Overarching Drinking Water Quality Management Plan

Presented by: Water and Waste Directorate
Current as at: 22 August 2024

ISAAC REGION
HELPING TO ENERGISE THE WORLD

ISAAC.QLD.GOV.AU ISAAC REGIONAL COUNCIL ABN 39 274 142 600
P 1300 472 227 F 07 4941 8666 A PO Box 97 Moranbah QLD 4744
isaacregionalcouncil isaacregionalcouncil Isaacrcouncil

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

OBJECTIVE

The Drinking Water Quality Management Plan (DWQMP) describes how Isaac Regional Council (IRC) protects public health by ensuring the safety of drinking water supplied to our customers.

SCOPE

- The DWQMP meets the requirements of the *Water Supply (Safety and Reliability) Act 2008*
- The DWQMP is generally aligned with the 12 Element Framework of the Australian Drinking Water Guidelines
- The DWQMP applies to the production and distribution of drinking water.
- Council's responsibility for drinking water is from catchment to water meter, after which point it is the responsibility of the customer.

DEFINITIONS

TERM / ACRONYM	MEANING
ADWG	Australian Drinking Water Guidelines
CCP	Critical Control Point
DRDMW	Department of Regional Development Manufacturing and Water
DWQMP	Drinking Water Quality Management Plan
DWQMP Guideline	Guideline for the preparation, review, and audit of DWQMPs
ECM	Enterprise Content Management
EDMS	Electronic Data Management System
IMS	Incident Management System
IRC	Isaac Regional Council
LOR	Limit of Reporting
MIB	Methylisoborneol
OCP	Operational Control Point
NTU	Nephelometric turbidity units
PHA	*Public Health Act 2005*
QCP	Quality Control Point
QH	Queensland Health – regulator of public health
Regulator	In the context of the DWQMP, the Regulator is DRDMW
RMIP	Risk Management Improvement Program
SCADA	Supervisory Control and Data Acquisition
SPID	Service Provider Identification Number
WSSRA	*Water Supply (Safety and Reliability) Act 2008*
WTP	Water Treatment Plant

OVERVIEW/BACKGROUND

The Australian Drinking Water Guidelines open with the following sentences.

> *Safe drinking water is essential to sustain life. Therefore, every effort needs to be taken to ensure that drinking water suppliers provide consumers with water that is safe to use.*

Isaac Regional Council recognises that the provision of safe drinking is an essential Council service that underpins the prospects and prosperity of our communities.

This Drinking Water Quality Management Plan is a risk-based plan that identifies the risks to the drinking water services, defines how Council operate the existing treatment infrastructure, and through the Risk Management Improvement Plan (RMIP) identifies required improvements that will be essential to both improving the quality of drinking water in the short term, but also to ensure compliance with the microbial health-based targets in the longer term.

BENEFITS

By providing safe and aesthetically pleasing drinking water, Council provides the foundation for our communities to prosper.

DRINKING WATER FRAMEWORK/STRATEGY

- Council will ensure that drinking water provided to our customers is safe and aesthetically pleasing.
- This is achieved through implementation of this overarching DWQMP and the site specific DWQMP for each drinking water scheme.
- Implementation of this plan requires:
  - Commitment and funding from Council
  - Planning of, and implementation of identified improvements
  - Commitment of water operations staff (operators, supervisors, and managers) to implement the plan on a daily basis; and
  - Implementation of incident and emergency responses as required if the safety of drinking water may be impacted.
- All Water and Wastewater staff are responsible for implementing different aspects of this plan.
- When implemented effectively, our customers will continually receive safe and aesthetically pleasing drinking water.

LEGISLATION AND GUIDELINES

- *Water Supply (Safety and Reliability) Act 2008*
- *Public Health Act 2005*
- *Water Supply (Safety and Reliability) Regulation 2011*
- *Public Health Regulation 2018*
- *Water Act 2000*
- How to Manage Workplace Health and Safety Risks Code of Practice 2021
- Australian Drinking Water Guidelines 6, 2021 (current version is V3.8 Updated September 2022, but the ADWG is updated on a rolling review and the most current version is the appropriate reference)
- Guideline for the preparation, review and audit of drinking water quality management plans V3 Oct 2022
- AS 2927:2019 The storage and handling of liquefied chlorine gas
- AS 4020:2018 Testing of products for use in contact with drinking water

REFERENCES

ID	NAME
	DWQMP Document Register

INTRODUCTION

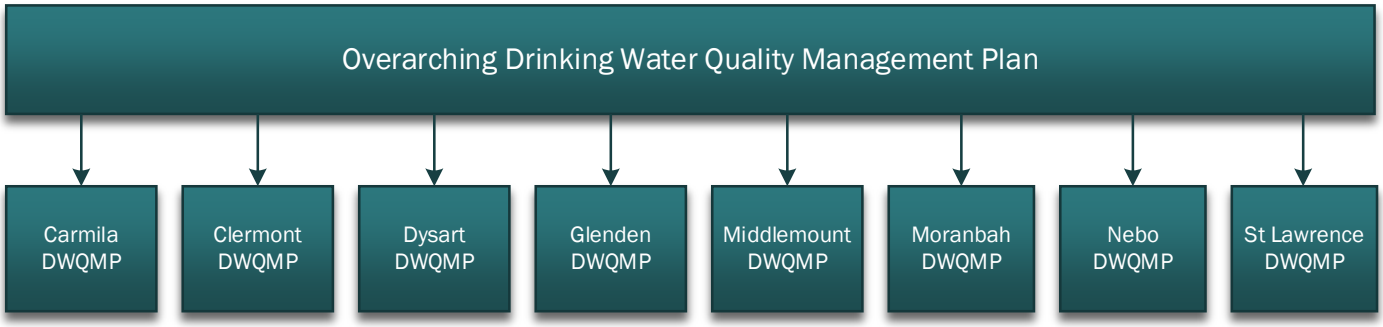
This Drinking Water Quality Management Plan (DWQMP) has been developed to ensure that our drinking water supplies are safe and protect public health. In implementing this plan, Isaac Regional Council meets the requirements of the *Water Supply (Safety and Reliability) Act 2008.*

The intent of the management plan is to address the relevant elements and components of the Australian Drinking Water Guidelines (ADWG), noting that some of the ADWG components are met through alternate regulatory requirements.

STRUCTURE OF THIS PLAN

This plan is written as an overarching DWQMP that includes the elements that are common across all schemes and site-specific plans that are intended to be more operationally focussed. For any individual scheme, the complete plan for that scheme is this overarching DWQMP plus the relevant Site Specific DWQMP.

Figure 1 Plan Structure



ISAAC REGIONAL COUNCIL

Isaac Regional Council (IRC) is located 1000km northwest of Brisbane and 900km south of Cairns. The Council area covers approximately 58000 km^2 and has a resident population of ~20,940 people. The Council area includes the coastal strip from Greenhill to St Lawrence, west across the Great Dividing Range through the central Queensland coalfields, and further west to where the Council boundary meets with Barcaldine and Charters Towers Regions.

The Isaac Region is a resource heavy region, with more than 30 coal and other resource operations. The area produces more than half of all Queensland's coal. Agriculture is also important, with significant livestock and cropping areas, supported in part by the Sunwater irrigation schemes. These activities result in some hazards being present in the drinking water supply catchments.

Table 1 Service Provider Details

SERVICE PROVIDER DETAILS	
PROVIDER	Isaac Regional Council, Service Provider ID 486
CONTACT DETAILS	Manager Maintenance and Operations Water and Wastewater Isaac Regional Council PO Box 97 Moranbah QLD 4744 1300 472 227

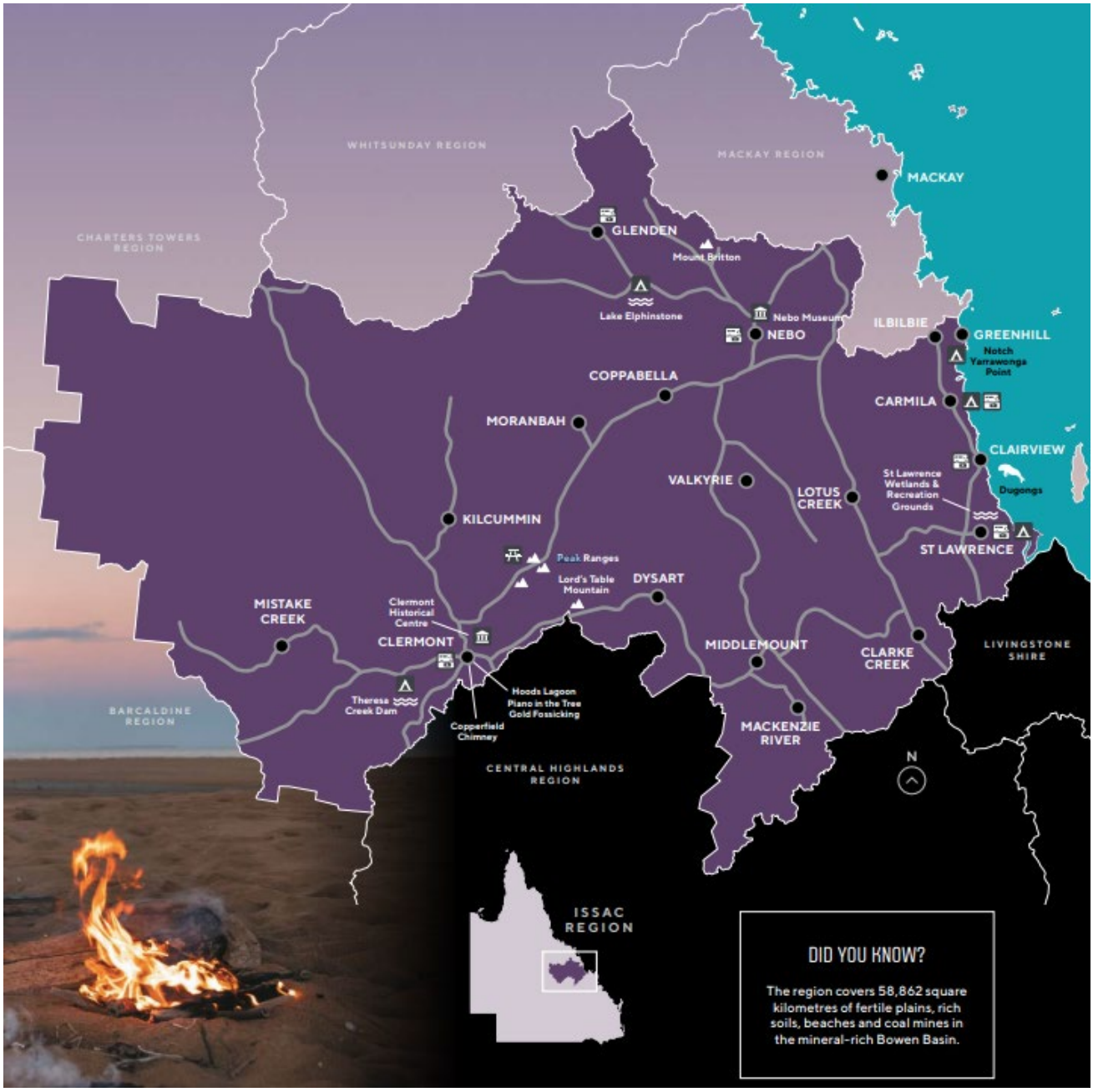


Figure 2 Isaac Regional Council area identifying the main communities.

OVERVIEW OF DRINKING WATER SUPPLY SCHEMES

Isaac Regional Council has eight (8) drinking water supply schemes, these are detailed in Table 2. 10-year projections, while based on the Queensland Government Statisticians Office medium projection time series are considered unreliable due to the volatility of the resource industry, and Council typically updates growth forecasts on a more frequent basis. Nonetheless, the estimated 10% growth for the Isaac Region has been applied across each scheme and demand forecast in alignment with the DWQMP Guideline requirements.

Table 2 Drinking water supply schemes

SCHEME		CURRENT (2023)			PROJECTED (2036)		
	PLANT CAPACITY (ML/D)	POPULATION	CONNECTIONS	DEMAND (ML/D)	POPULATION	CONNECTIONS	DEMAND (ML/D)
Carmila	0.22	333	71	0.05	366	78	0.055
Clermont	5.04	3031	1429	2.1	3334	1572	2.31
Dysart	5.76	2991	1500	2.24	3290	1650	2.464
Glenden	5.47	620	590	0.94	682	649	1.034
Middlemount	6.48	1841	969	1.27	2025	1065.9	1.397
Moranbah	16.56	8735	4194	6.5	9608	4613.4	7.15
Nebo	2	753	401	0.56	828	441	0.616
St Lawrence	0.39	235	137	0.06	259	151	0.066

STAKEHOLDERS

The relevant stakeholders for Isaac Regional Council are listed in Table 3.

Table 3 Key Stakeholders

STAKEHOLDER	ADDRESS	PHONE	CONTACT	RELEVANCE
Queensland Fire and Emergency Service (QFES)		13 74 68		Emergency service
State Emergency Service (SES)		132 500		Assistance in storms/ disasters
Department Regional Development, Manufacturing and Water (DRDMW)		1300 596 224		Drinking Water Regulator – regulator and incident reporting
Public Health Unit (Queensland Health)				Public health advice
Sunwater				Bulk water provider
Anglo American				Upstream water provider
CHEMICAL SUPPLIERS				
COMPANY	**ADDRESS**	**PHONE**	**CONTACT**	**EMAIL**
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

VULNERABLE CUSTOMERS

CARMILA

COMPANY	ADDRESS	PHONE	CONTACT	EMAIL
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

CLERMONT

COMPANY	ADDRESS	PHONE	CONTACT	EMAIL
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	-
[redacted]	[redacted]	[redacted]	[redacted]	-
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]		[redacted]	[redacted]	[redacted]

	[redacted]			
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
DYSART				
COMPANY	**ADDRESS**	**PHONE**	**CONTACT**	**EMAIL**
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

VULNERABLE CUSTOMERS				
		GLENDEN		
COMPANY	ADDRESS	PHONE	CONTACT	EMAIL
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
		MIDDLEMOUNT		
COMPANY	ADDRESS	PHONE	CONTACT	EMAIL
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

MORANBAH

COMPANY	ADDRESS	PHONE	CONTACT	EMAIL
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	-
[redacted]	[redacted]	[redacted]	[redacted]	-
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

[redacted] —	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted] [redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	-	-

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted] [redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted] [redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted] [redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
		NEBO		
COMPANY	ADDRESS	PHONE	CONTACT	EMAIL
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

	[redacted]			
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

ST LAWRENCE

COMPANY	ADDRESS	PHONE	CONTACT	EMAIL
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

RISK METHODOLOGY

OVERVIEW

The risk methodology used by Isaac Regional Council is a multi-stage risk assessment process that includes the following stages:

- Hazard identification
- Unmitigated risk assessment
- Mitigated risk assessment

These are detailed in the following sections.

HAZARD IDENTIFICATION

Hazards are defined in the ADWG as biological, chemical, physical, or radiological agents that have the potential to cause harm. In the hazard identification step, specific parameters representing each of the separate types of hazards are listed for assessment.

This definition above was slightly expanded to also include cyber security, operator error, terrorism, and sabotage as hazards; these additional aspects are required (through the DWQMP review and audit guideline) to be assessed in the risk assessment process and including them as specific hazards is the most appropriate way to include these issues.

Hazard identification is informed by operational understanding of the raw water sources and is supported by water quality data and operational knowledge.

Hazard identification was undertaken at the commencement of the risk assessment process with a pre-prepared list of hazards identified for the unmitigated risk assessment. Known and emerging hazards were pre-populated for discussion and added to throughout the process.

LIKELIHOOD AND CONSEQUENCE DEFINITIONS AND RISK MATRIX

Definitions

The following definitions were used for the risk assessment process.

- Hazardous event – an event that results in the hazard being present in the water supply.
- Consequence – this represents the outcome of the hazard being present.
- Likelihood – the frequency of the hazardous event resulting in the hazard being present and the consequence being realised.
- Risk – the product of the consequence and likelihood, represented by the intersection on the risk matrix.

The consequence descriptors refer to aesthetic, chronic health, or acute health issues. As an example, *Cryptosporidium* can cause immediate illness, and can potentially be fatal. As such the consequence of *Cryptosporidium* in the water supply is normally “Catastrophic”. Within the risk assessment process, in general, the consequence of a hazard would not normally change – rather it is the likelihood of that consequence should be reduced.

Likelihoods range from daily to weekly “Almost Certain” to less than once per five (5) years “Rare”. In general, this provides timeframes that are suitable for 24/7 operation of a water treatment plant but does come up against limitations when a rare event (major flood) may have catastrophic consequences as this risk is assessed as “Rare” but may require further consideration.

Risk Matrix

The risk matrix is based on the previous DNRMW 2010 DWQMP guideline with some modification. The matrix includes the definitions for consequence and likelihood within the matrix itself, ensuring that the participants in the workshop always considered the appropriate level. The matrix is included in Table 4 .

The matrix allows for sufficient granularity to separate out the significant risks to the drinking water service and is therefore preferred to the version provided in the more recent Guideline.

Risk Assessment Team

The team of people that undertook the risk assessments in 2023 and their experience in risk assessment processes is documented in Table 4.

Table 4 Risk Assessment Team

PERSON	POSITION	ORGANISATION	PREVIOUS PUBLIC HEALTH RISK ASSESSMENTS?	RELEVANT EXPERIENCE FOR RISK ASSESSMENT	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5
[redacted]	Maintenance Planner	IRC	None	9 years	Y				
[redacted]	Technical Officer - Dams	IRC	None	1 year	Y				
[redacted]	Manager Operations and Maintenance	IRC	Some	40 years	Y	Y	Y		Y
[redacted]	Planning Engineer	IRC	Lots	33 years	Y				
[redacted]	Treatment Plant Supervisor - North	IRC	Some	15 years	Y				Y
[redacted]	Facilitator	Bligh Tanner	15 years	20 years	Y	Y	Y	Y	Y
[redacted]	Water and Wastewater Engineer	Simmonds & Bristow	Some	8 years	Y	Y	Y	Y	Y
[redacted]	Program Leader - Compliance and IMS	IRC	Some	2 years	Y	Y	Y	Y	Y
[redacted]	Coordinator Water and Wastewater	IRC	Many	42 years	Y	Y	Y	Y	
[redacted]	Network Supervisor	IRC	None	12 years	Y				Y
[redacted]	Compliance and IMS Officer	IRC	Some	Nil	Y				
[redacted]	Business Services Trainee	IRC	None	Nil	Y				
[redacted]	Director Water and Waste	IRC	Some	33 years	Y			Y	Y
[redacted]	Operator	IRC	Some	4 years		Y			
[redacted]	Trainee Operator	IRC	None	1 year		Y			

[redacted]	Senior Operator	S&B	Some	5 years		Y			
[redacted]	Project Coordination Officer, Asset Management Department	IRC	None	1 year		Y		Y	
[redacted]	Operator	IRC	Some	10 years		Y			
[redacted]	Operator	IRC	Some	7 years		Y			
[redacted]	Senior Operator	IRC	Some	6 years			Y		
[redacted]	Operator	IRC	None	6 years			Y		
[redacted]	Operator	IRC	None	1.5 years			Y		
[redacted]	Operator	IRC	None	10 years				Y	
[redacted]	Operator in Training	IRC	None	11 years				Y	
[redacted]	Operator	IRC	None	11 years				Y	
[redacted]	Duty Operator	IRC	Some	15 years					Y

Table 5 Risk Matrix including likelihood and consequence descriptors.

Public Health Risk Matrix Likelihood	Consequence	Insignificant	Minor	Moderate	Major	Catastrophic
		Isolated aesthetic exceedance – little operational disruption	Local aesthetic exceedance or Potential isolated breach of chemical health parameter	Widespread aesthetic exceedances, or Repeated breaches of chronic health guidelines	Potential acute health impact, no outbreak expected	Potential acute health impact, declared outbreak likely
Almost Certain	Occurs daily to weekly	Medium	High	High	Extreme	Extreme
Likely	1-4 occurrences per month	Medium	Medium	High	High	Extreme
Possible	1-11 occurrences per year	Low	Medium	Medium	High	High
Unlikely	1 occurrence every 1-5 years	Low	Low	Medium	Medium	High
Rare	<1 occurrence every 5 years	Low	Low	Low	Medium	Medium

UNMITIGATED RISK ASSESSMENT

The unmitigated risk assessment combined the hazard identification process with the assessment of the unmitigated risk. The risk assessment team considered the hazard in the theoretical context of “no control measures”. In the case of a surface water supply, this considers what may occur if raw water was provided to customers with no treatment.

This definition then needs to be slightly modified when it comes to consideration of dosing. In that case, it is considered that a chemical (e.g. chlorine) is dosed without adequate design or operational control and or by untrained operators. Where there are system design controls in place that cannot be easily altered (such as the total volume of a chemical potentially stored on site), this can be considered.

The unmitigated risk assessment considered the sources of the hazard, and then through identifying the consequence and likelihood, the unmitigated risk is read from the risk matrix. As previously indicated, the unmitigated risk assessment considers the different water sources or circumstances that are present at each supply, and where the unmitigated risk is different across sites, additional lines are added.

The unmitigated risk assessment was then updated as necessary through the risk assessment process to ensure that any additional hazards that were identified during the mitigated risk assessment process were similarly captured.

The unmitigated risk assessment is included in Table 6.

MITIGATED RISK ASSESSMENT PROCESS

Mitigated risk assessments were then conducted for each treatment plant. Prior to conducting the risk assessment, each site was visited, and the operators interviewed to confirm the operation of the treatment plant and to verify the scheme descriptions and schematics are accurate.

The risks are assessed considering the barriers in place and the effectiveness of the current operational procedures.

Where a mitigated risk is high or extreme, this is unacceptable, and improvement items are identified.

WATER QUALITY DATA

Water quality data for raw water, treatment, and for reticulation was collated, statistically analysed and graphed. For this data, any results that were reported as lower than the limit of reporting (<LOR) were calculated as ½ LOR. This ensures that the mean and median are not skewed due to <LOR not being included in the dataset. This data was interrogated during the risk assessment to better quantify risk.

Table 6 Unmitigated risk assessment

PRIMARY HAZARD	SOURCE OF HAZARD	TYPE OF HAZARD	INHERENT CONSEQUENCE	INHERENT LIKELIHOOD	INHERENT RISK	COMMENTS
Bacteria/Virus	Wastewater Treatment Plants (WWTPs), septic tanks, grazing, recreational activities, recreational use of storages, ineffective disinfection (pH>8), reservoir contamination, mains contamination	Biological	Catastrophic	Almost Certain	Extreme 25	
Bacteria/ virus (Bores)	Carmila bores generally good, but one high incident with *E. coli* after rain event. Nebo has detections of *E. coli*. Nebo detections prior to upgrading bore infrastructure. Now sealed at borehead. Groundwater level responds to recharge events	Biological	Catastrophic	Possible	High 15	Nebo bores potentially Category 2, but not enough data since integrity improvements to be definitive.
Virus (Nebo)			Catastrophic	Possible	High 15	
Bacteria and Virus (Retic)	Contamination after main breaks	Biological	Catastrophic	Possible	High 15	
Cyanobacteria (Moranbah)	Nutrients, large water storages summer algal blooms	Biological	Minor	Almost Certain	High 10	
Cyanobacteria (Other schemes)	Lower level of cyanobacteria historically in these schemes	Biological	Minor	Possible	Medium 6	
Protozoa (Category 4)	WWTPs, septic tanks, grazing, recreational activities, recreational use of storages, reservoir contamination, mains contamination	Biological	Catastrophic	Almost Certain	Extreme 25	
Protozoa (Nebo Bores)	Bores (Category 3) are shallow and there is insufficient information on confining layers. Some *E. coli* detected, but not in all samples. Conductivity records not long enough to demonstrate no change with rain events.	Biological	Catastrophic	Unlikely	High 10	
Protozoa (Retic)	Contamination after main breaks	Biological	Catastrophic	Possible	High 15	
Amoeba (*Naegleria, Acanthamoeba* etc)	Ingress into reservoirs/ water mains, insufficient residual disinfection	Biological	Major	Possible	High 12	
Aluminium	High raw water concentration (total)	Chemical	Minor	Unlikely	Low 4	
Aluminium - coagulant	Overdose coagulant	Chemical	Minor	Possible	Medium 6	

PRIMARY HAZARD	SOURCE OF HAZARD	TYPE OF HAZARD	INHERENT CONSEQUENCE	INHERENT LIKELIHOOD	INHERENT RISK	COMMENTS
Chlorate	Chemical breakdown	Chemical	Moderate	Possible	Medium 9	A single exceedance in Carmila
Chlorine	Chemical overdose	Chemical	Moderate	Likely	High 12	
Copper	Algaecide	Chemical	Moderate	Possible	Medium 9	Dosed when required - see Blue Green Algae (BGA) management plan.
Cyanobacterial toxins	Summer blooms	Chemical	Moderate	Likely	High 12	
Cyanobacterial toxins (Middlemount)	Summer blooms	Chemical	Moderate	Possible	Medium 9	
DBPs	Elevated organics and long detention times	Chemical	Moderate	Possible	Medium 9	Middlemount is the main location where this happens - but there is preoxidation at some plants. Permanganate used in many locations.
Fluoride	Chemical overdose	Chemical	Moderate	Possible	Medium 9	Engineering controls in place to prevent overdoses.
Hardness (Nebo)	Inherent in bores	Chemical	Moderate	Almost Certain	High 15	Bores typically above 300 mg/L
Fluoride low	Underdose - fluoridation regulation	Chemical	Insignificant	Rare	Low 1	
Heavy metals	Natural geology, cattle dips	Chemical	Moderate	Possible	Medium 9	
Heavy metals bores	Natural geology, cattle dips	Chemical	Moderate	Possible	Medium 9	
Hydrocarbons	Road runoff, spill, road accidents, mains contamination	Chemical	Moderate	Possible	Medium 9	
Iron	Natural geology, sediment	Chemical	Minor	Almost Certain	High 10	
Iron bores	Natural geology, sediment	Chemical	Minor	Likely	Medium 8	
Manganese (Clermont and St Lawrence)	Known issue in these schemes	Chemical	Moderate	Almost Certain	High 15	
Manganese surface water	Natural geology, storage overturning	Chemical	Moderate	Likely	High 12	
Manganese (Carmila bores)	Riverbank bores	Chemical	Moderate	Almost Certain	High 15	
Manganese bores	Natural geology	Chemical	Moderate	Possible	Medium 9	
Manganese - dosing	Potassium permanganate overdosing	Chemical	Moderate	Likely	High 12	
Manganese - Reticulation	Resolubilisation in reticulation	Chemical	Moderate	Likely	High 12	
Oxygen	Stagnant water, long transport times	Chemical	Minor	Rare	Low 2	Carmila and St Lawrence sometimes observe low oxygen

PRIMARY HAZARD	SOURCE OF HAZARD	TYPE OF HAZARD	INHERENT CONSEQUENCE	INHERENT LIKELIHOOD	INHERENT RISK	COMMENTS
Pesticides	Agriculture, horticulture - Middlemount and Dysart more likely than others, but still low likelihood.	Chemical	Moderate	Unlikely	Medium 6	
Taste and odour	Algae blooms	Chemical	Minor	Likely	Medium 8	
Taste and odour - Bores	Not normally an issue	Chemical	Minor	Rare	Low 2	
Colour	Naturally occurring	Physical	Minor	Possible	Medium 6	Organics in Middlemount, Dysart and Carmila. UVA can be higher at St Lawrence at times.
Hardness	Local geology	Physical	Minor	Unlikely	Low 4	
Hardness (Nebo)	Local geology	Physical	Minor	Almost Certain	High 10	
TDS (Nebo)	Natural geology	Physical	Minor	Almost Certain	High 10	
Turbidity	Fires, storms, flooding, naturally in catchment	Physical	Minor	Almost Certain	High 10	
Turbidity (Carmila Bores)	Storms, flooding	Physical	Minor	Possible	Medium 6	
Turbidity Reticulation	Sloughing of biofilm, resuspension of sediment in reservoirs/mains, resolubilise iron and manganese, low flows in dead ends	Physical	Minor	Possible	Medium 6	Most commonly resolubilising iron and manganese.
Radioactivity Bores	Natural geology	Radiological	Moderate	Rare	Low 3	
Radioactivity	Natural geology	Radiological	Moderate	Rare	Low 3	
Operator error	Untrained/ overworked	Whole of System	Catastrophic	Likely	Extreme 20	
Availability of trained staff	Inability to attract/retain staff	Whole of System	Catastrophic	Likely	Extreme 20	
Sabotage/ Terrorism	Any chemical or microbiological hazard	Whole of System	Catastrophic	Unlikely	High 10	
Accidental bypass	Any chemical or microbiological hazard	Whole of System	Catastrophic	Likely	Extreme 20	Risk is only if used.
Allocation failure	Drought, contractual issue	Whole of System	Major	Rare	Medium 5	St Lawrence has had water tankered in 2021, but never happened anywhere else. Have water restrictions framework. Clermont has one water source.

PRIMARY HAZARD	SOURCE OF HAZARD	TYPE OF HAZARD	INHERENT CONSEQUENCE	INHERENT LIKELIHOOD	INHERENT RISK	COMMENTS
Allocation failure (Glenden)	Access to Glenden Dam as infrastructure is mining company.	Whole of System	Major	Unlikely	Medium 8	
Intake failure	Flooding, raw water main break, Pump failures	Whole of System	Major	Rare	Medium 5	Most plants have raw storage. St Lawrence and Carmila have single mains, Clermont has 3 days of treated storage.
Flooding Carmila	Flooding of Carmila Plant	Whole of System	Major	Rare	Medium 5	If there was a major flood, Carmila WTP may be vulnerable.
Treatment plant failure	Loss of power, natural disaster	Whole of System	Catastrophic	Rare	Medium 6	
Ageing infrastructure	Failure to replace aging assets	Whole of System	Major	Unlikely	Medium 8	Clermont Clarifier requires works
Loss of chemical supply	Availability of chemicals, supplier out of business	Whole of System	Catastrophic	Rare	Medium 6	Supply has been reliable
Flooding	Flood	Whole of System	Catastrophic	Rare	Medium 6	
Fire	WTP fire	Whole of System	Catastrophic	Unlikely	High 10	
Monomer	Magnasol 589, Poly DADMAC	Chemical	Moderate	Unlikely	Medium 6	
PFAS	PFAS contamination of water source	Chemical	Moderate	Rare	Low 3	
[redacted]	[redacted]	[redacted]	Catastrophic	Possible	High 15	[redacted]
Contractors	Unqualified contractors impacting water supply	Whole of System	Catastrophic	Possible	High 15	Managed through procurement processes that include level of training.
pH	Incorrect chemical dose - overdose of NaOH or combination of underdose of NaOH or overdose of alum	Chemical	Moderate	Possible	Medium 9	
Loss of supply	Power failure impacting ability to pump to water towers	Whole of System	Moderate	Possible	Medium 9	

PREVENTATIVE MEASURES

The current preventive measures in place were documented. For example, this includes design of the process, such as having multiple dosing pumps in duty standby mode, alarms (alarms are only a preventive measure when the response to the alarm is an action e.g., operator attends site to investigate the cause of the alarm), operational monitoring (where out of specification results will initiate a corrective response by the operator).

MITIGATED RISKS

The impact of the preventive measure was considered and the likelihood that the hazardous event will result in the consequence is then reassessed from the risk matrix.

UNCERTAINTY

The uncertainty of the mitigated risk was evaluated, using the uncertainty definitions in Table 7 below.

Table 7 Uncertainty definitions

UNCERTAINTY LEVEL	DESCRIPTION
Certain	The processes involved are thoroughly understood and supported by very extensive on-site knowledge covering multiple drought and flood cycles, and/or high frequency (weekly or better) water quality monitoring data.
Confident	The processes involved are well understood and supported by extensive on-site knowledge of more than one drought and flood cycle, and/or monthly water quality data
Reliable	There is a good understanding of the process which is supported by operational experience and periodic water quality data.
Estimate	The process is reasonably well understood, based on limited operational experience.
Unreliable	The process is not well understood.

ACCEPTABLE RISK

Medium and Low risk are acceptable while High and Extreme mitigated risks are unacceptable.

IMPROVEMENT ACTIONS

Where a risk is unacceptable with the current preventive measures in place, improvement actions have been identified and prioritised. These actions are included in the mitigated risk assessment tables as the final three (3) columns.

Reticulation and Whole of system mitigated risks are included in Table 8.

Table 8 Mitigated Reticulation and Whole of System Risks

REF	TREATMENT STAGE	PRIMARY HAZARD	OTHER HAZARDS MANAGED BY BARRIER	HAZARDOUS EVENT	UNMITIGATED RISK	CONTROL MEASURES IN PLACE	COMMENT	MITIGATED CONSEQUENCE	MITIGATED LIKELIHOOD	MITIGATED RISK	UNCERTAINTY	IMPROVEMENT ACTION REQUIRED - IMMEDIATE	IMPROVEMENT ACTION REQUIRED ~ 2 YEARS	IMPROVEMENT ACTION REQUIRED - LONG TERM
WOS1	Distribution System	Manganese - Reticulation	Iron, Taste and odour, Turbidity	Resolubilisation	High 12	Air scouring across last 10 years. Planning for 1 town per year. Have been eliminating dead end mains.	Dysart and Middlemount ~ 5 years ago. Complaints are now more isolated. Flushing is undertaken responsively.	Moderate	Unlikely	Medium 6	Confident			
WOS2	Distribution System	Bacteria and Virus (Retic)		Main break repair	High 15	Disinfection of new components, separated tools for water and wastewater, flush after repair. Residual disinfection		Catastrophic	Rare	Medium 6	Reliable			
WOS3	Distribution System	Protozoa (Retic)		Main break repair	High 15	Separated tools for water and wastewater, flush after repair.		Catastrophic	Rare	Medium 6	Reliable			
WOS4	Distribution System	Amoeba (Naegleria, Acanthamoeba etc)		Ingress into reservoirs or mains	High 12	Chlorine residual is dosed with critical limits above 1 mg/L in all schemes. Most customers will receive water above 0.5 mg/L for the majority of the time		Major	Rare	Medium 5	Reliable			
WOS5	Reservoirs	Bacteria/Virus		Ingress through roof or hatches/ edges of roof and wall.	Extreme 25	Roofed and vermin proof, Monthly visual inspections of roof and hatch. Divers are identified in maintenance plan - clean every 5 years. Inspections of towers to be determined. Residual disinfection.	Have been budget restrictions for divers. All reservoir inspections are Working at Heights.	Catastrophic	Rare	Medium 6	Confident			
WOS6	Distribution System	Protozoa (Retic)	Bacteria and viruses	Backflow	High 15	No outside contractors for testing of backflow prevention devices in Isaac Council Areas.	Meets the requirements of the Plumbing Act.	Catastrophic	Rare	Medium 6	Confident			
WOS7	Loss of supply - electricity failure	Loss of supply		Power supply lost	Medium 9	All systems have gravity, with some requiring pumps to high towers. Generators for all treatment plants.	Loss of power does not immediately result in loss of supply. All generators are large enough to run the whole treatment plant.	Moderate	Rare	Low 3	Confident			
WOS8	Water Towers, Nebo, Clermont, Glenden Moranbah	Bacteria/Virus		Ingress through roof or hatches/ edges of roof and wall.	Extreme 25	Concrete structure, but unable to climb and inspect frequently. Disinfection residual maintained.		Catastrophic	Rare	Medium 6	Reliable		Consider use of drone inspections to increase frequency.	
WOS9	Cyber	[redacted]		[redacted]	High 15	Separated servers from [redacted]	[redacted]	Catastrophic	Unlikely	High 10	Estimate	Have commenced upgrades on SCADA.	[redacted]	[redacted]
WOS10	Cyber	[redacted]		[redacted]	High 15	[redacted]	[redacted]	Catastrophic	Rare	Medium 6	Confident			
WOS11	Whole of system	Operator error		Operator error resulting in poor water quality to customers	Extreme 20	Trained operators across all schemes	Issues with attracting and retaining trained staff	Catastrophic	Unlikely	High 10	Estimate	Maintain training for all operational staff.	Develop succession plans, consider developing recruitment strategies, continue to develop more procedures to document operations.	

OPERATIONAL MONITORING AND PROCESS CONTROL

Operational monitoring is described in the site specific DWQMPs as this is undertaken by WTP operators. Operational monitoring is the monitoring undertaken by operators to ensure that the treatment process is working and that the water produced and about to be provided to customers is safe.

The most important treatment processes are operated and controlled as Critical Control Points (CCPs). These are documented as traffic light procedures and identify the hazard, how the process is controlled, and the target, adjustment and critical limits (with specific actions assigned against these limits). The critical limits are validated to ensure that the limits are appropriate to manage the relevant hazard. An example CCP chart is included below.

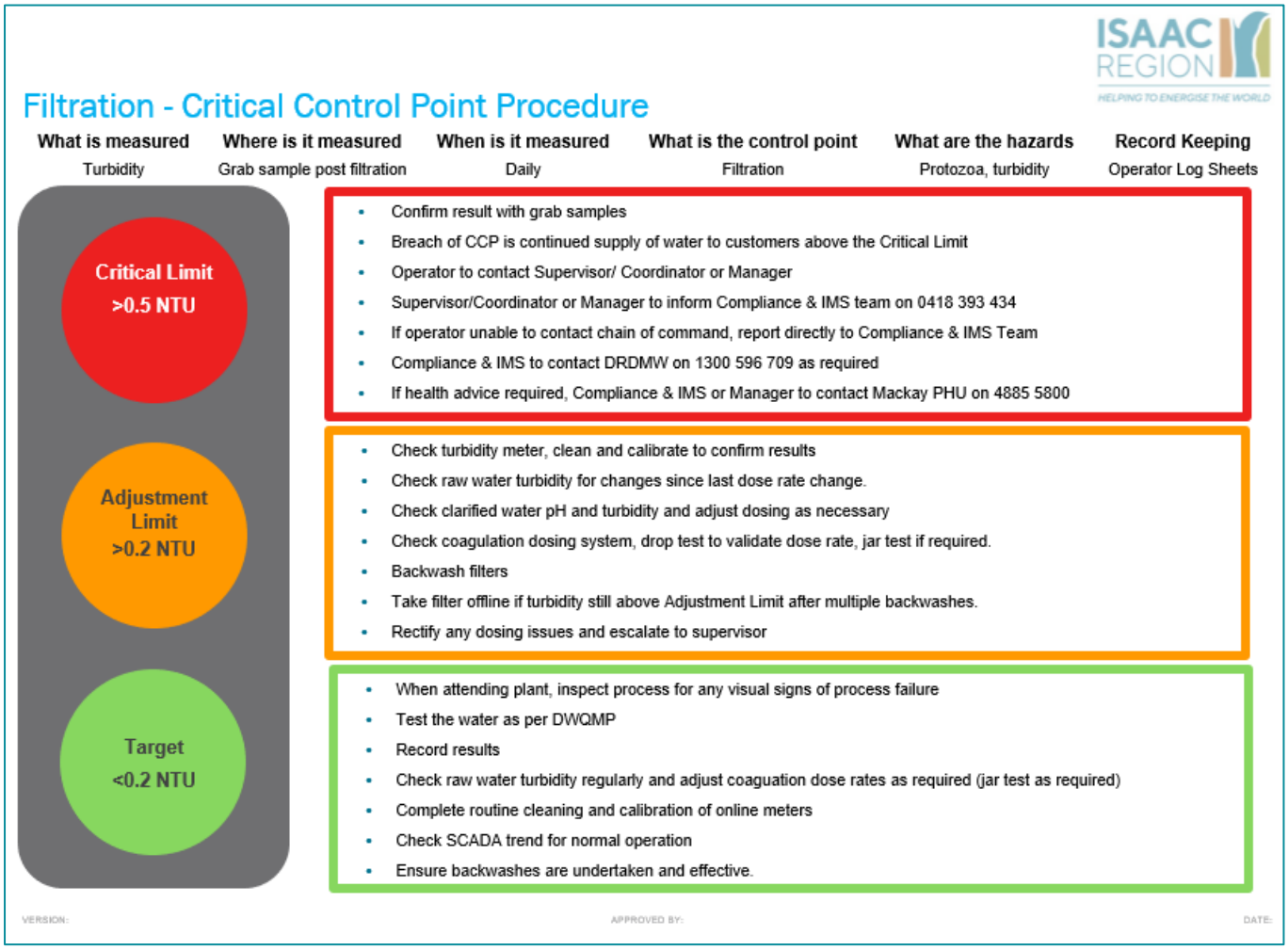


Figure 3 Example of a typical CCP

Critical control points are supported by Operational Control Points (OCPs). OCPs support the proper functioning of the CCPs, but themselves do not normally indicate an immediate health risk. For example, the coagulation OCP is intended to ensure that the water to be filtered is of the highest possible quality, which improves the performance of the filters and allows for longer filter run times. However, a short-term increase in the clarified water turbidity if the process is still operating may not itself immediately result in a public health impact. In contrast, a filter operating outside the critical limit means that the filtration barrier was ineffective. Failure of the coagulation barrier is reportable as an event. In addition to CCPs and OCPs, IRC uses Quality Control Points (QCPs) to further control aspects of the treatment process or identify issues earlier. These QCPs could be controlling coagulation processes through pH monitoring which affects coagulation performance or monitoring of manganese throughout the process prior to the final treated water sample.

Other monitoring is also undertaken at the treatment plants – and this is either online continuous monitoring in SCADA or by operator grab samples. This additional monitoring is to provide information to the operators to aid their decision making. A single parameter may be measured at multiple points through the treatment process (e.g., turbidity is measured in raw water, after coagulation, and after filtration) each value provides information on the current challenge to the treatment process, and the effectiveness of each treatment step.

Other parameters are measured for information but could also indicate an issue if significantly outside the normal range (e.g., pH can have an impact on disinfection, but in most treatment plants there is typically no pH adjustment, so there is no immediate ability to control the pH). Where an operational value is identified that is above the relevant ADWG health guideline value, this will trigger an incident if the water represents the quality being provided to customers. For example, turbidity in the raw water is not reportable, but a turbidity > 0.5 NTU immediately post the filters is reportable as an incident if the water was not isolated from the customers. If, however, turbidity is demonstrated to be low after the filter, but increases due to precipitation of oxidised manganese (as indicated by laboratory testing), this is not reportable.

PROCEDURES

The existing operation and maintenance documentation are detailed in Appendix 9 DWQMP Document Register. IRC has worked to update all Operating Procedures and documentation (including operations and maintenance manuals) for WTP and schemes. Work instructions (formerly referred to as Standard Operating Procedures) are standardised documents which are issued to all WTPs and are also available to the operators via the IRC intranet.

All documents included in the document register are available to the operators through the IRC intranet.

The current practise for information distribution to the operators via regular toolbox meetings will continue.

RAW WATER MONITORING

MICROBIAL

Microbial samples are collected in the raw water of the bore schemes to continuously characterise their catchment category and monitor the microbial risk. Samples in Carmila and Nebo raw water are collected on a monthly basis.

RADIOLOGICAL

Radiological samples are taken periodically as identified in the risk assessment. Testing for gross alpha and gross beta is completed every two (2) years as summary parameters for radiological activity in the raw water. Should radioactivity gross alpha or beta activity exceed the ADWG screening value of 0.5 Bq/L, further investigation is necessary to identify the nature of the radioactivity.

PESTICIDES / HERBICIDES

Pesticide analysis is completed in the raw water of all schemes that use surface water as indicated in the risk assessment. Pesticide analysis is completed quarterly. Results above the levels indicated below, additional testing will be carried out to identify any potential impacts on the treatment plant treated water to determine if there is potential for an incident.

1. Terbuthiuron - A provisional HBGV of 200 µg/L.
2. Endrin aldehyde - A provisional HBGV of 1 µg/L.
3. 2-methylnaphthalene - A provisional HBGV of 10 µg/L.
4. Sum of aldrin and dieldrin – A provisional HBGV of 0.3 µg/L.

ALGAL

Algal monitoring is undertaken seasonally in all schemes that use a surface water source with higher sampling frequencies during the warmer months.

For the baseline monitoring total cell counting is undertaken.

Table 9 Frequency of raw water algal monitoring

	CARMILA	CLERMONT	DYSART	GLENDEN	MIDDLEMOUNT	MORANBAH	NEBO	ST LAWRENCE
Winter	NA	M	M	M	M	M	NA	M
Spring	NA	F	F	F	F	F	NA	F
Summer	NA	W	W	W	W	W	NA	W
Autumn	NA	F	F	F	F	F	NA	F

NA= Not applicable W=Weekly F= Fortnightly M= Monthly

Should the total cell count exceed Alert Level 1 in the Blue Green Algae (BGA) Management Plan, weekly sampling will be initiated. Should a toxin producing cyanobacteria be identified as the dominating species, toxin testing in the treated water is undertaken. Further actions and alert levels are described in the IRC BGA Management Plan.

OTHER

In certain circumstances, such as algae outbreaks, additional monitoring for Geosmin and Methylisoborneol (MIB) is undertaken. This may be triggered through customer complaints or as part of the BGA management plan.

As not all schemes require all types of raw water monitoring, detailed monitoring for each scheme can be found in the relevant scheme specific DWQMPs.

These samples are used to demonstrate that the risk assessment has appropriately considered the hazards and inform operators to changing water quality.

VERIFICATION MONITORING

Verification monitoring is undertaken to demonstrate the quality of drinking water that was supplied to customers was safe. The verification monitoring program includes the parameters regulated under the *Public Health Act 2005*, including *Escherichia coli* (*E.coli)* and fluoride, and chemical parameters identified through the risk assessment process as being of potential concern for particular supplies.

Verification monitoring samples are collected by treatment plant operators and transported to the external service laboratory (Mackay Regional Council Laboratory). For this reason, the actual sampling program is listed in the site specific DWQMPs as it relates to the samples taken by that operator.

The laboratory analyses the samples and sends results to:

- The relevant WTP operators and Supervisors
- Compliance and IMS Team
- Coordinator Water and Wastewater
- Manager Operations and Maintenance
- IRC Records for record keeping (in ECM)
- Contractor (as approved by the Manager Operations and Maintenance)

SAMPLE LOCATIONS

The verification sample sites are chosen to be representative for the general reticulation network, with additional consideration given to vulnerable customers.

The full verification monitoring locations and details are included in the site specific DWQMPs as they relate to the specific scheme.

MICROBIOLOGICAL

Escherichia coli (*E.coli)* monitoring is required at or above the minimum frequency stated in the *Public Health Regulation 2018*. Isaac Regional Council water service area has a total population of ~18,400, so the minimum requirement is one (1) sample per week and an additional two (2) per month, for a total of 76 samples. Instead, Council undertakes *E .coli* monitoring on a scheme basis shown in Table 10 and meets the minimum requirement as applied to each scheme for a total of 268 samples annually.

Table 10 Verification monitoring (*E.coli*) minimum sampling frequency

SCHEME	POPULATION (2023)	MINIMUM WEEKLY SAMPLES	MONTHLY SAMPLES	MINIMUM ANNUAL SAMPLES
CARMILA	333	0	1	12
CLERMONT	3031	1	0	52
DYSART	2991	1	0	52
GLENDEN	477	0	1	12
MIDDLEMOUNT	1841	1	0	52
MORANBAH	8735	1	1	64
NEBO	753	0	1	12
ST LAWRENCE	235	0	1	12

STANDARD WATER ANALYSIS (SWA)

The standard water analysis (SWA) is undertaken monthly by the Mackay Regional Council Laboratory. The following parameters are tested as part of the SWA:

- Conductivity
- pH
- Total Hardness
- Alkalinity
- Residual Alkalinity
- Total Dissolved Solids
- True Colour
- Turbidity
- Aluminium
- Boron
- Copper
- Sodium
- Potassium
- Calcium
- Magnesium
- Fluoride
- Nitrite
- Nitrate
- Sulphate
- Iron
- Manganese
- Zinc

CHLORATE AND DISINFECTION BYPRODUCTS

All systems are disinfected with chlorine and therefore have the potential for the formation of disinfection by products (DBPs). Additionally, when the risk for chlorate formation exists, monitoring is required.

Verification monitoring is undertaken for:

- Trihalomethanes (THMs)
- Oxyhalides (chlorates, chlorites and bromates)

In IRC, sodium hypochlorite, calcium hypochlorite and chlorine gas are used for disinfection and pre-oxidation purposes on a scheme-by-scheme basis. Glenden uses sodium hypochlorite; St. Lawrence, and Carmila use calcium hypochlorite and all other schemes use chlorine gas. While Carmila and St Lawrence are much lower risk than Glenden, chlorate is monitored in these three (3) schemes.

Oxyhalides and THMs monitoring are undertaken quarterly. IRC follows the ADWG guiding principle that pathogens are the greatest risks to consumers, so at no point is it acceptable to reduce or compromise disinfection performance even if chlorate is present.

FLUORIDE

The Moranbah WTP and Moranbah “Boby” Plant supply fluoride. Dosing is managed as a CCP. Verification samples are cross checked against Council's own testing as per the Fluoridation Code of Practice.

METALS

Treated water samples are taken from each WTP and tested quarterly for metals. The specific metals for which testing is performed are:

- Aluminium
- Arsenic
- Cadmium
- Chromium
- Copper
- Iron
- Lead
- Manganese
- Mercury
- Nickel
- Selenium
- Silver
- Tin
- Uranium
- Zinc

RESPONSE TO OUT OF SPECIFICATION RESULTS

When water quality results are received, these are compared to the regulated Water Quality Criteria, which include ADWG health guideline values and chlorate above 0.8 mg/L (as required by DRDMW).

If a parameter is detected that does not have an ADWG health guideline value, IRC follows the recommendations of Section 6.5 of the ADWG where the alternate national and international guidelines listed (in sequence) are consulted to establish an *interim guideline value*. Where a chemical is detected by IRC, and

- There is no health-related guideline value in any of these documents, no interim guideline value is established. Therefore, the parameter is not considered to pose a health risk, and *the detection is not reportable*.
- The detected concentration is below the interim guideline value in the first document to reference the chemical, *the detection is not reportable*.

If the detected concentration is above the interim guideline in the first document to reference the chemical, this is reportable as if it were part of the Water Quality Criteria.

IRC has a reference table with the guidelines as of October 2023 which is used as the starting reference. This document is to be updated as per Council document management procedures.

INCIDENT AND EMERGENCY RESPONSE

In the event that a drinking water quality incident occurs in IRC the management of the incidents attempts to take every reasonable step to limit the impact on customers whilst ensuring their health, keep customers and regulators informed about the nature and extent of the incident and to return to normal service as soon as practically possible and when it is safe to do so.

INCIDENT HIERARCHY

Council operates a three-level incident hierarchy.

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

The definitions for an incident and an emergency are detailed in Table 11.

Table 11 Management of Incidents and Emergencies

Alert Level	Description	Key management response(s)	Position(s) responsible
High: **Declared Disaster**	• Declared disaster. Examples include flood, drought, bushfire and terrorism.	Activate disaster management plan.	CEO, Director Water and Waste, Manager Operations and Maintenance Emergency Management Committee (EMC)
Medium: **Incidents and Emergencies**	• Exceedance of ADWG health guideline value • Outbreak of waterborne disease • Detection of a parameter with no water quality criteria that may have an adverse effect on public health. • An event not managed under the DWQMP and may have an adverse effect on public health. • Loss of water supply for >6 hours. • Cyber Security breach impacting water quality	Activate incident response plan. Ensure all control measures identified in the DWQMP are functioning effectively.	Director Water and Waste, Manager of Operations and Maintenance, Coordinator Water and Wastewater, Supervisors, Senior Operators, Compliance and IMS Team
Low: **Operational Action**	• Exceed adjustment limits. *Effectively managed by the water treatment operators undertaking operational actions in line with the DWQMP.*	Ensure all operational steps identified in the DWQMP are functioning effectively. Check and act upon operations and maintenance records and procedures. Take appropriate actions to rectify situation.	Supervisors Operators

INCIDENT MANAGEMENT

Incidents arising from operational monitoring through exceedances of OCP/CCP procedures are evaluated as seen in Figure 4 and escalated accordingly.

Incidents arising out of verification monitoring are compared against the ADWG regulatory requirements and the DWQMP. If either are exceeded, action needs to be taken according to the severity of the result.

If the results indicate an event beyond the system's ability of control, a parameter with no ADWG guideline value, but which may present a risk to the public health or a ADWG health guideline, the incident needs to be escalated. The treatment operation staff and the relevant treatment plant supervisor under the supervision of the Manager Operations and Maintenance advise the Compliance and IMS team that this needs to be reported to DRDMW as an incident. This is done immediately after becoming aware of the incident, though 'immediately' is practically defined as being within a reasonable timeframe to allow initial information to be collated for the phone call.

The written incident report, as required under the Information Notice for the Decision is prepared by the Compliance and IMS Team.

After an incident has been raised an investigation as per incident management procedure needs to occur.

Should an exceedance of an aesthetic guidelines be received, the result should be discussed within treatment staff and supervisors and investigated as required.

Incident reporting forms are accessed from the DRDMW website.

Council has developed procedures for operators to follow in specific emergency situations. The documentation for these can be found on the IRC intranet. A list of procedures is attached to the DWQMP as Appendix 9 DWQMP Document Register.

COMPLAINT PROCEDURE

Customer complaints are received at Council's offices during working hours. Afterhours enquiries and service complaints are diverted to after-hours duty officers. Complaints are recorded in TechOne and registered as a CRM for operational staff to investigate as required and take appropriate action.

