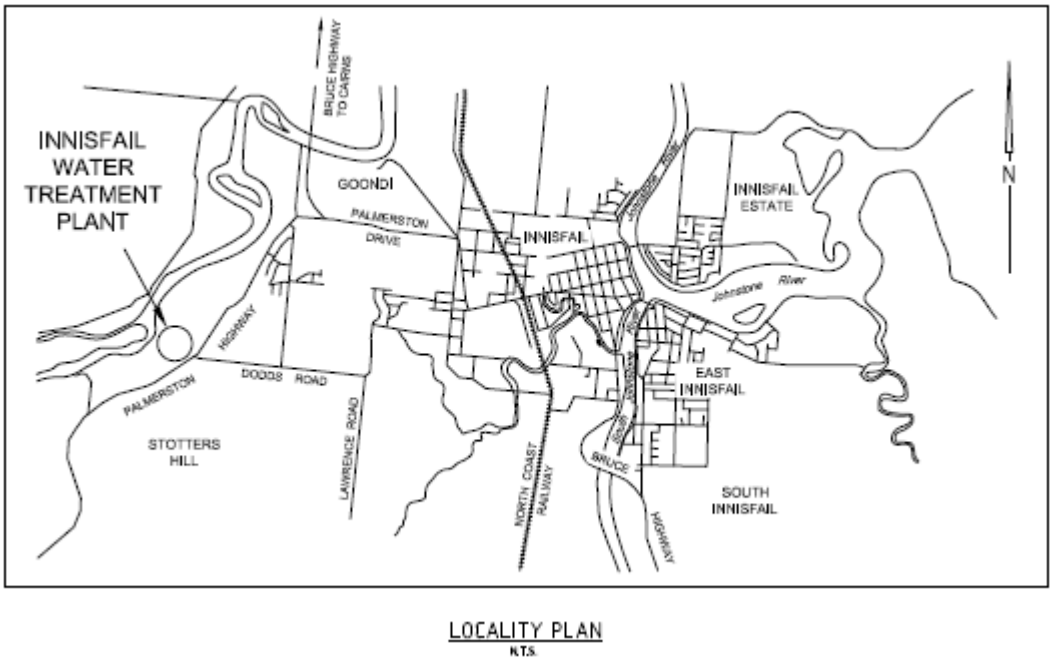
Please note that the concentration of total elements present may be higher than that of dissolved elements stated in this report.
The water complies with Australian Drinking Water Guidelines 2011 for the parameters tested.

3.2 Treatment, Disinfection and Processes

3.2.1 Innisfail Water Treatment Plant

The water treatment facilities for the Innisfail water supply scheme are located at the Innisfail Water Treatment Plant located off the Palmerston Highway as shown in Figure 3.4.

Figure 3.4: Innisfail WTP Locality Plan



LOCALITY PLAN
N.T.S.

In 2013, Council completed a major upgrade of the Innisfail Water Treatment Plant (WTP) which included major changes to the treatment processes, control systems, clear water storage, pumping systems coagulant and polymer dosing and disinfection. The layout of the treatment plant facilities is shown in Figure 3.5 and Figure 3.6.

The key elements of the new facility include two new media restrained upflow clarifiers and two new multi media filter beds.

The upgraded plant is fully automated and designed to treat up to 18.2 ML per day of treated potable water over a 22 hour operating period with average raw water turbidity levels of about 10NTU. The plant can operate satisfactorily for turbidity events to 300 NTU. At 150 NTU, the SCADA switches the coagulant type to maintain output. Production volumes decrease at higher turbidity levels as the time interval between backwash sequences deceases. If Council is able to achieve modest reductions in water consumption, at 450l/person/day (currently about 600l/person/day), the new plant should have capacity to supply approximately 40,400 people. The current population supplied from the WTP is 12,150 people.

The summary of the Innisfail Scheme Treatment and Disinfection Systems is shown in Table 3.1.

Table 3.1: Source & Treatment Details.

Component		Innisfail Scheme
Sources	Name	Johnstone River
	Type	*River*
	% of supply	100%
	Reliability	*Reliable Continuous Supply of water*
	Water quality issues	*Turbidity Spikes following high rainfall*
Sourcing Infrastructure	Type (pumped)	Pumped
	Description	*Location: Johnstone River,* *Height of Intake:* *1) Low normal operations:* *2) High flood events:* *Screen Type: Johnson T27-69* *2mm Slot size* *Pump: 2 x Flygt CP3231 170 kW* *Duty Point: 249 L/s @ 48.5 m.* *Generator in place for loss of power event.* *Flow rate reduced to 115L/s during flush or backwash cycle.*
Treatment Plant	Name	Innisfail Water Treatment Plant
	Process	*Process comprises, flocculation static mixing, upflow clarification, media filtration..*
	Design Capacity (22 hr operation-10NTU)	ML/d 18.2
	Daily flow range	ML/d 0 - 15 (Avg 8ML/d)
	Chemicals added	Flocculant aid Poly- WTS8-A0510P-used continuously injected in base of inlet upflow splitter box., Coagulants injected into raw water main before inlet upflow splitter box: Low turbidity <150 NTU use WTS8-CA1-5H High turbidity >150 NTU switch to WTS8-CA2-1 Sodium Hypochlorite - disinfection. Dosed before clear water transfer pumps.
	Water sourced from and %	*Johnson River - 100%*
	Filter Backwash Pumps	2 – Duty/Standby- Single pump duty 350 l/s at 15m
	Air Scour Blowers	2 – Duty/Standby- Blower capacity 1830m3/hr at 0.5 bar
	Air Compressor	2 – Duty/Standby
	Poly Dosing Pumps	1 – Duty (Replacement pump available at site if changeover needed)
	Coagulant Dosing Pumps	2 – Duty/Standby
	Clear Water Pumps To Stoters Hill Res.	2 – Duty/Standby - Peak flow 130L/s.
	Disinfection Pumps	3 - Duty and 2 standby
	Generator	1 - Standby
	% of average day demand provided	100%
	% of scheme supply Distribution area supplied	100%
	Bypasses / Variations	No provision for treatment system bypass.
Disinfection	Location	Innisfail WTP
	Type	Sodium Hypochlorite (NaOCl)
	Dose rate	200 l/day Approx average
	Target residual levels	Between 2.0 and 2.2 mg/l
	Duty/standby	3-Pumps Primary, Secondary, Standby
	Dosing arrangements	Fixed Residual Analyser & Flow
	Alarms	High , Low
	Auto shut-off arrangements	High and low chlorine residual, low storage level in NaOCl tank.

Figure 3.5: Innisfail WTP Site Plan.

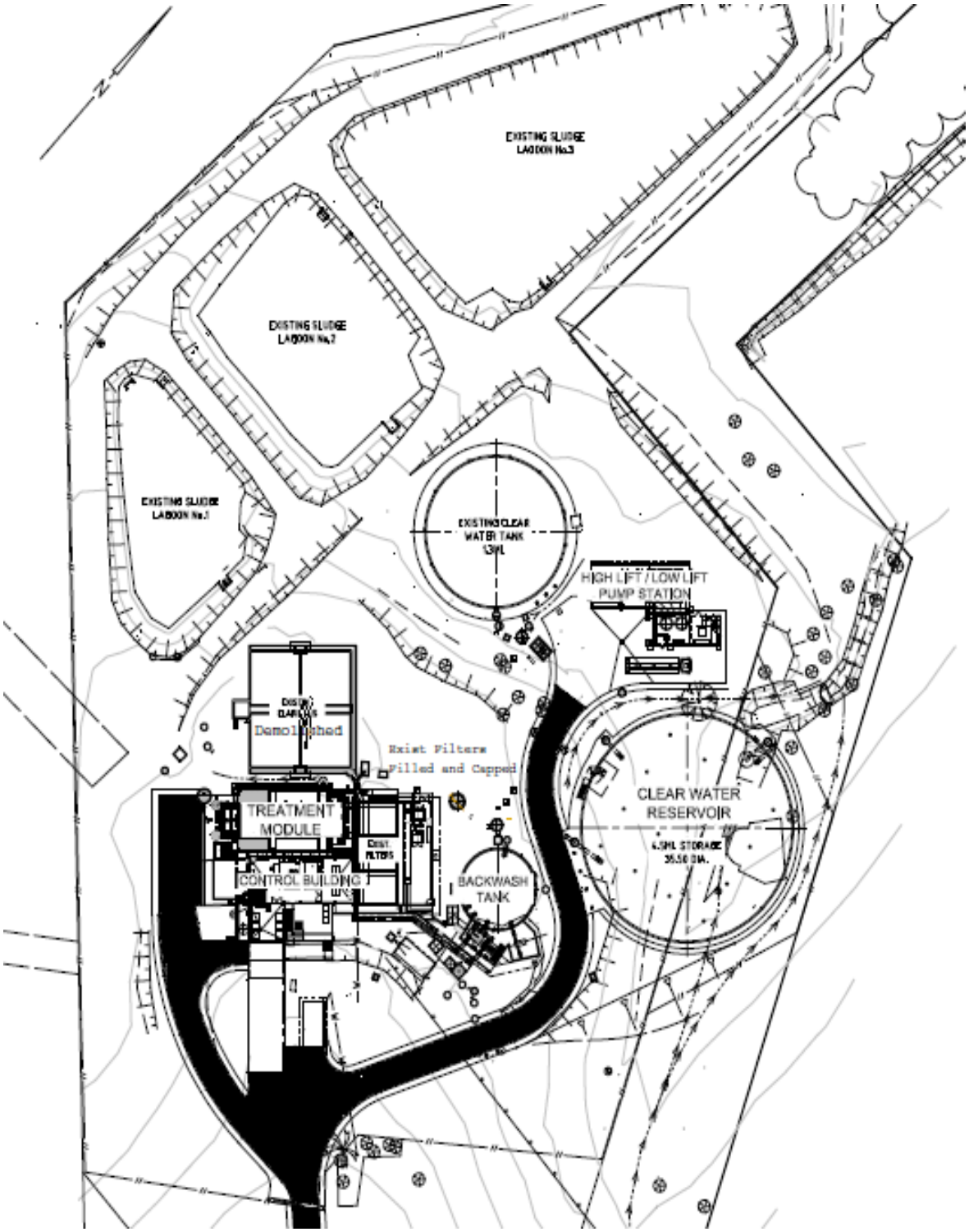
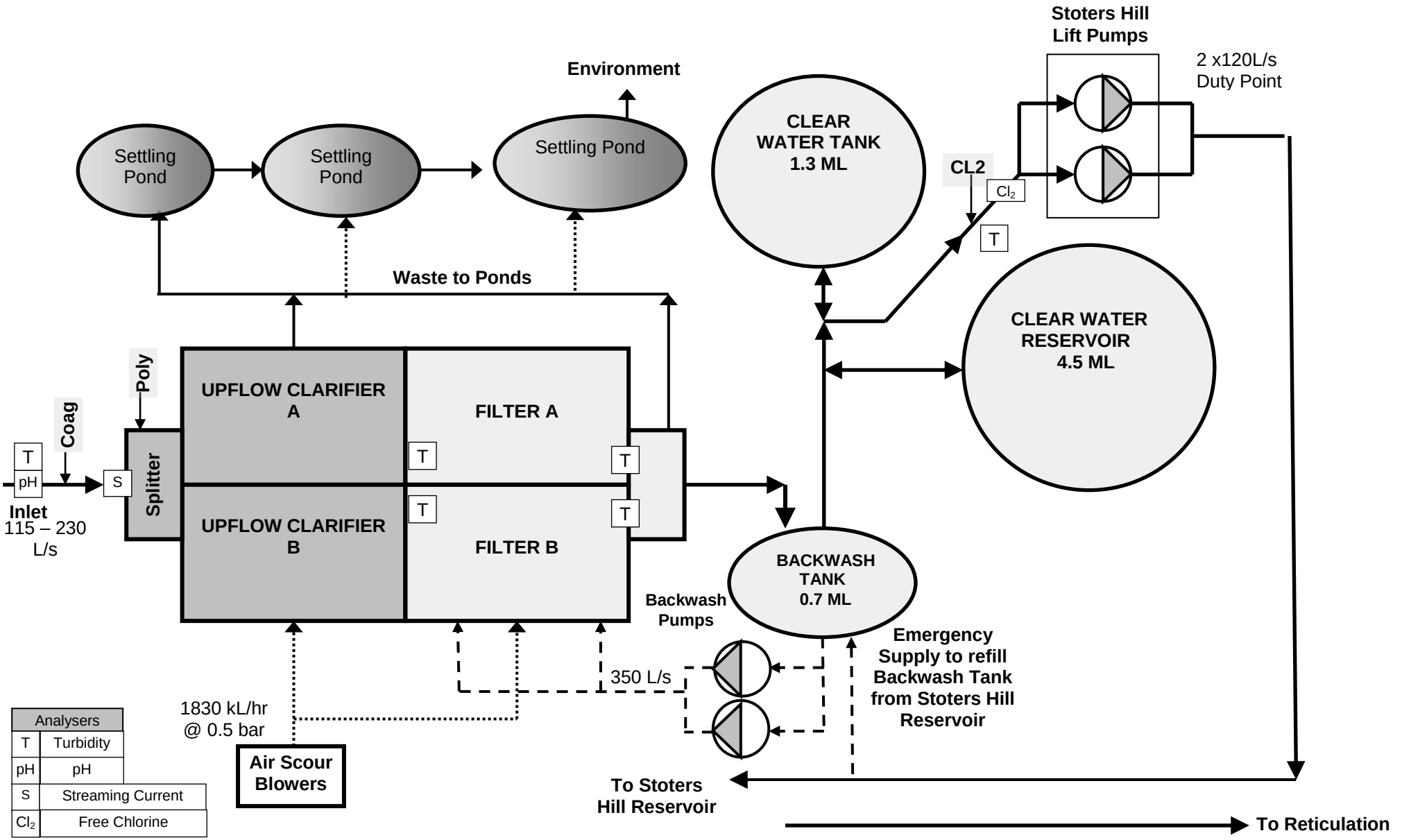


Figure 3.6: Innisfail WTP Treatment Schematic.



Details of the Innisfail WTP are provided in Appendix A.

Notes:

The treated water pumps for the main to the Stoters Hill reservoir have a normal operation of 120L/s and a peak flow of 137L/s.

Since the commencement of operations, the new plant has operated to anticipated parameters and produced a high standard of potable water. Details of treated water quality are included in Table 3.10.

For rare extreme turbidity events above 300 NTU, it has been necessary to shut the plant down. System demands are then met by reservoir storage. Typically these plant shut downs coincide with relatively low water consumption of 6 to 7 ML/day. Available reservoir storage in the system is 18.9 ML, excluding minor reservoirs and the 5.8ML at the WTP. This storage is adequate for a maximum of 3 days without water production.

Table 3.2 below shows there were only 4 incidences in the period 1/1/2009 to 16/6/216 when the raw water turbidity exceeded 150 NTU for more than 24 hours. Over the same time period there were 24 incidences when turbidly exceeded 150NTU on any occasion. Obviously there is some correlation between rainfall events and turbidity but there is no clear pattern that high rainfall automatically triggers a high turbidity. Refer Figure 3.9 for turbidity and rainfall data for the period 01/01/2012 to 01/04/2016. For the above period there were 191 incidences when rainfall exceeded 40mm in 24 hours and yet there were only 24 occasions of very high turbidity. Operational staff have developed a procedure for the shut down sequence of the WTP for very high turbidity events and part of the procedure entails ensuring all reservoirs are at full capacity immediately prior to predicted periods of intense rainfall.

Table 3.2: Rainfall and Turbidity Spikes.

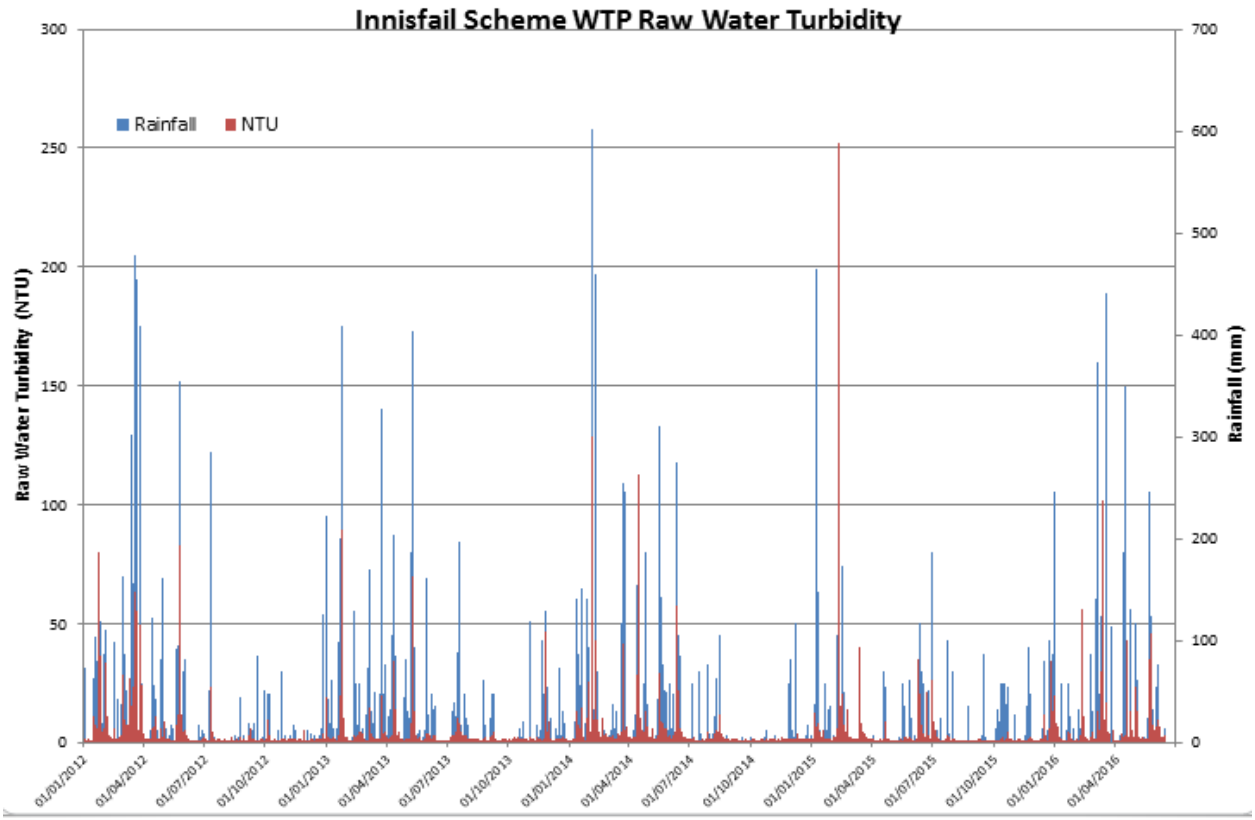
Date	Rainfall	NTU
14/1/11	44	77.20
15/1/11	6	159.20
16/1/11	61	68.20
17/1/11	7	53.20
18/1/11	1	326.00
19/1/11	28	68.40
20/1/11	7	68.50
21/1/11	26	676.00
22/1/11	71	486.00
23/1/11	51	141.90
24/1/11	1	27.00

26/3/11	10	23.70
27/3/11	68	187.60
28/3/11	107	187.40
29/3/11	27	40.30

Date	Rainfall	NTU
20/1/13	34	2.73
21/1/13	86	46.40
22/1/13	175	80.00
23/1/13	109	209.00
24/1/13	70	161.00
25/1/13	6	23.70
26/1/13	3	1.42

7/2/15	45	12.80
8/2/15	100	185.00
9/2/15	46	589.00
10/2/15	20	107.00
11/2/15	10	35.10
7/2/15	45	12.80
8/2/15	100	185.00
9/2/15	46	589.00

Figure 3.9


Innisfail Scheme WTP Raw Water Turbidity
Rainfall
NTU
Raw Water Turbidity (NTU)
Rainfall (mm)
300
250
200
150
100
50
0
700
600
500
400
300
200
100
0
01/01/2012
01/04/2012
01/07/2012
01/10/2012
01/01/2013
01/04/2013
01/07/2013
01/10/2013
01/01/2014
01/04/2014
01/07/2014
01/10/2014
01/01/2015
01/04/2015
01/07/2015
01/10/2015
01/01/2016
01/04/2016

3.3 Distribution and Reticulation Details

3.3.1 Overview of Distribution System

Construction of the original Innisfail Water Scheme commenced in the 1930's. Some of the original infrastructure is still in use today including a steel 250mm trunk water main that connects the treatment plant to Innisfail, heritage listed Water Tower and a network of cast iron reticulation mains. Over time the extent of the water serviced area has expanded considerably and besides the township of Innisfail, now includes the smaller towns of Flying Fish point, South Johnstone, Wangan, Mena Creek, Mourilyan, Etty Bay and many rural areas.

Treated water from the Innisfail WTP is pumped directly to the Stoters Hill Reservoir through a dedicated 300mm supply main. The transfer pumps are mated with variable frequency drives and are able to operate in a duty/standby arrangement pumping up to a maximum of 130 l/s.

From Stoters Hill reservoir there are 3 major trunk outlet mains that feed the greater Innisfail district:

The original 250mm steel main dating from 1933 that runs into the Innisfail CBD via Goondi;

a 300mm line that runs due west from Stoters Hill to Wangan and then via Mourilyan Rd connects to the water reservoirs near the Innisfail CBD and;

a 300mm line that runs from Stoters north along the Palmerston Highway and then south along the Bruce Highway and into then into town to the Water Tower near the CBD via Acacia St, Emily St and the Esplanade.

Aside from small high level zones, the 4.5ML Stoters Hill Reservoir (TWL61.5) is able to pressurise the complete Innisfail system. Water levels at Stoters Hill are typically maintained at a minimum of 80% capacity and the clear water transfer pumps at the WTP are controlled by SCADA inputs of the Stoters Hill storage level.

Lower level storages of Sth Johnstone, Flying Fish Point and Church St still rely on supply from Stoters Hill but operational and control systems have been established to make some functional use of these lower level storages.

Council has installed a solenoid control valve system on the trunk main to east Innisfail and Flying Fish Point that isolates Stoters Hill from that area and allows the 4.5ML Flying Fish Point Reservoir (TWL 48m) to supply flows to that area. Only when Flying Fish Point reservoir level falls below approximately 70% capacity does the control valve open allowing Stoters Hill to recharge the reservoir.

The 2.2Ml South Johnstone reservoir (TWL 50m) supplies the area of Mena Ck via local booster pumps. The South Johnstone township is normally serviced by the Stoters Hill reservoir but in emergency situations, the South Johnstone town area can be supplied from the South Johnstone reservoir but at a lower residual pressure. This operational scenario was used in January 2017, when the plant was unable to operate continuously over 4 days and clear water storages were becoming depleted.

The 9ML Church St reservoir at TWL32m is predominantly an emergency storage. Turnover is achieved by utilising booster pumps adjacent to the reservoir to pressurise the town and potentially backfill Stoters storage. The operation of the Church St reservoir relies on manual intervention to initiate the booster pumps.

The layout and extents of the Innisfail reticulation system are shown in Figure 3.10. A schematic of the Innisfail reticulation network showing the connections in each community is provided in Figure 3.11.

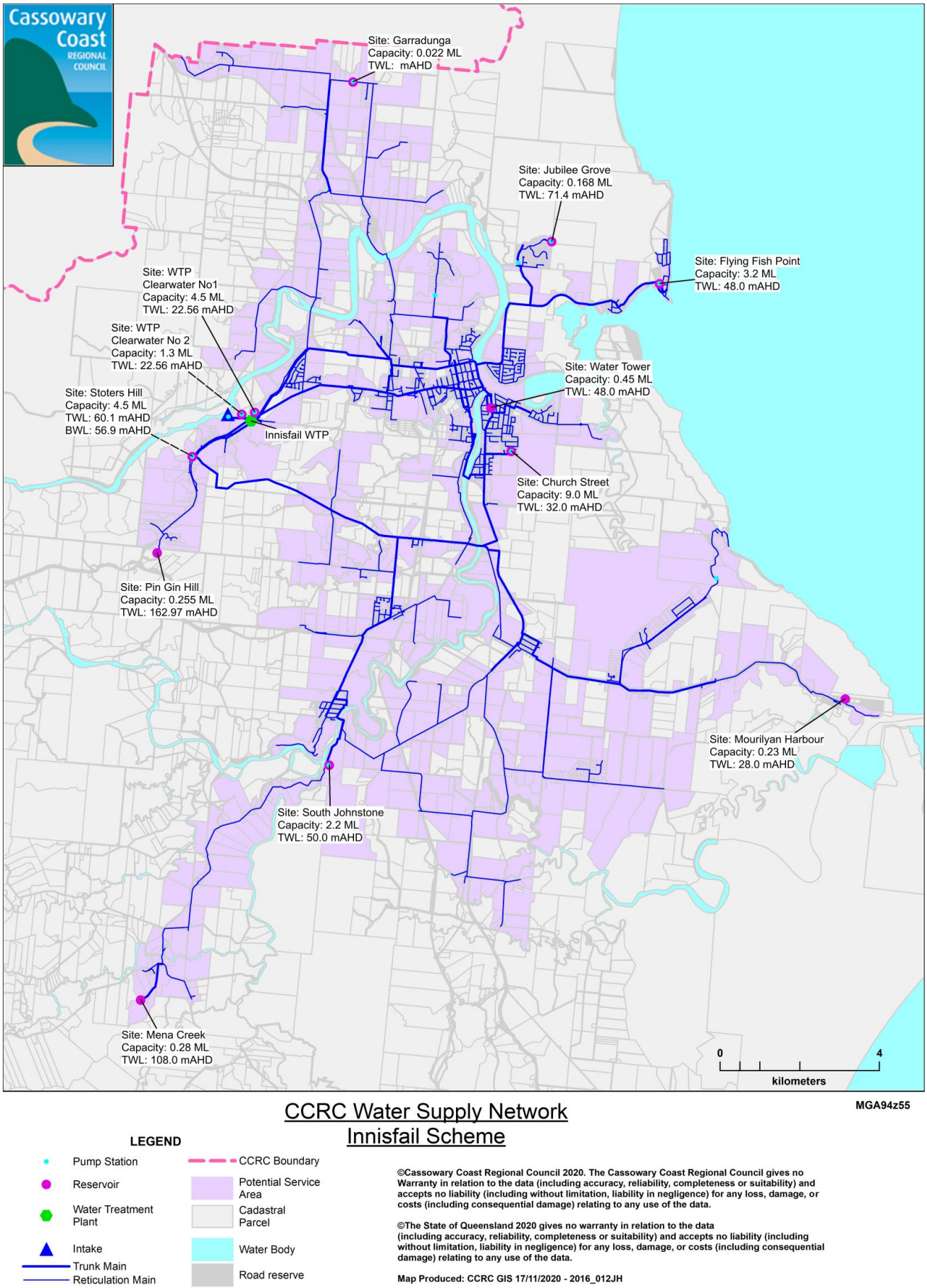
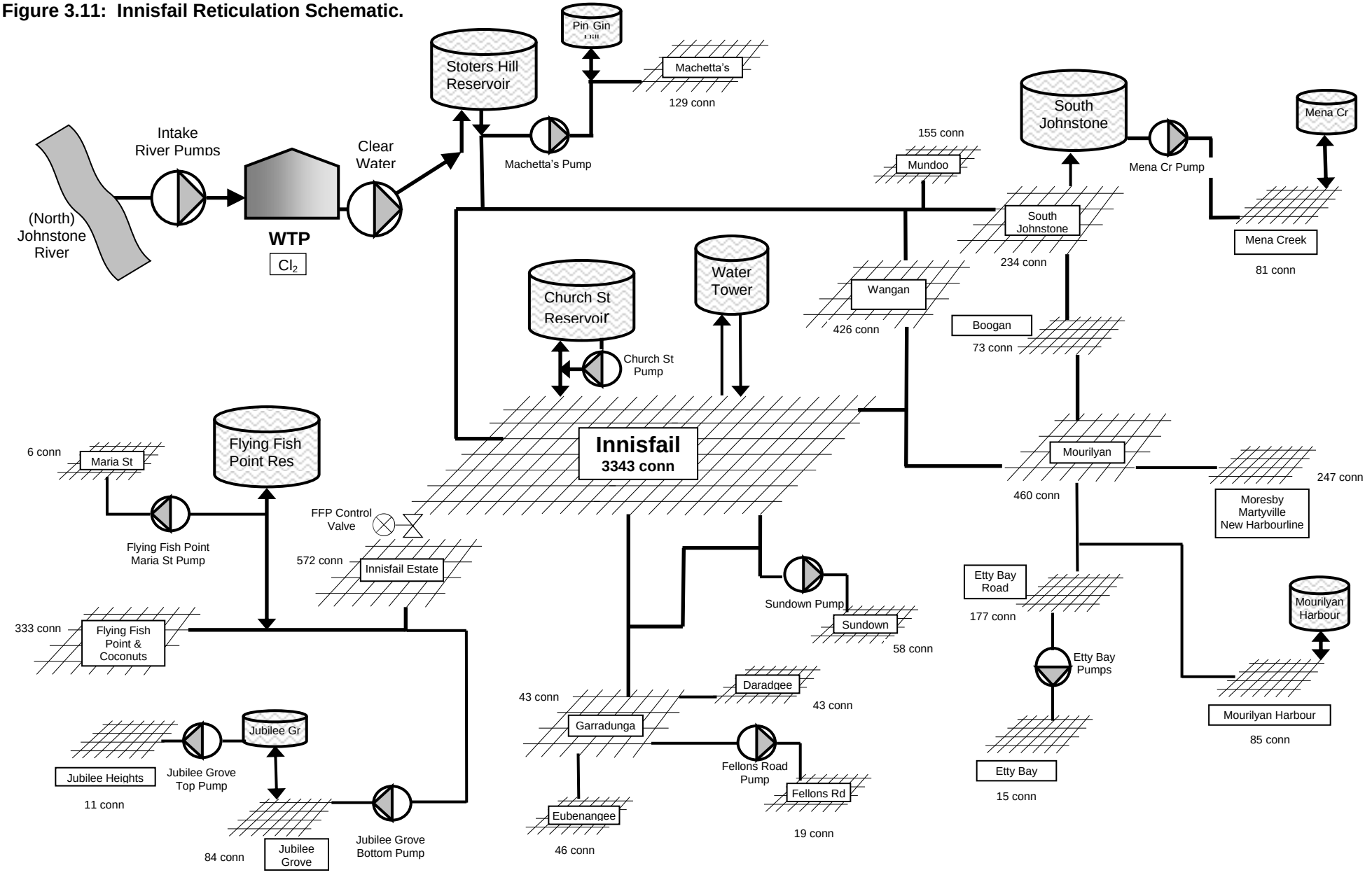


Figure 3.10: Water Supply Scheme Map.

Figure 3.11: Innisfail Reticulation Schematic.



Specific details about the reservoirs in the Innisfail scheme are provided in Table 3.3.

Table 3.3: Reservoir Asset Details.

Reservoirs	**Ground Level**			
	Name	**Stoters Hill**		
	Capacity (ML)	4.5 ML	TWL (m):	60.4
	Roofed (Y/N)	Aluminium Geodesic Dome		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		
Reservoirs	**Ground Level**			
	Name	**Church Street**		
	Capacity (ML)	9 ML	TWL (m):	32
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		
Reservoirs	**Elevated**			
	Name	**Mourilyan Road Water Tower**		
	Capacity (ML)	0.45 ML	TWL (m):	48
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		
Reservoirs	**Ground Level**			
	Name	**Flying Fish Point**		
	Capacity (ML)	3.2 ML	TWL (m):	48
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		
Reservoirs	**Ground Level**			
	Name	**Jubilee Grove**		
	Capacity (ML)	0.168 ML	TWL (m):	71.4
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		
Reservoirs	**Ground Level**			
	Name	**South Johnstone**		
	Capacity (ML)	2.2 ML	TWL (m):	50
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		
Reservoirs	**Ground Level**			
	Name	**Mena Creek**		
	Capacity (ML)	0.28 ML	TWL (m):	108
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		
Reservoir	**Ground Level**			
	Name	**Mourilyan Harbour**		
	Capacity (ML)	0.23 ML	TWL (m):	28
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		
Reservoir	**Ground Level**			
	Name	**Pin Gin Hill**		
	Capacity (ML)	0.255 ML	TWL (m)	163
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		

3.3.2 Asset Type and Condition

The trunk mains into Innisfail are predominantly asbestos cement (AC), cast iron or steel. Typically the trunk mains are in fair to good condition. Failures on the trunk system are limited and the conveyance capacity of the trunk system is adequate for the medium term. The 10 year capital works program does allow for the replacement of the 1933 steel main towards the end of the program but this will be monitored.

A significant portion of the Innisfail town reticulation system is comprised of unlined cast iron pipes which were installed in the 1930's. The smaller range of these pipes (80, 100 and 150mm diameter) has extensive internal ferric nodules and internal corrosion. The poor internal condition of these mains is impacting general capacity and fire flow capacity and the 10 year capital program includes funding allowances for the renewal of these cast iron reticulation mains.

The majority of reticulation mains in the Innisfail scheme are AC and are between 38 and 45 years old. Typically the AC mains are in fair to good condition. Failures have been observed with some of the AC mains that are continuously immersed in ground water. Failure types include soft spots, longitudinal splitting and collar leaks (possible ring failures).

There is no program for extensive replacement of any of the AC mains in the 10 year program. The majority of the AC mains will be nearing the end of their theoretical asset life in the 10 to 20 year horizon. Asset condition of AC mains will be monitored closely to determine if the AC renewal program can be spread over a longer cycle.

White class 12 PVC accounts for approximately 48km of the reticulation mains. Class 12 pvc was installed in the CCRC region from the early 1980's to about the year 2000. Since approximately the year 2000, all water mains installed in the region have been class 16. White class 12 pvc has a known history of premature failure when operating with pulsing high pressures, typically in excess of 60m. The residual pressures in the Innisfail system are typically less than 60m so the extent of fatigue failures of the pvc pipe is considerably lower in Innisfail compared to the southern schemes. There is no allowance in the 10 year program for the widespread renewal of white pvc mains in the Innisfail scheme.

Details of the pipe materials used in the Innisfail scheme are outlined in Table 3.4.

Table 3.4: Innisfail water Supply Scheme Pipe Asset Details (Revaluation May 2020).

Dia	50mm									Total Length
Pipe Material	AC			CU	32 40 GWI	Poly	PVC CL12	PVC CL16	32-50 PVC	(m)
Length				38	1549	2958	2117		2620	9282
Average Age				38.5		26.5	33.9		51	
Dia	63mm									
Pipe Material						Poly	PVC CL12	PVC CL16		
Length						2553				2553
Average Age						14				
Dia	80mm									
Pipe Material	AC	CI		CU	GWI	Poly	PVC CL12	PVC CL16		
Length	571	2257		83						2911
Average Age	45.5	85.3		29						
Dia	100mm									
Pipe Material	AC	CI	DI		GWI	Poly	PVC CL12	PVC CL16	PVC	
Length	76990	14052	1479		14	378	35662	13539	1487	143601
Average Age	48.6	75.3	14.4			16.6	25	13.9	15.3	
Dia	150mm									
Pipe Material	AC	CI	DI			Poly	PVC CL12	PVC CL16	Steel	
Length	28263	1801	9767.5			245	19969.1	5302.4	134	65482
Average Age	49.5	72.5	13.5			1.5	22.8	14.9	39	
Dia	200mm									
Pipe Material	AC	CI	DI			+180 Poly	PVC CL12	PVC CL16		
Length	6940	57	2711.2			290	121	1118.1		11237.3
Average Age	39.9	32	16			11	16	2.5		
Dia	225mm									
Pipe Material	AC	CI	DI			Poly	PVC CL12	PVC CL16	Steel	
Length	5326	4217	1612			0	6814	234		18203
Average Age	47.7	68.8	17.2				27	11		
Dia	250mm									
Pipe Material	AC	CI	DI			Poly	PVC CL12	PVC CL16	Steel	
Length	1954	498	21					1716.4	4920	9109.4
Average Age	43.8	69	2					17	75.6	
Dia	300mm									
Pipe Material	AC	CI	DI			Poly	PVC CL12	PVC CL16	Steel	
Length	12809	12727	668			136		1518	218	28076
Average Age	43.7	60.4	15.9			12		8.2	39	
Dia	375mm									
Pipe Material	AC	CI	DI			Poly	PVC CL12	PVC CL16	Steel	
Length			614			241		1878		2733
Average Age			19			21		7		
Dia	450mm									
Pipe Material	AC	CI	DI			Poly	PVC CL12	PVC CL16	Steel	
Length	739									739
Average Age	42									
Dia	600mm									
Pipe Material	AC	CI	DI			Poly	PVC CL12	PVC CL16	Steel	
Length			66							66
Average Age			19							293992.7
Total Lengths	133592	35609	16938.7	121	1563	6801	64683.1	25305.9	9379	293992.7
Per Mtl Type m										

Distribution and Reticulation System	Areas where potential long detention periods could be expected	Garradunga Daradgee, Jubilee Grove, Moresby, New Harbour line, Mourilyan Harbour, Mena Creek
	Areas where low water pressure (eg < 17.5 m) could be expected during peak or fire demand	The network extremities of: Mourilyan Harbour, Etty Bay, South Johnstone, Mundoo, Henderson Drive, Garradunga, Moresby

3.3.3 SCADA Deployment

Since 2013, capital works budgets had been allowing for the deployment of SCADA to key water infrastructure as a major risk mitigation measure in line with the 2013 DWQMP (ECM Doc # 2265542).

Table 3.5, shows status of key water infrastructure in the Innisfail scheme connected to SCADA.

Table 3.5: SCADA Deployment in Innisfail Scheme.

Innisfail		
Site Name	**Connected**	**Comment**
Treatment		
Innisfail WTP	✓	
Reservoirs	✓	
Stoters Hill	✓	
Pin Gin Hill	✓	
Church Street	✓	
Flying Fish Point	✓	
Water Tower	✓	
Jubilee Grove	✓	
South Johnstone	✓	
Mena Creek	✓	
Mourilyan Harbour	✓	
Pump Stations		
Intake Pumps	✓	
Machetta	✓	
Church Street	✓	
Jubilee Bottom	✓	
Etty Bay	✓	
Fallons Road	✓	
Sundown	✓	
Mena Creek	✓	
Control Valves		
Flying Fish Point	✓	
Mourilyan Harbour	✓	
Radio Repeater		
Council Chambers	✓	
Historian (data mgmt.)	✓	

3.4 Water Quality Data and Complaints

3.4.1 General

The following table and graphs summarise the available water quality data, complaints and responsibilities.

Council in-house testing is undertaken on a regular basis on the raw and treated water quality. In-house raw water testing is undertaken on turbidity and pH. In-house treated water testing is limited to turbidity, pH, free chlorine and E.coli. Standard water analysis (SWA) and pesticide testing of raw and treated water is undertaken by Qld Health in Brisbane. Testing frequency and the sites for testing are listed in Council's Sampling Manual.

Table 3.6 shows standard water analysis and in-house testing results (1995-2011) for the raw water from the Johnstone River. Table 3.7 shows the standard water analysis results from the Johnstone River for the period 1/2013 to 5/2016. Raw water quality has been quite stable over this entire testing time.

3.4.2 Data Interpretation

Peaks in raw water True Colour, Turbidity, Aluminium and Iron are short term and usually due to flood events in the Johnstone River. These high levels are short term events and related to the duration, intensity and position of rainfall within the catchment. The summaries also show that the standard clarification and filtration from the Treatment Plant are successfully able to reduce these parameters to within the ADWG limits.

Up until 2016, there was no centralised database for storing water quality data. Council is now progressively moving historical water quality data to the SWIM Local system. The historical system (pre 2016) consists of a combination of multiple spreadsheets, scanned and physical data. This creates difficulties in analysis and data quality control.

Some pesticides have been detected however all are below ADWG in the raw water before treatment. The ADWG listed pesticides have not been detected in the treated water. Imidacloprid is not listed in ADWG however as shown in the summary it is often detected in both the raw and treated water. The highest recorded level is 0.23 ug/L (ppb). Imidacloprid is an insecticide that is toxic to insects and is used to control sucking insects, termites, some soil insects and fleas on pets. The levels of Imidacloprid being detected in the source water are factors of up to 200 times below toxic levels listed by the US Environmental Protection Agency.

The pH chart shows relatively constant treated water at the WTP averaging 7.3 pH for the period of testing 2001 to 2011. Refer Table 3.8A. For the testing period since the completion of the new WTP in 2013, the pH of the treated water has risen slightly and is now averaging 7.47. Refer Table 3.8B. This may be due to a change in the type of polymer now being added. The Innisfail scheme reticulation water data for the period 2012 to 2021 as listed in Tables 3.10 and 3.10A show a rise in pH in the outer reaches of the scheme such as Eubenangee. This is due to the soft water characteristics and long retention time in the fibre reinforced concrete mains.

The chlorine residual values in Tables 3.10 and 3.10A show a relatively constant residual exiting the Treatment Plant and decreasing residuals in the reticulation scheme towards the outer lying or low use areas. The maintenance of good chlorine residuals demonstrates that Council's single point of dosing with Sodium Hypochlorite at the WTP is effective. Average turbidity in the network as shown in Table 3.10 is well below 1NTU demonstrating the effectiveness of the new treatment plant even with high source water turbidity. Standard Water Analysis for the reticulation scheme are provided in tables 3.9A and 3.9B.

Table 3.6: Raw Water Source Results Summary 1995-2011

(North) Johnstone River								
Sampling location	**Raw Water Innisfail Treatment Plant**							
Parameter (examples)	**Units**	**Time Period**	**No of samples**		**Summary of Results**			**Comments**
					Maximum Value	**Average Value**	**Minimum Value**	
E.coli								No Data
pH		1995-2011	32		7.52	7.2	6.77	
Total hardness		1995-2011	32		17	11.7	7.1	
Silica		1995-2011	32		16	13.1	8	
TD Solids		1995-2011	32		51	38.5	26	
True Colour		1995-2011	32		47	10.4	0	
Turbidity (NTU)		2009-2011	1092		676	16.42	0.70	In house sampling
Sat Index		1995-2011	32		-2.1	-2.7	-3.2	
Sodium	mg/l	1995-2011	32		9	4.7	3	
Chloride		1995-2011	32		8.1	5.4	3	
Fluoride		1995-2011	32		0.1	0.01	0.1	
Nitrate		1995-2011	32		0.7	0.5	0.5	
Sulphate		1995-2011	32		2	1	0.49	
Iron		1995-2011	32		0.45	0.1	0.01	
Manganese		1995-2011	32		0.01	0	0	
Zinc		1995-2011	32		0.03	0	0	
Aluminium		1995-2011	32		0.62	0.1	0.01	
Boron		1995-2011	32		0.03	0	0	
Copper		1995-2011	32		0.1	0	0	
Heavy Metals								No Data
Pesticides			Tot	pos				
Chlorpyrifos	ug/l	2004-2011	63	1	0.33	0.01	< 0.01	(0.01mg/L ADWG) one detection in 28/06/04
FenthionMethyl	ug/l	2004-2011	63	1	1.3	0.02	< 0.01	Fenthion 0.007 mg/L ADWG one detection in 15/07/04
Diuron	ug/l	2004-2011	63	4	0.10	0.01	< 0.01	(0.02mg/L ADWG)
Simazine	ug/l	2004-2011	63	1	0.01	0.01	< 0.01	(0.02mg/L ADWG) one detection in 18/02/2009
Imidacloprid	ug/l	2004-2011	63	26	0.1	0.02	< 0.01	Not listed in ADWG

Table 3.7: Innisfail Scheme - SWA of Johnstone River Source Water - 1/2013 to 5/2016

Innisfail Scheme Treated Water Quality									
Innisfail Water Treatment Plant RAW									
2013 - 2016									
Parameter	**Units**	**NO. Samples Collected**	**NO. in which parameter detected**	**NO. outside ADWG Health Limits**	**NO. outside ADWG Aesthetic Limits**	**Min**	**Max**	**Ave**	**Comments**
Iron	mg/L	19	19			0.02	0.174	0.07	
Manganese	mg/L	19	19			0.01	0.01	0.01	
Zinc	mg/L	19	19			0.01	0.05	0.02	
Boron	mg/L	19	19			0.02	0.03	0.02	
Copper	mg/L	19	19			0.03	0.03	0.03	
Total Hardness	mg/L	19	19			1	16	12.00	
Saturation Index	mg/L	19	19			-3.5	-2.1	-2.68	
Carbonate	mg/L	19	19			0	0	0.00	
Hydrogen	mg/L	19	19			0	0	0.00	
Residual Alkalinity	mg/L	19	19			0	0.1	0.04	
Conductivity	mg/L	19	19			43	72	54.58	
Calcium	mg/L	19	19			1.7	3	2.24	
pH	units	19	19			6.59	7.51	7.22	
SAR	mg/L	19	19			0.5	0.6	0.57	
Sulphate	mg/L	19	19			1	1.1	1.02	
Potassium	mg/L	19	19			0.2	1.3	0.80	
Figure Merit Ratio	mg/L	19	19			1.1	1.5	1.28	
Aluminium SWA	mg/L	19	19			0.05	3.3	0.74	
Chloride	mg/L	19	19			4.4	9.5	5.89	
Magnesium	mg/L	19	19			1.4	2.2	1.73	
Temporary Hardness	mg/L	19	19			9.1	16	12.43	
Nitrate	µg/L	19	19			0.5	0.7	0.56	
Silica	mg/L	19	19			11	16	13.47	
Total Disolved Ions	mg/L	19	19			29	44	34.26	
TDS	mg/L	19	19			33	47	38.58	
Mole Ratio	mg/L	19	19			2.3	3.8	2.77	
Turbidity	NTU	19	19			1	47	5.11	
Hydroxide	mg/L	19	19			0	0	0.00	
Sodium	mg/L	19	19			4	6	4.53	
Fluoride	mg/L	19	19			0.05	0.05	0.05	
pH Sat.	mg/L	19	19			9.6	10.1	9.92	
True Colour	mg/L	19	19			1	12	6.39	
Alkalinity	mg/L	19	19			9	20	14.74	
Bicarbonate	mg/L	19	19			11	24	17.84	
Imidacloprid	ug/L	30	30			0.02	0.23	0.06	

Innisfail Scheme - SWA of Johnstone River Source Water 1/2016 to 1/2021																		
Number of Samples 28		FE-Iron	Mn	Zn-ZINC	B-Boron	Cu-Copper	Total Hardness	Saturation Index	Carbonate	H	Residual Alkalinity	Conductivity	Ca	pH	SAR	Sulphate	K-Potassium	Figure Merit Ratio
	Min	<0.01	<0.01	<0.06	<0.02	<0.03	1.00	-3.60	0.00	0.00	0.00	42.00	1.70	6.30	0.40	<1	0.62	1.10
	Average	0.10	0.00	0.10	0.00	0.00	13.00	-3.00	0.10	0.00	0.10	52.10	2.41	6.87	0.50	0.90	0.84	1.40
	Max	0.20	0.00	0.50	0.00	0.00	22.00	0.00	1.60	0.00	0.10	78.00	7.60	9.10	0.60	1.00	1.40	1.80
Number of Samples 28		Al	Chloride	Mg	Temp. Hardness	Nitrate	Si-Silica	Total Dissolved Ions	TDS	Mole Ratio	Turbidity	Hydroxide	Na	Fluoride	pH Sat.	True Colour	Alkalinity	Bicarbonate
	Min	<0.05	5.00	0.65	1.00	<0.05	10.00	21.00	32.00	0.90	<1	0.00	3.00	<0.005	9.10	<1	9.00	1.00
	Average	0.40	5.60	1.60	13.00	0.50	13.70	35.00	39.00	3.10	6.00	0.00	4.20	0.00	9.80	7.00	16.00	19.00
	Max	3.30	9.50	2.30	22.00	0.90	17.00	55.00	53.00	3.80	47.00	0.20	5.50	0.10	10.10	23	27.00	29.00

Table 3.7A Innisfail Scheme – SWA Johnstone River 1/2016 to 1/2021

Notes:

1. Imidacloprid continues to be detected in the river water. Of 30 samples the min of this pesticide was 0.02ug/L, average of 0.065 and max of 0.23

Table 3.8A: Treated Water Summary 2001 to 2011 -Standard Water Analysis (Qld Health Brisbane) + In-House

Innisfail Scheme Treated Water Quality									
Innisfail Treatment Plant									
Parameter	Units	2001 to 2011							Comments
		No Samples Collected	No in which parameter detected	No outside ADWG Health Limits	No outside ADWG Aesthetic Limits	Min	Max	Ave	
Turbidity	NTU	318	318	0	0	0.05	2.06	0.17	From 2005. Incl In-house test results
Free Chlorine	mg/L	319	319	0	0	0.98	2.20	1.73	From 2005 Incl In-house test results
E.Coli	CFU/100mL	24	0	0	0	0	0	0	From 2010
pH	units	317	317	0	1	6.40	7.83	7.33	From 2005. 6.4pH 18/05/2011 Incl In-house test results
Total hardness	mg/L	35	35	0	0	6.18	17.35	12	
Silica	mg/L	35	35	0	0	6	16	13	
TD Solids	mg/L	35	35	0	0	26	55.86	43.5	
True Colour	mg/L	35	35	0	0	0	13	2.2	
Sat Index	mg/L	35	35	0	0	-3.2	-1.9	-2.5	
Sodium	mg/L	35	35	0	0	4	9.2	6.4	
Calcium	mg/L	35	35	0	0	1	3.2	2.1	
Chloride	mg/L	35	35	0	0	4.8	10.5	8	
Fluoride	mg/L	35	35	0	0	0	0.1	0.1	
Nitrate	µg/L	35	35	0	0	0	0.98	0.5	
Sulphate	mg/L	35	35	0	0	0.46	1.3	1.0	
Iron	mg/L	35	35	0	0	0	0.1	0	
Manganese	mg/L	35	35	0	0	0	0.01	0	
Zinc	mg/L	35	35	0	0	0	0.03	0	
Aluminium	mg/L	35	35	0	0	0	0.08	0	
Boron	mg/L	35	35	0	0	0	0.04	0	
Copper	mg/L	35	35	0	0	0	0.03	0	
THM(s)									No data
Imidiclodprid	ug/l	2009-2011	35 19	Not listed	Not listed	<0.01	0.1	0.02	

Innisfail Scheme Treated Water Quality									
Innisfail Water Treatment Plant									
2013 - 2016									
Parameter	**Units**	**NO. Samples Collected**	**NO. in which parameter detected**	**NO. outside ADWG Health Limits**	**NO. outside ADWG Aesthetic Limits**	**Min**	**Max**	**Ave**	**Comments**
Iron	mg/L	19	19	0	0	0.01	0.01	0.01	
Manganese	mg/L	19	19	0	0	0.01	0.01	0.01	
Zinc	mg/L	19	19	0	0	0.01	0.06	0.02	
Boron	mg/L	19	19	0	0	0.02	0.03	0.02	
Copper	mg/L	19	19	0	0	0.03	0.06	0.04	
Total Hardness	mg/L	19	19	0	0	10	17	12.58	
Saturation Index	mg/L	19	19	0	0	-3	-2	-2.39	
Carbonate	mg/L	19	19	0	0	0	0.1	0.01	
Hydrogen	mg/L	19	19	0	0	0	0	0.00	
Residual Alkalinity	mg/L	19	19	0	0	0	0.1	0.07	
Conductivity	mg/L	19	19	0	0	51	79	64.16	
Calcium	mg/L	19	19	0	0	1.8	3.1	2.27	
pH	units	19	19	0	0	7.05	7.7	7.47	
SAR	mg/L	19	19	0	0	0.6	0.9	0.79	
Sulphate	mg/L	19	19	0	0	1	1.1	1.02	
Potassium	mg/L	19	19	0	0	0.6	1.2	0.83	
Figure Merit Ratio	mg/L	19	19	0	0	0.7	1.1	0.91	
Aluminium SWA	mg/L	19	19	0	0	0.05	0.05	0.05	
Chloride	mg/L	19	19	0	0	6.5	9.1	7.89	
Magnesium	mg/L	19	19	0	0	1.4	2.2	1.71	
Temporary Hardness	mg/L	19	19	0	0	10	17	12.58	
Nitrate	µg/L	19	19	0	0	0.5	0.8	0.60	
Silica	mg/L	19	19	0	0	12	16	13.58	
Total Disolved Ions	mg/L	19	19	0	0	31	49	39.74	
TDS	mg/L	19	19	0	0	36	52	43.26	
Mole Ratio	mg/L	19	19	0	0	2.4	3.2	2.69	
Turbidity	NTU	19	19	0	0	1	2	1.40	
Hydroxide	mg/L	19	19	0	0	0	0	0.00	
Sodium	mg/L	19	19	0	0	5	8	6.42	
Fluoride	mg/L	19	19	0	0	0.05	0.05	0.05	
pH Sat.	mg/L	19	19	0	0	9.6	10.1	9.86	
True Colour	mg/L	19	19	0	0	1	2	1.17	
Alkalinity	mg/L	19	19	0	0	12	21	15.84	
Bicarbonate	mg/L	19	19	0	0	14	26	19.11	
Imidacloprid	ug/L	36	36			0.00	0.19	0.05	

Table 3.8B: Treated Water Summary Jan 2013 to Sept 2016 -Standard Water Analysis (Qld Health Brisbane)

Innisfail Scheme Treated Water Quality - Jan 2016 - Jan 2021 - (WTP and Stoters Res) - SWA and Pesticide Results												
Johnstone	**Number of Samples 26**		**FE-Iron**	**Mn-Manganese**	**Zn-ZINC**	**B-Boron**	**Cu-Copper**	**Total Hardness**	**Saturation Index**	**Carbonate**	**H-Hydrogen**	**Residual Alkalinity**
		Min	0.01	0.01	0.01	0.02	<0.01	9.70	-3.40	0.00	0.00	0.00
		Average	0.02	0.01	0.08	0.02	0.06	12.37	-2.53	0.00	0.00	0.10
		Max	0.10	0.01	0.50	0.02	0.16	17.00	2.60	0.10	0.00	0.20
Johnstone	**Number of Samples 26**		**Al-Aluminium**	**Chloride**	**Mg-Magnesium**	**Total Hardness**	**Nitrate**	**Si-Silica**	**Total Dissolved Ions**	**TDS**	**Mole Ratio**	**Turbidity**
		Min	0.05	7.00	1.30	9.70	0.08	10.00	33.00	14.00	2.30	1.00
		Average	0.05	7.90	1.68	12.37	0.49	13.46	40.27	42.00	3.03	1.00
		Max	0.05	9.00	2.20	17.00	0.90	17.00	53.00	53.00	3.60	1.00
Johnstone	**Number of Samples 26**		**Conductivity**	**Ca-Calcium**	**pH**	**SAR**	**Sulphate**	**K-Potassium**	**Figure Merit Ratio**			
		Min	50.00	1.70	6.55	0.07	0.70	0.60	0.70			
		Average	60.38	2.24	7.12	0.72	1.26	0.84	1.00			
		Max	76.00	3.40	7.68	0.90	7.00	1.30	1.20			
Johnstone	**Number of Samples 26**		**Hydroxide**	**Na-Sodium**	**Fluoride**	**pH Sat.**	**True Colour**	**Alkalinity**	**Bicarbonate**			
		Min	0.00	5.00	0.02	9.50	1.00	11.00	14.00			
		Average	0.00	5.90	0.04	9.85	1.50	16.69	20.50			
		Max	0.00	8.00	0.05	10.10	5	25.00	36.00			
Johnstone	**Number of Samples 41**		**Imidacloprid**	**Pesticides Various**								
		Min	0.02	0.00								
		Average	0.070	0.00								
		Max	0.19	0.00								

Table 3.8C: Treated Water Summary Jan 2016 to Sept 2021 -Standard Water Analysis (Qld Health Brisbane)

Table 3.9A: Innisfail Reticulation - In-House and SWA Test Results 2001 to 2011

Innisfail Scheme Reticulation Water Quality South Johnstone, Mena Creek, Wrights park, Flying Fish Point, Eubenangee, Garradunga and Castor Park									
Parameter	**Units**	**2001 to 2011**							**Comments**
		No Samples Collected	**No in which parameter detected**	**No outside ADWG Health Limits**	**No outside the ADWG Aesthetic Limits**	**Min**	**Max**	**Ave**	
Turbidity (Combined data)	NTU	1789	1789	0	9	0.06	22.2	0.42	2005-11 Scouring & main breaks. Incl. In-house test results
Free Chlorine	mg/L	1801	1801	0	0	0.01	2.5	1.13	2005-11 Incl. In-house test results
E.Coli	CFU/100mL	178	178	0	0				2005-11
pH (Combined data)	units	1782	1782	0	484	6.56	10.24	8.03	2005-11 soft water long AC mains
Total hardness (SWA)	mg/L	208	208	0	0	2.1	41.65	15.2	
Silica (SWA)	mg/L	208	208	0	0	6	25.5	12.7	
TD Solids (SWA)	mg/L	208	208	0	0	31	138	50.7	
True Colour (SWA)	HU	208	208	0	1	0	17	2.2	
Sat Index (SWA)	mg/L	208	208	0	0	-4.1	0.9	-1.9	
Sodium (SWA)	mg/L	208	208	0	0	4	55	8.2	
Calcium (SWA)	mg/L	208	208	0	0	0.1	16.2	3.8	
Chloride (SWA)	mg/L	208	208	0	0	3.95	13.51	7.8	
Fluoride (SWA)	mg/L	208	208	0	0	0	0.12	0	
Nitrate (SWA)	µg/L	208	208	0	0	0	5.22	0.4	
Sulphate (SWA)	mg/L	208	208	0	0	0	24.36	2.9	
Iron (SWA)	mg/L	208	208	0	0	0	0.28	0	
Manganese (SWA)	mg/L	208	208	0	0	0	0.04	0	
Zinc (SWA)	mg/L	208	208	0	0	0	0.63	0	
Aluminium (SWA)	mg/L	208	208	0	0	0	0.14	0	
Boron (SWA)	mg/L	208	208	0	0	0	0.1	0	
Copper (SWA)	mg/L	208	208	0	0	0	0.28	0	
THM(s)									No data

Innisfail Scheme Treated Water Quality									
Sth Johnstone, Mena Ck, Wrights Park, Flying Fish Pt, Eubenangee, Garradunga and Castor Park									
2012 – 2016									
Parameter	**Units**	**No. Samples Collected**	**No. in which parameter detected**	**No. outside ADWG Health Limits**	**No. outside ADWG Aesthetic Limits**	**Min**	**Max**	**Avg**	**Comments**
Iron	mg/L	82	82	0	0	0.0	0.2	0.04	
Manganese	mg/L	91	91	0	0	0.0	0.0	0.01	
Zinc	mg/L	82	82	0	0	0.0	0.5	0.06	
Boron	mg/L	82	82	0	0	0.0	0.0	0.02	
Copper	mg/L	91	91	0	0	0.0	0.1	0.03	
Total Hardness	mg/L	82	82	0	0	1.0	18.0	13.09	
Saturation Index	mg/L	82	82	0	0	-3.5	-0.5	-2.28	
Carbonate	mg/L	82	82	0	0	0.0	0.7	0.04	
Hydrogen	mg/L	82	82	0	0	0.0	0.0	0.00	
Residual Alkalinity	mg/L	91	91	0	0	0.0	0.1	0.07	
Conductivity	mg/L	91	91	0	0	6.0	82.0	61.95	
Calcium	mg/L	82	82	0	0	1.7	6.0	2.66	
pH	units	82	82	1	1	6.6	8.8	7.51	
SAR	mg/L	82	82	0	0	0.5	0.9	0.72	
Sulphate	mg/L	91	91	0	0	0.0	1.2	0.99	
Potassium	mg/L	91	91	0	0	0.2	1.3	0.83	
Figure Merit Ratio	mg/L	91	91	0	0	0.7	1.5	1.05	
Aluminium SWA	mg/L	91	91	0	0	0.1	3.3	0.18	
Chloride	mg/L	82	82	0	0	4.4	9.5	7.45	

Magnesium	mg/L	91	91	0	0	0.4	2.2	1.64	
Temporary Hardness	mg/L	91	91	0	0	9.1	18.0	13.32	
Nitrate	µg/L	82	82	0	0	0.5	0.8	0.59	
Silica	mg/L	82	82	0	0	11.0	16.0	13.55	
Total Disolved Ions	mg/L	91	91	0	0	29.0	52.0	39.89	
TDS	mg/L	82	82	0	0	33.0	421.0	47.52	
Mole Ratio	mg/L	91	91	0	0	1.3	3.8	2.57	
Turbidity	NTU	82	82	0	0	1.0	47.0	2.93	
Hydroxide	mg/L	91	91	0	0	0.0	0.1	0.00	
Sodium	mg/L	82	82	0	0	4.0	8.0	5.99	
Fluoride	mg/L	91	91	0	0	0.1	0.1	0.08	
pH Sat.	mg/L	91	91	0	0	9.1	10.1	9.78	
True Colour	mg/L	91	91	0	0	1.0	16.0	3.81	
Alkalinity	mg/L	82	82	0	0	9.0	23.0	16.24	
Bicarbonate	mg/L	91	91	0	0	11.0	28.0	20.07	
Imidacloprid	ug/L	99	99			0.0	0.2	0.05	

Table 3.9B: Innisfail Reticulation - SWA Test Results 2012 to 2016

Innisfail Scheme Treated Water Quality									
South Johnstone, Mena Creek, Wrights park, Flying Fish Point, Eubenangee, Garradunga and Castor Park Mourilylan Harbour									
2016 -2021									
Parameter	**Units**	**NO. Samples Collected**	**NO. in which parameter detected**	**NO. outside ADWG Health Limits**	**NO. outside ADWG Aesthetic Limits**	**Min**	**Max**	**Ave**	**Comments**
Iron	mg/L	78	78	0	0	<0.01	0.05	0.01	
Manganese	mg/L	78	78	0	0	0.12	2.2	1.05	
Zinc	mg/L	78	78	0	0	<0.06	0.25	0.07	
Boron	mg/L	78	78	0	0	<0.002	0.02	0.02	
Copper	mg/L	78	78	0	0	<0.003	0.04	0.02	
Total Hardness	mg/L	78	78	0	0	10	28	16.50	
Saturation Index	mg/L	78	78	0	0	-3	-0.6	-1.50	
Carbonate	mg/L	78	78	0	0	0	47	0.50	
Hydrogen	mg/L	78	78	0	0	0	0	0.00	
Residual Alkalinity	mg/L	78	78	0	0	0	0.2	0.09	
Conductivity	mg/L	78	78	0	0	6	96	68.30	
Calcium	mg/L	78	78	0	0	2	9.7	4.85	
pH	units	78	78	0	19	6.45	9.6	7.88	
SAR	mg/L	78	78	0	0	0.07	0.9	0.65	
Sulphate	mg/L	78	78	0	0	<1	1	0.90	
Potassium	mg/L	78	78	0	0	0.6	1.2	0.84	
Figure Merit Ratio	mg/L	78	78	0	0	0.8	2.1	1.27	
Aluminium SWA	mg/L	78	78	0	0	<0.05	0.05	0.05	
Chloride	mg/L	78	78	0	0	0	10	8.00	
Magnesium	mg/L	78	78	0	0	0.12	2.2	1.05	
Temporary Hardness	mg/L	78	78	0	0	10	28	17.00	
Nitrate	µg/L	78	78	0	0	<0.05	1	0.44	
Silica	mg/L	78	78	0	0	9	16	13.50	

Total Disolved Ions	mg/L	78	78	0	0	4	68	46.90	
TDS	mg/L	78	78	0	0	38	65	48.20	
Mole Ratio	mg/L	78	78	0	0	0	3.5	2.19	
Turbidity	NTU	78	78	0	0	<1	1	2.00	
Hydroxide	mg/L	78	78	0	0	0	0.5	0.10	
Sodium	mg/L	78	78	0	0	5	9	5.99	
Fluoride	mg/L	78	78	0	0	<0.005	0.05	0.06	
pH Sat.	mg/L	78	78	0	0	8.9	10	9.40	
True Colour	mg/L	78	78	0	0	<1	3	1.27	
Alkalinity	mg/L	78	78	0	0	14	35	21.00	
Bicarbonate	mg/L	78	78	0	0	16	41	24.50	
Pesticides (various)	ug/L	144	144			0	0	0.00	
Imidacloprid	ug/L	43	43			0.02	0.11	0.05	

Table 3.9C: Innisfail Reticulation - SWA Test Results 2016 to 2021

Table 3.10: Innisfail Scheme Reticulation Water Quality Data 2012 to 2016

Innisfail Scheme- Results of In-House Reticulation Water Quality Testing - 1/2012 to 5/2016												
Parameter		**1001 Raw Water**	**1002 Treated Water**	**1101 Allan Maruff house (Innisfail)**	**1102 Wrights Park**	**1106 Flying Fish Point**	**1107 Garradunga**	**1108 Eubenangee**	**1109 Castor Park**	**1110 South Johnstone Chappa**	**1111 Mena Creek Park**	**1113 Mourilyan Harbour Boat Ramp**
pH	**Min**	5.99	6.25	6.51	5.40	6.56	5.89	6.13	6.53	6.21	6.00	6.68
	Max	8.00	9.97	7.70	8.13	8.30	9.12	9.56	8.46	8.49	9.37	8.98
	Average	7.09	7.36	7.27	7.31	7.42	7.77	7.91	7.43	7.39	8.04	7.55
	Count	1580	1593	35	197	196	159	126	135	199	194	76
Chlorine residual	**Min**		0.42	0.00	0.20	0.05	0.17	0.08	0.22	0.32	0.04	0.17
	Max		3.09	2.54	2.60	2.02	2.24	1.83	2.25	2.07	1.17	2.00
	Average		1.97	1.19	1.19	1.08	1.12	0.86	1.14	1.33	0.45	0.96
	Count		1600	39	199	197	163	127	137	200	199	77
Turbidity	**Min**	0.73	0.01	0.09	0.01	0.03	0.03	0.05	0.05	0.00	0.01	0.03
	Max	589	7.45	2.46	3.50	2.39	2.24	2.10	6.28	4.08	3.50	3.00
	Average	8.80	0.26	0.75	0.59	0.60	1.12	0.62	0.73	0.55	0.46	0.53
	Count	1592	1601	36	199	197	163	127	137	200	198	77
E Coli	**Number of Tests**			23	39	37	46	35	30	32	49	22
	Number of Positives			0	0	0	0	0	0	0	0	0

3.3.3.1 Notes:

1. External verification for E-coli by a NATA lab was a yearly test for 2012 to 2015. In 2016, the frequency of external verification of E-coli increased to 6mthly. In 2017, the frequency of external verification E-coli increased to 3mthly all sites with an additional one site per month. Numbers of E-coli tests above include the external verification results.

Table 3.10A : Innisfail Scheme Reticulation Water Quality Data 2016 to 2021

Innisfail Water Quality Data Jan 2016 to Jan 2021												
Parameter		**1001 Raw Water**	**1002 Treated Water**	**1112 stotters res**	**1102 Wrights Park**	**1106 Flying Fish Point**	**1107 Garradunga**	**1108 Eubenangee**	**1109 Castor Park**	**1110 South Johnstone Chappa**	**1111 Mena Creek Park**	**1113 Mourilyan Harbour Boat Ramp**
pH	**Min**	6.39	7.00	6.84	6.03	6.60	6.60	6.63	6.70	6.31	6.65	6.60
	Max	7.93	7.93	8.86	8.87	9.54	9.54	9.74	9.02	9.50	9.81	9.42
	Average	7.17	7.46	7.45	7.60	7.70	8.09	8.35	7.70	7.66	7.83	8.13
	Count	1252.00	1549.00	84.00	172.00	184.00	131.00	127.00	74.00	162.00	163.00	149.00
Cl FREE	**Min**		0.95	1.23	0.54	0.29	0.29	0.11	0.78	0.35	0.20	0.25
	Max		2.74	2.60	2.69	2.43	2.29	2.75	2.33	2.56	1.70	1.99
	Average		0.16	1.93	1.41	1.30	1.39	1.12	1.59	1.62	0.30	1.08
	Count		1565.00	85.00	182.00	186.00	134.00	126.00	79.00	167.00	170.00	153.00
CL TOTAL	**Min**			1.32	0.56	0.43	0.38	0.19	0.93	0.78	0.22	0.24
	Max			2.73	2.26	2.30	2.89	3.01	2.74	2.61	1.70	2.35
	Average			2.00	1.49	1.32	1.49	1.24	1.73	1.69	0.84	1.13
	Count			61.00	95.00	102.00	67.00	74.00	37.00	89.00	93.00	91.00
Turbidity	**Min**	0.68	0.01	0.01	0.00	0.01	0.03	0.01	0.01	0.00	0.07	0.01
	Max	896.00	2.74	1.15	1.70	1.11	3.99	2.30	1.58	1.40	1.00	4.00
	Average	10.76	0.26	0.21	0.37	0.33	0.42	0.31	0.42	0.35	0.24	0.38
	Count	1265.00	1230.00	84.00	182.00	182.00	133.00	128.00	79.00	165.00	168.00	153.00
E Coli	**Number of Tests**	122.00	0.00	29.00	67.00	66.00	55.00	54.00	29.00	56.00	62.00	60.00
	Number of Positives	122	0	0	0	0	0	0	0	0	0	0

3.4.3 Complaints

Water Quality complaints as listed in Table 3.11 are mainly about dirty water and typically relate to mains break incidences. Mains flushing is undertaken in various locations in the scheme area. The flushing locations and frequency have been developed based on practical experience with dirty water complaints and network knowledge such as dead end mains.

Council monitors customer complaints and response time details as part of it Customer Service Charter (ECM document # 2327195. After each financial year, staff report outcomes of performance against key indicators in the Customer Service Charter and results are provided to the Regulator and uploaded onto the Council web site in the annual Performance Report.

The annual performance reports contain detailed analysis and commentary on each of the water quality complaints received by Council.

Table 3.11: Water Quality Complaints

Year	No of Water Quality Complaints	Water Quality Complaints per 1000 Connections	Main Reasons for Complaints	Likely Sources / Causes of Problems	Resolution of Problem
2019-2020	16	2.6	Dirty Water	Mains Breaks / Accumulation of silts in dead ends. A portion of the issues are due to the poor condition of old galv service lines that are the responsibility of the private owner.	Mains repaired, or scoured. Owners advised of their plumbing problems.
2018-2019	22	3.6	Dirty Water	Mains Breaks / Accumulation of silts in dead ends. A portion of the issues are due to the poor condition of old galv service lines that are the responsibility of the private owner.	Mains repaired, or scoured. Owners advised of their plumbing problems.
2017-2018	30	4.9	Dirty Water	Mains Breaks / Accumulation of silts in dead ends. A portion of the issues are due to the poor condition of old galv service lines that are the responsibility of the private owner.	Mains repaired, or scoured. Owners advised of their plumbing problems.
2016-2017	21	3.4	Dirty Water	Mains Breaks / Accumulation of silts in dead ends. A portion of the issues are due to the poor condition of old galv service lines that are the responsibility of the private owner.	Mains repaired, or scoured. Owners advised of their plumbing problems.
2014-2015	23	3.9	Dirty Water (Different method of recording complaints)	Main Breaks and scouring	Mains repaired, or scoured
2013-2014	12	2	Dirty Water	Main Breaks and scouring	Mains repaired, or scoured
2012-2013	17	2.8	Dirty Water	Main Breaks and scouring	Mains repaired, or scoured
2011-2012	14	2.3	Dirty Water	Main Breaks and scouring	Mains repaired, or scoured

SECTION 4

NYLETA WATER SUPPLY SCHEME

May 2021

4. Nyleta Scheme Details of Infrastructure

4.1 Source Details

4.1.1 Nyleta Creek Intake Source Details

The Nyleta Scheme sources its water from a run of stream intake in the Nyleta Creek and a bore off El Arish Mission Beach Road beside Jurs Creek. Nyleta Creek, which is a tributary to South Liverpool Creek, is a tropical stream with granite boulders and sandy bed located totally within the boundary of the World Heritage Listed Rainforest areas of Japoon National Park and Tully Gorge National Park. Nyleta Creek is subject to flooding.

The climate of this catchment can be described as tropical with distinctive wet and dry seasons. The average annual rainfall experienced at the WTP over the period of 2009 to 2012 is 4,267.3 mm with majority of rain fall from the months of December to April. The graphical representation of the daily rain fall and maximum temperature are displayed in Figure 4.0 below.

Figure 4.0: Monthly Rainfall for Silkwood (BOM)

Summary statistics for all years

Information about climate statistics

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	570.5	644.2	622.1	445.7	314.3	149.7	100.1	88.0	87.5	91.5	158.7	247.9	3503.7
Lowest	35.0	77.8	102.6	139.6	64.8	1.8	0.9	2.4	0.0	0.0	8.4	21.0	2066.9
5th %ile	89.8	253.8	182.6	195.1	116.1	28.5	15.0	6.2	1.2	3.1	32.8	41.5	2371.8
10th %ile	120.2	284.0	267.5	236.0	124.8	37.0	26.0	13.8	6.4	10.9	42.1	69.9	2536.6
Median	495.0	570.8	554.3	431.8	287.0	128.6	96.2	60.2	68.0	77.8	115.3	198.4	3421.0
90th %ile	981.0	1044.2	996.3	676.8	529.0	282.5	197.0	193.1	170.7	207.4	321.2	419.9	4351.3
95th %ile	1223.3	1326.9	1199.1	837.8	577.5	370.2	220.1	237.8	223.6	269.0	373.4	647.9	4790.3
Highest	2678.2	1450.8	1561.7	1098.6	771.3	472.0	312.4	340.2	508.6	342.7	575.8	1172.4	5518.8

The catchment above the intake is approximately 600 hectares. There has been no development and the area remains in a pristine condition. Access to the intake is via an unsealed gated road, 3.5km of the trail passes through the Japoon National Park. There are no permanent trails above the intake. The area is thickly vegetated tropical rainforest the region is subject to heavy rainfall and occasional tropical cyclones. The flow in the stream drops during long dry periods however the creek has not been known to fail completely.

4.1.2 Jurs Creek Bore Source Details

The Jurs Creek Bore water reserve is surrounded by Djiru National Park which remains in pristine condition. The bore is situated approximately 30m form Jurs Creek. Downstream and adjacent to the bore site there is agricultural land with Passion Fruit as the main crops. The average annual rainfall within the catchments is over 3550mm. Easy access is available to the site via a 700m gated unsealed road off the El Arish Mission Beach Road.

4.1.3 South Liverpool Creek Intake and Nyleta Hill Reservoir

The South Liverpool Creek Intake and Nyleta Hill Reservoir assets were constructed between 2016 and 2019 and consists of a sub-bed filtered pump intake on the South Liverpool Creek, pre-treatment 50 um autoscreens, and a 3.3ML reservoir on the adjoining Nyleta Hill with a primary disinfection system dosing directly into the reservoir.

Council's current water licence for Nyleta Ck allows 546ML per annum with a peak day demand of 3.64ML or 42L/s. Whilst this flow can be readily extracted for most months of the year, during periods of drought, the flows in Nyleta Ck become minimal. Moreover, the available allocation from Nyleta Ck is not sufficient for long term population growth in the supply zone, particularly at Mission Beach. Planning was completed in 2008 for water to be withdrawn from the South Liverpool Ck in a location adjoining the existing intake trunk main. (Nyleta Ck is a tributary of South Liverpool Ck.) The South Liverpool Ck system also runs quite low during dry periods but there is opportunity to extract from sub bed stream flow, hence the recommended intake incorporates a sub creek bed intake system with borehole pumps. On the basis of this planning, Council has obtained a license from DNRM to extract 1800ML per annum with a maximum of 120L/s on a peak day and a maximum of 210ML in any month.

In 2014, Nyleta Ck flow rates were very low and severe water restrictions were imposed. To improve the system resilience in these periods of low rainfall, Council accelerated the design and construction of the new Sth Liverpool Ck intake. Funding was set aside in 2015/16 and 2016/17 to design and construct the new intake. As the Nyleta Ck intake is able to gravitate to the proposed reservoir it will continue to be the primary source of supply and will only be supplemented by the Sth Liverpool Ck pumped system when demand exceeds the Nyleta supply or when turbidity is higher in the Nyleta Ck.

The Sth Liverpool Ck intake incorporates sand filters below the bed of the creek. Council has successfully utilised the intake to draw water through the filters at less than 5 NTU even when the Sth Liverpool Ck has turbidities as high as 45NTU. This feature has proven quite valuable during prolonged periods of turbidity in either the Nyleta or Sth Liverpool Cks.

The Sth Liverpool Ck catchment upstream of the intake is approximately 70Km2 (approximately 10 times larger than the Nyleta Ck catchment). The catchment area is entirely World Heritage listed rainforest national parks aside from a very small cane farm area opposite the intake site.

In early 2015, Council finalised the purchase of an elevated parcel of land (Nyleta Hill- lot 680 SP267852) on which to construct a 3.3ML reservoir. The Nyleta Hill reservoir site immediately adjoins the South Liverpool Ck intake. The site plan of the reservoir and new intake is shown in Figure 4.1. The proposed water reservoir was intended to buffer demands off the intake pipe, to provide emergency storage in the event the intakes or intake lines need maintenance and to provide a clear water storage of up to 24 hours if the source water from the intakes was greater than 5 NTU.