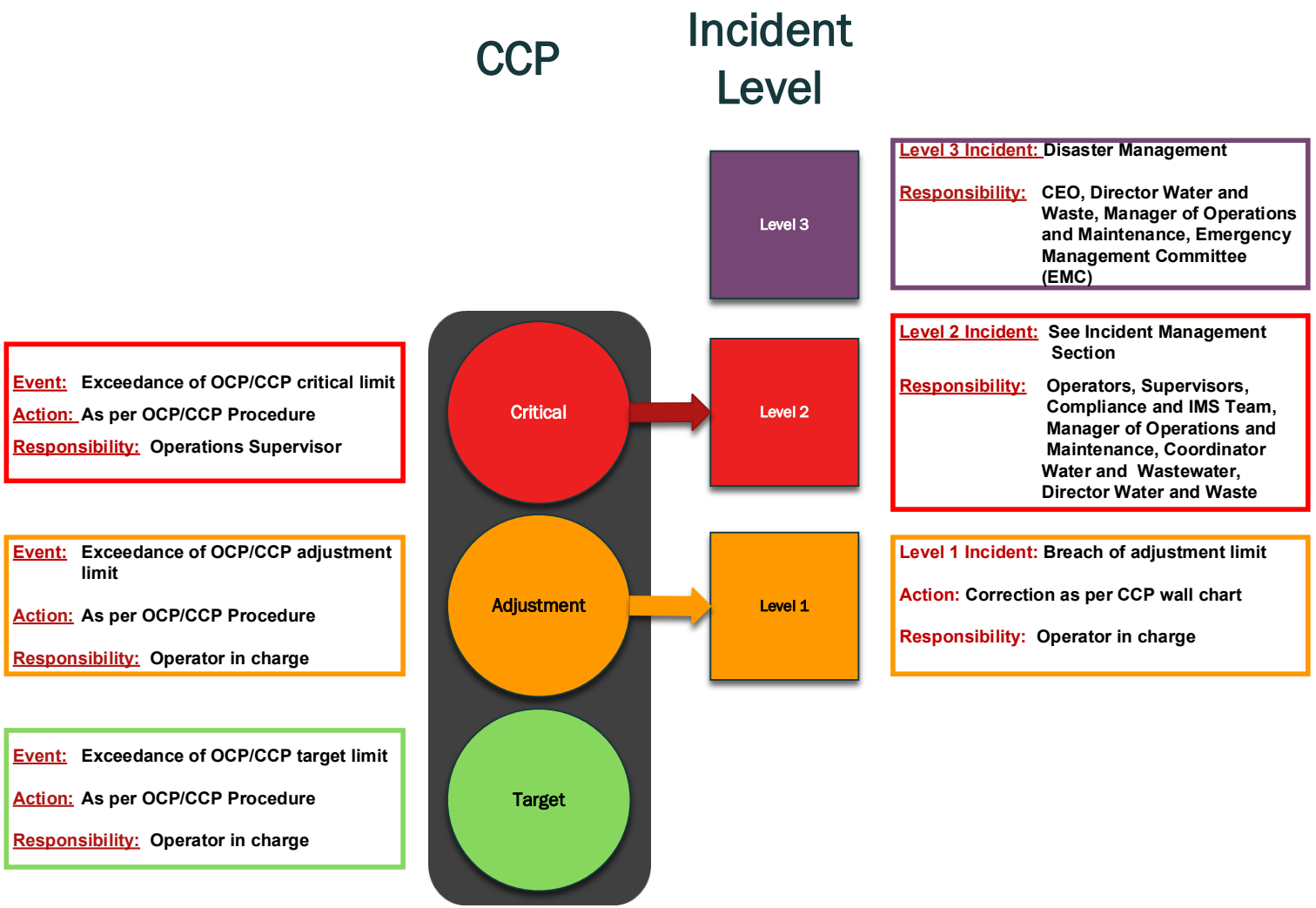


Figure 4 CCP to Incident Level Relation

Council has developed a non-compliance drinking water operational reporting process that outlines the process for reporting and investigating incidents. The current version of the procedure (as at 16/5/2024) is included in Figure 5.

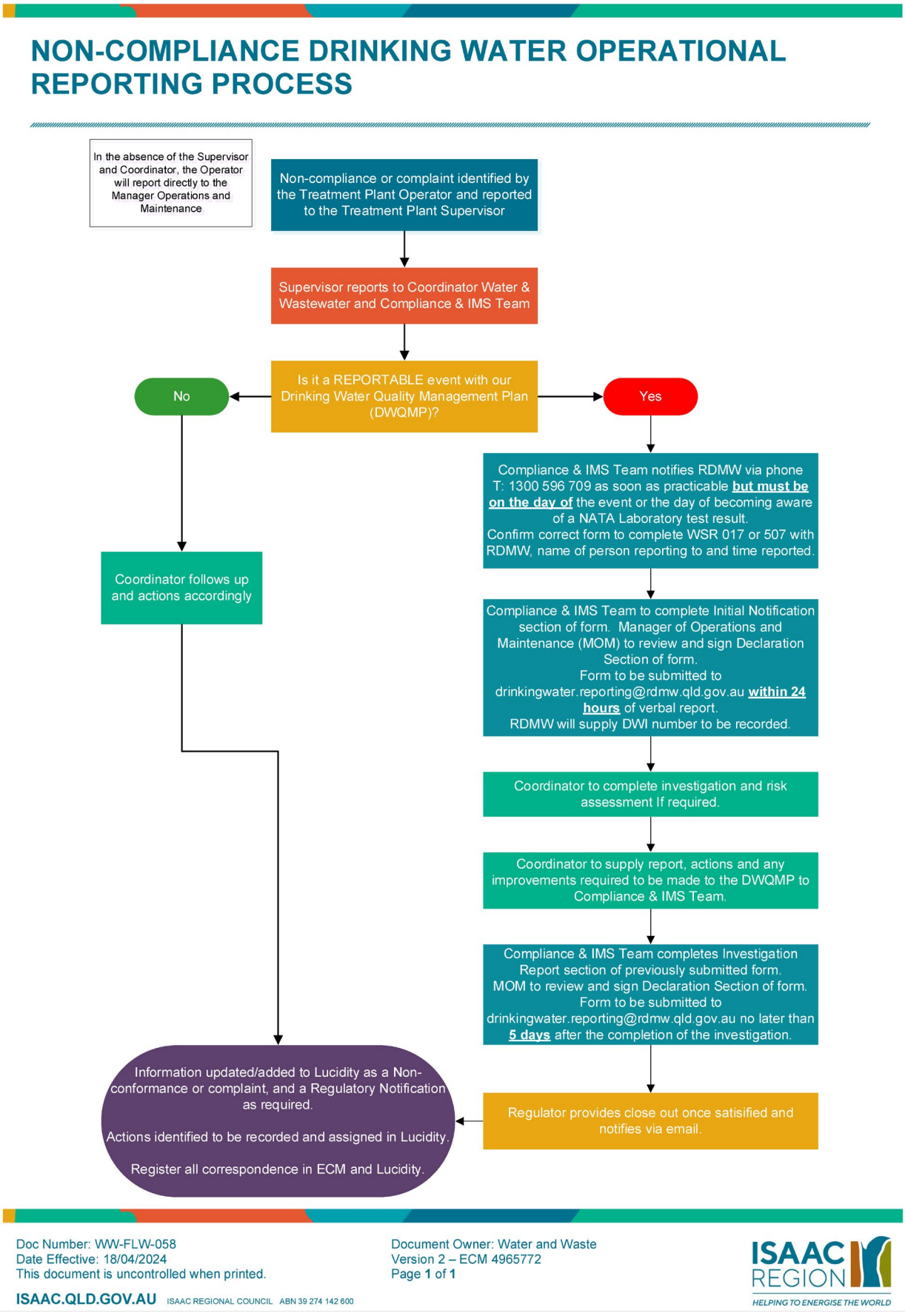
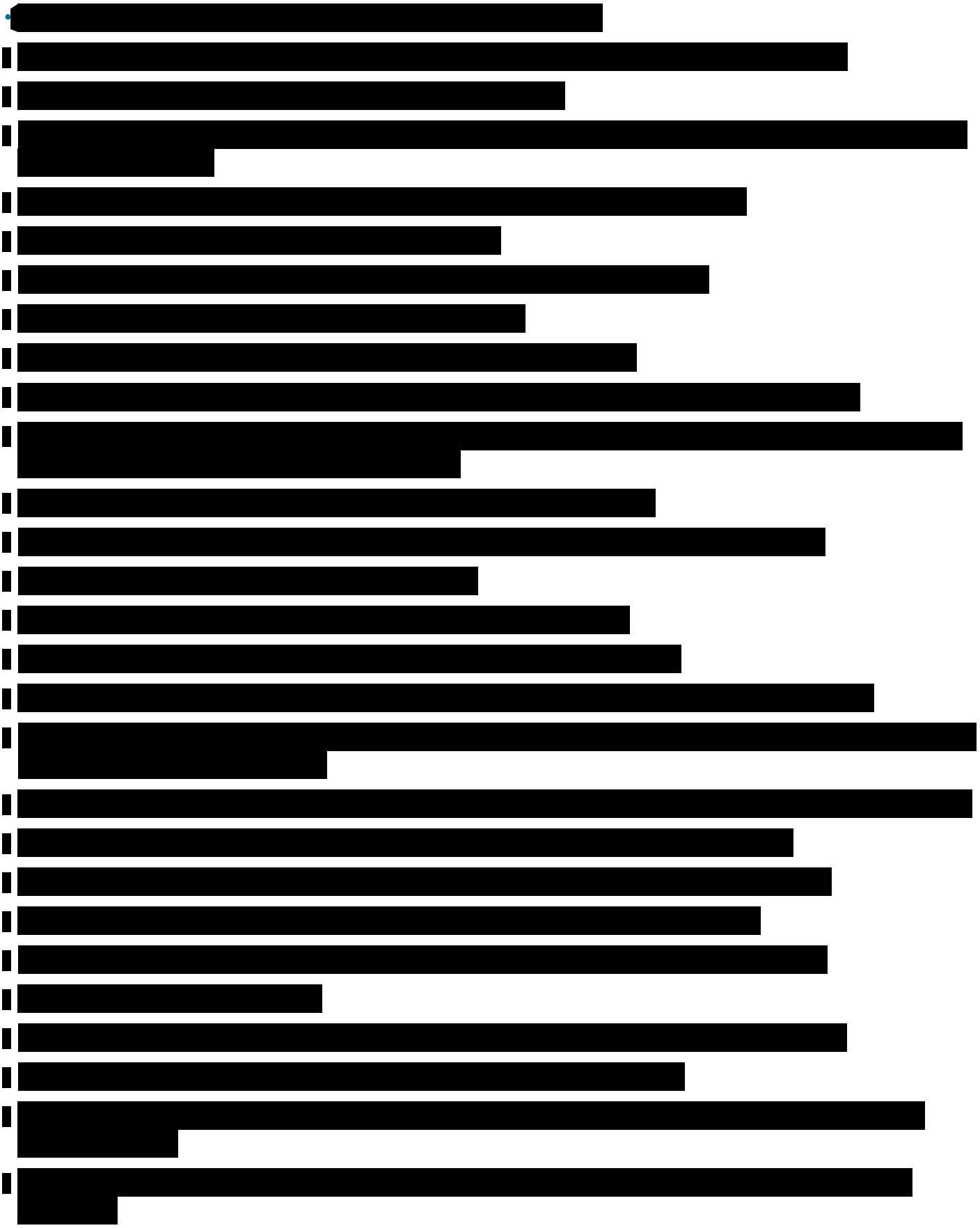


Figure 5 Incident reporting process

CYBERSECURITY

IRC's sites are managed through the following corporate and treatment plant specific systems.

CORPORATE SYSTEMS NETWORK



TREATMENT PLANT NETWORK

- [redacted]

EMPLOYEE AWARENESS AND TRAINING

Council ensures that each treatment plant is staffed by trained operators that are supported by appropriate procedures and processes. At times vacancies in operational roles constrain on the ability to cover all daily duties that may otherwise be expected of operators. To ensure that the treatment plants are appropriately operated Council utilises contract operators when vacancies remain unfilled for too long.

Additionally, Council is developing a succession planning strategy and continues training programs to keep operators skilled and processes running.

The recent DWQMP risk assessment was an opportunity to increase operator awareness, and Council intends to run training sessions when the new DWQMP is approved by the regulator.

COMMUNITY INVOLVEMENT AND AWARENESS

IRC operates multiple community engagement options through the Council website.

Website Water and Wastewater

Information provided typically includes:

- Water quality – How Isaac Regional Council manages the quality of water provided to the community.
- Water updates – Latest information on any schemes water quality where there are concerns.
- Water restrictions – Latest information on water restrictions in the different IRC areas
- Water charges – Latest information on the current water charges across IRC
- Water sources and water sewerage service areas – Mapping showing where water comes from and the areas serviced by IRC's water and sewage network.
- MiWater – Free water consumption tool

MiWater uses a smart meter system to generate data on water usage, leaks and provides this information to the community through their website and an app. The app allows customers to visualise their usage and encourages water saving, check for leaks or review current restriction levels.

IRC also actively maintains a Facebook page which is used to provide up to date information on water topics from restrictions, outages, charges etc.

DOCUMENTATION AND REPORTING

The operational monitoring results are entered into spreadsheet records and the files on the share drive are accessible to all IRC operational water and wastewater staff. The spreadsheets are transferred into IRC's Information Management System at the end of the monitoring period where they are locked and archived. The files can still be accessed by IRC staff for future reference. PDF copies of external test reports are sent directly to the relevant WTP Operators, Supervisor, Coordinator, Manager Operations and Maintenance, Water and Wastewater Engineer, Compliance and IMS Team, and IRC Records staff for filing through ECM.

IRC documents generally have a publish date on the cover to distinguish the document from the previous issues, if applicable. The IRC Electronic Data Management System (EDMS) application has version control. Documents are filed by subject and are made available to all IRC staff depending on sensitivity. Archiving is carried out by IRC Records staff in accordance with the State Archives Retention and Disposal Scheme.

IRC's document control procedure is available to operators via Council's intranet and listed in Appendix 9.

RESEARCH AND DEVELOPMENT

VALIDATION OF PROCESSES

Treatment processes have been validated as part of the risk assessment. For example, chlorine contact times have been calculated, and this is used to ensure that the minimum chlorine concentration ensures appropriate disinfection of the water supply prior to distribution to customers.

Chlorine contact time (*CT*) is calculated using the formula below. The calculation determines the worst-case chlorine contact time at the lowest critical chlorine concentration. Where this exceeds 15 mg.min/L, it is considered acceptable.

$CT = C \times t$

where:

C is the residual chlorine concentration in mg/L measured at, or downstream of, the point at which the contact time is achieved.

t is the time, measured in minutes, that the water is in contact with chlorine

t is calculated as:

V / f x Baffle Factor

Where:

V is the minimum volume of the contact tank in L (e.g., if the full volume is 100,000L but the tank level cycles between 50% - 90% of full volume (lowest level = 50%), V = 50,000).

f is the maximum flow rate leaving the contact tank in L/min.

Baffle factor defaults to 0.1 for separated and/or common inlet outlet tanks, 1 for plug flow, e.g., pipes.

When health-based targets need to be quantified for all processes, filtered water turbidity will be used to assess filter performance and determine the applicable log reduction values.

AUDIT AND REVIEW

The DWQMP is reviewed in accordance with the Act, at the minimum frequency stated in the Information Notice for the Decision. To date, this has required a review every two (2) years.

The DWQMP is also audited in accordance with the Act, at the minimum frequency stated in the Information Notice for the Decision. To date, this has required an external audit to be completed every four (4) years.

RISK MANAGEMENT IMPROVEMENT PROGRAM

The Risk Management Improvement Program (RMIP) has been developed through the risk assessment process. Where any mitigated risk is identified as high or extreme, an improvement item is required.

Improvements may be scheduled immediately, in the short term, or long term. Items are prioritised based on a combination of need and funding availability.

In terms of funding, items that have been identified as immediate will be actioned as soon as practical and will be funded from pre-existing budget items. Where funding for a project is not currently available, this may require a Council resolution or future budget consideration. In such cases, the commitment is that the item will be progressed for budget approval. If the Councillors approve the item, it can be progressed, however, if it is not approved, an alternative option will need to be developed for implementation.

Long term items are typically items that are going to take a number of years to progress – for example, where a treatment plant requires significant upgrades/ replacement, this is a multi-year project that is unlikely to be significantly progressed during the review cycle of the current DWQMP. These items are included to inform Councillors of the future need so that consideration can be given to identifying appropriate funding pathways. An example of this is when health-based targets are eventually regulated by DRDMW, this will potentially trigger significant treatment upgrades to water treatment plants. However, this is unlikely to occur until this is a requirement as this is a significant cost impost to IRC.

Table 12 IRC Risk Management Improvement Program

Site	Ref	Treatment Stage	Primary Hazard	Hazardous Event	Mitigated Risk	Improvement Action Required - Immediate	Improvement Action Required ~ 2 years	Improvement Action Required - Long term
Carmila	CAR1	Raw Water Abstraction	Protozoa (Category 4)	Normal operation	High 15	Turbidity meter	SCADA upgrades on all treatment plants over 5 years	UV disinfection required over time.
Carmila	CAR2	Raw water bypass	Protozoa (Category 4)	Opening the bypass valve allowing raw water into the clear water tank	Extreme 25	Disconnect or decommission the raw water bypass.		
Carmila	CAR3	Disinfection - calcium hypochlorite	Bacteria/Virus	Underdose of chlorine - high chemical demand resulting in undisinfected water to the community	Medium 6		Investigate post filtration disinfection into clearwater tank	
Carmila	CAR4	Disinfection - calcium hypochlorite	Chlorate	Breakdown of bulk solution	Medium 6		Investigate post filtration disinfection into clearwater tank	
Carmila	CAR8	Chemical Dosing - Aluminium Sulphate	Protozoa (Category 4)	Underdose Alum/ ineffective coagulation	High 15	Turbidity meter	SCADA upgrades on all treatment plants over 5 years	UV disinfection required over time.
Carmila	CAR9	Chemical Dosing - Polyelectrolyte	Protozoa (Category 4)	Underdose	High 10	Turbidity meter	SCADA upgrades on all treatment plants over 5 years	UV disinfection required over time.
Carmila	CAR11	Clarification	Protozoa (Category 4)	Poor coagulation resulting in filter breakthrough	High 15	Investigate flow paced dosing and implement as achievable, Turbidity meter	SCADA upgrades on all treatment plants over 5 years	
Carmila	CAR12	Filtration - Media filtration	Protozoa (Category 4)	Filter breakthrough	High 15	Turbidity meter	SCADA upgrades on all treatment plants over 5 years	UV disinfection required over time.
Carmila	CAR13	Filtration - Media filtration	Protozoa (Category 4)	Poor backwash	High 10	investigate ability to filter to waste on ripening and implement if achievable.		
Clermont	CLM1	Raw Water Abstraction	Protozoa (Category 4)	Normal operation	High 10	Review BGA management plan (By Dec 2024)		UV disinfection required over time.
Clermont	CLM2	Chlorine oxidation	DBPs	Overdose of chlorine	Low 3	Will require automation to reinstate.		
Clermont	CLM3	Chlorine oxidation	Manganese surface water	Underdose of chlorine	Low 3	Will require automation to reinstate.		
Clermont	CLM4	Chemical Dosing - Powdered Activated Carbon (PAC)	Cyanobacterial toxins	Underdose of PAC	Low 3	Review of BGA management plan (by Dec 2024)		
Clermont	CLM5	Chemical Dosing - Potassium permanganate	Manganese - dosing	Overdose of potassium permanganate	Medium 9	Reinstate online analysers, require flow switch for potassium permanganate to allow dosing into 2 ML raw water tank.		
Clermont	CLM7	Supernatant return and storage	Protozoa (Category 4)	Challenge plant by recycling protozoa	High 10	Exclude animals from accessing sludge lagoon.		UV disinfection required over time.

Site	Ref	Treatment Stage	Primary Hazard	Hazardous Event	Mitigated Risk	Improvement Action Required - Immediate	Improvement Action Required ~ 2 years	Improvement Action Required - Long term
Clermont	CLM8	Chemical Dosing - Sodium hydroxide	Protozoa (Category 4)	Overdose of caustic impacting coagulation (or disinfection)	High 10		Online pH analyser and operational control.	
Clermont	CLM9	Chemical Dosing - Sodium hydroxide	Protozoa (Category 4)	Underdose of caustic impacting coagulation	High 10		Online pH analyser and operational control.	
Clermont	CLM11	Chemical Dosing - Aluminium Chlorohydrate (ACH)	Protozoa (Category 4)	Underdose coagulant/ poor coagulation	High 10		Online pH analyser and operational control.	
Clermont	CLM15	Clarification	Protozoa (Category 4)	Ineffective coagulation resulting in breakthrough through filters	High 10		Online pH analyser and operational control.	
Clermont	CLM16	Bypass of flash mixer	Protozoa (Category 4)	Poor clarification process	High 10	Lock out valves		
Clermont	CLM17	Bypass of clarification process	Protozoa (Category 4)	No clarification - no floc formation prior to filtration	High 10	Lock out valves		
Clermont	CLM20	Chemical Dosing - PAC	Cyanobacterial toxins	Underdose of PAC	Medium 6	Review of BGA management plan (by Dec 2024)		
Clermont	CLM21	Filtration - Media filtration	Protozoa (Category 4)	Breakthrough through filters	High 15	Investigate online turbidity meters for individual filters.	Investigate improving control of filters, including automated backwashing	UV disinfection required over time.
Clermont	CLM22	Filtration - Media filtration	Protozoa (Category 4)	Poor backwash	High 15	Investigate online turbidity meters for filters.	Investigate improving control of filters, including automated backwashing	
Glenden	GLN1	Raw water sourcing	Allocation failure (Glenden)	No contract with providers to secure allocations	Medium 8	Ensure there is a process to engage with stakeholders to ensure access to Glencore Dam water.		
Glenden	GLN2	Raw Water Abstraction	Protozoa (Category 4)	Normal operation	High 10	Improve recording of online turbidity meter readings to confirm correct plant operation. Review BGA Management Plan (by Dec 2024)		SCADA upgrades on all treatment plants over 5 years, followed by upgrading plant automation.
Glenden	GLN3	Supernatant return and storage	Protozoa (Category 4)	Recycling of protozoan pathogens	High 10	Improve recording of online turbidity meter readings to confirm correct plant operation.		SCADA upgrades on all treatment plants over 5 years, followed by upgrading plant automation.
Glenden	GLN7	Chemical Dosing - Aluminium Sulphate	Protozoa (Category 4)	Underdose Alum/ ineffective coagulation	High 10	Improve recording of online turbidity meter readings to confirm correct plant operation.		SCADA upgrades on all treatment plants over 5 years, followed by upgrading plant automation.
Glenden	GLN10	Clarification	Protozoa (Category 4)	Failure of clarification process	High 10	Improve recording of online turbidity meter readings to confirm correct plant operation.		

Site	Ref	Treatment Stage	Primary Hazard	Hazardous Event	Mitigated Risk	Improvement Action Required - Immediate	Improvement Action Required ~ 2 years	Improvement Action Required - Long term
Glenden	GLN11	Filtration - Media filtration	Protozoa (Category 4)	Breakthrough through filters	High 10	Filter valves require repair or replacement.	Investigate plant shutdown on combined filtered water turbidity.	UV disinfection required over time.
Glenden	GLN12	Filtration - Media filtration	Protozoa (Category 4)	Poor backwash	High 10	Filter valves require repair or replacement.	Investigate plant shutdown on combined filtered water turbidity.	UV disinfection required over time.
Glenden	GLN14	Disinfection - sodium hypochlorite	Bacteria/Virus	Underdose of chlorine	Medium 6		Investigate an online chlorine meter with alarms.	
Middlemount	MMT1	Raw Water Abstraction	Protozoa (Category 4)	Normal operation	High 10	Consider options for immediate improvements in CT and implement appropriate solution noting that when water temperature is cold, adequate disinfection is not achieved.		
Middlemount	MMT3	Chemical Dosing - Potassium permanganate	Manganese surface water	Underdose of potassium permanganate	Medium 9		Consider alternative options such as raw water tank for permanganate oxidation.	
Middlemount	MMT4	Aeration	Cyanobacteria (Other schemes)	Failure of aeration	Medium 6	Review of BGA management plan (by Dec 2024)		
Middlemount	MMT5	Supernatant return and storage	Protozoa (Category 4)	Recycling of protozoan pathogens	High 15	Identify the control philosophy for the waste stream and reroute so that clarifier sludge cannot directly enter Turkeys Nest.		
Middlemount	MMT8	Chemical Dosing - PAC	Cyanobacterial toxins (Middlemount)	Underdose PAC	Medium 9	Review of BGA management plan (by Dec 2024)		
Middlemount	MMT12	Chemical Dosing - Aluminium Chlorohydrate (ACH)	Protozoa (Category 4)	Underdose of coagulant	High 10	Ensure that pump failure and or low flow for chemical dosing sends alarms to operators	Consider a turbidity meter for clarified water.	
Middlemount	MMT15	Clarification	Protozoa (Category 4)	Poor coagulation (can include underdosing polymer)	High 10	Ensure that pump failure and or low flow for chemical dosing sends alarms to operators	Consider a turbidity meter for clarified water.	
Middlemount	MMT16	Filtration - Media filtration	Protozoa (Category 4)	Filter breakthrough	High 10	Alarms to be checked to ensure operators are made aware at 0.2 NTU. May not shut down on exceeding critical limit.		Consider need for UV disinfection as second protozoan barrier.
Middlemount	MMT17	Filtration - Media filtration	Protozoa (Category 4)	Poor backwash	High 10	Investigate feasibility of automated backwash and implement if possible.		
Middlemount	MMT18	Disinfection - chlorine gas	Chlorine	Overdose	Medium 9	Investigate shutdown on high chlorine		
Middlemount	MMT20	Disinfection - chlorine gas	Bacteria/Virus	Underdose	Extreme 20	Consider options for immediate improvements in CT and implement appropriate solution noting that when water temperature is cold, adequate disinfection is not achieved.		
Dysart	DYS1	Raw Water Abstraction	Protozoa (Category 4)	Normal operation	Medium 6	Review of BGA management plan (by Dec 2024)		

Site	Ref	Treatment Stage	Primary Hazard	Hazardous Event	Mitigated Risk	Improvement Action Required - Immediate	Improvement Action Required ~ 2 years	Improvement Action Required - Long term
Dysart	DYS2	Supernatant return	Protozoa (Category 4)	Recirculation of protozoa to head of plant	Medium 6	Develop procedure to isolate supernatant return if raw water tank is offline. Is possible to discharge to sewer.		
Dysart	DYS3	Chemical Dosing - Aluminium Chlorohydrate (ACH)	Protozoa (Category 4)	Underdose coagulant/ poor coagulation	Medium 6	Consider alarms for DAF turbidity meter		
Dysart	DYS10	Chemical Dosing - Potassium permanganate	Manganese - dosing	Overdose of potassium permanganate	Medium 6	Have been incidents where dosing continued after plant has shut down. May be siphoning.		
Dysart	DYS12	Chemical Dosing -PAC	Taste and odour	Underdose PAC	Medium 8	Repair PAC scales to ensure chemical usage can be monitored.		
Dysart	DYS14	Chemical Dosing - Aluminium Chlorohydrate (ACH)	Protozoa (Category 4)	Underdose ACH	High 10	Ensure alarms to operators at 5 NTU or shuts down plant. Reinstate all meters and other alarms.		
Dysart	DYS16	Clarification	Protozoa (Category 4)	Failure of clarification process	High 10	Single dosing pump, Flow paced		
Dysart	DYS17	Chemical Dosing - Chlorine gas	Chlorine	Overdose chlorine	Low 3	Plant can operate without chlorine - investigate control philosophy. Replace dosing lines with chemical compatible materials		
Dysart	DYS19	Filtration - Media filtration	Protozoa (Category 4)	Filter breakthrough	High 10	Service meters and reinstate shutdowns		Undertake assessment of HBT performance and discuss with regulator the credit applied to the GAC filters.
Dysart	DYS20	Filtration - Media filtration	Protozoa (Category 4)	Poor backwash	High 10	Service meters and reinstate shutdowns		
Dysart	DYS24	Disinfection - chlorine gas	Bacteria/Virus	Underdose	High 10	Chlorine meter to be reinstated, ideally recirculating in clearwater tank.		
Moranbah WTP	MBHW1	Raw Water Abstraction	Protozoa (Category 4)	Normal operation	Medium 6	Review of BGA management plan (by Dec 2024)		
Moranbah WTP	MBHW8	Chemical Dosing - Aluminium Chlorohydrate (ACH)	Protozoa (Category 4)	Underdose of coagulant	High 10		Consider online meters for clarified water	
Moranbah WTP	MBHW11	Chemical Dosing - Polyelectrolyte	Turbidity	Overdose polymer impacting filter run times and backwashing	Low 2		Consider online meters for clarified water	
Moranbah WTP	MBHW12	Clarification	Protozoa (Category 4)	Poor clarification process	High 10		Investigate automating sludge bleed timers to manage boilups.	
Moranbah WTP	MBHW13	Filtration - Media filtration	Protozoa (Category 4)	Filter breakthrough	High 10	Actuators positioners and valve sets to be serviced/inspected/ repaired	Individual turbidity meters to be investigated and installed as budget becomes available.	Consider need for UV disinfection as second protozoan barrier.

Site	Ref	Treatment Stage	Primary Hazard	Hazardous Event	Mitigated Risk	Improvement Action Required - Immediate	Improvement Action Required ~ 2 years	Improvement Action Required - Long term
Moranbah WTP	MBHW14	Filtration - Media filtration	Protozoa (Category 4)	Poor backwash	High 10	Investigate improvements to actuators to allow for improved automation of processes.	When online meter is installed, set up to take filter offline on elevated turbidity.	
Moranbah WTP	MBHW16	Disinfection - chlorine gas	Bacteria/Virus	Underdose of chlorine	High 10	Install tapping into Clear water to allow installation of online chlorine meter	Install chlorine meter on clear water tank as funds are available	
Moranbah WTP	MBHW17	Disinfection - chlorine gas	Chlorine	Overdose of chlorine	Medium 9	Install tapping into Clear water to allow installation of online chlorine meter	Install chlorine meter on clear water tank as funds are available	
Moranbah WTP	MBHW22	Disinfection - chlorine gas	Bacteria/Virus	Bypassing chlorine contact tank leading to inadequate C.t.	High 10	Investigate necessity of bypass, review options for improved management of risk (e.g., air gapping, installing a second valve, etc.)		
Moranbah "Boby"	MBHB1	Raw Water Abstraction	Protozoa (Category 4)	Normal operation	Medium 6	Review of BGA management plan (by Dec 2024)		
Moranbah "Boby"	MBHB8	Chemical Dosing - Aluminium Chlorohydrate (ACH)	Aluminium - coagulant	Overdose of coagulant	Medium 6		Consider online meters for clarified water	
Moranbah "Boby"	MBHB11	Clarification	Protozoa (Category 4)	Poor clarification process	High 10	Investigate improved automation of processes.	Consider online pH meter for clarified water	
Moranbah "Boby"	MBHB12	Filtration - Media filtration	Protozoa (Category 4)	Filter breakthrough	Extreme 20	Currently refurbishing filters at Boby treatment plant including filter replacement. Require online turbidity meters - include tappings for these meters in current project - need to investigate whether pairs of filters can be individual meters, or combined meter on pair.	Online turbidity meters for filtered water	UV disinfection required over time.
Moranbah "Boby"	MBHB13	Filtration - Media filtration	Protozoa (Category 4)	Poor backwash	High 10	Currently refurbishing filters at Boby treatment plant including filter replacement. Require online turbidity meters - include tappings for these meters in current project - need to investigate whether pairs of filters can be individual meters, or combined meter on pair.	Online turbidity meters for filtered water	UV disinfection required over time.
Moranbah "Boby"	MBHB15	Disinfection - chlorine gas	Bacteria/Virus	Underdose of chlorine	High 10	Install tapping into Clear water to allow installation of online chlorine meter	Install chlorine meter on clear water tank as funds are available	
Moranbah "Boby"	MBHB19	Disinfection - chlorine gas	Bacteria/Virus	Bypassing chlorine contact tank leading to inadequate C.t.	High 10	Investigate necessity of valve, consider air gapping or removing infrastructure		
Nebo	NBO5	Filtration - Media filtration	Protozoa (Nebo Bores)	Poor backwash	Medium 6	Initiate backwash on turbidity trigger.		
Nebo	NBO9	Ultraviolet Disinfection	Protozoa (Nebo Bores)	Underdose of UV	Medium 6	Confirm that UV changes over on failure to meet dose.		
St Lawrence	STL1	Raw Water Abstraction	Protozoa (Category 4)	Normal operation	High 15	Consider ability to install turbidity meter and plant shut down on poor water quality.	SCADA upgrades on all treatment plants over 5 years	UV disinfection required over time.

Site	Ref	Treatment Stage	Primary Hazard	Hazardous Event	Mitigated Risk	Improvement Action Required - Immediate	Improvement Action Required ~ 2 years	Improvement Action Required - Long term
						Review BGA Management Plan (by Dec 2024)		
St Lawrence	STL4	Chemical Dosing - Potassium permanganate	Manganese - dosing	Overdose of potassium permanganate	Medium 9	Planning for ~0.5 ML raw water tank to smooth out variability in raw water		
St Lawrence	STL5	Chemical Dosing - Potassium permanganate	Manganese surface water	Underdose of potassium permanganate	Medium 9	Planning for ~0.5 ML raw water tank to smooth out variability in raw water		
St Lawrence	STL7	Chemical Dosing - Soda Ash	Protozoa (Category 4)	Underdose of soda ash resulting in coagulation failure	High 15	Consider ability to install turbidity meter and plant shut down on poor water quality		
St Lawrence	STL8	Chemical Dosing - Aluminium Chlorohydrate (ACH)	Protozoa (Category 4)	Underdose of coagulant	High 15	Consider ability to install turbidity meter and plant shut down on poor water quality		
St Lawrence	STL13	Filtration - Media filtration	Protozoa (Category 4)	Filter breakthrough	High 15	Consider ability to install turbidity meter and plant shut down on poor water quality	SCADA upgrades on all treatment plants over 5 years	UV disinfection required over time.
St Lawrence	STL14	Filtration - Media filtration	Protozoa (Category 4)	Poor backwash	High 15	Consider ability to install turbidity meter and plant shut down on poor water quality. Manual diversion of ripening water to waste.	SCADA upgrades on all treatment plants over 5 years	UV disinfection required over time.
St Lawrence	STL15	Disinfection - calcium hypochlorite	Bacteria/Virus	Failure of chlorine dosing resulting in undisinfected water to community	Medium 6		Chlorine meter to be installed, ideally recirculating in clearwater tank, low critical limit to shut plant down.	
Reticulation and whole of system	WOS8	Water Towers, Nebo, Clermont, Glenden Moranbah	Bacteria/Virus	Ingress through roof or hatches/ edges of roof and wall.	Medium 6		Consider use of drone inspections to increase frequency.	
Reticulation and whole of system	WOS9	Cyber	Cyber security	Cyber intrusion into system impacting treatment	High 10	Have commenced upgrades on SCADA.	SCADA upgrades on all treatment plants over 5 years	SCADA upgrades on all treatment plants over 5 years
Reticulation and whole of system	WOS11	Whole of system	Operator error	Operator error resulting in poor water quality to customers	High 10	Maintain training for all operational staff.	Develop succession plans, consider developing recruitment strategies, continue to develop more procedures to document operations.	

APPENDIX 1

CARMILA DRINKING WATER QUALITY MANAGEMENT PLAN

Carmila Drinking Water Quality Management Plan

Presented by: Water and Waste Directorate
Current as at: 22 August 2024

ISAAC REGION
HELPING TO ENERGISE THE WORLD

ISAAC.QLD.GOV.AU ISAAC REGIONAL COUNCIL ABN 39 274 142 600
P 1300 472 227 F 07 4941 8666 A PO Box 97 Moranbah QLD 4744
isaacregionalcouncil isaacregionalcouncil Isaacrcouncil

TABLE OF CONTENTS

OBJECTIVE

This plan details how Isaac Regional Council ensures the safety of drinking water for the Carmila community.

SCOPE

This plan is the Site-specific Drinking Water Quality Management Plan that together with the Overarching Drinking Water Quality Management Plan makes up the complete plan for Carmila.

DEFINITIONS

TERM / ACRONYM	MEANING
ADWG	Australian Drinking Water Guidelines
CCP	Critical Control Point
DRDMW	Department of Regional Development Manufacturing and Water
DWQMP	Drinking Water Quality Management Plan
DWQMP Guideline	Guideline for the preparation, review and audit of drinking water quality management plans.
IRC	Isaac Regional Council
OCP	Operational Control Point
NTU	Nephelometric turbidity units
PHA	*Public Health Act 2005*
QH	Queensland Health – regulator of public health – may take lead on managing incidents
Regulator	In the context of the DWQMP, the Regulator is DRDMW
RMIP	Risk Management Improvement Program
SCADA	Supervisory Control and Data Acquisition
SPID	Service Provider Identification Number
WSSRA	*Water Supply (Safety and Reliability) Act 2008*
WTP	Water Treatment Plant

REFERENCES

ID	NAME
	DWQMP Document Register

INTRODUCTION

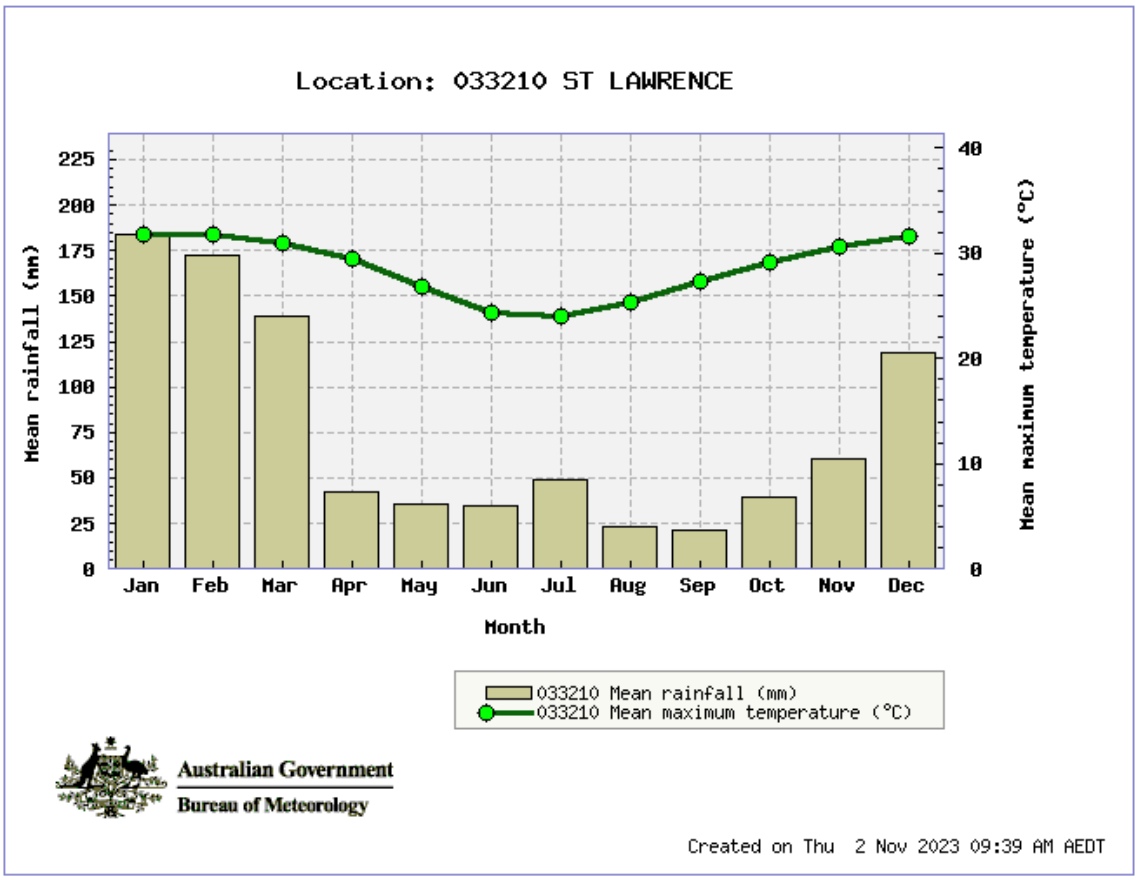
This site specific DWQMP documents the specific details of the Carmila drinking water scheme. It is intended to be an operational document that informs the operational staff.

OVERVIEW OF THE SUPPLY SCHEME

Carmila is a rural town and coastal locality of ~333 people. Due to the coastal position, Carmila is a holiday destination which means significant increases in the population during the local holiday season (winter). The town is located ~80 km south of Mackay and ~140km east of Moranbah. Drinking water for the community is sourced from two (2) river bores which are situated on the Carmila Creek.

CLIMATE

The Carmila climate is characterised by a subtropical semi-arid climate with coastal influence. Rainfall in St Lawrence, Figure 6, which is closest to the catchment and averages ~912 mm/year with more rain in summer than winter. The mean maximum temperature is 28.6°C, with a mean max. above 30°C between November to February.



Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
Mean rainfall (mm) for years 2004 to 2023	183.9	172.6	138.6	42.1	35.7	35.1	48.6	23.0	21.6	39.8	60.3	118.5	912.2	19
Statistics	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**	**Years**
Mean maximum temperature (°C) for years 2004 to 2023	31.8	31.8	31.0	29.4	26.8	24.4	24.1	25.3	27.3	29.2	30.6	31.6	28.6	19

Figure 6 Rainfall and Temperature Data for St Lawrence. (Carmila specific data unavailable)

CATCHMENT CATEGORISATION

Carmila Creek is a watercourse that receives inflow from several upstream creeks, including Prendergast Creek and McCaffery Creek. The upstream catchment is open, with livestock grazing and irrigated agriculture. There are expected to be septic systems in the catchment, and there is no restriction on water recreational activities.

With the location of the bores, and their design as bank filtration bores the catchment has been assessed as Category 4.

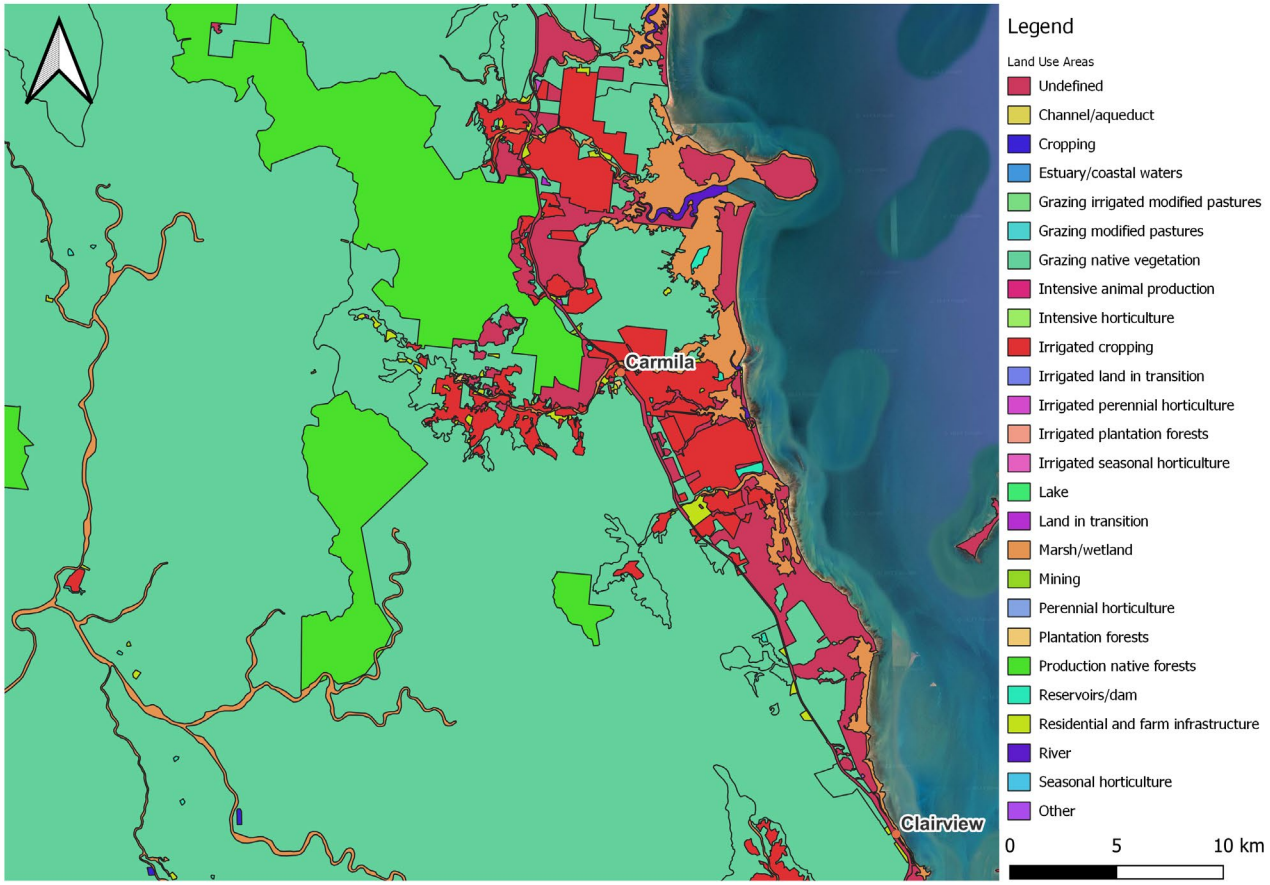


Figure 7 Land Use Map Carmila

TREATMENT PROCESS

OVERALL – CAPACITY

The Carmila WTP is a conventional treatment plant with a capacity of 3 L/s (220 kL/day). Typical production is 50 kL per day.

RAW WATER SOURCE

The Carmila Water Scheme sources its raw water from two (2) bores located on the bank of Carmila Creek, [redacted]

They are known to be shallow and relying on river level to supply raw water to the bore wells via bank filtration. The bores were refurbished in 2017 after they were damaged through flooding. The bore heads are now protected by rock armouring.

The bore water quality tends to change following rainfall events. These events can lead to higher levels of iron and manganese in the raw water; at times total manganese is up to 4 mg/L and iron levels are above 2mg/L. Turbidity is correlated with the iron and manganese levels; however, treated water conductivity does not vary, indicating that the bores are not simply responding to changes in river flow, and some microbial attenuation is probable.

BORE OPERATION

The two bores are operated as duty/standby, as selected by the operator. Bore 2 is considered to have the higher quality water, although both are subject to iron and manganese. The bore capacity is nominally 2.6 L/s but typically the flow rate is only 0.5 – 1.3 L/s. Flows into the treatment plant are monitored using a magnetic flow meter.

PLANT BYPASS

There is a raw water bypass that diverts raw water around all treatment processes to the clearwater tank. This is valved shut and is not used.

PRIMARY DISINFECTION AND OXIDATION

Calcium hypochlorite (2%) is manually batched, supplied from one tank and dosed (single dosing pump) to the raw water prior to the flash mixer. This is the only dosing point for chlorine, so this is the primary disinfection step. The chlorine is also used as an oxidant to remove iron and manganese.

COAGULANT

Aluminium sulphate (10%) is manually batched and dosed (single dosing pump) into the raw water prior to the flash mixer.

FLOCCULATION - CLARIFICATION

Polymer is added into the flash mixer chamber using a single dosing pump. Water then enters the upflow clarifier. Sludge is removed to the sludge drying beds based on time, or by manual operator intervention. Clarified water flows to the glass media filter.

FILTRATION

The filter operates on water level; when the water level reaches the set point the filtered water outlet valve opens. The media filter then continues to operate for approximately four (4) hours before initiating a backwash sequence.

The clarifier and filter receive full drain out at least once per week and twice per week if it is found that additional cleaning is required.

WASTEWATER AND SLUDGE HANDLING

Sludge from the clarifier and backwash from the glass media filter enter sludge drying beds. No water is returned to the process from drying beds.

CLEARWATER TANK AND TREATED WATER RESERVOIR

Treated water from the filters is pumped by duty/standby pumps to the clearwater tank (16 kL). From the clearwater tank, the water is pumped to the treated water reservoir using two high lift pumps (duty/standby). From this reservoir, the water is distributed to the residents of Carmila through a gravity-based reticulation network.

RETICULATION NETWORK

The reticulation pipes were installed in 1971 and the total length is approximately 4.2 km. The range of pipe ages can be seen in Table 14. The reticulation mains are constructed of Asbestos Cement (AC) with a combination of 100 mm and 150 mm diameters. Part of the reticulation pipes are constructed of uPVC and Poly with diameters of 20 mm or 100 mm. See Table 1.

The introduction of Smart Meters has also been implemented to gain better insights into water usage, losses, and to detect leaks and mains breaks more effectively.

Table 13 Pipe materials and length - Carmila

MATERIAL	DIAMETER [DN]	LENGTH [M]
Asbestos Cement	100	2307
	150	793
Poly	20	346
	100	73

MATERIAL	DIAMETER [DN]	LENGTH [M]
uPVC	100	224
Unknown	0	470
	100	96

Table 14 Range of pipe age - Carmila

PIPE AGE	1-10 YEARS	11-20 YEARS	21-30 YEARS	31-40 YEARS	41-50 YEARS	51-60 YEARS	61-70 YEARS
Percentage of Network	6%	0%	25%	2%	0%	67%	0%

Carmila Scheme

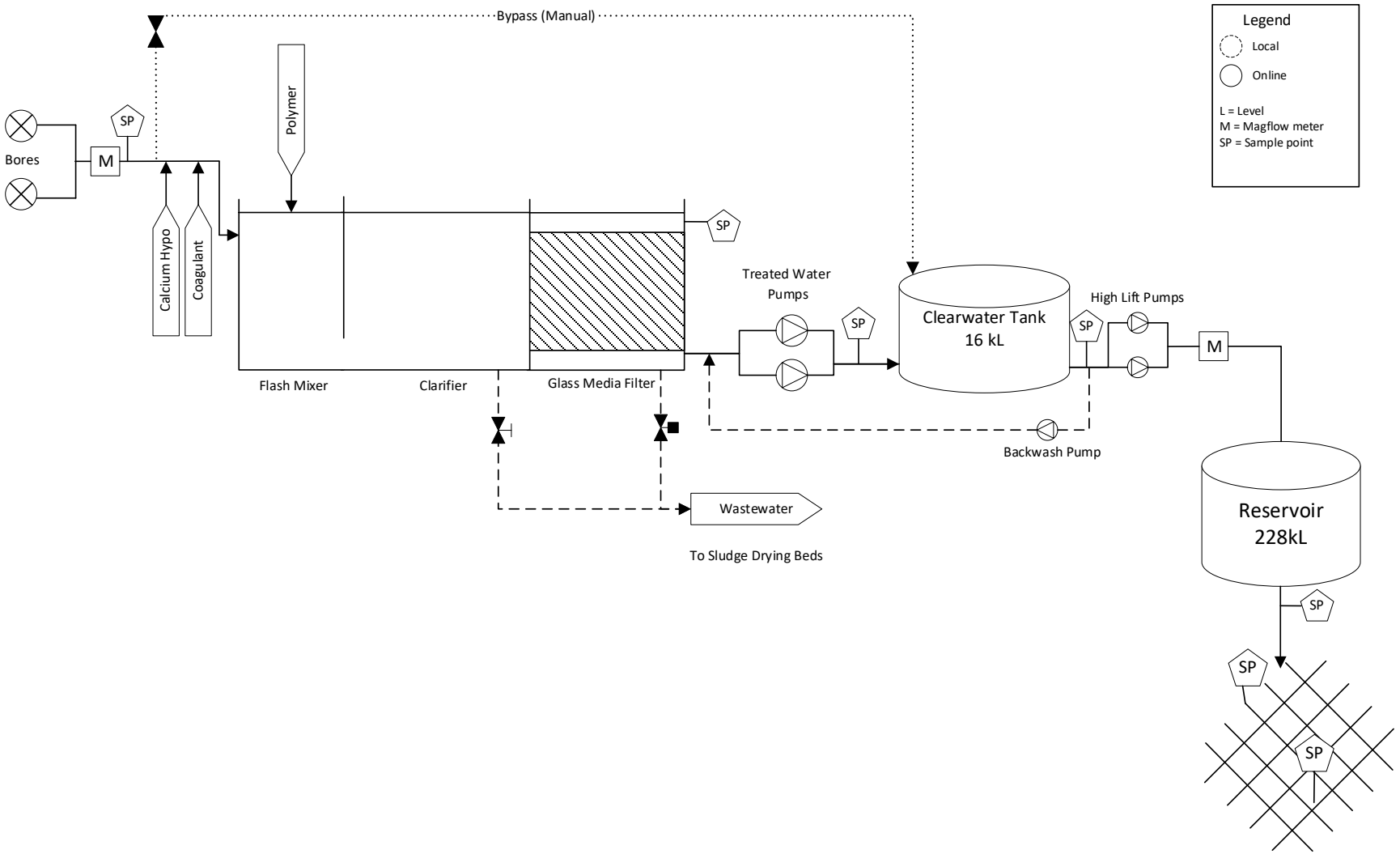


Figure 8 Carmila catchment to tap and Treatment Plant Schematic

WATER QUALITY

RAW WATER

Raw water issues in Carmila often include high manganese and iron content with occasionally high colour and turbidity which supports the catchment characterisation (Cat 4) above as the bores have strong surface water influence.

Table 15 Carmila raw water monitoring (2020-2023)

	UNIT	# OF SAMPLES	MIN.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Alkalinity	mg/L $CaCO_3$	444	0	60	174	109	36
Hardness	mg/L $CaCO_3$	330	50	58	110	93	21
pH		1284	6.8	7.1	7.4	7.3	0.14
Sol. Iron	mg/L	101	0	0.4	4.3	1.7	1.2
Sol. Manganese	mg/L	85	0.002	0.018	1.6	0.42	0.57
Tot. Aluminium	mg/L	44	0	0.02	0.18	0.09	0.042
Tot. Iron	mg/L	1117	0	0.06	2.3	1	0.78
Tot. Manganese	mg/L	1096	0.002	0.04	2	0.83	0.68
True Colour	HU	959	0	0	30	7.1	17
Turbidity	NTU	1260	0	0.1	3	1.3	6.9
UVA_{254}	Abs	124	0.014	0.034	0.29	0.13	0.11

TREATED WATER

Operational

In the past, issues in Carmila have mostly been related to high iron and manganese out of which particularly manganese with an ADWG health guideline is a concern.

Table 16 Summary treated water monitoring (2017-2023)

	UNIT	# OF SAMPLES	MIN.	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Alkalinity	mg/L $CaCO_3$	440	0	190	55	135	97	27
Free Chlorine	mg/L	1317	0.2	5.4	1.1	2.8	1.8	0.58
Hardness	mg/L $CaCO_3$	299	35	120	70	105	92	13
pH		1307	7	8.2	7.3	7.8	7.7	0.17
Tot. Aluminium	mg/L	527	0	0.58	0.007	0.17	0.063	0.059
Tot. Iron	mg/L	592	0	0.99	0	0.04	0.012	0.049
Tot. Manganese	mg/L	604	-0.009	0.65	0	0.02	0.014	0.063
True Colour	mg/L	993	0	7.6	0	1	0.67	1.2
Turbidity	mg/L	1266	0	7.6	0.08	0.4	0.23	0.62
UVA_{254}	HU	91	0.007	0.33	0.011	0.25	0.052	0.063

Verification

Verification monitoring data for Carmila is presented in Table 17. Chemical parameters with values under the limit of detection are presented as 0.5xLOD. Microbiological results under LOD are presented as 0.

Table 17 Summary of treated water verification monitoring (2014-2023)

	# OF SAMPLES	MIN.	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Alkalinity - Residual (mq/L)	44	-0.039	0.05	0	0.05	0.041	0.021
Alkalinity (mg/L)	129	54	279	75	115	95	20
Aluminium (µg/L)	154	2.5	104	20	62	39	13
Ammonia (mg/L)	53	0.0025	0.053	0.0025	0.034	0.0072	0.0088
Arsenic (µg/L)	19	0.25	1.3	0.25	1.3	0.51	0.31
Barium (µg/L)	4	18	28	18	28	23	4.7
Beryllium (µg/L)	4	0.25	0.5	0.25	0.5	0.31	0.13
Boron (µg/L)	4	15	18	15	18	16	1.4
Bromate (µg/L)	117	2.5	25	5	25	7.7	5
Bromate^ (µg/L)	2	25	25	25	25	25	0
Cadmium (µg/L)	13	0.05	0.5	0.05	0.5	0.085	0.12
Calcium (mg/L)	90	6.7	34	18	32	24	4.2
Chlorate (µg/L)	115	10	2290	25	1426	374	413
Chlorate^ (µg/L)	2	567	657	567	657	612	63
Chlorite (µg/L)	116	2.5	25	5	25	7.8	5
Chlorite^ (µg/L)	2	25	25	25	25	25	0
Chromium (µg/L)	13	0.05	0.5	0.05	0.5	0.092	0.13
Cobalt (Total) (µg/L)	1	0.1	0.1	0.1	0.1	0.1	0
Colour - True (TCU)	127	0.5	31	0.5	7.6	1.9	3.3
Copper (µg/L)	13	0.5	11	0.5	11	3.6	3.4
Dissolved Oxygen (% Sat)	97	46	105	51	100	82	15
E. coli (cfu/100mL)	2	0.5	0.5	0.5	0.5	0.5	0
E. coli (MPN/100mL)	933	0	2420	0	0	2.6	79
Fluoride (mg/L)	106	0.005	0.15	0.05	0.14	0.09	0.035
Formaldehyde (mg/L)	41	0.05	0.05	0.05	0.05	0.05	0
Free Chlorine Residual (Client tested) (mg/L)	743	0.06	3.8	0.2	2.6	1.2	0.82
Free Chlorine Residual (mg/L)	154	0.01	3.1	0.28	2	0.96	0.58
Gross alpha (Bq/L)	14	0.025	0.025	0.025	0.025	0.025	0
Gross beta (Bq/L)	14	0.05	0.05	0.05	0.05	0.05	0
Hardness - Temporary (mg/L)	115	54	279	73	114	94	21
Hardness (mg/L)	124	29	170	80	133	103	17
Iodide (µg/L)	8	1.7	10	1.7	10	9	2.9
Iron (µg/L)	158	1	38	1	7.7	3	4.2
Lead (µg/L)	18	0.25	0.5	0.25	0.5	0.29	0.096

	# OF SAMPLES	MIN.	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Magnesium (mg/L)	90	2.4	14	7.5	13	10	1.8
Manganese (µg/L)	158	0.5	40	0.5	3.5	1.6	4.7
Mercury (µg/L)	19	0.025	0.5	0.025	0.5	0.24	0.096
Molybdenum (µg/L)	4	0.5	0.5	0.5	0.5	0.5	0
Nickel (µg/L)	13	0.25	0.5	0.25	0.5	0.27	0.069
Nitrate (mg/L)	126	0.0075	1.2	0.0075	0.63	0.23	0.2
Nitrite (mg/L)	126	0.002	0.2	0.002	0.2	0.063	0.091
pH (Client tested) (pH unit)	755	6.9	9.1	7	7.8	7.6	0.27
pH (pH unit)	222	6.9	8.2	7.3	8.1	7.6	0.25
Residual Alkalinity (mg/L)	61	0.05	0.05	0.05	0.05	0.05	0
Selenium (µg/L)	19	0.5	2.5	0.5	2.5	2.1	0.84
Silver (µg/L)	4	0.05	0.5	0.05	0.5	0.16	0.23
Sulphide (mg/L)	35	0.0025	0.04	0.0025	0.017	0.0042	0.0066
Tin (µg/L)	4	0.5	1.4	0.5	1.4	0.96	0.39
Total Dissolved Solids (mg/L)	465	97	752	156	254	202	43
Trihalomethanes (Total) (µg/L)	166	13	201	23	130	70	35
Trihalomethanes (Total)^ (µg/L)	50	5.1	134	7.5	68	34	22
Turbidity (Client tested) (NTU)	322	0.05	1	0.05	0.4	0.17	0.14
Turbidity (NTU)	187	0.05	23	0.05	2.5	0.9	2.1
Uranium (µg/L)	4	0.25	0.5	0.25	0.5	0.31	0.13
Zinc (µg/L)	13	0.5	12	0.5	12	4.4	3.8

CUSTOMER COMPLAINTS

Customer complaints received in 2016/17 and 2023 described discoloured, dirty or smelly water.

Table 18 Summary of customer complaints - Carmila

Year	No of Water Quality Complaints	Main Reasons for Complaints	Likely Sources / Causes of Problems	Resolution of Problem
2016-17	2	Dirty water	No information recorded to indicate the cause of complaint. The water quality data are generally in line with the ADWG.	Localised and mains flushing performed. WTP processes reviewed.
2023	1	Smelly water		Found to be on the customer's side of the water meter and was due to a dirty tap filter.

INCIDENTS

There were six incidents reported to the regulator in the recent years (2017-2023) in Carmila. There were no incidents reported between 2017 and 2020. Most incidents reported the detection of *E.coli* in 2021/22. There were two (2) CCP breaches which were detected late and reported to the regulator in bulk with some others during the FY 21/22. In Carmila both incidents related to low chlorine in the network.

Table 19 Summary of incidents reported to the regulator (2017-2023)

INCIDENT DATE	REFERENCE	LOCATION	PARAMETER	DESCRIPTION OF EVENT	IMPROVEMENT
09/10/2023	NA	Treated water	Endrin Aldehyde	Endrin Aldehyde was measured at 0.131 µg/L in the treated water.	Ongoing investigation
13/04/2022	DWI-486-22-09568	Network	*E.coli* (1 MPN/100 ml)	*E.coli* was detected in the network. A visual inspection identified the potential for ingress into the treated water reservoir through gaps between the wall and roof.	Treated water reservoir cleaned and repairs taken to eliminate ingress potential. Capital improvements planned for online analyser for chlorine measurement with automated shutdown. Scouring of the network pipelines was completed in 2023.
23/02/2022	DWI-486-22-09484	Treated water	*E.coli* (5.3 MPN/100 ml)	The calcium hypochlorite pump failed. Visual inspection indicated the treated water reservoir hatch could be blown open during strong winds with the potential for ingress of contaminants.	Replaced failed chlorine dosing pump with spare. Purchase a new spare. The hatch was secured.
21/12/2021	DWI-486-21-09395	Network	*E.coli* (6 MPN/100 ml)	There was a decrease in the use of drinking water which increased storage time and reduced the free chlorine below the recommended minimum threshold to maintain an effective disinfection residual.	Maintain a residual of > 0.2 mg/L in the network and reduce storage volumes for holiday periods.
15/12/2021	*NA*	*Network*	*Free chlorine (0.1 mg/L)*	*A network sample in Carmila measured less than 0.2 mg/L free chlorine, the lower limit nominated within IRC DWQMP.*	*Internal reporting* *Configuration of automated breach emails*
8/12/2021	*NA*	*Network*	*Free chlorine (0.11 mg/L)*	*A network sample in Carmila measured less than 0.2 mg/L free chlorine, the lower limit nominated within IRC DWQMP.*	*Internal reporting* *Configuration of automated breach emails*
03/03/2021	DWI-486-22-09679	Network	Chlorate (0.897 mg/L)	Noted by the Regulator (in 2022-23 annual report)	
2/11/2022	DWI-486-22-09932	Treated water	Chlorate (1.54 mg/L)	Chlorate in the treated water was measured at 1.54 mg/L against a QH limit of 0.8 mg/L.	Investigate change in procedures where each treatment plant manages their own chemical stock levels rather than central bulk ordering

RISK ASSESSMENT

SCHEME MITIGATED RISK ASSESSMENT

Table 20 Mitigated Risk Assessment - Carmila

Ref	Treatment Stage	Primary Hazard	Other hazards managed by barrier	Hazardous Event	Unmitigated Risk	Control Measures in place	Comment	Mitigated Consequence	Mitigated Likelihood	Mitigated Risk	Uncertainty	Improvement Action Required - Immediate	Improvement Action Required ~ 2 years	Improvement Action Required - Long term
CAR1	Raw Water Abstraction	Protozoa (Category 4)	Bacteria and virus, turbidity, iron and manganese.	Normal operation	Extreme 25	Conventional treatment	Cat 4, bores are for bank filtration, Bore 2 pumps at 1.6 L/s, but Bore 1 only able to produce 0.8 L/s.	Catastrophic	Possible	High 15	Estimate	Turbidity meter	SCADA upgrades on all treatment plants over 5 years	UV disinfection required over time.
CAR2	Raw water bypass	Protozoa (Category 4)	bacteria and viruses, iron and manganese	Opening the bypass valve allowing raw water into the clear water tank	Extreme 25	Manual valve shut	This is not used, and the risk is assessed if it was.	Catastrophic	Almost Certain	Extreme 25	Unreliable	Disconnect or decommission the raw water bypass.		
CAR3	Disinfection - calcium hypochlorite	Bacteria/Virus	Iron and manganese	Underdose of chlorine - high chemical demand resulting in undisinfected water to the community	Extreme 25	Dose rate based on operator experience. Greater than 200 mg.min/L in treated water reservoir with typically > 4 days supply, daily monitoring.	Dose rate is high to allow for chlorine demand. Change in bore flow rate not compensated by dosing Manually batched single dosing pump	Catastrophic	Rare	Medium 6	Confident		Investigate post filtration disinfection into clearwater tank	
CAR4	Disinfection - calcium hypochlorite	Chlorate		Breakdown of bulk solution	Medium 9	Continual dosing with single dosing pump. Operator sets dosing level.	Change in bore flow rate not compensated by dosing Manually batched single dosing pump	Moderate	Unlikely	Medium 6	Reliable		Investigate post filtration disinfection into clearwater tank	
CAR5	Chemical Dosing - Calcium hypochlorite	Chlorine		Overdose of chlorine	High 12	Continual dosing with single dosing pump. Operator sets dosing level.	Change in bore flow rate not compensated by dosing manually batched single dosing	Moderate	Unlikely	Medium 6	Reliable			
CAR6	Chlorine contact and oxidation	Manganese bores	Iron	Insufficient contact time to oxidise Mn	Medium 9	Predose chlorine	There is a low contact time before filtration	Moderate	Possible	Medium 9	Reliable			
CAR7	Chemical Dosing - Aluminium Sulphate	Aluminium - coagulant		Overdose of alum	Medium 6	Continual dosing with single dosing pump. Operator sets dosing level.	Change in bore flow rate not compensated by dosing Manually batched Single dosing pump	Minor	Possible	Medium 6	Estimate			
CAR8	Chemical Dosing - Aluminium Sulphate	Protozoa (Category 4)		Underdose Alum/ ineffective coagulation	Extreme 25	Continual dosing with single dosing pump. Operator sets dosing level.	Change in bore flow rate not compensated by dosing Manually batched Single dosing pump	Catastrophic	Possible	High 15	Estimate	Turbidity meter	SCADA upgrades on all treatment plants over 5 years	UV disinfection required over time.
CAR9	Chemical Dosing - Polyelectrolyte	Protozoa (Category 4)	Turbidity	Underdose	Extreme 25	Visual inspection of dosing	Acrylamide based polymer. Single dosing pump	Catastrophic	Unlikely	High 10	Estimate	Turbidity meter	SCADA upgrades on all treatment plants over 5 years	UV disinfection required over time.
CAR10	Chemical Dosing - Polyelectrolyte	Monomer		Overdose	Medium 6	Visual inspection of dosing	Acrylamide based polymer. Single dosing pump	Moderate	Unlikely	Medium 6	Reliable			
CAR11	Clarification	Protozoa (Category 4)	Turbidity, Mn and Fe	Poor coagulation resulting in filter breakthrough	Extreme 25	Manual dose rate set, Jar testing as required.	Flash mixer, bore 1 flow rate reduces over time but fixed paced dosing of chemicals.	Catastrophic	Possible	High 15	Estimate	Investigate flow paced dosing and implement as achievable, Turbidity meter	SCADA upgrades on all treatment plants over 5 years	
CAR12	Filtration - Media filtration	Protozoa (Category 4)	Turbidity	Filter breakthrough	Extreme 25	Daily monitoring of turbidity	No turbidity meter, level controlled	Catastrophic	Possible	High 15	Estimate	Turbidity meter	SCADA upgrades on all treatment plants over 5 years	UV disinfection required over time.
CAR13	Filtration - Media filtration	Protozoa (Category 4)		Poor backwash	Extreme 25	Automatic backwash triggered by filter run time	No turbidity meter, level controlled	Catastrophic	Unlikely	High 10	Estimate	Investigate ability to filter to waste on ripening and implement if achievable.		

OPERATIONAL MONITORING

Operational monitoring is undertaken to assess and confirm that individual barriers and preventive strategies for controlling hazards are functioning properly and effectively. Frequencies are based on the risk of each parameter to significantly change. As Carmila WTP is not operational every day of the year, the monitoring frequency “daily” is considered as “daily when plant is operational”. For an informed comparison of samples taken and operational days the daily log sheet records whether the plant was operational.

Table 21 Operational Monitoring - Carmila

PARAMETER	RAW WATER	CLARIFIED WATER	FILTERED WATER	TREATED WATER	CT WATER	NETWORK WATER
Alkalinity	Weekly			Weekly		
Aluminium		Weekly		Weekly		
pH	Daily			Daily	2 x Weekly	Weekly
Free Chlorine				Daily	2 x Weekly	Weekly
Temperature	Daily			Daily		Weekly
Tot. Hardness	Weekly			Weekly		
Tot. Iron	Daily			Weekly		Weekly
Tot. Manganese	Daily			Weekly		Weekly
True Colour	Daily			Daily		Weekly
Turbidity	Daily	Daily	Daily	Daily	2 x Weekly	Weekly
Sol. UVA_{254}	Weekly			Weekly		

- Response to out of specification results for relevant parameters are managed through CCPs and OCPs
- Operators check the calibration of online instruments with the results from their lab/benchtop analysis as part of the operational monitoring.

CRITICAL CONTROL POINTS

CRITICAL CONTROL POINTS

CRITICAL CONTROL POINTS

The critical control points for the scheme were identified in the risk assessment process, and include:

- Disinfection – treated water free chlorine
- Filtration – filtered water turbidity

The CCP procedures are included in the following pages. These are presented as traffic lights and identify the location, monitoring, performance, and validation of the process. The traffic lights are aligned to SCADA where the low and high limits match the adjustment level and (as appropriate) the high high and low low alarms match the critical limit.

OPERATIONAL CONTROL POINTS

Carmila WTP has three operational control points for the following process.

- Oxidation – chlorinated water total manganese
- Coagulation – clarified water turbidity
- Chlorination – chlorinated water free chlorine

An OCP exceedance is generally not reportable to the regulator except if it is an event that requires reporting. Incident reporting to the regulator is based on CCPs or exceedances of ADWG health guidelines.

QUALITY CONTROL POINTS

Carmila WTP has one quality control points for the following processes.

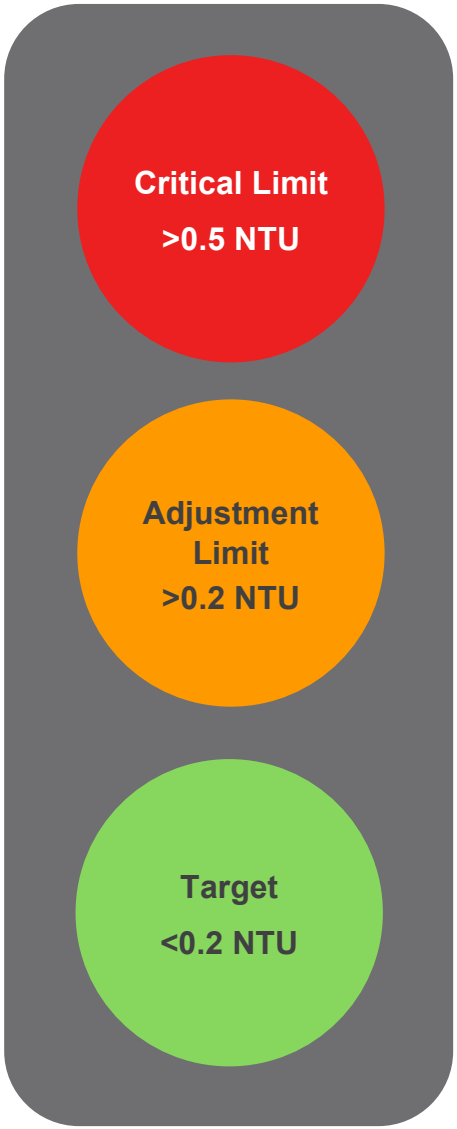
- Coagulation – clarified water aluminium

The CCPs, OCPs and QCPs can be found below.

CRITICAL CONTROL PROCEDURE - CARMILA

Filtration

What is measured	Where is it measured	When is it measured	What is the control point	What are the hazards	Record Keeping
Turbidity	Grab sample post filtration	Daily	Filtration	Protozoa, turbidity	Operator Log Sheets



- Confirm result with grab samples
- Breach of CCP is continued supply of water to customers above the Critical Limit
- Operator to contact Supervisor/Coordinator or Manager
- Supervisor/Coordinator or Manager to inform Compliance & IMS team on [redacted]
- If operator unable to contact chain of command, report directly to Compliance & IMS Team
- Compliance & IMS to contact DRDMW on 1300 596 709 as required
- If health advice required, Compliance & IMS or Manager to contact Mackay PHU on 4885 5800

- Check turbidity meter, clean and calibrate to confirm results
- Check raw water turbidity for changes since last dose rate change.
- Check clarified water pH and turbidity and adjust dosing as necessary
- Check coagulation dosing system, drop test to validate dose rate, jar test if required.
- Backwash filters if coagulation is effective
- Shut down plant if filtered water turbidity still above Adjustment Limit after multiple backwashes.
- Rectify any dosing issues and escalate to supervisor/coordinator

- When attending plant, inspect process for any visual signs of process failure
- Test the water as per DWQMP
- Record results
- Check raw water turbidity regularly and adjust coaguation dose rates as required (jar test as required)
- Complete routine cleaning and calibration of online meters
- Check SCADA trend for normal operation
- Ensure backwashes are undertaken and effective

CRITICAL CONTROL PROCEDURE - CARMILA

Disinfection

What is measured	Where is it measured	When is it measured	What is the control point	What are the hazards	Record Keeping
Free Chlorine	Post treated water reservoir	Twice per week	Disinfection	Bacteria, viruses, chlorine	Operator Log Sheets

Critical Limit
>3.0 mg/L
<1.0 mg/L

- Confirm result with grab samples
- Operator to contact Supervisor/Coordinator or Manager
- If low chlorine, Supervisor/Coordinator and/or Manager to ensure sufficient chlorine contact time for disinfection with actual operational parameters.
- If water with < 15 mg.min/L is supplied to customers this is a reportable event
- If chlorine is > 5 mg/L this is reportable as an incident
- Supervisor/Coordinator or Manager to inform Compliance & IMS Team on [redacted]
- If operator unable to contact chain of command, report directly to Compliance & IMS Team
- Compliance & IMS to contact DRDMW on 1300 596 709 as required

Adjustment Limit
>2.5 mg/L
<1.5 mg/L

- Confirm result with grab sample
- Check handheld chlorine meter, clean and calibrate to confirm result
- Check dosing system for any issues or air locks
- Rectify any dosing issues
- Take WTP offline or reduce plant flow as required

Target
>1.5 mg/L
<2.5 mg/L

- When attending plant, inspect process for any visual signs of process failure
- Test the water as per DWQMP
- Record results
- Check chemical stock and make new CaOCl solution as required
- Complete routine calibrations of online instruments to ensure accuracy

Validation: The CWT has a volume of 16 kL, a minimum operational volume of 65 % and is unbaffled (Baffle factor 0.1). The maximum flow of the plant is 3 L/s. The minimum chlorine residual of 1.0 mg/L out of the CWT achieves 5.8mg.min/L CT. All water is pumped to the treated water reservoir which has a volume of 228 kL and a minimum operational volume of 70% and is unbaffled. A maximum flow out of the reservoir of 1.3 L/s (assumed from current demand with peaking factor of 2.3) adding another 63.8 mg.min/ CT.

Table 22 Operational Control Points - Carmila WTP

PROCESS	PARAMETER	WHERE IS IT MEASURED	HAZARD	WHEN IS IT MEASURED	TARGET	ALERT LIMIT	ACTION IF ADJUSTMENT LIMIT EXCEEDED	ADJUSTMENT LIMIT	ACTION IF ALERT LIMIT EXCEEDED	REPORTING
Oxidation	Total Manganese	Treated water	Manganese	Weekly	<0.1 mg/L	>0.1 mg/L	Confirm manganese reading, Check soluble manganese in treated water and free chlorine, Check clarifier total and soluble manganese, Investigate adjustment of dosing rate	>0.5 mg/L	Confirm manganese reading, Divert the clarifier water, Shutdown if uncertain of cause, Check treated water free chlorine, Check network total and soluble manganese, free chlorine and colour, Operator to notify Supervisor/Coordinator/Manager Consider treated water reservoir drain down and network flushing,	Operator to contact Supervisor/Coordinator and/or Manager as total manganese in treated water > 0.5 mg/L is a reportable event. Assess closely related reportables such as effective disinfection, treated water colour and network turbidity.
Coagulation	Turbidity	Clarified Water	Protozoa, Turbidity	Daily	< 1 NTU	> 2 NTU	Confirm turbidity reading, Check raw water turbidity, Check coagulation dosing system, drop test to validate dose rate.	> 5 NTU	Confirm turbidity reading, Check dosing system, Adjust dosing rate, Operator to notify Supervisor/Coordinator/Manager	Operator to contact Supervisor/Coordinator and/or Manager as failure to coagulate effectively is a reportable event
Chlorination	Free chlorine	Treated water	Bacteria and viruses	Daily	>1.5 mg/L and <3.0 mg/L	<1.5 mg/L and >3.0 mg/L	Confirm free chlorine reading, Check chlorine dosing, Adjust dosing rate and monitor	< 1 mg/L Or > 3.5 mg/L	Confirm free chlorine reading, Check chlorine dosing, Adjust dosing rate and monitor, Operator to notify Supervisor/Coordinator/Manager	Internal reporting, Further see Disinfection CCP. Confirm CT is adequate
OCP EXCEEDANCES ARE GENERALLY NOT REPORTABLE TO THE REGULATOR EXCEPT IF IT IS AN EVENT OR REPORTABLE HEALTH LIMIT										

Table 243 Quality Control Points

PROCESS	PARAMETER	WHERE IS IT MEASURED?	HAZARD	WHEN IS IT MEASURED	TARGET	ACTION IF TARGET LIMIT EXCEEDED	REPORTING
Coagulation	Aluminium	Clarified water	Aluminium	Weekly	<0.1 mg/L	Confirm Aluminium reading, Check coagulation performance and adjust dosing if required.	Operator to notify Supervisor/Coordinator/Manager
QCP EXCEEDANCES ARE GENERALLY NOT REPORTABLE TO THE REGULATOR EXCEPT IF THIS RESULTS IN ADWG (HEALTH) OR CCP EXCEEDANCE							

RAW WATER MONITORING

Raw water monitoring in Carmila is undertaken based on the principles outlined in the overarching DWQMP.

Table 24 Raw water monitoring parameters

PARAMETER	FREQUENCY
E.coli	Monthly
Radiological	2 – years
Pesticides	Quarterly

VERIFICATION MONITORING

Table 25 Verification monitoring parameters

PARAMETER	FREQUENCY	WTP	SAMPLE POINTS IN RETICULATION
E.coli	Weekly	No	SP 1
SWA	Monthly	Yes	SP 1
THMs	Quarterly	No	SP 1
Oxyhalides	Quarterly	Yes	SP 1
Metals	Quarterly	Yes	SP 1

VERIFICATION MONITORING LOCATIONS

The monitoring location in Carmila is shown in Figure 9 and Table 26. This location is located central in Carmila and represents the majority of the water quality provided to Carmila's customers. As all water comes from the reservoir into town, the reservoir can be used as an alternative sampling point if the [redacted] is closed at the time of sampling, however DBPs should be tested at the [redacted] for more accurate reflection of water quality.

Table 26 Carmila Monitoring Points

SAMPLE POINTS	NETWORK SAMPLING LOCATIONS	COMMENT
1	[redacted]	[redacted]

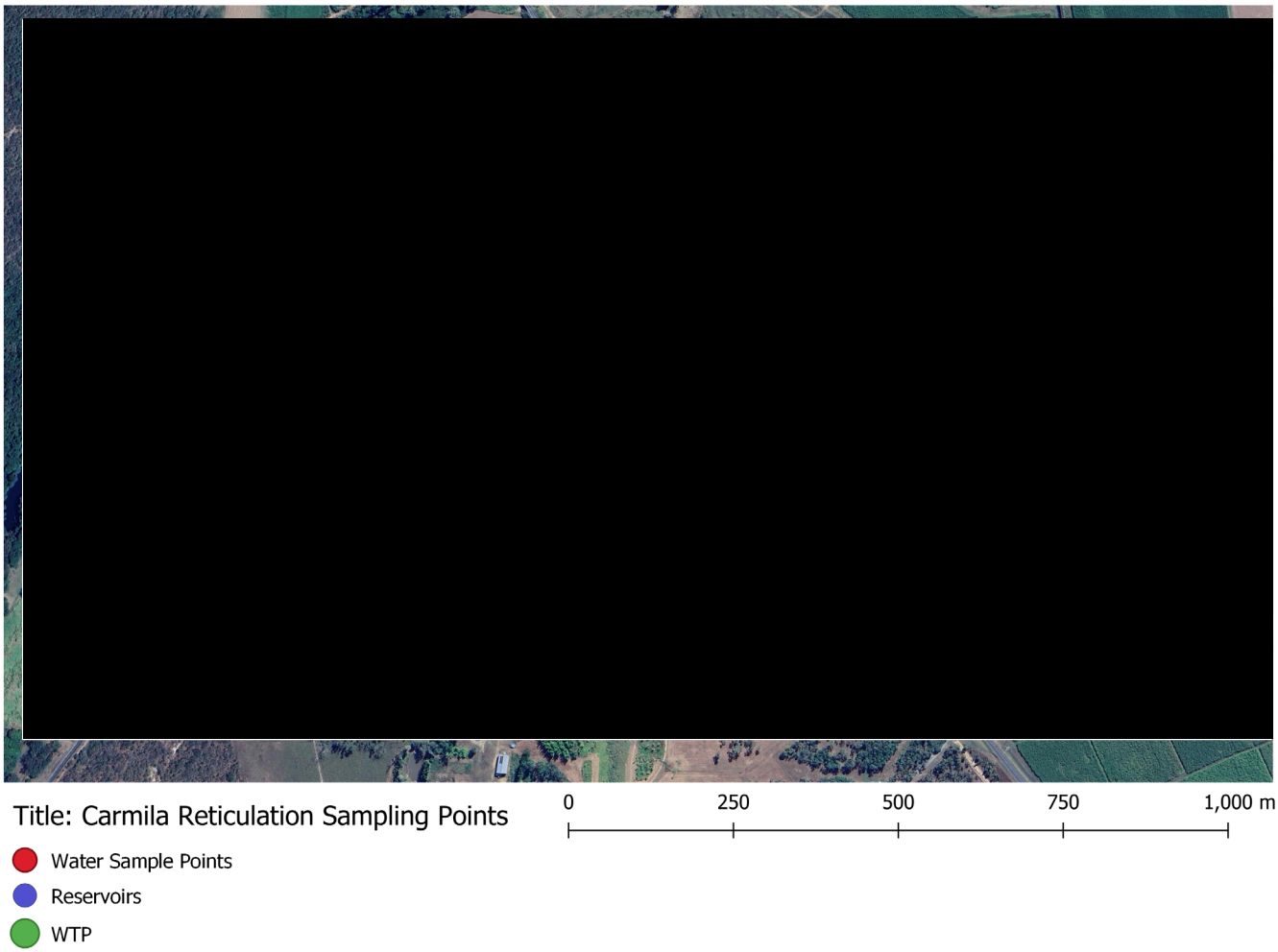


Figure 9 Carmila Verification Monitoring Locations

Response to out of specification results

Data from the verification monitoring is accessible via the Mackay Laboratory Monitor Pro Portal. The data is entered into spreadsheet records and the files on the share drive are accessible to all IRC Water and Wastewater Operational Staff. Refer to IRC Overarching DWQMP for Incident and Emergency Management.

APPENDIX 2

CLERMONT DRINKING WATER QUALITY MANAGEMENT PLAN

Clermont Drinking Water Quality Management Plan

Presented by: Water and Waste Directorate
Current as at: 22 August 2024

ISAAC REGION
HELPING TO ENERGISE THE WORLD

ISAAC.QLD.GOV.AU ISAAC REGIONAL COUNCIL ABN 39 274 142 600
P 1300 472 227 F 07 4941 8666 A PO Box 97 Moranbah QLD 4744
isaacregionalcouncil isaacregionalcouncil Isaacrcouncil

TABLE OF CONTENTS

OBJECTIVE

This plan details how Isaac Regional Council ensures the safety of drinking water for the Clermont community.

SCOPE

This plan is the Site-specific Drinking Water Quality Management Plan that together with the Overarching Drinking Water Quality Management Plan makes up the complete plan for Clermont.

DEFINITIONS

TERM / ACRONYM	MEANING
ADWG	Australian Drinking Water Guidelines
CCP	Critical Control Point
DRDMW	Department of Regional Development Manufacturing and Water
DWQMP	Drinking Water Quality Management Plan
DWQMP Guideline	Guideline for the preparation, review and audit of drinking water quality management plans.
IRC	Isaac Regional Council
MIB	Methylisoborneol
OCP	Operational Control Point
NTU	Nephelometric turbidity units
PHA	*Public Health Act 2005*
QH	Queensland Health – regulator of public health – may take lead on managing incidents
Regulator	In the context of the DWQMP, the Regulator is DRDMW
RMIP	Risk Management Improvement Program
SCADA	Supervisory Control and Data Acquisition
SPID	Service Provider Identification Number
WSSRA	*Water Supply (Safety and Reliability) Act 2008*
WTP	Water Treatment Plant

REFERENCES

ID	NAME
	DWQMP Document Register

INTRODUCTION

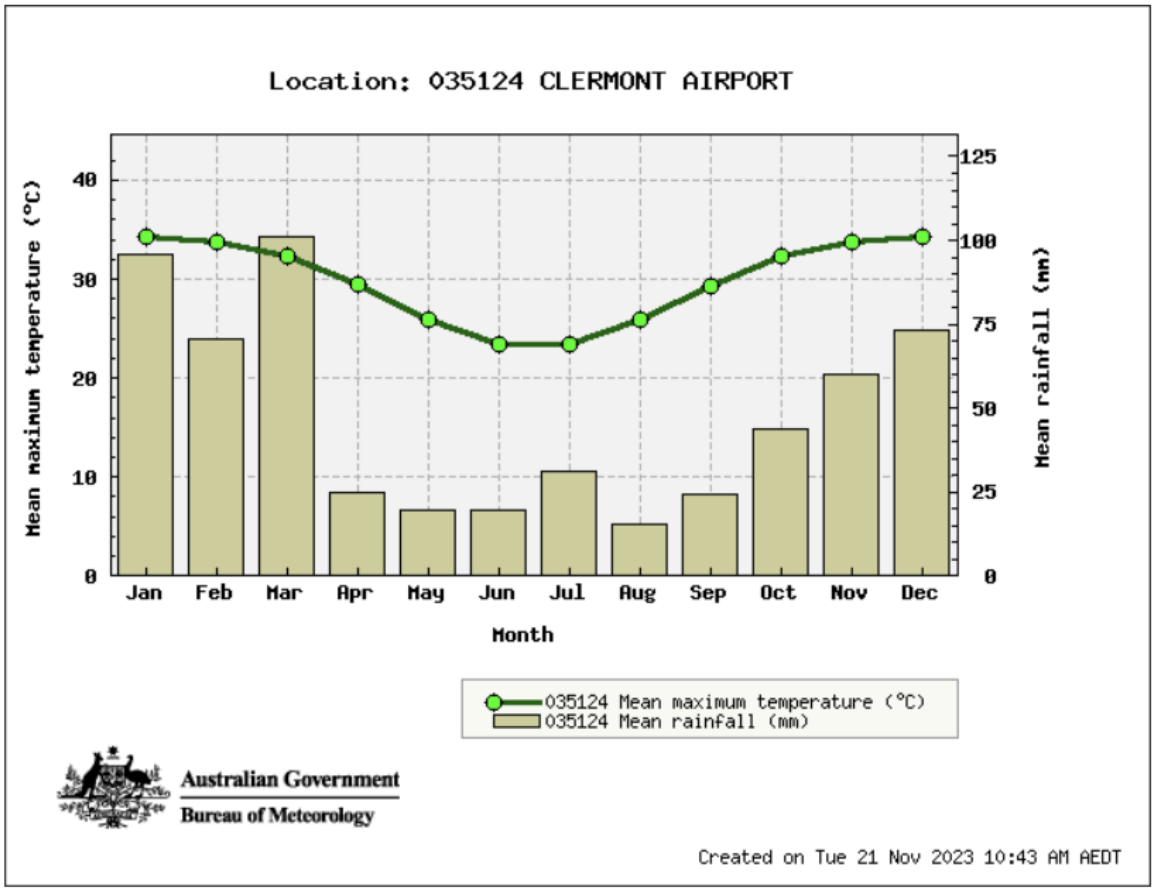
This site specific DWQMP documents the specific details of the Clermont drinking water scheme. It is intended to be an operational document that informs the operational staff.

OVERVIEW OF THE SUPPLY SCHEME

Clermont is a rural town of ~3000 people located in central Queensland. Clermont is a major hub for several large coal mines and other agricultural properties in the region. The town is located ~300 km south-west of Mackay. Drinking water for the community is sourced from Theresa Creek Dam.

CLIMATE

Rainfall (See Figure 10) within the catchment averages ~563 mm/year with more rain in summer than winter. The mean maximum temperature is 29.9 °C, with a mean max. above 30°C between October to March.



Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
Mean maximum temperature (°C) for years 2010 to 2023	34.3	33.8	32.4	29.5	25.9	23.4	23.4	25.9	29.3	32.3	33.7	34.3	29.9	14
Statistics	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**	**Years**
Mean rainfall (mm) for years 2010 to 2023	96.0	70.6	101.1	24.9	19.7	19.6	31.3	15.3	24.1	44.0	60.2	73.2	568.3	14

Figure 10 Rainfall Data from BOM for Clermont

CATCHMENT CATEGORISATION

The Theresa Creek Dam catchment is located in the Queensland Central Highlands. Apart from serving as the raw water source for the Clermont WTP, the Theresa Creek Dam catchment is utilised for stock farming, cropping, recreational activities (swimming, sailing, fishing, picnicking, bushwalking, camping, and boating). Based on the activity in the catchment area and the unprotected nature of the river and dam the raw water is characterised as a Category 4 catchment.

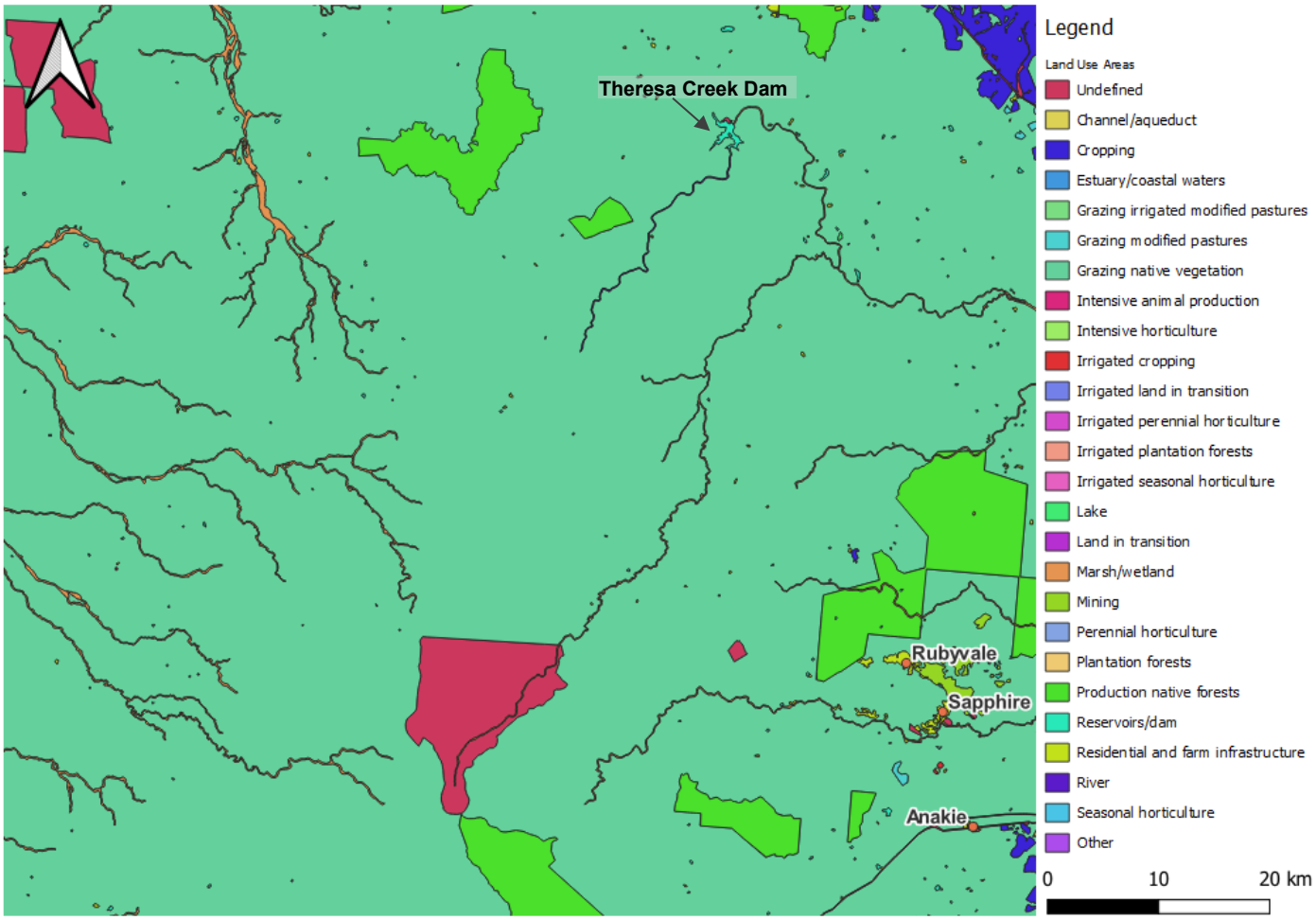


Figure 11 Theresa Creek Dam Catchment - Clermont

TREATMENT PROCESS

CLERMONT SCHEME DESCRIPTION

Overall – Capacity

The typical throughput is set at 60 L/s, and the plant operates intermittently based on the water level in the Treated Water Reservoir. After high rainfall elevated turbidity in the raw water often only allows the plant to run at 40 L/s, which is close to the towns water consumption rate and requires the plant to run continuously to keep up with demand.

Raw water source

The Clermont Water Scheme sources its raw water from the Theresa Creek Dam, which is situated approximately 22 km southwest of the Clermont WTP. Theresa Creek Dam, covering an area of 250 hectares, is designed with a capacity of roughly 9,200 ML, although its maximum usable storage has been reduced to approximately 7,000 ML due to siltation. The dam experiences significant evaporation rates, particularly during the summer months, leading to reduced raw water availability during dry periods. Additionally, there are requirements for riparian release of water downstream to support local farmers.

Raw water pumping

Theresa Creek dam features a raw water intake tower with a floating intake and a debris screen. This screen is manually cleaned by operators when necessary. Raw water is pumped from the dam to the Raw Water Balance Reservoir (0.45 ML) by a two centrifugal high lift pumps in a duty/standby configuration. The intake measures 300 mm in diameter, and each pump can deliver 112 L/s at a head of 78 m through an open surge standpipe into the Raw Water Balance Reservoir. The pumps start and stop automatically when the low and high reservoir levels are reached.

Supernatant Return

Supernatant can be returned to the Raw Water Tank (post dosing) from the existing 8 ML sludge lagoons. The average rate of return is <5% (manually controlled) with a maximum return rate of 6.9%. The return flow is measured with a manual flow meter.

Potassium Permanganate

Potassium permanganate is either dosed into the raw water line entering the raw water reservoir, or alternatively, following the raw water reservoir before reaching the plant. Potassium permanganate is dosed using a single dosing pump with auto shut down on zero plant flow.

Powdered Activated Carbon (PAC) dosing

PAC is dosed into the raw water line entering the raw water reservoir. PAC can also be dosed into the second dosing pit following the raw water reservoir and prior to the flash mixer. A third dosing location is after the clarifier. PAC is dosed using a single dosing pump equipped with auto shut down on zero plant flow. Dosing is based on operator adjustable flow rates and preparation of different batch strengths.

Raw Water Reservoir

The Raw Water Reservoir is an open reservoir (2 ML) which is equipped with a control valve at the inlet to allow filling as required. The gravity main from the Raw Water Balance Reservoir to the Raw Water Reservoir typically remains full. The raw water flows from the raw water tank to the flash mixer via a magnetic flowmeter. The supernatant return from the sludge lagoons can be pumped back into the raw water reservoir. There is a flow meter and a sample point on the line to monitor the return.

Sodium hydroxide

Sodium hydroxide can be optionally dosed in multiple locations. One pump doses sodium hydroxide into the raw water prior to the raw water reservoir. A second pump doses sodium hydroxide prior to the flash mixer for pH adjustment before coagulation and post the filters for filtered water pH adjustments. The dosing is completed by two (2) dosing pumps for three (3) dosing locations in a duty/duty configuration.

Coagulant and polymer

Aluminium Chlorohydrate (ACH) is dosed at the inlet to the flash mixer using a single dosing pump. The ACH pump is interlocked with the process and turns off the plant if pump flow ceases. A polymer preparation unit with one dosing pump is available to dose polymer into the flash mixer outlets as a flocculation aid.

Flocculation – Clarification

Water flows from the flash mixer into the clarifier and clarified water is directed through launders to the filters via the outlet channel.

Sludge removal is facilitated by an air-actuated de-sludge valve opening automatically based on a timer. Changing the sludge bleed settings requires an electrician.

There is a filter bypass which can direct clarified water to the drain to protect the filters from bad quality water. The Flash mixer has a bypass to pre clarifier, and the Raw water can be bypassed to pre filter.

Chlorine oxidation

Prior to entering the filters, the clarified water is dosed with chlorine to facilitate the oxidation of any remaining soluble manganese. Chlorine gas is dosed from 2 drums in duty/standby configuration with auto change over and automatic shut down on zero flow.

Chlorine can also be dosed prior to the raw water reservoir and pre flash mixer if required.

Filtration

The clarified water flows into three rapid sand filters. Backwash requirements on the filters are monitored through differential pressure meters. The process of backwashing the filters is initiated manually, but the entire sequence is automatically controlled through SCADA. The backwash sequence includes air scouring followed by a water wash. The operators supervise the backwash process and only return the filter to active service when the discharged water is visually clear. The backwash water from the filters is directed into a designated backwash holding tank and either used for irrigation or discharged to lagoon ponds.

Wastewater and sludge handling

Backwash water from the filters is collected in the backwash tank. The supernatant is reused for on-site irrigation, and the rest, including thickened sludge and waste from the clarifier, is sent to the sludge lagoons.

Primary disinfection

Filtered water is disinfected with chlorine gas at the inlet to the clear water tank. Chlorine gas is dosed from two (2) drums in duty/standby configuration with auto change over and automatic shut down on zero flow. If it becomes necessary to boost the residual chlorine in the water supplied to the distribution network, treated water (post clearwater tank) can be dosed with a chlorine trim dose before it enters the high lift pumps.

Additionally, sodium hydroxide may be dosed into the pipeline prior to the clear water tanks (CWT) as needed for pH correction which can improve disinfection efficiency.

Clear water tanks and treated water reservoirs

The filtered water from the three (3) filters is directed by gravity to two (2) clear water tanks (3 ML & 5 ML), which are designed to maintain hydraulic balance with simultaneous inlet and outlet flow.

Two (2) high lift pumps are responsible for transferring water from the 3 ML CWT to the Jeffrey Street reservoir (0.52 ML). These pumps operate in a duty/standby configuration and start and stop based on the water level in the Jeffrey Street Reservoir. From the Jeffrey St reservoir the Capricorn St reservoir (0.45ML) is fed to provide additional water storage capacity.

Reticulation network

The reticulation pipelines are mostly constructed of asbestos cement, and most are over 40 years old. A summary of pipe ages can be seen in Table 28. When pipelines are replaced or a new section is installed, these are being constructed from suitable materials. A summary of the pipe materials and their length can be seen in Table 27.

The mains in the reticulation system vary in size from 25mm to 450mm with the majority of the distribution network consisting of 90mm and 100 mm pipework.

The Clermont mains have been scoured and cleaned in the last five (5) years. Most of the previous dead ends in the reticulation system have been replaced.

The introduction of Smart Meters has also been implemented to gain better insights into water usage, losses, and to detect leaks and mains breaks more effectively.

Table 27 Pipe Materials and Length

MATERIAL	DIAMETER [DN]	LENGTH [M]
Asbestos Cement	25	57
	40	61
	50	252
	80	1887
	100	24276
	150	4892
	200	3133
	225	3760
	250	1196
	375	4432
	450	159
	Unknown	1969
Copper	30	37
DICL	450	52

MATERIAL	DIAMETER [DN]	LENGTH [M]
Poly	50	299
	63	6780
	90	10574
	100	79
	110	724
PVC	50	2092
	80	44
	100	2725
	150	3
	225	1437
Steel	50	55
uPVC	50	356
	100	1085
	150	53
Unknown	Unknown	455
	50	36
	63	9498

Table 28 Range of pipe age - Clermont

PIPE AGE	1-10 YEARS	11-20 YEARS	21-30 YEARS	31-40 YEARS	41-50 YEARS	51-60 YEARS	61-70 YEARS
Percentage of Network	3%	0%	16%	17%	44%	21%	0%

Clermont Overall Water Scheme

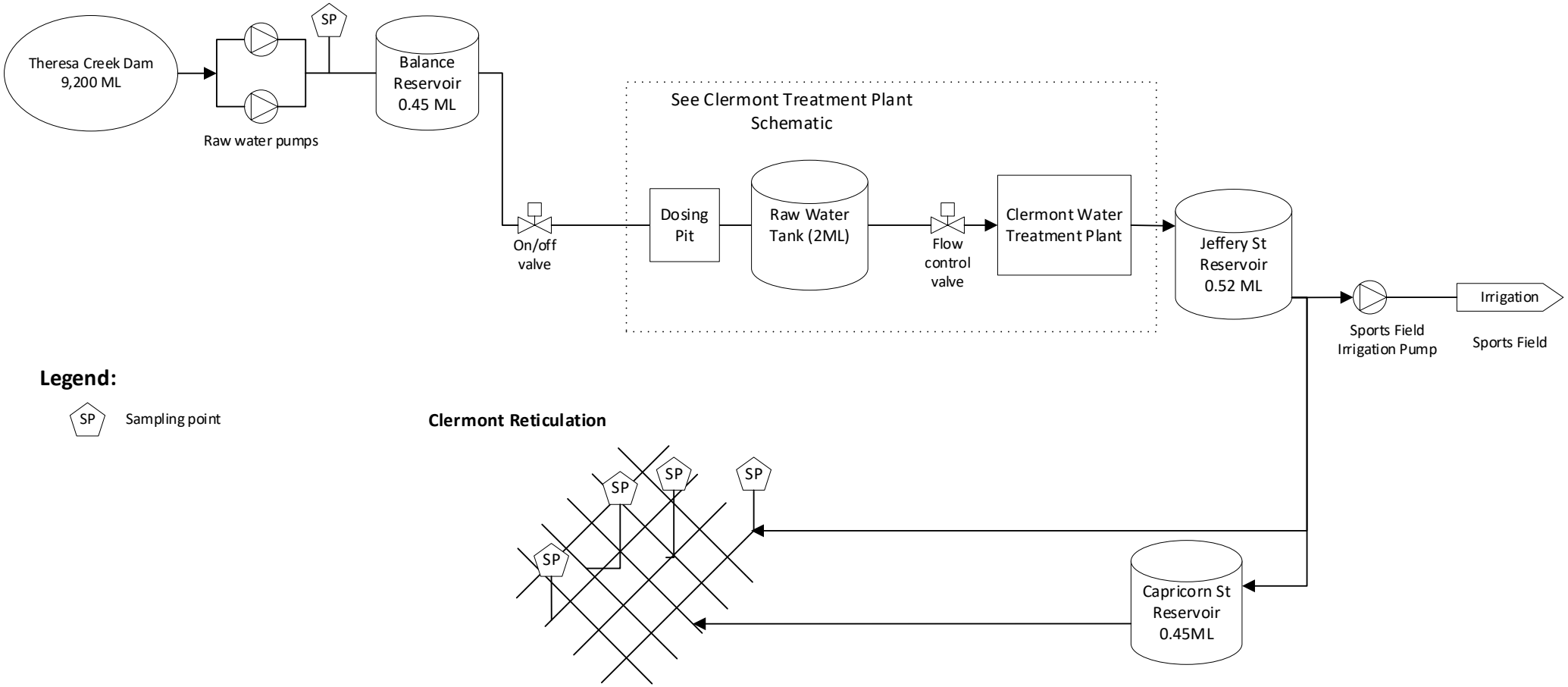


Figure 12 Clermont Catchment to Tap Schematic

Clermont Water Treatment Plant

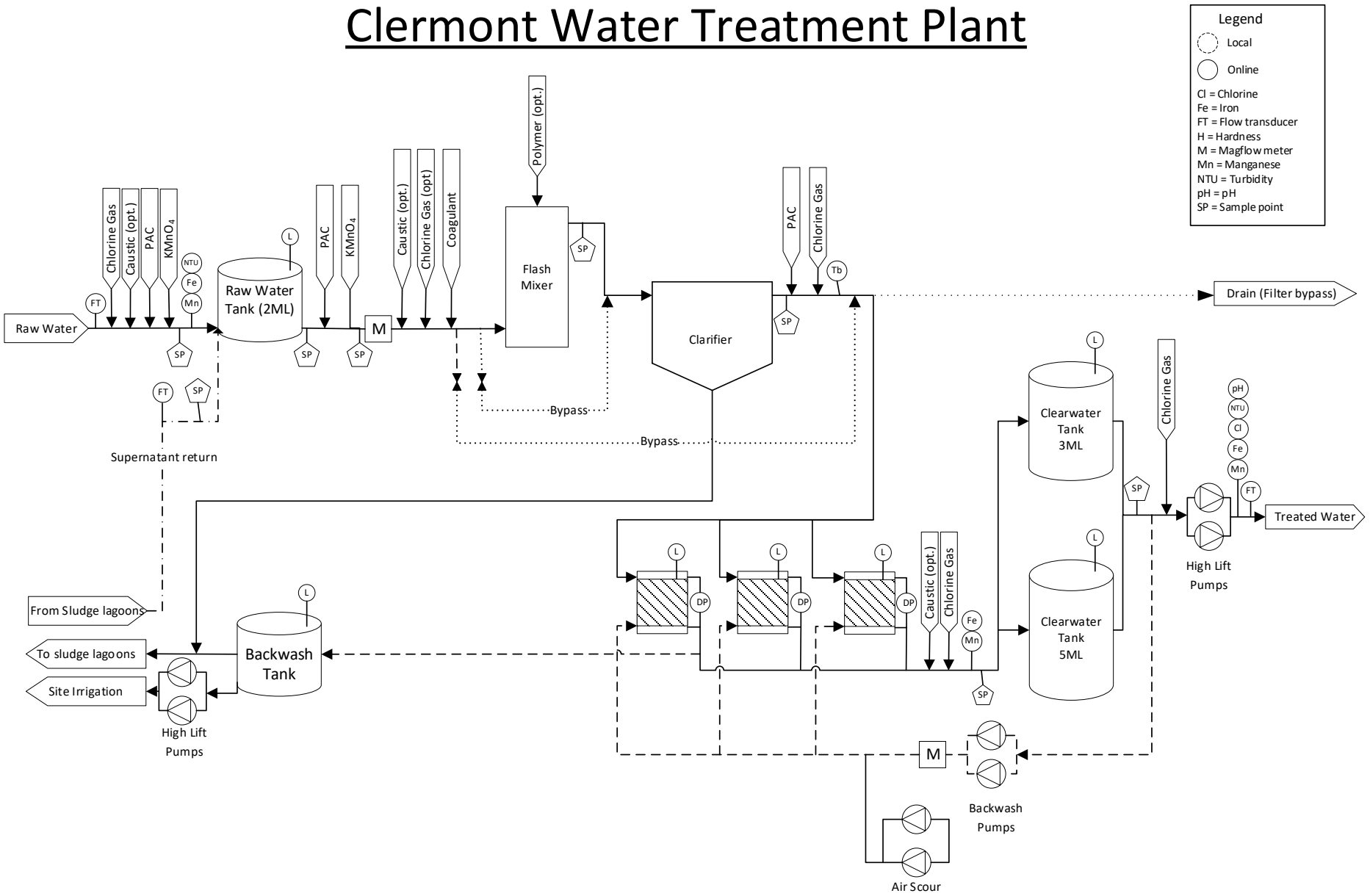


Figure 13 Clermont Treatment Plant Schematic

WATER QUALITY

RAW WATER

The source water shows occasionally elevated iron and manganese levels and some pH fluctuations. A seasonal pattern shows significantly increased turbidity levels particularly during summer months.