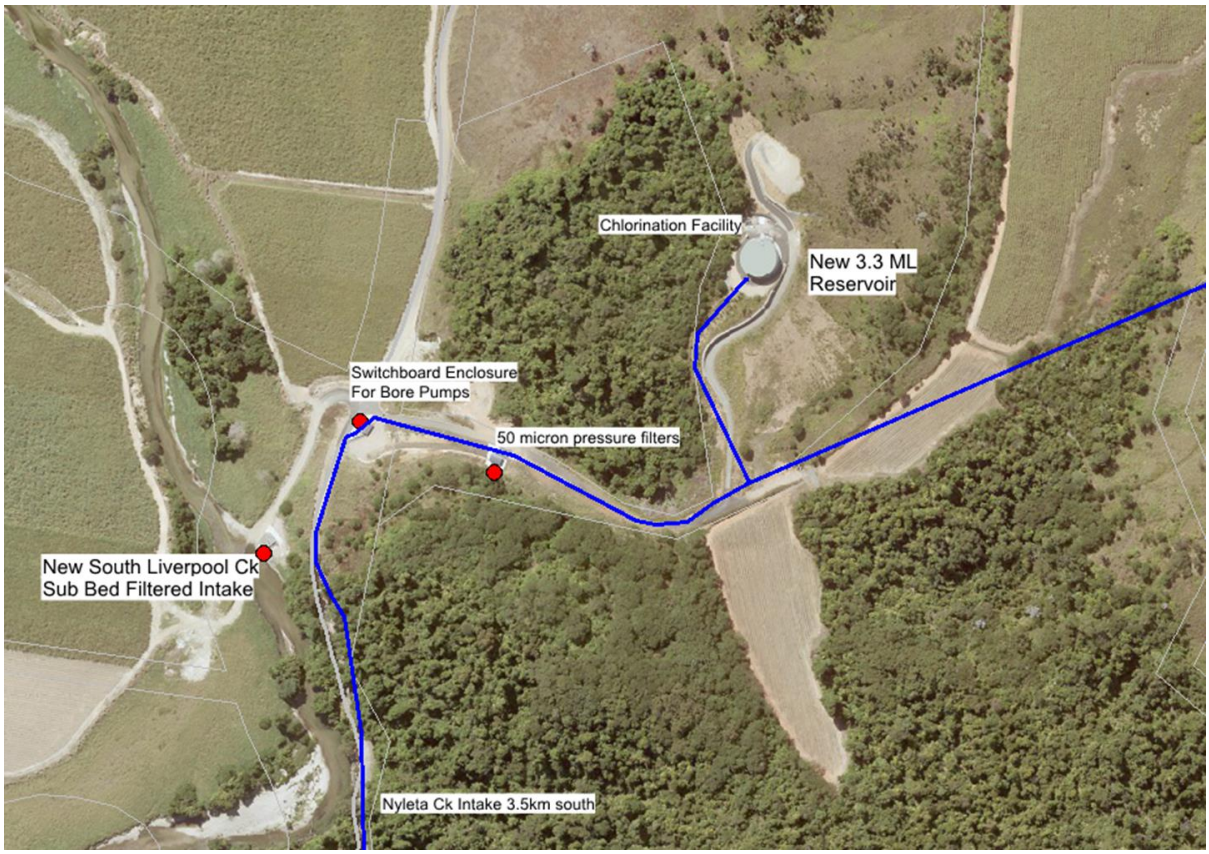


Figure 4.1: Site Plan of Reservoir and New Intake

4.2 Treatment, Disinfection and Processes

4.2.1 Intake Source Water

4.2.1.1 Nyleta Ck intake

The Nyleta intake consists of a small weir like structure across the stream. As water traverses the weir, a portion of the flow passes through a *Johnston Screen* to remove larger sticks, leaves and sand and then enters the pipe system. There are no intake pumps as the natural water head is sufficient to feed the system. A 4.4km majority cast iron main runs along the access trail to the No4 Branch Chlorinator and filter.

4.2.1.2 Jurs Ck Bore

The Jurs Creek bore consists of two bores which are not operated together. The pumps are connected to mains power and operated on demand from a height sensor on Fenby's Gap Reservoir via a mobile link. The bores are concrete capped and in good condition. A 4.2 km AC main runs from the bore along El Arish Mission Beach Road to Fenby's Gap Reservoir. The pump capacity of the existing bores is only able to supply Mission Beach. The site has good easy access.

4.2.1.3 Sth Liverpool Intake

The intake facility in the bed of the Sth Liverpool Ck consists of 4*5.5m * 300mm dia "Johnstone" stainless steel screens with 1.5mmm openings. The inlet capacity of the screens is 201 L/s which allows approximately 50% excess capacity for potential blockage. Surrounding the screens is a gravel filter pack of 2.5 to 5mm gravel 3m wide * 1.5m deep. Above the filter gravels, the bed of the creek is lined with 300mm deep course river rock. A manifold from the screens is connected to 2 inclined 60kW borehole pumps which

will be operated initially on a duty/standby arrangement. Under the ultimate case, the system will be upgraded to a duty/duty/standby arrangement at which point 2 pumps will be able to operate in parallel.

The single point duty is approximately 54L/s and 75m and the parallel duty is 120L/s and 80m. There have been some operational difficulties in achieving the design duty flows. The current system comfortably pumps to approximately 40L/s but the submergence of the bore pumps and possibly the losses in the manifold system are restricting the flow rates available. It is likely the pumping system will need to be replaced before these long term duties are required.

Council's long term planning projections out to 2061 indicate that with no supply from either Nyleta Ck or Jurs Ck, the South Liverpool intake should not be required to pump more than 96L/s MDMM 20 hours per day to the adjoining Nyleta Hill reservoir. This conservatively assumes the coastal areas of greater Mission Beach including Wongaling Beach and South Mission Beach are also supplied from the Nyleta system and not from the Tully system (Bulgun Creek intake).

4.2.2 Pre-Treatment

Water sourced from Nyleta Intake and the South Liverpool Intake is pre-treated by a 50 micron pressure screen prior to the Nyleta Reservoir.

Constructed in 2018 the Nyleta Autoscreen's consists of two 50 micron stainless steel wedge wire screens. The screens are installed in a duty plus duty arrangement with each unit capable of 60 litres per second (or 100% of the flow) or 120 litres per second for the ultimate case.

The screens are self cleaning and feature an automatic backwash sequence which is triggered by differential pressure or time period.

The screens do not provide treatment but is sufficient to remove larger organic material and sand prior to the reservoir and chlorination.

An older self flushing 200 micron disk filter is installed at No4 Branch Chlorinator. This filter is currently not being operated.

4.2.3 Treatment

There is no treatment in the Nyleta Scheme.

A major feature of the upgrades with the Sth Liverpool Ck intake and the new Nyleta Hill reservoir will be the ability to control turbidity in the downstream reticulation system. The current system of filtration at the No4 Branch Chlorinator is quite course (200 micron) and is not able to restrict fine sediments from passing into the distribution system. With the new intake and reservoir, Council has other options for the management of turbidity. Turbidity analysers have been established on the Nyleta Ck and Sth Liverpool Intake systems. Nyleta Ck will be the primary source water as it is gravity fed but if the turbidity rises above a predefined limit (approximately 5NTU), an automated control valve will close off the Nyleta Ck supply. Water for the community will initially be sourced directly from the reservoir but as the reservoir drops, the Sth Liverpool Ck intake system will be initiated. The buried filter beds of the Sth Liverpool intake will be able to filter much of the fine sediments that cause problems in the distribution network.

4.2.4 Disinfection

4.2.4.1 Nyleta Reservoir Chlorinator

This is the primary disinfection dosing site for water sourced from Nyleta creek and South Liverpool Creek.

The chlorinator consists of a recirculation pump, dosing pumps and chlorine analyser. Water from the reservoir is drawn from outlet of the reservoir using a small pump and passed through a chlorine analyser. A

PLC using a PID control loop adds Sodium Hypochlorite (NaOCL) before passing the water back to the reservoir. This system operates continuously to maintain the chlorine residual in the reservoir at a controlled set point, nominally 2.0 mg/L.

The site is inspected twice a week or if an alarm is triggered through the SCADA. The site has mains power and an emergency generator.

4.2.4.2 No4 Branch Chlorinator

Formally the primary disinfection dosing site, this site is now used to provide a re-chlorination dose of Sodium Hypochlorite prior to the main reticulation site.

The site has a turbidity analyser and a chlorine analyser, and can be used as secondary dosing site if dosing is not available from the Nyleta Reservoir chlorinator.

Sodium hypochlorite (NaOCl) is injected into the reticulation main from a storage tank via a dosing pump. Chlorination levels are set between ADWG health limits. Dosing is automatically flow paced by the PLC using inputs from the turbidity analyser and flow meter. In periods of high turbidity, dosing can also be increased remotely through SCADA. For turbidity above 5 NTU (critical level), SCADA automatically adjusts the chlorine dosing rate based on flow rate and turbidty factor. SCADA alarms have been set up to alert when turbidity is greater than 5 NTU for longer than 4 hours. A high chlorine alarm registers when chlorine residual exceeds the setpoint level. The site is inspected twice a week or if an alarm is triggered through the SCADA. The site has mains power and an emergency generator.

4.2.4.3 Jaffa Road Chlorinator

This site has a chlorine analyser. This site can be used as a re-chlorination point in emergency situations. Chlorine residuals downstream of the Nyleta Hill reservoir are generally quite stable and not impacted by turbidity as they were previously so this rechlorination facility is not needed. Sodium hypochlorite (NaOCl) can be injected into the reticulation main from a storage tank via a dosing pump. The dose rate is manually adjusted on site as required by water treatment operators. The site has mains power. A portable generator could be connected to this site if needed.

4.2.4.4 Daveson Road Chlorinator

This site has a chlorine analyser only. Since the commissioning of the new head reservoir at Nyleta there has been no need for additional hypochlorite dosing at Daveson Rd. The site has mains power. A portable generator could be connected to this site if needed.

4.2.4.5 Jurs Creek Chlorinator

Sodium hypochlorite (NaOCl) is injected into the main from a storage tank via a dosing pump. The dose rate is flow paced and manually adjusted on site as required by water treatment operators. The site is inspected twice a week. The site has mains power. A portable generator could be connected to this site if needed.

The Chlorination Systems for the Nyleta Scheme are shown in Figure 4.2. Refer to the quality control procedure that has been developed for high turbidity events.

A summary of the intake, pumping and disinfection system is shown in Table 4.0.

Figure 4.2: Chlorinator Schematic

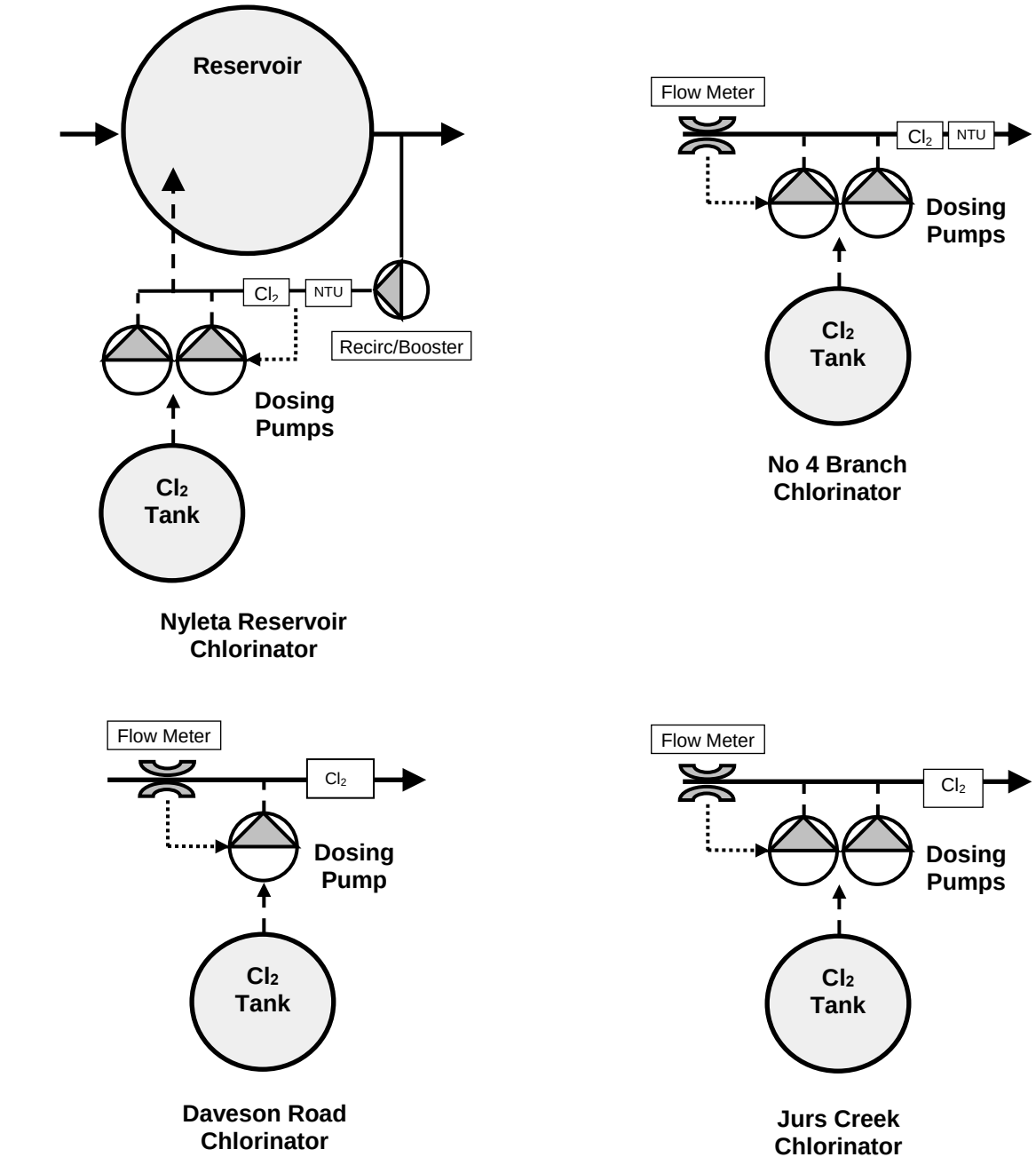


Table 4.0: Source & Treatment Details

Component		Nyleta Scheme
Sources	Name	**Nyleta Creek**
	Type	Creek
	% of supply	80%
	Reliability	Generally reliable continuous supply of water. Low flow in drought periods
	Water quality issues	Turbidity Spikes following high rainfall.
	Name	**Sth Liverpool Ck**
	Type	Creek
	% of supply	Variable 3 to 7% (To date wet weather use only when Nyleta Ck impacted by high turbidity).
	Reliability	Resilient- 10* larger catchment than Nyleta Ck
	Water quality issues	Turbidity spikes after high rainfall but mitigated by in bed filtration.
	Name	**Jurs Creek Bore**
	Type	Bore
	% of supply	Variable < 20%. Will decline with use of Clump Mtn booster.
	Reliability	Reliable continuous supply of water
	Water quality issues	Low pH
Sourcing Infrastructure	Type	Intake
	Description	Location: Nyleta Creek, Concrete Weir Screen Type: Johnson 1.2mm
	Type	Sub-bed filtered intake
	Description	Location: Sth Liverpool Ck **(Commissioned 1/18)** Screen Type: 1.5mm slotted vee-wire SS Screen 22m long * 300mm dia Bed filter pack: 2.5 to 5 mm gravel 3m wide * 1.5 m deep * 23.3m long. Pumps: 2* Inclined Borehole Type Lowara Z10275 3/2B-L8W SD Pump duty : 54L/s at 75m single 120L/s at 80m for 2 pump operation.
	Type	Bore
	Description	Location: Jurs Creek, Pump 1: 1 x Grundfoss SP46-11 18 kW (approx. 6l/s) Pump 2: 1 x Grundfoss SP60-12 22 kW (approx. 10l/s) Bore 1: Is being used predominantly due to problems with recharging larger bore. Pump suction of both bores set 40m depth. Bore 1: Casing S/S OD177 150mm ID Inlet screens 8m to 10m and 31m to 41m

Component		Nyleta Scheme
		Bore 2: Casing S/S OD315 Inlet screens 11m to 13m and 31m to 41m.

Pre-Treatment	Name	**Nyleta Autoscreens**
	Process	**50um Self Cleaning Pressure Filter** *(STF Filter Model FMA-2010)*
	Design Capacity	60 lps (Duty + Duty, each unit capable of 100% of the flow)
	Daily flow range	5.2 ML/day
	Filter Backwash	Time or pressure differential – No pumps
	Control	PLC control with integration into Councils SCADA system for remote monitoring and control
	Bypasses / Variations	Backwash initiated on time and/or differential pressure.
Pre-Treatment	Name	**No 4 Branch Filter (not in use)**
	Process	200um *Arkal* disc filter
	Design Capacity (20 hr operation)	ML/d 3.6 with average water quality
	Daily flow range	ML/d 0 - 3
	Filter Backwash	Time or pressure differential – No pumps
	Bypasses / Variations	Manual bypass possible

Disinfection	Location	**Nyleta reservoir**
	Type	Sodium Hypochlorite
	Dose rate	76 l/day Approx. average
	Target residual levels	Between 1.5. and 2.5 mg/l
	Duty	2-Pumps pumping together
	Dosing arrangements	Residual Set Point – PID control Loop
	Alarms	Scada set points
	Generator	Yes – auto start
Disinfection	Location	**No 4 Branch Chlorinator**
	Type	Sodium Hypochlorite
	Dose rate	6 l/day Approx. average
	Target residual levels	Between 1.5 and 2.5 mg/l
	Duty	2-Pumps pumping together
	Dosing arrangements	Flow paced,
	Alarms	Scada set points
	Generator	Yes – auto start
Disinfection	Location	**Jaffa Road Chlorinator (Analyser only since 2017)**
	Location	**Daveson Road Chlorinator (Analyser only since 2017)**

Disinfection	Location	**Jurs Creek Chlorinator**
	Type	Sodium Hypochlorite
	Dose rate	10 l/day Approx. average
	Target residual levels	Between 1.8 and 2.8 mg/l
	Duty	1-Pump
	Dosing arrangements	On pump start
	Alarms	Scada set points
	Generator	No - portable available with notice

4.3 Distribution and Reticulation Details

The Nyleta Water Supply Scheme was constructed in the late 1950's to service the townships of Silkwood, El Arish and Kurrimine Beach. Jurs Creek intake, constructed in 1971, pumped to Fenby's Gap Reservoir to supply (North) Mission Beach and Bingil Bay. In the mid 1980's a major trunk main was constructed from Silkwood to Bingil Bay allowing the gravity fed Nyleta Creek to be the primary source of supply. In 1996, the Jurs Ck intake was decommissioned due to water quality issues and two bores were installed adjoining the creek.

4.3.1 Nyleta Supply

Following disinfection at Nyleta Reservoir water is supplied directly to reticulation. There are no service reservoirs in the upper part of the scheme. The main traverses a difficult path through Hill 60 down to the Jaffa Road Chlorinator. The original 250mm cast Iron main installed in 1959 from the intake to Jaffa Rd remains in service and is in good condition. The network supplies small rural communities, agricultural and remote properties therefore there are long service mains with few connections. PRV's reduce supply pressures to parts of lower El Arish, Silkwood, Kurrimine Beach and Mission Beach. These valves were installed to reduce repeated main breaks in the relevant areas.

A 150mm branch line runs from Silkwood to Kurrimine Beach along Murdering Point Rd and Kurrimine Beach Rd to the Bay Hill Reservoir which is located on the western extremities of Kurrimine Beach town. Peak demands and fire flows in Kurrimine Beach are satisfied by the Bay Hill reservoir. A control valve along Murdering Point Road closes during the day to work the reservoir and maintain chlorine residual and is activated by radio telemetry to fill based on time and low level set point. Due to the long service main, soft water and low consumption Kurrimine Beach has often recorded high pH levels.

The Mission Beach supply line runs from Jaffa Rd along King Rd, Daveson Road and Bingil Bay Rd. A significant portion of this main was constructed in glass reinforced plastic (Hobas). Some of the Hobas pipe was supplied with in class 10 which resulted in large numbers of breaks. Council is progressively replacing all the class 10 Hobas pipe. The King Road (Mission Beach) PRV was installed to reduce pressure and breaks on the Daveson Road main. Currently the King Rd PRV is set at about 65m HGL. The Bingil Bay Booster Pumps increase mains pressure to levels sufficient to fill the Bingil Bay Reservoir. The pumps are operated by radio telemetry from the reservoir based on high and low level set points.

The Narragon Beach PRV reduces and soothes main pressures into Mission Beach for system leakage reduction. Council has been progressively replacing the AC mains in Mission Beach which have a history of failures largely related to softening in the high water table and the high pressures. A new 200mm main connects with the 375mm main in Seaview St and runs along Porters Promenade to service the commercial Mission Beach hub area up to the Council caravan park.

4.3.2 Jurs Ck Bore Supply

Following disinfection the Jurs Creek bores pump through 4 km of 150mm AC main to Fenby's Gap Reservoir. The pumps are connected to mains power and operated by radio telemetry from the reservoir based on high and low level set points. The reservoir telemetry equipment is powered by solar panels.

Fenby's Gap Reservoirs feed into the reticulation network a though PRV located in the Clump Mountain Station.

In periods of low flow or poor water quality from Nyleta Creek the Jurs Creek system is isolated through Mission Beach along Seaview Street. During planned maintenance or main breaks flow can be reversed and the Jurs Creek/Fenby's Gap reservoir utilised to supply water to the majority of the Nyleta scheme network.

Although drawdown testing has confirmed there is scope to increase the output from the Jurs Ck bores to 15l/s, the AC rising main to Fenby's Gap has some history of failures due to the high operating pressures of the system and is currently restricted to about 8l/s. The long term usage of the Jurs Ck bore will be reconsidered when the AC pipeline to Fenby's Gap reservoir becomes too unreliable.

4.3.3 Clump Mountain Pump Station

Clump Mt pump station provide two functions. Its primary function is to reduce the pressure (480 kPa) into the reticulation main of water supplied from Fenby's Reservoir. Its second function is to recharge Fenbys Reservoir from the Nyleta intake reticulation system by pumping up water during period of low demand (night).

The pump is a duty + duty variable speed booster system, with a nominal duty point of 10 lps at 40m for each pump set.

The ability to recharge Fenbys reservoir from Nyleta enhances the security of supply to Mission Beach and Wongaling Beach via the Nyleta and Tully scheme interconnection during period of low water quality in the Tully Scheme.

4.3.4 Mission Beach - Interconnection between Nyleta and Tully Systems

A section of 225mm main along Tully Mission Beach Rd, Mission Beach (between Mission Circle and Stephens St) was completed in 2016 that interconnects the Nyleta and Tully reticulation schemes. This important interconnection allow flows to be redirected into either catchment during periods of water shortages or high demand. This is a significant supply risk mitigation measure. On normal day to day operations, a flow of about 2L/s is directed south from Nyleta through the interconnection but during boil water events in the Tully Scheme area, this is regularly increased to about 9L/s to extend the available clean water storage in the Wheatleys Hill reservoir and ensure the South Mission Beach and Wongaling communities avoid the boil water requirements.

A control valve and flowmeter has been installed on the main at Mission Circle. The control valve can be SCADA actuated to allow flow reversal as needed.

The Nyleta Water Supply Scheme Map is shown Figure 4.3 and the Nyleta Scheme Reticulation Schematic is shown in Figure 4.4.

Details of the reservoirs in the Nyleta Scheme are shown in Table 4.1.

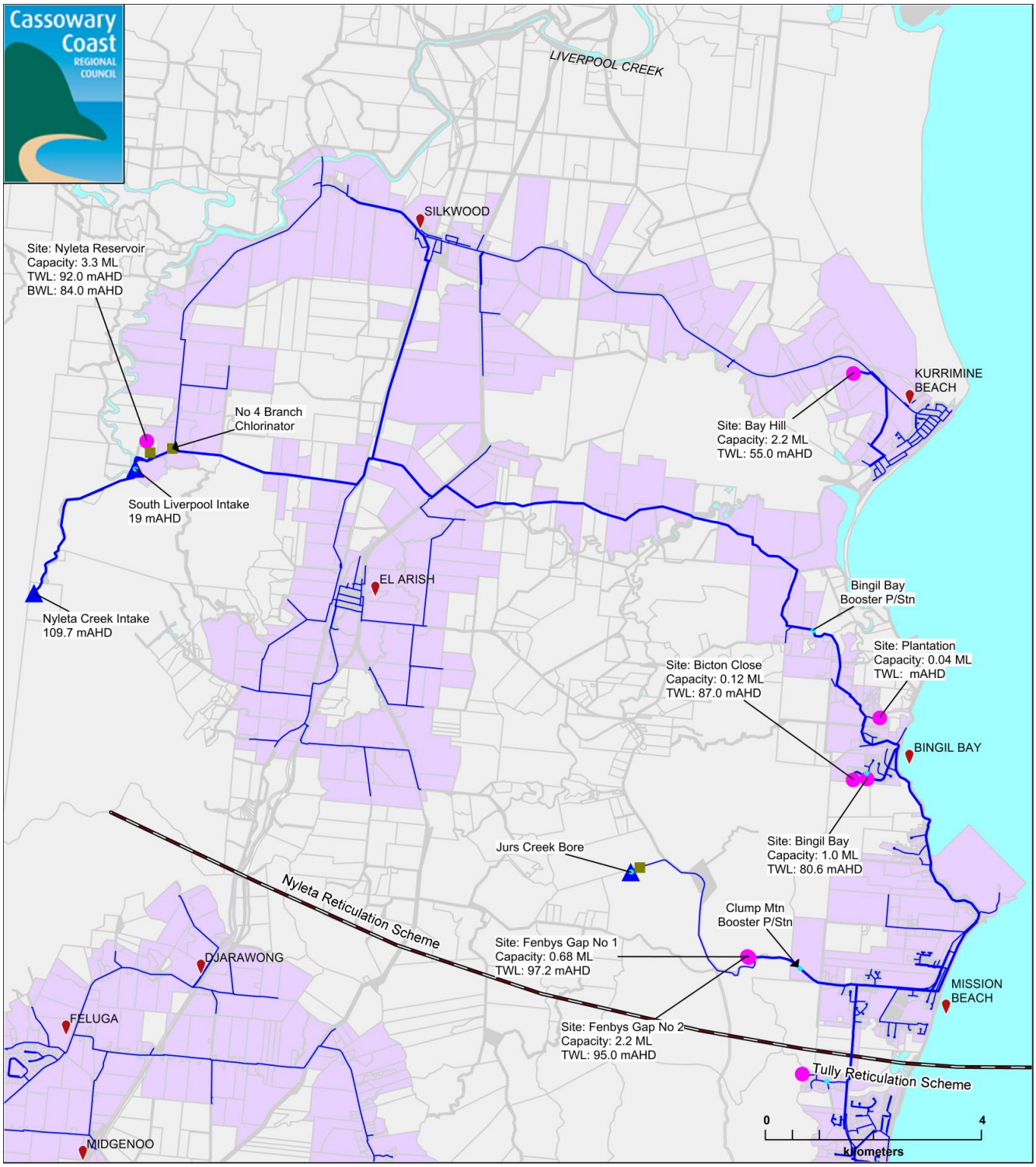


Figure 4.3: Water Supply Scheme Map

Figure 4.4: Reticulation Schematic

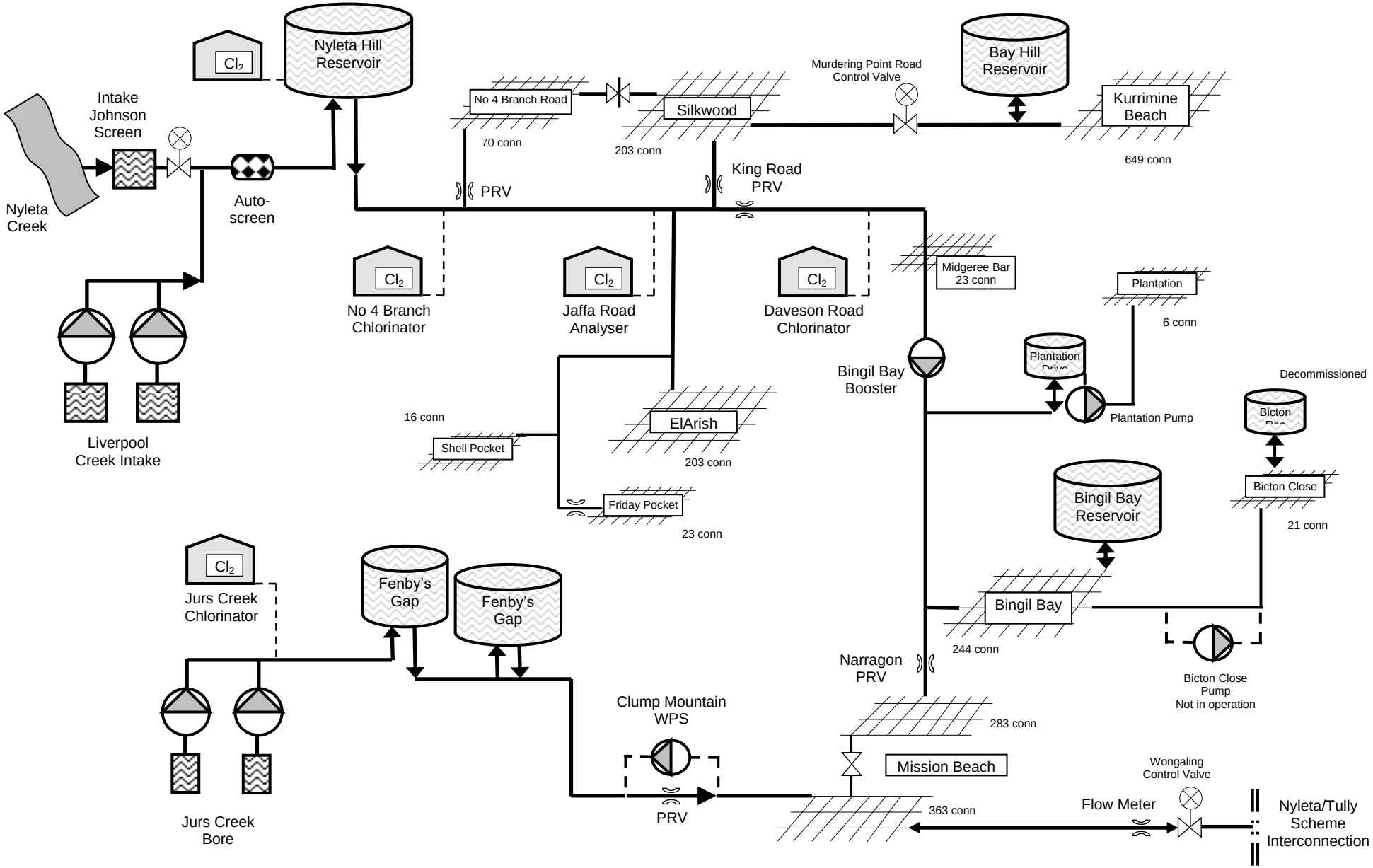


Table 4.1: Reservoir Asset Details

Reservoirs	**Ground (No)**			
	Name	**Bay Hill**		
	Capacity (ML)	2.2 ML	TWL (m):	55
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		
Reservoirs	**Ground (No)**			
	Name	**Plantation**		
	Capacity (ML)	2 * 0.02 ML	TWL (m):	
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		
Reservoirs	**Elevated (No)**			
	Name	**Bingil Bay**		
	Capacity (ML)	1.0 ML	TWL (m):	80.6
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		
Reservoirs	**Ground (No)**			
	Name	**Bicton Close**		
	Capacity (ML)	0.12 ML	TWL (m):	87.0
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		
Reservoirs	**Ground (No)**			
	Name	**Fenby's Gap No 1**		
	Capacity (ML)	0.67 ML	TWL (m):	97.2
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		
Reservoirs	**Ground (No)**			
	Name	**Fenby's Gap No 2**		
	Capacity (ML)	2.2 ML	TWL (m):	95
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		
	Ground (No)			
	Name	**Nyleta Hill**		
	Capacity (ML)	3.3ML	TWL 92m, BWL 84m	
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		

4.3.5 Asset Type and Condition

The supply pipe from the Nyleta Ck intake to the Jaffa Rd chlorinator is cement lined cast iron. Although this pipe was constructed in 1959, recent inspections indicate the pipe is in good condition.

A substantial portion of the trunk main system to Mission Beach was constructed in GRP. Portions of this main have suffered repeated failures particularly the sections of class 10 pipe. From 2017 to 2019 Council replaced approximately 3.8km of 525mm and 1.3km of 450mm GRP. The replacement main is 300mm diameter and is predominantly class 16 m PVC. A refinement of the long term demand models allowed the reduction in the trunk main sizing.

Approximately 50% of the complete Nyleta water distribution network is AC and of the 100 and 150 reticulation mains, AC represents 62%. The average age of all the AC mains is 45 years. The AC pipes are typically in fair to good condition but some problems have been observed, particularly in areas of high water table where the AC pipes are observed to be softening. Problems have been noted in Silkwood and along Porter Promenade, Mission Beach. The mains in these known problem areas will need to be renewed within the current 10 year program but the major component of renewal works is not anticipated until post 2026.

There is approximately 20km of class 12 white pvc in the Nyleta scheme. Some problems have been observed but typically the ongoing condition of these assets is being managed by pressure control. There is no allowance in the 10 year program for significant renewal of white pvc mains in the Nyleta scheme.

Details of the pipe materials used in the Nyleta scheme are outlined in Table 4.2.

Table 4.2: Nyleta Water Supply Scheme Pipe Asset Details (Revaluation May 2020)

Dia	50mm									Total Length
Pipe Material	AC	CI	DI	CU	32 40 GWI	Poly	PVC CL12	PVC CL16		(m)
Length					29	1987	415			2431
Average Age						30.6	15.9			
Dia	63mm									
Pipe Material		CI	DI	CU	GWI	Poly	PVC CL12	PVC CL16		
Length						2553				2553
Average Age						14				
Dia	80mm									
Pipe Material	AC	CI	DI	CU	GWI	Poly	PVC CL12	PVC CL16		
Length	669									669
Average Age	55									
Dia	100mm									
Pipe Material	AC	CI	DI	CU	GWI	Poly	PVC CL12	PVC CL16	PVC	
Length	27127	83	395			1741	7118	16064	4175	56703
Average Age	49.3	51.8	23.9			25	21.5	20.9	15.5	
Dia	150mm									
Pipe Material	AC	CI	DI	CU		Poly	PVC CL12	PVC CL16	Steel	
Length	15622		303			59	3410	60		19454
Average Age	53.3		4.7			42	22.3	14		
Dia	200mm					+180mm				
Pipe Material	AC	CI	DI	CU		Poly	PVC CL12	PVC CL16	Steel	
Length	5828					350	497			6675
Average Age	57.8					11.3	11			
Dia	225mm									
Pipe Material	AC	CI	DI	CU		Poly	PVC CL12	PVC CL16	Steel	
Length	2468		2713					594		5775
Average Age	35		30.5					12		
Dia	250mm									
Pipe Material	AC	CI	DI	CU		Poly	PVC CL12	PVC CL16	Steel	
Length	351	7692	14							8057
Average Age	30	60	14.7							
Dia	300mm									
Pipe Material	AC	CI	DI	CU		Poly	PVC CL12	PVC CL16	PVC	
Length			3699						12781	16480
Average Age			13						4.5	
	375mm									
Pipe Material	AC	CI	DI	CU		Poly	PVC CL12	PVC CL16	Steel	
Length	5296		2940					456		8692
Average Age	33		24.3					2		
Dia	450mm									
Pipe Material	AC	CI	DI	CU	GRP	Poly	PVC CL12	PVC CL16	Steel	
Length	1826		60		2618			158		4662
Average Age	32		33		29.3			2		
Dia	660mm									
Pipe Material	AC	CI	DI	CU		Poly	PVC CL12	PVC CL16	Steel	
Length									661	661
Average Age									28	132812
Total Lengths	59187	7775	10124	0	2647	6690	11440	17332	17617	132812
Per Mtl Type m										

Distribution and Reticulation System	Areas where potential long detention periods could be expected	Kurrimine Beach
	Areas where low water pressure (eg < 17.5 m) could be expected during peak or fire demand	Rural extremities with small mains or high elevation

4.3.6 SCADA Deployment

Since 2013, capital works budgets had been allowing for the deployment of SCADA to key water infrastructure as a major risk mitigation measure in line with the 2013 DWQMP (ECM Doc # 2265542).

Table 4.3, shows status of key water infrastructure in the Nyleta Scheme connected to SCADA.

Table 4.3: Nyleta Scheme SCADA deployment

Nyleta		
Site Name	**Connected**	**Comments**
Treatment		
Nyleta Hill Chlorinator	✓	
No 4 Branch Chlorinator	✓	
Jaffa Road Chlorinator	✓	
Daveson Road Chlorinator	✓	
Jurs Creek Chlorinator	✓	
Reservoirs		
Bay Hill	✓	
Bingil Bay	✓	
Fenby Gap	✓	
Nyleta Hill	✓	
Pump Stations		
Liverpool Ck WPS	✓	
Bingil Bay Boost	✓	
Control Valves		
King Road PRV	✓	
Kurrimine CV	✓	
Clump Mountain PRV	✓	
Mission Interconnection CV	✓	
Nyleta/Sth Liverpool CV	✓	
Radio Repeater		
Cowley Hill	✓	

4.4 Water Quality Data, Complaints and Service Issues

4.4.1 Quality Testing Results

Standard Water Analysis (SWA) on raw water from Nyleta Creek intake, the proposed South Liverpool Ck intake and Jurs Ck bore from January 2012 to January 2021 are included in Tables 4.5A, 4.5B and 4.5C. Sampling from the South Liverpool Ck intake site is limited but water quality appears to align very closely with the Nyleta Ck. Aside from an occasional turbidity issue associated with high rainfall events in the catchment, the raw water sourced from both Nyleta and South Liverpool Creeks is of good quality. Standard Water Analysis results for Nyleta Creek show the water to be fairly neutral and averaging a pH of 7.2. The pH results for the Jurs Creek Bore average 6.2 but Jurs bore is considered to be of consistent good quality.

In-house water quality sampling at No 4 Branch Chlorinator indicated that there were 19 incidents between January 2012 and May 2016 when the turbidity (immediately downstream of the No.4 Branch Filters) exceeded the ADWG aesthetic limit of 5. These high levels are short term events and related to the duration, intensity and position of rainfall within the catchment. The results in Table 4.4 below show that increased turbidity events are short term and chlorine residuals are managed to ensure no E-coli detections.

Location	No4 Branch Chlorinator			
Date	cL2	pH	NTU	E-COLI
16/03/12	2.92	7.14	3.71	
19/03/12	2.58	6.97	7.71	ND
21/03/12	3.91	6.98	3.56	
23/03/12	4.1	7.56	4	
26/03/12	4.63	7.15	19.0	ND
30/03/12	3.42	7.04	2.49	
18/05/12	2.32	7.21	5.43	ND
21/05/12	1.9	7.16	18.7	ND
25/05/12	2.81	7.11	6.41	ND
28/05/12	2.77	7.14	3.56	
1/06/12	2.9	7.51	3.68	
6/07/12	1.86	7.39	1.12	
9/07/12	1.5	6.89	6.27	ND
13/07/12	2.25	7.23	2	
18/01/13	3.85	7.55	1.21	
22/01/13	3.42	7.12	9.46	ND
25/01/13	2.67	7.09	10.1	ND
28/01/13	3.4	7.06	1.65	

Table 4.4- Sample of In-House Testing Results from No4 Branch Chlorinator.

The data above in Table 4.4 is reflective of water quality data prior to the construction of the new intake reservoir and new intake facility. Table 4.8A includes sampling data for site 2006 (Nyleta Reservoir) which reflects turbidity following the completion of the reservoir. Overall the turbidity into the network has been consistently low with only a maximum of 2.48 and an average of 0.94.

The results in *Table 4.7, 4.8 and 4.8A show water quality data for the reticulation system.* The Kurramine Beach Boat Ramp testing site is the most remote site from the Nyleta reservoir for the northern part of the

Nyleta reticulation network. The Stinger Net at Mission Beach is the most remote testing site for the southern part of the Nyleta reticulation network. Typically Cl_2 residuals are satisfactory at both extreme sites particularly since the upgrade of the dosing systems and the automation with SCADA. The low residual levels in the historical records typically reflect the period of dosing prior to the introduction of dosing automation and system controls. Chlorine dosing levels are automatically incremented as turbidity of the source water increases but with the completion of the Nylea reservoir and new intake, adjustment to chlorine dose rates are minimal. Refer Quality Control Plan for relevant procedures. Procedures have been implemented to test for E-coli whenever high turbidity is recorded.

Council has in house capability to undertake E-coli, pH, chlorine testing (residual and total) and turbidity. Up until this revision of the DWQMP, external verification by a NATA registered laboratory has been undertaken on a 3 monthly cycle for all sampling sites with an additional sample at one site once per month. Verification testing is also undertaken after an E-coli detection. The NATA and internal laboratory testing are repeatedly showing matching results so the Sampling Manual of this revision of the DWQMP shows a lower level of external verification testing.

Council's testing program results as listed in *Table 4.8 Nyleta Scheme Reticulation Water Quality Data 1/2012 to 5/2016* indicates **average** turbidity in the Nyleta scheme ranging from 1 NTU at Bingil Bay to 2.3 NTU at No.4 Branch. Despite this nominally high average turbidity there were very few E-coli detections. This is also reflected in the data from the specific high turbidity event in *Table 4.4.* The lack of detection of E-coli demonstrates that the disinfection processes adopted by Council are effective.