Table 29 Clermont Raw Water Monitoring

	UNIT	# OF SAMPLES	MIN.	25TH %TILE	MEDIAN	75TH %TILE	MAX.	RANGE	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Alkalinity	mg/L $CaCO_3$	1501	0.05	70	85	105	380	380	50	135	89	32
Free Chlorine	mg/L	985	0	2.5	3.2	4.2	6.7	6.7	1.6	5.3	3.3	1.2
pH	-	1534	6.2	7.2	7.4	7.5	9.8	3.6	6.8	7.8	7.3	0.29
Sol. Iron	mg/L	119	0	0.01	0.02	0.04	0.11	0.11	0	0.09	0.025	0.024
Sol. Manganese	mg/L	119	0	0.029	0.059	0.16	0.72	0.72	5.3^{-18}	0.55	0.12	0.15
Tot. Aluminium	mg/L	153	0.008	0.05	0.06	0.08	0.17	0.16	0.02	0.1	0.062	0.023
Tot. Iron	mg/L	1455	0	0.03	0.04	0.07	0.88	0.88	0.01	0.22	0.07	0.096
Tot. Manganese	mg/L	1422	0	0.009	0.02	0.036	308	308	0.004	0.64	0.32	8.2
True Colour	HU	1395	0	15	20	60	4560	4560	5	170	49	136
Turbidity	NTU	1532	0.75	9	16	60	1430	1429	4.7	408	80	180

TREATED WATER

Operational

In the past, aluminium levels above the ADWG aesthetic guideline were measured, but aluminium levels have been reduced since 2021. Historical problems also included high turbidity, as well as elevated manganese and iron levels. These issues have led to a significant number of customer complaints.

Table 30 Summary Treated Water Monitoring

	UNIT	# OF SAMPLES	MIN.	25TH %TILE	MEDIAN	75TH %TILE	MAX.	RANGE	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Alkalinity	mg/L $CaCO_3$	1716	20	60	70	85	150	130	40	120	74	23
Free Chlorine	mg/L	1760	0.39	1.7	2	2.3	11	10	1.3	2.7	2	0.54
Hardness	mg/L $CaCO_3$	1671	0.004	55	70	80	140	140	40	95	68	17
pH	-	1761	6.5	7.2	7.4	7.5	9.5	2.9	7.1	7.7	7.4	0.21
Tot. Aluminium	mg/L	1725	0	0.04	0.05	0.08	0.51	0.51	0.02	0.2	0.067	0.059
Tot. Iron	mg/L	1730	0	0	0	0.01	0.07	0.07	0	0.02	0.0057	0.0073
Tot. Manganese	mg/L	1735	0	0.001	0.003	0.006	3	3	0	0.024	0.0089	0.076
Turbidity	NTU	1760	0	0.12	0.18	0.32	38	38	0.07	0.96	0.4	1.3

Verification

Verification monitoring data for Clermont is presented in Table 31. Chemical parameters with values under the limit of detection (LOD) are presented as 0.5xLOD. Microbiological results under LOD are presented as 0.

Table 31 Summary of Treated Water Verification Monitoring (2014-2023)

	# OF SAMPLES	MIN.	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Alkalinity - Residual (mq/L)	13	0	0.05	-0.039	0.05	0.043	0.025
Alkalinity (mg/L)	104	23	197	39	150	84	32
Aluminium (µg/L)	192	2.5	446	7.5	91	34	41
Ammonia (mg/L)	42	0.0025	0.024	0.005	0.02	0.0061	0.004
Arsenic (µg/L)	18	0.25	0.83	0.25	0.83	0.4	0.17
Barium (µg/L)	4	34	48	34	48	40	5.7
Beryllium (µg/L)	4	0.25	0.5	0.25	0.5	0.31	0.13
Boron (µg/L)	4	24	56	24	56	38	14
Bromate (µg/L)	90	2.5	25	5	25	8.5	5.4
Bromate^ (µg/L)	2	25	25	25	25	25	0
Cadmium (µg/L)	13	0.05	0.5	0.05	0.5	0.085	0.12
Calcium (mg/L)	65	11	47	12	38	23	7.6
Chlorate (µg/L)	90	5	1287	10	204	50	158
Chlorate^ (µg/L)	2	25	25	25	25	25	0
Chlorite (µg/L)	89	2.5	25	5	25	8.8	5.6
Chlorite^ (µg/L)	2	25	25	25	25	25	0
Chromium (µg/L)	13	0.05	0.5	0.05	0.5	0.085	0.12
Colour - True (TCU)	104	0.5	9	0.5	4	1.3	1.3
Conductivity (µS/cm)	413	113	894	220	607	342	125
Copper (µg/L)	13	0.5	4.2	0.5	4.2	2.5	1.1
Dissolved Oxygen (% Sat)	91	71	103	75	99	89	7.5
E. coli (MPN/100mL)	963	0	0	0	0	0	0
Fluoride (mg/L)	84	0.005	0.23	0.034	0.19	0.08	0.048
Formaldehyde (mg/L)	51	0.05	0.7	0.05	0.14	0.07	0.093
Free Chlorine Residual (Client tested) (mg/L)	733	0.05	8.8	0.66	3.9	1.9	1.1
Free Chlorine Residual (mg/L)	208	0.01	3.5	0.22	2.9	1.4	0.71
Gross alpha (Bq/L)	10	0.025	0.05	0.025	0.05	0.028	0.0079
Gross beta (Bq/L)	10	0.05	0.26	0.05	0.26	0.077	0.067
Hardness - Temporary (mg/L)	90	23	197	38	151	86	33
Hardness (mg/L)	100	37	206	43	158	84	32
Iodide (µg/L)	15	10	10	10	10	10	0
Iron (µg/L)	196	1	51	1	6.9	2.1	4.1
Lead (µg/L)	18	0.25	0.5	0.25	0.5	0.29	0.096

	# OF SAMPLES	MIN.	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Magnesium (mg/L)	65	3.3	22	3.7	16	8.5	3.8
Manganese (µg/L)	196	0.5	254	0.5	40	9.2	36
Mercury (µg/L)	18	0.025	0.25	0.025	0.25	0.21	0.086
Molybdenum (µg/L)	4	0.5	0.5	0.5	0.5	0.5	0
Nickel (µg/L)	13	0.25	0.56	0.25	0.56	0.29	0.11
Nitrate (mg/L)	102	0.0075	3.6	0.0075	1.7	0.64	0.57
Nitrite (mg/L)	102	0.002	0.2	0.002	0.2	0.076	0.095
pH (Client tested) (pH unit)	735	6.7	30	7	15	8.4	3.5
pH (pH unit)	171	6.5	8.6	6.6	7.7	7.2	0.29
Residual Alkalinity (mg/L)	61	0.05	0.05	0.05	0.05	0.05	0
Selenium (µg/L)	18	0.5	2.5	0.5	2.5	2.2	0.77
Silver (µg/L)	4	0.05	0.5	0.05	0.5	0.16	0.23
Sulphide (mg/L)	30	0.0025	0.03	0.0025	0.017	0.0036	0.0051
Tin (µg/L)	4	0.5	0.84	0.5	0.84	0.59	0.17
Total Dissolved Solids (mg/L)	413	68	536	132	364	205	75
Trihalomethanes (Total) (µg/L)	129	48	342	71	201	115	42
Trihalomethanes (Total)^ (µg/L)	23	2.8	140	3.5	137	61	36
Turbidity (Client tested) (NTU)	321	0.05	12	0.05	0.99	0.31	0.82
Turbidity (NTU)	143	0.05	7.2	0.16	3.7	0.92	1.1
Uranium (µg/L)	4	0.25	0.5	0.25	0.5	0.31	0.13
Zinc (µg/L)	13	0.5	7.5	0.5	7.5	2.5	2.3

WET WEATHER EVENTS

Wet weather periods (often during summer months), often lead to high turbidity which increases sludge production, pushing the clarifier to its operational limits. Additionally, there are higher levels of true colour in the treated water during these events.

CUSTOMER COMPLAINTS

Most water quality customer complaints in Clermont are based on discoloured water, which likely relates to iron and manganese in the concentrations. There were 433 customer complaints between 2011 and 2021, which decreased significantly to two (2) customer complaints relating to discoloured and murky water in the FY 2022/23.

Table 32 Summary of Customer Complaints - Clermont

Year	No of Water Quality Complaints	Main Reasons for Complaints	Likely Sources / Causes of Problems	Resolution of Problem
2014-15	6	Unknown	No information recorded to indicate the cause of complaint. The water quality data are generally in line with the ADWG.	
2015-16	26	Discoloured water	No information recorded to indicate the cause of complaint. The water quality data are generally in line with the ADWG.	Localised and mains flushing performed. WTP processes reviewed.

2016-17	31	Discoloured water	No information recorded to indicate the cause of complaint.	Localised and mains flushing performed. WTP processes reviewed.
2017-18	39	Discoloured water	No information recorded to indicate the cause of complaint.	Localised and mains flushing performed. WTP processes reviewed.
2018-19	91	Discoloured water	Failure of alum dosing pump, with lack of interlock.	Localised and mains flushing performed. Interlock added to all alum dosing pumps.
2019-20	203	Discoloured water	Samples taken within ADWG	Localised and mains flushing performed. WTP processes reviewed.
2020-21	28	Discoloured water	Samples taken within ADWG	Localised and mains flushing performed.

INCIDENTS

There were six (6) incidents in Clermont between 2017 and 2023. Five (5) incidents were caused by turbidity post filters in treated water or the network and one (1) reported incident related to high THMs in the network.

Table 33 Summary of incidents in Clermont (2017-2023)

INCIDENT DATE	Date/ Reference	Location	Parameter	Description of event	Improvement
20/09/2023	NA	Clarified Water	Turbidity	Turbidity of 8 NTU detected in clarified water.	Investigation of clarification issues
07/09/2022	DWI-486-23-10627	Treated Water	Formaldehyde	Formaldehyde detected in verification monitoring data in network.	Ongoing investigation
06/01/2021	DWI-486-22-09679	Ex-clear well	THM (0.254 mg/L)		Changeover to potassium permanganate for pre-oxidation planned for January 2022
13/01/2021	DWI-486-22-09515	Ex-clear well	Turbidity (1.2 NTU)		Under investigation
15/03/2022	DWI-486-22-09529	Filtered water	Turbidity (0.56 NTU)	On review of the treatment plant log sheets, the filtered water was noted to be higher than the critical limit and not reported internally. The filter was backwashed and returned to service with follow-up checks carried out but not recorded	Improve reporting of breaching critical limits and recording of follow-up quality testing. Capital improvements planned for filter media and online turbidity meters with automatic shutdown.
23/03/2022	*NA*	*Treated water*	*Turbidity (1.45 NTU)*	*Treated water turbidity was measured at 1.45 NTU against a limit in IRC DWQMP of 1 NTU*	*Internal reporting* *Configuration of automated breach emails*
19/12/2021	DWI-486-21-09396	Network	Turbidity (18 NTU)	An increase in raw water manganese and iron was not detected. An investigation highlighted the test method utilised at the time did not identify elevated residual manganese and iron in settled water that subsequently precipitated during a pH increase at disinfection to form the discoloration and elevated turbidity.	Change in coagulant and oxidising agent. Change in order of dosing for pH correction. Revised operational setpoints and quality testing equipment and reagents. Capital improvements planned for filter media, online turbidity meters and chemical dosing.
1/12/2021	*NA*	*Treated Water*	*Turbidity (1.2 NTU)*	*Treated water turbidity was measured at 1.2 NTU against a limit in IRC DWQMP of 1 NTU*	*Internal reporting* *Configuration of automated breach emails*

RISK ASSESSMENT

SCHEME MITIGATED RISK ASSESSMENT

Table 34 Clermont Mitigated Risk Assessment

Ref	Treatment Stage	Primary Hazard	Other hazards managed by barrier	Hazardous Event	Unmitigated Risk	Control Measures in place	Comment	Mitigated Consequence	Mitigated Likelihood	Mitigated Risk	Uncertainty	Improvement Action Required - Immediate	Improvement Action Required ~ 2 years	Improvement Action Required - Long term
CLM1	Raw Water Abstraction	Protozoa (Category 4)	bacteria viruses and turbidity, cyanobacterial toxins	Normal operation	Extreme 25	Conventional treatment, disinfection, but limited online monitoring and control.	Multiple offtakes duty/standby pumps. High recreational use at Theresa Ck Dam at holiday periods - camping mostly in winter, on water activities in summer.	Catastrophic	Unlikely	High 10	Reliable	Exclude animals from accessing sludge lagoon		UV disinfection required over time.
CLM2	Chlorine oxidation	DBPs	Chlorine	Overdose of chlorine	Medium 9	Duty standby cylinders Not currently automated sufficiently for use.	Not normally used	Moderate	Rare	Low 3	Confident	Will require automation to reinstate.		
CLM3	Chlorine oxidation	Manganese surface water		Underdose of chlorine	High 12	Single dosing pump. Not currently automated sufficiently for use .	Not normally used	Moderate	Rare	Low 3	Confident	Will require automation to reinstate.		
CLM4	Chemical Dosing - Powdered Activated Carbon (PAC)	Cyanobacterial toxins	Taste and odour	Underdose of PAC	High 12	Not normally used in this location, or post raw water tank.	Single dosing pump - same pump used with operator to select dosing location. Not currently automated sufficiently for use in this location.	Moderate	Rare	Low 3	Confident	Review of BGA management plan (by Dec 2024)		
CLM5	Chemical Dosing - Potassium permanganate	Manganese - dosing		Overdose of potassium permanganate	High 12	Can be dosed pre raw water, but typically after. Jar testing as required, and use table for calculating minimum oxidising dose.	Multiple potential dosing points - longer contact time the earlier in the process that potassium permanganate is added Single dosing pump, flow paced dosing. Online analysers, but not currently working.	Moderate	Possible	Medium 9	Reliable	Reinstate online analysers, require flow switch for potassium permanganate to allow dosing into 2 ML raw water tank.		
CLM6	Chemical Dosing - Potassium permanganate	Manganese surface water		Underdose of potassium permanganate	High 12	Can be dosed pre raw water, but typically after. Jar testing as required, and use table for calculating minimum oxidising dose.	Multiple potential dosing points - longer contact time the earlier in the process that potassium permanganate is added Single dosing pump. Exceedances in 2021 were when dosing chlorine as oxidant.	Moderate	Possible	Medium 9	Reliable			
CLM7	Supernatant return and storage	Protozoa (Category 4)	Turbidity	Challenge plant by recycling protozoa	Extreme 25	Manually controlled, operated during staffed hours, return ~3 L/s or 10 L/h (<5%).	Returns to RW tank - water quality set points.	Catastrophic	Unlikely	High 10	Estimate	Exclude animals from accessing sludge lagoon.		UV disinfection required over time.
CLM8	Chemical Dosing - Sodium hydroxide	Protozoa (Category 4)	Bacteria and Virus	Overdose of caustic impacting coagulation (or disinfection)	Extreme 25	pH 7.8 - 8 target	Single dosing pump, shuts down when plant stops. Online pH at treated water. Clarified water turbidity meter can catch poor clarification.	Catastrophic	Unlikely	High 10	Reliable		Online pH analyser and operational control.	
CLM9	Chemical Dosing - Sodium hydroxide	Protozoa (Category 4)	pH	Underdose of caustic impacting coagulation	Extreme 25	pH 7.8 - 8 target	Single dosing pump, shuts down when plant stops. Online pH at treated water. Clarified water turbidity meter can catch poor clarification.	Catastrophic	Unlikely	High 10	Reliable		Online pH analyser and operational control.	
CLM10	Chemical Dosing - Aluminium Chlorohydrate (ACH)	Aluminium - coagulant	Turbidity	Overdose of coagulant	Medium 6	Jar testing as required, manually adjusted dose rate.	Single dosing pump auto shutdown. Turbidity meter on clarified water with shutdown at 2 NTU	Minor	Unlikely	Low 4	Reliable			
CLM11	Chemical Dosing - Aluminium Chlorohydrate (ACH)	Protozoa (Category 4)	Turbidity	Underdose coagulant/ poor coagulation	Extreme 25	Jar testing as required, manually adjusted dose rate.	Single dosing pump auto shutdown. Turbidity meter on clarified water with shutdown at 2 NTU	Catastrophic	Unlikely	High 10	Reliable		Online pH analyser and operational control.	
CLM12	Chemical Dosing - Polyelectrolyte	Turbidity	Protozoa	Underdose of Polymer	High 10	Typical dose ~0.2 mg/L	Single dosing pump. Auto shutdown, clarified water turbidity meter	Minor	Unlikely	Low 4	Reliable			
CLM13	Chemical Dosing - Polyelectrolyte	Turbidity		Overdose of polymer - resulting in filter blockage	High 10	Typical dose ~0.2 mg/L	Single dosing pump. Auto shutdown,	Minor	Unlikely	Low 4	Reliable			

Ref	Treatment Stage	Primary Hazard	Other hazards managed by barrier	Hazardous Event	Unmitigated Risk	Control Measures in place	Comment	Mitigated Consequence	Mitigated Likelihood	Mitigated Risk	Uncertainty	Improvement Action Required - Immediate	Improvement Action Required ~ 2 years	Improvement Action Required - Long term
CLM14	Clarification	Turbidity		Ineffective coagulation resulting in breakthrough through filters	High 10	Jar testing as required, manually adjusted dose rate.	Online turbidity meter, with shutdown at 2 NTU. Automatic sludge bleed.	Minor	Unlikely	Low 4	Reliable			
CLM15	Clarification	Protozoa (Category 4)		Ineffective coagulation resulting in breakthrough through filters	Extreme 25	Jar testing as required, manually adjusted dose rate.	Online turbidity meter, with shutdown at 2 NTU. Automatic sludge bleed.	Catastrophic	Unlikely	High 10	Reliable		Online pH analyser and operational control.	
CLM16	Bypass of flash mixer	Protozoa (Category 4)	Turbidity	Poor clarification process	Extreme 25	Not normally used.	Risk assessed if used as only single valve.	Catastrophic	Unlikely	High 10	Estimate	Lock out valves		
CLM17	Bypass of clarification process	Protozoa (Category 4)	Turbidity	No clarification - no floc formation prior to filtration	Extreme 25	Not normally used		Catastrophic	Unlikely	High 10	Estimate	Lock out valves		
CLM18	Chlorine oxidation	DBPs	Chlorine	Overdose of chlorine	Medium 9	Target chlorine post filter of 0.2 - 0.5 mg/L. measured daily.	Duty/standby Auto shutdown and changeover, treated water chlorine meter. Clarified water UVA used to monitor organics.	Moderate	Unlikely	Medium 6	Confident			
CLM19	Chlorine oxidation	Manganese surface water	iron	Underdose of chlorine	High 12	Duty/standby Auto shutdown and changeover, treated water chlorine meter. Clarified water UVA used to monitor organics. Alarms on elevated iron and manganese.	Chlorine maintenance on filters is required as filters retain manganese	Moderate	Unlikely	Medium 6	Confident			
CLM20	Chemical Dosing - Powdered Activated Carbon (PAC)	Cyanobacterial toxins	Taste and odour, pesticides	Underdose of PAC	High 12	Not normally used. Initiated if algal blooms.	Multiple dosing points Manual batch strengths single dosing pump	Moderate	Unlikely	Medium 6	Confident	Review of BGA management plan (by Dec 2024)		
CLM21	Filtration - Media filtration	Protozoa (Category 4)	Turbidity	Breakthrough through filters	Extreme 25	Once per day monitoring, no online monitoring.	Manual backwash with up to 48 hour run time. DP and level alarms, no current automation. Filter ripening back into production	Catastrophic	Possible	High 15	Estimate	Investigate online turbidity meters for individual filters.	Investigate improving control of filters, including automated backwashing	UV disinfection required over time.
CLM22	Filtration - Media filtration	Protozoa (Category 4)		Poor backwash	Extreme 25	Operators initiate backwash	With up to 48 hour run time. DP and level alarms, no current automation. Filter ripening back into production	Catastrophic	Possible	High 15	Estimate	Investigate online turbidity meters for filters.	Investigate improving control of filters, including automated backwashing	
CLM23	Chemical Dosing - Sodium hydroxide	pH		Under or overdosing	Medium 9	Duty/standby multiple dosing locations (pre coagulation) and post filter	pH correction typically at head of plant. Option to dose at this location is available, but not typically used	Moderate	Rare	Low 3	Reliable			
CLM24	Chemical Dosing - Sodium hydroxide	Bacteria/Virus		Overdose leading to ineffective disinfection	Extreme 25	Duty/standby multiple dosing locations (pre coagulation) and post filter	pH correction typically at head of plant. Option to dose at this location is available, but not typically used	Catastrophic	Rare	Medium 6	Confident			
CLM25	Disinfection - chlorine gas	Chlorine		Overdose chlorine	High 12	Duty/standby Auto shutdown and changeover		Moderate	Rare	Low 3	Confident			
CLM26	Disinfection - chlorine gas	Bacteria/Virus		Underdose chlorine	Extreme 25	CCP - online monitoring, alarms, daily grab samples.	Duty/standby Auto shutdown and changeover One regulator per set of cylinders, and critical spares. Max demand 4 ML/ day.	Catastrophic	Rare	Medium 6	Confident			
CLM27	Trim dosing	Chlorine		Overdose chlorine	High 12	Target chlorine same as CCP, used to top up dose if chlorine is decaying in reservoir.	Duty dosing from cylinder	Moderate	Unlikely	Medium 6	Confident			
CLM28	Disinfection - chlorine gas	DBPs		Reaction of chlorine with organics	Medium 9	Duty/standby Auto shutdown and changeover		Moderate	Rare	Low 3	Confident			

OPERATIONAL MONITORING AND PROCESS CONTROL

OPERATIONAL MONITORING

Table 35 Operational Monitoring Table

PARAMETER	RAW WATER	POST-FLASH MIXER	CLARIFIED WATER	FILTERED WATER	CHLORINATED WATER	TREATED WATER	NETWORK WATER
Alkalinity	Weekly					Weekly	
Aluminium						Weekly	
Free chlorine				Daily	Daily	Daily, Online	2 x Weekly
pH	Daily	Daily	Daily		Daily	Daily, Online	2 x Weekly
Temperature	Daily		Daily				2 x Weekly
Tot. Hardness	Weekly						
Tot. Iron	Weekly, Online				Online	Weekly, Online	Weekly
Sol. Iron	Daily		Weekly				
Tot. Manganese	Weekly, Online				Online	Daily, Online	Weekly
Sol. Manganese	Daily		Weekly				
True Colour	Daily					Daily	2 x Weekly
Turbidity	Daily, Online		Daily, Online	Daily, Online	Daily	Daily, Online	2 x Weekly
Sol. UVA_{254}	Daily		Weekly				

Response to out of specification results for relevant parameters are managed through CCPs and OCPs

Operators check the calibration of online instruments with the results from their lab/benchtop analysis as part of the operational monitoring.

CONTROL POINTS

CRITICAL CONTROL POINTS

The critical control points (CCP) for the scheme were identified in the risk assessment process, and include:

- Filtration
- Disinfection

The CCP procedures are included in the following pages. These are presented as traffic lights and identify the location, monitoring, performance, and validation of the process. The traffic lights are aligned to SCADA where the low and high limits match the adjustment level and (as appropriate) the high and low alarms match the critical limit.

OPERATIONAL CONTROL POINTS

Clermont has four operational control points (OCP) for the following processes.

- Oxidation – treated water total manganese
- Coagulation – clarified water turbidity
- Chlorination – chlorinated water free chlorine
- Disinfection – treated water pH

An OCP exceedance is generally not reportable to the regulator except if it is an event that requires reporting (such as failure in coagulation, noted by clarified water turbidity >5 NTU. Incident reporting to the regulator is based on CCPs or exceedances of ADWG health guidelines.

QUALITY CONTROL POINTS

Clermont WTP has three quality control points (QCP) for the following processes.

- Oxidation (Potassium Permanganate) – clarified water soluble iron, manganese, and UVA
- Coagulation – dosed water, post flash mixer pH
- Coagulation – clarified water aluminium

The CCPs, OCPs and QCP’s can be found below.

CRITICAL CONTROL POINT PROCEDURE - CLERMONT

Filtration

What is measured	Where is it measured	When is it measured	What is the control point	What are the hazards	Record Keeping
Turbidity	Grab sample post filtration	Daily	Filtration	Protozoa, turbidity	Operator Log Sheets

Critical Limit
>0.5 NTU

- Confirm result with grab samples
- Breach of CCP is continued supply of water to customers above the Critical Limit
- Operator to contact Supervisor/Coordinator or Manager
- Supervisor/Coordinator or Manager to inform Compliance & IMS team on [redacted]
- If operator unable to contact chain of command, report directly to Compliance & IMS Team
- Compliance & IMS to contact DRDMW on 1300 596 709 as required
- If health advice required, Compliance & IMS or Manager to contact Mackay PHU on 4885 5800

Adjustment Limit
>0.2 NTU

- Check turbidity meter, clean and calibrate to confirm results
- Check raw water turbidity for changes since last dose rate change.
- Check clarified water pH and turbidity and adjust dosing as necessary
- Check coagulation dosing system, drop test to validate dose rate, jar test if required.
- Backwash filters
- Take filter offline if turbidity still above Adjustment Limit after multiple backwashes.
- Rectify any dosing issues and escalate to supervisor/coordinator

Target
<0.2 NTU

- When attending plant, inspect process for any visual signs of process failure
- Test the water as per DWQMP
- Record results
- Check raw water turbidity regularly and adjust coaguation dose rates as required (jar test as required)
- Complete routine cleaning and calibration of online meters
- Check SCADA trend for normal operation
- Ensure backwashes are undertaken and effective

CRITICAL CONTROL POINT PROCEDURE - CLERMONT

Disinfection

What is measured	Where is it measured	When is it measured	What is the control point	What are the hazards	Record Keeping
Free Chlorine	Grab sample post treated water reservoir	Daily (online)	Disinfection	Bacteria, viruses, chlorine	Operator Log Sheets

Critical Limit
>3.0 mg/L
<1.0 mg/L

- Confirm result with grab samples
- Operator to contact Supervisor/Coordinator or Manager
- If low chlorine, Supervisor/Coordinator and/or Manager to ensure sufficient chlorine contact time for disinfection with actual operational parameters.
- If water with < 15 mg.min/L is supplied to customers this is a reportable event
- If chlorine is > 5 mg/L this is reportable as an incident
- Supervisor/Coordinator or Manager to inform Compliance & IMS Team on [redacted]
- If operator unable to contact chain of command, report directly to Compliance & IMS Team
- Compliance & IMS to contact DRDMW on 1300 596 709 as required
- If health advice required contact Mackay PHU on 4885 5800

Adjustment Limit
>2.5 mg/L
<1.5 mg/L

- Confirm result with grab sample
- Check chlorine meter, clean and calibrate to confirm result
- Check dosing system for any issues or air locks
- Rectify any dosing issues
- Take WTP offline or reduce plant flow as required

Target
>1.5 mg/L
<2.5 mg/L

- When attending plant, inspect process for any visual signs of process failure
- Test the water as per DWQMP
- Record results
- Check cylinder weights and change empty cylinders as required
- Complete routine calibrations of online instruments to ensure accuracy

Validation: The smaller clearwater tank has a volume of 3 ML, a minimum operational volume of 50% and is not baffled (Baffle factor 0.1). The maximum plant flow rate is 60 L/s. Chlorine residual of 1 mg/L out of the smaller Clearwater tank at Clermont WTP achieves 41.6mg.min/L CT.

Table 36 Operational Control Points - Clermont WTP

PROCESS	PARAMETER	WHERE IS IT MEASURED	HAZARD	WHEN IS IT MEASURED	TARGET	ADJUSTMENT LIMIT	ACTION IF ADJUSTMENT LIMIT EXCEEDED	ALERT LIMIT	ACTION IF ALERT LIMIT EXCEEDED	REPORTING
Oxidation	Total Manganese	Treated water	Manganese	Daily	<0.1 mg/L	>0.1 mg/L	Confirm manganese reading, Check soluble manganese in treated water and free chlorine, Check clarifier total and soluble manganese, Adjust dosing rate	>0.5 mg/L	Confirm manganese reading, Divert the clarifier water to drain, Check permanganate dosing system, Shutdown if uncertain of cause, Check treated water free chlorine, Check network total and soluble manganese, free chlorine and colour, Operator to notify Supervisor/Coordinator/Manager Consider treated water reservoir drain down and network flushing, Assess permanganate dosing through jar testing	Operator to contact Supervisor/Coordinator and/or Manager as total manganese in treated water > 0.5 mg/L is a reportable event. Assess closely related reportables such as effective disinfection, treated water colour and network turbidity.
Coagulation	Turbidity	Clarified Water	Protozoa, Turbidity	Daily	< 1 NTU	> 2 NTU	Confirm turbidity reading, Check raw water turbidity, Check coagulation dosing system, drop test to validate dose rate.	> 5 NTU	Confirm turbidity reading, Check dosing system, Adjust dosing rate, Operator to notify Supervisor/Coordinator/Manager	Operator to contact Supervisor/Coordinator and/or Manager as failure to coagulate effectively is a reportable event
Chlorination	Free chlorine	Chlorinated water	Bacteria and viruses	Daily	>1.5 mg/L and <3.0 mg/L	<1.5 mg/L and >3.0 mg/L	Confirm free chlorine reading, Check chlorine dosing, Adjust dosing rate and monitor	< 1 mg/L Or > 3.5 mg/L	Confirm free chlorine reading, Check chlorine dosing, Adjust dosing rate and monitor, Operator to notify Supervisor/Coordinator/Manager	Internal reporting, Further see Disinfection CCP. Confirm CT is adequate
Disinfection	pH	Treated Water	pH, bacteria, and viruses	Daily	<7.5 >7.0	>7.5 <7.0	Confirm pH reading, Check dosing system, Adjust dosing rate	>8 <6.5	Confirm pH reading, Check dosing system, Adjust dosing rate, Operator to notify Supervisor/Coordinator/Manager	Internal reporting, Further See Coagulation OCP and Filtration CCP
OCP EXCEEDANCES ARE GENERALLY NOT REPORTABLE TO THE REGULATOR EXCEPT IF IT IS AN EVENT OR REPORTABLE HEALTH LIMIT										

Table 37 Quality Control Points

PROCESS	PARAMETER	WHERE IS IT MEASURED?	HAZARD	WHEN IS IT MEASURED	TARGET	ACTION IF TARGET LIMIT EXCEEDED	REPORTING
Oxidation Potassium permanganate	Soluble Manganese Soluble Iron Soluble UVA	Clarified water	Manganese and Iron	Weekly	Soluble Mn <0.03 mg/L Soluble Fe <0.05 mg/L Soluble UVA < 0.06	Confirm manganese, iron and UVA readings, Check permanganate dosing system and adjust dosing if required, Assess dosing rate of PAC for organic removal	Operator to notify Supervisor/Coordinator/Manager
Coagulation	pH	Post flash mixer	Protozoan / Turbidity	Daily	7.8 to 7.9	Confirm pH reading Check coagulation performance, Adjust dosing rate of alkali chemical, Refer to Filtration CCP	Operator to notify Supervisor/Coordinator/Manager
Coagulation	Aluminium	Clarified water	Aluminium	Weekly	<0.1 mg/L	Confirm Aluminium reading, Check coagulation performance and adjust dosing if required.	Operator to notify Supervisor/Coordinator/Manager
QCP EXCEEDANCES ARE GENERALLY NOT REPORTABLE TO THE REGULATOR EXCEPT IF THIS RESULTS IN ADWG (HEALTH) OR CCP EXCEEDANCE							

RAW WATER MONITORING

Raw water monitoring in Clermont is undertaken based on the principles outlined in the overarching DWQMP or as described in the algal management plan.

Table 38 Raw Water Monitoring Parameters

PARAMETER	FREQUENCY
Algal	Seasonally
Radiological	2 – years
Pesticides	Quarterly

VERIFICATION MONITORING

Water treatment operators are responsible for collecting and sending verification water quality samples to the laboratory. The monitoring principles and resulting minimum frequencies are identified in the overarching DWQMP. Table 39 summarises the verification monitoring in Clermont at both the WTP and in the reticulation network.

Table 39 Verification Monitoring

PARAMETER	FREQUENCY	TREATMENT PLANT	SAMPLE POINTS IN RETICULATION
E.coli	Weekly	No	SP 1-3
SWA	Monthly	Yes	Rotation SP 1-3
THMs	Quarterly	No	SP 3
Metals	Quarterly	Yes	Rotation SP 1-3

VERIFICATION MONITORING LOCATIONS

The monitoring locations in Clermont are shown in Figure 14 and Table 40. These locations are spread throughout Clermont and are representative of the water quality provided to the bulk of Clermont's customers.

Table 40 Clermont Monitoring Points

SAMPLE POINTS	NETWORK SAMPLING LOCATIONS	DESCRIPTION
1	[redacted]	[redacted]
2	[redacted]	[redacted]
3	[redacted]	[redacted]

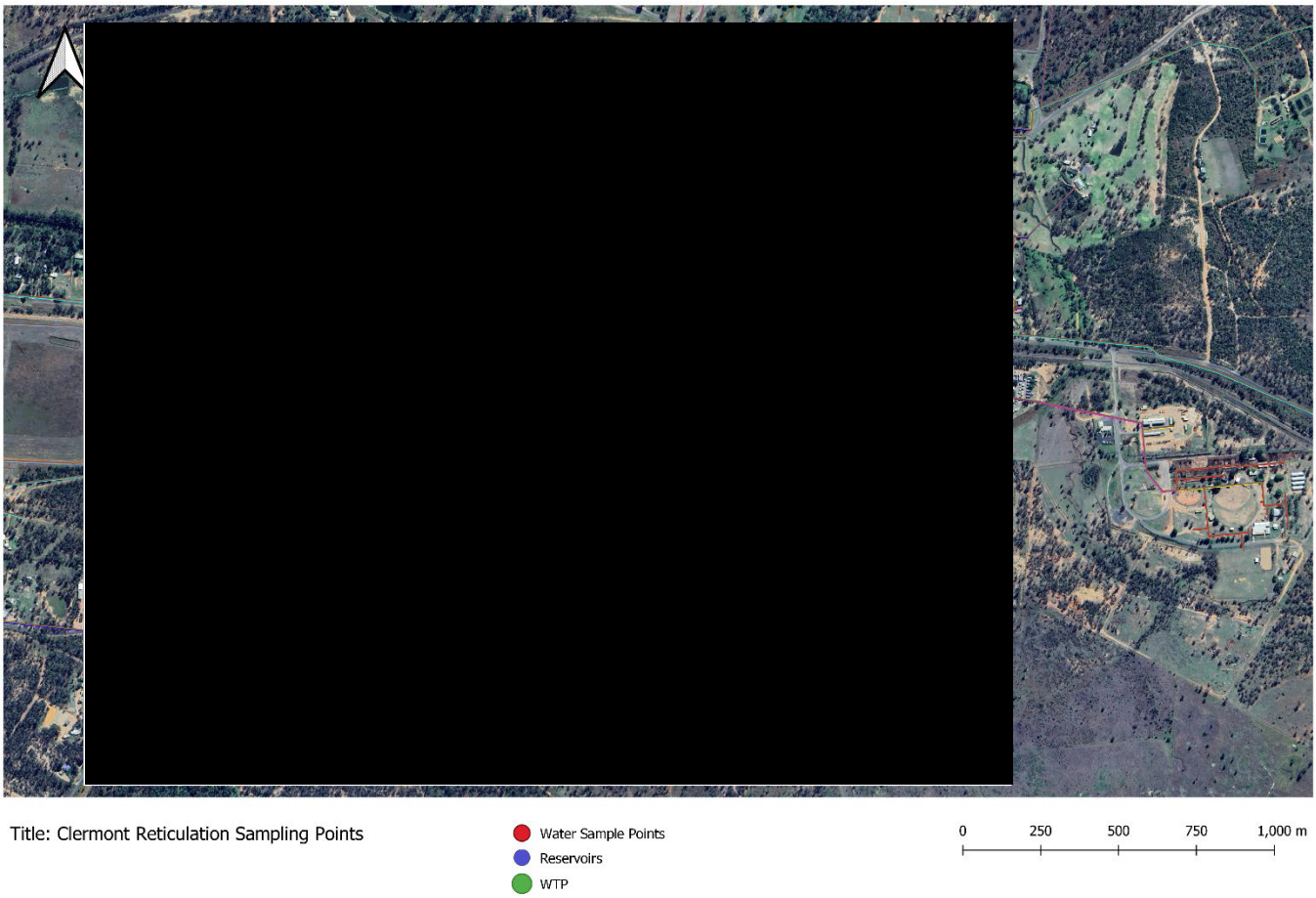


Figure 14 Clermont Verification Monitoring Locations

Response to out of specification results

Data from the verification monitoring is accessible via the Mackay Laboratory Monitor Pro Portal. The data is entered into spreadsheet records and the files on the share drive are accessible to all IRC Water and Wastewater Operational Staff. Refer to IRC Overarching DWQMP for Incident and Emergency Management.

APPENDIX 3

DYSART DRINKING WATER QUALITY MANAGEMENT PLAN

Dysart Drinking Water Quality Management Plan

Presented by: Water and Waste Directorate
Current as at: 20 August 2024

ISAAC REGION
HELPING TO ENERGISE THE WORLD

ISAAC.QLD.GOV.AU ISAAC REGIONAL COUNCIL ABN 39 274 142 600
P 1300 472 227 F 07 4941 8666 A PO Box 97 Moranbah QLD 4744
isaacregionalcouncil isaacregionalcouncil Isaacrcouncil

TABLE OF CONTENTS

OBJECTIVE

This plan details how Isaac Regional Council ensures the safety of drinking water for the Dysart community.

SCOPE

This plan is the Site-specific Drinking Water Quality Management Plan that together with the Overarching Drinking Water Quality Management Plan makes up the complete plan for Dysart.

DEFINITIONS

TERM / ACRONYM	MEANING
ADWG	Australian Drinking Water Guidelines
CCP	Critical Control Point
DRDMW	Department of Regional Development Manufacturing and Water
DWQMP	Drinking Water Quality Management Plan
DWQMP Guideline	Guideline for the preparation, review and audit of drinking water quality management plans.
IRC	Isaac Regional Council
OCP	Operational Control Point
NTU	Nephelometric turbidity units
PHA	*Public Health Act 2005*
QCP	Quality Control Point
QH	Queensland Health – regulator of public health – may take lead on managing incidents
Regulator	In the context of the DWQMP, the Regulator is DRDMW
RMIP	Risk Management Improvement Program
SCADA	Supervisory Control and Data Acquisition
SPID	Service Provider Identification Number
WSSRA	*Water Supply (Safety and Reliability) Act 2008*
WTP	Water Treatment Plant

REFERENCES

ID	NAME
	DWQMP Document Register

INTRODUCTION

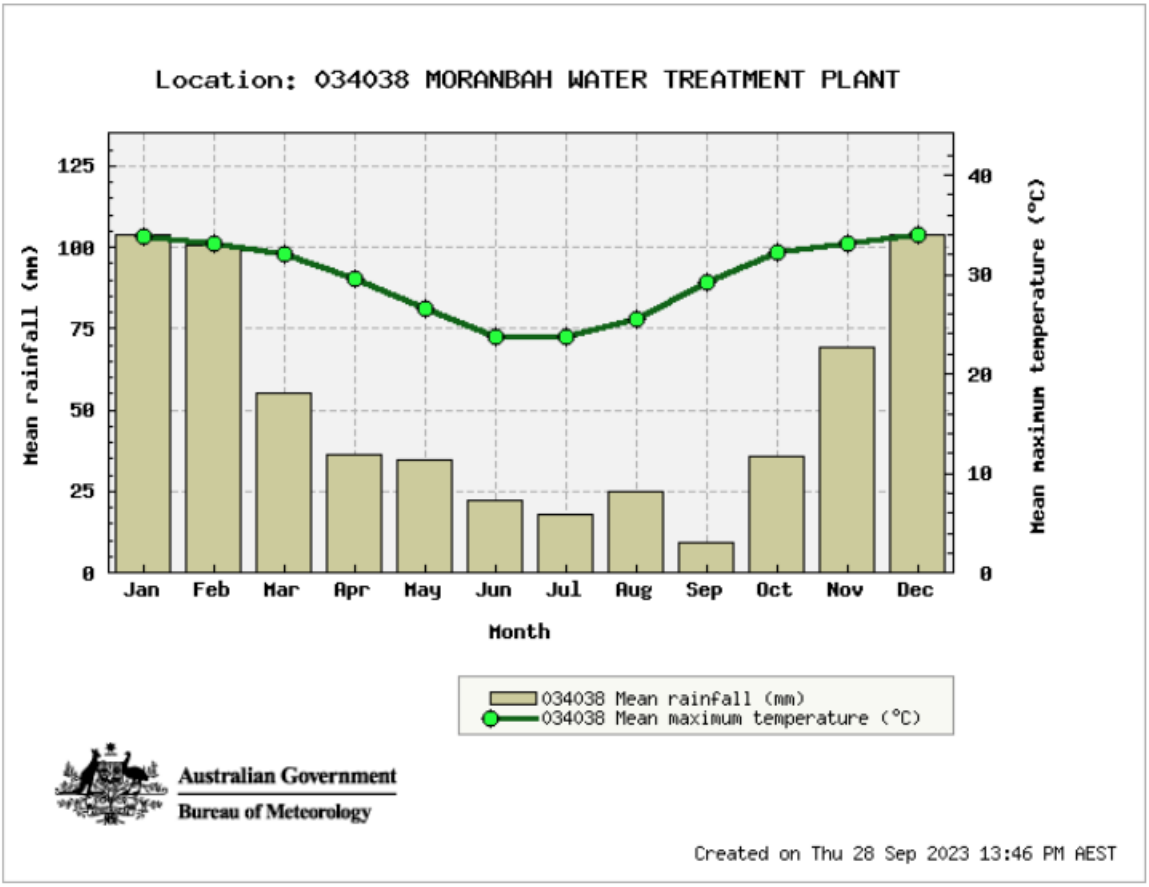
This site specific DWQMP documents the specific details of the Dysart drinking water scheme. It is intended to be an operational document that informs operational staff.

OVERVIEW OF THE SUPPLY SCHEME

Dysart is a rural town in Isaac Region of ~2900 people. In addition to the local residing population Dysart has a large fly-in fly-out population. The town is located ~85 km southeast of Moranbah and is a major hub for several large coal mines in central Queensland. Drinking water for the community is sourced from the Bingegang Weir of the Mackenzie River.

CLIMATE

The Dysart climate is characterised by a subtropical semi-arid climate. Rainfall (See Figure 15) within the catchment averages ~613 mm/year with more rain in summer than winter. The mean maximum temperature is 29.7 °C, with a mean max. above 30°C between October to March.



Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
Mean rainfall (mm) for years 1972 to 2012	103.8	100.7	55.4	36.4	34.5	22.1	18.0	25.0	9.1	35.7	69.3	103.9	613.0	39
Statistics	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**	**Years**
Mean maximum temperature (°C) for years 1986 to 2012	33.8	33.1	32.1	29.5	26.5	23.7	23.7	25.5	29.2	32.3	33.1	34.0	29.7	26

Figure 15 Rainfall and Temperature Data for Moranbah (closest to Dysart)

CATCHMENT CATEGORISATION

The Mackenzie River catchment encompasses an area of 79,615 km^2 and experiences an average annual rainfall ranging from 550 to 650 mm. The main activities in the catchment are mining related with some grazing and recreational activities such as swimming, sailing, and fishing. Based on the activity in the catchment area and the unprotected nature of the river and weir the raw water is characterised as a Category 4 catchment.

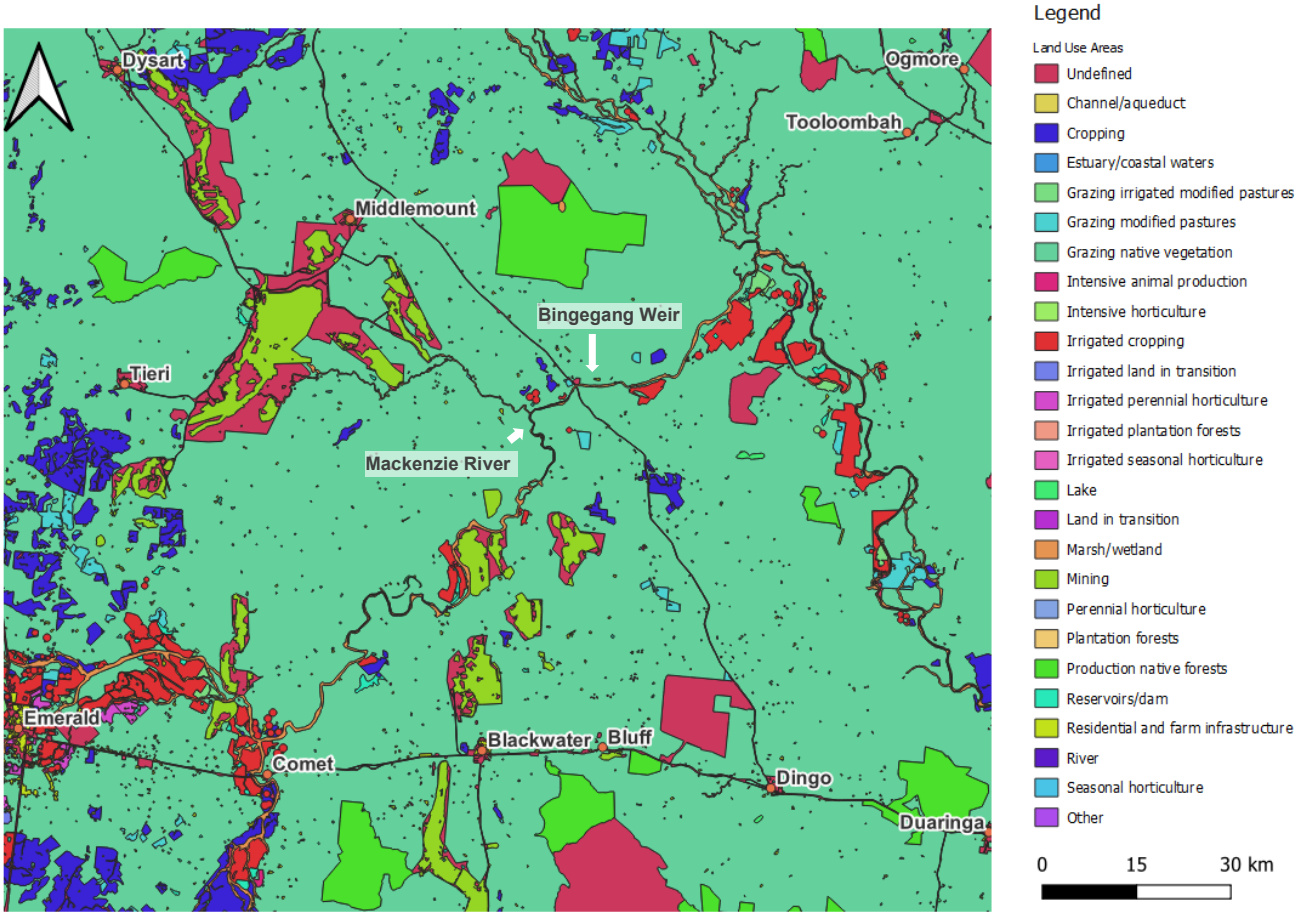


Figure 16 Land Use Map for Dysart Water Supply

TREATMENT PROCESS

OVERALL – CAPACITY

The Dysart WTP has a capacity rating of 70 L/s.

RAW WATER SOURCE

The Dysart WTP sources its raw water supply from the Bingegang Weir, which in turn draws water from the Mackenzie River. Before being pumped to Dysart WTP, water is kept in the Norwich Park Mine storage (200 ML) and a BMA operated Turkey's nest located adjacent to the Dysart WTP. A by-pass exists around the mine storage which can provide water straight to the BMA operated Turkey's nest.

RAW WATER PUMPING

SunWater is responsible for the management of the dam. The water scheme spanning from the Bingegang Weir to the turkey's nest is owned by BMA but is operated and maintained by SunWater. The raw water pipeline connecting the Bingegang Weir to BMA's Norwich Park Mine spans a distance of 134 km and has a

diameter ranging from 375 to 395 mm. This extensive pipeline route, supported by six (6) pump stations, serves various users, including mines, farms, and the Dysart WTP.

TURKEYS NEST

The raw water coming into Dysart is first collected in the turkey's nest where it is aerated. Raw water from the turkey's nest is pumped to the raw water tank and monitored using duty/standby raw water pumps and a flow meter.

RAW WATER TANK

A raw water tank (5 ML) serves as additional storage with buffering capacity. The WTP is gravity-fed from this tank through an operator-controlled valve. While there is piping and valving available to supply water from the raw water pump station straight to chemical dosing and oxidation tank (bypass raw water tank and Dissolved air flotation (DAF) unit), the valves are closed, and the raw water tank and DAF are permanently used. The supernatant return from the wastewater tank and sludge drying beds enters the raw water tank.

SUPERNATANT RETURN

Supernatant can optionally be returned to the Raw Water Tank from the drying beds at a rate of less than 5% of the total daily flow. Backwash water is typically irrigated and not recycled.

DAF

The DAF unit comprises two flocculation stages and a flotation chamber equipped with a float scraper. Raw water is dosed with Aluminium Chlorohydrate (ACH) using duty/standby pumps, standby arrangement is manually configured by operator. Sludge float is floated with saturated air and the float is continuously removed and directed to a sludge tank. From there, it is pumped to the sludge drying beds for further processing. The DAF sub natant is online monitored for turbidity before it is pumped into the raw water main upstream of the raw water dosing points and the oxidation tank.

POTASSIUM PERMANGANATE

Potassium permanganate is dosed, using duty/standby pumps with auto changeover, and auto shut down on zero plant flow, into the raw water main before it reaches the oxidation tank. The dose rate is flow paced and is subject to adjustment by operators.

POWDERED ACTIVATED CARBON (PAC)

Following the oxidation tank, PAC is dosed into the raw water upstream of the PAC contact tower using two pumps in duty/standby configuration with auto changeover and auto shut down on zero plant flow. Dosing is based on a fixed flow which limits PAC adjustments to preparation of different batch strengths.

ACH

Prior to the flash mixer ACH is dosed using two (2) pumps in duty/standby configuration with auto changeover and auto shut down on no flow. The dose rate is flow paced and is subject to adjustment by operators. After the coagulant is dosed water pumped into the flash mixer.

POLYMER

Polymer is dosed using three (3) dosing pumps in duty/duty/standby configuration into two (2) locations. Polymer is dosed post flash mixer and into individual pipes which lead to the individual flocculation chamber for each clarifier.

CLARIFICATION

Water flows from the flash mixer into the central flocculation chamber, which is situated within one (1) of two (2) clarifiers. A manually adjusted valve evenly distributes the flow to each clarifier.

Sludge removal is facilitated by an air-actuated de-sludge valve opening automatically based on a timer set by the operator.

Clarified water enters the launders and flows to the filters via the outlet channels.

CHLORINE OXIDATION

Prior to entering the filters, the clarified water is dosed with chlorine to facilitate the oxidation of any remaining soluble manganese. Chlorine gas is dosed from two (2) drums in duty/standby configuration with auto change over and automatic shut down on zero plant flow.

Chlorine can also be dosed prior to the raw water inlet, oxidation tank and filtered water tank if required.

FILTRATION

Clarified water flows into four (4) dual media filters, with two (2) filters dedicated to each clarifier. All filters have continuous monitoring for pressure differential, water level, and individual outlet turbidity, chlorine residual and pH. Filtered water is collected in the filtered water tank.

The initiation of the backwash sequence can occur either manually through operator intervention or automatically based on preprogrammed set points for run time, head loss and turbidity which are operator adjustable. Backwash water from the multi-media and Granular Activated Carbon (GAC) filters is collected in the wastewater tank.

WASTEWATER AND SLUDGE HANDLING

Backwash water is repurposed for irrigation on the WTP vicinity. Additionally, wastewater supernatant can be returned to the inlet of the raw water tank. Any surplus wastewater can either be pumped to sewer or be discharged into the sludge beds. The drying beds at the WTP serve as the recipient for both clarifier sludge and DAF float. Two (2) decant pumps, in duty/standby configuration with auto changeover and auto shutdown on no flow, situated in the overflow well at the end of the drying beds, facilitates the transfer of supernatant, redirecting it either back to the raw water tank or into the sewer system.

GRANULAR ACTIVATED CARBON (GAC) FILTER

The filtered water is treated using three (3) GAC filters with continuous monitoring of filter pressure differential and water levels. The initiation of the backwash sequence for the GAC filters can be carried out either manually by operators or automatically based on predetermined set points (operator adjustable) such as run time or head loss. The GAC filters can be bypassed by supplying filtered water straight into the clearwater tank pipe prior to the chlorine dosing point.

PRIMARY DISINFECTION

Filtered water is disinfected with chlorine gas at the inlet to the clear water tank. Chlorine gas is dosed from two (2) drums in duty/standby configuration with auto change over and automatic shut down on zero plant flow.