Analysis in *Table 4.8* also indicates that the pH increases significantly in the outer reaches of the scheme particularly Kurrimine Beach and Mission Beach. A number of pH records have exceeded desirable limits. This is due to the soft water characteristics and long retention time in the fibre reinforced and concrete lined mains and concrete reservoirs. When high pH readings above 8.5 are detected, the outer reaches of the reticulation system are flushed to increase the turnover in the mains.

In late 2017, Council completed the Nyleta reservoir and the South Liverpool Ck intake. These works have had noticeable impact on turbidity results in the reticulation network. Average turbidity results shown in Table 4.8A show declines in all test locations. Maximum turbidity results are also reduced following the construction of these works. No ecoli detections have been noted in the system even with the range of turbidity

The SWA reticulated system water quality test results for the period 2001-2016 are shown in Table 4.6A and 4.6B. Since January 2013, no health related water quality issues have been identified in the SWA. Test results for the Jurs Ck Chlorinator and No4 Branch Chlorinator for the period 2001-2011 are shown in Table 4.7.

Up until 2016, there was no centralised database for storing water quality data. Council is now progressively moving historical water quality data to the SWIM Local system. The historical system (pre 2016) consists of a combination of multiple spreadsheets, scanned and physical data. This creates difficulties in analysis and data quality control.

4.4.2 Complaints

Water Quality complaints are mainly concerned with dirty water, outages and low pressure. Generally the causes are associated with main breaks, stream turbidity and high demand. Details of the complaints in the Nyleta Scheme are listed in Table 4.9.

Council monitors customer complaints and response time details as part of it Customer Service Charter (ECM document # 2327195). After each financial year, staff report outcomes of performance against key indicators in the Customer Service Charter and results are reported to the Regulator and uploaded onto the Council web site in Council's annual Performance Report.

Each complaint is actioned as part of Council's Customer Request (CR) system. Comments of actions taken to rectify a complaint are noted against the individual CR. The annual performance report includes detailed analysis and commentary on each water complaint received.

4.4.3 Service Issues

Main breaks are due to combined factors of high static pressure, mechanical operation of pumps and valves creating pressure spikes, underperforming pipe materials particularly *white PVC* and glass reinforced fibre *(Hobas)* and site ground conditions. On going programs of pressure reduction and main replacements are in place to improve performance and reduce breakages. A program of mains flushing is in place to help reduce dirty water complaint and improve water quality. The flushing locations and frequency have been developed based on practical experience with dirty water complaints and network knowledge such as dead end mains.

Mechanical maintenance is conducted by in-house staff with electrical, instrumentation and radio being serviced by external contractors. Council staff have developed some skills with the telemetry and SCADA systems but still rely heavily on the service agreement with Welcon for the ongoing management of the SCADA operations.

Maintenance and operational procedures are being developed and are to be reviewed and improved over time.

Jan 2012 - May 2016 - Cassowary Coast Regional Council Raw Water Standard Water Analysis Results																			
	Number of Samples		Fe	Mn	Zn	B	Cu	Total Hardness	Saturation Index	Carbonate	H	Residual Alkalinity	Conductivity	Ca	pH	SAR	Sulphate	K	Figure Merit Ratio
Nyleta Creek	20	Min	0.0	0.0	0.0	0.0	0.0	5.4	-3.4	0.0	0.0	0.0	38.0	1.5	6.9	0.6	1.0	0.8	0.5
		Average	0.0	0.0	0.0	0.0	0.0	6.9	-2.9	0.0	0.0	0.1	43.9	2.0	7.2	0.8	1.0	0.9	0.7
		Max	0.0	0.0	0.1	0.0	0.0	10.0	-2.6	0.0	0.0	0.1	52.0	3.3	7.3	0.9	1.1	1.0	1.0
South Liverpool Creek	2	Min	0.0	0.0	0.0	0.0	0.0	5.0	-3.4	0.0	0.0	0.1	41.0	1.3	6.9	1.0	1.0	1.1	0.5
		Average	0.0	0.0	0.0	0.0	0.0	5.6	-3.1	0.0	0.0	0.1	44.5	1.5	7.1	1.1	1.0	1.2	0.5
		Max	0.0	0.0	0.0	0.0	0.0	6.1	-2.8	0.0	0.0	0.1	48.0	1.6	7.3	1.1	1.0	1.2	0.5
Jurs Creek	20	Min	0.0	0.0	0.0	0.0	0.0	13.0	-4.6	0.0	0.0	0.0	65.0	1.3	5.7	0.6	1.0	0.2	0.6
		Average	0.0	0.1	0.1	0.0	0.1	15.8	-3.9	0.0	0.0	0.0	85.8	2.7	6.2	0.8	1.7	0.4	1.4
		Max	0.0	0.2	0.4	0.0	0.2	25.0	-1.5	0.1	0.0	0.1	240.0	5.9	8.0	1.1	9.7	0.9	6.7

	Number of Samples		Al	Chloride	Mg	Water temp	Temporary Hardness	Nitrate	Si	Total Dissolved Ions	TDS	Mole Ratio	Turbidity	Hydroxide	Na	Fluoride	pH Sat.	True Colour	Alkalinity	Bicarbonate
Nyleta Creek	20	Min	0.1	4.2	0.4	20.0	5.4	0.6	14.0	23.0	32.0	2.6	1.0	0.0	4.0	0.1	9.8	2.0	8.0	10.0
		Average	0.1	5.1	0.5	21.8	6.8	0.6	16.3	27.6	37.2	2.9	2.0	0.0	4.9	0.1	10.1	6.2	10.5	13.3
		Max	0.1	5.6	0.6	23.0	10.0	0.6	20.0	31.0	44.0	3.2	3.0	0.0	6.0	0.1	10.3	16.0	13.0	16.0
South Liverpool Creek	2	Min	0.0	4.9	0.5	21.0	5.0	0.0	18.0	27.0	39.0	2.6	2.0	0.0	5.0	0.0	10.1	3.0	10.0	13.0
		Average	0.0	5.0	0.5	21.0	5.6	0.0	20.0	29.0	42.0	2.9	2.0	0.0	5.5	0.0	10.2	4.5	11.5	14.5
		Max	0.0	5.0	0.5	21.0	6.1	0.0	22.0	31.0	45.0	3.2	2.0	0.0	6.0	0.0	10.3	6.0	13.0	16.0
Jurs Creek	20	Min	0.1	9.2	0.2	20.0	7.8	0.6	12.0	35.0	42.0	2.0	1.0	0.0	6.0	0.1	7.9	1.0	8.0	10.0
		Average	0.1	11.9	2.2	21.8	16.1	3.0	13.2	50.3	48.6	4.2	2.6	0.0	7.0	0.1	9.9	1.5	12.2	20.0
		Max	0.1	15.0	3.0	23.0	93.0	4.1	16.0	184.0	57.0	4.8	6.0	0.0	10.0	0.1	10.3	3.0	19.0	113.0

Above ADWG Guideline Values
Below ADWG Guideline Value

Table 4.5A: SWA results for Nyleta Scheme Supply Sources - Jan 2012 to May 2016.

Table 4.5B: SWA results for South Liverpool Ck Sub Bed Filtered Intake - Commissioned 1/18.

May 2016 - October 2017 Cassowary Coast Regional Council Raw Water Standard Water Analysis Results

	No. of Samples		Conductivity	pH	Water Temp	Total Hardness	Temp. Hardness	Alkalinity	Residual Alkalinity	Silica (SiO2)	Total Dissolved Ions	TDS	True Colour	Turbidity	pH Sat.	Saturat'n Index	Mole Ratio	SAR	Figure Merit Ratio
South Liverpool Creek	6	Min	40.0	6.6	21.0	4.9	4.9	9.0	0.1	18.0	25.0	37.0	2.0	1.0	10.0	-3.6	3.0	0.9	0.5
		Avg	42.0	6.8	21.5	5.4	5.4	11.2	0.1	19.8	28.0	40.8	4.2	1.7	10.2	-3.4	3.3	1.0	0.5
		Max	45.0	7.2	22.0	6.2	6.2	14.0	0.1	22.0	32.0	45.0	8.0	3.0	10.4	-3.1	3.5	1.0	0.5

	No. of Samples		Sodium	K	Ca	Mg	H	Bicarbonate	Carbonate	Hydroxide	Chloride	Fluoride	Nitrate	Sulphate	Fe SWA	Mn SWA	Zn SWA	Al SWA	B SWA	Cu SWA
South Liverpool Creek	6	Min	5.0	1.1	1.2	0.4	0.0	11.0	0.0	0.0	4.7	0.1	0.1	1.0	0.0	0.0	0.0	0.1	0.0	0.0
		Avg	5.3	1.2	1.4	0.5	0.0	13.7	0.0	0.0	4.9	0.1	0.4	1.0	0.0	0.0	0.0	0.1	0.0	0.0
		Max	6.0	1.4	1.6	0.5	0.0	16.0	0.0	0.0	5.0	0.1	0.5	1.0	0.0	0.0	0.0	0.1	0.0	0.0

Above ADWG Guideline Values

Below ADWG Guideline Value

Table 4.5C Nyleta Scheme - Raw Water SWA 1/2016 to 1/2021

Nyleta Scheme - Raw Water SWA 1/2016 to 1/2021

	Number of Samples		FE	Mn	Zn	B	Cu	Total Hardness	Saturation Index	Carbonate	H	Residual Alkalinity	Conductivity	Ca	pH	SAR	Sulphate	K	Figure Merit Ratio
Nyleta Creek	24	Min	<0.01	<0.001	0.00	<0.02	<0.03	5.30	-4.00	0.00	0.00	0.10	34.00	1.50	6.20	0.10	<1	0.80	0.07
		Average	0.03	0.01	0.10	<0.02	<0.03	6.60	-3.30	0.00	0.00	0.10	41.90	1.80	6.80	0.80	0.90	0.90	0.60
		Max	0.10	0.01	0.50	<0.02	<0.03	12.00	-2.60	0.00	0.00	0.20	62.00	3.00	7.40	1.10	1.00	1.10	0.80
South Liverpool Creek	20	Min	<0.01	<0.01	<0.06	<0.02	<0.03	4.40	-4.00	0.00	0.00	0.00	34.00	1.10	6.20	0.70	<1	0.80	0.40
		Average	0.03	0.01	0.015	0.02	0.02	5.20	-3.60	0.00	0.00	0.10	39.40	1.30	6.70	0.90	0.90	1.10	0.50
		Max	0.10	0.01	0.03	0.02	0.03	6.20	-2.70	0.00	0.00	0.20	45.00	1.70	7.30	1.00	1.00	1.40	0.70
Jurs Creek (Bore)	20	Min	<0.01	<0.03	0.00	<0.02	<0.03	12.00	-4.30	0.00	0.00	0.00	59.00	1.30	5.90	0.60	<1.0	0.30	0.60
		Average	0.01	0.18	0.10	0.02	0.02	16.50	-3.90	0.00	0.00	0.00	75.00	2.10	6.10	0.70	1.10	0.30	1.20
		Max	0.01	1.00	0.50	0.02	0.03	30.00	-2.90	0.00	0.00	0.00	102.00	6.60	6.80	1.10	2.00	0.40	1.90

Nyleta Scheme - Raw Water SWA 1/2016 to 1/2021

	Number of Samples		Al	Chloride	Mg	Temporary Hardness	Nitrate	Si	Total Dissolved Ions	TDS	Mole Ratio	Turbidity	Hydroxide	Na	Fluoride	pH Sat.	True Colour	Alkalinity	Bicarbonate
Nyleta Creek	24	Min	<0.03	4.70	0.30	5.30	<0.5	10.00	21.00	15.00	2.60	<1	0.00	3.00	<0.05	9.80	0.20	8.00	10.00
		Average	0.05	5.20	0.44	6.60	0.30	16.90	28.00	36.40	3.40	1.40	0.00	5.00	0.04	10.10	5.50	11.60	14.00
		Max	0.05	8.00	0.60	12.00	0.50	22.00	44.00	54.00	2.40	3.00	0.00	8.00	0.05	10.30	18.00	18.00	23.00
South Liverpool Creek	20	Min	<0.03	4.00	0.40	4.40	<0.5	12.00	22.00	29.00	2.70	<1	0.00	3.50	<0.05	2.00	2.00	8.00	10.00
		Average	0.05	4.80	0.40	5.20	0.20	18.60	26.80	38.50	3.50	1.00	0.00	4.60	0.02	6.00	6.00	11.10	13.50
		Max	0.05	5.10	0.50	6.20	0.50	23.00	32.00	46.00	3.90	3.00	0.00	6.00	0.07	16.00	16.00	15.00	18.00
Jurs Creek (Bore)	20	Min	<0.03	11.00	2.20	15.00	1.70	10.00	36.00	44.00	3.70	<	0.00	6.00	<0.05	9.20	<1	9.00	11.00
		Average	0.05	12.00	2.80	16.50	3.20	13.00	44.00	49.00	4.40	1.00	0.00	6.50	0.04	10.00	1.10	13.20	16.00
		Max	0.05	18.00	3.40	30.00	4.40	16.00	67.00	67.00	4.60	1.00	0.00	10.00	0.05	10.30	2.00	27.00	33.00

Table 4.6A: In-House and SWA Results - Reticulation Network Table 2001-2011

Nyleta Scheme Reticulation Water Quality Silkwood, El Arish, Kurrimine Beach, Bingil Bay, Mission Beach									
Parameter	**Units**	**2001 to 2011**							**Comments**
		No Samples Collected	**No in which parameter detected**	**No outside ADWG Health Limits**	**No outside the ADWG Aesthetic Limits**	**Min**	**Max**	**Ave**	
Turbidity	NTU	1445	1445	0	72	0.09	72.2	2.17	2009- 1.47NTU 50%tile – no treatment
Free Chlorine	mg/L	1874	1874	2	1262	0	5.36	1.04	2009- dose rate reflects NTU
E.Coli	CFU/100mL	239	5	5					2009- disinfection only
pH	units	1871	1871	0	82	5.4	9.85	7.63	2009- soft water long AC mains
Total hardness	mg/L	400	400	0	0	5.81	72	13.2	
Silica	mg/L	400	400	0	0	0	40	15.5	
TD Solids	mg/L	400	400	0	0	28	134	50	
True Colour	HU	400	400	0	19	-1	34	3.9	
Sat Index	mg/L	399	399	0	0	-4.1	1.7	-1.2	
Sodium	mg/L	399	399	0	0	4.1	17	7.7	
Calcium	mg/L	399	399	0	0	0.8	20	4.8	
Chloride	mg/L	399	399	0	0	3.71	25	9.2	
Fluoride	mg/L	399	399	0	0	0	0.24	0	
Nitrate	µg/L	399	399	0	0	0	4	0.3	
Sulphate	mg/L	399	399	0	0	0	2.9	0.8	
Iron	mg/L	399	399	9	0	0	0.56	0	Iron main and storm events
Manganese	mg/L	399	399	0	0	0	0.08	0	
Zinc	mg/L	399	399	0	0	0	0.23	0	
Aluminium	mg/L	399	399	0	1	0	0.4	0	1 event 02/09/2011
Boron	mg/L	399	399	0	0	0	0.08	0	
Copper	mg/L	399	399	0	0	0	0.38	0	
THM(s)									No data

Nyleta Scheme Treated Water Quality									
Silkwood, El Arish, Kurrimine Beach, Bingil Bay, Mission Beach									
2012 - 2016									
Parameter	**Units**	**NO. Samples Collected**	**NO. in which parameter detected**	**NO. outside ADWG Health Limits**	**NO. outside ADWG Aesthetic Limits**	**Min**	**Max**	**Ave**	**Comments**
Iron	mg/L	142	142	0	0	0.0	0.1	0.02	
Manganese	mg/L	158	158	0	0	0.0	0.4	0.04	
Zinc	mg/L	142	142	0	0	0.0	0.5	0.08	
Boron	mg/L	142	142	0	0	0.0	0.0	0.02	
Copper	mg/L	158	158	0	0	0.0	0.4	0.06	
Total Hardness	mg/L	143	143	0	0	1.0	109.0	12.31	
Saturation Index	mg/L	142	142	0	0	-4.6	-0.5	-2.43	
Carbonate	mg/L	142	142	0	0	0.0	1.0	0.10	
Hydrogen	mg/L	142	142	0	0	0.0	0.0	0.00	
Residual Alkalinity	mg/L	159	159	0	0	0.0	1.0	0.08	
Conductivity	mg/L	159	159	0	0	35.0	273.0	70.34	
Calcium	mg/L	142	142	0	0	1.2	38.0	3.65	
pH	units	143	143	10	10	5.7	9.1	7.34	
SAR	mg/L	142	142	0	0	0.4	1.4	0.98	
Sulphate	mg/L	158	158	0	0	1.0	11.7	1.23	
Potassium	mg/L	158	158	0	0	0.2	1.2	0.75	
Figure Merit Ratio	mg/L	158	158	0	0	0.4	6.7	0.79	
Aluminium SWA	mg/L	158	158	0	0	0.1	0.1	0.05	
Chloride	mg/L	142	142	0	0	4.2	22.0	9.53	
Magnesium	mg/L	158	158	0	0	0.0	3.0	0.77	
Temporary Hardness	mg/L	159	159	0	0	4.9	93.0	11.69	
Nitrate	µg/L	142	142	0	0	0.5	4.2	2.22	
Silica	mg/L	143	143	0	0	11.0	22.0	15.59	
Total Disolved Ions	mg/L	159	159	0	0	23.0	199.0	42.74	
TDS	mg/L	142	142	0	0	32.0	157.0	48.60	
Mole Ratio	mg/L	158	158	0	0	1.2	4.8	2.89	
Turbidity	NTU	142	142	0	0	1.0	7.0	1.97	
Hydroxide	mg/L	158	158	0	0	0.0	0.2	0.01	
Sodium	mg/L	142	142	0	0	4.0	12.0	7.43	
Fluoride	mg/L	158	158	0	0	0.1	0.1	0.08	
pH Sat.	mg/L	158	158	0	0	7.9	10.4	9.77	
True Colour	mg/L	158	158	0	0	1.0	18.0	3.34	
Alkalinity	mg/L	143	143	0	0	8.0	89.0	14.51	
Bicarbonate	mg/L	158	158	0	0	10.0	113.0	18.24	

Table 4.6B: SWA Results – Nyleta Reticulation Network Jan 2012 to Sept 2016

Table 4.6C: SWA Results - Nyleta Reticulation Network - 1/2016 to 1/2021

Nyleta Scheme Treated Water Quality - 1/2016 to 1/2021									
Silkwood, El Arish, Kurrimine Beach, Bingil Bay, Mission Beach									
Parameter	**Units**	**No. Samples Collected**	**No. in which parameter detected**	**No. outside ADWG Health Limits**	**No. outside ADWG Aesthetic Limits**	**Min**	**Max**	**Avg**	**Comments**
Iron	mg/L	58	58	0	0	<0.01	0.20	0.02	
Manganese	mg/L	58	58	0	0	<0.01	0.01	0.01	
Zinc	mg/L	58	58	0	0	<0.01	0.51	0.05	
Boron	mg/L	58	58	0	0	<0.02	0.02	0.02	
Copper	mg/L	58	58	0	0	<0.003	0.01	0.04	
Total Hardness	mg/L	58	58	0	0	5.60	39.00	10.20	
Saturation Index	mg/L	58	58	0	0	-3.80	1.40	-2.21	
Carbonate	mg/L	58	58	0	0	0.00	12.00	0.30	
Hydrogen	mg/L	58	58	0	0	0.00	0.00	0.00	
Residual Alkalinity	mg/L	58	58	0	0	10.00	48.00	15.60	
Conductivity	mg/L	58	58	0	0	44.00	124.00	64.50	
Calcium	mg/L	58	58	0	0	1.60	16.00	3.67	
pH	units	58	58	9	9	6.12	9.92	7.47	
SAR	mg/L	58	58	0	0	0.70	1.40	1.08	
Sulphate	mg/L	58	58	0	0	<1	1.00	0.99	
Potassium	mg/L	58	58	0	0	0.09	1.50	0.86	
Figure Merit Ratio	mg/L	58	58	0	0	0.40	1.90	0.61	
Aluminium SWA	mg/L	58	58	0	0	<0.05	0.08	0.05	
Chloride	mg/L	58	58	0	0	7.00	14.00	8.97	
Magnesium	mg/L	58	58	0	0	<0.1	2.10	2.00	
Temporary Hardness	mg/L	58	58	0	0	5.60	39.00	10.10	
Nitrate	µg/L	58	58	0	0	<0.5	4.10	0.87	
Silica	mg/L	58	58	0	0	10.0	27.0	16.5	
Total Disolved Ions	mg/L	58	58	0	0	31.0	79.0	41.3	
TDS	mg/L	58	58	0	0	4.00	91.00	47.90	
Mole Ratio	mg/L	58	58	0	0	0.10	4.10	2.75	
Turbidity	NTU	58	58	1	1	1.00	18.00	2.39	
Hydroxide	mg/L	58	58	0	0	0.00	1.30	6.03	
Sodium	mg/L	58	58	0	0	6.00	10.00	7.63	
Fluoride	mg/L	58	58	0	0	<0.05	0.07	0.05	
pH Sat.	mg/L	58	58	0	0	8.60	10.20	9.70	
True Colour	mg/L	58	58	0	0	<1	5.00	1.80	
Alkalinity	mg/L	58	58	0	0	10.00	48.00	15.60	
Bicarbonate	mg/L	58	58	0	0	12.00	35.00	18.20	

Table 4.7: Treated Water Summary Table 2001-2011

Nyleta Scheme Treated Water Quality No 4 Branch Chlorinator & Jurs Creek Chlorinator									
Parameter	**Units**	**2001 to 2011**							**Comments**
		No Samples Collected	**No in which parameter detected**	**No outside ADWG Health Limits**	**No outside ADWG Aesthetic Limits**	**Min**	**Max**	**Avg**	
No 4 Branch Chlorinator									
Turbidity	NTU	202	202	0	27	0.61	190	4.29	From 2009 2.32 NTU 50%tile
Free Chlorine	mg/L	274	274	0	272	0.05	4.63	2.56	From 2009
E.Coli	CFU/100mL	5	0	0	0	0	0	0	From 2010
pH	units	273	273	0	0	6.51	8.4	7.4	From 2009.
Jurs Creek Chlorinator									
Turbidity	NTU	150	150	0	3	0.11	9.9	1.35	From 2010
Free Chlorine	mg/L	153	153	0	117	0.01	4.48	1.24	From 2010
E.Coli	CFU/100mL	29	29	0	0	0	0	0	From 2010
pH	units	151	151	0	59	5.12	8.94	6.4	From 2010

Nyleta Scheme Reticulation Water Quality Data 1/2012 to 5/2016											
		Nyleta Ck Source Water								Jurs Ck Bore Source Water	
Parameter		**No. 4 Branch Chlorinator**	**2101 Jaffa Road Chlorinator**	**2103 Silkwood Gun Club**	**2104 Kurrimine Boat Ramp**	**2107 Progress Hall (Elarish)**	**2108 Daveson Road Chlorinator**	**2109 Bingil Bay**	**2114 Stinger Net M/B**	**2004 Jurs Creek Bore Chlorinator**	**2115 Clump Mountain Pumps**
pH	**Min**	6.17	6	6.01	5.21	6.1	6	6	6	4.16	6.23
	Max	8	8	8.77	8.95	8.35	9.01	8.3	8.91	8.28	8.01
	Average	7.19	7.62	7.28	7.54	7.35	7.37	7.30	7.40	6.17	7.09
	Count	425	131	408	402	366	381	358	378	365	51
Chlorine Residual	**Min**	0.19	0.51	0.01	0.01	0.07	0.1	0.05	0.05	0.04	0.54
	Max	4.72	3.75	3.69	2.73	3.6	4.32	3.01	3.33	3.47	2.14
	Average	2.63	2.25	1.80	1.07	1.50	1.65	1.29	1.19	1.34	1.29
	Count	431	146	418	412	376	394	370	390	313	51
Turbidity	**Min**	0.05	0.01	0.09	0.09	0.07	0.03	0.01	0.02	0	0.15
	Max	190	4.6	32.2	18.5	20.3	12.1	8.96	5.05	4.45	2.02
	Average	2.30	1.29	1.41	1.15	1.26	1.07	1.00	0.87	0.68	0.52
	Count	429	130	416	410	374	391	369	388	390	51
E Coli	**Number of Tests**	17	11	23	23	21	15	18	17	0	8
	Number of Positives	0	0	0	0	0	0	0	0	0	0

Table 4.8: In-House Test Results for period 1/1/12 to 25/5/16.

Notes:

1. External verification for E-coli by a NATA lab was a yearly test for 2012 to 2015. In 2016, the frequency of external verification of E-coli increased to 6mthly. In 2017, the frequency of external verification E-coli increased to 3mthly all sites with an additional one site per month. Numbers of E-coli tests above include the external verification results.

2. Average turbidity in the scheme (sourced from Nyleta Ck) varied from 1 at Bingil Bay and 2.3 at No 4. Branch Chlorinator. No E-coli was detected in any testing.

Table 4.8A: Nyleta Water Quality Data 1/2016-1/2021

Nyleta Water Quality Data 1/2016-1/2021															
Parameter		**2001 Nyleta raw**	**2005 Liverpool raw**	**2006 Nyleta res dose site**	**2002 No 4 Branch**	**2101 Jaffa Road Chlorinator**	**2103 Silkwood Gun Club**	**2104 Kurrimine Boat Ramp**	**2107 Progress Hall (Elarish)**	**2108 Daveson Road Chlorinator**	**2109 Bingil Bay**	**2114 Stinger Net M/B**	**2003 Jurs Bore Raw**	**2004 Jurs Creek Chlorinator**	**2121 NMB5**
pH	**Min**	6.01	6.00	6.05	5.93	6.00	5.76	6.00	5.69	6.09	6.50	6.25	5.02	5.02	5.37
	Max	9.98	9.78	9.07	9.15	8.96	9.00	9.43	8.80	9.89	9.15	9.06	7.12	7.44	9.33
	Average	7.53	7.51	7.62	7.42	7.50	7.53	8.21	7.59	7.60	7.65	7.77	6.01	6.25	7.04
	Count	191	165	105	344	315	273	282	282	344	291	322	14	219	217
cL free	**Min**			1.59	1.45	1.14	0.21	0.20	0.55	0.60	0.20	0.06		0.35	0.20
	Max			3.25	3.95	3.45	3.40	2.34	2.79	3.26	2.55	2.36		3.16	2.44
	Average			2.26	2.50	2.27	1.92	1.14	1.70	1.96	1.60	1.19		1.61	1.09
	Count			105	349	319	278	290	238	349	298	331		231	232
cl total	**Min**			1.68	1.61	1.43	0.32	0.22	0.79	0.68	0.43	0.25		0.39	0.20
	Max			3.09	3.94	3.23	3.28	2.50	2.95	3.30	2.91	2.69		2.78	2.67
	Average			2.31	2.62	2.40	2.04	1.29	1.80	2.07	1.68	1.27		1.75	1.14
	Count			50	129	197	182	194	161	165	167	190		64	150
Turbidity	**Min**	0.20	0.20	0.08	0.23	0.09	0.12	0.05	0.06	0.07	0.08	0.01	0.15	0.09	0.01
	Max	10.11	89.00	2.48	9.11 (9/2/2016)	4.45	4.75	4.11	5.43	4.26	6.58	3.21	3.66	4.00	2.44
	Average	1.44	2.38	0.94	1.11	1.11	0.89	0.71	1.04	0.90	0.81	0.65	1.11	0.44	0.42
	Count	194	170	104	355	315	276	287	269	347	296	328	14	229	229
E Coli	**Number of Tests**	138	115			34	68	70	87	13	70	75	14	12	68
	Number of Positives	138	115			0	0	0	0	0	0	0	1	0	0

Table 4.9: Water Quality Complaints Table

Year	No of Water Quality Complaints	Water Quality Complaints per 1000 Connections	Main Reasons for Complaints	Likely Sources / Causes of Problems	Resolution of Problem
2019-2020	3	1.4	Dirty Water	Mains Breaks / Accumulation of silts in dead ends. A portion of the issues are due to the poor condition of old galv service lines that are the responsibility of the private owner.	Mains repaired, or scoured. Owners advised of their plumbing problems.
2018-2019	3 (Nyleta reservoir completed Nov 2017)	1.4	Dirty Water	Mains Breaks / Accumulation of silts in dead ends. A portion of the issues are due to the poor condition of old galv service lines that are the responsibility of the private owner.	Mains repaired, or scoured. Owners advised of their plumbing problems.
2017-2018	11	5.0	Dirty Water	High turbidity from rain events, main breaks, scouring. scouring	Mains scoured, event passes.
2016-2017	7	3.2	Dirty Water	High turbidity from rain events, main breaks, scouring. scouring	Mains scoured, event passes.
2014-2015	2	1.1	Dirty Water	High turbidity from rain events, main breaks, scouring. scouring	Mains scoured, event passes.
2013-2014	4	2	Dirty Water	High turbidity from rain events, main breaks, scouring. scouring	Mains repaired, scoured, event passes.
2012-2013	11	6	Dirty Water	High turbidity from rain events, main breaks, scouring. scouring	Mains scoured, event passes.
2011-2012	8	3.9	Dirty Water	High turbidity from rain events, main breaks, scouring. scouring	Mains scoured, event passes.

SECTION 5

TULLY WATER SUPPLY SCHEME

May 2021

5. Tully Scheme Details of Infrastructure

5.1 Source, treatment and distribution details

5.1.1 Source Details

The Tully Scheme sources its water from two run of stream intakes within the Bulgun and Boulder Creeks.

Bulgun Creek is a tropical stream with granite boulders and sandy bed the catchment above the water supply intake is located totally within the boundary of the *World Heritage* listed rainforest areas of the Tully Gorge National Park. Bulgun Creek is subject to flooding.

The climate of this catchment can be described as tropical with distinctive wet and dry seasons. The average annual rainfall experienced at the WTP over the period of 2011 to 2015 was 3862.3mm with majority of rain fall from the months of December to April. The graphical representation of the daily rain fall is displayed in Figure 5.0 below.

Figure 5.0: Monthly Rainfall Tully (BOM)

Summary statistics for all years

Information about climate statistics

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	600.6	722.5	755.5	525.7	331.6	199.6	150.7	123.6	110.7	108.6	169.3	266.1	4083.8
Lowest	11.0	126.8	88.6	40.1	13.0	6.0	0.0	0.0	0.0	0.0	2.0	16.3	2110.6
5th %ile	110.9	179.6	269.8	153.7	55.8	37.8	22.2	9.1	0.4	3.3	20.4	37.0	2626.0
10th %ile	163.9	252.1	310.4	205.1	107.4	48.0	35.1	16.6	6.5	6.5	26.4	62.8	2920.7
Median	518.5	646.2	685.5	480.6	323.1	177.5	137.0	85.8	72.8	71.8	116.6	191.0	3904.7
90th %ile	1137.8	1301.2	1351.8	855.4	544.8	405.6	288.4	258.9	242.2	267.3	401.1	511.4	5335.6
95th %ile	1354.4	1505.7	1556.7	1101.9	613.0	467.3	341.8	313.6	332.8	344.0	498.7	792.1	5626.5
Highest	2003.0	1818.7	1907.4	1586.4	806.2	584.2	535.7	484.4	610.2	652.8	702.8	1501.1	7898.0

The catchment above the Bulgun intake is approximately 650 hectares. There has been no development and the area remains in a pristine condition. Access to the intake is via a partly sealed gated road, 2.3km of the trail passes through the Tully Gorge National Park. There are no permanent trails above the intake. The area is thickly vegetated tropical rainforest the region is subject to heavy rainfall and occasional tropical cyclones. The flow in the stream drops during long dry periods however the creek has not been known to fail completely.

Boulder Creek is a tropical stream with granite boulders and sandy bed the catchment above the water supply intake is surrounded totally by the boundary of the *World Heritage* listed rainforest areas of the Tully Gorge National Park. Boulder Creek is subject to flooding. The catchment above the Boulder intake is approximately 750. There has been no development and the area remains in a pristine condition. Access to the intake is via an unsealed gated road which is subject to flooding. 2.3km of the trail passes through the Tully Gorge National Park. There are no permanent trails above the intake. The area is thickly vegetated tropical rainforest the region is subject to heavy rainfall and occasional tropical cyclones. The flow in the stream drops during long dry periods however the creek has not been known to fail completely.

5.2 Treatment, Disinfection and Processes

A summary of the treatment disinfection and pumping systems of the Tully Scheme is shown in Table 5.0.

5.2.1 Intake

The Bulgun intake consists of a small weir like concrete structure across the stream. As water traverses the weir a portion of the flow passes through a *Johnston Screen* to remove larger sticks, leaves and sand and then enters the pipe system.

The Boulder intake consists of a small weir like concrete structure across the stream. As water traverses the weir a portion of the flow passes through a *Johnston Screen* to remove larger sticks, leaves and sand and then enters the pipe system. There are no intake pumps as the natural water head is sufficient to feed the system. A 2.4 km majority ductile iron main runs along the access trail to the Boulder Chlorinator.

5.2.2 Treatment

There is no treatment in the Tully Scheme.

In October 2020 Council completed the construction of 4.5ML reservoir just downstream of the Bulgun Creek intake. Intake flows are directed into the reservoir on a continuous basis unless the Bulgun Creek source water has turbidity above 5NTU. Turbidity analysis equipment has been installed upsteam of the reservoir and when the turbidity exceeds 5NTU, the intake valve into the reservoir is automatically closed and only reopened when turbidity falls below 5NTU. The clear water storage in the new Bulgun intake reservoir and other reservoirs in the network are then able to supply clean water into the network. Photos of the completed reservoir, the SCADA arrangement and the automated valves are shown in Figures 5.1 to 5.3.

A similar system of turbidity analysis and automated valving has also been installed on the Boulder Creek intake line so it can also be isolated during periods of high turbidity. If the Boulder Creek intake is isolated due to high turbidity, a valve on the main interconnecting the two systems is automatically opened and the Boulder Creek supply area will obtain clear water from the Bulgun Creek intake reservoir. The interconnection valve is on Bulgun Road (near the Bulgun chlorinator) has mains power with generator backup. The status of this valve can be operated remotely by SCADA.

In system storage at key reservoir sites in the network is also important in the long term turbidity management strategy. In 2019, Council completed the construction of a 4.6ML reservoir at Wheatleys Hill, South Mission Beach. This reservoir supplements the existing 0.7ML reservoir at the site. Together with the 0.7 ML reservoir at Mantons Hill in South Mission Beach, the combined storage in this area is sufficient for long term population growth in South Mission Beach and Wongaling as well as providing the clear water buffer storage during turbidity events. .

The 2.2 ML storage at Hyatt St is also a key storage for turbidity events. This reservoir typically supplies the Tully Heads/Hull Heads region.

Council has commenced the planning of an additional high level reservoir at Hyatt St which will be used for supply to Tully township. The elevation of the existing Hyatt St reservoir is not adequate for some of the higher supply areas in the town. It is envisaged the high level reservoir will be constructed by 2025.

Since the Bulgun Creek intake reservoir was completed in late 2020 up to the date of this DWQMP revision of June 2021, there have been no boil water alerts needed to be issued which demonstrates the effectiveness of the measures Council has implemented to manage turbidity in the network. During the summer months of 2021 there were significant rainfall events that would otherwise have triggered a boil water event. In January and February 2021, Tully recorded 1223mm and 1041mm respectively.

Details showing the level trends for the operation of the reservoir versus turbidity during a rain event in April 2021 are shown in Figure 5.4.

When the inlet pipe into Bulgun Intake Reservoir is automatically isolated due to turbidity greater than 5 NTU at the intake (this also initiates SCADA alarms), the operators simultaneously shut the pipe inlets into the Wheatleys Hill and Hyatt St reservoirs to prolong the available storage at the Bulgun Intake reservoir. For extended periods of rainfall, even with the outer reservoirs supplementing clean water supply, as noted in Figure 5.4, the level in the Bulgun Intake reservoir can drop to about 20%. This supports the case for the

construction of the Hyatt St high level reservoir which in such incidences would be available to supply Tully town.

Figure 5.1: 4.5 Ml Bulgun intake reservoir and Chlorine dosing building

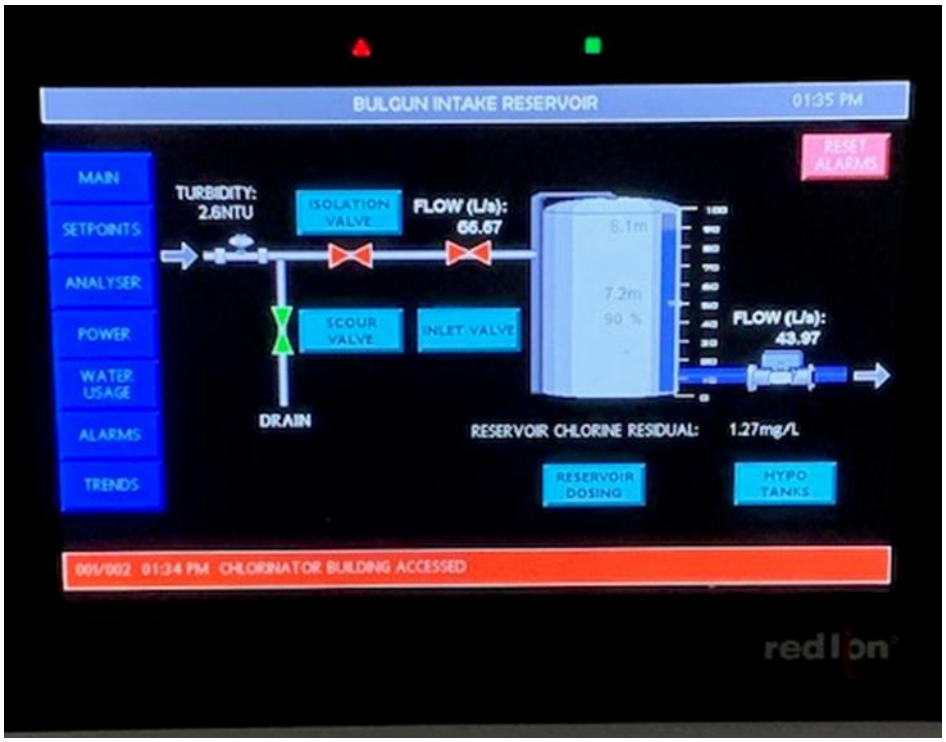
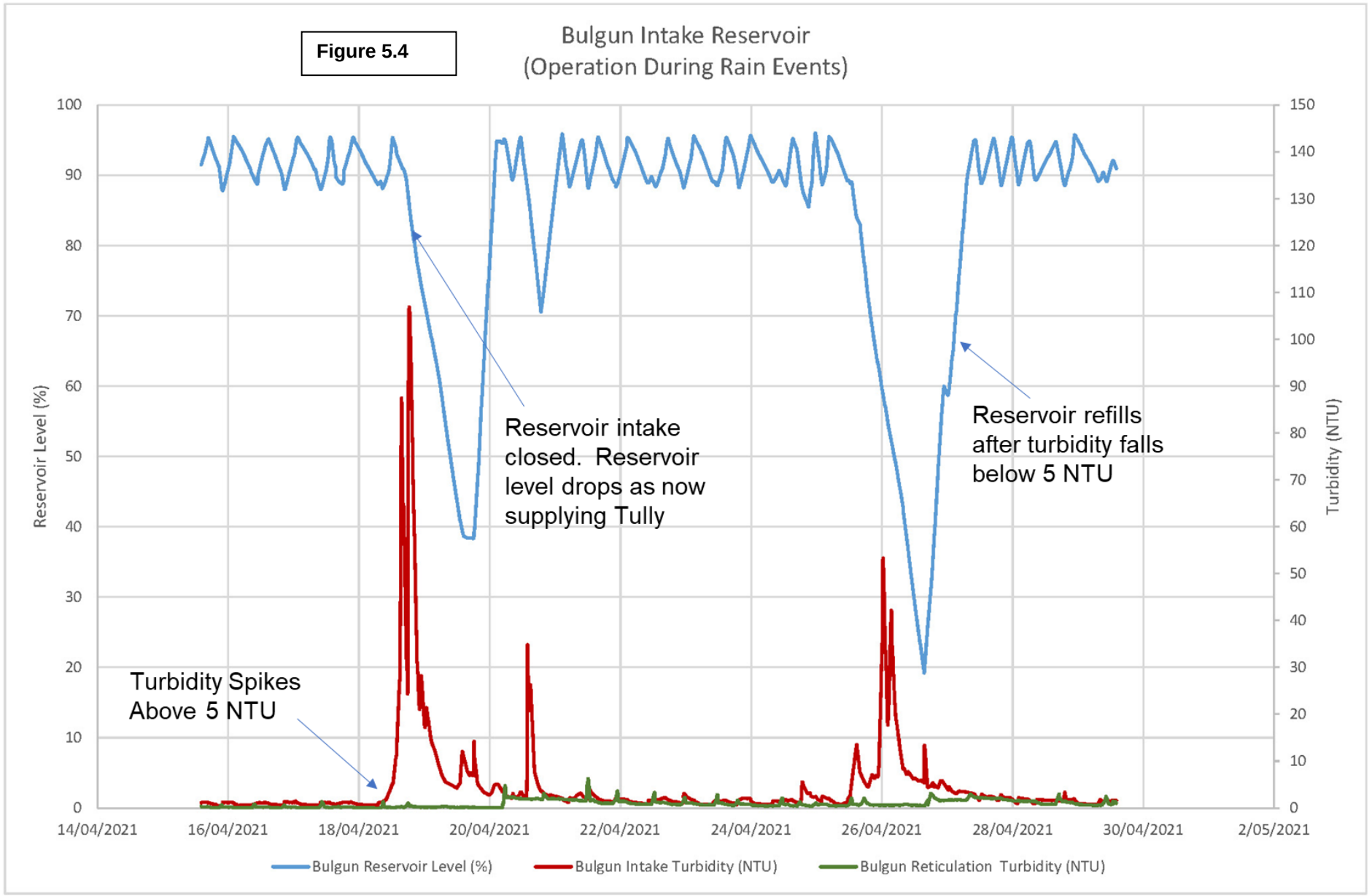


Figure 5.2: Bulgun intake SCADA screen

Figure 5.3 Bulgun intake isolation valve and scour valve upstream of the reservoir

In May 2017, Council commenced compiling extra source water data that will eventually be used for Health Based Treatment Options assessment. The preliminary advice received as part of the 2021 DWQMP audit of the Tully Scheme suggests the Tully supply sources are within protected catchments. Funding has not been allocated in Council's 10 year budget planning for any higher degree of treatment than is currently provided.