CLEARWATER TANK AND RESERVOIRS

Two (2) high lift pumps transfer treated water into two (2) high-level reservoirs. The reservoirs are interconnected reservoirs, one with a capacity of 5.25 ML and the other with a capacity of 3.75 ML. These reservoirs are situated approximately 2.8 km to the northwest of the WTP. The water then gravity feeds from

these elevated reservoirs into the Dysart reticulation network. Both reservoirs are enclosed with fencing, their roofs are secured to prevent entry by vermin to ensure safety and integrity.

RETICULATION NETWORK

The Dysart area is serviced by a network of approximately 33 km of reticulation pipelines (97% asbestos cement). Additionally, there are other pipeline materials in use, including Medium-Density Polyethylene (HDPE), PVC and Poly. The range of pipe age can be seen in Table 42.

The introduction of Smart Meters has also been implemented to gain better insights into water usage, losses, and to detect leaks and mains breaks more effectively.

Table 41 Dysart Reticulation Pipe Materials

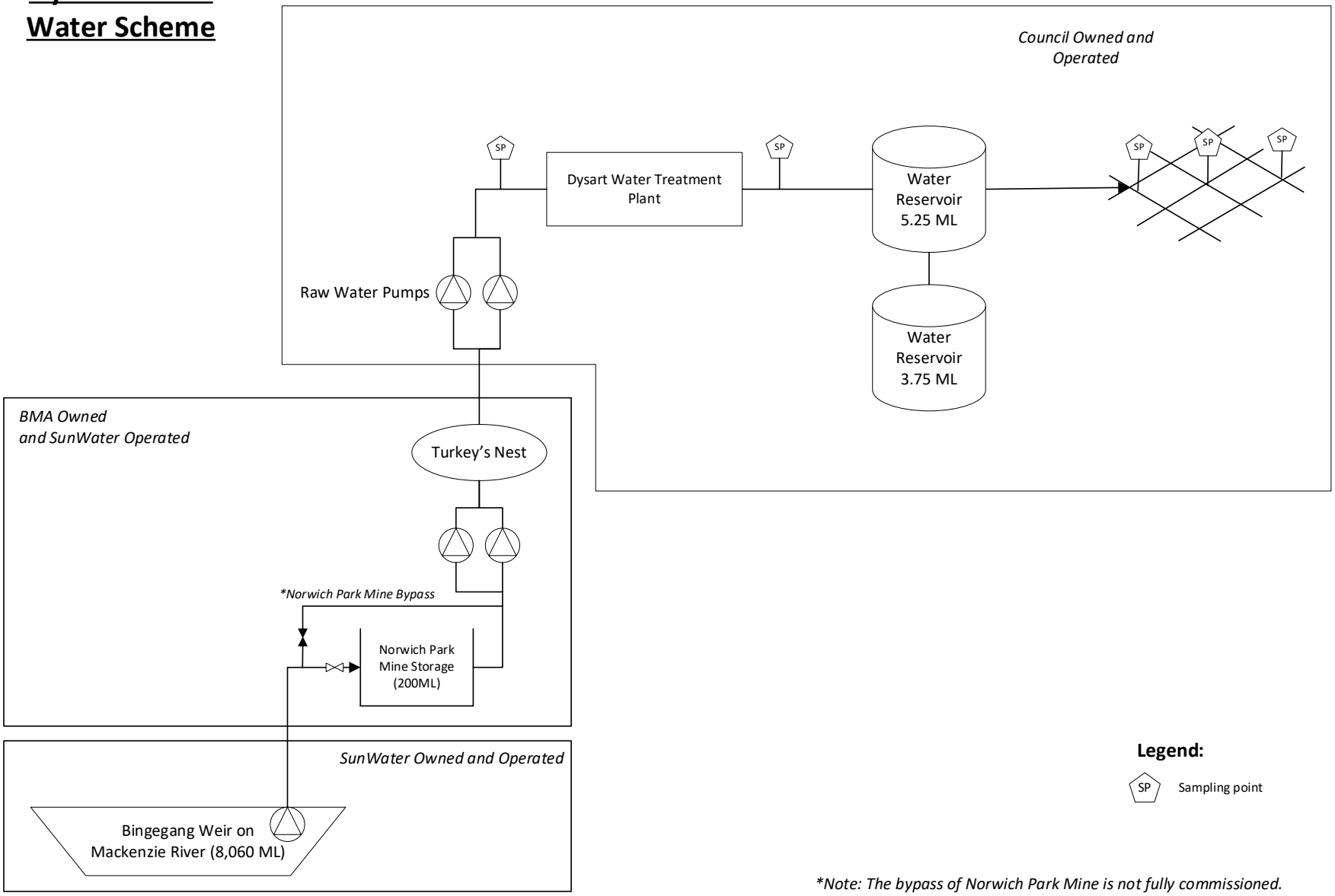
MATERIAL	DIAMETER [DN]	LENGTH [M]
Asbestos cement	65	29
	80	5
	100	11752
	150	10643
	200	2519
	225	1780
	300	871
	375	2907
	450	153
	525	1567
DICL	100	239
Poly	25	4
	50	519
	63	1201
	65	249

MATERIAL	DIAMETER [DN]	LENGTH [M]
PVC	100	4310
	150	787
uPVC	25	126
	65	223
	100	335
	150	131
	300	32
	375	17
oPVC	200	270
HDPE	40	58
	50	13
	100	22
Unknown	0	26
	100	41
	150	16

Table 42 Range of Pipe Age - Dysart

PIPE AGE	1-10 YEARS	11-20 YEARS	21-30 YEARS	31-40 YEARS	41-50 YEARS	51-60 YEARS	61-70 YEARS
Percentage of Network	3%	15%	0%	2%	80%	0%	0%

Dysart Overall Water Scheme



*Note: The bypass of Norwich Park Mine is not fully commissioned.

Figure 17 Dysart Catchment to Tap Schematic

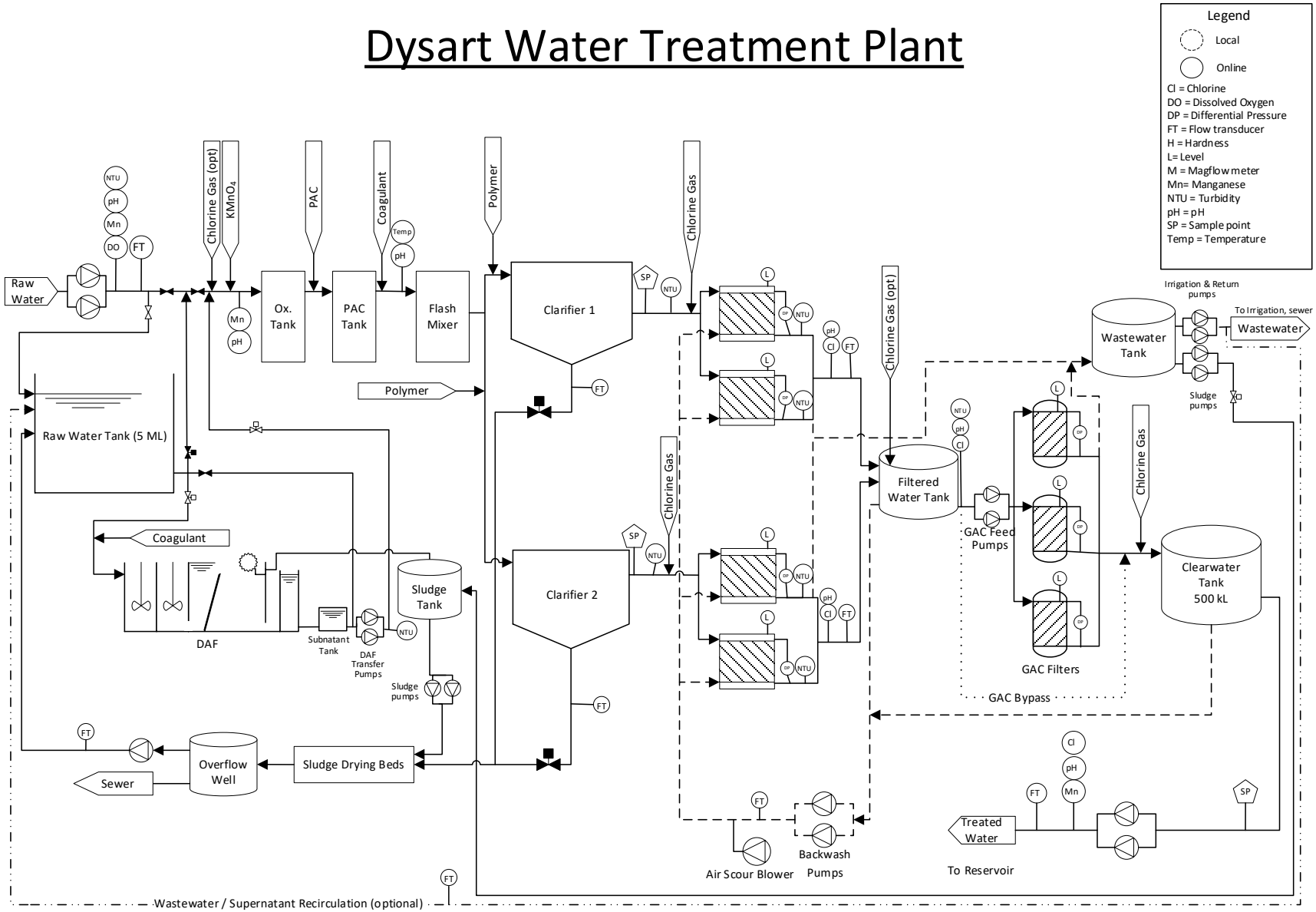


Figure 18 Dysart Treatment Plant Schematic

WATER QUALITY

RAW WATER

Raw water in Dysart is highly variable specifically for turbidity, pH and colour. Occasional spikes in total manganese and iron have been reported and have led to some issues in the treated water as well.

Table 43 Dysart Raw Water Monitoring (2017-2023)

	UNIT	# OF SAMPLES	MIN.	25TH %TILE	MEDIAN	75TH %TILE	MAX.	RANGE	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Alkalinity	mg/L $CaCO_3$	1711	0	85	100	110	250	250	65	140	100	23
App. Colour	HU	271	0	0	5	10	38	38	0	21	6.4	7.3
Conductivity	µS/cm	30	301	308	318	330	348	47	302	348	320	14
Free Chlorine	mg/L	243	0	0.19	0.53	0.97	3.9	3.9	0	2.1	0.72	0.67
Hardness	mg/L $CaCO_3$	28	25	41	50	60	65	40	30	65	49	10
pH	mg/L	1740	7	7.6	7.7	7.8	8.6	1.6	7.4	8.1	7.7	0.21
Sol. Iron	mg/L	81	0	0.015	0.03	0.04	0.18	0.18	0	0.089	0.032	0.029
Sol. Manganese	mg/L	79	0	0.032	0.047	0.068	0.11	0.11	0.026	0.092	0.05	0.022
Tot. Aluminium	mg/L	28	0	0.01	0.02	0.03	0.05	0.05	0.0045	0.046	0.021	0.011
Tot. Iron	mg/L	1681	0	0.02	0.04	0.06	1.2	1.2	0.01	0.26	0.06	0.093
Tot. Manganese	mg/L	1609	0	0.003	0.006	0.015	1.3	1.3	0.001	0.29	0.044	0.11
True Colour	HU	1733	0	20	30	40	260	260	10	65	33	18
Turbidity	NTU	1738	0.57	11	21	48	209	208	6.1	90	34	32
Sol. UVA_{254}	Abs	128	0.014	0.12	0.15	0.18	1.1	1.1	0.1	0.68	0.23	0.21

TREATED WATER

Operational

Treated water in Dysart shows a wide range of turbidity as well as total iron and in 2017 also total manganese. These issues have led to a number of customer complaints. The pH fluctuates greatly over a range of 6.2 to 8.8, but the majority is within ADWG aesthetic guideline.

Table 44 Summary Treated Water Monitoring (2017-2023)

	UNIT	# OF SAMPLES	MIN.	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Alkalinity	mg/L $CaCO_3$	1684	0	275	60	115	84	18
App. Colour	HU	281	0	5	0	0	0.15	0.8
Free Chlorine	mg/L	1731	0.07	4.7	1.3	2.9	2.1	0.5
Hardness	mg/L $CaCO_3$	1682	5	220	50	125	85	23
pH		1735	6.8	8.8	7.0	7.9	7.4	0.27
Sol. Iron	mg/L	10	0	0	0	0	0	0
Tot. Aluminium	mg/L	1590	0	0.4	0	0.09	0.037	0.029
Tot. Iron	mg/L	1633	0	0.15	0	0.02	0.0082	0.012
Tot. Manganese	mg/L	1571	0	0.85	0	0.02	0.022	0.091
True Colour	HU	1514	0	75	0	10	2	4.8
Turbidity	NTU	422	0.095	12	0.13	1.9	0.61	0.93
Turbidity (Inline)	NTU	1262	0	7.3	0.01	0.75	0.24	0.37
Turbidity (Lab)	NTU	1710	0	6.1	0.09	0.36	0.18	0.19
Sol. UVA_{254}	Abs	127	0.006	0.22	0.009	0.048	0.023	0.021

Verification

Verification monitoring data for Dysart is presented in Table 45. Chemical parameters with values under the limit of detection are presented as 0.5xLOD. Microbiological results under LOD are presented as 0.

Table 45 Verification monitoring – Dysart (2014-2023)

	# OF SAMPLES	MIN.	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Alkalinity - Residual (mq/L)	17	-0.039	0.05	-0.039	0.05	0.041	0.023
Alkalinity (mg/L)	108	51	287	56	120	83	34
Aluminium (µg/L)	155	2.4	201	4.6	34	16	18
Ammonia (mg/L)	46	0.0025	0.017	0.0025	0.014	0.0057	0.0029
Arsenic (µg/L)	19	0.25	0.88	0.25	0.88	0.4	0.19
Barium (µg/L)	5	36	48	36	48	42	6
Beryllium (µg/L)	4	0.25	0.5	0.25	0.5	0.31	0.13

	# OF SAMPLES	MIN.	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Boron (µg/L)	5	35	60	35	60	47	10
Bromate (µg/L)	89	2.5	25	5	25	8.5	5.4
Bromate^ (µg/L)	2	25	25	25	25	25	0
Cadmium (µg/L)	14	0.05	0.5	0.05	0.5	0.11	0.16
Calcium (mg/L)	71	14	89	16	32	24	12
Chlorate (µg/L)	87	5	164	10	25	22	19
Chlorate^ (µg/L)	2	25	25	25	25	25	0
Chlorite (µg/L)	88	2.5	25	5	25	8.6	5.5
Chlorite^ (µg/L)	2	25	25	25	25	25	0
Chromium (µg/L)	14	0.05	0.5	0.05	0.5	0.12	0.16
Cobalt (µg/L)	1	0.5	0.5	0.5	0.5	0.5	0
Colour - True (TCU)	118	0.5	29	0.5	7	2.2	3.4
Conductivity (µS/cm)	374	117	1138	209	569	319	117
Copper (µg/L)	14	12	366	12	366	53	91
E. coli (MPN/100mL)	907	0	1	0	0	0.0011	0.033
Fluoride (mg/L)	90	0.005	0.22	0.05	0.19	0.1	0.051
Formaldehyde (mg/L)	40	0.05	0.2	0.05	0.05	0.054	0.024
Free Chlorine Residual (Client tested) (mg/L)	691	0.02	4.4	0.27	2.7	1.5	0.73
Free Chlorine Residual (mg/L)	210	0.01	5	0.036	4.1	1.6	1.3
Gross alpha (Bq/L)	11	0.025	0.025	0.025	0.025	0.025	0
Gross beta (Bq/L)	11	0.05	0.17	0.05	0.17	0.082	0.048
Hardness - Temporary (mg/L)	94	30	127	52	111	78	17
Hardness (mg/L)	106	52	400	58	142	92	48
Iodide (µg/L)	7	10	10	10	10	10	0
Iron (µg/L)	161	1	64	1	8	3.3	8.3
Lead (µg/L)	19	0.25	4	0.25	4	0.59	0.85
Magnesium (mg/L)	71	5.7	44	6.2	18	10	6.3
Manganese (µg/L)	161	0.5	31	0.5	4.5	1.2	2.9
Mercury (µg/L)	19	0.025	0.3	0.025	0.3	0.22	0.086
Molybdenum (µg/L)	5	0.5	1	0.5	1	0.61	0.24
Nickel (µg/L)	14	0.25	2.5	0.25	2.5	1	0.57
Nitrate (mg/L)	108	0.0075	12	0.0075	2.1	0.9	2
Nitrite (mg/L)	108	0.002	0.44	0.002	0.2	0.077	0.1
pH (Client tested) (pH unit)	691	6.8	8.6	7	7.8	7.4	0.24
pH (pH unit)	174	4.8	8.7	7	8.1	7.5	0.39
Selenium (µg/L)	19	0.5	2.5	0.5	2.5	2.1	0.84
Silver (µg/L)	5	0.05	0.5	0.05	0.5	0.23	0.25
Sulphide (mg/L)	30	0.0025	0.04	0.0025	0.021	0.0039	0.0069
Tin (µg/L)	5	0.5	0.83	0.5	0.83	0.57	0.15

	# OF SAMPLES	MIN.	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Total Dissolved Solids (mg/L)	372	0.5	422	124	306	187	60
Trihalomethanes (Total) (µg/L)	136	10	247	21	168	68	46
Trihalomethanes (Total)^ (µg/L)	23	2.6	103	3.7	97	39	23
Turbidity (Client tested) (NTU)	314	0.05	3	0.05	0.46	0.21	0.26
Turbidity (NTU)	125	0.05	92	0.05	3.3	1.6	8.3
Uranium (µg/L)	5	0.25	0.5	0.25	0.5	0.35	0.14
Zinc (µg/L)	14	5	27	5	27	14	6.8

CUSTOMER COMPLAINTS

Historic customer complaints in Dysart, thirty (30) in total between 2014-2021, covered discoloured water as well as taste and odour. There were no customer complaints in the FY 22-23.

Table 46 Customer complaints - Dysart

Year	No of Water Quality Complaints	Main Reasons for Complaints	Likely Sources / Causes of Problems	Resolution of Problem
2014-15	1	Dirty water	Related to mains flushing	
2015-16	13	Discoloured water and odour	The water quality data are generally in line with the ADWG.	Localised and mains flushing performed. Raw water quality and WTP processes reviewed and adjusted.
2016-17	6	Water taste	No information recorded to indicate the cause of complaint.	Localised and mains flushing performed. Raw water quality and WTP processes reviewed and adjusted.
2017-18	4	Discoloured water	No information recorded to indicate the cause of complaint.	Localised and mains flushing performed. WTP processes reviewed.
2018-19	2	Discoloured water	No information recorded to indicate the cause of complaint.	Localised and mains flushing performed. WTP processes reviewed.
2019-20	2	Discoloured water	Cause of the complaint not known	Localised and mains flushing performed.
2020-21	2	Odour	Samples taken within ADWG	Supervisor unable to determine the cause

INCIDENTS

There were two (2) incidents between 2017 and 2023 in Dysart. Both reported elevated turbidity.

Table 47 Summary of reported incidents - Dysart (2017-2023)

INCIDENT DATE	Date/ Reference	Location	Parameter	Description of event	Improvement
23/06/2021	DWI-486-22-09512	Ex-clear well	Turbidity (3.03 NTU)	Transcription error	
11/11/2020	DWI-486-22-09513	Ex-clear well	Turbidity (2.56 NTU)	Transcription error	

RISK ASSESSMENT

SCHEME MITIGATED RISK ASSESSMENT

Table 48 Mitigated Risk Assessment - Dysart

Ref	Treatment Stage	Primary Hazard	Other hazards managed by barrier	Hazardous Event	Unmitigated Risk	Control Measures in place	Comment	Mitigated Consequence	Mitigated Likelihood	Mitigated Risk	Uncertainty	Improvement Action Required - Immediate	Improvement Action Required ~ 2 years	Improvement Action Required - Long term
DYS1	Raw Water Abstraction	Protozoa (Category 4)	Bacteria and virus, turbidity, Cyanobacteria	Normal operation	Extreme 25	DAF and conventional filtration, GAC filtration and chlorine disinfection.	Cat 4	Catastrophic	Rare	Medium 6	Reliable	Review of BGA management plan (by Dec 2024)		
DYS2	Supernatant return	Protozoa (Category 4)		Recirculation of protozoa to head of plant	Extreme 25	Supernatant returned based on level in the pump well, maximum flow of 6L/s into the 80L/s raw water flow but not linked to plant flow. Coagulation, filtration, GAC filtration.	Enters into pipe into the inlet of the raw water tank. Normally diluted in the raw water tank. Backwash water normally irrigated.	Catastrophic	Rare	Medium 6	Reliable	Develop procedure to isolate supernatant return if raw water tank is offline. Is possible to discharge to sewer.		
DYS3	Chemical Dosing - Aluminium Chlorohydrate (ACH)	Protozoa (Category 4)	Turbidity, Cyanobacteria and toxins	Underdose coagulant/ poor coagulation	Extreme 25	Dose rate adjusted based on historical information. Typically 8 mg/L. Coagulation, filtration, GAC filtration.	Single dosing pump Auto shutdown Flow paced, clarification, filtration, GAC filtration.	Catastrophic	Rare	Medium 6	Reliable	Consider alarms for DAF turbidity meter		
DYS4	Chemical Dosing - Aluminium Chlorohydrate (ACH)	Aluminium - coagulant	Turbidity	Overdose of coagulant	Medium 6	Dose rate adjusted based on historical information.	Single dosing pump Auto shutdown Flow paced	Minor	Rare	Low 2	Confident			
DYS5	Dissolved Air Flotation (DAF)	Protozoa (Category 4)	Turbidity	Underdose coagulant/ poor coagulation. Failure of dissolved air.	Extreme 25	Coagulation, filtration, GAC filtration.	Online NTU on subnatant- but no alarms to operator. Option to run water through DAF without coagulant.	Catastrophic	Rare	Medium 6	Confident			
DYS6	DAF Bypass	Protozoa (Category 4)		Bypass of DAF	Extreme 25	DAF can be bypassed, but this is not the normal operation. Still a clarification process after the DAF. Coagulation, filtration, GAC filtration.	Manual valve closed	Catastrophic	Rare	Medium 6	Certain			
DYS7	Chemical Dosing - Chlorine gas	Manganese surface water		Underdose preoxidant resulting in Mn in treated water	High 12	Optional dosing point, not used since KMnO4. Chlorine monitored downstream of disinfection process.	Duty/standby Auto shutdown and changeover	Moderate	Rare	Low 3	Confident			
DYS8	Chemical Dosing - Chlorine gas	Chlorine	DBPs	Overdose of preoxidant, increasing DBPs above health guideline	High 12	Optional dosing point, not used since KMnO4. Chlorine monitored downstream of disinfection process.	Duty/standby Auto shutdown and changeover	Moderate	Rare	Low 3	Confident			
DYS9	Chemical Dosing - Potassium permanganate	Manganese surface water	Iron	Underdose of potassium permanganate	High 12	Jar Tests as required	Duty/standby Auto shutdown and changeover Flow paced	Moderate	Possible	Medium 9	Reliable			
DYS10	Chemical Dosing - Potassium permanganate	Manganese - dosing		Overdose of potassium permanganate	High 12	Jar Tests as required	Duty/standby Auto shutdown and changeover Flow paced	Moderate	Unlikely	Medium 6	Reliable	Have been incidents where dosing continued after plant has shut down. May be siphoning.		
DYS11	Chemical Dosing - Sodium hydroxide	pH		Over or underdose	Medium 9	Not currently used	Pipes in place but no pumps setup at all	Moderate	Unlikely	Medium 6	Reliable			
DYS12	Chemical Dosing - Powdered Activated Carbon (PAC)	Taste and odour	Cyanobacterial toxins	Underdose PAC	Medium 8	Typical 1% concentration dose rate. Required for MIB and geosmin.	Duty/standby Auto shutdown and changeover, no alarms, no working scale on chemical storage.	Minor	Likely	Medium 8	Reliable	Repair PAC scales to ensure chemical usage can be monitored.		

Ref	Treatment Stage	Primary Hazard	Other hazards managed by barrier	Hazardous Event	Unmitigated Risk	Control Measures in place	Comment	Mitigated Consequence	Mitigated Likelihood	Mitigated Risk	Uncertainty	Improvement Action Required - Immediate	Improvement Action Required ~ 2 years	Improvement Action Required - Long term
DYS13	Chemical Dosing - Powdered Activated Carbon (PAC)	Turbidity		Overdose PAC	High 10	Typical 1% concentration dose rate. Required for MIB and geosmin.	Duty/standby Auto shutdown and changeover	Minor	Unlikely	Low 4	Reliable			
DYS14	Chemical Dosing - Aluminium Chlorohydrate (ACH)	Protozoa (Category 4)	Turbidity	Underdose ACH	Extreme 25	Turbidity meter on clarifier. 5 NTU. Coagulation, filtration, GAC filtration.	Single dosing pump, Flow paced	Catastrophic	Unlikely	High 10	Reliable	Ensure alarms to operators at 5 NTU or shuts down plant. Reinstate all meters and other alarms.		
DYS15	Chemical Dosing - Aluminium Chlorohydrate (ACH)	Aluminium - coagulant	Turbidity	Overdose ACH	Medium 6	Turbidity meter on clarifier. 5 NTU.	Single dosing pump, Flow paced	Minor	Rare	Low 2	Confident			
DYS16	Clarification	Protozoa (Category 4)	Turbidity	Failure of clarification process	Extreme 25	Turbidity meter on clarifier. 5 NTU. Coagulation, filtration, GAC filtration.	Single dosing pump, Flow paced	Catastrophic	Unlikely	High 10	Estimate	Single dosing pump, Flow paced		
DYS17	Chemical Dosing - Chlorine gas	Chlorine		Overdose chlorine	High 12	Typical target is 0.3 mg/L off the filter.	Duty/standby Auto shutdown and changeover Can dose up to 2.5 mg/L to achieve 0.3 mg/L off filter.	Moderate	Rare	Low 3	Reliable	Plant can operate without chlorine - investigate control philosophy. Replace dosing lines with chemical compatible materials		
DYS18	Chemical Dosing - Chlorine gas	DBPs		Reaction of chlorine with organics	Medium 9	GAC filtration, chlorine CCP	Duty/standby Auto shutdown and changeover GAC filtration.	Moderate	Unlikely	Medium 6	Confident			
DYS19	Filtration - Media filtration	Protozoa (Category 4)	Turbidity	Filter breakthrough	Extreme 25	Backwashed typically every 9 hours of operation, also on turbidity. Target < 0.2 NTU. Coagulation, filtration, GAC filtration.	Individual online DP, NTU, level, pH and Cl2, GAC filtration.	Catastrophic	Unlikely	High 10	Estimate	Service meters and reinstate shutdowns		Undertake assessment of HBT performance and discuss with regulator the credit applied to the GAC filters.
DYS20	Filtration - Media filtration	Protozoa (Category 4)	Turbidity	Poor backwash	Extreme 25	Backwashed typically every 9 hours of operation, also on turbidity. Coagulation, filtration, GAC filtration.	Individual online DP, NTU, level, pH and Cl2, GAC filtration.	Catastrophic	Unlikely	High 10	Reliable	Service meters and reinstate shutdowns		
DYS21	Filtered water to town	Bacteria/Virus		Underdose chlorine	Extreme 25	Only used if downstream maintenance is required, preventing use of clear water tank.	500kL filtered water tank can also be disinfected and directed to town. Not normally used. Would need to rely on treated water chlorine meter for CCP under this scenario.	Catastrophic	Rare	Medium 6	Reliable			
DYS22	Filtration - Granular Activated Carbon (GAC)	DBPs	Cyanobacterial toxins, Turbidity	DBP in reticulation	Medium 9	GAC in place	Online level and DP, final treated water turbidity. Backwashed ~ 90 hours of operation.	Moderate	Unlikely	Medium 6	Reliable			
DYS23	GAC bypass	DBPs		DBP in reticulation	Medium 9	Chlorine CCP, daily monitoring.	GAC can be taken offline for maintenance. Can either use clearwater tank, or also bypass clearwater tank.	Moderate	Unlikely	Medium 6	Reliable			
DYS24	Disinfection - chlorine gas	Bacteria/Virus		Underdose	Extreme 25	Validated CCP limit	Duty/standby Auto shutdown and changeover. Can also optionally disinfect into the filtered water tank (if GAC offline).	Catastrophic	Unlikely	High 10	Reliable	Chlorine meter to be reinstated, ideally recirculating in clearwater tank.		
DYS25	Disinfection - chlorine gas	Chlorine	DBPs	Overdose	High 12	Conventional treatment, Chlorination CCP	Duty/standby Auto shutdown and changeover. Can also optionally disinfect into the filtered water tank (if GAC offline). DBPs removed by GAC filtration.	Moderate	Unlikely	Medium 6	Confident			

OPERATIONAL MONITORING

Table 49 Dysart Operational Monitoring

PARAMETER	RAW WATER	POST DAF	DOSED WATER PRE FLASH	CLARIFIED WATER	FILTERED WATER	TREATED WATER	CT WATER (POST TWR)	NETWORK WATER
Alkalinity	Weekly					Weekly		
Aluminium				Weekly		Weekly		
pH	Daily, Online	Online	Online	Daily	Online	Daily, Online	2 x Weekly	2 x Weekly
Free Chlorine					Daily, Online	Daily, Online	2 x Weekly	2 x Weekly
Temperature	Daily		Online			Daily		Weekly
Tot. Hardness						Weekly		
Tot. Iron	Weekly					Weekly		Weekly
Sol. Iron	Daily			Weekly				
Tot. Manganese	Weekly, Online	Online				Daily, Online		Weekly
Sol. Manganese	Daily			Weekly				
True Colour	Daily			Daily		Daily		2 x Weekly
Turbidity	Daily, Online	Online		Daily, Online	Daily, Online	Daily, Online	2 x Weekly	2 x Weekly
Sol. UVA_{254}	Weekly			Weekly				

Response to out of specification results for relevant parameters are managed through CCPs and OCPs

Operators check the calibration of online instruments with the results from their lab/benchtop analysis as part of the operational monitoring.

CRITICAL CONTROL POINTS

CRITICAL CONTROL POINTS

The critical control points (CCP) for the scheme were identified in the risk assessment process, and include:

- Filtration – filtered water turbidity
- Chlorination – free chlorine

The CCP procedures are included in the following pages. These are presented as traffic lights and identify the location, monitoring, performance, and validation of the process. The traffic lights are aligned to SCADA where the low and high limits match the adjustment level and (as appropriate) the high and low alarms match the critical limit.

OPERATIONAL CONTROL POINTS

Dysart WTP has four (4) operational control points (OCP) for the following process.

- Coagulation – clarified water turbidity
- Oxidation – treated water total manganese.
- Chlorination – treated water free chlorine
- Disinfection – treated water pH

An OCP exceedance is generally not reportable to the regulator except if it is an event that requires reporting. Incident reporting to the regulator is based on CCPs or exceedances of ADWG health guidelines.

QUALITY CONTROL POINTS

Dysart WTP has three (3) quality control points (QCP) for three (3) processes.

- DAF - turbidity
- Oxidation (Potassium Permanganate) – clarified water soluble iron, manganese, and UVA
- Coagulation – clarified water aluminium

The CCPs, OCPs and QCPs can be found below.

CRITICAL CONTROL POINT PROCEDURE - DYSART

Filtration

What is measured	Where is it measured	When is it measured	What is the control point	What are the hazards	Record Keeping
Turbidity	Post filtration	Continous online and daily grab sample	Filtration	Protozoa, turbidity	Operator Log Sheets

- Confirm result with grab samples
- Breach of CCP is continued supply of water to customers above the Critical Limit
- Operator to contact Supervisor/Coordinator or Manager
- Supervisor/Coordinator or Manager to inform Compliance & IMS team on [redacted]
- If operator unable to contact chain of command, report directly to Compliance & IMS Team
- Compliance & IMS to contact DRDMW on 1300 596 709 as required
- If health advice required, Compliance & IMS or Manager to contact Mackay PHU on 4885 5800

- Check turbidity meter, clean and calibrate to confirm results
- Check raw water turbidity for changes since last dose rate change
- Check clarified water pH and turbidity and adjust dosing as necessary
- Check coagulation dosing system, jar test if required
- Backwash filters
- Take filter offline if turbidity still above Adjustment Limit after multiple backwashes
- Rectify any dosing issues and escalate to supervisor

- When attending plant, inspect process for any visual signs of process failure
- Test the water as per DWQMP
- Record results
- Check raw water turbidity regularly and adjust coaguation dose rates as required (jar test as required)
- Complete routine cleaning and calibration of online meters
- Check SCADA trend for normal operation
- Ensure backwashes are undertaken and effective

CRITICAL CONTROL POINT PROCEDURE - DYSART

Disinfection

What is measured	Where is it measured	When is it measured	What is the control point	What are the hazards	Record Keeping
Free Chlorine	Grab sample post treated water reservoir	2x weekly	Disinfection	Bacteria, viruses, chlorine	Operator Log Sheets

Critical Limit
>3.0 mg/L
<0.7 mg/L

- Confirm result with grab samples
- Operator to contact Supervisor/Coordinator or Manager
- If low chlorine, Supervisor/Coordinator and/or Manager to ensure sufficient chlorine contact time for disinfection with actual operational parameters
- If water with < 15 mg.min/L is supplied to customers this is a reportable event
- If chlorine is > 5 mg/L this is reportable as an incident
- Supervisor/Coordinator or Manager to inform Compliance & IMS Team on [redacted]
- If operator unable to contact chain of command, report directly to Compliance & IMS Team

Adjustment Limit
>2.0 mg/L
<1.0 mg/L

- Confirm result with grab sample
- Check chlorine meter, clean and calibrate to confirm result
- Check dosing system for any issues or air locks
- Rectify any dosing issues
- Take WTP offline or reduce plant flow as required

Target
>1.0 mg/L
<2.0 mg/L

- When attending plant, inspect process for any visual signs of process failure
- Test the water as per DWQMP
- Record results
- Check cylinder weights and change empty cylinders as required
- Complete routine calibrations of online instruments to ensure accuracy

Validation: Chlorine residual of 0.7 mg/L out of the clearwater tank at Dysart WTP achieves 6.6mg.min/L C.t. The clearwater tank has a volume of 500 kL, a minimum operational volume of 80% and is not baffled (Baffle factor 0.1). The maximum plant flow rate is 70 L/s. Following the CWT water is stored in the 2 interconnected treated water reservoirs. The smaller reservoir is 3.75 ML, at a peak flow of 41.5 L/s, chlorine residual of 0.7 mg/L, 70% minimum operational capacity and a baffle factor of 0.1 the reservoir provides an additional 73.8 mg.min/L C.t.

Table 50 Operational Control Points - Dysart WTP

PROCESS	PARAMETER	WHERE IS IT MEASURED?	HAZARD	WHEN IS IT MEASURED	TARGET	ADJUSTMENT LIMIT	ACTION IF ADJUSTMENT LIMIT EXCEEDED	ALERT LIMIT	ACTION IF ALERT LIMIT EXCEEDED	REPORTING
Coagulation	Turbidity	Clarified water	Protozoa, Turbidity	Daily	< 1 NTU	> 2 NTU	Confirm turbidity reading, Check raw water turbidity, Check coagulation dosing system, drop test to validate dose rate.	> 5 NTU	Confirm turbidity reading, Check dosing system, Adjust dosing rate, Operator to notify Supervisor / Manager	Operator to contact Supervisor/Coordinator and/or Manager as failure to coagulate effectively is a reportable event
Oxidation	Total Manganese	Treated water	Manganese	Weekly	<0.1 mg/L	>0.1 mg/L	Confirm manganese reading, Check soluble manganese in treated water and free chlorine, Check clarifier total and soluble manganese, Adjust dosing rate	>0.5 mg/L	Confirm manganese reading, Divert the clarified water, Check permanganate dosing system, Shutdown if uncertain of cause, Check treated water free chlorine, Check network total and soluble manganese, free chlorine and colour, Operator to notify Supervisor / Manager Consider treated water reservoir drain down and network flushing, Assess permanganate dosing through jar testing	Operator to contact Supervisor/Coordinator and/or Manager as total manganese in treated water > 0.5 mg/L is a reportable event. Assess closely related reportables such as effective disinfection, treated water colour and network turbidity
Chlorination	Free chlorine	Treated water	Bacteria and virus	Daily	>2 mg/L and < 3 mg/L	< 2 mg/L and > 3 mg/L	Confirm free chlorine reading, Check chlorine dosing, Adjust dosing rate and monitor	<1.5mg/L and >3.5mg/L	Confirm free chlorine reading, Check chlorine dosing, Adjust dosing rate and monitor, Operator to notify Supervisor / Manager	Internal reporting, Further see Disinfection CCP. Confirm Ct is adequate
Disinfection	pH	Treated water	pH, Bacteria, Viruses, Protozoa	Daily	>7.0, <8.0	<7.0, >8.0	Confirm pH reading	>8.5, <6.5	Confirm pH reading, Operator to notify Supervisor / Manager	Operator to contact Supervisor/Coordinator and/or Manager as high pH above 8.5 may impact disinfection effectiveness
OCP EXCEEDANCES ARE GENERALLY NOT REPORTABLE TO THE REGULATOR EXCEPT IF IT IS AN EVENT OR REPORTABLE HEALTH LIMIT										

Table 51 Quality Control Points - Dysart WTP

PROCESS	PARAMETER	WHERE IS IT MEASURED?	HAZARD	WHEN IS IT MEASURED	TARGET	ACTION IF TARGET LIMIT EXCEEDED	REPORTING
DAF	Turbidity	Post DAF	Protozoa, Turbidity	Daily, Online	< 5 NTU	Confirm turbidity reading, Check DAF system, Adjust dosing rate, aeration rate or other parameters Operator to notify Supervisor / Manager	Operator to notify Supervisor/Coordinator and/or Manager
Oxidation	Soluble Manganese Soluble Iron Soluble UVA	Clarified water	Manganese and Iron	Weekly	Soluble Mn <0.03 mg/L Soluble Fe <0.05 mg/L Soluble UVA < 0.06	Confirm manganese, iron and UVA readings, Check permanganate dosing system and adjust dosing if required, Assess dosing rate of PAC for organic removal	Operator to notify Supervisor/Coordinator and/or Manager
Coagulation	Aluminium	Clarified water	Aluminium	Weekly	<0.1 mg/L	Confirm Aluminium reading, Check coagulation performance and adjust dosing if required.	Operator to notify Supervisor/Coordinator and/or Manager
QCP EXCEEDANCES ARE GENERALLY NOT REPORTABLE TO THE REGULATOR EXCEPT IF THIS RESULTS IN ADWG (HEALTH) OR CCP EXCEEDANCE							

RAW WATER MONITORING

Raw water monitoring in Dysart is undertaken based on the principles outlined in the overarching DWQMP.

Table 52 Raw water monitoring parameters

PARAMETER	FREQUENCY
Radiological	2 – years
Algal	Seasonally
Pesticides	Quarterly

VERIFICATION MONITORING

Table 53 Verification monitoring parameters

PARAMETER	FREQUENCY	WTP	SAMPLE POINTS IN RETICULATION
E.coli	Weekly	No	SP 1-3
SWA	Monthly	Yes	Rotation SP 1-3
THMs	Quarterly	No	SP 1
Metals	Quarterly	Yes	Rotation SP 1-3

VERIFICATION MONITORING LOCATIONS

The monitoring locations in Dysart are shown in Figure 19 and Table 54. These locations are spread around Dysart and represent the majority of the water quality provided to Dysart's customers. THMs should be tested at [redacted] for a more accurate reflection of the water quality in the peripheric parts of town.

Table 54 Dysart Monitoring Points

SAMPLE POINTS	NETWORK SAMPLING LOCATIONS	COMMENT
1	[redacted]	
2	[redacted]	
3	[redacted]	

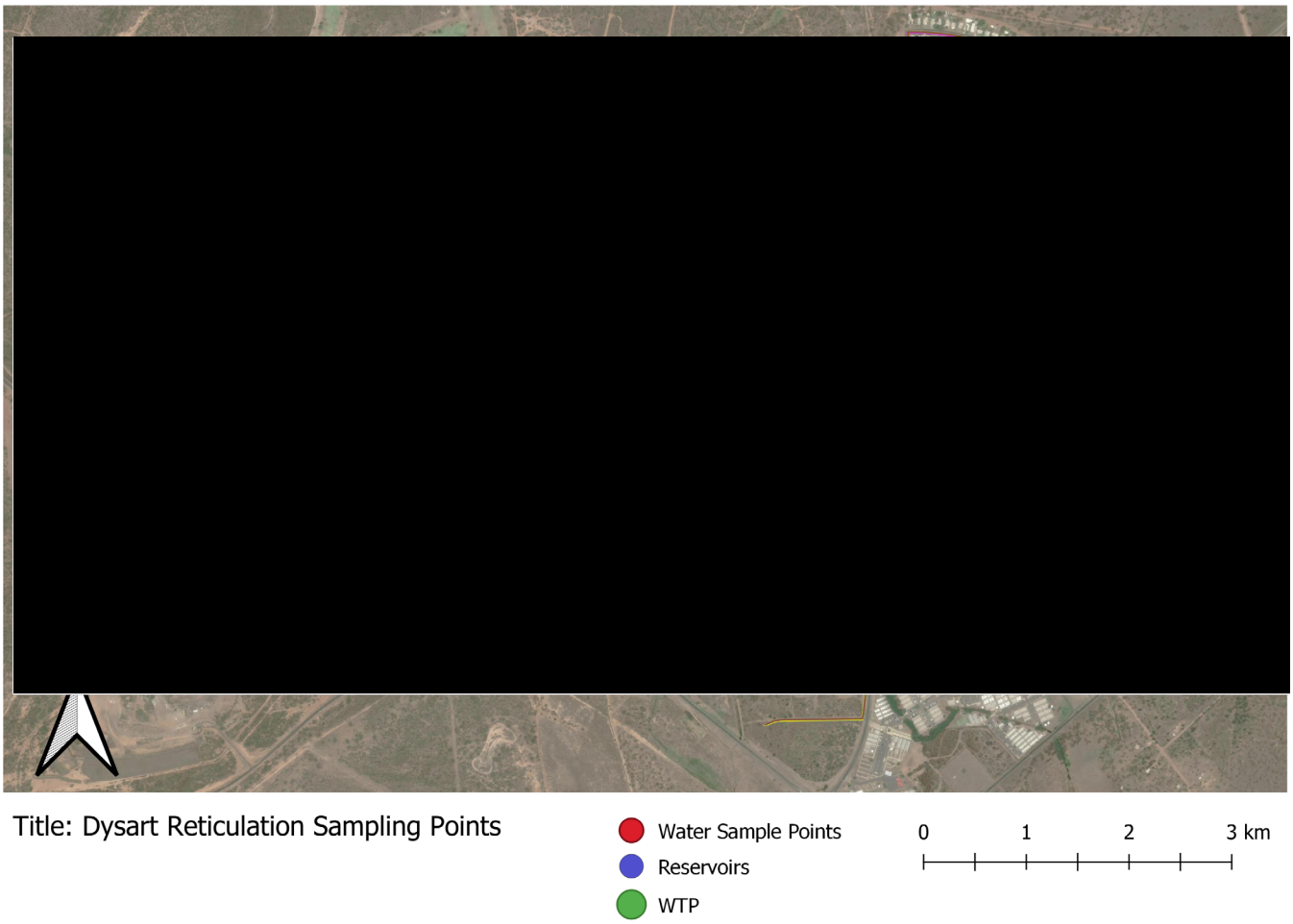


Figure 19 Dysart Verification Monitoring Locations

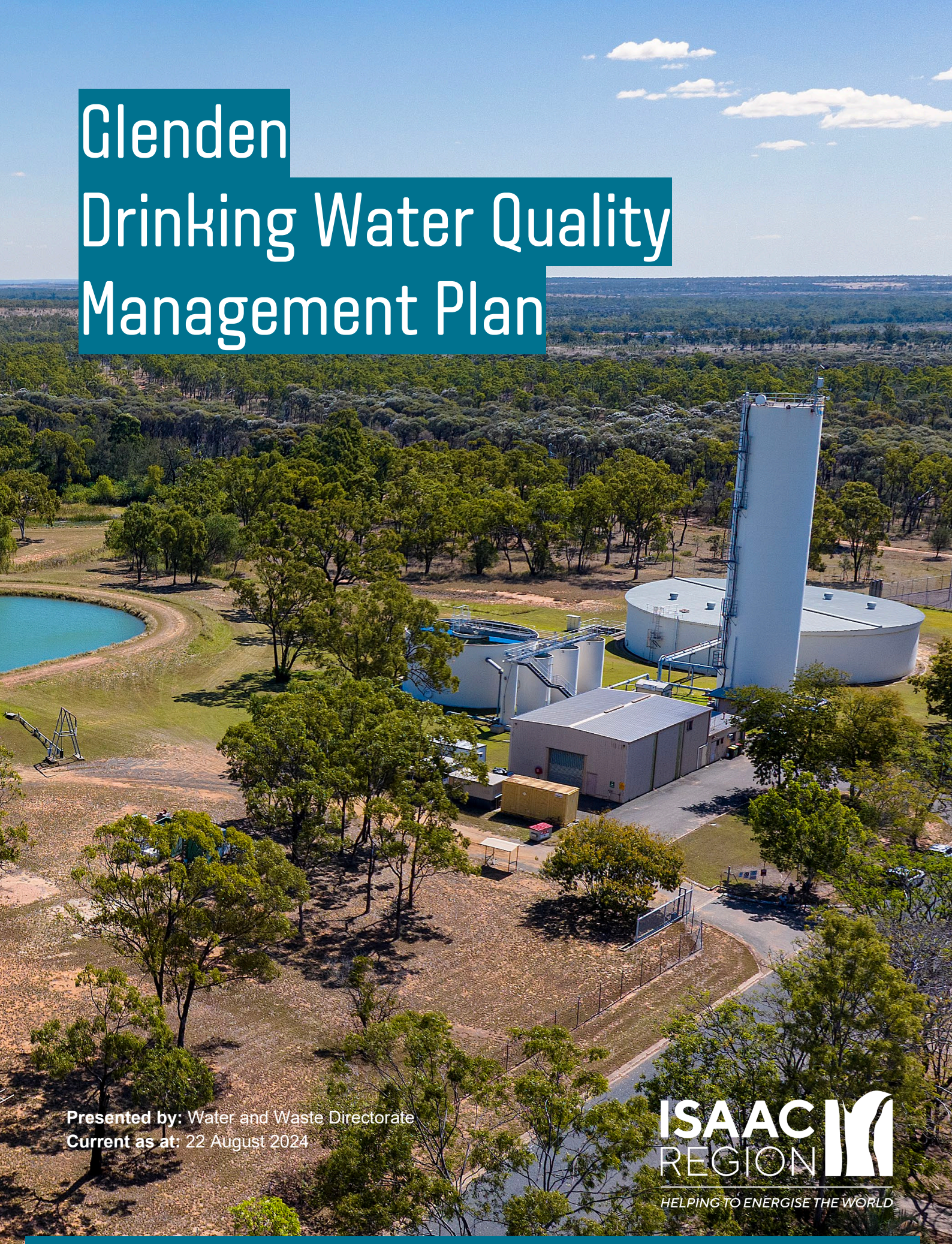
Response to out of specification results

Data from the verification monitoring is accessible via the Mackay Laboratory Monitor Pro Portal. The data is entered into spreadsheet records and the files on the share drive are accessible to all IRC Water and Wastewater Operational Staff. Refer to IRC Overarching DWQMP for Incident and Emergency Management.

APPENDIX 4

GLENDEN DRINKING WATER QUALITY MANAGEMENT PLAN

Glenden Drinking Water Quality Management Plan



Presented by: Water and Waste Directorate
Current as at: 22 August 2024

ISAAC REGION
HELPING TO ENERGISE THE WORLD

ISAAC.QLD.GOV.AU ISAAC REGIONAL COUNCIL ABN 39 274 142 600
P 1300 472 227 F 07 4941 8666 A PO Box 97 Moranbah QLD 4744
isaacregionalcouncil isaacregionalcouncil Isaacrcouncil

TABLE OF CONTENTS

OBJECTIVE

This plan details how Isaac Regional Council ensures the safety of drinking water for the Glenden community.

SCOPE

This plan is the Site-specific Drinking Water Quality Management Plan that together with the Overarching Drinking Water Quality Management Plan makes up the complete plan for Glenden.

DEFINITIONS

TERM / ACRONYM	MEANING
ADWG	Australian Drinking Water Guidelines
CCP	Critical Control Point
DRDMW	Department of Regional Development Manufacturing and Water
DWQMP	Drinking Water Quality Management Plan
DWQMP Guideline	Guideline for the preparation, review and audit of drinking water quality management plans.
IRC	Isaac Regional Council
OCP	Operational Control Point
NTU	Nephelometric turbidity units
PHA	*Public Health Act 2005*
QCP	Quality Control Point
QH	Queensland Health – regulator of public health – may take lead on managing incidents
Regulator	In the context of the DWQMP, the Regulator is DRDMW
RMIP	Risk Management Improvement Program
SCADA	Supervisory Control and Data Acquisition
SPID	Service Provider Identification Number
WSSRA	*Water Supply (Safety and Reliability) Act 2008*
WTP	Water Treatment Plant

REFERENCES

ID	NAME
	DWQMP Document Register

INTRODUCTION

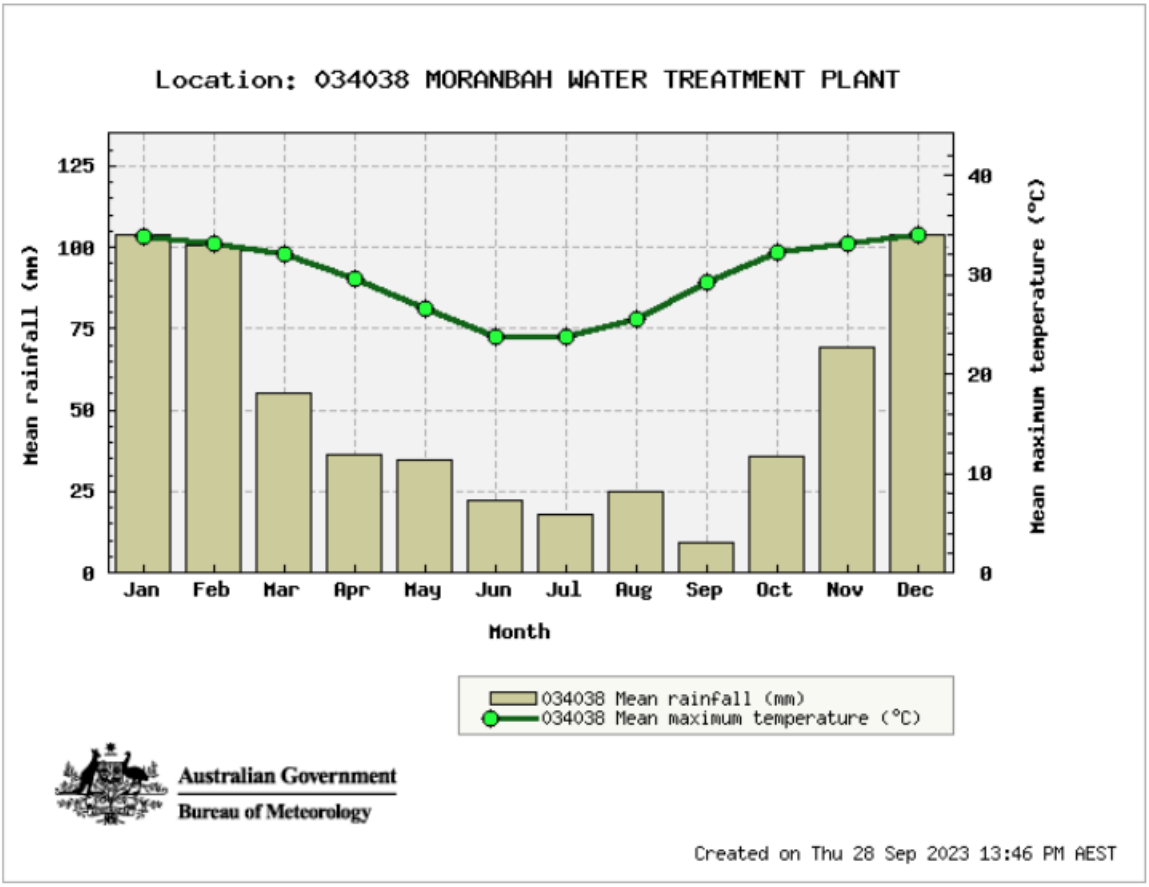
This site specific DWQMP documents the specific details of the Glenden drinking water scheme. It is intended to be an operational document that informs the operational plant staff.

OVERVIEW OF THE SUPPLY SCHEME

Glenden is a rural town in Isaac Region of ~620 people. The town is located ~117 km north of Moranbah and is a major locality for a large coal mine. Drinking water for the community is sourced from the Bowen River.

CLIMATE

The Glenden climate is characterised by a subtropical semi-arid climate. Rainfall (See Figure 20) within the catchment averages ~613 mm/year with more rain in summer than winter. The mean maximum temperature is 29.7 °C, with a mean max. above 30°C between October to March.



Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
Mean rainfall (mm) for years 1972 to 2012	103.8	100.7	55.4	36.4	34.5	22.1	18.0	25.0	9.1	35.7	69.3	103.9	613.0	39
Statistics	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**	**Years**
Mean maximum temperature (°C) for years 1986 to 2012	33.8	33.1	32.1	29.5	26.5	23.7	23.7	25.5	29.2	32.3	33.1	34.0	29.7	26

Figure 20 Rainfall and Temperature Data for Moranbah (closest to Glenden)

CATCHMENT CATEGORISATION

The Bowen River catchment area serves various purposes, including farming, water irrigation, and mining activities. Based on the activity in the catchment area and the unprotected nature of the river and take off storage, the raw water is charaterised as a Category 4 catchment.