Figure 5.4


Bulgun Intake Reservoir
(Operation During Rain Events)
Reservoir Level (%)
Turbidity (NTU)
Reservoir intake closed. Reservoir level drops as now supplying Tully
Reservoir refills after turbidity falls below 5 NTU
Turbidity Spikes Above 5 NTU
14/04/2021
16/04/2021
18/04/2021
20/04/2021
22/04/2021
24/04/2021
26/04/2021
28/04/2021
30/04/2021
2/05/2021
Bulgun Reservoir Level (%)
Bulgun Intake Turbidity (NTU)
Bulgun Reticulation Turbidity (NTU)

5.2.3 Disinfection

A schematic of the disinfection systems in the Tully Scheme are shown Figure 5.8

5.2.3.1 Bulgun Intake Reservoir Chlorinator

Sodium hypochlorite (NaOCl) is injected into the reservoir at the inlet injection nozzle from a storage tank and dosing pump. Chlorination levels are monitored continuously in the reservoir and dosing is automatically adjusted to maintain approximately 2 mg/L in the reservoir. In periods of high turbidity, dosing can also be increased remotely through SCADA. The site is inspected twice a week or if an alarm is triggered through the SCADA. The site has solar power and an emergency generator. This site is a primary dosing point.

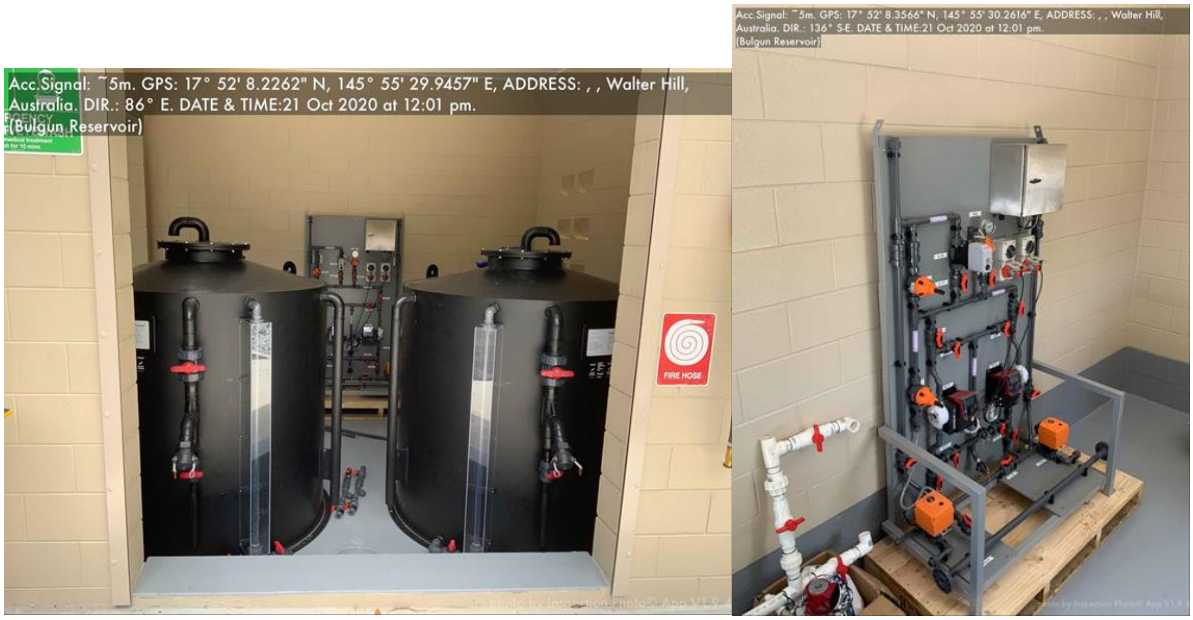


Figure 5.5 Chlorine Tanks and dosing panel at Bulgun Intake Reservoir

5.2.3.2 Bulgun Chlorinator

This site is some 2.5km downstream of the intake reservoir and is the original Bulgun chlorine dosing point. Following the commissioning of the intake reservoir dosing facility, this dosing site will be converted to a secondary dosing facility. Chlorine levels in the trunk main from the reservoir will be monitored and sodium hypochlorite (NaOCl) is injected as needed to maintain total chlorine levels at about 2.5 mg/L. Dosing is automatically flow paced by the PLC using inputs from the turbidity analyser and flow meter. In periods of high turbidity, dosing can also be increased remotely through SCADA. The site is inspected twice a week or if an alarm is triggered through the SCADA. The site has mains power and an emergency generator. The facilities at this site are shown in Figures 5.6 and 5.7.

Figure 5.6: Facilities at the Bulgun Ck Chlorinator - SCADA and dual dosing pumps.

Figure 5.7: Facilities at the Bulgun Ck Chlorinator - Chlorine and Turbidity Analysers, Back Up Generator.

5.2.3.3 Boulder Chlorinator

Sodium hypochlorite (NaOCl) is injected into the reticulation main from a storage tank via a dosing pump. Chlorination levels are set between ADWG health limits. Dosing is automatically flow paced by the PLC using inputs from the turbidity analyser and flow meter. In periods of high turbidity, dosing can also be increased remotely through SCADA. The site is inspected twice a week or if an alarm is triggered through the SCADA. The site has mains power. Back up power can be provided by a portable generator.

5.2.3.4 Wheatleys Hill Reservoir Chlorinator

This site is a re-chlorination point, sodium hypochlorite (NaOCl) is injected into the delivery main on the outlet from the Wheatleys Hill reservoir from a storage tank via a dosing pump. A chlorine analyser monitors the chlorine residual and dosing is automatically adjusted to maintain a minimum free chlorine level of 1 mg/L. The dose rate can be adjusted remotely by SCADA as required by treatment operators and maintenance staff. The site is inspected twice a week. The site is connected to the SCADA system primarily for alarms associated with the dosing equipment. Dosing can be adjusted remotely by SCADA. The chlorinator has mains power.

5.2.3.5 Hyatt St Reservoir Chlorinator

This site is a re-chlorination point. The site is inspected at least twice per week with events such as heavy rainfall prompting more frequent visits. Sodium hypochlorite (NaOCl) is dosed directly into the reservoir at a fix rate determined by the treatment operator. A chlorine, pH and turbidity analyser monitors the chlorine residual at the outlet of the reservoir and maintained at 2 mg/L. The site is connected to the SCADA system primarily for alarms associated with the dosing equipment. Dosing can be adjusted remotely by SCADA. The chlorinator has mains power.

Figure 5.8: Chlorinator Schematic

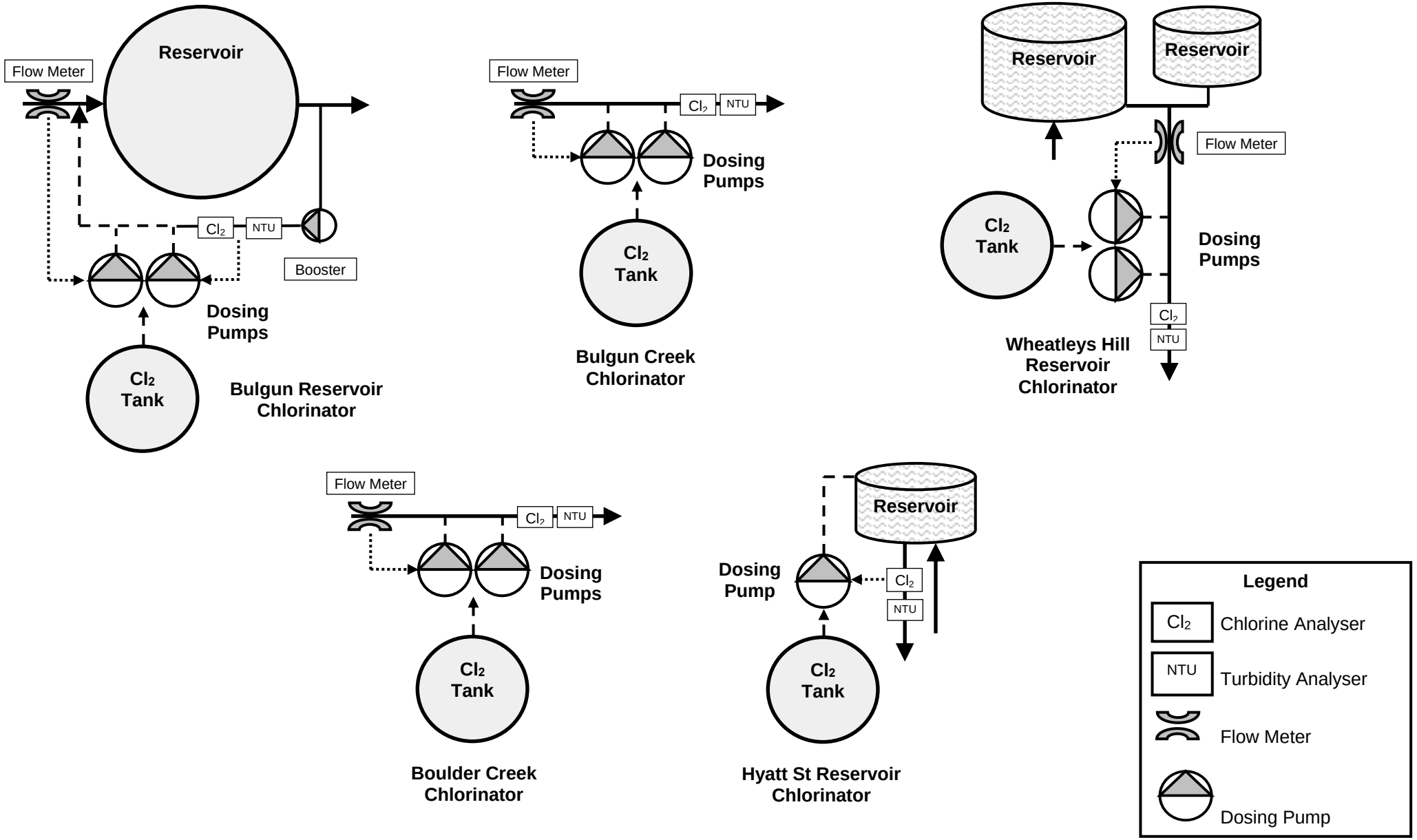


Table 5.0: Source & Treatment Details

Component		Tully Scheme
Sources	Name	Bulgun Creek
	Type	*Creek*
	% of supply	50%
	Reliability	Reliable Continuous Supply of water
	Water quality issues	Turbidity Spikes following high rainfall. Low flow in drought periods
	Name	Boulder Creek
	Type	Creek
	% of supply	50%
	Reliability	Reliable Continuous Supply of water
	Water quality issues	Turbidity Spikes following high rainfall. Low flow in drought periods
Sourcing Infrastructure	Type	Intake
	Description	Location: Bulgun Creek, Concrete Weir Screen Type: Johnson 1.2mm
	Type	Intake
	Description	Location: Boulder Creek, Concrete Weir Screen Type: Johnson 1.2mm
Treatment	Name	Bulgun Filter (Not operational)
	Process	200um *Arkal* disc filter
	Design Capacity (20 hr operation)	ML/d 3.6 with average water quality
	Daily flow range	ML/d 0 - 3
	Filter Backwash	Time or pressure differential – No pumps
	Bypasses / Variations	Manual bypass possible
Disinfection	Location	Bulgun Creek Intake Reservoir Chlorinator
	Type	Sodium Hypochlorite
	Dose rate	83 l/day approx average into reservoir at intake nozzle.
	Target residual levels	Approx 2.0 mg/l in reservoir
	Duty	2-Pump duty/standby.
	Dosing arrangements	Chlorine level monitored on outlet.
	Alarms	SCADA - High / Low residual Chlorine Pump flow fault etc.to operator via SMS
Disinfection	Location	Bulgun Creek Chlorinator
	Type	Sodium Hypochlorite
	Dose rate	20 l/day Approx average
	Target residual levels	Between 2.5and 3.5 mg/l
	Duty	2-Pump duty/standby.
	Dosing arrangements	Flow paced,
	Alarms	SCADA - High / Low residual Chlorine Pump flow fault etc.to operator via SMS
	Generator	Yes- Auto changeover
Disinfection	Location	Boulder Chlorinator
	Type	Sodium Hypochlorite
	Dose rate	84 l/day Approx average
	Target residual levels	Between 2.5 and 4.5 mg/l
	Duty	2-Pump duty/standby.
	Dosing arrangements	Flow paced,
	Alarms	SCADA - High / Low residual Chlorine Pump flow fault etc.to operator via SMS
	Generator	Yes

Component		Tully Scheme
Disinfection	Location	Wheatleys Hill Chlorinator
	Type	Sodium Hypochlorite
	Dose rate	15 l/day Approx average
	Target residual levels	Between 1.0 and 1.5 mg/l
	Duty	2-Pump
	Dosing arrangements	Fixed rate,
	Alarms	SCADA - High / Low residual Chlorine Pump flow fault etc.to operator via SMS
	Generator	No -Portable generator available if needed.
Disinfection	Location	Hyatt St Chlorinator
	Type	Sodium Hypochlorite
	Dose rate	4 l/day Approx average
	Target residual levels	Between 1.5 and 2.5 mg/l
	Duty	1-Pump
	Dosing arrangements	Fixed rate,
	Alarms	SCADA - High / Low residual Chlorine Pump flow fault etc.to operator via SMS
	Generator	No -Portable generator available if needed.

5.3 Distribution and Reticulation Details

5.3.1 Distribution Network

The Tully Water Supply Scheme was originally constructed in the 1930's to service the township of Tully. Over time the scheme has expanded and during the 1970s was augmented by the intake on Bulgun Creek and the rural network. The Bulgun Creek and Boulder Creek reticulation networks were originally designed to run in isolation but are actually interlinked in several locations. The scheme supplies the communities of Tully, Euramo, Silky Oak, Tully Heads, Hull Heads, Feluga, Wongaling Beach and South Mission Beach.

Following disinfection at Bulgun and Boulder Chlorinators water is supplied directly to reticulation. There are no service reservoirs in the upper part of the scheme. The network supplies small rural communities, agricultural and remote properties therefore there are long service mains with few connections. PRV's reduce supply pressures to the Mission Beach main and to balance the differing intake pressures towards lower Tully.

Hyatt Street Reservoir was intended as a storage reservoir for the Tully Township however due to its low elevation it was not utilised for daily demands but available for emergency and fire flows. The reservoir has been since connected to Hull Heads/Tully Heads service main and supplies re-chlorinated water and head pressure. The supply main for Hyatt St reservoir passes through the Tully town. The town reticulation mains are connected to the main supply main in a few locations. During peak demands there can be inadequate pressure at Hyatt St to recharge the reservoir. The 10 year capital budget has funding allocations for a high level reservoir and the construction of a dedicated supply main through the town to ensure the reservoir is able to be recharged. Several other small service reservoirs are located around Tully to service small high elevation subdivisions these are filled via pump stations. Bell Street and Peace Street pumps are controlled by a reservoir float switch and Maple terrace operates on a timer.

The small outlying communities Tully Heads and Hull Heads have recorded high pH levels due to long service mains, soft water and low consumption.

A branch line runs through to Wheatleys Hill Reservoir where the water is chlorine boosted. Wheatleys Reservoir maintains pressure to Wongaling Beach and South Mission Beach. Mantons Hill Reservoir is slightly lower than Wheatleys Hill reservoir so to maintain turnover of this reservoir and ensure chlorine residuals, an automated control valve has been installed on South Mission Beach Rd near Commodore St which automatically isolates the Wheatleys reservoir from South Mission Beach until the Mantons reservoir depletes to about 70% and then reopens.

The Mission Circle Reservoir supplies a local elevated subdivision and filled with a pump station controlled by radio telemetry.

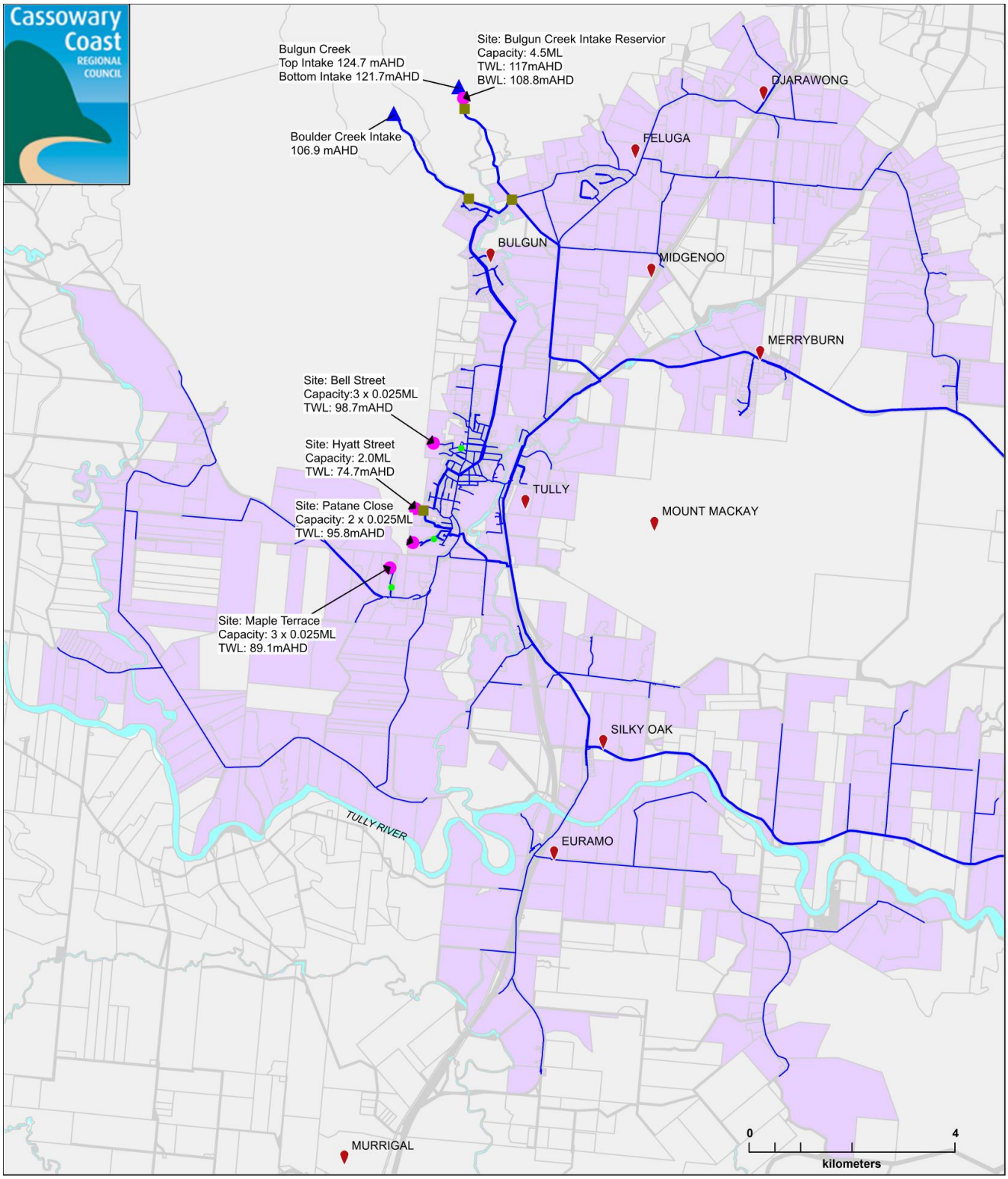
Details of the reservoirs in the Tully Scheme are shown in Table 5.1.

Layout maps of the Tully distribution network are shown on Figures 5.9 and 5.10 below. A schematic of the Tully Scheme is shown in Figure 5.11.

Although the areas of Tully rural (north of Tully) and Mission Beach (South Mission and Wongaling) are supplied by the Bulgun Ck system and Tully town and the Tully Heads and southern rural area are supplied from the Boulder Ck system, the two schemes have points of interconnection that can be opened manually to allow either system to be used to supply the other area. This interconnection is undertaken during long term planned maintenance or in the case of a long term supply outage.

Table 5.1: Tully Scheme Reservoir Details

Reservoirs	**Ground (No)**			
	Name	**Bulgun Intake**		
	Capacity (ML)	4.5 ML	TWL (m):	117
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		
Reservoirs	**Ground (No)**			
	Name	**Bell Street Tanks**		
	Capacity (ML)	0.15 ML	TWL (m):	98.7
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		
Reservoirs	**Ground (No)**			
	Name	**Brannigan Street**		
	Capacity (ML)	0.45 ML	TWL (m):	65.3
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		
Reservoirs	**Elevated (No)**			
	Name	**Hyatt Street**		
	Capacity (ML)	2.2 ML	TWL (m):	74.7
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		
Reservoirs	**Ground (No)**			
	Name	**Patane Close**		
	Capacity (ML)	2 x 0.025 ML	TWL (m):	95.8 approx
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		
Reservoirs	**Ground (No)**			
	Name	**Maple Terrace**		
	Capacity (ML)	0.15 ML	TWL (m):	89.1
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		
Reservoirs	**Ground (No)**			
	Name	**Wheatleys Hill**		
	Capacity (ML)	0.7 ML	TWL (m):	69.8
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		
Reservoirs	**Ground (No)**			
	Name	**Wheatleys Hill**		
	Capacity (ML)	4.6 ML	TWL (m):	69.8
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		
Reservoirs	**Ground (No)**			
	Name	**Manton's Hill**		
	Capacity (ML)	0.7 ML	TWL (m):	64.5
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		
Reservoirs	**Ground (No)**			
	Name	**Mission Circle**		
	Capacity (ML)	0.2 ML	TWL (m):	90
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		



CCRC Water Supply Network
Tully Scheme Map 1 of 2

MGA94z55

LEGEND

- Chlorinator
- Pump Station
- Reservoir
- Intake
- Trunk Main
- Reticulation Main
- Potential Service Area
- Cadastral Parcel
- Water Body
- Road Reserve

Map Produced: CCRC GIS 17/11/2020 - 2016_012JH

Figure 5.9: Water Supply Scheme Map

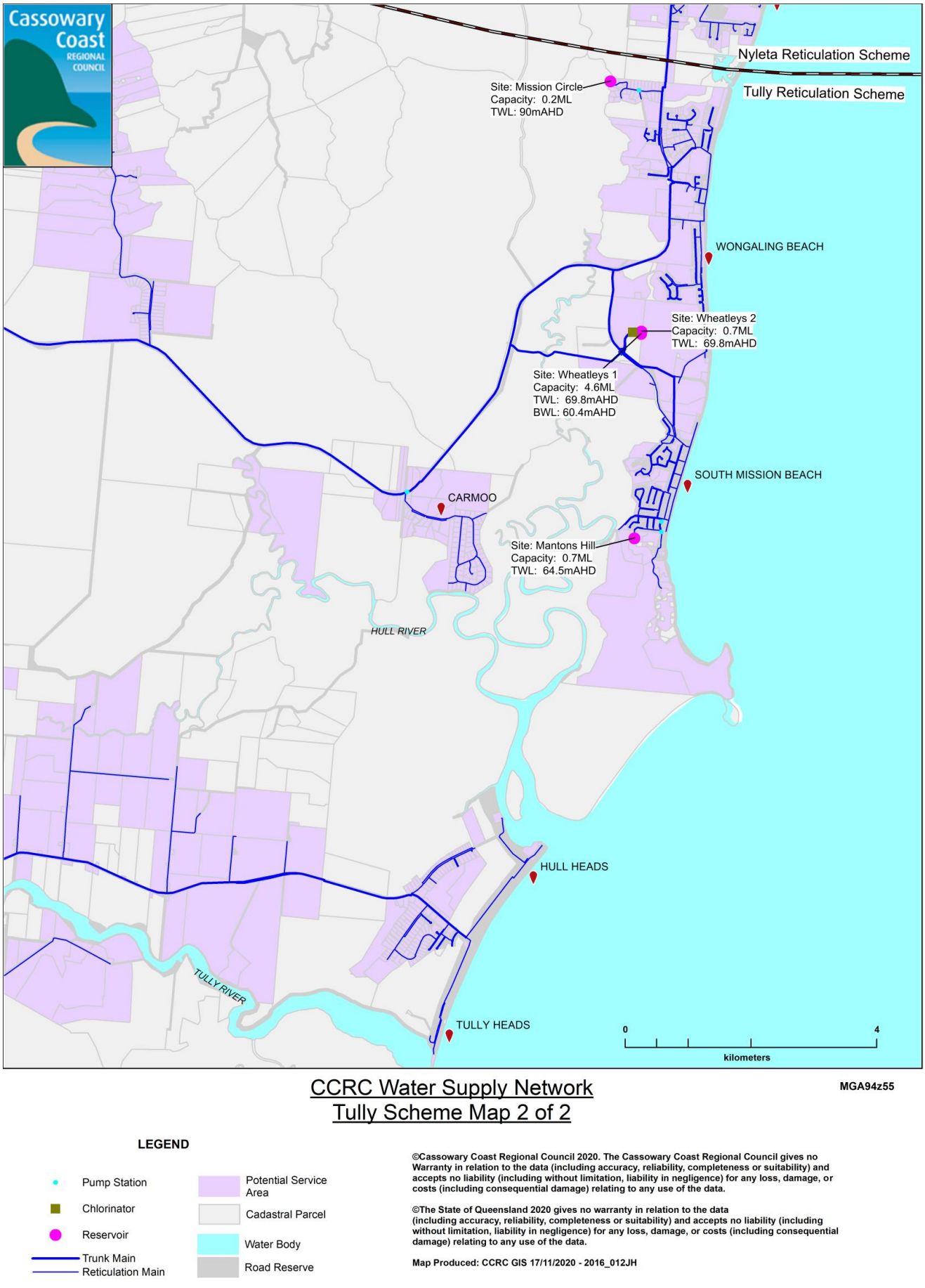


Figure 5.10: Water Supply Scheme Map

Figure 5.11:- Reticulation Schematic

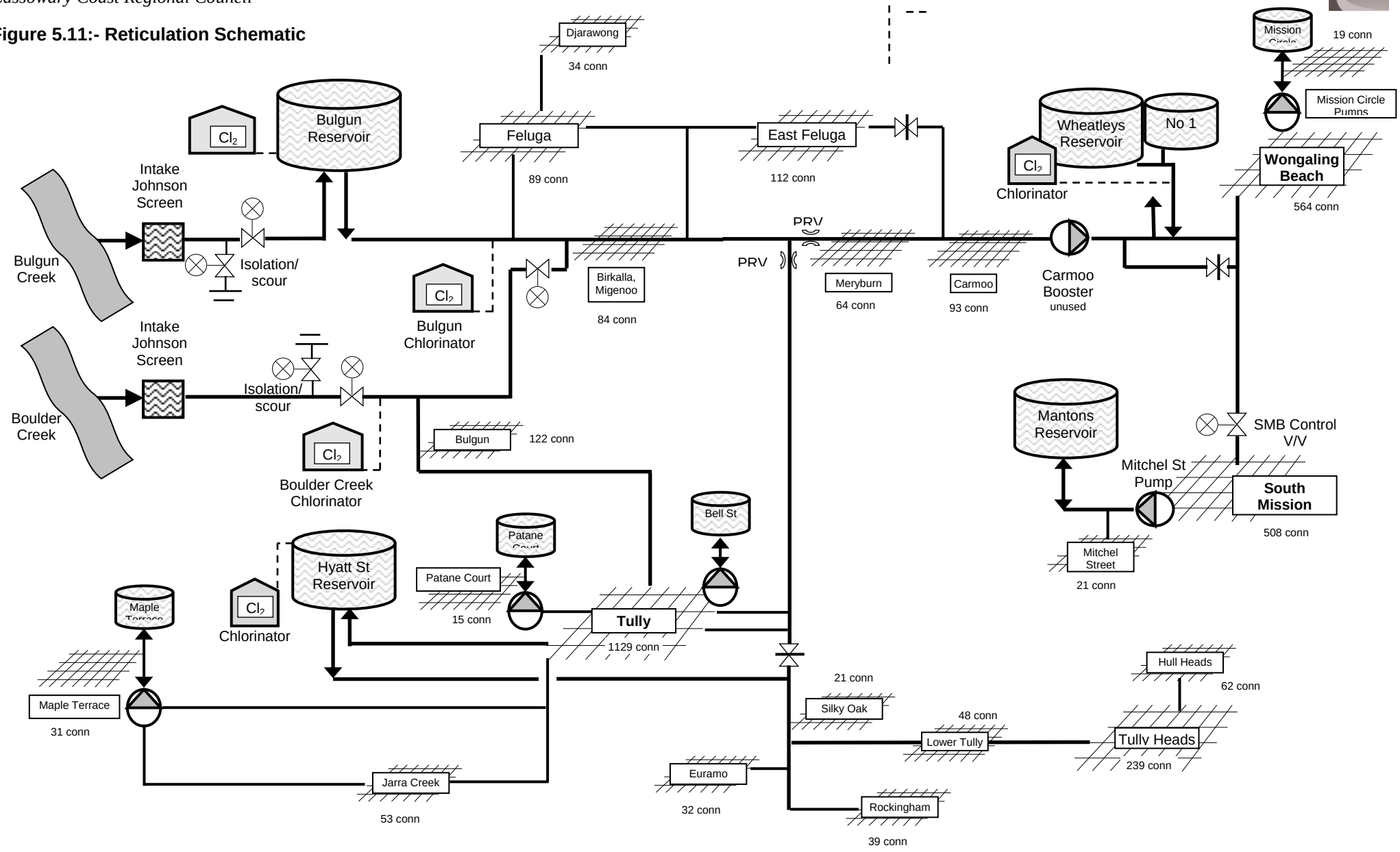
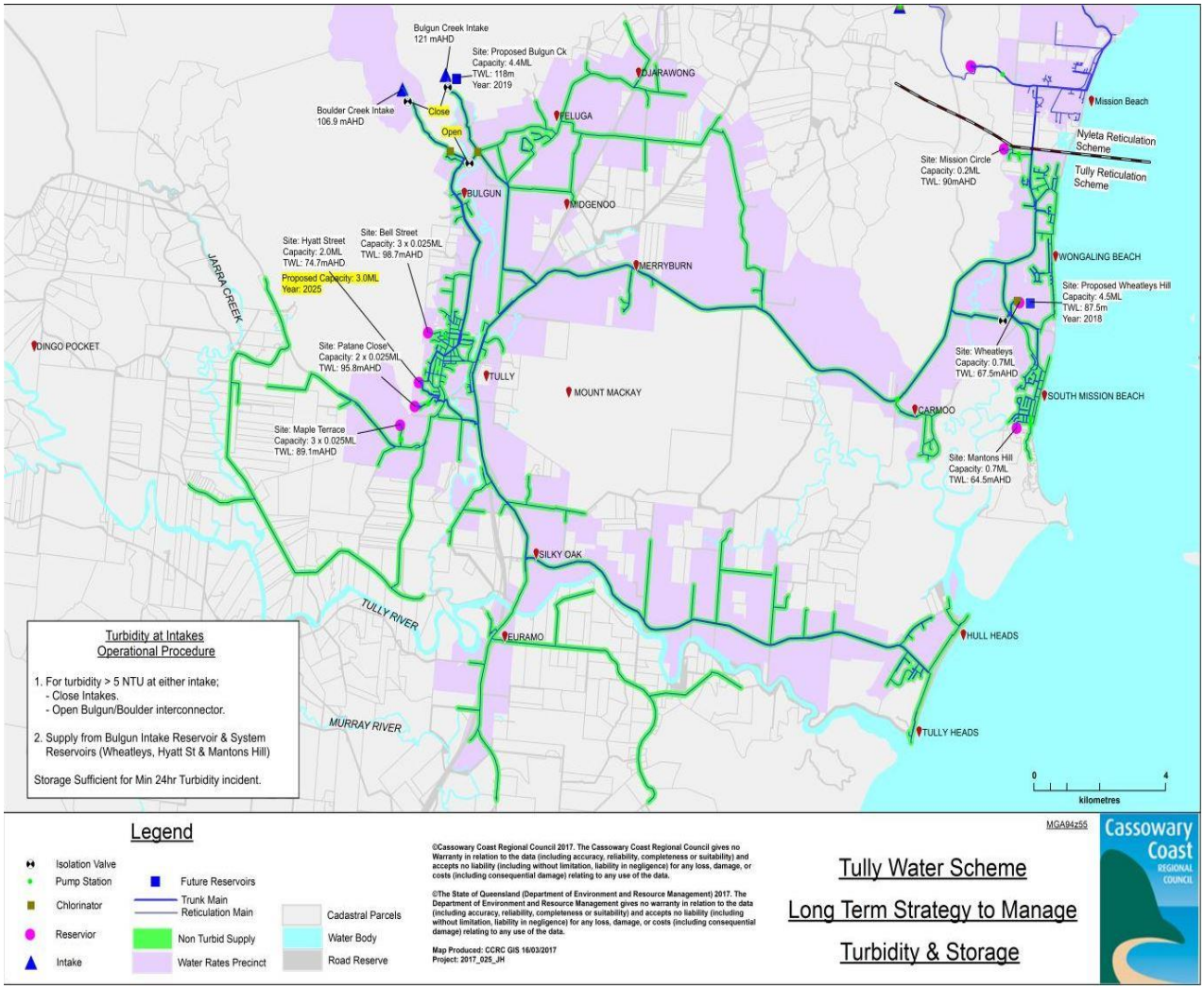


Figure 5.12 Tully Water Scheme Long Term Turbidity Strategy

5.3.2 Figure 5.10 Tully Water Scheme Long Term Turbidity Strategy



5.3.3 Asset Type and Condition

Details of the water mains in the Tully Scheme are shown in Table 5.2.

The reticulation mains in the older sections of Tully are typically unlined cast iron. These mains were typically installed in the period 1945 to 1953. The unlined cast iron pipes have extensive internal ferric nodules and internal corrosion. The poor internal condition of these mains is impacting general capacity and fire flow capacity and the 10 year capital program includes funding allowances for the renewal of these cast iron reticulation mains. The replacement works is initially focussing on the CBD area and then into the residential areas. As at 2015, there were approximately 16km of unlined cast iron reticulation mains of 100mm and 150mm diameter.

The trunk main from Boulder Ck intake was initially constructed in 1970. The upstream sections are 375mm AC. Along Bulgun Road and into the Tully town the trunk mains are a combination of pipe diameters and materials with sections of 300mm DICL and closer to town 225 mm CI and AC. Typically the trunk mains into Tully from the intake are in good condition.

The trunk main from the Bulgun Ck intake that supplies the rural area north of Tully and Mission Beach (Wongaling and South Mission Beach) is predominantly 300mm diameter. The initial section from the intake to the Bruce Highway was installed in the early 1970's in AC. The section along Tully Mission Beach Rd was installed in about 1993. Significant portions of this main are class 12 pvc.

In the period from about 1960 to the early 1980's, the reticulation mains installed in and surrounding Tully were AC. Typically the AC mains are in fair to good condition. Failures have been observed with some of the AC mains that are continuously immersed in ground water. Failure types include soft spots, longitudinal splitting and collar leaks (possible ring failures).

There is no program for extensive replacement of any of the AC mains in the 10 year program. The majority of the AC mains will be nearing the end of their theoretical asset life in the 10 to 20 year horizon. Asset condition of AC mains will be monitored closely to determine if the AC renewal program can be spread over a longer cycle.

White class 12 PVC accounts for approximately 50% of the 100 and 150mm diameter reticulation mains in the Tully scheme. These mains were installed in the period from the mid 70's to about the year 2000. The predominant areas with class 12 pvc include the rural areas north of Tully (Feluga) and Mission Beach. Since approximately the year 2000, all water mains installed in the region have been class 16. White class 12 pvc has a known history of premature failure when operating with pulsing high pressures, typically in excess of 60m. A significant portion of the Tully system was subject to very high operating pressures before the pressure reducing valves were introduced into the system at key points. Whilst the introduction of the pressure reducing valves will extend the life of these class 12 pvc assets, the fatigue damage is unknown. There is no allowance in the 10 year program for the widespread renewal of white pvc mains in the Tully scheme.

Pipeline asset data in the Tully scheme is poor. There are significant portions of the network with no known date of installation or material type. Council has made some progress over the last few years to update the records and this asset collection work will be ongoing.

Table 5.2: Tully Water Supply Scheme Pipe Asset Details (Revaluation May 2020)

Dia	50mm									Total Length
Pipe Material	AC			CU	32 40 GWI	32 40 Poly	PVC CL12	PVC CL16	32-50 PVC	(m)
Length					207	20834		1087	41577	63705
Average Age					42	20.3		19	28.6	
Dia	63mm									
Pipe Material						Poly	PVC CL12	PVC CL16		
Length										0
Average Age										
Dia	80mm									
Pipe Material	AC	CI		CU	GWI	Poly	PVC CL12	PVC CL16	75 PVC	
Length									147	147
Average Age									44	
Dia	100mm									
Pipe Material	AC	CI	DI		GWI	Poly	PVC CL12	PVC CL16	+110 PVC	
Length	22655	5980	311			363	799	13872	80602	124582
Average Age	50.9	65.5	6.4			10	27	19	26.5	
Dia	150mm									
Pipe Material	AC	CI	DI			Poly	PVC CL12	PVC CL16	PVC	
Length	11709	4896	3956					2155	5309	28025
Average Age	47.2	64.9	4.8					3.7	32.3	
Dia	200mm									
Pipe Material	AC	CI	DI			Poly	PVC CL12	PVC CL16	PVC	
Length	13487						938		1670	16095
Average Age	51						11		41	
Dia	225mm									
Pipe Material	AC	CI	DI			Poly	PVC CL12	PVC CL16	PVC	
Length	5143	5190	230				3920		9699	24182
Average Age	49.3	47.8	6.4				29.7		20.9	
Dia	250mm									
Pipe Material	AC	CI	DI			Poly	PVC CL12	PVC CL16	Steel	
Length			87							87
Average Age			26							
Dia	300mm									
Pipe Material	AC	CI	DI			280 Poly	PVC CL12	PVC CL16	Steel	
Length	6842		3153			2364	17058			29417
Average Age	50		19.8			6	34			
Dia	375mm									
Pipe Material	AC	CI	DI			Poly	PVC CL12	PVC CL16	Steel	
Length	2784		552							3336
Average Age	49		1							
Dia	400mm									
Pipe Material	AC	CI	DI			Poly	PVC CL12	PVC CL16	Steel	
Length							138			138
Average Age							44			
										289714
Total Lengths	62620	16066	8289	0	207	23561	22853	17114	139004	289714
Per Mtl Type m										

Distribution and Reticulation System	Areas of potential long detention	Hull Heads, Mission Circle, extremities
	Areas where low water pressure could be expected	Rural extremities with small mains or high elevation

5.3.4 SCADA Deployment

Since 2013, capital works budgets had been allowing for the deployment of SCADA to key water infrastructure as a major risk mitigation measure in line with the 2013 DWQMP (ECM Doc # 2265542).

Table 5.3, shows status of key water infrastructure in the Tully scheme connected to SCADA

Table 5.3: Tully Scheme SCADA Deployment

Tully		
Site Name	**Connected**	**Comment**
Treatment		
Bulgun Chlorinator	✓	
Boulder Chlorinator	✓	
Wheatleys Chlorinator	✓	
Hyatt St	✓	
Reservoirs		
Bulgun Intake	✓	
Hyatt Street	✓	
Patane Close	✓	
Maple Terrace	✓	
Wheatleys Hill	✓	
Mantons Hill	✓	
Mission Circle	✓	
Bell Street	✓	
Pump Stations		
Patane Court	✓	
Maple Terrace	✓	
Carmoo Boost		Currently not in use
Mitchell St	✓	
Mission Circle	✓	
Bell Street	✓	
Control Valves		
Mission Bch/ Hull Hds PRV	✓	
Radio Repeater		
Tully STP	✓	

5.4 Water Quality Data and Analysis

5.4.1 Interpretation

Raw water quality data from the Bulgun and Boulder Creek intakes are considered to be of good quality with the exception of occasional colour and turbidity spikes caused from high rainfall events. The water hardness is classified *soft* and has a low saturation index. No pesticides have been detected. Standard Water Analysis results for the Tully Intakes are shown in Tables 5.4, 5.5 and 5.6.

Standard water analysis for the reticulation system for the period 2009-2016 is shown in Table 5.7A and 5.7B.

The Bulgun Intake Reservoir Chlorinator and Boulder Chlorinator are the first disinfection points for the Tully Scheme. In-house data in Table 5.8: *Tully Scheme Reticulation Water Quality Data 1/15 to 5/16* shows periods of high turbidity above the ADWG aesthetic limit. (The location of sampling points is shown in Council's Sampling Manual in Appendix E) Incidences of high turbidity levels are short term events and related to the duration, intensity and position of rainfall within the catchment. The data in Table 5.8 shows average turbidity in the network above 1 at most sampling points. Specific data for NTU and ecoli sampling where the NTU is greater than 1 is shown in Table 5.9. The lack of detection of E-coli demonstrates that the disinfection processes adopted by Council are effective. It is acknowledged that in extreme turbidity events, the chlorine dosing system may be less effective even if chlorine residuals are being maintained. However with the turbidity control measures now in place with the Bulgun intake reservoir, there is strong confidence that clean water will be consistently supplied with low turbidity values and good levels of chlorine. Procedures have been implemented to increase the sampling and testing frequency for E-coli whenever high turbidity is recorded. Refer Quality Control Procedures.

Chlorination levels are set between aesthetic and health limits. Dosing at the Bulgun and Boulder Chlorinators is automatically flow paced by the PLC using inputs from the turbidity analyser and flow meter. In periods of high turbidity, dosing can also be increased remotely through SCADA. The Wheatleys Hill Reservoir Chlorinator doses a constant rate directly into the reservoir to boost residuals. The data in Table 5.8: *Tully Scheme Reticulation Water Quality Data 1/15 to 5/16* shows Cl_2 residual decreasing in the reticulation scheme towards the outer lying areas particularly south of Tully such as Hull Heads and along the Tully Gorge Rd. Council is aware of this issue and in 2016/17 installed additional chlorine dosing facilities into the Hyatt St reservoir. Aside from the impact of turbidity in the reticulated water, chlorine residuals are also impacted by the lack of turnover in some areas. Council has installed autoscour facilities at points in the Tully network where turnover is otherwise low. Council is progressively upgrading autoscour facilities to ensure they have timer actuation and metering.

Samples for disinfection by-products have not been tested within this scheme. In 2017, Council acquired testing kits for total chlorine. These kits will be used to regular check total chlorine is being maintained below 5mg/l. At primary dosing points, chlorine residual approximates total chlorine. Quality procedures were amended in 2017 to reflect the requirement for testing of total chlorine.

It can be seen from Table 5.8: *Tully Scheme Reticulation Water Quality Data 1/15 to 5/16* the pH increases towards the outer reaches of the scheme particularly Hull Heads. This is due to the soft water characteristics and long retention time in the fibre reinforced, cement lined mains and concrete reservoirs.

Up until 2016, there was no centralised database for storing water quality data. Council is now progressively moving historical water quality data to the SWIM Local system. The historical system (pre 2016) consists of a combination of multiple spreadsheets, scanned and physical data. This creates difficulties in analysis and data quality control.

5.4.2 Complaints

Water Quality complaints are mainly concerned with dirty water, outages and low pressure. Generally the causes are associated with main breaks, stream turbidity and high demand. Details of the complaints in the Tully Scheme are listed in Table 5.10.

Council monitors customer complaints and response time details as part of it Customer Service Charter (ECM document # 2327195). After each financial year, staff report outcomes of performance against key indicators in the Customer Service Charter and results are provided to the Regulator and uploaded onto the Council web site.

Each complaint is actioned as part of Council's Customer Request (CR) system. Comments of actions taken to rectify a complaint are noted against the individual CR. The annual performance report includes detailed analysis and commentary on each water complaint received.

5.4.3 Service Problems

Main breaks are due to combined factors of high static pressure, operation of pumps and valves creating pressure spikes, underperforming pipe materials particularly *white PVC* and site ground conditions. On going programs of main replacements are in place to improve performance and reduce breakages. Mains flushing is conducted on an as needs process in response to dirty water complaint to improve water quality. The flushing locations and frequency have been developed based on practical experience and network knowledge such as dead end mains. A number of *auto-scours* are in place to automatically scour some dead end mains. These are valves operated on a timer programmed to open for a set time each night. System supply is set by stream flow and system physical pipe capacity therefore high demand can occasionally cause low pressure within parts of the network. Water restrictions are implemented when required to reduce demand or as triggered by the Drought Management Plan.

Mechanical maintenance is conducted by in-house staff with electrical, instrumentation and radio being serviced by external contractors. Council staff have developed some skills with the telemetry and SCADA systems but still rely heavily on the service agreement with Welcon for the ongoing management of the SCADA operations.

Staff are required to undertake multiple roles including operations, maintenance and other activities. Due to multiple responsibilities water quality may not always be given the highest priority. System changes are not always well communicated to treatment staff. Maintenance and operational procedures are being developed and are to be reviewed and improved over time.

Table 5.4: Bulgun Ck Raw Water Source SWA Results Summary -1996-2011

Tully Scheme Raw Water - Bulgun Creek							
Sampling location	**Bulgun Creek Intake**						
Parameter (examples)	**Units**	**Time Period**	**No of samples**	**Summary of Results**			**Comments**
				Maximum Value	**Average Value**	**Minimum Value**	
E.coli							No Data
pH		1996-2011	11	7.25	7	6.84	
Total hardness		1996-2011	11	8.2	4.9	3.4	
Silica		1996-2011	11	17.7	15	12	
TD Solids		1996-2011	11	40	33.7	28	
True Colour		1996-2011	11	19	8.6	3	1 occurrences above 15
Turbidity (NTU)		1996-2011	11	6	1.4	0.3	1 occurrence above 5 NTU
Sat Index		1996-2011	10	-2.9	-3.3	-3.7	
Sodium	mg/l	1996-2011	11	5.2	4.5	4	
Chloride		1996-2011	11	5.7	4.8	4.2	
Fluoride		1996-2011	11	0.1	0.1	0.1	
Nitrate		1996-2011	11	0.7	0.4	0	
Sulphate		1996-2011	11	1.9	0.9	0	
Iron		1996-2011	11	0.01	0.01	0.01	
Manganese		1996-2011	11	0.01	0.01	0	
Zinc		1996-2011	11	0.03	0.01	0	
Aluminium		1996-2011	11	0.05	0.04	0.01	
Boron		1996-2011	11	0.02	0.01	0	
Copper		1996-2011	11	0.03	0.02	0	
Heavy Metals							No Data
Pesticides			Tot	pos			
Bulgun Creek		2010-2011	10	0			No detections

Table 5.5: Boulder Ck Raw Water Source SWA Results Summary -1996-2011

Tully Scheme Raw Water Boulder Creek							
Sampling location	**Boulder Creek Intake**						
Parameter (examples)	**Units**	**Time Period**	**No of samples**	**Summary of Results**			**Comments**
				Maximum Value	**Average Value**	**Minimum Value**	
E.coli							No Data
pH		1997-2011	9	7.02	6.9	6.75	
Total hardness		1997-2011	9	3.39	2.9	2.5	
Silica		1997-2011	9	14	12.5	10	
TD Solids		1997-2011	9	32	28.7	24	
True Colour		1997-2011	9	13	7	3	
Turbidity (NTU)		1997-2011	9	3	1.2	0.4	
Sat Index		1997-2011	8	-3.7	-3.9	-4.1	
Sodium	mg/l	1997-2011	9	4.3	3.9	3	
Chloride		1997-2011	9	5	4.6	4.3	
Fluoride		1997-2011	9	0.1	0.1	0	
Nitrate		1997-2011	9	1.1	0.6	0.3	
Sulphate		1997-2011	9	1	0.94	0.43	
Iron		1997-2011	9	0.02	0.01	0.01	
Manganese		1997-2011	9	0.01	0.01	0	
Zinc		1997-2011	9	0.04	0.01	0	
Aluminium		1997-2011	9	0.05	0.05	0.02	
Boron		1997-2011	9	0.02	0.02	0	
Copper		1997-2011	9	0.03	0.03	0	
Heavy Metals							No Data
Pesticides			Tot	pos			
Boulder Creek		2010-2011	10	0			No Detections

Table 5.6: SWA Results for Tully Water Sources - 2012 - 2016.

Jan 2012 - May 2016 - Cassowary Coast Regional Council Raw Water Standard Water Analysis Results																		
	Number of Samples		Fe	Mn	Zn	B	Cu	Total Hardness	Saturation Index	Carbonate	H	Residual Alkalinity	Conductivity	Ca	pH	SAR	Sulphate	K	Figure Merit Ratio
Boulder Creek	15	Min	0.0	0.0	0.0	0.0	0.0	2.6	-4.3	0.0	0.0	0.0	30.0	0.5	6.7	0.9	1.0	1.2	0.3
		Average	0.0	0.0	0.0	0.0	0.0	3.1	-3.8	0.0	0.0	0.1	35.7	0.6	7.0	1.1	1.0	1.3	0.3
		Max	0.0	0.0	0.0	0.0	0.0	3.8	-3.2	0.0	0.0	0.1	50.0	0.9	7.3	1.5	1.0	1.5	0.4
Bulgun Creek	18	Min	0.0	0.0	0.0	0.0	0.0	4.2	-3.6	0.0	0.0	0.0	34.0	0.6	7.0	0.8	1.0	1.0	0.4
		Average	0.0	0.0	0.0	0.0	0.0	5.3	-3.1	0.0	1.1	0.1	41.6	1.3	7.2	1.0	1.1	1.1	0.8
		Max	0.1	0.0	0.0	0.0	0.0	6.4	-2.6	0.0	17.0	0.2	57.0	1.7	7.4	1.3	1.4	1.6	6.0

	Number of Samples		Al	Chloride	Mg	Water temp	Temporary Hardness	Nitrate	Si	Total Dissolved Ions	TDS	Mole Ratio	Turbidity	Hydroxide	Na	Fluoride	pH Sat.	True Colour	Alkalinity	Bicarbonate
Boulder Creek	15	Min	0.0	4.4	0.3	21.0	2.6	0.5	12.0	18.0	27.0	3.0	1.0	0.0	4.0	0.1	10.5	1.0	4.0	5.0
		Average	0.0	4.8	0.4	21.7	3.1	0.7	15.3	21.7	32.6	3.3	1.0	0.0	4.4	0.1	10.8	5.3	6.9	8.3
		Max	0.0	7.0	0.4	23.0	3.8	1.0	20.0	29.0	41.0	3.8	1.0	0.0	6.0	0.1	11.1	10.0	10.0	12.0
Bulgun Creek	18	Min	0.1	4.2	0.0	21.0	4.2	0.5	14.0	21.0	30.0	2.5	1.0	0.0	1.2	0.1	10.0	2.0	7.0	0.0
		Average	0.1	4.9	0.5	21.9	5.3	0.6	17.7	27.1	37.9	2.8	1.0	0.0	4.7	0.1	10.3	5.8	10.1	11.8
		Max	0.1	7.4	0.6	24.0	6.5	0.6	22.0	35.0	47.0	3.2	1.0	0.0	7.0	0.1	10.5	11.0	14.0	19.0

Above ADWG Guideline Values
Below ADWG Guideline Value

Note 1: Results of Pesticides Testing - From 15 samples for Boulder and 18 samples for Bulgun there were no detections.

Tully Supply Sources - Jan 2016 - Jan 2021 - Standard Water Analysis Results																			
	No. of Samples		Iron SWA	Mn	Zinc SWA	B	Cu	Total Hardness	Sat'n Index	Carbonate	H	Residual Alkalinity	Conductivity	Ca	pH	SAR	Sulphate	K	Figure Merit Ratio
Boulder Creek	29	Min	<0.01	<0.00	<0.01	<0.02	<0.00	2.30	-4.70	0.00	0.00	0.00	29.00	0.40	5.96	0.70	0.80	1.10	0.30
		Avg	<0.01	<0.01	<0.06	<0.02	<0.03	2.96	-4.27	0.00	0.00	0.10	33.28	0.58	6.53	0.91	0.91	1.43	0.39
		Max	0.02	<0.01	<0.06	<0.02	<0.03	3.60	-3.70	0.00	0.00	0.10	40.00	0.80	6.99	1.20	1.10	4.90	0.50
Bulgun Creek	29	Min	<0.01	<0.00	<0.01	<0.02	<0.03	3.70	-4.10	0.00	0.00	0.10	30.00	0.90	6.00	0.60	0.70	0.90	0.50
		Avg	<0.01	<0.01	<0.06	<0.02	<0.03	5.31	-3.52	0.03	0.00	0.10	39.24	1.39	6.74	0.82	0.94	1.07	0.57
		Max	0.07	<0.01	<0.06	<0.02	<0.03	9.90	-0.70	0.80	0.00	0.20	66.00	3.90	8.95	1.00	1.10	1.60	0.70
							0.0	0.0											

	No. of Samples		Al	Cl-	Mg	Water temp	Temp Hardness	Nitrate	Silica	Total Disolved Ions	TDS	Mole Ratio	Turbidity	OH-	Na	Fluoride	pH Sat.	True Colour	Alkalinity	Bicarbonate
Boulder Creek	29	Min	<0.03	4.00	0.30	2.30	0.30	8.00	17.00	22.00	3.30	<1.0	0.00	2.90	0.03	10.50	2.00	4.00	5.00	<0.03
		Avg	<0.05	4.88	0.36	2.96	0.52	14.03	20.83	30.21	3.78	1.80	0.00	3.65	<0.05	10.81	6.00	6.97	8.55	<0.05
		Max	0.08	6.00	0.43	3.60	1.00	20.00	26.00	40.00	4.20	3.00	0.00	5.00	0.06	11.10	20.00	10.00	12.00	0.08
Bulgun Creek	29	Min	<0.03	<0.4	<0.1	3.70	0.09	11.00	20.00	27.00	1.30	1.00	0.00	3.00	<0.01	9.60	1.00	7.00	9.00	<0.03
		Avg	<0.05	<5.04	<0.46	5.31	0.14	16.45	25.62	35.76	3.27	3.57	<0.1	4.35	<0.04	10.26	6.11	15.00	12.69	<0.05
		Max	0.06	9.20	0.60	9.90	0.18	23.00	40.00	46.00	4.00	18.00	0.10	7.00	0.07	10.60	25.00	10.41	18.00	0.06

Table 5.6A: SWA Results for Tully Water Sources - 2016 - 2021

Table 5.7A: Reticulation Summary Table Combination of SWA and In-House Test results

Tully Scheme Reticulation Water Quality Tully, Feluga, Silky Oak, Euramo, Tully Heads, Hull Heads, Wongaling Beach, South Mission Beach									
Parameter	**Units**	**2009 to 2011**							**Comments**
		No Samples Collected	**No in which parameter detected**	**No outside ADWG Health Limits**	**No outside the ADWG Aesthetic Limits**	**Min**	**Max**	**Ave**	
Turbidity	NTU	1138	1138	0	142	0.62	120	3.74	2.25NTU 50%tile – no treatment
Free Chlorine	mg/L	1260	1260	0	1026	0	4.96	1.41	dose rate reflects NTU
E.Coli	CFU/100mL	278	1	1		1	1	1	disinfection only
pH	units	1259	1259	0	6	6.48	8.56	7.08	soft water long AC mains
Total hardness	mg/L	23	23	0	0	2.82	21	5.8	
Silica	mg/L	23	23	0	0	10	42.6	14.6	
TD Solids	mg/L	23	23	0	0	29	86.8	38.5	
True Colour	HU	23	23	0		0	11	2.7	
Sat Index	mg/L	23	23	0	0	-3.7	-1.7	-3	
Sodium	mg/L	23	23	0	0	4	8	6	
Calcium	mg/L	23	23	0	0	0.7	6.2	1.6	
Chloride	mg/L	23	23	0	0	3.75	9.4	6.7	
Fluoride	mg/L	23	23	0	0	0	0.17	0.1	
Nitrate	µg/L	23	23	0	0	0	2.08	0.5	
Sulphate	mg/L	23	23	0	0	0	1	0.7	
Iron	mg/L	23	23	0	0	0	0.03	0	
Manganese	mg/L	23	23	0	0	0	0.02	0	
Zinc	mg/L	23	23	0	0	0	0.04	0	
Aluminium	mg/L	23	23	0	0	0	0.05	0	
Boron	mg/L	23	23	0	0	0	0.02	0	
Copper	mg/L	23	23	0	0	0	0.06	0	
THM(s)									No data

Table 5.7B: Reticulation SWA Summary 1/1/12 to 5/2016

Tully Scheme Treated Water Quality								
Tully, Feluga, Silky Oak, Euramo, Tully Heads, Hull Heads, Wongaling Beach, South Mission Beach								
2012 - 2016								
Parameter	**Units**	**NO. in which parameter detected**	**NO. outside ADWG Health Limits**	**NO. outside ADWG Aesthetic Limits**	**Min**	**Max**	**Ave**	**Comments**
Iron	mg/L	54	0	0	0.0	0.1	0.02	
Manganese	mg/L	65	0	0	0.0	0.0	0.01	
Zinc	mg/L	54	0	0	0.0	3.0	0.09	
Boron	mg/L	54	0	0	0.0	0.0	0.02	
Copper	mg/L	65	0	0	0.0	0.0	0.03	
Total Hardness	mg/L	54	0	0	2.9	12.0	6.51	
Saturation Index	mg/L	54	0	0	-3.9	-0.4	-2.28	
Carbonate	mg/L	54	0	0	0.0	1.1	0.13	
Hydrogen	mg/L	54	0	0	0.0	0.0	0.00	
Residual Alkalinity	mg/L	65	0	0	0.0	0.2	0.10	
Conductivity	mg/L	65	0	0	42.0	77.0	57.34	
Calcium	mg/L	54	0	0	0.7	4.7	2.25	
pH	units	54	0	1	6.8	9.1	7.81	
SAR	mg/L	54	0	0	0.8	1.8	1.32	
Sulphate	mg/L	65	0	0	1.0	1.1	1.00	
Potassium	mg/L	65	0	0	1.0	1.6	1.23	
Figure Merit Ratio	mg/L	65	0	0	0.2	0.7	0.40	
Aluminium SWA	mg/L	65	0	0	0.1	0.2	0.05	
Chloride	mg/L	54	0	0	6.4	11.0	8.30	
Magnesium	mg/L	65	0	0	0.1	0.5	0.24	
Temporary Hardness	mg/L	65	0	0	2.9	12.0	6.37	
Nitrate	µg/L	54	0	0	0.4	8.0	0.80	
Silica	mg/L	54	0	0	8.0	22.0	15.81	
Total Disolved Ions	mg/L	65	0	0	23.0	49.0	34.89	
TDS	mg/L	54	0	0	31.0	60.0	43.50	
Mole Ratio	mg/L	65	0	0	1.0	3.8	2.56	
Turbidity	NTU	54	0	1	1.0	9.0	1.61	
Hydroxide	mg/L	65	0	0	0.0	0.2	0.02	
Sodium	mg/L	54	0	0	5.0	11.0	7.36	
Fluoride	mg/L	65	0	0	0.1	0.1	0.06	
pH Sat.	mg/L	65	0	0	9.5	10.8	10.09	
True Colour	mg/L	65	0	0	1.0	7.0	2.02	
Alkalinity	mg/L	54	0	0	5.0	18.0	11.46	
Bicarbonate	mg/L	65	0	0	6.0	25.0	13.97	

Table 5.7C: Reticulation SWA Summary 2016-2021

Tully Scheme Treated Water Quality								
Tully, Feluga, Silky Oak, Euramo, Tully Heads, Hull Heads, Wongaling Beach, South Mission Beach								
2016-2021								
Parameter	**Units**	**NO. in which parameter detected**	**NO. outside ADWG Health Limits**	**NO. outside ADWG Aesthetic Limits**	**Min**	**Max**	**Ave**	**Comments**
Iron	mg/L	54	0	0	< 0.01	0.06	< 0.02	
Manganese	mg/L	65	0	0	< 0.00	< 0.01	< 0.01	
Zinc	mg/L	54	0	0	0.01	3.00	< 0.16	
Boron	mg/L	54	0	0	< 0.02	0.02	< 0.02	
Copper	mg/L	65	0	0	< 0.03	< 0.03	< 0.03	
Total Hardness	mg/L	54	0	0	0.40	35.00	6.98	
Saturation Index	mg/L	54	0	0	-4.30	-0.40	-2.67	
Carbonate	mg/L	54	0	0	0.00	1.10	0.07	
Hydrogen	mg/L	54	0	0	0.00	0.00	0.00	
Residual Alkalinity	mg/L	65	0	0	0.00	0.20	0.11	
Conductivity	mg/L	65	0	0	38.00	83.00	55.60	
Calcium	mg/L	54	0	0	0.60	4.70	2.39	
pH	units	54	0	16	6.12	9.13	7.34	
SAR	mg/L	54	0	0	0.70	3.80	1.24	
Sulphate	mg/L	65	0	0	0.80	1.10	< 1.00	
Potassium	mg/L	65	0	0	0.90	1.90	1.21	
Figure Merit Ratio	mg/L	65	0	0	0.20	0.80	0.44	
Aluminium SWA	mg/L	65	0	0	< 0.03	0.18	< 0.06	
Chloride	mg/L	54	0	0	4.70	16.00	8.64	
Magnesium	mg/L	65	0	0	0.03	0.52	< 0.22	
Temporary Hardness	mg/L	65	0	0	2.60	12.00	6.71	
Nitrate	µg/L	54	0	0	0.16	8.00	< 0.59	
Silica	mg/L	54	0	0	8.00	23.00	15.63	
Total Disolved Ions	mg/L	65	0	0	24.00	47.00	35.83	
TDS	mg/L	54	0	0	10.00	57.00	43.60	
Mole Ratio	mg/L	65	0	0	1.00	4.20	2.98	
Turbidity	NTU	54	0	2	1.00	19.00	2.65	
Hydroxide	mg/L	65	0	0	0.00	0.20	0.01	
Sodium	mg/L	54	0	0	4.00	11.00	7.00	
Fluoride	mg/L	65	0	0	0.03	0.06	< 0.05	
pH Sat.	mg/L	65	0	0	9.50	10.80	10.01	
True Colour	mg/L	65	0	0	< 1	7.00	2.07	
Alkalinity	mg/L	54	0	0	5.00	19.00	12.48	
Bicarbonate	mg/L	65	0	0	6.00	23.00	14.97	

Table 5.8: In-House Testing for Tully Scheme Reticulation Water Quality Data 1/1/12 to 30/9/16

Parameter		3003 Bulgun Cr Chlorinator	3004 Boulder Cr Chlorinator	3101 Costigans	3102 Murry St Bronzewing Cr	3103 Tully Gorge Rd Cemetery	3104 Mullins Rd Hydrant	3105 Silky Oak Service Station	3106 Hull Heads Tap	3107 Mars Creek	3108 Merryburn	3109 Wongaling Reid Rd Wheatley Park
pH	Min	6.69	6.38	6.34	6.38	6.37	6.38	6.4	6.28	6.31	6.3	6.32
	Max	8.01	8.08	8.01	7.73	7.88	7.52	8.42	8.61	8.44	8.38	7.82
	Average	7.4	7.26	6.96	6.99	7.02	6.99	7.14	7.73	7.08	7.14	7.2
	Count	280	280	470	471	467	463	469	465	468	465	468
Cl	Min	1.37	1.71	.13	.12	.06	0	.02	0	.28	.09	.01
	Max	4.44	3.90	4.96	4.81	3.66	2.79	3.32	2.61	4.13	3.37	4.43
	Average	2.92	2.91	2.54	2.31	1.93	1.1	1.62	.81	2.55	2.03	1.68
	Count	324	280	470	471	467	463	470	468	468	465	468
Turbidity	Min	.29	0	.02	0.04	.14	.23	.14	.42	.04	.15	.12
	Max	15.4	108	40.8	82.1	31.8	9.78	32.3	11.7	18.9	24.4	8.2
	Average	1.89	1.56	1.25	1.28	1.71	1.55	1.31	2.45	1.53	1.4	1.07
	Count	280	280	470	471	466	68	470	74	467	465	468
E Coli	Number of Tests	1	2	98	116	97	23	89	32	98	91	98
	Number of Positives	0	0	1	1	1	0	0	0	1	0	0

Note 1: The positive E.Coli results at Tully Gorge Rd on 14/4/2016 were due to a high rainfall event with in system turbidity of 12. CL2 residual was increased and mains flushing undertaken. No positive result on next day.

Positive E.Coli recorded on 19/7/16 at Costigans (Turbidity 80) and Murray St (Turbidity 40). Overnight high rainfall event saw turbidity reach 108 NTU at chlorinator.
Positive E.Coli at Mars was recorded on 31/1/12 along with 9.06 Turbidity at test point.

Table 5.8A: Tully Scheme Reticulation Water Quality Data January 2016 to January 2021

Parameter		3001 Bulgun Creek Intake	3002 Boulder Creek Intake	3101 Costigans	3102 Murray St Bronzewing Cr	3103 Tully Gorge Rd Cemetery	3104 Mullins Rd Hydrant	3105 Silky Oak Service Station	3106 Hull Heads Tap	3107 Mars Creek	3108 Merryburn	3125 SMB Esplanade	3126 Banfield Pde
pH	Min	6.59	6.45	6.51	6.56	6.57	6.2	6.54	6.58	6.57	6.45	6.51	6.5
	Max	7.39	7.21	8.04	7.74	7.65	7.93	8.3	9.2	7.96	7.91	8.38	8.23
	Average	6.96	6.73	7.13	7.10	7.09	7.08	7.15	8.08	7.31	7.35	7.57	7.54
	Count	179	178	566	568	274	546	269	545	570	552	411	230
Cl Free	Min	N/A	N/A	0.13	0	0.03	0	0.02	0	0.05	0	0	0
	Max	N/A	N/A	4.02	3.48	3.12	2.73	2.94	1.97	3.63	3.45	3.02	2.42
	Average	N/A	N/A	2.45	2.21	1.80	1.20	1.56	0.94	2.44	2.11	1.37	1.20
	Count	N/A	N/A	566	568	274	547	269	548	571	553	411	231
Cl Total	Min	N/A	N/A	0.24	0.02	0.07	0.01	0.08	0	0.25	0.02	0	0
	Max	N/A	N/A	3.75	3.55	3.13	2.65	2.98	2.05	3.75	3.81	3.56	2.55
	Average	N/A	N/A	2.66	2.41	1.96	1.32	1.73	1.07	2.59	2.28	1.47	1.28
	Count	N/A	N/A	442	442	152	430	148	428	448	432	411	231
Turbidity	Min	0.07	0.09	0.07	0.04	0.06	0.06	0.05	0.06	0.03	0.02	0.09	0.04
	Max	7.09	4.7	40.8	82.1	19.6	11.3	5.15	22.6	18.7	17.4	14.8	9.35
	Average	0.75	0.81	1.07	1.26	1.47	0.93	1.04	1.29	0.93	1.08	1.05	0.93
	Count	180	179	565	568	273	543	269	546	571	553	410	230
E.Coli	Number of Tests	171	172	171	166	102	173	122	191	183	176	123	65
	Number of Positive	58 (Avg)	34 (Avg)	2	1	2	0	0	2	1	3	2	0

Note: All positive ecoli results in the reticulation relate to boil water events before the completion of the Bulgun Intake Reservoir in late 2020.

Boulder Creek Supply Source – NTU and Ecoli Data							
Site	Costigans	Murray St / Bronzewing Cr	Mullins Rd Hydrant	Hull Heads Tap	Tully Gorge Rd Cemetery	Silky Oak Service Stn	Tully Hospital
No.of samples from 1/7/2017 to 31/5/2021	138	139	136	143	66	58	3
No. of positive ecoli	1	0	0	0	0	0	0
Details of positive ecoli	19/10/2017 NTU 32.4, Cl2 0.16						
No. of Samples > 1NTU	59	71	45	53	50	33	0
No. of Samples > 5NTU	7	9	3	10	6	1	0

Table 5.9 Boulder Creek Supply Source – NTU and Ecoli Data

Notes:

1. Positive ecoli on 19/10/2017 coincided with peak NTU recorded anywhere in system.
2. Highest turbidity recorded in network after commissioning of Bulgun Intake Reservoir December 2020 was 3.71 NTU on 6/1/21. Typically the new reservoir and associated control system ensures water is not entering the reticulation network above 4 NTU.
3. The sampling at the hospital is not part of Council's standard test sites.

Bulgun Creek Supply Source – NTU and Ecoli Data					
Site	Mars Ck	Merryburn	Sth Mission Beach	McNamara St/Banfield Pde	Reid Rd
No.of samples from 1/7/2017 to 31/5/2021	146	143	122	119	10
No. of positive ecoli	1	2	3	2	0
Details of positive ecoli	3/7/2019 NTU 1.4, Cl2 2.95	7/12/2018 NTU 1.67 Cl2 0.06 30/12/2019 NTU 6.53 Cl2 0	12/12/2018 NTU 1.77 Cl2 0.03 13/12/2018 NTU 2.37 Cl2 0 3/4/2019 NTU 2.34 Cl2 0.03	23/10/2017 NTU 2.61 Cl2 0.01 11/12/2018 NTU 8.62 Cl2 0.04	
No. of Samples > 1NTU	46	60	45	49	7
No. of Samples > 5NTU	7	9	3	7	1

Table 5.9A Bulgun Creek Supply Source – NTU and Ecoli Data

Notes:

1. The ecoli positive at Mars Ck on 3/7/2019 could have been a contaminated sample/plate. No correlation with internal testing.
2. Aside from the Mars Ck ecoli result all other positive ecoli correlate with very low free chlorine results.
3. The retention of chlorine in the network has improved with the turbidity control measures put in place since the completion of the Bulgun Creek intake reservoir.

Table 5.10: Water Quality Complaints Table

Year	No of Water Quality Complaints	Water Quality Complaints per 1000 Connections	Main Reasons for Complaints	Likely Sources / Causes of Problems	Resolution of Problem
2019-2020	31	8.3	Dirty Water	High turbidity from rain events, main breaks, scouring.	Mains scoured, event passes
2018-2019	13	3.5	Dirty Water	High turbidity from rain events, main breaks, scouring.	Mains scoured, event passes
2017-2018	17	4.7	Dirty Water	High turbidity from rain events, main breaks, scouring.	Mains scoured, event passes
2016-2017	7	3.2	Dirty Water	High turbidity from rain events, main breaks, scouring.	Mains scoured, event passes
2014-2015	26	8.3	Dirty Water	High turbidity from rain events, main breaks, scouring.	Mains scoured, event passes
2013-2014	24	7	Dirty Water	High turbidity from rain events, main breaks, scouring.	Mains scoured, event passes
2012-2013	23	6	Dirty Water	High turbidity from rain events, main breaks, scouring.	Mains scoured, event passes
2011-2012	13	3.8	Dirty Water	High turbidity from rain events, main breaks, scouring.	Mains scoured, event passes

SECTION 6

CARDWELL WATER SUPPLY SCHEME

May 2021

6. Cardwell Scheme Details of Infrastructure

6.1 Source, treatment and distribution details

6.1.1 Source Details

The Cardwell Water supply scheme is supplied from Meunga Creek located in Girringun National Park. Two groundwater bores, Ellerbeck Road Bore and Kennedy Bore, supplement the water supply scheme in the event of an emergency.

6.1.2 Meunga Creek

The Cardwell Scheme sources its water from a run of stream intake in the Meunga Creek. Meunga Creek is a tropical stream with granite boulders and sandy bed the catchment above the water supply intake is located totally within the boundary of the *World Heritage* listed rainforest areas of Girringun National Park. Meunga Creek is subject to flooding.

The climate of this catchment can be described as tropical with distinctive wet and dry seasons. The average annual rainfall experienced at the WTP over the period of 2011 to 2015 is 1868.7mm with majority of rain fall from the months of December to April. The graphical representation of the daily rainfall is displayed in Figure 6.0 below.

Figure 6.0: Cardwell Daily Rainfall

Figure 6.0: Monthly Rainfall Cardwell (BOM)

Summary statistics for all years

Information about climate statistics

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	438.1	464.5	402.0	205.5	95.2	46.2	32.4	28.6	38.2	55.7	113.7	197.1	2113.8
Lowest	5.6	36.3	25.1	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	900.4
5th %ile	60.7	110.6	78.4	31.4	18.6	3.5	0.0	0.0	0.1	0.1	6.1	13.8	1209.7
10th %ile	112.0	157.0	110.9	53.8	23.4	8.3	1.8	0.7	1.9	1.8	19.6	29.5	1387.7
Median	376.6	431.0	320.1	153.3	79.7	33.1	23.2	21.0	20.9	37.1	82.4	138.8	2052.2
90th %ile	780.0	861.5	784.0	403.0	194.0	98.6	74.4	70.5	80.8	124.3	246.1	454.7	2898.4
95th %ile	973.4	1042.9	940.7	530.6	237.7	119.4	93.0	83.8	142.8	157.4	340.9	562.7	3130.4
Highest	1836.0	1330.5	1311.9	1178.8	347.4	270.8	190.6	142.0	336.0	328.0	653.2	1051.8	4087.7

The catchment above the intake is approximately 2500 hectares. There has been no development and the area remains in a pristine condition. Access to the intake is via an unsealed gated road of 3.5km through the National Park and 2 km of State Forest. There are no permanent trails above the intake. The area is thickly vegetated tropical forest the region is subject to heavy rainfall and occasional tropical cyclones. The flow in the stream drops during long dry periods however the creek has not been known to fail completely. The average annual rainfall within the catchments is estimated at over 2100mm.

6.1.3 Kennedy Bore

The Kennedy Bore is a potable water source located adjacent to Ellerbeck Road KENNEDY, approximately 550 meters from the intersection of Kennedy Creek Road. The surrounding area is reserved for plantation forestry. The bore is accessing shallow alluvial springs. The bore was drilled in 2009 and can produce up to 36 lps.

6.1.4 Ellerbeck Bore

The Ellerbeck Road Bore is a non-potable water source located adjacent to 444 Ellerbeck Road CARRUCHAN. The surrounding area is agricultural land with sugarcane and bananas being the main crops. The bore is accessing shallow alluvial springs and was installed by the former Cardwell shire council as a drought mitigation measure. The bore has not yet been used to supplement reticulated supply.

6.2 Treatment, Disinfection and Processes

A summary of the intake and disinfection systems in the Cardwell Scheme are shown in Table 6.0.

6.2.1 Intake/Source Water

The Meunga Creek intake consists of a small weir like structure across the stream. As water traverses the weir a portion of the flow passes through a *Johnston Screen* to remove larger sticks, leaves and sand and then enters the pipe system. There are no intake pumps as the natural water head is sufficient to feed the system. A 7.8km ductile iron main runs along the access trail to the Sullivan Road Chlorinator.

Located 1km downstream of the intake is the Meunga Creek Autoscour. The autoscour consist of two motorised valves (main line and scour), a turbidity analyser and a SCADA system with radio telemetry. The autoscour allows the treatment operators to remotely monitor the turbidity in the source water close to the intake and automatically change over to the supplementary supply at Kennedy Bore if required.

Figure 6.1: Meunga Autoscour

6.2.2 Kennedy Bore

Kennedy Bore consists of a single submersible bore pump and a block building housing a disinfection system and SCADA system.

Figure 6.2: Kennedy Bore - Chlorinator

Water is sourced from the bore using a submersible bore pump and pumped into the reticulation main at Ellerbeck Road. The control of the pump is via a variable speed drive (VSD) that is programed to provide a constant pressure (6 Bar) at the point of discharge while maintaining the required flow demand to the network. The pump station is connected to mains power or alternatively via a portable Generator. The bore head is above the Q100 flood elevation, concrete capped and sealed in good condition.

During turbid water events in Meunga Creek, monitored at Meunga Autoscour, the source water for Cardwell Water Supply Scheme can be automatically changed over to Kennedy Bore and maintain supply. The bore can supply the complete demand for the Cardwell system until the Meunga Ck source water clears which is usually within three (3) days.