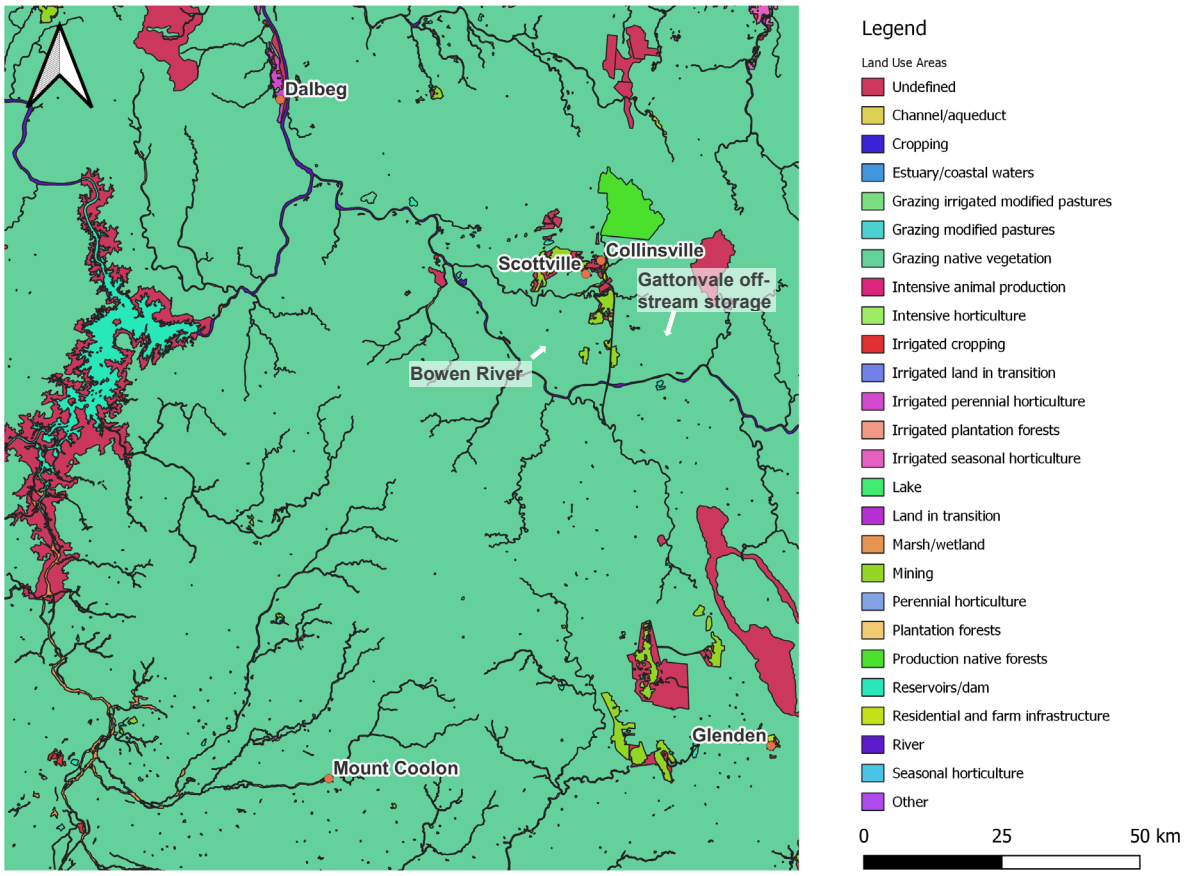


Figure 21 Land Use Map for Glenden Water Supply

TREATMENT PROCESS

OVERALL – CAPACITY

The Glenden WTP operates at a fixed operator-selected flow setpoint, typically around 50 L/s.

RAW WATER SUPPLY

The Glenden Water Scheme sources its raw water through the Gattonvale off-stream storage in the Bowen River Weir, located about 80 km away. The Bowen River Weir provides 5200 ML of water storage capacity which mitigates the risks associated with drought conditions. SunWater (Glencore) manages the pipeline (54 km, 450 mm) that runs from the Bowen River Weir through a 100 ML Newlands Coal Mine (Glencore) lagoon to the 6 ML Turkey's nest, located at the Glenden WTP. The water is transported using a pump station with duty standby pumps. The total annual water allocation for the Glenden Water Scheme is 1,690 ML.

RAW WATER PUMPING

Raw water is pumped from the Turkey's nest to the plant using two (2) pumps in duty/standby configuration at a rate of 50 L/s (fixed speed) and measured using a magnetic flowmeter.

TURKEY'S NEST

The Turkey's nest (6 ML) at Glenden is under the management of the Council. Water in the Turkey's nest is aerated through a fountain aerator. The Turkey's nest is used to collect the supernatant return and mix it with the main raw water. Raw water from the Turkey's nest is pumped and monitored using duty/standby raw water pumps and a flow meter.

POWDERED ACTIVATED CARBON (PAC)

PAC is dosed into the bottom of the flash mixer using a single dosing pump with two (2) universal spare pumps on site. The dosing setpoint is manually adjustable by the operators.

COAGULANT

Alum is dosed just before the entry to the flash mixer. The chemical is dosed using a single dosing pump, with two (2) critical spare pumps onsite. The chemical dosing setpoints are manually adjusted by the operators as needed.

POLYMER

Polymer is dosed into the top of the flash mixer. The chemical is dosed using a single dosing pump, with two (2) critical spare pumps onsite. The chemical dosing setpoints are manually adjusted by the operators as needed.

FLOCCULATION - CLARIFICATION

After the flocculation process, the flocs settle to the bottom of the clarifier after which the clarified water flows out through launders and into the filters via an outlet channel.

Sludge management is based on an air-actuated de-sludge valve at the bottom of the clarifier which opens automatically based on a timer setting.

FILTRATION

Following clarification, the water gravity flows into three sand filters. After the filters an inline combined filtered water turbidity monitor is used to control the process. Every filter has a sample point on its outlet for manual sampling when required. Flow distribution between the filters is manually controlled by turning the filter inlet valves on/off.

Filter backwash sequences are initiated manually by operators based on pressure differential (head loss). Backwashing can be completed through an automated sequence or manually if required.

WASTEWATER AND SLUDGE HANDLING

The backwash water is collected in the Backwash tank where it is settled and used for site irrigation. The backwash recovery tank has a capacity of 10 kL which is sufficient storage for a single backwash only.

Sludge that accumulates in the Backwash tank together with clarifier sludge is discharged into the sludge ponds. Supernatant from the sludge ponds can be returned to the Turkey's nest, but the flow is not metered.

PRIMARY DISINFECTION

Sodium hypochlorite is dosed into the filtered water line for disinfection using a single dosing pump with a critical spare onsite. The dosage of sodium hypochlorite is adjusted to maintain a target chlorine residual at the outlet of the water tower as defined in the Critical Control Point (CCP).

While the treatment process is started and stopped based on the reservoir level, the clearwater tank has enough capacity for multiple days of water demand.

SODIUM HYDROXIDE

Sodium hydroxide is dosed into the filters water line leading into the clearwater tank using a single dosing pump with a critical spare onsite.

WATER TOWER

Water from the Clearwater tank is pumped to the water tower using two (2) high lift pumps with a capacity of 130 L/s. The operation of these pumps is controlled by pressure sensors in the water tower. The water tower has an overflow mechanism that allows excess water to flow back into the clearwater tank. The water tower can also be bypassed to provide bulk water to town if needed.

RETICULATION

The water from the water tower then gravity feeds the Glenden reticulation network. The network comprises of ~17km pipework out of which most pipe material is not well documented. The two (2) known materials are asbestos cement and poly pipe.

It's worth noting that no issues have not encountered such as low water pressure or flow stagnation in the reticulation network. Most of Glenden's reticulation network is 40-50 years old as can be seen in Table 56.

The introduction of Smart Meters has also been implemented to gain better insights into water usage, losses, and to detect leaks and mains breaks more effectively.

Table 55 Pipe Materials and Length

MATERIAL	DIAMETER [DN]	LENGTH [M]
Asbestos cement	100	355
	150	584
	200	94
	250	39
Poly	25	67
	50	459
	65	431
	100	37
	150	118

MATERIAL	DIAMETER [DN]	LENGTH [M]
Unknown	0	18
	100	5223
	150	5659
	200	2207
	250	543
	300	950
	450	242

Table 56 Range of Pipe Age - Glenden

PIPE AGE	1-10 YEARS	11-20 YEARS	21-30 YEARS	31-40 YEARS	41-50 YEARS	51-60 YEARS	61-70 YEARS
Percentage of Network	0%	0%	0%	6%	94%	0%	0%

Glenden Overall Water Scheme

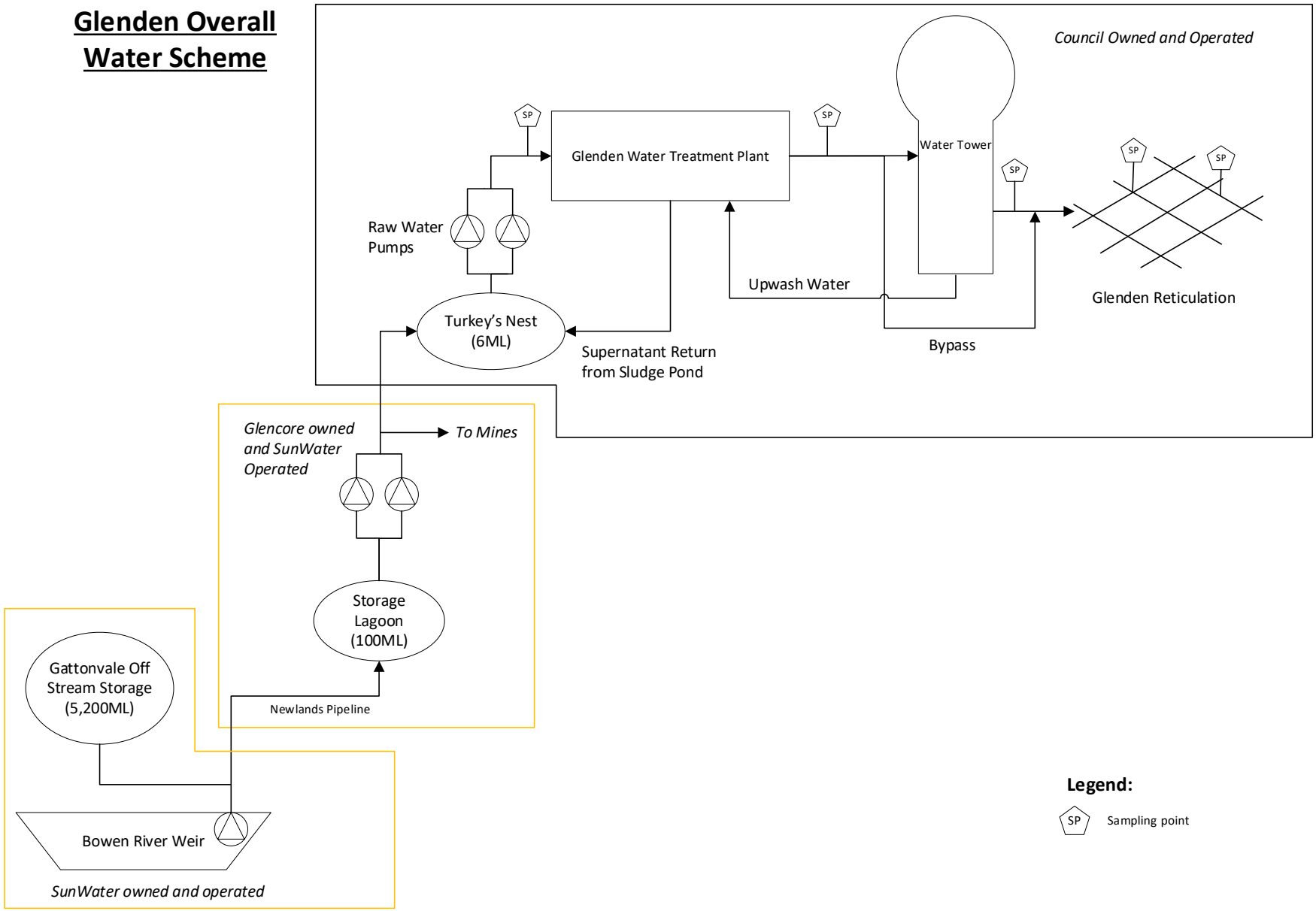


Figure 22 Glenden Catchment to Tap Schematic

Glenden Water Treatment Plant

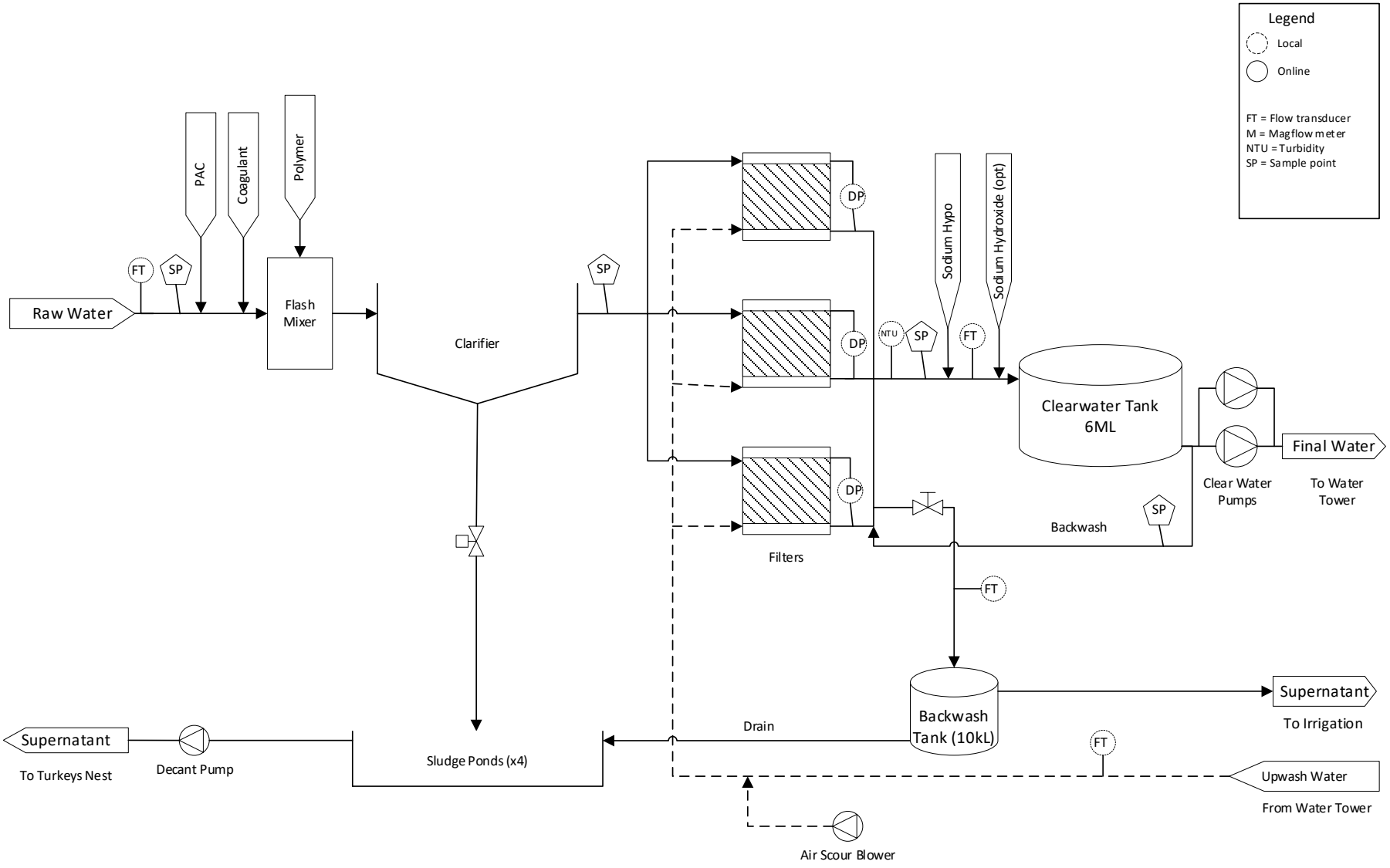


Figure 23 Glenden Treatment Plant Schematic

WATER QUALITY

RAW WATER

Raw water quality in Glenden is highly variable and often characterised by high turbidity and colour. pH fluctuated within the full ADWG aesthetic guideline range from 6.5 to 8.5.

Table 57 Glenden Raw Water Monitoring (2020-2023)

	UNIT	# OF SAMPLES	75TH %TILE	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Alkalinity	mg/L $CaCO_3$	263	80	120	45	100	70	17
Colour	HU	268	200	430	77	296	165	67
pH		287	8.2	8.5	7.1	8.4	8	0.34
Tot. Iron	mg/L	252	0.038	0.33	0	0.11	0.033	0.044
Tot. Manganese	mg/L	248	0.004	0.011	0.002	0.0075	0.0035	0.0018
Turbidity	NTU	277	29	73	9.5	38	22	10

TREATED WATER

Operational

Treated water quality has historically been very variable, but in recent years (2021-2023) has improved and is producing consistent water quality.

Table 58 Summary Treated Water Monitoring (2021-2023)

	UNIT	# OF SAMPLES	MIN.	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Alkalinity	mg/L $CaCO_3$	336	25	85	35	75	52	13
Free Chlorine	mg/L	357	0.37	2.4	1.1	1.9	1.4	0.28
pH		358	6.5	7.8	7	7.5	7.2	0.16
Tot. Aluminium	mg/L	305	0	0.1	0	0.08	0.033	0.023
Tot. Iron	mg/L	325	0	0.09	0	0.02	0.0034	0.0099
Tot. Manganese	mg/L	311	0	0.15	0.001	0.015	0.0039	0.0092
Turbidity	NTU	357	0	2	0.009	0.32	0.078	0.15

Verification

Verification monitoring data for Glenden is presented in Table 59. Chemical parameters with values under the limit of detection (LOD) are presented as 0.5xLOD. Microbiological results under LOD are presented as 0.

Table 59 Summary of Verification Monitoring - Glenden (2014-2023)

	# OF SAMPLES	MIN.	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Alkalinity - Residual (mq/L)	17	-0.039	0.05	-0.039	0.05	0.041	0.023
Alkalinity (mg/L)	108	51	287	56	120	83	34
Aluminium (µg/L)	155	2.4	201	4.6	34	16	18
Ammonia (mg/L)	46	0.0025	0.017	0.0025	0.014	0.0057	0.0029
Arsenic (µg/L)	19	0.25	0.88	0.25	0.88	0.4	0.19
Barium (µg/L)	5	36	48	36	48	42	6
Beryllium (µg/L)	4	0.25	0.5	0.25	0.5	0.31	0.13
Boron (µg/L)	5	35	60	35	60	47	10
Bromate (µg/L)	89	2.5	25	5	25	8.5	5.4
Bromate^ (µg/L)	2	25	25	25	25	25	0
Cadmium (µg/L)	14	0.05	0.5	0.05	0.5	0.11	0.16
Calcium (mg/L)	71	14	89	16	32	24	12
Chlorate (µg/L)	87	5	164	10	25	22	19
Chlorate^ (µg/L)	2	25	25	25	25	25	0
Chlorite (µg/L)	88	2.5	25	5	25	8.6	5.5
Chlorite^ (µg/L)	2	25	25	25	25	25	0
Chromium (µg/L)	14	0.05	0.5	0.05	0.5	0.12	0.16
Cobalt (µg/L)	1	0.5	0.5	0.5	0.5	0.5	0
Colour - True (TCU)	118	0.5	29	0.5	7	2.2	3.4
Conductivity (µS/cm)	374	117	1138	209	569	319	117
Copper (µg/L)	14	12	366	12	366	53	91
Dissolved Oxygen (% Sat)	95	48	105	74	101	89	9.3
E. coli (MPN/100mL)	907	0	1	0	0	0.0011	0.033
Fluoride (mg/L)	90	0.005	0.22	0.05	0.19	0.1	0.051
Formaldehyde (mg/L)	40	0.05	0.2	0.05	0.05	0.054	0.024
Free Chlorine Residual (Client tested) (mg/L)	691	0.02	4.4	0.27	2.7	1.5	0.73
Free Chlorine Residual (mg/L)	210	0.01	5	0.036	4.1	1.6	1.3
Gross alpha (Bq/L)	11	0.025	0.025	0.025	0.025	0.025	0
Gross beta (Bq/L)	11	0.05	0.17	0.05	0.17	0.082	0.048
Hardness - Temporary (mg/L)	94	30	127	52	111	78	17
Hardness (mg/L)	106	52	400	58	142	92	48
Iodide (µg/L)	7	10	10	10	10	10	0
Iron (µg/L)	161	1	64	1	8	3.3	8.3
Lead (µg/L)	19	0.25	4	0.25	4	0.59	0.85

	# OF SAMPLES	MIN.	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Magnesium (mg/L)	71	5.7	44	6.2	18	10	6.3
Manganese (µg/L)	161	0.5	31	0.5	4.5	1.2	2.9
Mercury (µg/L)	19	0.025	0.3	0.025	0.3	0.22	0.086
Molybdenum (µg/L)	5	0.5	1	0.5	1	0.61	0.24
Nickel (µg/L)	14	0.25	2.5	0.25	2.5	1	0.57
Nitrate (mg/L)	108	0.0075	12	0.0075	2.1	0.9	2
Nitrite (mg/L)	108	0.002	0.44	0.002	0.2	0.077	0.1
pH (Client tested) (pH unit)	691	6.8	8.6	7	7.8	7.4	0.24
pH (pH unit)	174	4.8	8.7	7	8.1	7.5	0.39
Residual Alkalinity (mg/L)	61	0.05	0.05	0.05	0.05	0.05	0
Selenium (µg/L)	19	0.5	2.5	0.5	2.5	2.1	0.84
Silver (µg/L)	5	0.05	0.5	0.05	0.5	0.23	0.25
Sulphide (mg/L)	30	0.0025	0.04	0.0025	0.021	0.0039	0.0069
Tin (µg/L)	5	0.5	0.83	0.5	0.83	0.57	0.15
Trihalomethanes (Total) (µg/L)	136	10	247	21	168	68	46
Trihalomethanes (Total)^ (µg/L)	23	2.6	103	3.7	97	39	23
Turbidity (Client tested) (NTU)	314	0.05	3	0.05	0.46	0.21	0.26
Turbidity (NTU)	125	0.05	92	0.05	3.3	1.6	8.3
Uranium (µg/L)	5	0.25	0.5	0.25	0.5	0.35	0.14
Zinc (µg/L)	14	5	27	5	27	14	6.8

CUSTOMER COMPLAINTS

There were no complaints recorded from 2021 to 2023. Historically, very few dirty or discoloured water customer complaints have been received.

Table 60 Summary of customer complaints - Glenden

Year	o of Water Quality Complaints	Main Reasons for Complaints	Likely Sources / Causes of Problems	Resolution of Problem
2015-16	2	Discoloured water	No information recorded to indicate the cause of complaint. The water quality data are generally in line with the ADWG.	Localised and mains flushing performed. WTP processes reviewed.
2019-20	3	Discoloured water	Cause of the complaint not known. Samples taken within ADWG	Localised and mains flushing performed

INCIDENTS

There were no incidents reported between 2017 and 2023.

RISK ASSESSMENT

SCHEME MITIGATED RISK ASSESSMENT

Table 61 Mitigated Risk Assessment - Glenden

Ref	Treatment Stage	Primary Hazard	Other hazards managed by barrier	Hazardous Event	Unmitigated Risk	Control Measures in place	Comment	Mitigated Consequence	Mitigated Likelihood	Mitigated Risk	Uncertainty	Improvement Action Required - Immediate	Improvement Action Required ~ 2 years	Improvement Action Required - Long term
GLN1	Raw water sourcing	Allocation failure (Glenden)		No contract with providers to secure allocations	Medium 8	Working with State and other entities to ensure continuity of supply.	Glenden owns and operates the pumps and pipelines for Glencore mine that is about to go into Caretaker mode	Major	Unlikely	Medium 8	Estimate	Ensure there is a process to engage with stakeholders to ensure access to Glencore Dam water.		
GLN2	Raw Water Abstraction	Protozoa (Category 4)	Bacterial and virus, Cyanobacteria	Normal operation	Extreme 25	Convention filtration, chlorine disinfection plant operated when manned.	SCADA and no Alarms	Catastrophic	Unlikely	High 10	Estimate	Improve recording of online turbidity meter readings to confirm correct plant operation. Review BGA Management Plan (by Dec 2024)		SCADA upgrades on all treatment plants over 5 years, followed by upgrading plant automation.
GLN3	Supernatant return and storage	Protozoa (Category 4)		Recycling of protozoan pathogens	Extreme 25	Plant runs at 50 L/s, return rate not known, but diluted in the Turkeys Nest, enters at opposite end. Full treatment.	No flow monitoring Returns to Turkeys nest, supernatant flows into bell mouth, and pumped based on level. Estimated as max 60 kL/ day.	Catastrophic	Unlikely	High 10	Estimate	Improve recording of online turbidity meter readings to confirm correct plant operation.		SCADA upgrades on all treatment plants over 5 years, followed by upgrading plant automation.
GLN4	Chemical Dosing - Powdered Activated Carbon (PAC)	Turbidity		Overdose PAC	High 10	PAC always dosed typically 5mg/L	Single dosing pump spares on site.	Minor	Rare	Low 2	Reliable			
GLN5	Chemical Dosing - Powdered Activated Carbon (PAC)	Taste and odour	Colour, Cyanotoxins	Underdose PAC	Medium 8	PAC always dosed typically 5mg/L	Single dosing pump spares on site.	Minor	Unlikely	Low 4	Reliable			
GLN6	Chemical Dosing - Aluminium Sulphate	Aluminium - coagulant		Overdose of alum	Medium 6	Conventional coagulation, typical coagulation pH 6.8. Jar testing as required.	Single dose pump, manual dose rate	Minor	Unlikely	Low 4	Confident			
GLN7	Chemical Dosing - Aluminium Sulphate	Protozoa (Category 4)		Underdose Alum/ ineffective coagulation	Extreme 25	Conventional coagulation, typical coagulation pH 6.8. Jar testing as required.	Single dose pump, manual dose rate	Catastrophic	Unlikely	High 10	Estimate	Improve recording of online turbidity meter readings to confirm correct plant operation.		SCADA upgrades on all treatment plants over 5 years, followed by upgrading plant automation.
GLN8	Chemical Dosing - Polyelectrolyte	Turbidity	Monomer	Overdose polymer impacting filter run times and backwashing	High 10	Optional dosing of polymer, maximum dose rate. Mostly required to be used, not required if high turbidity.	Single dose pump, manual dose rate, dosed top of FM	Minor	Rare	Low 2	Reliable			
GLN9	Chemical Dosing - Polyelectrolyte	Protozoa (Category 4)		Underdose polymer resulting in ineffective coagulation	Extreme 25	Optional dosing of polymer, maximum dose rate. Mostly required to be used, not required if high turbidity.	Single dose pump 2 spare pumps manual dose rate dosed top of FM	Catastrophic	Unlikely	High 10	Estimate			

Ref	Treatment Stage	Primary Hazard	Other hazards managed by barrier	Hazardous Event	Unmitigated Risk	Control Measures in place	Comment	Mitigated Consequence	Mitigated Likelihood	Mitigated Risk	Uncertainty	Improvement Action Required - Immediate	Improvement Action Required ~ 2 years	Improvement Action Required - Long term
GLN10	Clarification	Protozoa (Category 4)	Turbidity	Failure of clarification process	Extreme 25	Conventional coagulation, typical coagulation pH 6.8. Jar testing as required.	Single clarifier	Catastrophic	Unlikely	High 10	Estimate	Improve recording of online turbidity meter readings to confirm correct plant operation.		
GLN11	Filtration - Media filtration	Protozoa (Category 4)	Turbidity	Breakthrough through filters	Extreme 25	Daily grab sampling of combined filtered water. Individual testing if required.	3 filters, combined NTU, sample point post filter, manual b/w on DP	Catastrophic	Unlikely	High 10	Estimate	Filter valves require repair or replacement.	Investigate plant shutdown on combined filtered water turbidity.	UV disinfection required over time.
GLN12	Filtration - Media filtration	Protozoa (Category 4)		Poor backwash	Extreme 25	Backwash on loss of head.	3 filters, combined NTU, sample point post filter, manual b/w on DP	Catastrophic	Unlikely	High 10	Confident	Filter valves require repair or replacement.	Investigate plant shutdown on combined filtered water turbidity.	UV disinfection required over time.
GLN13	Chemical Dosing - Sodium hypochlorite	Chlorine		Overdose of chemical	High 12	Operator sets dose, correct size chemical storage prevents significant overdose.	Single dosing pump 1 spare pump, limited volume of chemical available to dose.	Moderate	Rare	Low 3	Confident			
GLN14	Disinfection - sodium hypochlorite	Bacteria/Virus		Underdose of chlorine	Extreme 25	Daily monitoring of chlorine in network, multiple days of storage in treated water tank.	Single dosing pump 1 spare pump	Catastrophic	Rare	Medium 6	Reliable		Investigate an online chlorine meter with alarms.	
GLN15	Chemical Dosing - Sodium hypochlorite	Chlorate		Breakdown of bulk solution	Medium 9	Chlorine supply turned over every 6-8 weeks.	Single dosing pump 1 spare pump, two storage tanks.	Moderate	Unlikely	Medium 6	Reliable			
GLN16	Chemical Dosing - Sodium hydroxide	Bacteria/Virus		Overdose resulting in ineffective disinfection	Extreme 25	Optional dosing, typically used 2-3 months per year, operator grab samples taken daily. Dilution in treated water reservoir.	Single dosing pump 1 spare pump	Catastrophic	Rare	Medium 6	Reliable			
GLN17	Chemical Dosing - Sodium hydroxide	pH		Underdose resulting in low pH water to customers	Medium 9	Optional dosing, typically alum dose is not sufficiently high for pH to drop below 6.5	Single dosing pump 1 spare pump	Moderate	Rare	Low 3	Certain			

OPERATIONAL MONITORING

Operational monitoring is undertaken to assess and confirm that individual barriers and preventive strategies for controlling hazards are functioning properly and effectively. Frequencies are based on the risk of each parameter to significantly change. As Glenden WTP is not operational every day of the year, the monitoring frequency “daily” is considered as “daily when plant is operational”. For an informed comparison of samples taken and operational days the daily log sheet records whether the plant was operational.

Table 62 Glenden Operational Monitoring

PARAMETER	RAW WATER	CLARIFIED WATER	FILTERED WATER	CHLORINATED WATER	TREATED WATER	NETWORK WATER
Alkalinity	Weekly				Weekly	
Aluminium		Weekly			Weekly	
pH	Daily	Daily		Daily	Daily	Weekly
Free Chlorine				Daily	Daily	Weekly
Tot. Iron	Daily				Weekly	
Tot. Manganese	Daily				Weekly	
True Colour	Daily	Daily	Daily		Daily	
Turbidity	Daily	Daily	Daily, Online		Daily	Weekly

Response to out of specification results for relevant parameters are managed through CCPs and OCPs

Operators check the calibration of online instruments with the results from their lab/benchtop analysis as part of the operational monitoring.

CRITICAL CONTROL POINTS

CRITICAL CONTROL POINTS

The critical control points (CCP) for the scheme were identified in the risk assessment process, and include:

- Disinfection – free chlorine
- Filtration - turbidity

The CCP procedures are included in the following pages. These are presented as traffic lights and identify the location, monitoring, performance, and validation of the process.

OPERATIONAL CONTROL POINTS

Glenden WTP has three (3) operational control points (OCP) for the following processes:

- Oxidation – treated water manganese
- Coagulation – clarified water turbidity
- Chlorination – chlorinated water free chlorine

An OCP exceedance is generally not reportable to the regulator except if it is an event that requires reporting. Incident reporting to the regulator is based on CCPs or exceedances of ADWG health guidelines.

QUALITY CONTROL POINTS

Glenden WTP has one (1) quality control point (QCP) for the following processes:

- Coagulation – clarified water aluminium

The CCPs, OCPs and QCPs can be found below.

CRITICAL CONTROL POINT PROCEDURE - GLENDEN

Filtration

What is measured	Where is it measured	When is it measured	What is the control point	What are the hazards	Record Keeping
Turbidity	Post filtration	Daily	Plant production	Protozoa, turbidity	Operator Log Sheets

Critical Limit
>0.5 NTU

- Confirm result with grab samples
- Breach of CCP is continued supply of water to customers above the Critical Limit
- Operator to contact Supervisor/Coordinator or Manager
- Supervisor/Coordinator or Manager to inform Compliance & IMS team on [redacted]
- If operator unable to contact chain of command, report directly to Compliance & IMS Team
- Compliance & IMS to contact DRDMW on 1300 596 709 as required
- If health advice required, Compliance & IMS or Manager to contact Mackay PHU on 4885 5800

Adjustment Limit
>0.2 NTU

- Check turbidity meter, clean and calibrate to confirm results
- Check raw water turbidity for changes since last dose rate change.
- Check clarified water pH and turbidity and adjust dosing as necessary
- Check coagulation dosing system, drop test to validate dose rate, jar test if required.
- Backwash filters if coagulation process is effective
- Take filter offline if turbidity still above Adjustment Limit after multiple backwashes.
- Rectify any dosing issues and escalate to supervisor/coordinator

Target
<0.2 NTU

- When attending plant, inspect process for any visual signs of process failure
- Test the water as per DWQMP
- Record results
- Check raw water turbidity regularly and adjust coaguation dose rates as required (jar test as required)
- Complete routine cleaning and calibration of online meters
- Ensure backwashes are undertaken and effective.

CRITICAL CONTROL POINT PROCEDURE - GLENDEN

Disinfection

What is measured	Where is it measured	When is it measured	What is the control point	What are the hazards	Record Keeping
Free Chlorine	Grab sample from post clearwater tank	Daily	Disinfection	Bacteria, viruses, chlorine	Operator Log Sheets

Critical Limit
>3.0 mg/L
<1.0 mg/L

- Confirm result with grab samples
- Operator to contact Supervisor/Coordinator or Manager
- If low chlorine, Supervisor/Coordinator and/or Manager to ensure sufficient chlorine contact time for disinfection with actual operational parameters.
- If water with < 15 mg.min/L is supplied to customers this is a reportable event
- If chlorine is > 5 mg/L this is reportable as an incident
- Supervisor/Coordinator or Manager to inform Compliance & IMS Team on [redacted]
- If operator unable to contact chain of command, report directly to Compliance & IMS Team
- Compliance & IMS to contact DRDMW on 1300 596 709 as required
- If health advice required, Compliance & IMS or Manager to contact Mackay PHU on 4885 5800

Adjustment Limit
>2.0 mg/L
<1.2 mg/L

- Confirm result with grab sample
- Check chlorine meter, clean and calibrate to confirm result
- Check dosing system for any issues or air locks
- Rectify any dosing issues
- Take WTP offline or reduce plant flow as required

Target
>1.2 mg/L
<2.0 mg/L

- When attending plant, inspect process for any visual signs of process failure
- Test the water as per DWQMP
- Record results
- Check chemical stock of NaOCl

Validation: The CWT has a volume of 6ML, a minimum operational volume of 50% and is not baffled (Baffle factor 0.1). The maximum flow, assumed from current demand with peaking factor (1.6), is 37 L/s. Chlorine residual of 1.0 mg/L out of the CWT achieves >135 mg.min/L C.t.

Table 63 Operational Control Points - Glenden

PROCESS	PARAMETER	WHERE IS IT MEASURED	HAZARD	WHEN IS IT MEASURED	TARGET	ADJUSTMENT LIMIT	ACTION IF ADJUSTMENT LIMIT EXCEEDED	ALERT LIMIT	ACTION IF ALERT LIMIT EXCEEDED	REPORTING
Coagulation	Turbidity	Clarified Water	Protozoa, Turbidity	Daily	< 1 NTU	> 2 NTU	Confirm turbidity reading, Check raw water turbidity, Check coagulation dosing system, drop test to validate dose rate.	> 5 NTU	Confirm turbidity reading, Check dosing system, Adjust dosing rate, Operator to notify Supervisor/Coordinator/Manager	Operator to contact Supervisor/Coordinator and/or Manager as failure to coagulate effectively is a reportable event
Oxidation	Total Manganese	Treated water	Manganese	Weekly	< 0.1 mg/L	> 0.1 mg/L	Confirm manganese reading, Check soluble manganese in treated water and free chlorine, Check clarifier total and soluble manganese, Adjust dosing rate and monitor	>0.5 mg/L	Confirm manganese reading, Divert the clarifier water, Check chlorine dosing system, Shutdown if uncertain of cause, Check treated water free chlorine, Check network total and soluble manganese, free chlorine and colour, Operator to notify Supervisor/Coordinator/Manager Consider treated water reservoir drain down and network flushing,	Operator to contact Supervisor/Coordinator and/or Manager as total manganese in treated water > 0.5 mg/L is a reportable event. Assess closely related reportables such as effective disinfection, treated water colour and network turbidity.
Chlorination	Free chlorine	Chlorinated water	Bacteria and viruses	Daily	>1.5 mg/L and <3.0 mg/L	<1.5 mg/L and >3.0 mg/L	Confirm free chlorine reading, Check chlorine dosing, Adjust dosing rate and monitor	< 1 mg/L Or > 3.5 mg/L	Confirm free chlorine reading, Check chlorine dosing, Adjust dosing rate and monitor, Operator to notify Supervisor/Coordinator/Manager	Internal reporting, Further see Disinfection CCP. Confirm CT is adequate

OCP EXCEEDANCES ARE GENERALLY NOT REPORTABLE TO THE REGULATOR EXCEPT IF IT IS AN EVENT OR REPORTABLE HEALTH LIMIT

Table 64 Quality Control Points

PROCESS	PARAMETER	WHERE IS IT MEASURED	HAZARD	WHEN IS IT MEASURED	TARGET	ACTION IF TARGET LIMIT EXCEEDED	REPORTING
Coagulation	Aluminium	Clarified water	Aluminium	Weekly	<0.1 mg/L	Confirm Aluminium reading, Check coagulation performance and adjust dosing if required.	Operator to notify Supervisor/Coordinator/Manager

QCP EXCEEDANCES ARE GENERALLY NOT REPORTABLE TO THE REGULATOR EXCEPT IF THIS RESULTS IN ADWG (HEALTH) OR CCP EXCEEDANCE

RAW WATER MONITORING

Raw water monitoring in Glenden is undertaken based on the principles outlined in the overarching DWQMP.

Table 65 Raw Water Monitoring Parameters

PARAMETER	FREQUENCY
Radiological	2 – years
Algal	Seasonally
Pesticides	Quarterly

VERIFICATION MONITORING

Table 66 Verification Monitoring Parameters

PARAMETER	FREQUENCY	WTP	SAMPLE POINTS IN NETWORK
E.coli	Weekly	No	SP 1-2
SWA	Monthly	Yes	Rotation SP 1-2
Oxyhalides	Quarterly	Yes	SP 2
THMs	Quarterly	No	SP 2
Metals	Quarterly	Yes	Rotation SP 1-2

VERIFICATION MONITORING LOCATIONS

The monitoring locations in Glenden are shown in Figure 24 and Table 67. These locations are spread around Glenden and represent the majority of the water provided to Glenden's customers. DBPs should be tested at the [redacted] for a more accurate reflection of the water quality.

Table 67 Glenden Monitoring Points

SAMPLE POINTS	NETWORK SAMPLING LOCATIONS	COMMENT
1	[redacted]	
2	[redacted]	

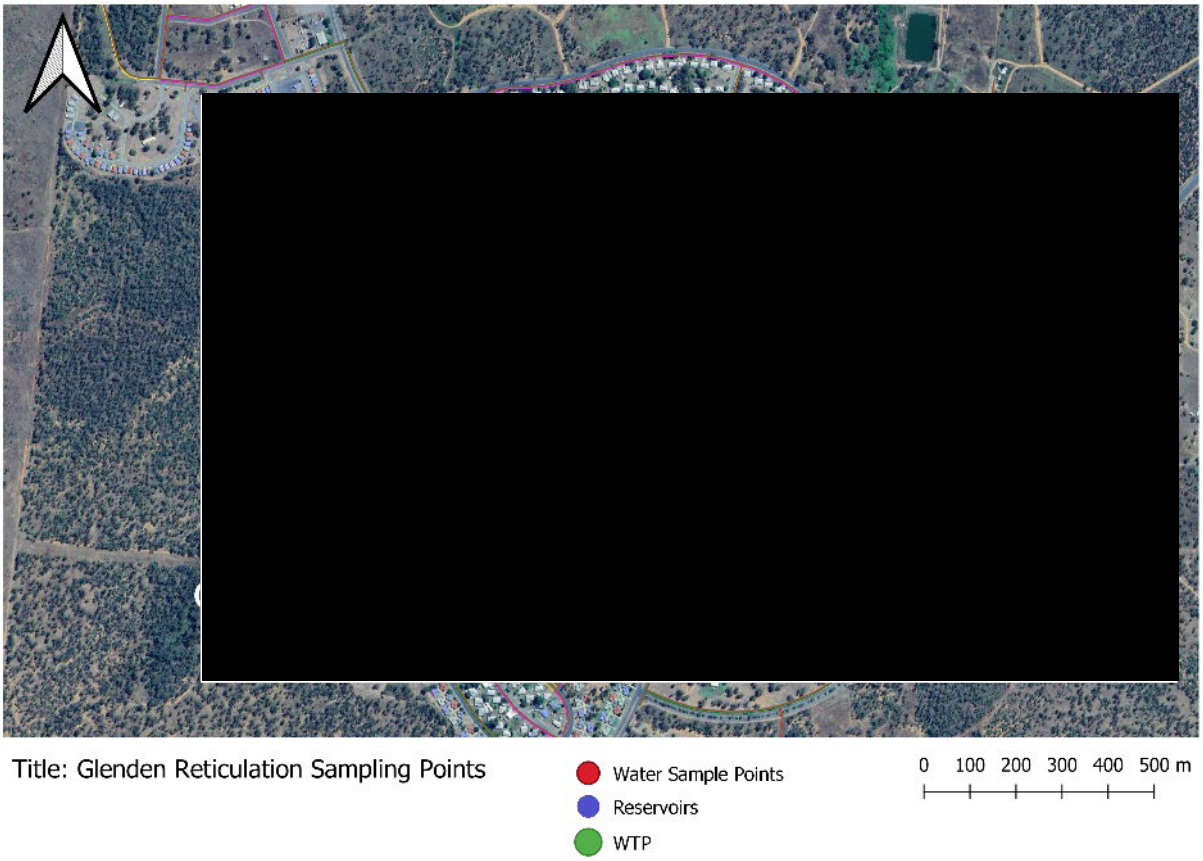


Figure 24 Glenden Verification Monitoring Locations

Response to out of specification results

Data from the verification monitoring is accessible via the Mackay Laboratory Monitor Pro Portal. The data is entered into spreadsheet records and the files on the share drive are accessible to all IRC Water and Wastewater Operational Staff. Refer to IRC Overarching DWQMP for Incident and Emergency Management.

APPENDIX 5

MIDDLEMOUNT DRINKING WATER QUALITY MANAGEMENT PLAN

Middlemount Drinking Water Quality Management Plan

Presented by: Water and Waste Directorate
Current as at: 22 August 2024

ISAAC REGION
HELPING TO ENERGISE THE WORLD

ISAAC.QLD.GOV.AU ISAAC REGIONAL COUNCIL ABN 39 274 142 600
P 1300 472 227 F 07 4941 8666 A PO Box 97 Moranbah QLD 4744
isaacregionalcouncil isaacregionalcouncil Isaacrcouncil

TABLE OF CONTENTS

OBJECTIVE

This plan details how Isaac Regional Council ensures the safety of drinking water for the Middlemount community.

SCOPE

This plan is the Site-specific Drinking Water Quality Management Plan that together with the Overarching Drinking Water Quality Management Plan makes up the complete plan for Middlemount.

DEFINITIONS

TERM / ACRONYM	MEANING
ADWG	Australian Drinking Water Guidelines
CCP	Critical Control Point
DRDMW	Department of Regional Development Manufacturing and Water
DWQMP	Drinking Water Quality Management Plan
DWQMP Guideline	Guideline for the preparation, review and audit of drinking water quality management plans.
IRC	Isaac Regional Council
OCP	Operational Control Point
NTU	Nephelometric turbidity units
PHA	*Public Health Act 2005*
QCP	Quality Control Point
QH	Queensland Health – regulator of public health – may take lead on managing incidents
Regulator	In the context of the DWQMP, the Regulator is DRDMW
RMIP	Risk Management Improvement Program
SCADA	Supervisory Control and Data Acquisition
SPID	Service Provider Identification Number
WSSRA	*Water Supply (Safety and Reliability) Act 2008*
WTP	Water Treatment Plant

REFERENCES

ID	NAME
	DWQMP Document Register

INTRODUCTION

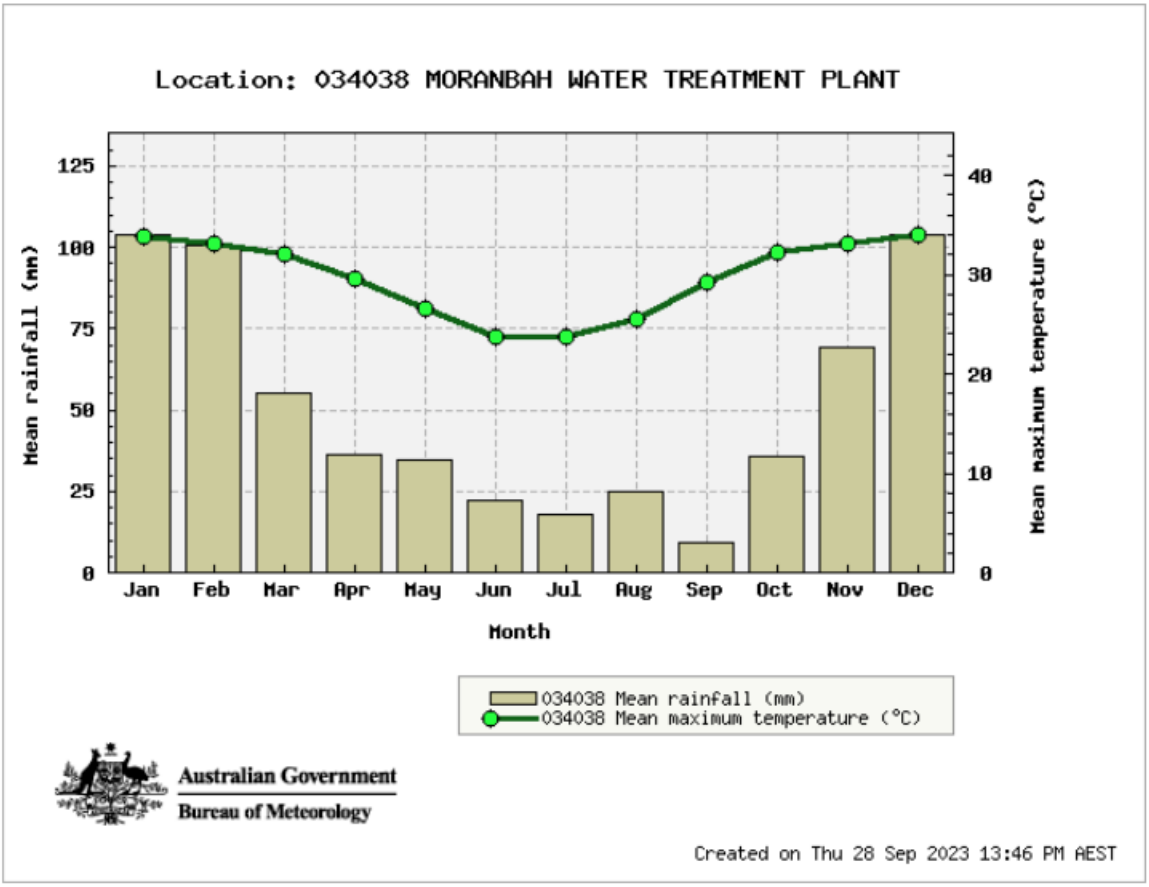
This site specific DWQMP documents the specific details of the Middlemount drinking water scheme. It is intended to be an operational document that informs the operational staff.

OVERVIEW OF THE SUPPLY SCHEME

Middlemount is a rural town in Isaac Region of ~1800 people. In addition to the local residing population Middlemount has a large fly-in fly-out population. The town is located ~150 km southeast of Moranbah and is a major hub for several large coal mines in central Queensland. Drinking water for the community is sourced from the Bingegang Weir of the Mackenzie River.

CLIMATE

The Middlemount climate is characterised by a subtropical semi-arid climate. Rainfall (See Figure 25) within the catchment averages ~613 mm/year with more rain in summer than winter. The mean maximum temperature is 29.7 °C, with a mean max. above 30°C between October to March.



Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
Mean rainfall (mm) for years 1972 to 2012	103.8	100.7	55.4	36.4	34.5	22.1	18.0	25.0	9.1	35.7	69.3	103.9	613.0	39
Statistics	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**	**Years**
Mean maximum temperature (°C) for years 1986 to 2012	33.8	33.1	32.1	29.5	26.5	23.7	23.7	25.5	29.2	32.3	33.1	34.0	29.7	26

Figure 25 Rainfall and Temperature Data for Moranbah (closest to Middlemount)

CATCHMENT CATEGORISATION

The Mackenzie River catchment encompasses an area of 79,615 km^2 and experiences an average annual rainfall ranging from 550 to 650 mm. The main activities in the catchment are mining related with some grazing and recreational activities such as swimming, sailing, and fishing. Based on the activity in the catchment area and the unprotected nature of the river and weir the raw water is characterised as a Category 4 catchment.

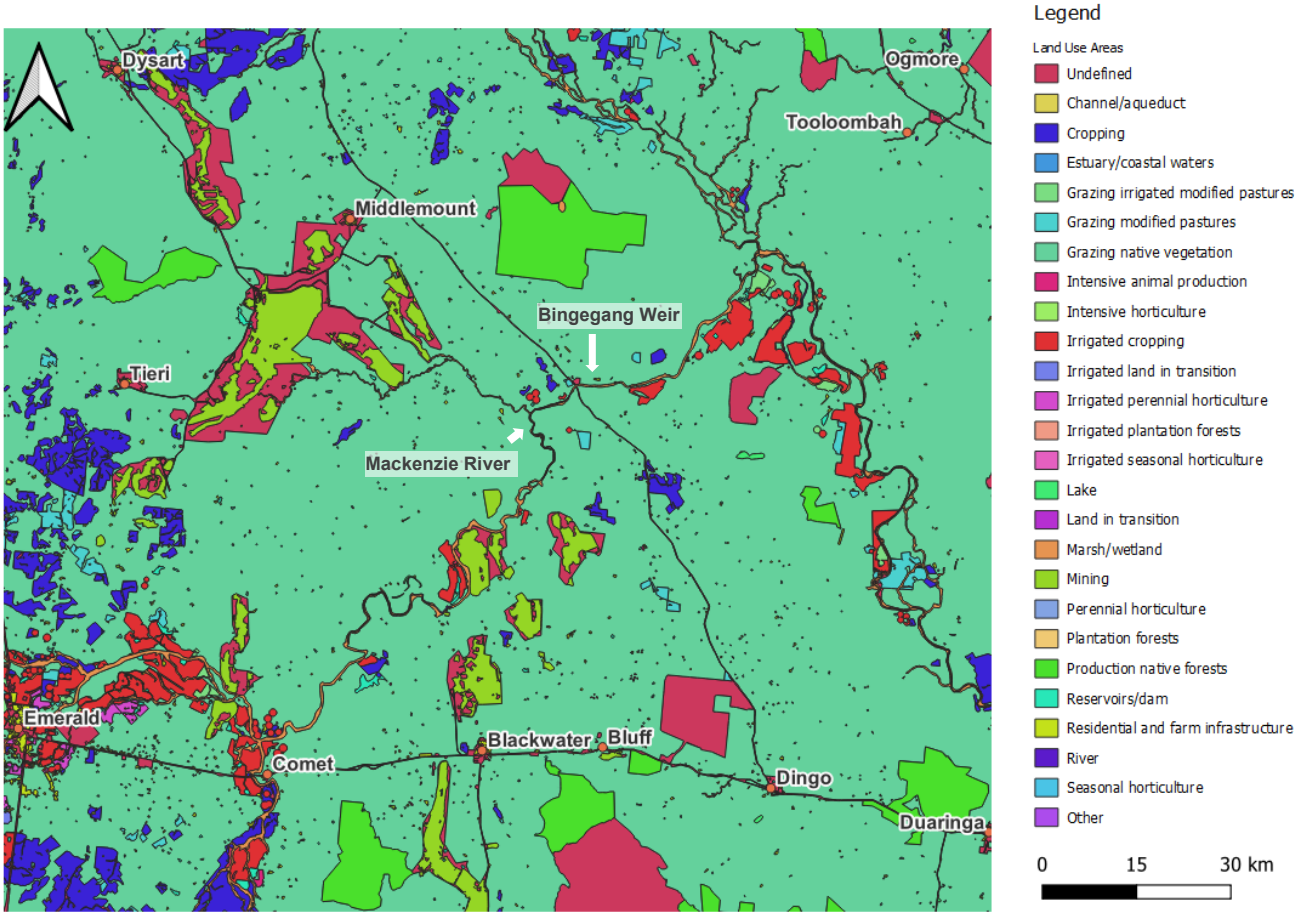


Figure 266 Land Use Map for Middlemount Water Supply

TREATMENT PROCESS

OVERALL – CAPACITY

The Middlemount WTP is a conventional treatment plant with a capacity rating of 90 L/s.

RAW WATER SOURCE

The Middlemount Water Scheme sources its raw water supply from the Tralee pump station which can receive water from Bingegang Weir (Mackenzie River) or from Bundoora Dam.

RAW WATER PUMPING

SunWater is responsible for the management of the Bingegang Weir from which Anglo American obtains the water for their operations. Anglo American operates the Tralee pump station, which, besides providing water to the mines, forms the direct source to the Middlemount Water Treatment Plant's Turkey Nest. Operation of the Tralee pump station is highly dependent on Anglo American operators, their shift length, and their knowledge of the need to supply water to Middlemount WTP.