Figure 6.3: Kennedy Bore

Ellerbeck Bore

The Ellerbeck Road bore consists of a single submersible bore pump. The pump is connected to mains power and operated manually for maintenance and if required for drought or other long term emergency

situations. The bore has not been utilised to supply reticulation since installation in 2004. The bore is concrete capped and in good condition. The site has good easy access and is within a few metres of the Ellerbeck Road main. Water quality investigations undertaken in 2016/17 have proven that this bore is unsuitable for drinking water as extensive flushing is required before the source improves to a suitable turbidity. This bore is being retained and could be utilised as a possible filling point for construction activities where untreated water is suitable.

6.2.3 Treatment

There is no treatment in the Cardwell Scheme.

The management of turbidity in the reticulated network is a key strategy identified in Council's DWQMP Improvement Plan. The bore located at the Kennedy site and the associated control systems outlined above in the short to medium term has improve water quality to the Cardwell system, with no water quality events recorded since December 2017. Council is also investigating a site near the Meunga Autoscour for an intake reservoir. This intake reservoir is Council's preferred long term outcome for managing water quality. The bore option involves considerable operational running costs and may prove susceptible to bore contamination or reduction in supply. The intake reservoir will be controlled in a similar fashion to Council's other intake reservoirs. Data from a turbidity analyser on the intake main will control an isolation valve upstream of the reservoir. It is envisaged that the intake will be isolated from the reservoir for turbidity greater than approximately 5NTU. In line filtration will also be investigated as a further option to improve turbidity.

6.2.4 Disinfection

A schematic of the disinfection system is shown in Figure 6.1.

Sullivan Road Chlorinator: Sodium hypochlorite (NaOCl) is injected into the reticulation main from a storage tank via a dosing pump. The dose rate is flow paced and manually adjusted as required by treatment operators and maintenance staff. The site is inspected twice a week with events such as heavy rainfall prompting more frequent visits and dosing adjustments. The site does have SCADA control and remote access via telemetry. The site has mains power and a permanent emergency generator with automatic transfer switch.

Kennedy Bore Chlorinator: Sodium hypochlorite (NaOCl) is injected into the reticulation main from a storage tank via a dosing pump. The dose rate is flow paced and adjusted as required by treatment operators and maintenance staff.

The normal pH level of the bore water is about 5.5 and Council is currently using Sodium Hydroxide (NaOH) to buffer the pH to approximately 6.2 to 6.5.

The site is inspected twice a week with events such as heavy rainfall prompting more frequent visits and dosing adjustments. The site does have SCADA control and remote access via telemetry. The site has mains power and the facility to connect and emergency portable generator from the Cardwell depot if required.

Cardwell Reservoir Chlorinator: This site is a re-chlorination point, sodium hypochlorite (NaOCl) is injected into Cardwell reservoir No 2 from a storage tank via a dosing pump. The dose rate is manually adjusted as required by treatment operators and maintenance staff. The site is inspected twice a week with events such as heavy rainfall prompting more frequent visits. Funding has been set aside to upgrade the dosing system and SCADA control. The chlorinator is solar powered. The site does not have mains power at this stage.

Figure 6.4: Chlorinator Schematic

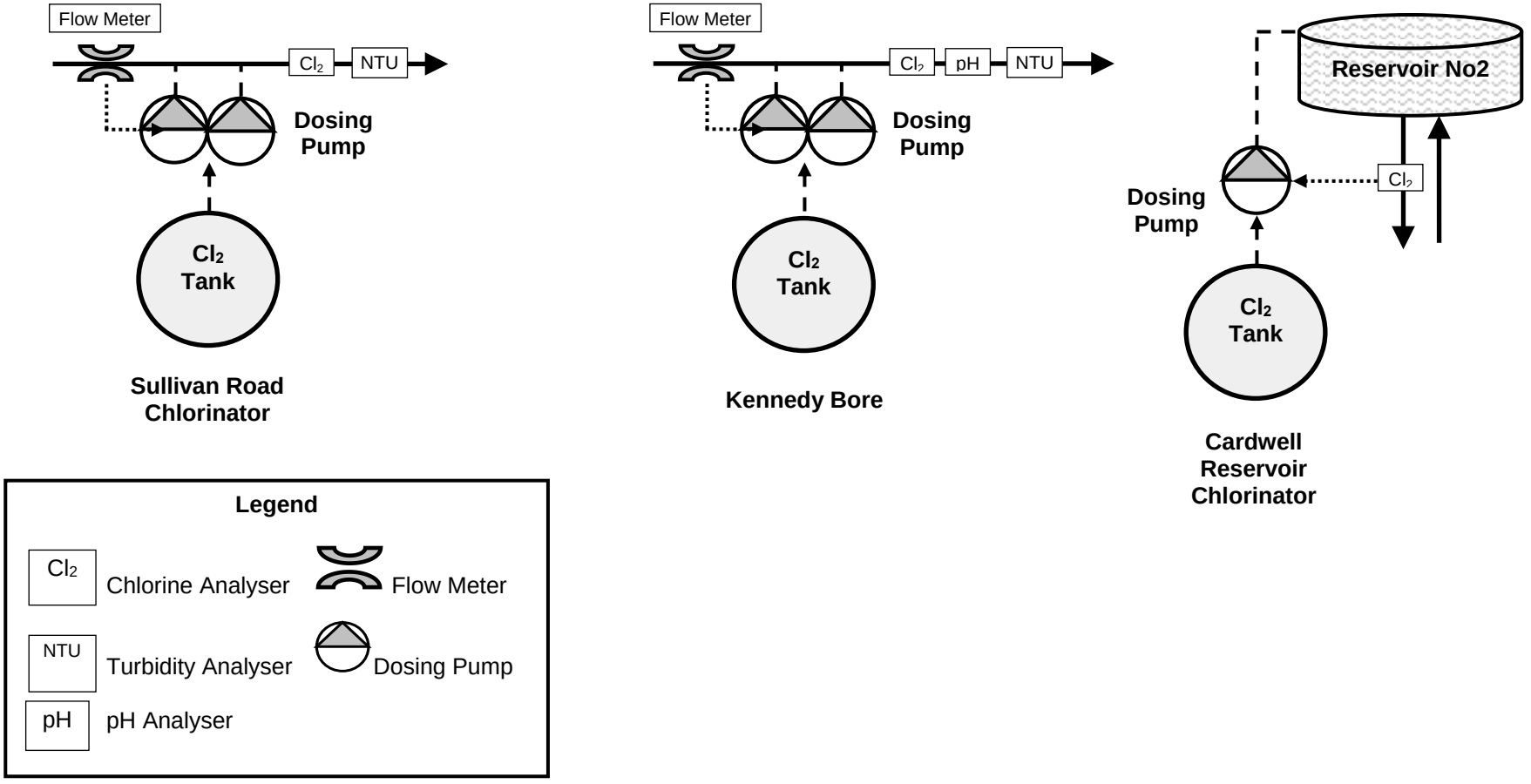


Table 6.0: Source & Treatment Details

Component		Cardwell Scheme
Sources	Name	Meunga Creek
	Type	Creek
	% of supply	100% normal conditions
	Reliability	Reliable Continuous Supply of water
	Water quality issues	Turbidity Spikes following high rainfall. Low flow in drought periods
	Name	Kennedy Bore
	Type	Bore
	% of supply	Up to 10% Used when turbidity in Meunga Ck
	Reliability	Reliable continuous supply of water.
	Water quality	NTU <1 , pH 5.5 pH is corrected by dosing with NaOH
	Bore Details	Casing Length 45m S/S OD 280mm Inlet screens 10m to 14m 17m to 18m 34m to 35m 39m to 43m Suction set at 38m
Sourcing Infrastructure	Type	Intake
	Description	Location: Meunga Creek, Concrete Weir Screen Type: Johnson 1.2mm
Treatment	Name	none
	Process	
	Design Capacity (20 hr operation)	
	Daily flow range	
	Filter Backwash	
	Bypasses / Variations	
Disinfection	Location	Sullivan Road Chlorinator
	Type	Sodium Hypochlorite
	Dose rate	93 l/day Approx average
	Target residual levels	Between 2.5 and 4.2 mg/l
	Duty	2-Pump (duty/standby)
	Dosing arrangements	Flow paced,
	Alarms	SCADA
	Generator	No – portable available with notice
Disinfection	Location	Kennedy Bore
	Type	Sodium Hypochlorite
	Dose rate	35 l/day Approx average
	Target residual levels	Between 1.5 and 2.5 mg/l
	Duty	2-Pump (duty/standby)
	Dosing arrangements	Flow paced,
	Alarms	SCADA
	Generator	No – portable available with notice
Disinfection	Location	Cardwell Reservoir Chlorinator
	Type	Sodium Hypochlorite
	Dose rate	24 l/day Approx average
	Target residual levels	Between 1.5 and 2.5 mg/l
	Duty	1-Pump
	Dosing arrangements	Fixed rate,
	Alarms	To be deployed.
	Generator	No

6.3 Distribution and Reticulation Details

6.3.1 Distribution Network

The Cardwell Water Supply Scheme was constructed in the late 1950's to service the township of Cardwell, later the intake was moved upstream and the network was extended to Curruchan, Kennedy, Port Hinchinbrook and Stoney Creek.

Following disinfection at Sullivan Road Chlorinator, water is supplied directly to reticulation. There are no service reservoirs in the upper part of the scheme. The network supplies small rural communities, agricultural and remote properties and there are long service mains with few connections. PRV's reduces supply pressures to the branch line servicing parts of Curruchan and Kennedy.

The main line runs through to the Cardwell Reservoir No 2 where the water is chlorine boosted. Water then flows to Reservoir No 1 and back to reticulation pressurising the township of Cardwell and the Port Hinchinbrook development. The Stoney Creek pump station fills the Stoney Creek Reservoirs and is controlled from reservoir high and low levels via radio telemetry.

Longer term contingency and water quality planning will focus on the construction of reservoir near the Meaunga Ck intake. This would provide a contingency supply in periods of high turbidity or other events impacting the intake. Funding and land acquisition issues will need to be addressed before this reservoir can proceed.

Layout plans of the Cardwell Scheme are shown in Figures 6.5 and 6.6.

A schematic of the Cardwell Scheme showing all facilities is shown in Figure 6.7.

Details of the reservoirs in the Cardwell Scheme are shown in Table 6.1.

Table 6.1: Cardwell Reservoir Details

Reservoirs	**Ground (No)**			
	Name	**Cardwell Greenwood Hill No 1**		
	Capacity (ML)	0.45 ML	TWL (m):	39.6
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		
Reservoirs	**Ground (No)**			
	Name	**Cardwell Greenwood Hill No 2**		
	Capacity (ML)	2.2 ML	TWL (m):	39.6
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		
Reservoirs	**Elevated (No)**			
	Name	**Stoney Creek**		
	Capacity (ML)	3x0.05 ML	TWL (m):	48.2 approx
	Roofed (Y/N)	Y		
	Vermin-proof (Y/N)	Y		
	Runoff directed off roof (Y/N)	Y		

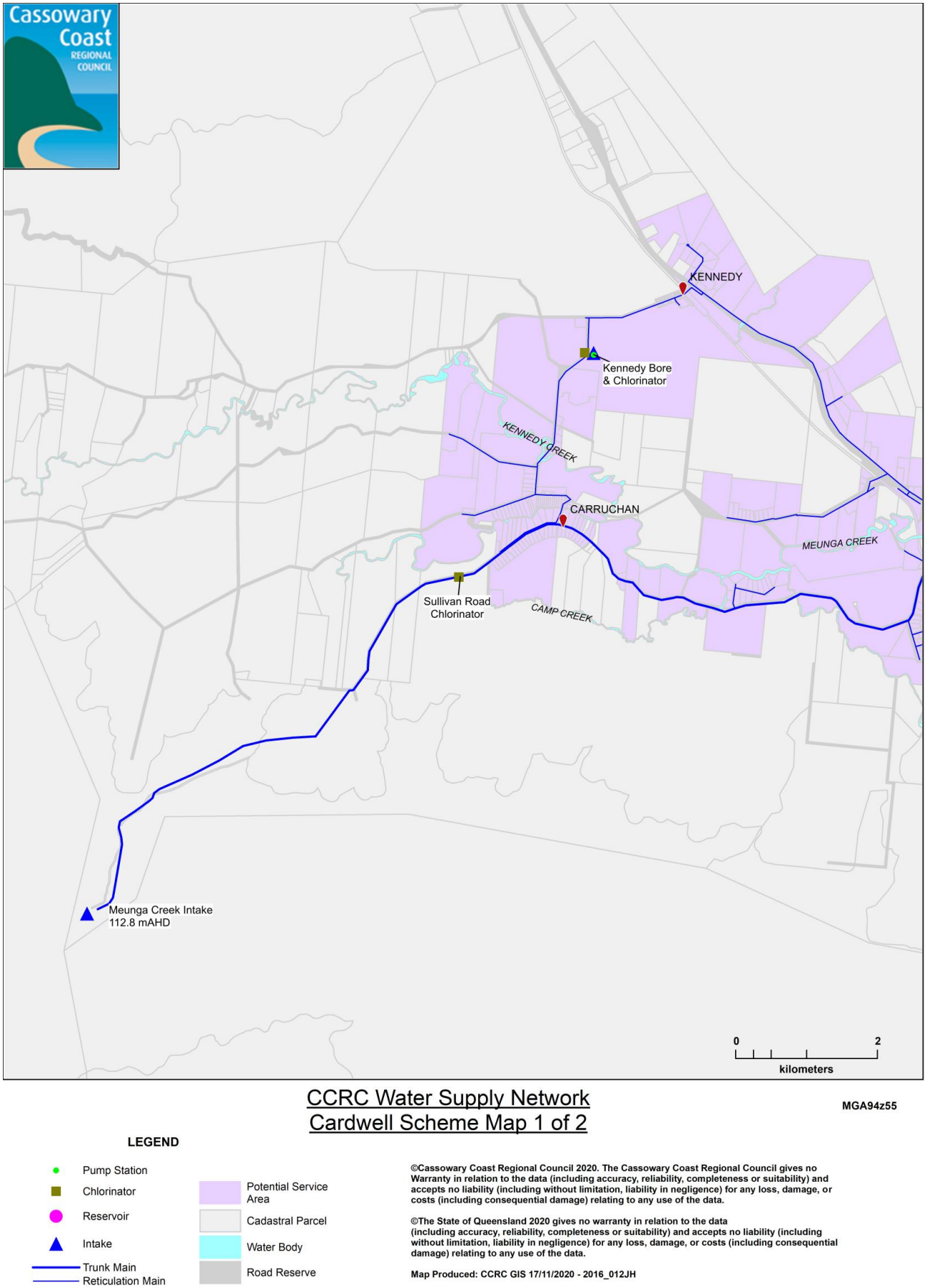


Figure 6.1: Water Supply Scheme Map

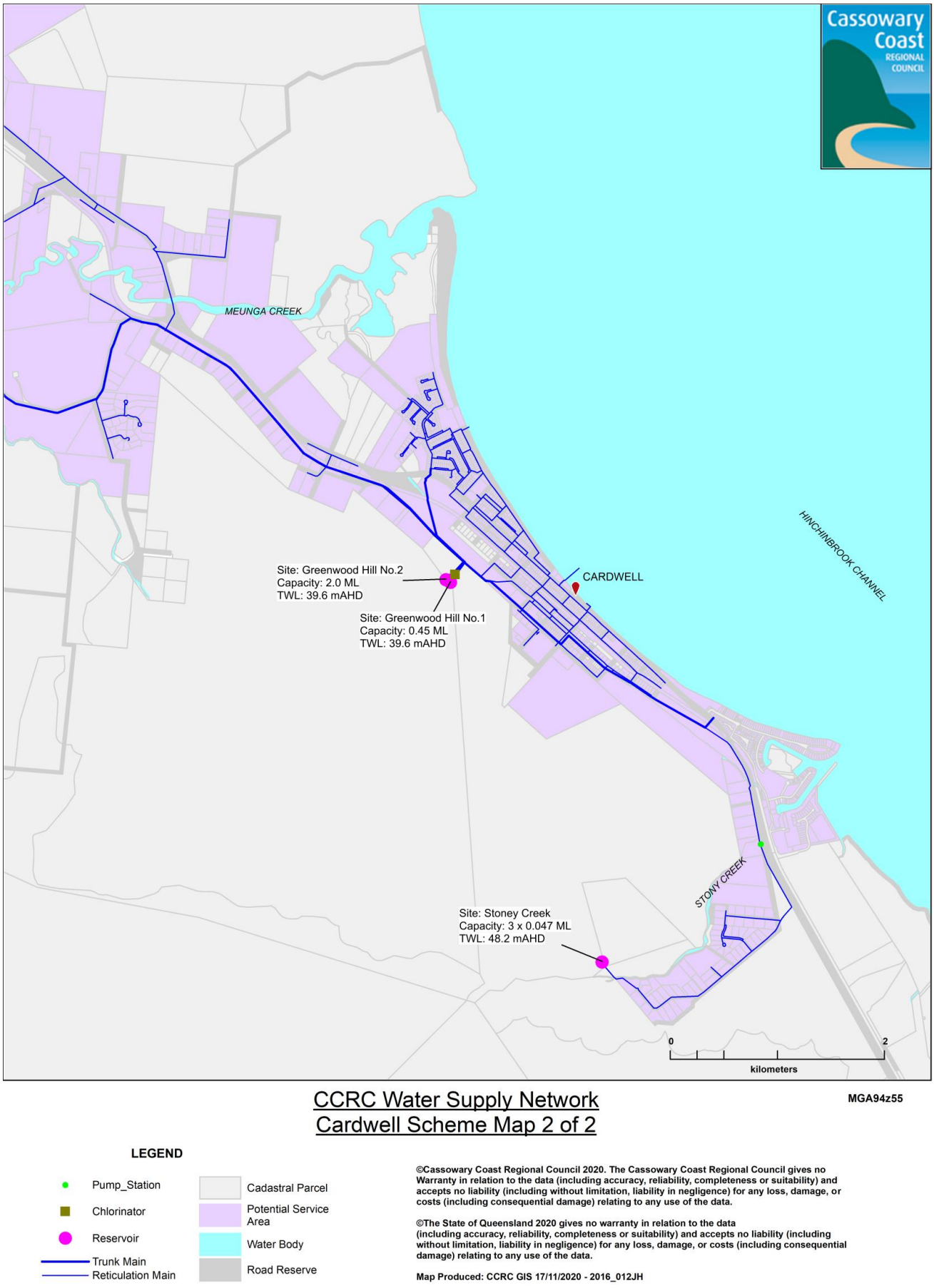
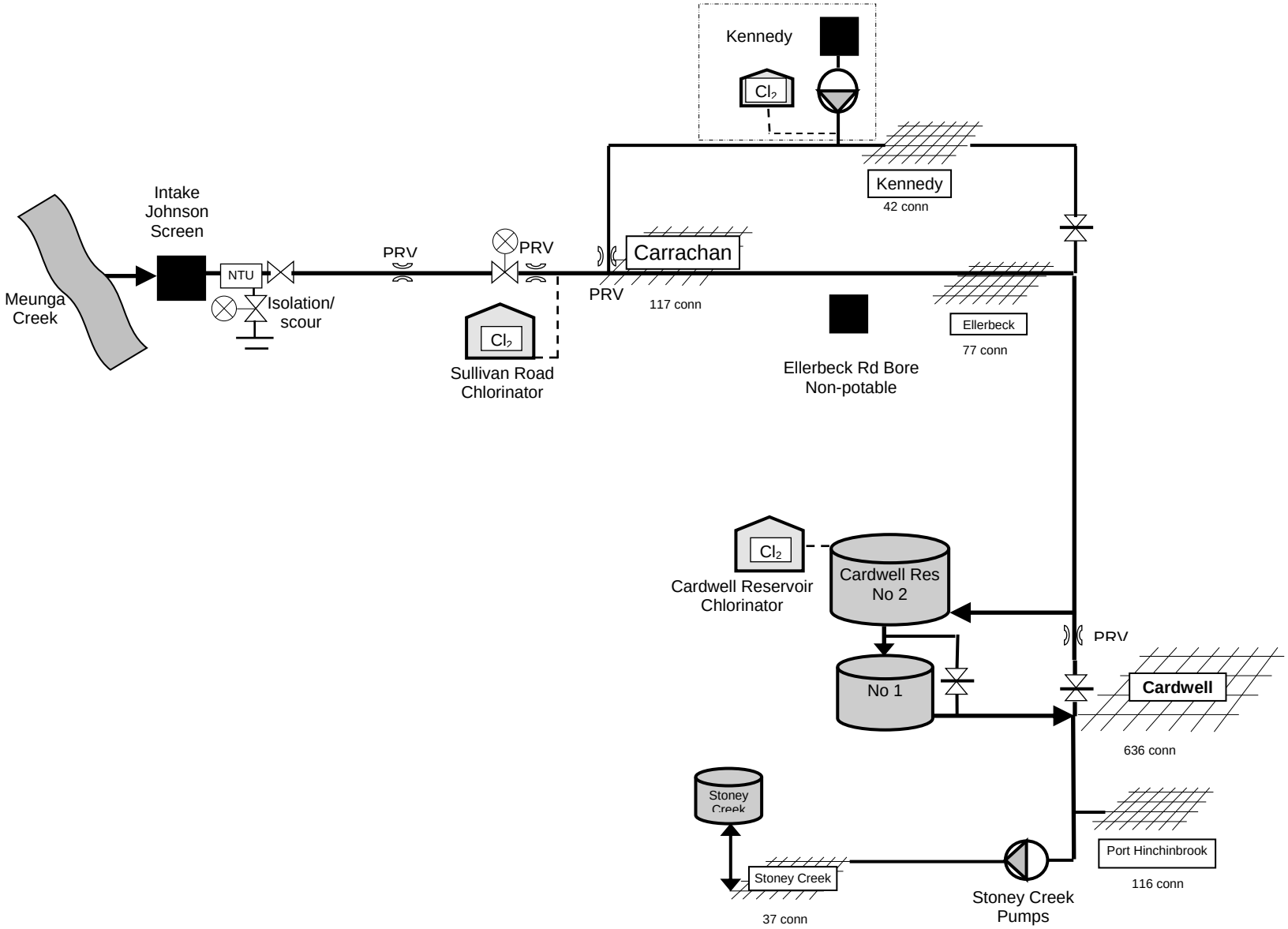


Figure 6.2: Water Supply Scheme Map

Figure 6.3: Reticulation Schematic



6.3.2 Asset Condition

The 375mm DICL pipeline form the intake to Ellerbeck Rd (near the rail line crossing) is in good condition. At this location 3 parallel mains run back to the Cardwell reservoir. Two of the mains are trunk lines; a 200mm class 16 pvc and a 225mm class 16 pvc. These pvc mains are in good condition.
From the reservoir there are 3 mains that run into Cardwell, one a 300mm class 16 pvc that predominantly supplies Port Hinchinbrook and two150mm AC mains that supply the town. The majority of the reticulation mains in the Cardwell town are AC and generally installed in the early 1970's. There are some known problems with the AC mains (eg softening of mains along the Esplanade) but typically the AC mains are in fair to good condition.

There are some class 12 pvc mains in the rural reticulation areas that were installed in the early1990's. These mains will have an accelerated loss of asset life due to the high working pressures that were imposed on the system prior to the installation of the pressure reducing valves.

Table 6.2: Cardwell Water Supply Scheme Pipe Asset Details (Revaluation May 2020)

Pipe Size DN50	Pipe Material									Total Length
Pipe Material	AC			CU	32 40 GWI	Poly	PVC CL12	PVC CL16	PVC	
Length							2241		3336	5577
Average Age							7		25.8	
Pipe Size DN63	Pipe Material									Total Length
Pipe Material						Poly	PVC CL12	PVC CL16		
Length										0
Average Age										
Pipe Size DN80	Pipe Material									Total Length
Pipe Material	AC	CI		CU	GWI	Poly	PVC CL12	PVC CL16		
Length										0
Average Age										
Pipe Size DN100	Pipe Material									Total Length
Pipe Material	AC	CI	DI		GWI	Poly	PVC CL12	PVC CL16	PVC	
Length	16095		159					5915	5337	27506
Average Age	48		6.3					7	24.78	
Pipe Size DN150	Pipe Material									Total Length
Pipe Material	AC	CI	DI			Poly	PVC CL12	PVC CL16	PVC	
Length	8114		171					1816	9985	20086
Average Age	49		2.75					7	25.6	
Pipe Size DN200	Pipe Material									Total Length
Pipe Material	AC	CI	DI			Poly	PVC CL12	PVC CL16		
Length	1246							3764		5010
Average Age	49							7		

Pipe Size DN225	Pipe Material									Total Length
Pipe Material	AC	CI	DI			Poly	PVC CL12	PVC CL16	Steel	
Length								3768		3768
Average Age								7		
Pipe Size DN250	Pipe Material									Total Length
Pipe Material	AC	CI	DI			Poly	PVC CL12	PVC CL16	Steel	
Length								2190		2190
Average Age								7		
Pipe Size DN300	Pipe Material									Total Length
Pipe Material	AC	CI	DI			Poly	PVC CL12	PVC CL16	Steel	
Length			15786					741		16527
Average Age			20					7		
Pipe Size DN375	Pipe Material									Total Length
Pipe Material	AC	CI	DI			Poly	PVC CL12	PVC CL16	Steel	
Length			394							394
Average Age			20							
Pipe Size DN450	Pipe Material									Total Length
Pipe Material	AC	CI	DI			Poly	PVC CL12	PVC CL16	Steel	
Length										0
Average Age										
Total Length										81058

Distribution and Reticulation System	Areas of potential long detention	Hull Heads, rural extremities
	Areas where low water pressure could be expected	Nil

6.3.3 SCADA Deployment

Since 2013, capital works budgets had been allowing for the deployment of SCADA to key water infrastructure as a major risk mitigation measure in line with the 2013 DWQMP (ECM Doc # 2265542).

Table 6.3, shows status of key water infrastructure in the Cardwell Scheme connected to SCADA.

Table 6.3: Cardwell Scheme SCADA deployment

Cardwell		
Site Name	**Connected**	**Comments**
Treatment		
Sullivans Road Chlorinator	✓	
Cardwell Res Chlorinator	✓	
Reservoirs		
Cardwell Res	✓	
Stoney Creek Res	✓	
Pump Stations		
Stoney Creek	✓	
Kennedy Bore	✓	
Control Valves		
Meunga Autoscour	✓	

6.4 Water Quality Data and Analysis

The following Tables 6.4, 6.5, 6.6, 6.7, 6.8 and 6.9 summarise the available raw and reticulated water quality data for the Cardwell Scheme.

6.4.1 Interpretation

Raw water from Meunga Creek intake is typically of good quality with occasional colour and turbidity spikes caused from high rainfall events. The water hardness is classified *soft* and has a low saturation index. One reticulation sample shows an aluminium level slightly over the aesthetic guideline value. This is thought to be due to a short term high rainfall event in a particular area of the catchment and not reflective of a long term. No pesticides have been detected. *Standard Water Analysis (SWA)* and Pesticide samples taken from the Ellerbeck Road Bore indicate that the water is within safe limits for drinking water.

There are no reservoirs at the top of the system. There is no water treatment for the Cardwell Scheme. Sullivans Road Chlorinator is the first disinfection point. Water Quality information has not been recorded at the Sullivan Road Chlorinator site. In-house data in the *Reticulation Turbidity Chart* shows periods of high turbidity above the ADWG aesthetic limit. These high levels are short term events and related to the duration, intensity and position of rainfall within the catchment. Chlorination levels are set between aesthetic and health limits and increased manually during periods of high turbidity to achieve disinfection residual throughout the system. Dosing at the Sullivan's Rd Chlorinator is automatically flow paced by the PLC using inputs from the turbidity analyser and flow meter. In periods of high turbidity, dosing can also be increased remotely through SCADA. The Cardwell Reservoir Chlorinator doses a constant rate directly into the reservoir to boost residuals. The *Reticulated Water Cl_2 Residual Chart* shows Cl_2 residual decreasing in the reticulation scheme towards the outer lying areas. The data in Table 6.9 shows average turbidity in the network above 1 at most sampling points. The lack of detection of E-coli demonstrates that the disinfection processes adopted by Council are effective. This is further supported by the information in Table 6.10. The turbidity control measures now in place with the Kennedy bore and automated isolation of the intake improve the confidence that chlorine residuals will be consistent in the network and with lower turbidity there will be very low risk of ineffective disinfection.

The *Raw Water Source Table* shows pH from Meunga Creek to be averaging 7.1 and the *Reticulated Water pH Chart* pH averaging around 7.7. This increase is likely due to the soft water characteristics and long retention time in the concrete lined and fibre reinforced, concrete mains and concrete reservoirs.

Samples for disinfection by-products have not been tested within this scheme. Positive E-coli results have been known to coincide with high turbidity. Procedures have been implemented to test for E-coli when ever high turbidity is recorded.

In the period 1/3/16 to 18/3/16, rainfall of 803mm was recorded in the Meunga Ck catchment and the creek became quite turbid. The high turbidity was passed into the reticulation system and this impacted residual chlorine levels and E coli was detected. A boil water notice was initiated following liaison with the Water Regulator. Details of the sampling results for the period of this E-coli detection are included in Table 6.9. Turbidity on the 11/3/16 at Sullivan's Rd Chlorinator was tested at 104NTU.

Up until 2016, there was no centralised database for storing water quality data. Council is now progressively moving historical water quality data to the SWIM Local system. The historical system (pre 2016) consists of a combination of multiple spreadsheets, scanned and physical data. This creates difficulties in analysis and data quality control.

6.4.2 Quality Complaints

Water Quality complaints are mainly concerned with dirty water typically due to turbid source water. Service or mains failures are relatively few. Details of the complaints history for Cardwell are shown in Table 6.11.

Council monitors customer complaints and response time details as part of it Customer Service Charter (ECM document # 2327195). After each financial year, staff report outcomes of performance against key indicators in the Customer Service Charter and results are provided to the Regulator and uploaded onto the Council web site.

Each complaint is actioned as part of Council's Customer Request (CR) system. Comments of actions taken to rectify a complaint are noted against the individual CR. The annual performance report includes detailed analysis and commentary on each water complaint received.

6.4.3 Service Issues

Available pressures from the intake to the Cardwell reservoir in some areas is in excess of 100m and failure of the pressure control valves upstream of the Cardwell reservoir can lead to service failures. The proper maintenance of these pressure control valves is critical and recent repair works indicate they are susceptible to issues from accumulated silt and "debris" in the mains. This will need to be monitored.

Water main flushing is undertaken as a reactive measure to dirty water complaints and following maintenance works. System supply is set by stream flow and system physical pipe capacity therefore high demand can occasionally cause low pressure within parts of the network.

Water restrictions are implemented when required to reduce demand when stream flows become reduced. A history of intake levels is being collected to better understand the criticality of creek flows and the relative change of creel levels in dry conditions. Anecdotally, Meunga Ck drops more slowly than Council's other run of the creek intake systems particularly Nyleta Ck.

Mechanical maintenance is conducted by in-house staff with electrical, instrumentation and radio being serviced by external contractors. Council staff have developed some skills with the telemetry and SCADA systems but still rely heavily on the service agreement with Welcon for the ongoing management of the SCADA operations.

Due to the remoteness and small Council presence in the area staff are required to undertake multiple roles including operations, maintenance and other activities. Due to multiple responsibilities water quality may not always be given the highest priority. System changes are not always well communicated to treatment staff. Maintenance and operational procedures are being developed and are to be reviewed and improved over time.

Table 6.4: Raw Water Source Results Summary 2010 - 2011

Cardwell Scheme Meunga Creek (No data for Ellerbeck Road bore Raw Water)								
Sampling location	**Raw Water Meunga Creek Intake**							
Parameter (examples)	**Units**	**Time Period**	**No of samples**		**Summary of Results**			**Comments**
					Maximum Value	**Average Value**	**Minimum Value**	
E.coli CFU/100ml								No Data
pH		2010-2011	10		7.39	7.1	6.68	
Total hardness	mg/l	2010-2011	10		6.8	5.4	3	
Silica	mg/l	2010-2011	10		28	23.7	19	
TD Solids	mg/l	2010-2011	10		54	47.3	40	
True Colour	HU	2010-2011	10		16	8.5	5	1 occurrences above 15
Turbidity	NTU	2010-2011	10		3	1.4	0.3	No online sampling
Sat Index	mg/l	2010-2011	10		-2.6	-3.1	-3.9	
Sodium	mg/l	2010-2011	10		7	6	5	
Calcium	mg/l	2010-2011	10		1.9	1.3	0.6	
Chloride	mg/l	2010-2011	10		7.1	5.4	4.7	
Fluoride	mg/l	2010-2011	10		0.1	0.1	0	
Nitrate	mg/l	2010-2011	10		1.2	0.5	0	
Sulphate	mg/l	2010-2011	10		1	0.94	0.48	
Iron	mg/l	2010-2011	10		0.05	0.03	0.02	
Manganese	mg/l	2010-2011	10		0.01	0.01	0	
Zinc	mg/l	2010-2011	10		0.03	0.01	0	
Aluminium	mg/l	2010-2011	10		0.09	0.05	0.01	
Boron	mg/l	2010-2011	10		0.02	0.02	0	
Copper	mg/l	2010-2011	10		0.04	0.03	0	
Heavy Metals	mg/l							No Data
Pesticides			Tot	pos				
Meunga Creek		2009-2011	10	0				

Table 6.5A: SWA Results for Meunga Ck Intake 2012-2016

Jan 2012 - May 2016 - Cassowary Coast Regional Council Raw Water Standard Water Analysis Results

	Number of Samples		Fe	Mn	Zn	B	Cu	Total Hardness	Saturation Index	Carbonate	H	Residual Alkalinity	Conductivity	Ca	pH	SAR	Sulphate	K	Figure Merit Ratio
Meunga Creek	15	Min	0.0	0.0	0.0	0.0	0.0	5.8	-3.3	0.0	0.0	0.1	45.0	1.4	7.0	0.9	1.0	1.5	0.4
		Average	0.0	0.0	0.0	0.0	0.0	7.0	-2.7	0.0	0.0	0.2	54.7	1.7	7.3	1.1	1.1	1.8	0.5
		Max	0.1	0.0	0.0	0.0	0.0	8.2	-2.4	0.0	0.0	0.2	62.0	2.3	7.5	1.2	1.4	2.2	0.6

	Number of Samples		Al	Chloride	Mg	Water temp	Temporary Hardness	Nitrate	Si	Total Dissolved Ions	TDS	Mole Ratio	Turbidity	Hydroxide	Na	Fluoride	pH Sat.	True Colour	Alkalinity	Bicarbonate
Meunga Creek	15	Min	0.1	4.9	0.5	21.0	5.8	1.1	19.0	28.0	40.0	2.5	1.0	0.0	5.0	0.1	9.8	1.0	10.0	12.0
		Average	0.1	5.6	0.7	21.6	7.0	1.1	25.9	35.5	52.1	2.7	1.2	0.0	6.5	0.1	10.0	11.0	14.7	17.8
		Max	0.2	6.3	0.8	23.0	8.2	1.1	31.0	42.0	61.0	3.2	2.0	0.0	8.0	0.1	10.2	28.0	18.0	22.0

Above ADWG Guideline Values
Below ADWG Guideline Value

Note 1 : Pesticides Results Testing - Meunga Creek 15 samples no detections.

Table 6.5B: SWA Results for Kennedy Bore – Bore Became Operational 1/18

May 2017-Sept 2017 - Cassowary Coast Regional Council Kennedy Bore Raw Water Standard Water Analysis Results

	No.of Samples		Fe	Mn	Zn	B	Cu	Total Hardness	Saturation Index	Carbonate	H	Residual Alkalinity	Conductivity	Ca	pH	SAR	Sulphate	K	Figure Merit Ratio
Kennedy Bore	4	Min	0.01	<0.01	0.01	0.02	<0.03	8.6	-3.3	0.0	0.0	0.1	76.0	1.7	6.1	1.5	<1	1.6	0.4
		Avg	0.01	0.01	0.02	0.02	<0.03	8.8	-3.4	0.0	0.0	0.2	77.0	1.7	6.4	1.6	<1	1.6	0.4
		Max	0.01	0.07	0.04	0.02	<0.03	9.3	-3.5	0.0	0.0	0.2	81.0	1.8	6.6	1.6	<1	1.7	0.4

	No.of Samples		Al	Chloride	Mg	Water temp	Temporary Hardness	Nitrate	Si	Total Dissolved Ions	TDS	Mole Ratio	Turbidity	Hydroxide	Na	Fluoride	pH Sat.	True Colour	Alkalinity	Bicarbonate
Kennedy Bore	4	Min	<0.05	9.0	1.0	21.0	8.6	3.4	39.0	46.0	76.0	3.6	<1	0.0	10.0	<0.05	9.9	<1	14.0	17.0
		Avg	<0.05	9.5	1.0	21.6	8.8	3.9	39.3	50.5	78.5	3.8	<1	0.0	10.0	<0.05	9.9	<1	18.0	21.8
		Max	<0.05	10.0	1.1	23.0	9.3	4.3	40.0	52.0	80.0	4.2	1.0	0.0	11.0	<0.05	10.0	1.0	20.0	24.0

Above ADWG Guideline Values
Below ADWG Guideline Value

Note 1 : Pesticides Results Testing – Kennedy Bore 4 samples no detections.

Table 6.5C: SWA Raw Water Results for Cardwell Water Sources 2016-2021

Cardwell Supply Sources - Jan 2016 - Jan 2021 - Standard Water Analysis Results																			
	No. of Samples		Iron SWA	Mn	Zinc SWA	B	Cu	Total Hardness	Sat'n Index	Carbonate	H	Residual Alkalinity	Conductivity	Ca	pH	SAR	Sulphate	K	Figure Merit Ratio
Meunga Creek	29	Min	<0.01	<0.00	<0.01	<0.02	<0.00	5.40	-3.80	0.00	0.00	0.10	37.00	1.20	6.12	0.70	0.80	0.90	0.50
		Avg	0.03	<0.01	<0.06	<0.02	<0.03	6.76	-3.19	0.00	0.00	0.16	49.97	1.69	6.83	0.99	0.99	1.72	0.54
		Max	0.14	0.01	0.08	0.04	0.05	9.60	-2.40	0.00	0.00	0.30	62.00	2.80	7.48	1.10	1.30	2.40	0.70
Kennedy Bore	18	Min	<0.01	<0.01	<0.01	<0.02	<0.03	7.60	-4.30	0.00	0.00	0.10	69.00	1.50	5.71	1.40	<0.2	1.50	0.40
		Avg	<0.01	<0.01	<0.06	<0.02	<0.03	8.10	-3.85	0.05	0.00	0.20	71.35	1.63	6.11	1.50	<1	1.60	0.40
		Max	<0.01	0.02	<0.06	<0.02	0.03	9.50	-3.30	1.00	0.00	0.20	76.00	1.90	6.55	1.60	<1	2.60	0.40
							0.0	0.0											

	No. of Samples		Al	Cl-	Mg	Water temp	Temp Hardness	Nitrate	Silica	Total Disolved Ions	TDS	Mole Ratio	Turbidity	OH-	Na	Fluoride	pH Sat.	True Colour	Alkalinity	Bicarbonate
Meunga Creek	29	Min	<0.03	3.50	0.50	5.40	<0.05	16.00	26.00	35.00	2.50	<1	0.00	0.90	0.02	9.70	2.00	11.00	14.00	<0.03
		Avg	<0.05	5.48	0.61	6.76	<0.5	25.10	35.03	50.66	3.18	<1	0.00	5.75	<0.05	10.01	10.24	15.17	18.59	<0.05
		Max	0.17	6.00	0.80	9.60	<0.5	31.00	43.00	62.00	3.80	5.00	0.00	7.00	0.13	10.20	31.00	20.00	25.00	0.17
Kennedy Bore	18	Min	<0.03	7.80	0.90	7.60	4.00	32.00	45.00	73.00	3.60	<1	0.00	1.00	0.02	9.80	<1	15.00	18.00	<0.03
		Avg	<0.05	8.24	0.98	8.10	5.07	37.05	49.65	75.65	4.00	<1	0.05	9.35	0.03	9.96	<1.25	18.05	22.05	<0.05
		Max	<0.05	9.00	1.10	9.50	5.80	39.00	52.00	79.00	4.40	<1	1.00	11.00	<0.05	10.10	<7	19.00	23.00	<0.05

Table 6.6: Reticulation Summary Table 2010 - 2011 (SWA and In-House Results)

Cardwell Scheme Reticulation Water Quality Carruchan, Kennedy, Ellerbeck, Cardwell, Stoney Creek									
Parameter	**Units**	**2010 to 2011**							**Comments**
		No Samples Collected	**No in which parameter detected**	**No outside ADWG Health Limits**	**No outside the ADWG Aesthetic Limits**	**Min**	**Max**	**Ave**	
Turbidity	NTU	292	292		15	0.51	17.5	1.98	1.3 NTU 50%tile – no treatment
Free Chlorine	mg/L	574	574	0	469	0.05	3.6	1.22	dose rate reflects NTU
E.Coli	CFU/100mL	152	0	0					disinfection only
pH	units	572	572	0	0	6.63	8.38	7.66	soft water long AC mains
Total hardness	mg/L	9	9	0	0	7.9	9.5	8.6	
Silica	mg/L	9	9	0	0	18	26	22.4	
TD Solids	mg/L	9	9	0	0	46.7	62	58.2	
True Colour	HU	9	9	0	19	2	7	4.4	
Sat Index	mg/L	9	9	0	0	-2.2	-1.5	-1.8	
Sodium	mg/L	9	9	0	0	7.1	10	9.3	
Calcium	mg/L	9	9	0	0	2.5	3.4	2.9	
Chloride	mg/L	9	9	0	0	5.8	12	10.3	
Fluoride	mg/L	9	9	0	0	0	0.1	0.1	
Nitrate	µg/L	9	9	0	0	0	0.6	0.5	
Sulphate	mg/L	9	9	0	0	0	1	0.89	
Iron	mg/L	9	9	9	0	0.02	0.07	0.04	
Manganese	mg/L	9	9	0	0	0.01	0.01	0.01	
Zinc	mg/L	9	9	0	0	0	0.01	0.01	
Aluminium	mg/L	9	9	0	1	0	0.25	0.08	1 event 21/04/2011
Boron	mg/L	9	9	0	0	0	0.02	0.02	
Copper	mg/L	9	9	0	0	0	0.03	0.03	
THM(s)									No data

Table 6.7: Treated Water SWA Summary Table 2012 - 2016

Cardwell Scheme Treated Water Quality								
Carruchan, Kennedy, Ellerbeck, Cardwell, Stoney Creek								
2012 - 2016								
Parameter	**Units**	**NO. in which parameter detected**	**NO. outside ADWG Health Limits**	**NO. outside ADWG Aesthetic Limits**	**Min**	**Max**	**Ave**	**Comments**
Iron	mg/L	33	0	0	0.0	0.1	0.03	
Manganese	mg/L	37	0	0	0.0	0.0	0.01	
Zinc	mg/L	33	0	0	0.0	0.0	0.01	
Boron	mg/L	33	0	0	0.0	0.0	0.02	
Copper	mg/L	37	0	0	0.0	0.0	0.03	
Total Hardness	mg/L	33	0	0	7.8	12.0	9.26	
Saturation Index	mg/L	33	0	0	-2.3	-1.0	-1.81	
Carbonate	mg/L	33	0	0	0.0	0.4	0.10	
Hydrogen	mg/L	33	0	0	0.0	0.0	0.00	
Residual Alkalinity	mg/L	37	0	0	0.1	0.3	0.17	
Conductivity	mg/L	37	0	0	67.0	110.0	82.42	
Calcium	mg/L	33	0	0	2.5	4.2	3.11	
pH	units	33	0	0	7.5	8.5	7.88	
SAR	mg/L	33	0	0	1.3	2.0	1.57	
Sulphate	mg/L	37	0	0	1.0	1.4	1.06	
Potassium	mg/L	37	0	0	1.5	2.3	1.82	
Figure Merit Ratio	mg/L	37	0	0	0.3	0.5	0.39	
Aluminium SWA	mg/L	37	0	0	0.1	0.2	0.06	
Chloride	mg/L	33	0	0	8.4	17.0	11.24	
Magnesium	mg/L	37	0	0	0.1	0.5	0.36	
Temporary Hardness	mg/L	37	0	0	7.8	12.0	9.21	
Nitrate	µg/L	33	0	0	0.5	0.9	0.52	
Silica	mg/L	33	0	0	18.0	31.0	25.61	
Total Disolved Ions	mg/L	37	0	0	42.0	61.0	50.49	
TDS	mg/L	33	0	0	57.0	76.0	65.01	
Mole Ratio	mg/L	37	0	0	1.7	3.0	2.38	
Turbidity	NTU	33	0	0	1.0	3.0	1.11	
Hydroxide	mg/L	37	0	0	0.0	0.0	0.00	
Sodium	mg/L	33	0	0	8.0	15.0	10.92	
Fluoride	mg/L	37	0	0	0.0	0.1	0.06	
pH Sat.	mg/L	37	0	0	9.5	9.8	9.67	
True Colour	mg/L	37	0	0	1.0	8.0	2.23	
Alkalinity	mg/L	33	0	0	13.0	22.0	17.73	
Bicarbonate	mg/L	37	0	0	16.0	28.0	21.55	

Table 6.7A: Treated Water SWA Summary Table 2016 - 2021

Cardwell Scheme Treated Water Quality								
Carruchan, Kennedy, Ellerbeck, Cardwell, Stoney Creek								
2016-2021								
Parameter	**Units**	**NO. in which parameter detected**	**NO. outside ADWG Health Limits**	**NO. outside ADWG Aesthetic Limits**	**Min**	**Max**	**Ave**	**Comments**
Iron	mg/L	56	0	0	< 0.01	0.08	0.03	
Manganese	mg/L	56	0	0	<0.00	<0.01	<0.01	
Zinc	mg/L	56	0	0	<0.01	<0.06	<0.06	
Boron	mg/L	56	0	0	<0.02	<0.02	<0.02	
Copper	mg/L	56	0	0	<0.00	0.04	<0.03	
Total Hardness	mg/L	56	0	0	7.00	24.00	9.78	
Saturation Index	mg/L	56	0	0	-3.30	-1.60	-2.46	
Carbonate	mg/L	56	0	0	0.00	0.10	0.01	
Hydrogen	mg/L	56	0	0	0.00	0.00	0.00	
Residual Alkalinity	mg/L	56	0	0	0.10	0.60	0.21	
Conductivity	mg/L	56	0	0	60.00	147.00	79.34	
Calcium	mg/L	56	0	0	2.20	7.90	3.18	
pH	units	56	0	4	6.28	8.15	7.18	
SAR	mg/L	56	0	0	1.10	2.20	1.48	
Sulphate	mg/L	56	0	0	0.50	1.20	0.97	
Potassium	mg/L	56	0	0	1.40	2.70	1.78	
Figure Merit Ratio	mg/L	56	0	0	0.30	0.90	0.42	
Aluminium SWA	mg/L	56	0	0	<0.03	0.11	<0.05	
Chloride	mg/L	56	0	0	8.00	17.00	10.75	
Magnesium	mg/L	56	0	0	0.20	0.46	1.90	
Temporary Hardness	mg/L	56	0	0	7.00	24.00	9.78	
Nitrate	µg/L	56	0	0	0.10	4.60	1.36	
Silica	mg/L	56	0	0	4.00	40.00	25.68	
Total Disolved Ions	mg/L	56	0	0	42.00	113.00	52.79	
TDS	mg/L	56	0	0	55.00	120.00	66.70	
Mole Ratio	mg/L	56	0	0	2.20	3.90	3.01	
Turbidity	NTU	56	0	0	1.00	2.00	1.25	
Hydroxide	mg/L	56	0	0	0.00	0.00	0.00	
Sodium	mg/L	56	0	0	8.00	23.00	10.60	
Fluoride	mg/L	56	0	0	<0.02	0.06	<0.05	
pH Sat.	mg/L	56	0	0	8.90	99.00	9.64	
True Colour	mg/L	56	0	0	1.00	6.00	2.11	
Alkalinity	mg/L	56	0	0	14.00	53.00	20.18	
Bicarbonate	mg/L	56	0	0	17.00	60.00	24.48	

Table 6.8 : Cardwell Scheme Reticulation Water Quality Data 1/2012 to 5/2016						
Parameter		**4002 Sullivan's Road Chlorinator**	**4101 Ellerbeck Road**	**4102 Cardwell Pool**	**4104 Kennedy Store**	**4105 Stoney Creek Pumps**
pH	**Min**	6.48	6.38	6.40	6.44	6.39
	Max	8.40	8.33	8.32	8.18	8.34
	Average	7.58	7.34	7.45	7.20	7.37
	Count	274	473	474	437	350
Cl	**Min**	1.13	0.0	0.0	0.01	0.0
	Max	4.50	3.69	3.72	4.22	3.24
	Average	2.83	1.41	1.66	1.48	1.58
	Count	274	474	475	438	350
Turbidity	**Min**	0.13	0.02	0.04	0.01	0.0
	Max	104.0	23.90	10.5	38.40	17.5
	Average	2.02	1.05	1.02	1.22	1
	Count	274	472	473	437	347
E Coli	**Number of Tests**	6	118	145	78	101
	Number of Positives	0	2	2	2	0

Data results for period 1/115 to 25/5/16.
An extreme rainfall event in March 2016 was the cause of the E Coli detections.

Table 6.8A : [Meunga Creek] Cardwell Scheme Reticulation Water Quality Data 2016 to Jan 2021

Parameter		4001 Meunga Creek Int	4101 Ellerbeck PRV	4102 Cardwell Pool	4104 Kennedy Store	4105 Stoney Creek Pumps
pH	Min	6.58	6.53	6.42	6.45	6.45
	Max	7.34	8.06	8.25	7.92	7.89
	Average	7.08	7.43	7.35	7.32	7.29
	Count	170	257	258	261	264
Cl	Min	N/A	0.3	0.25	0.03	0.19
	Max	N/A	3.76	3.32	3.68	3.49
	Average	N/A	2.13	1.46	1.63	1.39
	Count	N/A	256	258	261	262
Cl Total	Min	N/A	0.34	0.3	0.04	0.24
	Max	N/A	4.04	3.51	3.83	3.51
	Average	N/A	2.27	1.56	1.7	1.49
	Count	N/A	255	257	260	261
Turbidity	Min	0.12	0.1	0.11	0.1	0.09
	Max	13.5	8.46	1.87	2.53	1.92
	Average	0.84	0.53	0.46	0.48	0.46
	Count	175	254	258	262	262
E.Coli	Number of Tests	161	48	50	61	62
	Number of Positive (Avg)	98	0	0	0	0

Test Results for period 01/01/2016 - 01/01/2021

Table 6.8B : [Kennedy Bore] Cardwell Scheme Reticulation Water Quality Data Jan 2016 to Jan 2021						
Parameter		**4004 Kennedy Bore**	**4101 Ellerbeck PRV**	**4102 Cardwell Pool**	**4104 Kennedy Store**	**4105 Stoney Creek Pumps**
pH	**Min**	5.48	5.56	6.31	5.6	6.24
	Max	5.48	7.76	7.73	7.56	7.59
	Average	5.48	6.63	6.94	6.49	6.94
	Count	1	40	42	44	48
Cl	**Min**	1.5	0.36	0.62	0.29	0.66
	Max	1.66	3.16	3.32	2.62	3.49
	Average	1.60	1.70	1.78	1.49	1.83
	Count	4	40	43	44	48
Cl Total	**Min**	N/A	0.39	0.72	0.3	0.76
	Max	N/A	3.29	3.65	2.79	3.51
	Average	N/A	1.83	1.92	1.6	1.97
	Count	N/A	39	42	43	47
Turbidity	**Min**	0.16	0.01	0.12	0.01	0.04
	Max	1.56	2.4	1.07	2.53	1.36
	Average	0.86	0.55	0.55	0.48	0.54
	Count	2	40	43	43	48
E.Coli	**Number of Tests**	9	5	6	9	7
	Number of Positive	0	0	0	0	0

Table 6.9: Sampling results for the period of the boiled water notice at Cardwell.

	4002				4101				4104				4102				4105			
Location	Sullvian's Rd Chlorinator				Ellerbeck Rd				Kennedy Store				Cardwell Pool				Stoney Ck Pumps Tap			
Date	cL2	pH	NTU	E-coli	cL2	pH	NTU	E-coli	cL2	pH	NTU	E-coli	cL2	pH	NTU	E-coli	cL2	pH	NTU	E-coli
1/03/16	2.76	7.15	1.37		0.74	7.40	0.49	ND	0.75	7.36	0.40	ND	0.56	7.47	0.28		0.79	7.34	0.27	ND
3/03/16	2.92	7.19	1.27		0.44	7.11	0.22	ND	1.20	7.10	0.19	ND	0.47	7.65	0.27	ND	0.85	7.52	0.22	ND
8/03/16	3.86	7.33	10.60		0.05	7.57	1.75	ND	0.05	6.79	34.40	**4.00**	0.08	7.43	0.79	**1.00**	0.08	7.34	0.49	ND
9/03/16	3.44	7.36	13.60		0.05	7.20	4.06	**1.00**	0.09	7.09	38.40	**1.00**	0.08	7.40	0.78	**1.00**	0.04	7.38	0.66	ND
10/03/16	3.48	7.35	10.40		0.00	7.38	7.41	**2.00**	0.03	7.04	15.50	ND	0.00	6.65	1.18	ND	0.03	6.94	0.46	ND
11/03/16	3.05	7.44	104.00		0.02	6.81	5.43	ND	0.01	7.08	4.84	ND	0.00	7.28	4.59	ND	0.10	7.42	2.65	ND
11/03/16					0.58	6.92	4.86	ND	0.58	6.92	4.86	ND	0.09	7.63	3.99	ND	0.06	7.21	2.39	ND
12/03/16	4.50	7.50	26.20		0.12	7.24	23.90	ND	0.23	7.05	10.30	ND	0.02	7.09	4.95	ND	0.04	7.27	4.53	ND
13/03/16					0.16	7.21	3.80	ND	0.36	7.01	4.49	ND	0.70	7.37	7.27	ND	0.54	7.28	2.86	ND
14/03/16	2.95	7.30	23.90		0.07	7.16	7.53	ND	1.03	7.10	4.62	ND	1.49	7.41	9.71	ND	0.87	7.19	8.73	ND
15/03/16	2.65	7.36	2.74		0.70	7.26	1.40	ND	1.20	7.04	1.10	ND	0.92	7.20	6.54	ND	1.60	7.17	8.13	ND
16/03/16	3.42	7.41	3.86		1.48	7.42	0.79	ND	1.45	7.28	0.79	ND	1.87	7.40	5.68	ND	0.64	7.22	6.03	ND
17/03/16	3.60	7.14	5.30		1.45	7.13	0.56		1.01	7.28	3.33		2.73	7.69	3.39		2.16	7.12	4.98	
18/03/16					0.16	7.25	9.32	ND	1.16	7.12	6.34	ND	2.44	7.13	4.03		2.60	7.3	3.83	
19/03/16	3.78	7.39	6.80		0.77	7.22	5.75	ND	0.78	7.30	5.24	ND	0.99	7.31	5.75	ND	1.81	7.34	4.01	
20/03/16	3.27	7.36	2.70		1.49	7.29	1.22		1.58	7.19	1.83		0.48	7.19	5.98	ND	0.94	7.12	4.34	
21/03/16					1.09	7.45	1.08		1.14	7.06	2.06		0.34	7.34	6.69	ND	0.22	7.17	4.79	
22/03/16	2.99	7.25	2.37		1.23	7.43	0.87		1.27	7.50	0.86		0.68	7.52	3.93		0.44	7.17	3.72	

Note : Rainfall for the period 1/3/16 to 18/3/16 was 803mm. High turbidity in the reticulation system was impacting residual chlorine levels.

ND means "No detection".

Meunga Creek Supply Source (Kennedy Bore used to supplement post Dec 2018)				
Site	Ellerbeck PRV	Kennedy Store	Cardwell Pool	Stoney Ck Pumps Tap
No.of samples from 1/7/2016 to 31/5/2021	110	128	102	127
No. of positive ecoli	3	1	1	3
Details of positive ecoli	10/01/2017 NTU 6.39, Cl2 0.23 8/02/2017 NTU 22.6 Cl2 0.05 23/02/2017 NTU 16.9 Cl2 0	10/01/2017 NTU 9.2 Cl2 0.05	10/01/2017 NTU 2.64 Cl2 0.07	10/01/2017 NTU 1.66 Cl2 0.15 11/01/2017 NTU 2.83 Cl2 0.03 12/01/2017 NTU 4.49 Cl2 0.05
No. of Samples > 1NTU	23	71	19	21
No. of Samples > 5NTU	11	9	3	3

Table 6.10 Cardwell NTU and ecoli data

Notes:

1. A widespread contamination issue was triggered on 10/1/2017.
2. No positive ecoli since Kennedy Bore became operational in December 2018.

Table 6.11: Water Quality Complaints

Year	No of Water Quality Complaints	Water Quality Complaints per 1000 Connections	Main Reasons for Complaints	Likely Sources / Causes of Problems	Resolution of Problem
2019-2020	5 Kennedy bore completed in early 2019.	4.4	Dirty Water	Mains breaks, scouring	Mains scoured.
2018-2019	11	9.9	Dirty Water	High turbidity from rain events, main breaks, scouring.	Mains scoured, event passes, alternate source
2017-2018	3	2.7	Dirty Water	High turbidity from rain events, main breaks, scouring.	Mains scoured, event passes, alternate source
2016-2017	2	1.6	Dirty Water	High turbidity from rain events, main breaks, scouring.	Mains scoured, event passes, alternate source
2014-2015	2	1.8	Dirty Water	High turbidity from rain events, main breaks, scouring.	Mains scoured, event passes, alternate source
2013-2014	5	4.7	Dirty Water	High turbidity from rain events, main breaks, scouring.	Mains scoured, event passes, alternate source
2012-2013	3	3	Dirty Water	High turbidity from rain events, main breaks, scouring.	Mains scoured, event passes, alternate source
2011-2012	0	0	Dirty Water	High turbidity from rain events, main breaks, scouring.	Mains scoured, event passes, alternate source

7. Assessment of Risks & Mitigation

7.1 Methodology

Cassowary Coast Regional Council has adopted an *Enterprise* risk framework at a corporate level. This framework has been applied to this plan in order to ensure a consistent application of risk across all council activities.

This framework adopts a common likelihood matrix across all council activities with consequences customised to the specific application of risk. These consequences are moderated across all area's to ensure the severities of consequences are aligned across all areas of the organisation.

Through the adoption of this organisational wide matrix all risks across Council will be evaluated using the same criteria. This will align the water quality risks with all others and allow appropriate justification for the allocation of additional funding by Council to minimise these risks.

Risk scores were calculated according to the following frame work, where the level of risk was determined by the likelihood of the hazard occurring and subsequent consequence of the hazard using the following Risk Analysis Matrix.

Likelihood	Rating	Consequence									
		1		2		3		4		5	
		Insignificant		Minor		Moderate		Major		Catastrophic	
A – Almost certain	5	M	52	H	64	H	76	E	88	E	100
B – Likely	4	L	44	M	56	H	68	H	80	E	92
C - Possible	3	L	36	M	48	M	60	H	72	E	84
D - Unlikely	2	L	28	L	40	M	52	H	64	H	76
E - Rare	1	L	20	L	32	L	44	M	56	H	68

Table 7.0: Enterprise Risk Framework Risk Rating System

As stated the likelihood table is defined for all areas within councils system and is described below:

Likelihood	Description	Indicative Frequency Values	Rating
Almost Certain	The event is expected to occur in most circumstances	Greater than one or more per annum	**5**
Likely	The event will probably occur in most circumstances	Will probably occur on one occasion in the coming year. 20-90% probability the event will occur in the next year	**4**
Possible	The event might occur at some time	Between 3 – 10 years	**3**
Unlikely	The event could occur at some time but is not considered likely to occur	Between 10 - 50 years	**2**
Rare	The event may occur only in exceptional circumstances	Every 50 – 100 years	**1**

Table 7.1: Enterprise Risk Framework Likelihood Rating System

The consequence criteria are defined for each risk area to council with water quality risk moderated against all other to ensure balanced severity of consequences across the organisation.

With this methodology the Likelihood remains constant with the consequence descriptions defined in reference to water quality.

Consequence	Rating	Water Quality
Catastrophic	**5**	Potential acute health impact for a large percentage of the population, declared outbreak expected
Major	**4**	Potential acute health impact for a small percentage of the population, no declared outbreak expected
Moderate	**3**	Potential widespread aesthetic impact or repeated breach of chronic health parameter, significant disruption in normal operation but manageable
Minor	**2**	Potential local aesthetic, isolated exceedence of chronic health parameter, manageable operational disruption
Insignificant	**1**	Isolated exceedence of aesthetic parameter with little or no disruption to normal operation

Table 7.2: Enterprise Risk Framework Consequence Rating System - Water Quality

In order to achieve continuity across all of council the consequences are compared across consequences from other business areas of council. This list of water quality risk consequences in then added to councils risk matrix as is seen below.

The reason for adopting this approach stems from the organisational structure in that Water services is a section of the Works department. Thus any risk program or improvement program needs to be uniform across the department. This will enable risk across different projects to be assessed using similar criteria and the funding allocated based on the risk to council.

Funding priority is not guaranteed for the DWQMP as the Council has financial limitations. By utilising this methodology DWQMP projects will be funded on a priority basis against all other projects across council.

Consequence	Rating	Water Quality	Operational – Business Continuity	Environmental	Information Technology	Strategic/Corporate Governance – Reputation - Political	Human Resources	Infrastructure, Asset & Property	Workplace Health & Safety	Financial and Economic
Catastrophic	**5**	Potential acute health impact for a large percentage of the population, declared outbreak expected	The continuing failure of Council to deliver essential services. The removal of key revenue generation. Substantial loss of operating capacity for a period greater than 1 week.	Widespread and irreversible environmental damage attributed by the courts to be negligent or incompetent actions of Council.	Widespread, long term loss of IT network/hardware.	Loss of State Government support with scathing criticism and removal of the council. National media exposure Loss of power and influence restricting decision making and capabilities	Staff issues cause continuing failure to deliver essential services In excess of 1 month	Widespread, long term loss of substantial key assets and infrastructure. In excess of 1 month	Fatality or significant irreversible disability.	Greater than $5 Million
Major	**4**	Potential acute health impact for a small percentage of the population, no declared outbreak expected	Failure of Council services causing lengthy service interruption up to 1 week	Severe environmental impact requiring significant remedial action. Penalties and/or direction or compliance order incurred.	Short to medium term loss of key IT network systems affecting substantial Council operations 24 hours – 1 week	State media and public concern/ exposure with adverse attention and long-term loss of support from Cassowary Coast residents. Adverse impact and intervention by State Government	Staff issues cause failure to service delivery 1 – 4 weeks.	Widespread, short to medium term loss of key assets and infrastructure 1 – 4 weeks.	Extensive injuries. Lost time of more than 4 working days.	Between $1 - $3 Million
Moderate	**3**	Potential widespread aesthetic impact or repeated breach of chronic health parameter, significant disruption in normal operation but manageable	Temporary & recoverable failure of Council causing intermittent service interruption for a week. Up to 24 hours	Moderate impact on the environment; no long term or irreversible damage. May incur cautionary notice or infringement notice	Short to medium term loss of key IT network systems affecting substantial Council operations. Up to 24 Hours	Significant regional concern/ exposure and short to mid term loss of support from Cassowary Coast residents. Adverse impact and involvement of LGAQ.	Staff issues cause failure to service delivery. Up to 1 week	Short to medium term loss of key assets and infrastructure Up to 1 week	Medical treatment. Lost time of up to 4 working days.	Between $250,000 - $1 Million
Minor	**2**	Potential local aesthetic, isolated exceedence of chronic health parameter, manageable operational disruption	Temporary and recoverable failure of council causing intermittent service interruption.	Minor environmental damage such as remote temporary pollution.	Minor loss/damage. Repairs required	Minor local community concern manageable through good public relations.	Staff issues cause several days interruption of day to day service delivery	Minor loss/damage. Repairs required	First aid treatment. No lost time.	Between $50,000 - $250,000
Insignificant	**1**	Isolated exceedence of aesthetic parameter with little or no disruption to normal operation	Negligible impact of Council, brief service interruption.	Brief, non hazardous, transient pollution or damage.	Damage where repairs are required however equipment still operational	Transient matter, e.g. Customer complaint, resolved in day-to-day management. Negligible impact on other stakeholders.	Staff issues cause negligible impact of day to day service delivery	Damage where repairs are required however facility or infrastructure is still operational	No injury.	Up to $50,000

Table 7.3: Enterprise Risk Framework Consequence Rating System All Categories

Amdt 10/2020

All identified potential hazards have been risk assessed in a two stage approach. Maximum risk levels were assessed as the level of risk with no controls in place, assuming that particular system was not operational. Residual risks were evaluated based on existing control measures in place that, under current normal operating conditions, would work to improve water quality.

Each residual risk is allocated an "uncertainty" score of between 1 and 5 based upon the uncertainty/confidence criteria detailed in the following table.

Level of Uncertainty	Definition
5 - Certain	There is 5 years of continuous monitoring data, which has been trended and assessed, with at least daily monitoring; or The processes involved are thoroughly understood.
4 - Confident	There is 5 years of continuous monitoring data, which has been collated and assessed, with at least weekly monitoring or for the duration of seasonal events; or There is a good understanding of the processes involved.
3 - Reliable	There is at least a year of continuous monitoring data available, which has been assessed; or There is reasonable understanding of the processes involved.
2 - Estimate	There is limited monitoring data available; or There is limited understanding of the processes involved.
1 - Uncertain	There is limited or no monitoring data available; or The processes are not well understood.

Table 7.4: Residual Risk Uncertainty Scoring

An uncertainty score of 2 or below will require an *Improvement Plan* (IP) action that will aim to increase the level of certainty before progressing and will be clearly documented in the risk register

7.1.1 Acceptable Risk Level

For the purposes of this plan level Council requires deems any hazard, that retains a residual risk after control measure, of **HIGH (>64)** to be deemed unacceptable and require improvement measure to be developed and implemented in a manner appropriate to the risk.

7.2 Hazard Identification, Risk Assessment & Mitigation

Hazard identification and risk assessments can be found in Appendix B.

8. Managing Risk

8.1 Operations and Maintenance Procedures

The following table lists the status of existing operation and maintenance procedure documentation. These have been created in consultation with appropriate operational and maintenance staff. The procedures are stored electronically in a common folder accessible to all supervisors and staff with computer access. All supervisors have computer access and are able to print hard copies for distribution. The Manager Water is responsible for the implementation and review of procedures.

Manual Name	Version Date	Status
DWQMP Sampling Manual	09/2020	For approval
Incident Response Manual	11/2016	approved
Quality Control Plan	09/2020	For approval

Table 8.0: Approved Operational and Maintenance Manuals

Operational and maintenance procedures are contained in a file entitled *Document Control Register* Version 2 located in G:\CCRC Shared Resources\Works\Water\DWQMP Procedures & Document Control This register has all procedures in use by the Water Section of CCRC. More work is needed to progress the status of procedures across all areas within the Section. Progress on the improvement of documented procedures is hampered by limited resourcing.

8.2 Management of Incidents and Emergencies

CCRC has developed an ***Incident Response Manual*** that is included as an Appendix C.

This manual details requirements of the DWQMP and supports the CCRC disaster management plan when dealing with water quality incidents.

8.3 Risk Management Improvement Program

A ***Risk Management Improvement Plan*** (RMIP) is attached in the Appendix D. This plan outlines how Council intends to;

Manage unacceptable residual risks identified by the hazard/risk assessment,

Manage any gaps in the Plan; and/or

Improve those parts of the Plan where deficiencies in information did not allow the criteria to be completely and accurately addressed.

8.4 Service Wide Support – Information Management

Presently information is stored in multiple formats with little standardisation. Reporting is excessively time consuming and at limited times inaccurate. Generally operational staff have a poor level of computer literacy.

CCRC are presently installing a new corporate software system that apparently has the ability to improve the management of maintenance documentation and customer service information. It is also the Water Departments intention to utilise the *SWIM Local* software to record manage and report water quality data however these decisions are dictated by Councils IT department.

Electronic water data is accessible to all supervisors and staff with computer access.

Table 8.1: Summary of Water Quality Management Information

Information/ Document	Format (hardcopy / electronic)	Where stored (at WTP / on electronic system / other)	Position Responsible / Business Unit	Comments
Innisfail WTP - Raw & Treated in-house sampling	*Hardcopy Electronic Spreadsheet*	*WTP CCRC IT system Swim Data Management System*	*Operators*	
Innisfail, Nyleta Scheme inhouse sampling	*Electronic Spreadsheet*	*CCRC IT system Swim Data Management System*	*Operators*	
Innisfail, Nyleta Chlorinator Inspection log	*Hardcopy / Diary*	*WTP*	*Senior operator (operations)*	
SWA, Pesticides	*Electronic (pdf) Electronic Spreadsheet*	*CCRC document management system Swim Data Management System*	*Operators*	
Tully, Cardwell Scheme in-house sampling	*Electronic Spreadsheet*	*CCRC IT system Swim Data Management System*	*Operators*	
Tully, Cardwell Chlorinator Inspection log	*Hardcopy / Diary*	*WTP*	*Operators*	
SWA, Pesticides	*Electronic (pdf) Electronic Spreadsheet*	*CCRC document management system Swim Data Management System*	*Operators*	
Flow data - Innisfail, Nyleta, Tully, Cardwell	*Electronic Spreadsheet CCRC SCADA*	*CCRC IT system Swim Data Management System*	*Operators*	
Maintenance logs	*hard copy*	*Innisfail Water Office*	*Supervisor Mechanical Maintenance*	
Pump Station logs	*Electronic -Summary and History*	*CCRC SCADA System*	*Supervisor Mechanical Maintenance/ Coordinator Treatment/ Operators*	
Maintenance Manuals, information	*Hard copy,Converting some records to electronic. Work in progress*	*Innisfail Water Office/ CCRC IT system*	*Supervisor Mechanical Maintenance/ Program Planner*	*Small amount of data existing*
Procedures	*Electronic Spreadsheet*	*CCRC IT system*	*everyone*	*assessable*
Complaints & Main breaks	*Electronic Database*	*CCRC document management system*	*Customer Service/Water Administration*	

Information/ Document	Format (hardcopy / electronic)	Where stored (at WTP / on electronic system / other)	Position Responsible / Business Unit	Comments
Annual Performance Report incl SWIM	*Electronic*	*Web site*	*Manager Water*	

9. Operational and Verification Monitoring Programs

Further to the Sampling Manual, the Appendix F ***Quality Control Plan*** outlines quality limits and actions for operational and critical limits. These plans have been implemented to reduce biological risk as identified in the risk assessment.

Coordinator Treatment interprets results and as per the *Water Quality Reporting Procedure*, contacts the *Office of the Water Supply Regulator* for any values above the ADWG health values.

9.1 Operational Monitoring Program

Continuous chlorine residual monitoring is undertaken with analysers at the following sites:

Innisfail - Innisfail WTP (primary dosing site)

Nyleta – Nyleta Hill Reservoir (primary dosing site), No.4 Branch Chlorinator (secondary dosing site), Jaffa Rd (analyser only), Daveson Rd (analyser only), Seaview St (analyser only) and Jurs Ck bore (primary dosing site)

Tully – Bulgun Ck Intake Reservoir (primary dosing site),Boulder Ck Chlorinator (primary dosing site) and Bulgun Ck Chlorinator (secondary dosing site), Wheatleys Hill Reservoir(secondary dosing site), Hyatt St Reservoir (secondary dosing site)

Cardwell - Sullivan Rd Chlorinator(primary dosing site), Cardwell Reservoir (secondary dosing site), (Kennedy Bore primary dosing site when operational)

Turbidity analysers are located at the following sites:

Innisfail - Innisfail WTP (raw and treated)

Nyleta – Nyleta Ck source water, Sth Liverpool Ck source water, No.4 Branch Chlorinator.

Tully – Bulgun Ck intake upstream of intake reservoir, Boulder Ck Chlorinator and Bulgun Ck Chlorinator

Cardwell – Meunga Ck intake, Sullivan Rd Chlorinator.

Chlorine dosing levels are adjusted automatically by the controls in the SCADA to maintain appropriate residual values. If the analysers detect a residual below the alert level as indicated on the CCP plans, the SCADA triggers a phone alert to operations personnel. The SCADA allows dosing levels to be adjusted remotely. Chlorine residuals, turbidity and flow figures are recorded with the SCADA system and are stored on Council's Historian data system. All turbidity analysers are connected to SCADA. As noted in the details of each supply scheme, considerable progress has been made in the management of turbidity events in our creek supply schemes with the installation of automated isolation systems and the provision of backup supply sources (intake reservoirs at Tully and Nyleta and a bore for Cardwell). It is envisaged that improved levels of turbidity across the network in all weather conditions will reduce Council's reliance on secondary chlorine dosing facilities. Council has already decommissioned secondary dosing facilities in the Nyleta Scheme at Jaffa Rd and Daveson Rd. Improvements in water quality completed in the past couple of years should allow for reductions in the amount of verification testing.

For the Tully and Cardwell Schemes there is only a single operator assigned to operate these schemes. Operational monitoring frequency is in accordance with the sampling manual and is resource limited.

9.2 Verification Monitoring Program

The Appendix E ***Sampling Manual*** contains the operational and verification monitoring programs including the sampling process, parameters being monitored, sampling frequency and location maps. The data obtained by verification monitoring programs is stored within excel spreadsheets on the CCRC servers and retained for a period of no less than 7 years.

The location of sample points has been chosen from practical experience to give a realistic coverage of water quality to the vast majority of consumers. Water quality operational samples found above ADWG limits or internal standards are reported to the appropriate supervisor for action. Verification monitoring includes Standard Water Analysis (SWA) and Pesticides. These results are obtained from the States Forensic Services Laboratory and emailed to Council and directly to the coordinator Treatment. The results (pdf) are entered to the corporate data management system. Hard copies of the SWA and Pesticide data are stored in the Coordinators office at the Innisfail Wastewater Treatment Plant. The information flow can be found in the below *Sampling Analysis Responsibility Flowchart in Figure 9.0.*

9.2.1 Monitoring of E-coli

The verification monitoring program for the detection of E-coli involves the sampling of a representative number of sites through out different times with in the month such that a minimum of 4 samples are taken at a regular interval. There are then additional samples taken on a random time basis preferably during or shortly after events to ensure that no E-coli is present with in the network during times of increased risk (high turbidity and lower residual).

The e-coli sampling frequency is described for each scheme in table 4.2 of the Sampling Manual. For example Nyleta has 1 sample per week plus 3 extra samples per month of internal testing plus 4 sites every 3 months of external verification testing plus an additional 1 site per month of external verification. This method provides flexibility with sampling and increases the likelihood of detecting E-coli with the advantage of reducing operational burden through minimising the number of samples required to cover the network.

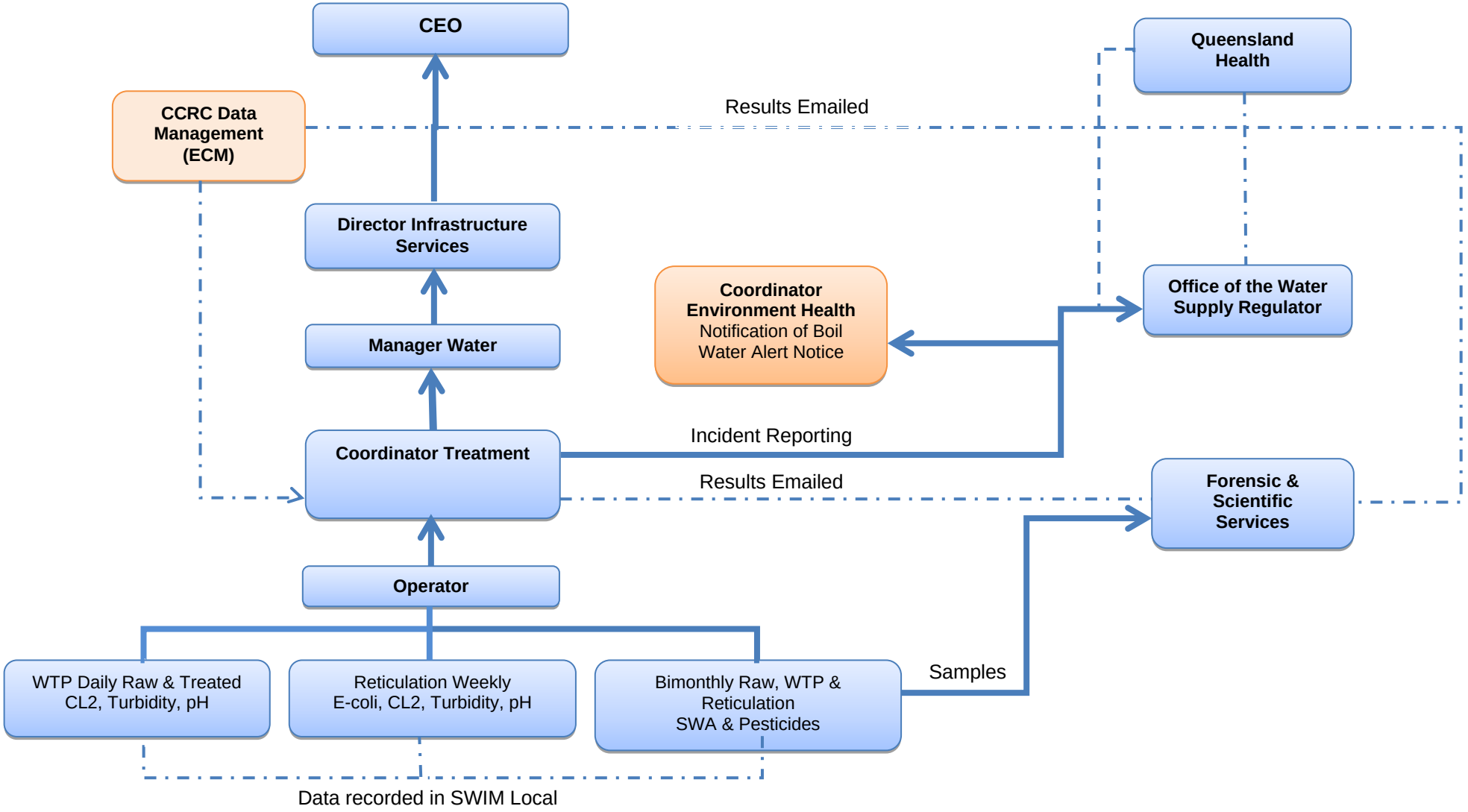
E-coli is tested using the Colli-Alert method and is conducted by operational personnel the accuracy of the methodology is verified by double sampling 4 times a year and having the second set of samples verified by a NATA lab.

The Verification monitoring program is adequate as the additional sampling allows flexibility that is used based on a risk approach. That is more sampling can be conducted during events of high risk and locations with in the network that service vulnerable customers.

9.2.2 Monitoring of Pesticides

The monitoring of pesticide in the raw water is in accordance with the sampling manual.

Figure 9.0: Sampling and Analysis Responsibility Flow Chart



10. Appendices

A. Details of the Innisfail WTP

B. Risk Assessment & Hazard Identification (Tables)

C. Incident Response Manual

D. Risk Management Improvement Plan (Tables)

E. Sampling Manual

F. Quality Control Plan