TURKEYS NEST

The Turkey's Nest (10 ML) at Middlemount is under the management of the Council. Water in the Turkey's Nest is aerated through an aeration tower when entering and periodically using floating aerators. The Turkey's Nest is used to collect the supernatant return and mix it with the main raw water flow. Raw water from the Turkey's Nest is pumped using duty/standby raw water pumps and monitored with a flow meter.

SUPERNATANT RETURN

Supernatant from the drying beds is returned to the Turkey's Nest. Most backwash water is irrigated, and there is a reliance on dispersion in the 10 ML Turkey's Nest to mix supernatant with the raw water.

POTASSIUM PERMANGANATE

Potassium permanganate is dosed after the pump station and prior to flash mixer. There are duty/standby dosing pumps with auto shut down on zero flow. The pumps have no alarms installed.

An optional potassium permanganate dosing point also exist before the Turkey's Nest.

POWDERED ACTIVATED CARBON (PAC)

PAC can be dosed optionally prior to the flash mixer as well as between the clarifier and the filters. PAC dosing is provided with duty/standby pumps with auto shut down on zero flow. The pumps have no alarms installed.

SODIUM HYDROXIDE

Sodium hydroxide can be dosed (when required) in three (3) locations; before the Turkey's Nest, after the raw water pump station and post filters before the clearwater tank. Sodium hydroxide is dosed using two (2) pumps in duty/standby configuration with auto shut down on zero flow. The pumps have no alarms installed.

COAGULANT DOSING

The currently used coagulant is an Aluminium Chlorohydrate (ACH)/Poly blend and is dosed at the inlet of the flash mixer. The operator determines and adjusts the coagulant dosage rate as necessary. Coagulant dosing is provided with duty/standby pumps which have auto shut down on zero flow, auto-changeover, but no alarm installed.

FLOCCULATION - CLARIFICATION

Water flows from the flash mixer into the central flocculation chamber, which is situated within one of two clarifiers. A manually adjusted valve evenly distributes the flow to each clarifier.

Sludge removal is facilitated by an air-actuated de-sludge valve opening automatically based on a timer set by the operator.

Clarified water enters the launders and flows to the filters via the outlet channels.

POLYMER DOSING

If a coagulant is used that is not pre-blended with polymer, additional polymer can be dosed at the inlet of each clarifier using duty/standby pumps which have auto shut down on zero flow, auto-changeover, but no alarm installed.

FILTRATION

Water flows into four (4) sand filters, with each clarifier supplying two (2) filters. Continuous monitoring of differential pressure and turbidity is carried out for each individual filter. Operators manually initiate

backwashing cycles on any for head loss, turbidity, or the volume of flow through the filter. During backwashing flow is reduced and has air scouring and upwash.

WASTEWATER AND SLUDGE HANDLING

Backwash water flows to a backwash tank. and can be repurposed for irrigation around the plant or redirected with clarifier sludge to the wastewater pump station and drying bed. The backwash tank is designed to accommodate one backwash volume at a time and relies on the irrigation system to be operational when consecutive backwashes are needed. Additionally supernatant from the sludge drying beds can be directed to the Turkey's Nest.

PRIMARY DISINFECTION

The filtered water main, which carries water from the filters to the clear water tank, undergoes disinfection through the dosing of chlorine (gas). There are two (2) gas drums in duty/standby configuration, auto change over and automatic shut down on zero plant flow.

CLEARWATER TANKS AND TREATED WATER RESERVOIR

There are two (2) interconnected clearwater tanks. Water from these clearwater tanks is then transported by a series of pressure pumps to a high-level reservoir. The reservoir has only a single pipe for inflow and outflow, which means the reservoir cannot be filled while providing water to the town. When the reservoir is being filled water from the clearwater tanks is provided straight into town.

RETICULATION

Middlemount has approximately 25 km of reticulation pipelines. Most of the existing pipelines on record are asbestos cement with new pipes and replacements made of poly, PVC and uPVC. Most pipes are 40-50 years old as can be seen in Table 69.

Table 68 Pipe Materials and Length

MATERIAL	DIAMETER [DN]	LENGTH [M]
Asbestos Cement	0	230
	100	5685
	110	261
	150	7910
	200	3602
	250	2663
	300	728
	375	475
	450	1692

MATERIAL	DIAMETER [DN]	LENGTH [M]
Poly	50	1165
PVC	100	109
uPVC	100	263
	110	554

Table 69 Range of Pipe Age - Middlemount

PIPE AGE	1-10 YEARS	11-20 YEARS	21-30 YEARS	31-40 YEARS	41-50 YEARS	51-60 YEARS	61-70 YEARS
Percentage of Network	4%	0%	0%	3%	93%	0%	0%

Middlemount Overall Water Scheme

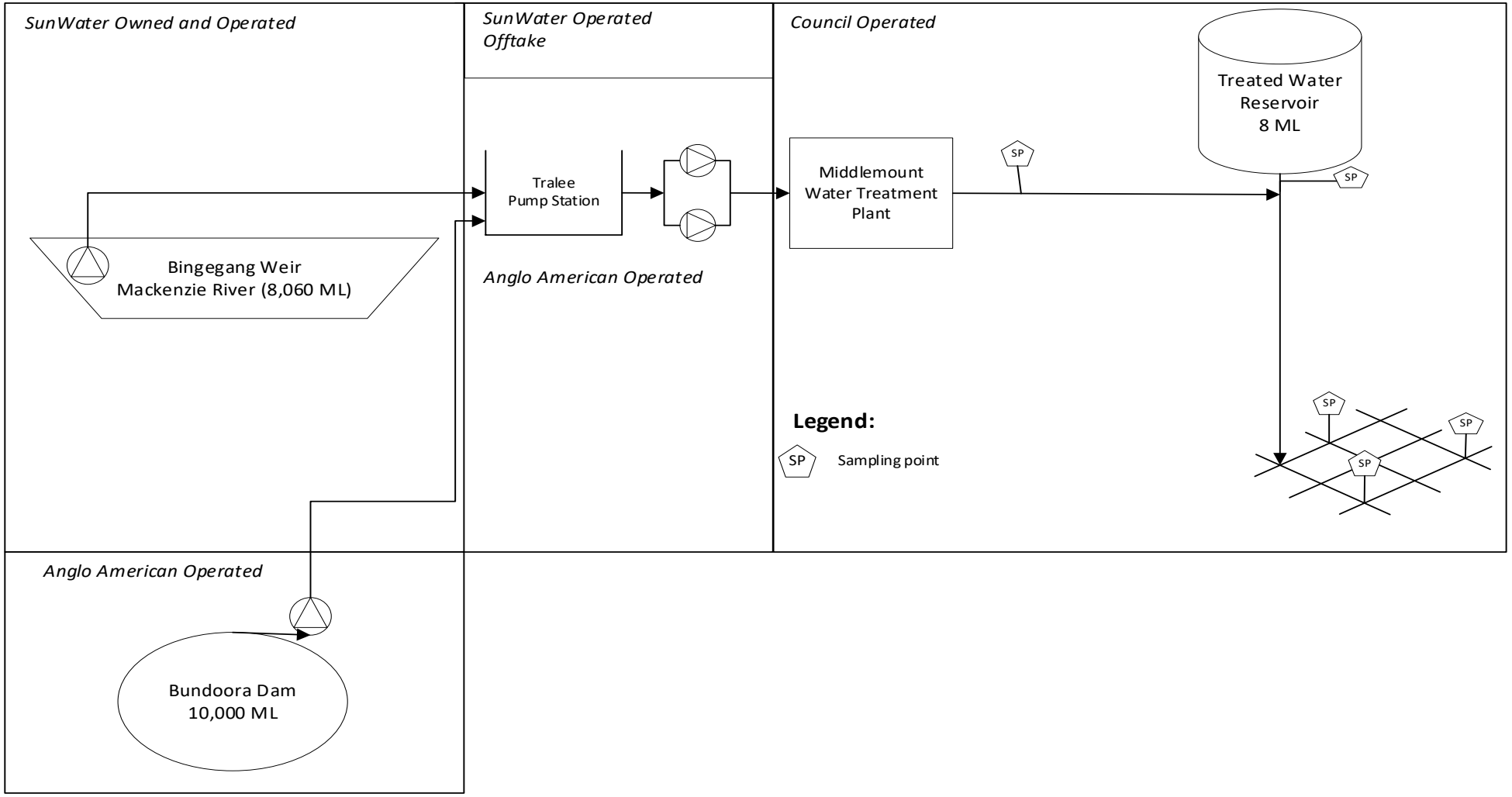


Figure 27 Middlemount Catchment to Tap Schematic

Middlemount Water Treatment Plant

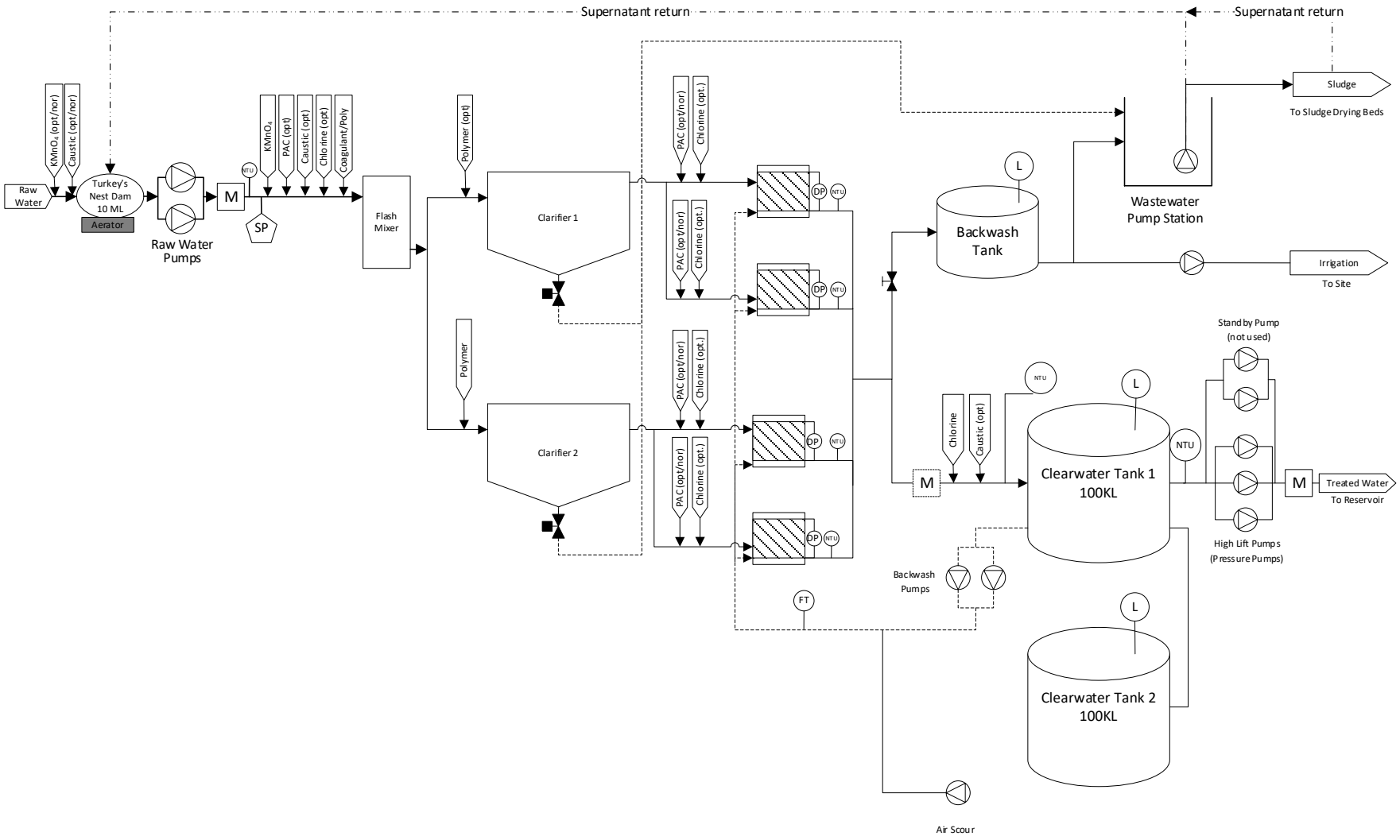


Figure 28 Middlemount Treatment Plant Schematic

WATER QUALITY

RAW WATER

Raw water quality is highly variable with a large range of turbidity and colour. Occasionally iron and manganese are recorded.

Table 70 Middlemount Raw Water Monitoring (2021-2023)

	UNIT	# OF SAMPLES	75TH %TILE	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Alkalinity	mg/L $CaCO_3$	33	92	125	55	115	80	16
Conductivity		272	242	402	187	282	226	32
Free Chlorine	Mg/L	341	3.2	4.8	0.79	4.1	2.2	1.1
Hardness	mg/L $CaCO_3$	31	65	90	15	90	52	21
pH		360	8.2	9.9	7.5	8.5	8	0.35
Sol. Iron	mg/L	120	0.04	1	0	0.15	0.051	0.12
Sol. Manganese	mg/L	109	0.06	0.56	0	0.095	0.045	0.065
Tot. Iron	mg/L	187	0.05	2.4	0	1.4	0.16	0.44
Tot. Manganese	mg/L	246	0.025	0.32	0	0.083	0.022	0.045
True Colour	HU	360	52	360	0	75	37	32
Turbidity	NTU	360	253	551	16	439	181	129
Sol. UVA_{254}	Abs	336	0.1	0.99	0.067	0.14	0.096	0.077

TREATED WATER

Treated water shows a variability in pH and Total Dissolved Solids (TDS) with occasional spikes in manganese and iron.

Table 71 Middlemount Summary Treated Water Monitoring (2021-2023)

	UNIT	# OF SAMPLES	75TH %TILE	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Alkalinity	mg/L $CaCO_3$	40	84	140	51	95	75	15
Free Chlorine	mg/L	357	3.1	4.3	1.6	3.7	2.7	0.64
Hardness	mg/L $CaCO_3$	38	71	90	35	85	61	15
pH		361	7.8	9.5	7	8	7.5	0.35
TDS	mg/L	359	146	401	96	199	131	37
Tot. Aluminium	mg/L	38	0.04	0.09	0	0.071	0.023	0.023
Tot. Iron	mg/L	361	0.02	0.1	0	0.04	0.014	0.013
Tot. Manganese	mg/L	359	0.012	0.19	0	0.031	0.011	0.021

True Colour	HU	360	0	3	0	0.21	0.073	0.36
Turbidity	NTU	228	0.2	1.3	0.1	0.3	0.18	0.12
Sol. UVA_{254}	Abs	179	0.057	0.5	0.044	0.064	0.059	0.045

Verification

Verification monitoring data for Middlemount is presented in Table 72. Chemical parameters with values under the limit of detection (LOD) are presented as 0.5xLOD. Microbiological results under LOD are presented as 0.

Table 72 Verification monitoring – Middlemount (2014-2023)

	# OF SAMPLES	MIN.	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Alkalinity - Residual (mq/L)	21	-0.019	0.05	-0.017	0.05	0.041	0.02
Alkalinity (mg/L)	106	38	146	47	116	79	21
Aluminium (µg/L)	146	1.9	16	2.5	9.5	3.9	2.6
Ammonia (mg/L)	42	0.0025	0.11	0.0029	0.042	0.009	0.018
Arsenic (µg/L)	20	0.5	1.2	0.5	1.2	0.79	0.25
Barium (µg/L)	5	27	49	27	49	39	7.9
Beryllium (µg/L)	4	0.25	0.5	0.25	0.5	0.31	0.13
Boron (µg/L)	5	34	53	34	53	43	7.6
Bromate (µg/L)	87	2.5	25	5	25	8.4	5.5
Bromate^ (µg/L)	2	25	25	25	25	25	0
Cadmium (µg/L)	14	0.05	0.5	0.05	0.5	0.11	0.16
Calcium (mg/L)	72	11	35	13	28	20	4.5
Chlorate (µg/L)	85	5	734	10	70	34	86
Chlorate^ (µg/L)	2	25	25	25	25	25	0
Chlorite (µg/L)	86	2.5	25	5	25	8.6	5.6
Chlorite^ (µg/L)	2	25	25	25	25	25	0
Chromium (µg/L)	14	0.05	0.5	0.05	0.5	0.15	0.16
Cobalt (µg/L)	1	0.5	0.5	0.5	0.5	0.5	0
Colour - True (TCU)	106	0.5	13	0.5	5	1.8	2
Conductivity (µS/cm)	378	99	673	185	547	309	112
Copper (µg/L)	14	9.1	26	9.1	26	14	4.8
Dissolved Oxygen (% Sat)	89	80	107	83	103	94	5.6
E. coli (MPN/100mL)	912	0	0	0	0	0	0
Fluoride (mg/L)	88	0.005	0.22	0.03	0.19	0.11	0.052
Formaldehyde (mg/L)	44	0.05	0.1	0.05	0.05	0.051	0.0075
Free Chlorine Residual (Client tested) (mg/L)	691	0.01	3.8	0.33	2.9	1.6	0.92
Free Chlorine Residual (mg/L)	222	0.01	4.4	0.03	3	1.3	1
Gross alpha (Bq/L)	12	0.02	0.025	0.02	0.025	0.025	0.0014
Gross beta (Bq/L)	12	0.05	0.2	0.05	0.2	0.086	0.058
Hardness - Temporary (mg/L)	96	38	146	47	117	79	21

	# OF SAMPLES	MIN.	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Hardness (mg/L)	105	42	158	46	132	82	25
Iodide (µg/L)	8	10	10	10	10	10	0
Iron (µg/L)	160	0.5	76	1	4	1.9	6.1
Lead (µg/L)	20	0.25	0.5	0.25	0.5	0.31	0.11
Magnesium (mg/L)	72	4.3	19	5.2	16	9.5	3.2
Manganese (µg/L)	160	0.5	3.9	0.5	2.2	0.68	0.54
Mercury (µg/L)	20	0.025	0.55	0.025	0.55	0.25	0.12
Molybdenum (µg/L)	5	0.5	1.2	0.5	1.2	0.64	0.3
Nickel (µg/L)	14	0.77	1.6	0.77	1.6	1.3	0.23
Nitrate (mg/L)	106	0.0075	2.8	0.081	2	0.85	0.63
Nitrite (mg/L)	106	0.002	0.5	0.002	0.2	0.072	0.1
pH (Client tested) (pH unit)	691	6.9	8.5	7.1	7.8	7.5	0.22
pH (pH unit)	172	6.9	8.5	7	8.2	7.5	0.35
Residual Alkalinity (mg/L)	60	0.05	0.05	0.05	0.05	0.05	0
Selenium (µg/L)	20	0.5	2.5	0.5	2.5	2	0.89
Silver (µg/L)	5	0.05	0.5	0.05	0.5	0.23	0.25
Sulphide (mg/L)	29	0.0025	0.006	0.0025	0.006	0.0027	0.0009
Tin (µg/L)	5	0.5	1.1	0.5	1.1	0.69	0.28
Total Dissolved Solids (mg/L)	378	59	404	111	326	185	67
Trihalomethanes (Total) (µg/L)	151	2.5	287	30	248	141	63
Trihalomethanes (Total)^ (µg/L)	26	9.9	216	14	196	85	48
Turbidity (Client tested) (NTU)	303	0.05	0.62	0.05	0.28	0.15	0.076
Turbidity (NTU)	118	0.05	10	0.17	2.8	0.88	1.4
Uranium (µg/L)	5	0.25	0.5	0.25	0.5	0.35	0.14
Zinc (µg/L)	14	4.6	12	4.6	12	7.3	2

CUSTOMER COMPLAINTS

During the FY 22/23 there was one (1) customer complaint which related to discoloured water. Historically, from 2017 there were a few customer complaints of discoloured water, taste and odour and one (1) complaint which claimed a correlation for a skin reaction to the water, which was further investigated and found no water quality concerns.

Table 73 Summary of Customer Complaints - Middlemount

Year	No of Water Quality Complaints	Main Reasons for Complaints	Likely Sources / Causes of Problems	Resolution of Problem
2014-15	2	Unknown	Possibly related to mains flushing	
2015-16	1	Discoloured water	No information recorded to indicate the cause of complaint. The water quality data are generally in line with the ADWG.	Localised and mains flushing performed. WTP processes reviewed.
2016-17	28	Discoloured water and water taste	No information recorded to indicate the cause of complaint.	Localised and mains flushing performed. Raw water quality and WTP processes reviewed and adjusted.
2017-18	1	Unknown	No information recorded to indicate the cause of complaint.	
2018-19	1	Discoloured water	No information recorded to indicate the cause of complaint.	Localised and mains flushing performed. WTP processes reviewed.
2019-20	2	Taste and odour	Cause of the complaint not known. Samples taken within ADWG	WTP processes reviewed.
2020-21	1	Health Concern	Complaint investigated; no known cause could be found.	Customer advised no reoccurring issue.

INCIDENTS

Reports to the regulator in Middlemount covered one (1) low free chlorine and one (1) high THMs incident in the network.

Table 74 Summary of Incidents in Middlemount (2017-2023)

Incident date	Date/ Reference	Location	Parameter	Description of event	Improvement
05/01/2022	DWI-486-22-09403	Network (all 5 sample locations except the Football Fields)	Free chlorine (0.04 mg/L)	A network sample in Middlemount measured less than 0.2 mg/L free chlorine, the lower limit nominated within IRC DWQMP.	Short term: shorter run length, reduce water store in the treated water reservoir, daily testing and flushing where required. Medium term: capital installation of in-tank dosing and mixing
2/11/2022	DWI-486-22-09950	Treated water	THMs (0.28 mg/L)	THMs were detected in the Middlemount treated water above the ADWG guideline of 0.25 mg/L. PAC dosing was under repair at the time of the event.	Investigation to use potassium permanganate for primary oxidation in preference to chlorine when NOM in raw water is elevated.
13/09/2023	DWI-486-23-10406	Network	Free Chlorine	Free chlorine was detected below the critical limit of 0.2 mg/L at Emu Park	Review of chlorine dosing and critical control.

RISK ASSESSMENT

SCHEME MITIGATED RISK ASSESSMENT

Table 75 Mitigated Risk Assessment - Middlemount

Ref	Treatment Stage	Primary Hazard	Other hazards managed by barrier	Hazardous Event	Unmitigated Risk	Control Measures in place	Comment	Mitigated Consequence	Mitigated Likelihood	Mitigated Risk	Uncertainty	Improvement Action Required - Immediate	Improvement Action Required ~ 2 years	Improvement Action Required - Long term
MMT1	Raw Water Abstraction	Protozoa (Category 4)	Bacteria and viruses, turbidity, iron and manganese	Normal operation	Extreme 25	Conventional treatment, disinfection.	Catchment is open Category 4.	Catastrophic	Unlikely	High 10	Reliable	Consider options for immediate improvements in CT and implement appropriate solution noting that when water temperature is cold, adequate disinfection is not achieved.		
MMT2	Chemical Dosing - Potassium permanganate	Manganese - dosing		Overdose of potassium permanganate	High 12	Duty standby pumps	Automation to be developed with on/ off signal. Dose with incoming raw water into Turkeys Nest. Insufficient chemical stored to be able to overdose whole dam	Moderate	Rare	Low 3	Confident			
MMT3	Chemical Dosing - Potassium permanganate	Manganese surface water		Underdose of potassium permanganate	High 12	Duty standby pumps, dosing point can be moved to at treatment plant	Automation to be developed with on/ off signal. Dose with incoming raw water into Turkeys Nest. Insufficient chemical stored to be able to overdose whole dam. Second dosing point available.	Moderate	Possible	Medium 9	Reliable		Consider alternative options such as raw water tank for permanganate oxidation.	
MMT4	Aeration	Cyanobacteria (Other schemes)	Manganese and iron	Failure of aeration	Medium 6	Aeration at the inlet, 4 other aerators in Turkeys Nest.		Minor	Possible	Medium 6	Reliable	Review of BGA management plan (by Dec 2024)		
MMT5	Supernatant return and storage	Protozoa (Category 4)		Recycling of protozoan pathogens	Extreme 25	Return to Turkeys Nest is not controlled, but low percentage. Coagulation, filtration.	Supernatant enters Turkeys Nest. Clarifier sludge may be able to be returned. Still full treatment at plant with all chemical dosing. Some raw water samples indicate an influence of the waste stream.	Catastrophic	Possible	High 15	Unreliable	Identify the control philosophy for the waste stream and reroute so that clarifier sludge cannot directly enter Turkeys Nest.		
MMT6	Chemical Dosing - Potassium permanganate	Manganese - dosing		Overdose of potassium permanganate	High 12	Jar testing as required, or change in raw or treated water quality	Can be dosed either ahead of Turkeys Nest or prior to the flash mixer. Duty/standby, Auto shutdown. No alarms.	Moderate	Unlikely	Medium 6	Confident			
MMT7	Chemical Dosing - Potassium permanganate	Manganese surface water		Underdose of potassium permanganate	High 12	Jar testing as required, or change in raw or treated water quality	Can be dosed either ahead of Turkeys Nest or prior to the flash mixer. Duty/standby, Auto shutdown. No alarms	Moderate	Unlikely	Medium 6	Reliable			
MMT8	Chemical Dosing - Powdered Activated Carbon (PAC)	Cyanobacterial toxins (Middlemount)	Taste and odour	Underdose PAC	Medium 9	Typically not required. Will require maintenance to be operationally ready. Chlorine oxidation, permanganate oxidation.	Can be dosed prior to the flash mixer, or immediately before the filters. Duty/standby, Auto shutdown,	Moderate	Possible	Medium 9	Confident	Review of BGA management plan (by Dec 2024)		
MMT9	Chemical Dosing - Sodium hydroxide	pH		Overdose/ Underdose Caustic	Medium 9	Typically not required. Will require maintenance to be operationally ready.	Can be after the raw water pump station and post filters before the clearwater tank, Duty/Standby, with auto shutdown, no alarms	Moderate	Possible	Medium 9	Confident			
MMT10	Chemical Dosing - Chlorine gas	Chlorine		Overdose chlorine	High 12	Optional dosing point, not normally used. See chlorine disinfection risk lines.	Duty/Standby Auto changeover and shutdown Rare as not used. Can also dose ahead of the filters.	Moderate	Rare	Low 3	Confident			

Ref	Treatment Stage	Primary Hazard	Other hazards managed by barrier	Hazardous Event	Unmitigated Risk	Control Measures in place	Comment	Mitigated Consequence	Mitigated Likelihood	Mitigated Risk	Uncertainty	Improvement Action Required - Immediate	Improvement Action Required ~ 2 years	Improvement Action Required - Long term
MMT11	Chemical Dosing - Chlorine gas	DBPs		Overdose chlorine	Medium 9	Optional dosing point, not normally used.	Duty/Standby Auto changeover and shutdown. DBPs are not generated at this point in the process when this dosing is not used. Can also be dosed ahead of filters.	Moderate	Rare	Low 3	Confident			
MMT12	Chemical Dosing - Aluminium Chlorohydrate (ACH)	Protozoa (Category 4)	Turbidity	Underdose of coagulant	Extreme 25	Jar testing as required, daily grab samples. Coagulation, filtration.	Dose rate set in SCADA, Duty/Standby Auto changeover and shutdown No alarms	Catastrophic	Unlikely	High 10	Estimate	Ensure that pump failure and or low flow for chemical dosing sends alarms to operators	Consider a turbidity meter for clarified water.	
MMT13	Chemical Dosing - Aluminium Chlorohydrate (ACH)	Aluminium - coagulant	Turbidity	Overdose of coagulant	Medium 6	Jar testing as required, weekly testing of treated water.	Manual dose rate Duty/Standby Auto changeover and shutdown No alarms	Minor	Rare	Low 2	Confident			
MMT14	Chemical Dosing - Polyelectrolyte	Monomer		Overdose polymer impacting filter run times and backwashing	Medium 6	Currently using a coagulant with added polymer. Jar Testing	Optional dosing of polymer (may be polyDADMAC, can be acrylamide base). Duty standby dosing.	Moderate	Unlikely	Medium 6	Confident			
MMT15	Clarification	Protozoa (Category 4)	Turbidity	Poor coagulation (can include underdosing polymer)	Extreme 25	Jar testing as required, daily grab samples. Coagulation, filtration.	Dose rate set in SCADA, Duty/Standby Auto changeover and shutdown No alarms	Catastrophic	Unlikely	High 10	Estimate	Ensure that pump failure and or low flow for chemical dosing sends alarms to operators	Consider a turbidity meter for clarified water.	
MMT16	Filtration - Media filtration	Protozoa (Category 4)	Turbidity	Filter breakthrough	Extreme 25	Critical control point procedure. Coagulation, filtration.	Online DP and NTU Has air scour. Alarms on turbidity for individual filters. Backwash able to be initiated through SCADA.	Catastrophic	Unlikely	High 10	Estimate	Alarms to be checked to ensure operators are made aware at 0.2 NTU. May not shut down on exceeding critical limit.		Consider need for UV disinfection as second protozoan barrier.
MMT17	Filtration - Media filtration	Protozoa (Category 4)	Turbidity	Poor backwash	Extreme 25	Operators initiate backwash as required. Coagulation, filtration, GAC filtration.	Backwash is operator initiated, based on time, turbidity or headloss. Not automated.	Catastrophic	Unlikely	High 10	Reliable	Investigate feasibility of automated backwash and implement if possible.		
MMT18	Disinfection - chlorine gas	Chlorine		Overdose	High 12	Daily monitoring and implementation of CCP.	Duty/Standby Auto changeover and shutdown. Online chlorine analyser.	Moderate	Possible	Medium 9	Reliable	Investigate shutdown on high chlorine		
MMT19	Disinfection - chlorine gas	DBPs		Reaction of chlorine with organics	Medium 9	Coagulation, filtration. Chlorine critical limit recently increased until solution for low CT is implemented.	Duty/Standby Auto changeover and shutdown. Online chlorine analyser. Historical issues mostly prior to KMnO4 dosing.	Moderate	Possible	Medium 9	Reliable			
MMT20	Disinfection - chlorine gas	Bacteria/Virus		Underdose	Extreme 25	Daily testing at outlet of clearwater tanks.	Duty/Standby Auto changeover and shutdown. Online chlorine analyser. Previous low critical limit validated as too low. Immediately increased. Requires a permanent solution.	Catastrophic	Likely	Extreme 20	Estimate	Consider options for immediate improvements in CT and implement appropriate solution noting that when water temperature is cold, adequate disinfection is not achieved.		

OPERATIONAL MONITORING

Table 76 Middlemount Operational Monitoring

PARAMETER	RAW WATER	POST FLASH	CLARIFIED WATER	FILTERED WATER	TREATED WATER	CT WATER	NETWORK WATER
Alkalinity	Weekly				Weekly		
Aluminium			Weekly		Weekly		
pH	Daily	Daily	Daily		Daily	2 x Weekly	2 x Weekly
Free Chlorine					Daily	2 x Weekly	2 x Weekly
Temperature	Daily				Daily		Weekly
Tot. Hardness	Weekly				Weekly		
Tot. Iron	Weekly				Weekly		Weekly
Sol. Iron	Daily		Weekly				
Tot. Manganese	Weekly				Daily		Weekly
Sol. Manganese	Daily		Weekly				
True Colour	Daily		Daily		Daily		2 x Weekly
Turbidity	Daily, Online		Daily	Daily Online	Daily	2 x Weekly	2 x Weekly
Sol. UVA_{254}	Daily		Weekly				

Response to out of specification results for relevant parameters are managed through CCPs and OCPs

Operators check the calibration of online instruments with the results from their lab/benchtop analysis as part of the operational monitoring.

CRITICAL CONTROL POINTS

CRITICAL CONTROL POINTS

The critical control points (CCP) for the scheme were identified in the risk assessment process, and include:

- Filtration – filtered water turbidity.
- Chlorination – free chlorine.

The CCP procedures are included in the following pages. These are presented as traffic lights and identify the location, monitoring, performance, and validation of the process. The traffic lights are aligned to SCADA where the low and high limits match the adjustment level and (as appropriate) the high high and low low alarms match the critical limit.

OPERATIONAL CONTROL POINTS

Middlemount WTP has four (4) operational control points (OCP) for the following process.

- Oxidation – treated water total manganese.
- Coagulation – clarified water turbidity.
- Chlorination – treated water free chlorine
- Disinfection – treated water pH.

An OCP exceedance is generally not reportable to the regulator except if it is an event that requires reporting. Incident reporting to the regulator is based on CCPs or exceedances of ADWG health guidelines.

QUALITY CONTROL POINTS

Middlemount WTP has three (3) quality control points (QCP) for the following processes.

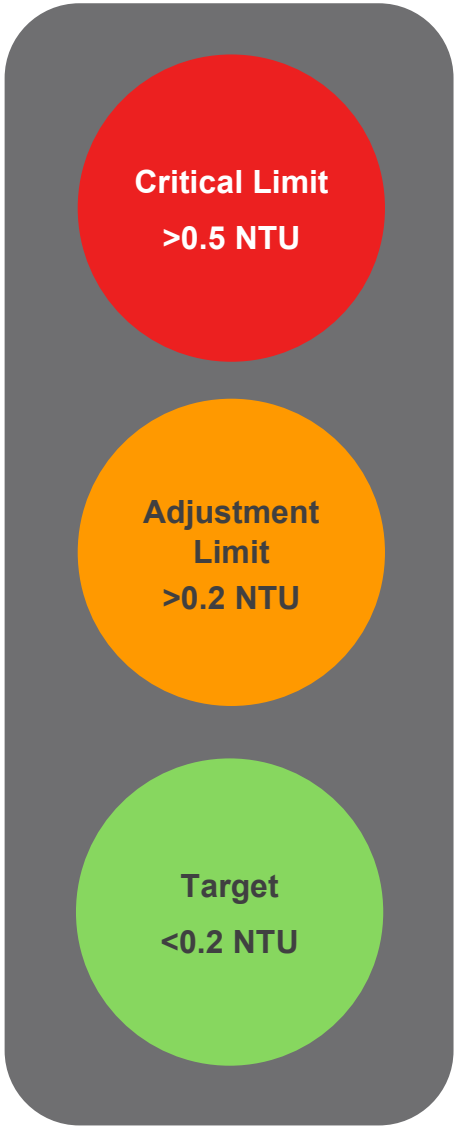
- Oxidation (Potassium Permanganate) – clarified water-soluble iron, manganese, and UVA.
- Coagulation – dosed water, post flash mixer pH
- Coagulation – clarified water aluminium.

The CCPs, OCPs and QCPs can be found below.

CRITICAL CONTROL POINT PROCEDURE - MIDDLEMOUNT

Filtration

What is measured	Where is it measured	When is it measured	What is the control point	What are the hazards	Record Keeping
Turbidity	Post filtration	Continous online and daily grab sample	Filtration	Protozoa, turbidity	Operator Log Sheets



- Confirm result with grab samples
- Breach of CCP is continued supply of water to customers above the Critical Limit
- Operator to contact Supervisor/Coordinator or Manager
- Supervisor/Coordinator or Manager to inform Compliance & IMS team on [redacted]
- If operator unable to contact chain of command, report directly to Compliance & IMS Team
- Compliance & IMS to contact DRDMW on 1300 596 709 as required
- If health advice required, Compliance & IMS or Manager to contact Mackay PHU on 4885 5800

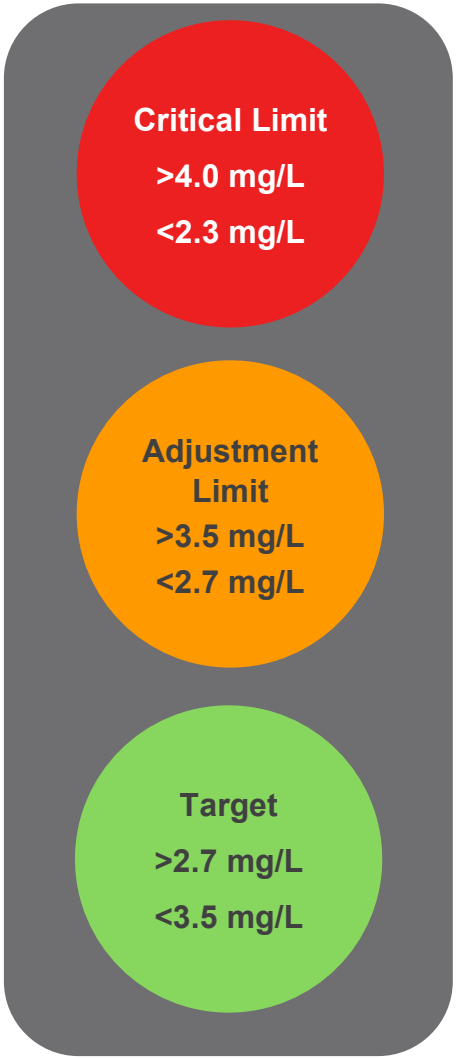
- Check turbidity meter, clean and calibrate to confirm results
- Check raw water turbidity for changes since last dose rate change.
- Check clarified water pH and turbidity and adjust dosing as necessary
- Check coagulation dosing system, drop test to validate dose rate, jar test if required.
- Backwash filters
- Take filter offline if turbidity still above Adjustment Limit after multiple backwashes.
- Rectify any dosing issues and escalate to supervisor/coordinator

- When attending plant, inspect process for any visual signs of process failure
- Test the water as per DWQMP
- Record results
- Check raw water turbidity regularly and adjust coaguation dose rates as required (jar test as required)
- Complete routine cleaning and calibration of online meters
- Check SCADA trend for normal operation
- Ensure backwashes are undertaken and effective

CRITICAL CONTROL POINT PROCEDURE - MIDDLEMOUNT

Disinfection

What is measured	Where is it measured	When is it measured	What is the control point	What are the hazards	Record Keeping
Free Chlorine	Grab sample post treated water reservoir (when supplied to reservoir), Grab sample from Footy Fields network location (when supplied from WTP directly)	Daily (online)	Disinfection	Bacteria, viruses, chlorine	Operator Log Sheets



- Confirm result with grab samples
- Operator to contact Supervisor/Coordinator or Manager
- If low chlorine, Supervisor/Coordinator and/or Manager to ensure sufficient chlorine contact time for disinfection with actual operational parameters.
- If water with < 15 mg.min/L is supplied to customers this is a reportable event
- If chlorine is > 5 mg/L this is reportable as an incident
- Supervisor/Coordinator or Manager to inform Compliance & IMS Team on [redacted]
- If operator unable to contact chain of command, report directly to Compliance & IMS Team
- Compliance & IMS to contact DRDMW on 1300 596 709 as required
- If health advice required, Compliance & IMS or Manager to contact Mackay PHU on 4885 5800

- Confirm result with grab sample
- Check chlorine meter, clean and calibrate to confirm result
- Check dosing system for any issues or air locks
- Rectify any dosing issues
- Take WTP offline or reduce plant flow as required

- When attending plant, inspect process for any visual signs of process failure
- Test the water as per DWQMP
- Record results
- Check cylinder weights and change empty cylinders as required
- Complete routine calibrations of online instruments to ensure accuracy

Validation: The CWT has a volume of 100 kL, a minimum operational volume of 70% (unbaffled, baffle factor 0.1). The maximum pumped flow rate through CWT is 55 L/s. At a minimum chlorine residual of 2.3 mg/L, the clearwater tank at Middlemount WTP achieves 4.9 mg.min/L CT When in use the reservoir provides 913 mg.min/L CT with a volume of 8 ML, min operating level of 70% (unbaffled) and a peak flow of 23.5 L/s. At times when water is supplied from WTP directly to network, an additional CT of 3.4 mg.min/L is achieved in the pipe to the footy fields (9817L pipe volume) resulting in a total CT of 8.3 mg.min/L. Following the WaterVal protocol, a log reduction of 4 is achieved at 8 mg.min/L when pH <8, ≤2 NTU, >20°C. This applies in Middlemount during summer with an immediate improvement action in the RMIP to prepare for winter.

Table 77 Operational Control Points - Middlemount WTP

PROCESS	PARAMETER	WHERE IS IT MEASURED?	HAZARD	WHEN IS IT MEASURED	TARGET	ADJUSTMENT LIMIT	ACTION IF ADJUSTMENT LIMIT EXCEEDED	ALERT LIMIT	ACTION IF ALERT LIMIT EXCEEDED	REPORTING
Oxidation	Total Manganese	Treated water	Manganese	Daily	<0.1 mg/L	>0.1 mg/L	Confirm manganese reading, Check soluble manganese in treated water and free chlorine, Check clarifier total and soluble manganese, Adjust dosing rate	>0.5 mg/L	Confirm manganese reading, Divert the clarifier water, Check permanganate dosing system, Shutdown if uncertain of cause, Check treated water free chlorine, Check network total and soluble manganese, free chlorine and colour, Operator to notify Supervisor/Coordinator/Manager Consider treated water reservoir drain down and network flushing, Assess permanganate dosing through jar testing	Operator to contact Supervisor/Coordinator and/or Manager as total manganese in treated water > 0.5 mg/L is a reportable event. Assess closely related reportables such as effective disinfection, treated water colour and network turbidity.
Coagulation	Turbidity	Clarified water	Protozoa, Turbidity	Daily	< 2 NTU	> 2 NTU	Confirm turbidity reading, Check raw water turbidity, Check coagulation dosing system, drop test to validate dose rate.	> 5 NTU	Confirm turbidity reading, Check dosing system, Adjust dosing rate, Operator to notify Supervisor/Coordinator/Manager	Operator to contact Supervisor/Coordinator and/or Manager as failure to coagulate effectively is a reportable event
Chlorination	Free chlorine	Treated water	bacteria and viruses	Daily	>2.7 mg/L and <3.5 mg/L	<2.7 mg/L and >3.5 mg/L	Confirm free chlorine reading, Check chlorine dosing, Adjust dosing rate and monitor	< 2.5 mg/L Or > 4.0 mg/L	Confirm free chlorine reading, Check chlorine dosing, Adjust dosing rate and monitor, Operator to notify Supervisor/Coordinator/Manager	Internal reporting, Further see Disinfection CCP. Confirm CT is adequate
Disinfection	pH	Treated water	pH, bacteria, and viruses	Daily	>7.3 <7.8	>7.8 <7.3	Confirm pH reading, Check dosing system, Adjust dosing rate	>8.0 <7.0	Confirm pH reading, Check dosing system, Adjust dosing rate, Operator to notify Supervisor/Coordinator/Manager	Internal reporting, Further See Coagulation OCP and Filtration CCP
OCP EXCEEDANCES ARE GENERALLY NOT REPORTABLE TO THE REGULATOR EXCEPT IF IT IS AN EVENT										

Table 78 Quality Control Points Middlemount

PROCESS	PARAMETER	WHERE IS IT MEASURED?	HAZARD	WHEN IS IT MEASURED	TARGET	ACTION IF TARGET LIMIT EXCEEDED	REPORTING
Oxidation	Soluble Manganese Soluble Iron Soluble UVA	Clarified water	Manganese and Iron	Weekly	Soluble Mn <0.03 mg/L Soluble Fe <0.05 mg/L Soluble UVA < 0.06	Confirm manganese, iron and UVA readings, Check permanganate dosing system and adjust dosing if required, Assess dosing rate of PAC for organic removal	Operator to notify Supervisor/Coordinator/Manager
Coagulation	pH	Post flash mixer	Protozoan / Turbidity	Daily	7.4 to 7.6	Confirm pH reading Check coagulation performance, Adjust dosing rate of alkali chemical, Refer to Filtration CCP	Operator to notify Supervisor/Coordinator/Manager
Coagulation	Aluminium	Clarified water	Aluminium	Weekly	<0.1 mg/L	Confirm Aluminium reading, Check coagulation performance and adjust dosing if required.	Operator to notify Supervisor/Coordinator/Manager
QCP EXCEEDANCES ARE GENERALLY NOT REPORTABLE TO THE REGULATOR EXCEPT IF THIS RESULTS IN ADWG (HEALTH) OR CCP EXCEEDANCE							

RAW WATER MONITORING

Raw water monitoring in Middlemount is undertaken based on the principles outlined in the overarching DWQMP.

Table 79 Raw Water Monitoring Parameters

PARAMETER	FREQUENCY
Radiological	2 – years
Algal	Seasonally
Pesticides	Quarterly

VERIFICATION MONITORING

Table 80 Verification Monitoring Parameters

PARAMETER	FREQUENCY	WTP	SAMPLE POINTS IN RETICULATION
E.coli	Weekly	No	SP 1-4
SWA	Monthly	Yes	Rotation SP 1-4
THMs	Quarterly	No	SP 2
Metals	Quarterly	Yes	Rotation SP 1-4

VERIFICATION MONITORING LOCATIONS

The monitoring locations in Middlemount are shown in Figure 29 and Table 81. These locations are located spread around Middlemount and represent the majority of the water quality provided to Middlemount's customers. As the reservoir infrastructure cannot provide water to town while being filled, it is useful to also test the water in the reservoir in addition to the town's reticulation. DBPs should be tested at the [redacted] for a more accurate reflection of water quality.

Table 81 Middlemount Monitoring Points

SAMPLE POINTS	NETWORK SAMPLING LOCATIONS	COMMENT
1	[redacted]	
2	[redacted]	[redacted]
3	[redacted]	
4	[redacted]	[redacted]

Figure 29 Middlemount Verification Monitoring Locations

Response to out of specification results

Data from the verification monitoring is accessible via the Mackay Laboratory Monitor Pro Portal. The data is entered into spreadsheet records and the files on the share drive are accessible to all IRC Water and Wastewater Operational Staff. Refer to IRC Overarching DWQMP for Incident and Emergency Management.

APPENDIX 6

MORANBAH DRINKING WATER QUALITY MANAGEMENT PLAN

Moranbah Drinking Water Quality Management Plan

Presented by: Water and Waste Directorate
Current as at: 22 August 2024

ISAAC REGION
HELPING TO ENERGISE THE WORLD

ISAAC.QLD.GOV.AU ISAAC REGIONAL COUNCIL ABN 39 274 142 600
P 1300 472 227 F 07 4941 8666 A PO Box 97 Moranbah QLD 4744
isaacregionalcouncil isaacregionalcouncil Isaacrcouncil

TABLE OF CONTENTS

OBJECTIVE

This plan details how Isaac Regional Council ensures the safety of drinking water for the Moranbah community.

SCOPE

This plan is the Site-specific Drinking Water Quality Management Plan that together with the Overarching Drinking Water Quality Management Plan makes up the complete plan for Moranbah.

DEFINITIONS

TERM / ACRONYM	MEANING
ADWG	Australian Drinking Water Guidelines
CCP	Critical Control Point
DRDMW	Department of Regional Development Manufacturing and Water
DWQMP	Drinking Water Quality Management Plan
DWQMP Guideline	Guideline for the preparation, review, and audit of drinking water quality management plans.
IRC	Isaac Regional Council
OCP	Operational Control Point
NTU	Nephelometric turbidity units
PHA	*Public Health Act 2005*
QCP	Quality Control Point
QH	Queensland Health – regulator of public health – may take lead on managing incidents
Regulator	In the context of the DWQMP, the Regulator is DRDMW
RMIP	Risk Management Improvement Program
SPID	Service Provider Identification Number
WSSRA	*Water Supply (Safety and Reliability) Act 2008*
WTP	Water Treatment Plant

REFERENCES

ID	NAME
	DWQMP Document Register

INTRODUCTION

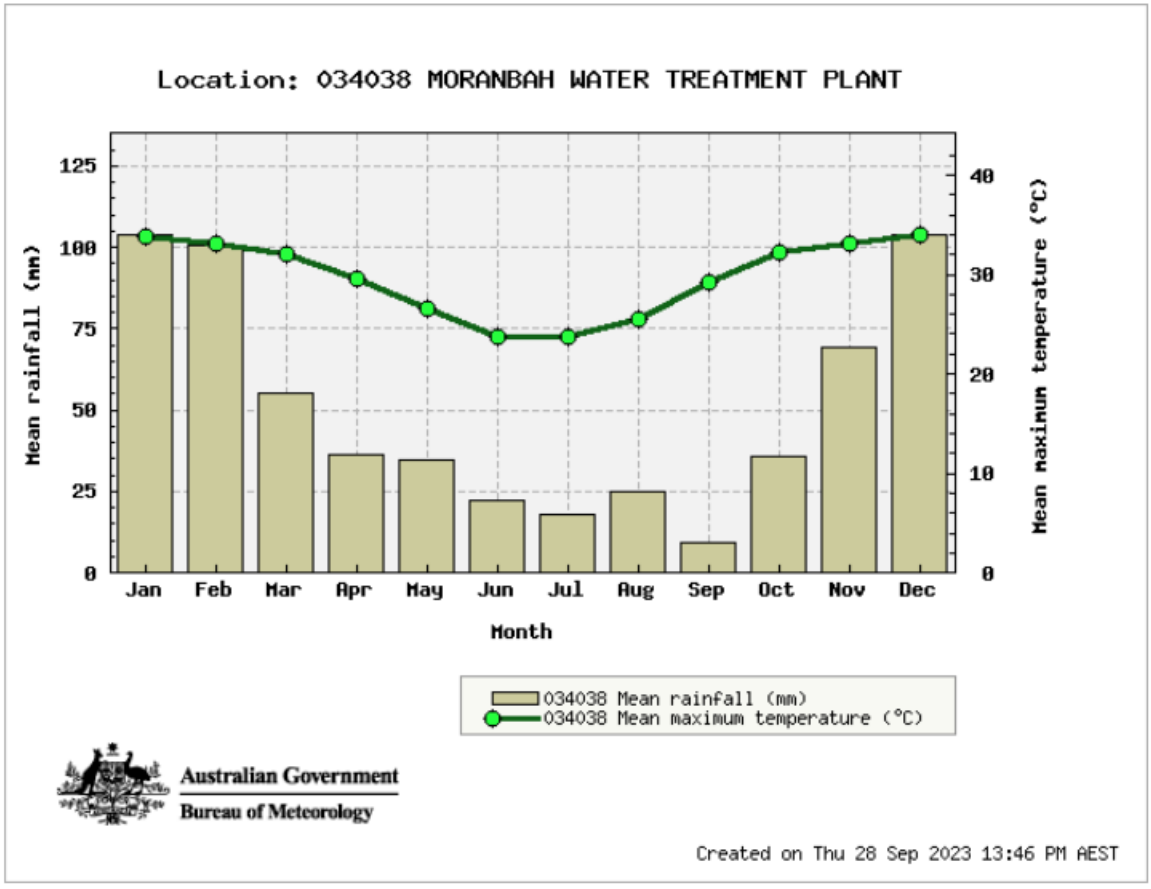
This site specific DWQMP documents the specific details of the Moranbah drinking water scheme. It is intended to be an operational document that informs the operational plant staff. As there are two (2) treatment plants (Main WTP and Boby Plant) which operate in duty/assist configuration this document is arranged in two (2) separate sections for the two (2) plants. However, the common aspects for both plants such as catchment, reticulation and verification monitoring are summarised in joint sections.

OVERVIEW OF THE SUPPLY SCHEME

Moranbah is a rural town of ~8700 people, which makes it the biggest town in Isaac Region. In addition to the local residing population Moranbah has a large fly-in fly-out population. Moranbah is a major hub for several large coal mines in central Queensland.

CLIMATE

The Moranbah climate is characterised by a subtropical semi-arid climate. Rainfall (See Figure 30) within the catchment averages ~613 mm/year with more rain in summer than winter. The mean maximum temperature is 29.7 °C, with a mean max. above 30°C between October to March.



Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
Mean rainfall (mm) for years 1972 to 2012	103.8	100.7	55.4	36.4	34.5	22.1	18.0	25.0	9.1	35.7	69.3	103.9	613.0	39
Statistics	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**	**Years**
Mean maximum temperature (°C) for years 1986 to 2012	33.8	33.1	32.1	29.5	26.5	23.7	23.7	25.5	29.2	32.3	33.1	34.0	29.7	26

Figure 30 Rainfall Data from BOM for Moranbah

CATCHMENT CATEGORISATION

Raw water for the Moranbah Water Scheme primarily originates from the Burdekin Dam, situated approximately 200 km to the northwest and Eungella Dam which is located approx. 100 km northeast of the Moranbah WTP.

The Burdekin dam catchment serves multiple purposes, including raw water supply to other water schemes, irrigation, grazing, agriculture (cotton and maize), mining, recreation (swimming, sailing, fishing), and future hydro schemes.

The Eungella dam catchment covers an area of 142 km^2 with most of it made up by national park and state forests with land uses ranging from grazing native vegetation to contact recreation (swimming, canoeing, fishing) and non-contact recreational activities (picnicking, bushwalking, and camping).

Based on the activity in the catchment area and the unprotected nature of the dams the raw water is characterised as a Category 4 catchment.

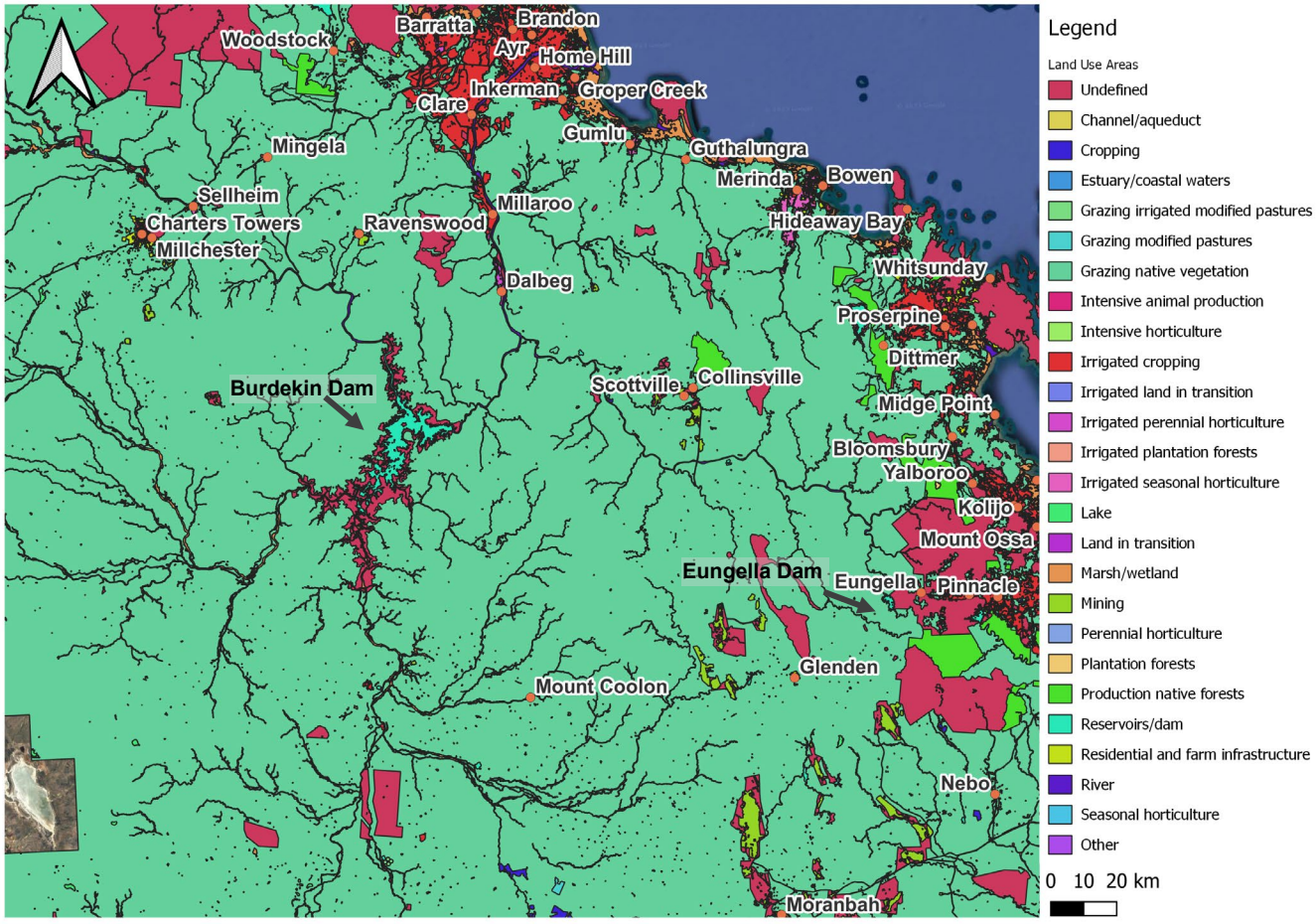


Figure 31 Burdekin and Eungella Dam Catchment - Moranbah

COMMON TREATMENT PROCESSES

Overall – Capacity

The Moranbah WTP is made up of two (2) treatment processes known as the Main WTP and the Boby Plant. These two (2) processes can operate either in series or parallel. Typically, the Main WTP functions as the duty plant, while the Boby Plant serves as the assist plant to meet peak demand. The estimate maximum capacities for both plants are 60-80 L/s for the Boby plant and 180 L/s for the Main WTP.

Raw water source:

Moranbah sources its raw water from two (2) main sources: Burdekin Falls Dam and Eungella Dam. Additionally, to the raw water allocations to both the Eungella Dam and Burdekin Dam, Council has an option to purchase additional water from Mining Company BMA.

Raw water pumping

The Burdekin Falls Dam is connected to Moranbah through a pipeline (BMA Line) that delivers the allocation of 23,000 ML per annum to Moranbah WTP. As a buffer a 600 ML storage dam is located north of Moranbah to ensure a consistent water supply, supported by four (4) booster pump stations.

The Eungella Dam is connected to Moranbah through a 119 km pipeline (IRC Line) with two (2) pump stations, providing 6,200 ML per annum. This pipeline also supplies water to various mines.

The route taken by the raw water includes several SunWater-managed infrastructures including the Gorge Weir, and the Burdekin-Moranbah pipeline.

Water from Eungella Dam flows through the Eungella water pipeline operated by Sunwater before it reaches Moranbah.

Water from both dams can be pumped into Council's 400 ML Turkey's Nest 3 or directly into the treatment plant.

Raw Water Turkey's Nests

Raw water is transported into three (3) Turkey's Nest Dams at the Moranbah WTP. From the 400 ML dam, raw water is pumped to the 8 ML and 12 ML Turkey's Nests, which are hydraulically linked, resulting in a total volume of 20 ML.

Level sensors in the 8 ML and 12 ML Turkey's Nests control the flow of two (2) raw water pumps from the 400 ML Turkey's nest dam. The two (2) pumps can operate simultaneously in duty/assist mode.

Water is the supplied from Turkey's Nest 1 to the Boby plant and from Turkey's Nest 2 to the Main WTP.

Treated water reservoirs and towers

The Moranbah Water Treatment scheme has three (3) treated water reservoirs: Both treatment plants discharge into reservoir 1 (5.7 ML). All three (3) reservoirs are interconnected through an underground pipe so reservoir 2 (8 ML) and 3 (13.8 ML) are fed from reservoir 1. The treated water reservoirs collectively have a capacity of 27.1 ML. The valves that connect the reservoirs can be used to isolate each of the treated water reservoirs. There is a bypass for the treated water reservoir which is valved off and fails into closed position on power outage. Water from the treated water tanks is pumped into two (2) water towers using two (2) sets of high lift pumps. Each set of high lift pumps comprises two (2) pumps organised in a duty/standby configuration. One additional standby pump is a diesel-powered pump, capable of operating in the event of a power failure. The Western Tower is situated onsite at the WTP, and the Eastern Tower is located at the intersection of Clements Street and Mills Avenue in Moranbah East. Each of these towers provides a storage capacity of 0.45 ML, resulting in a combined total capacity of 0.9 ML.

Reticulation

In Moranbah, there are two (2) trunk mains that supply water to the eastern and western parts of the town, drawing water from the Eastern and Western Water Towers, respectively. The West Moranbah trunk main has a diameter of 450 mm, while the East Moranbah trunk main measures 525 mm in diameter. Normally, these two (2) water towers are kept isolated from each other due to water pressure considerations, although they can be interconnected if the need arises.

Occasional complaints about discoloured or black water have arisen, which likely comes from precipitated iron and manganese. There currently is a program of works where pipe sections requiring renewal are being replaced with polyethylene. A range of pipe ages can be seen in Table 83.

To monitor and maintain the water system, pressure sensors have been strategically placed around the town, and these are regularly checked. The introduction of Smart Meters has also been implemented to gain better insights into water usage, losses, and to detect leaks and mains breaks more effectively.

Table 82 Pipe Materials and Length

MATERIAL	DIAMETER [DN]	LENGTH [M]
Asbestos Cement	0	193
	50	16
	75	357
	100	22911
	150	9648
	200	2210
	225	436
	250	1877
	375	2386
	300	2589
	525	3812
DICL	100	50
	150	187
	200	40
	250	98
	300	423
	375	774
	450	1640
Poly	25	102
	63	673
PVC	50	206
	100	640
	150	1461
	200	244
uPVC	63	136
	100	6167
	150	4421
	200	2718
	300	2400
	375	681
MDPE	63	476
oPVC	300	380
HDPE	100	14
	125	287
	150	9
	200	41
	250	1883
	300	1251
Unknown	0	7638
	25	27
	32	69
	50	114
	63	806
	100	4367
	125	61
	150	4728
	200	872
	250	12
	300	462
	375	495
	450	1

Table 83 Range of Pipe Age - Moranbah

PIPE AGE	1-10 YEARS	11-20 YEARS	21-30 YEARS	31-40 YEARS	41-50 YEARS	51-60 YEARS	61-70 YEARS
Percentage of Network	21%	16%	8%	6%	29%	20%	0%

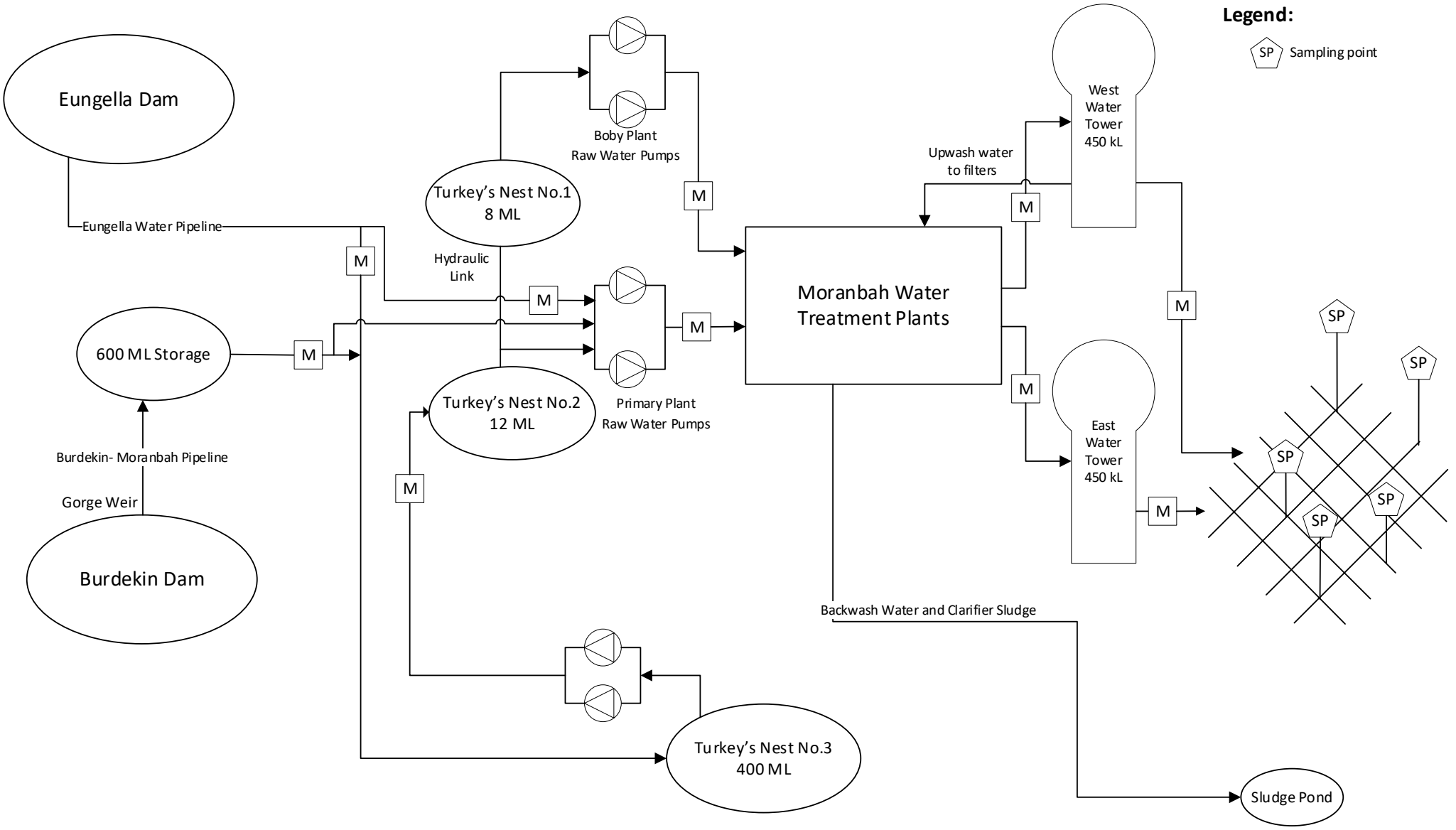


Figure 32 Overall Moranbah Treatment Plant Schematic

WATER QUALITY

RAW WATER

The source water shows seasonally higher turbidity with and overall increasing trend over the last four (4) years. Turbidity often occurs after strong rainfalls. Seasonally there are algal outbreaks in the Turkey Nests which have been captured in the risk assessment. While there is a relatively consistent concentration of iron and manganese some seasonal increases (higher in summer) can be seen.

Table 84 Raw Water Quality Summary (2019-2023)

	UNIT	# OF SAMPLES	75TH %TILE	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Alkalinity	mg/L $CaCO_3$	144	52	91	38	70	48	11
pH	-	1166	7.8	8.4	7.3	8.1	7.7	0.23
Sol. Iron	mg/L	84	0.15	0.55	0.033	0.23	0.11	0.076
Sol. Manganese	mg/L	63	0.018	27	0.008	0.039	0.45	3.4
Tot. Aluminium	mg/L mg/L	153	0.08	0.17	0.02	0.1	0.062	0.023
Tot. Iron		142	0.37	0.92	0.07	0.7	0.3	0.19
Tot. Manganese	mg/L	118	0.08	122	0.029	0.14	1.1	11
True Colour	HU	1122	67	222	20	133	54	34
Turbidity	NTU	1166	28	51	9.6	40	21	9.7
Sol. UVA_{254}		181	0.3	0.37	0.15	0.34	0.22	0.074

TREATED WATER

Operational

In the past, water with a true colour above 5 HU and once above the ADWG aesthetic guideline of 15 HU have been seen, as well as elevated manganese and iron levels. These mostly colour related issues have led to some customer complaints. Problems also included high turbidity (above 1 NTU). Moranbah has also had issues with low free chlorine residual and has recently been on a boil water alert (03/2023).

Table 85 Treated Water Quality Summary (2019-2023)

	UNIT	# OF SAMPLES	MIN.	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Alkalinity	mg/L $CaCO_3$	115	0.32	80	21	60	40	12
Aluminium	mg/L	116	0.001	0.059	0.01	0.041	0.024	0.01
Sol. iron	mg/L	73	0	0.02	0.0073	0.02	0.011	0.0042
Sol. manganese	mg/L	70	0.001	0.007	0.001	0.006	0.0037	0.0017
Fluoride	mg/L	2293	0.047	0.92	0.5	0.79	0.66	0.091
Free chlorine	mg/L	2312	0.07	2.3	0.82	1.8	1.4	0.29
Hardness	mg/L $CaCO_3$	115	21	94	31	67	48	12

pH	-	2359	5.5	8.3	7.2	7.8	7.4	0.18
Temperature	°C	325	17	35	20	29	25	2.9
Total iron	mg/L	105	0	0.04	0.01	0.02	0.014	0.0067
Tot. Manganese	mg/L	1684	0	0.66	0.001	0.0089	0.0053	0.023
True colour	HU	921	0	18	0	1	0.18	0.95
Turbidity	NTU	2355	0	3.6	0.09	0.33	0.18	0.15
Sol. UVA_{254}		215	0	0.7	0	0.016	0.011	0.048

Verification

Verification monitoring data for Moranbah is presented in Table 86. Chemical parameters with values under the limit of detection (LOD) are presented as 0.5xLOD. Microbiological results < LOD are presented as 0.

Table 86 Verification monitoring – Moranbah (2014-2023)

	# OF SAMPLES	MIN.	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Alkalinity - Residual (mq/L)	17	-0.019	0.05	-0.019	0.05	0.043	0.02
Alkalinity (mg/L)	104	28	101	33	87	55	17
Aluminium (µg/L)	152	2.5	23	2.5	17	8.9	4.4
Ammonia (mg/L)	41	0.0025	0.005	0.0025	0.005	0.0048	0.00066
Arsenic (µg/L)	20	0.25	1.2	0.25	1.2	0.35	0.23
Barium (µg/L)	4	28	42	28	42	35	5.9
Beryllium (µg/L)	4	0.25	0.5	0.25	0.5	0.31	0.13
Boron (µg/L)	4	27	39	27	39	31	5.4
Bromate (µg/L)	78	2.5	25	5	25	8.8	5.7
Bromate^ (µg/L)	2	25	25	25	25	25	0
Cadmium (µg/L)	13	0.05	0.5	0.05	0.5	0.085	0.12
Calcium (mg/L)	70	8.8	21	10	19	14	2.3
Chlorate (µg/L)	76	5	840	10	89	34	97
Chlorate^ (µg/L)	2	25	25	25	25	25	0
Chlorite (µg/L)	77	2.5	25	5	25	8.9	5.7
Chlorite^ (µg/L)	2	25	25	25	25	25	0
Chromium (µg/L)	13	0.05	0.5	0.05	0.5	0.085	0.12
Colour - True (TCU)	104	0.5	10	0.5	3	1.2	1.4
Conductivity (µS/cm)	375	112	3031	148	269	212	162
Copper (µg/L)	13	0.5	2.5	0.5	2.5	0.81	0.59
Dissolved Oxygen (% Sat)	92	82	106	87	104	96	5.3
E. coli (MPN/100mL)	1353	0	0	0	0	0	0
Fluoride (mg/L)	914	0.021	1	0.19	0.82	0.6	0.18
Formaldehyde (mg/L)	35	0.05	0.1	0.05	0.1	0.054	0.014
Free Chlorine Residual (Client tested) (mg/L)	1022	0.17	6.3	0.74	2.9	1.5	0.69
Free Chlorine Residual (mg/L)	326	0.01	3.7	0.25	2.3	1.3	0.68
Gross alpha (Bq/L)	10	0.02	0.05	0.02	0.05	0.027	0.0082

	# OF SAMPLES	MIN.	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Gross beta (Bq/L)	10	0.05	0.3	0.05	0.3	0.09	0.081
Hardness - Temporary (mg/L)	95	0.02	101	32	87	56	18
Hardness (mg/L)	103	36	93	39	81	57	13
Iodide (µg/L)	5	10	10	10	10	10	0
Iron (µg/L)	157	1	68	1	6.5	2.4	5.8
Lead (µg/L)	20	0.25	0.5	0.25	0.5	0.31	0.11
Magnesium (mg/L)	70	3.6	11	4.4	9.7	6.7	1.6
Manganese (µg/L)	157	0.5	60	0.5	1.8	1	4.8
Mercury (µg/L)	20	0.025	0.5	0.025	0.49	0.23	0.1
Molybdenum (µg/L)	4	0.5	0.5	0.5	0.5	0.5	0
Nickel (µg/L)	13	0.25	0.8	0.25	0.8	0.34	0.18
Nitrate (mg/L)	104	0.0075	1.6	0.0075	0.64	0.3	0.22
Nitrite (mg/L)	104	0.002	0.2	0.002	0.2	0.07	0.094
pH (Client tested) (pH unit)	1024	6.5	23	7.1	15	8	2.5
pH (pH unit)	228	6.5	8.1	6.9	8	7.5	0.33
Selenium (µg/L)	20	0.5	2.5	0.5	2.5	2	0.85
Silver (µg/L)	4	0.05	0.5	0.05	0.5	0.16	0.23
Sulphide (mg/L)	32	0.0025	0.013	0.0025	0.0084	0.003	0.002
Tin (µg/L)	4	0.5	0.84	0.5	0.84	0.58	0.17
Total Dissolved Solids (mg/L)	374	16	1819	89	161	127	98
Trihalomethanes (Total) (µg/L)	129	10	154	17	79	45	20
Trihalomethanes (Total)^ (µg/L)	22	0.5	51	0.83	49	22	13
Turbidity (Client tested) (NTU)	342	0.05	2.1	0.05	0.7	0.21	0.24
Turbidity (NTU)	148	0.05	9.9	0.13	1.9	0.74	1.1
Uranium (µg/L)	4	0.25	0.5	0.25	0.5	0.31	0.13
Zinc (µg/L)	13	3.6	17	3.6	17	9.2	3.8

CUSTOMER COMPLAINTS

Table 87 summarises the customer complaints in Moranbah from 2014 to 2023. Most complaints are regarding discoloured water with some complaints regarding taste and odour.

Table 87 Summary of Customer Complaints - Moranbah

Year	No of Water Quality Complaints	Main Reasons for Complaints	Likely Sources / Causes of Problems	Resolution of Problem
2014-15	8	Unknown	No information recorded to indicate the cause of complaint.	
2015-16	21	Water taste	No information recorded to indicate the cause of complaint. The water quality data are generally in line with the ADWG.	Localised and mains flushing performed. Raw water quality and WTP processes reviewed and adjusted.
2016-17	90	Discoloured water	No information recorded to indicate the cause of complaint.	Localised and mains flushing performed. WTP processes reviewed.

2017-18	67	Unknown/ Discoloured water	No information recorded to indicate the cause of complaint.	Localised and mains flushing performed. WTP processes reviewed.
2018-19	8	Discoloured water and water odour	No information recorded to indicate the cause of complaint.	Localised and mains flushing performed. WTP processes reviewed.
2019-20	15	Discoloured water	Cause of the complaint not known	Localised and mains flushing performed.
2020-21	4	Discoloured water	Cause of the complaint not known. Samples taken within ADWG	Localised and mains flushing performed.

INCIDENTS

There were two (2) incidents reported to the regulator in the recent years (2017-2023) in Moranbah. There were no incidents reported between 2017 and 2022. From the two (2) incidents reported, one (1) incident was regarding algal management, and one (1) was a turbidity exceedance which caused Moranbah to go onto a boil water alert.

Table 88 Summary of incidents reported to the regulator (2017-2023)

Incident date	Date/ Reference	Location	Parameter	Description of event	Improvement
30/03/2022	DWI-486-22-09557	Raw water	Cyanobacteria (0.6 mm^3/L)	Cyanobacteria in raw water was detected with a biovolume of 0.8845 mm^3/L against the IRC BG Algae Management Plan of 0.6 mm^3/L for Alert level 2. Preventative measures were implemented in the treatment process and weekly testing showed there was no impact to the treated water during this period.	Short term: Reduce throughput and increased powdered activated carbon dosing. Medium term: Assess improvements to the catchment and raw water storage reservoirs. Capital improvements planned for filter media and online turbidity meters in Moranbah WTP. Update Blue-Green Algae Management Plan
24/03/2023	DWI-486-23-10228	Combined filtered Water	Turbidity (1.73 NTU)	Combined filtered water turbidity was measured at 22.6 NTU against the DWQMP CCP critical limit of 1 NTU. Further, network water turbidity was measured at 1.73 NTU. Moranbah went on a boil water alert on 25/3/23.	The plant is shut down or to be put on divert if the filtered turbidity exceeds 1 NTU and corrective measures taken. The coagulant and polymer pumps are being drop tested in the morning and afternoon.

Moranbah “Main Plant”

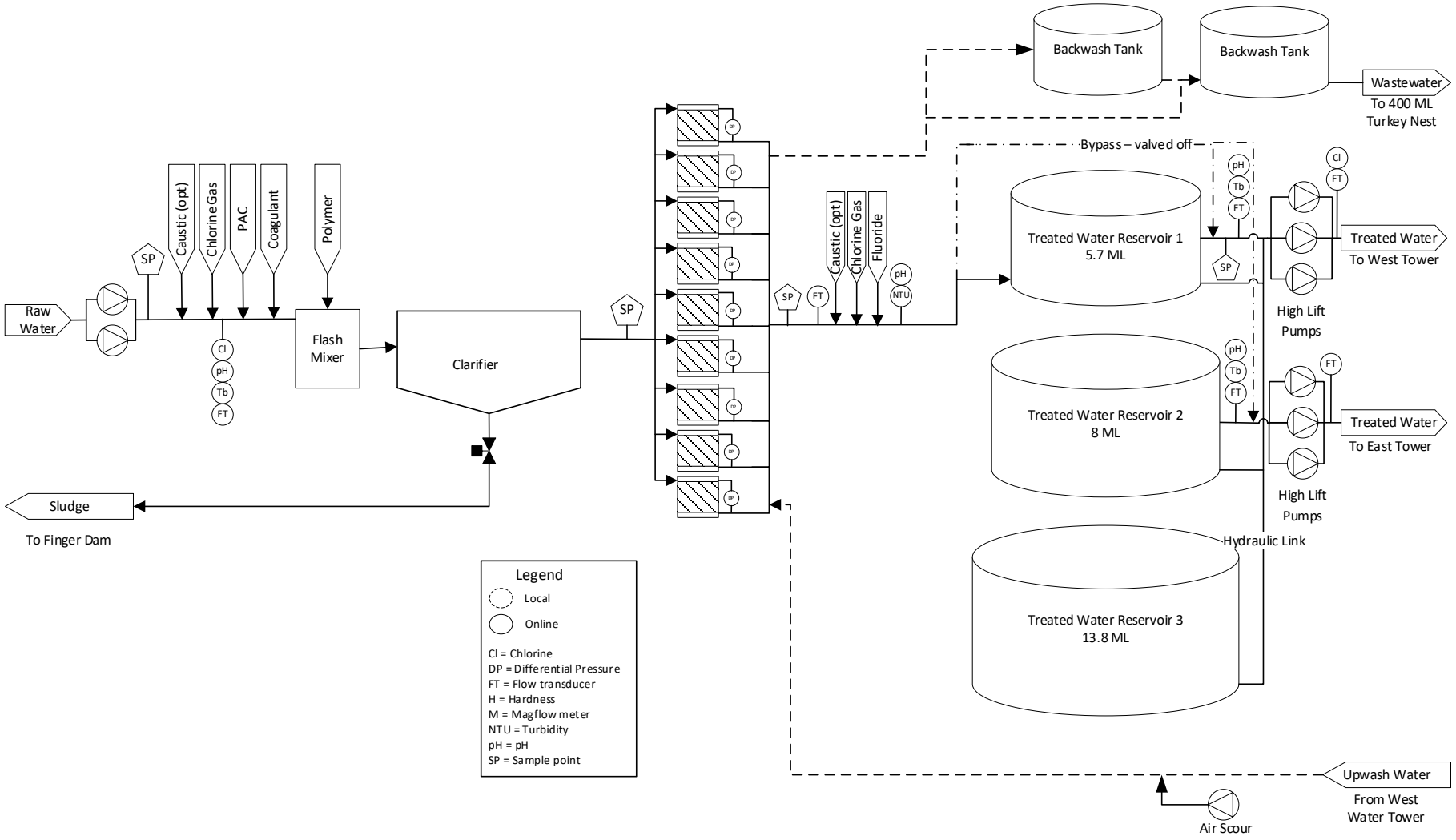


Figure 33 Moranbah Main Plant Schematic

MAIN WATER TREATMENT PLANT

Sodium hydroxide

Sodium hydroxide is dosed (when required) for pH adjustment before the flash mixer, shortly after the raw water pumps, near the inlet to the Main WTP. Additionally, there is an optional dosing point after the filters. There is a single dosing pump for each of the two (2) locations with auto shut down on zero plant flow. Sodium hydroxide flow not measured.

Chlorine oxidation

Chlorine gas can be dosed as an oxidant prior to the flash mixer. Chlorine gas is dosed from two (2) drums in duty/standby configuration with auto change over and automatic shut down on zero plant flow.

POWDERED ACTIVATED CARBON (PAC)

PAC is dosed prior to the flash mixer. There are two (2) pumps in duty/standby configuration with auto shut down on zero plant flow. PAC flow measured and configured with automatic changeover to standby pump or low-flow alarm and shutdown.

Coagulant

Coagulant (All Clear 300) is dosed prior to the flash mixer. There are two (2) pumps in duty/standby dosing into the bottom of the flash mixer, Coagulant flow measured and configured with automatic changeover to standby pump or low-flow alarm and shutdown.

Polymer

Polymer is dosed into the top of the flash mixer using two (2) pumps in duty/standby configuration with auto shut down on zero plant flow. Polymer flow measured and configured with automatic changeover to standby pump or low-flow alarm and shutdown.

Clarification

The Main WTP has one (1) large clarifier which features a central flocculation chamber. After settling the flocs, the clarified water flows out through launders and proceeds into the filters via the outlet launder. To remove sludge, an automated air-actuated de-sludge valve is employed at the bottom of the clarifiers which operates based on a time setting. The sludge is then directed to the backwash holding tank before being discharged to sludge ponds/Finger Dam.

Filtration

Following the clarification process, the water flows into the nine (9) river sand filters. Filter backwashing is automatically triggered based on head loss. The backwash process follows a water sequence first followed by air scouring. The backwash water is captured in the two (2) backwash waste tanks and discharged to the Finger Dam.

The Main WTP is equipped with an air compressor, supplying air to the filter valve actuators. Both plants have their independent air compressors, these can be interconnected to provide a duty-standby arrangement to create equipment redundancy.

Wastewater and sludge handling

Backwash water from the filters is collected in the two (2) backwash tanks. From there the water can gravity flow into the finger dam unless otherwise redirected. Sludge from the clarifiers and sediment in the backwash tanks is send to the sludge pond/finger dam.

Primary disinfection

Filtered water is disinfected with chlorine gas at the inlet to the clear water tank. Chlorine gas is dosed from two (2) drums in duty/standby configuration with auto change over and automatic shut down on zero plant flow.

Fluoride

Fluoride is dosed using duty/standby pumps with manual changeover and automatic shut down on zero plant flow.

RISK ASSESSMENT – MORANBAH MAIN WTP

SCHEME MITIGATED RISK ASSESSMENT – MORANBAH MAIN WTP

Table 89 Mitigated Risk Assessment – Moranbah Main WTP

Ref	Treatment Stage	Primary Hazard	Other hazards managed by barrier	Hazardous Event	Unmitigated Risk	Control Measures in place	Comment	Mitigated Consequence	Mitigated Likelihood	Mitigated Risk	Uncertainty	Improvement Action Required - Immediate	Improvement Action Required ~ 2 years	Improvement Action Required - Long term
MBHW1	Raw Water Abstraction	Protozoa (Category 4)	Bacteria, Turbidity, cyanotoxins	Normal operation	Extreme 25	Full treatment plant, automated chemical dosing, online chlorine analysers. Coagulation, filtration.	Assumes treatment plant is operating within specification. However there is an overall shortfall in treatment.	Catastrophic	Rare	Medium 6	Reliable	Review of BGA management plan (by Dec 2024)		
MBHW2	Backwash return	Protozoa (Category 4)		Recycling of protozoan pathogens	Extreme 25	Dilution into 400 ML raw water storage, undergoes full treatment. Coagulation, filtration.	Currently non operational. Enters Turkey's nest. Dilution in 400 ML storage, but no drying bed Will go through pre dosing. There is some natural filtration of backwash water prior to return.	Catastrophic	Rare	Medium 6	Estimate			
MBHW3	Chemical Dosing - Sodium hydroxide	pH		Overdose (or underdose) of caustic impacting coagulation	Medium 9	This is an optional dosing point, not normally used.	Single dosing pump Auto shutdown on zero flow No alarms	Moderate	Rare	Low 3	Certain			
MBHW4	Chemical Dosing - Chlorine gas	Chlorine		Overdosing of chlorine	High 12	Dose rate target 0.3 mg/L Manually adjust dosing. Auto shutdown of dosing on no plant flow	Duty/standby Auto shutdown and changeover	Moderate	Rare	Low 3	Reliable			
MBHW5	Chemical Dosing - Chlorine gas	Manganese surface water	Iron	Underdosing of chlorine	High 12	Dose rate target 0.3 mg/L Manually adjust dosing. Auto shutdown of dosing on no plant flow	Duty/standby Auto shutdown and changeover Has not been high Mn in treated water (data entry errors)	Moderate	Unlikely	Medium 6	Reliable			
MBHW6	Chemical Dosing - Powdered Activated Carbon (PAC)	Cyanobacterial toxins	THMs, Taste and odour	Underdose of PAC	High 12	Typical dose rate 7mg/L	Duty/standby Auto shutdown on zero flow Plant shutdown on failure to dose	Moderate	Rare	Low 3	Reliable			
MBHW7	Chemical Dosing - Powdered Activated Carbon (PAC)	Turbidity		Overdose of PAC	High 10	Typical dose rate 7mg/L	Duty/standby Auto shutdown on zero flow No alarms	Minor	Rare	Low 2	Confident			
MBHW8	Chemical Dosing - Aluminium Chlorohydrate (ACH)	Protozoa (Category 4)	Turbidity	Underdose of coagulant	Extreme 25	Jar testing as required (e.g. significant change in source water, or clarifier above 2 NTU). Daily grab sample from clarifier when plant running. Filtered water turbidity meter interlocked. Sludge bleed offs are operator selectable. Coagulation, filtration.	Dosed in bottom of FM Duty/standby, Plant shutdown on failure to dose.	Catastrophic	Unlikely	High 10	Reliable		Consider online meters for clarified water	
MBHW9	Chemical Dosing - Aluminium Chlorohydrate (ACH)	Aluminium - coagulant	Aluminium	Overdose of coagulant	Medium 6	Jar testing as required (e.g. significant change in source water, or clarifier above 2 NTU). Daily grab sample from clarifier when plant running. Filtered water turbidity meter interlocked. Sludge bleed offs are operator selectable.	Dosed in bottom of FM Duty/standby	Minor	Unlikely	Low 4	Reliable			
MBHW10	Chemical Dosing - Polyelectrolyte	Protozoa (Category 4)	Turbidity	Underdose of Polymer	Extreme 25	0.15 mg/L typical dose rate, maximum dose of 2 mg/L. Coagulation, filtration.	Dosed in top of FM Duty/standby Auto shutdown on zero flow No alarms	Catastrophic	Rare	Medium 6	Confident			
MBHW11	Chemical Dosing - Polyelectrolyte	Turbidity	acrylamide	Overdose polymer impacting filter run times and backwashing	High 10	0.15 mg/L typical dose rate, maximum dose of 2 mg/L	Dosed in top of FM Duty/standby Auto shutdown on zero flow No alarms	Minor	Rare	Low 2	Confident		Consider online meters for clarified water	

Ref	Treatment Stage	Primary Hazard	Other hazards managed by barrier	Hazardous Event	Unmitigated Risk	Control Measures in place	Comment	Mitigated Consequence	Mitigated Likelihood	Mitigated Risk	Uncertainty	Improvement Action Required - Immediate	Improvement Action Required ~ 2 years	Improvement Action Required - Long term
MBHW12	Clarification	Protozoa (Category 4)		Poor clarification process	Extreme 25	Jar testing as required (e.g. significant change in source water, or clarifier above 2 NTU). Daily grab sample from clarifier when plant running. Filtered water turbidity meter interlocked. Sludge bleed offs are operator selectable. Coagulation, filtration.	Sludge blanket clarifier Are boil ups most afternoons, wind shear causes issues.	Catastrophic	Unlikely	High 10	Reliable		Investigate automating sludge bleed timers to manage boilups.	
MBHW13	Filtration - Media filtration	Protozoa (Category 4)	Turbidity	Filter breakthrough	Extreme 25	Daily grab sampling from individual filters, combined turbidity meter shuts down plant at 0.5 NTU. Alarm at 0.2 NTU. Coagulation, filtration.	Alarm to SCADA on DP. Backwash all filters daily. air scour and water wash. Filters come straight into production after backwash. Combined pH, CL2, NTU pre TWT air actuated valves stick, filters do not filter at same rate.	Catastrophic	Unlikely	High 10	Reliable	Actuators positioners and valve sets to be serviced/inspected/ repaired	Individual turbidity meters to be investigated and installed as budget becomes available.	Consider need for UV disinfection as second protozoan barrier.
MBHW14	Filtration - Media filtration	Protozoa (Category 4)	Turbidity	Poor backwash	Extreme 25	Daily operator initiated backwash. Coagulation, filtration.	Alarm to SCADA on DP. Backwash all filters daily. air scour and water wash. Filters come straight into production after backwash. Combined pH, CL2, NTU pre TWT air actuated valves stick, filters do not filter at same rate. Air actuated valves are not able to be operated automatically	Catastrophic	Unlikely	High 10	Reliable	Investigate improvements to actuators to allow for improved automation of processes.	When online meter is installed, set up to take filter offline on elevated turbidity.	
MBHW15	Chemical Dosing - Sodium hydroxide	pH		Overdose/ underdose	Medium 9	Not normally used	Single dosing pump (second pump for alternate dosing point) Auto shutdown on zero flow No alarms	Moderate	Rare	Low 3	Confident			
MBHW16	Disinfection - chlorine gas	Bacteria/Virus		Underdose of chlorine	Extreme 25	daily inspections, daily measurement, online chlorine measurement after treated water pump station	Duty/standby Auto shutdown and changeover. Pipework is in place to provide water to tower from clear water tank.	Catastrophic	Unlikely	High 10	Estimate	Install tapping into Clear water to allow installation of online chlorine meter	Install chlorine meter on clear water tank as funds are available	
MBHW17	Disinfection - chlorine gas	Chlorine		Overdose of chlorine	High 12	daily inspections, daily measurement, online chlorine measurement after treated water pump station	Duty/standby Auto shutdown and changeover	Moderate	Possible	Medium 9	Estimate	Install tapping into Clear water to allow installation of online chlorine meter	Install chlorine meter on clear water tank as funds are available	
MBHW18	Trim chlorination	Chlorine		Overdose of chlorine	High 12	Automatic trim dosing into reticulation or towers.	Towers are floating and water goes directly to customers.	Moderate	Possible	Medium 9	Reliable			
MBHW19	Disinfection - chlorine gas	DBPs		Formation of DBPs with reactions from organics	Medium 9	Low pre dose, PAC, Coagulation, Controlled chlorine disinfection dose	Not historically an issue	Moderate	Unlikely	Medium 6	Reliable			
MBHW20	Chemical Dosing - Fluoridation	Fluoride		Overdose	Medium 9	Manually selected dose rate, daily monitoring, flow switches.	Duty/standby auto shutdown, multiple days of storage. Chemical storage is sized to prevent major overdose.	Moderate	Unlikely	Medium 6	Reliable			
MBHW21	Chemical Dosing - Fluoridation	Fluoride low		Underdose	Low 1	Manually selected dose rate, daily monitoring, flow switches.	Duty/standby auto shutdown - reports to QH if no dose for regulated time period.	Insignificant	Rare	Low 1	Reliable			
MBHW22	Disinfection - chlorine gas	Bacteria/Virus	Operator Error	Bypassing chlorine contact tank leading to inadequate C.t.	Extreme 25	Bypass is valved off; valve fails into closed position on power outage.	Valves to be labelled with "Do not operate" whilst RMIP is being implemented.	Catastrophic	Unlikely	High 10	Estimate	Investigate necessity of bypass, review options for improved management of risk (e.g., air gapping, installing a second valve, etc.)		

OPERATIONAL MONITORING – MAIN WTP

Table 90 Operational Monitoring Table Moranbah Main WTP

PARAMETER	RAW WATER *	RAW WATER – POST CHLORINE	CLARIFIED WATER	FILTERED WATER	CHLORINATED WATER	TREATED WATER	NETWORK WATER
Alkalinity	Weekly					Weekly	
Aluminium			Weekly			Weekly	
Free chlorine		Daily, Online	Daily		Daily, Online	Daily, Online	Weekly
Fluoride	Weekly					Daily	Weekly
pH	Daily	Daily, Online	Daily			Daily, Online	Weekly
Temperature	Daily		Daily			Daily	Weekly
Tot. Hardness	Weekly					Weekly	
Tot. Iron	Weekly					Weekly	
Sol. Iron	Weekly						
Tot. Manganese	Weekly					Weekly	Weekly
Sol. Manganese	Weekly		Weekly				
True Colour	Daily		Daily			Daily	Weekly
Turbidity	Daily, Online		Daily	Daily, Online		Daily, Online	Weekly
Sol. UVA_{254}	Daily		Daily				

*Sampling on raw water line currently in use

Response to out of specification results for relevant parameters are managed through CCPs, OCPs, and QCPs.

Operators check the calibration of online instruments with the results from their lab/benchtop analysis as part of the operational monitoring.

CONTROL POINTS- MAIN WTP AND BOBY PLANT

As the main WTP and the Boby plant are operated with the same Critical Control Points (CCPs), Operational Control Points (OCPs), and Quality Control Points (QCPs), these are summarised for both plants below.

CRITICAL CONTROL POINTS

The CCPs for the scheme were identified in the risk assessment process, and include:

- Filtration
- Disinfection
- Fluoridation

The CCP procedures are included in the following pages. These are presented as traffic lights and identify the location, monitoring, performance, and validation of the process. The traffic lights are aligned to SCADA where the low and high limits match the adjustment level and (as appropriate) the high high and low low alarms match the critical limit.

As the CCPs are similar for both plants, they are combined so that there is one set of CCPs for both plants.

OPERATIONAL CONTROL POINTS

Moranbah Main WTP has four (4) OCPs. The OCPs are summarised in Table where the upper limit is an alert limit. This process is essential to good operation of the treatment plant.

- Oxidation - Chlorine
- Coagulation - Turbidity
- Chlorination - Chlorine
- Disinfection - pH

An OCP exceedance is generally not reportable to the regulator except if it is an event that requires reporting. Incident reporting to the regulator is based on CCPs or exceedances of an ADWG health guideline.

Quality Control Points

Moranbah Main WTP has three (3) QCPs. The quality control points provide guidance for the Operator in process adjustment to achieve quality targets relating to aesthetic limits and achieving downstream OCPs.

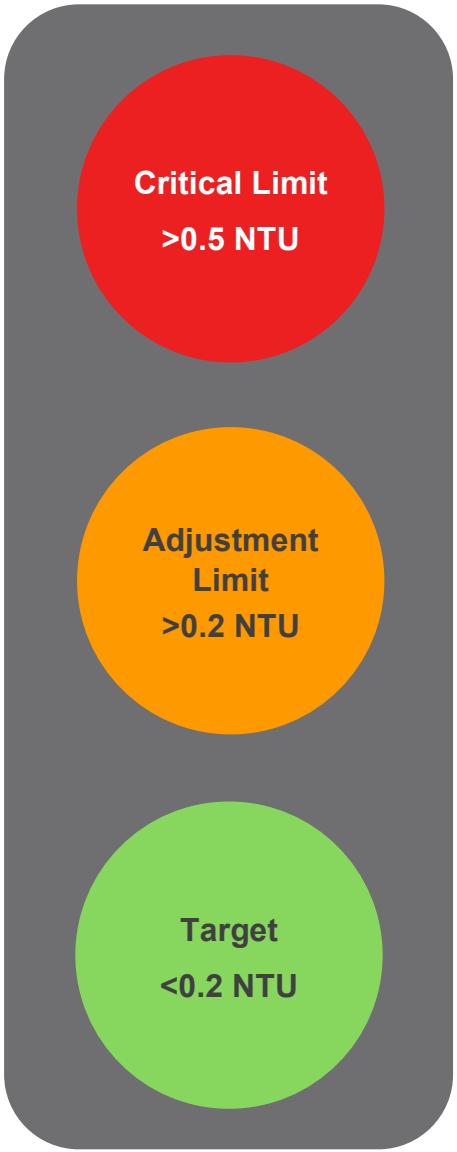
- Oxidation - Chlorine
- Coagulation – UVA
- Coagulation– Aluminium

The CCPs, OCPs and QCPs are included below.

CRITICAL CONTROL POINT PROCEDURE - MORANBAH

Filtration

What is measured	Where is it measured	When is it measured	What is the control point	What are the hazards	Record Keeping
Turbidity	Post filtration	Daily	Plant production	Protozoa, turbidity	Operator Log Sheets



- Confirm result with grab samples
- Breach of CCP is continued supply of water to customers above the Critical Limit
- Operator to contact Supervisor/Coordinator or Manager
- Supervisor/Coordinator or Manager to inform Compliance & IMS team on [redacted]
- If operator unable to contact chain of command, report directly to Compliance & IMS Team
- Compliance & IMS to contact DRDMW on 1300 596 709 as required
- If health advice required, Compliance & IMS or Manager to contact Mackay PHU on 4885 5800

- Check turbidity meter, clean and calibrate to confirm results
- Check raw water turbidity for changes since last dose rate change.
- Check clarified water pH and turbidity and adjust dosing as necessary
- Check coagulation dosing system, drop test to validate dose rate, jar test if required.
- Backwash filters
- FOR MAIN PLANT - Take filter offline if turbidity still above Adjustment Limit after multiple backwashes.
- FOR BOBY PLANT – Take filter pair offline if still above adjustment limit after multiple backwashes
- Rectify any dosing issues Escalate to supervisor/coordinator

- When attending plant, inspect process for any visual signs of process failure
- Test the water as per DWQMP
- Record results
- Check raw water turbidity regularly and adjust coaguation dose rates as required (jar test as required)
- Complete routine cleaning and calibration of online meters
- Check SCADA trend for normal operation
- Ensure backwashes are undertaken and effective.

CRITICAL CONTROL POINT PROCEDURE - MORANBAH

Disinfection

What is measured	Where is it measured	When is it measured	What is the control point	What are the hazards	Record Keeping
Free Chlorine	Grab sample from treated water	Daily	Chlorine dosing	Bacteria, viruses, chlorine	Operator Log Sheets

Critical Limit
>3.0 mg/L
<1.0 mg/L

- Confirm result with grab samples
- Operator to contact Supervisor/Coordinator or Manager
- If low chlorine, Supervisor/Coordinator and/or Manager to ensure sufficient chlorine contact time for disinfection with actual operational parameters.
- If water with < 15 mg.min/L is supplied to customers this is a reportable event
- If chlorine is > 5 mg/L this is reportable as an incident
- Supervisor/Coordinator or Manager to inform Compliance & IMS Team on [redacted]
- If operator unable to contact chain of command, report directly to Compliance & IMS Team
- Compliance & IMS to contact DRDMW on 1300 596 709 as required
- If health advice required, Compliance & IMS or Manager to contact Mackay PHU on 4885 5800

Adjustment Limit
>2.5 mg/L
<1.5 mg/L

- Confirm result with grab sample
- Check chlorine meter, clean and calibrate to confirm result
- Check dosing system for any issues or air locks
- Rectify any dosing issues
- Take WTP offline or reduce plant flow as required

Target
>1.5 mg/L
<2.5 mg/L

- When attending plant, inspect process for any visual signs of process failure
- Test the water as per DWQMP
- Record results
- Check cylinder weights and change empty cylinders as required
- Complete routine calibrations of online instruments to ensure accuracy

Validation: Clearwater tank has a volume of 5.7 ML, a minimum operational volume of 80% and is not baffled (Baffle factor 0.1). The maximum plant flow rate is 500 L/s. Chlorine residual of 1.0 mg/L out of the Clearwater tank at Moranbah WTP achieves 15.2mg.min/L CT.

CRITICAL CONTROL POINT PROCEDURE - MORANBAH

Fluoridation

What is measured	Where is it measured	When is it measured	What is the control point	What are the hazards	Record Keeping
Fluoride	Grab sample from treated water	Daily	Fluoride dosing	Fluoride	Operator Log Sheets

Critical Limit
>0.9 mg/L

- Confirm result with grab samples
- Manually shutdown Fluoridation plant immediately
- Operator to contact Supervisor/Coordinator or Manager
- If water >1.5mg/L is supplied to customers this is a reportable event
- Supervisor/Coordinator or Manager to inform Compliance & IMS Team on [redacted]
- If operator unable to contact chain of command, report directly to Compliance & IMS Team
- Compliance & IMS to contact DRDMW on 1300 596 709 as required
- If health advice required, Compliance & IMS or Manager to contact Mackay PHU on 4885 5800

Adjustment Limit
>0.75 mg/L
<0.65 mg/L

- Confirm result with grab sample
- Check Fluoride meter, clean and calibrate to confirm result
- Check dosing system for any issues or air locks
- Rectify any dosing issues
- Take WTP offline or reduce plant flow as required

Target
>0.65 mg/L
<0.75 mg/L

- When attending plant, inspect process for any visual signs of process failure
- Test water as per DWQMP
- Record results
- Check dosing systems are working
- Complete routine calibrations of online instruments to ensure accuracy

Table 91 Operational Control Points - Moranbah WTP & Boby Plant

PROCESS	PARAMETER	WHERE IS IT MEASURED?	HAZARD	WHEN IS IT MEASURED	TARGET	ADJUSTMENT LIMIT	ACTION IF ADJUSTMENT LIMIT EXCEEDED	ALERT LIMIT	ACTION IF ALERT LIMIT EXCEEDED	REPORTING
Oxidation	Total Manganese	Treated water	Manganese	Weekly	<0.05 mg/L	>0.05 mg/L, <0.2 mg/L	Recheck treated water manganese, Check chlorine meter, Check dosing system,	>0.2 mg/L	Check chlorine gas system, reduce plant flow/shutdown as required, Operator to notify Supervisor/Coordinator/Manager	Manganese exceedance above ADWG guideline is reportable incident
Coagulation	Turbidity	Clarified water	Protozoa, Turbidity	Daily	< 2NTU	>3 NTU, <5 NTU	Check turbidity meter, Check raw water turbidity, Check coagulation system, Check flash mixer pH	>5 NTU	Check turbidity meter, Check raw water turbidity, check coagulation system, check flash mixer pH, Operator to notify Supervisor/Coordinator/Manager	Failure to coagulate is reportable event
Chlorination	Free chlorine	Chlorinated water	Bacteria, Virus	Daily	>1.5 mg/L, >2.5 mg/L	>2.5 mg/L <1.5 mg/L	Check chlorine meter, Check dosing system	>3.0 mg/L <1.2 mg/L	Check chlorine meter, Check dosing system, Operator to notify Supervisor/Coordinator/Manager	Internal reporting, Further See Disinfection CCP
Disinfection	pH	Treated water	pH, Bacteria, Viruses, Protozoa	Online, Daily	>7.0, <7.5	<7.0, >7.5	Confirm pH reading, Check dosing system, Adjust dosing rate	>8.0, <6.8	Confirm pH reading, Check dosing system, Adjust dosing rate, Operator to notify Supervisor/Coordinator/Manager	Internal reporting, Further See Clarification OCP/QCPs and Filtration CCP

OCP EXCEEDANCES ARE GENERALLY NOT REPORTABLE TO THE REGULATOR EXCEPT IF IT IS AN EVENT OR REPORTABLE HEALTH LIMIT

Table 92 Quality Control Points Moranbah WTP & Boby Plant

PROCESS	PARAMETER	WHERE IS IT MEASURED?	HAZARD	WHEN IS IT MEASURED	TARGET	ACTION IF TARGET LIMIT EXCEEDED	REPORTING
Oxidation	Soluble Manganese	Clarified Water	Manganese and Iron	Weekly	Mn <0.03 mg/L	Recheck clarified water manganese, Check clarified water soluble iron is < 0.05 mg/L Check chlorine meter, Check dosing system and adjust dosing if required,	Operator to notify Supervisor/Coordinator and/or Manager
Coagulation	Soluble UVA	Clarified Water	Disinfection By-products	Daily	< 0.05 Abs	Check clarification system,	Operator to notify Supervisor/Coordinator and/or Manager
Coagulation	Aluminium	Clarified Water	Aluminium	Weekly	< 0.1mg/L	Check coagulant dosing Check settling performance	Operator to notify Supervisor/Coordinator and/or Manager

QCP EXCEEDANCES ARE GENERALLY NOT REPORTABLE TO THE REGULATOR EXCEPT IF THIS RESULTS IN ADWG (HEALTH) OR CCP EXCEEDANCE

Moranbah “Boby” Plant

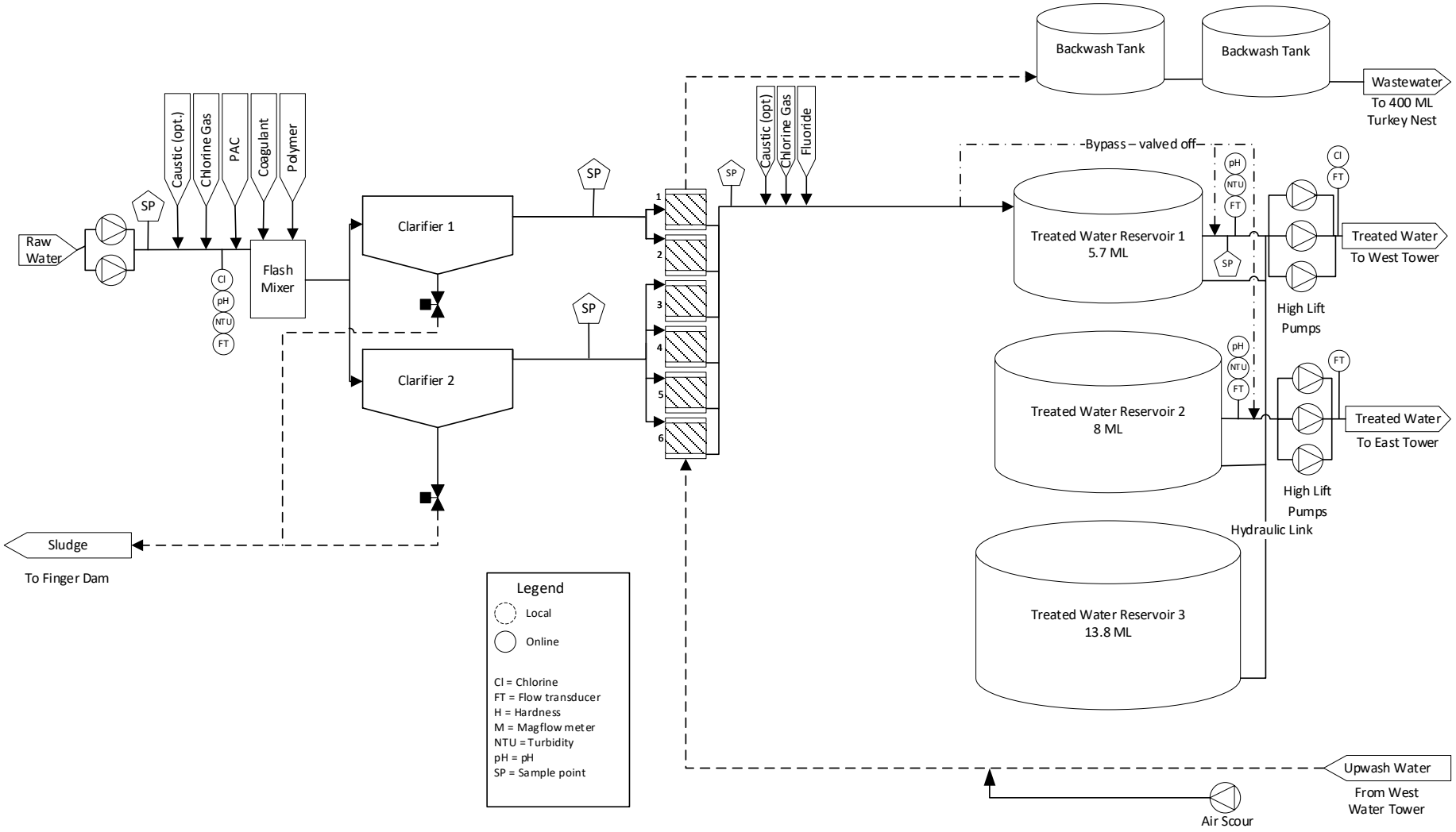


Figure 34 Moranbah Boby Plant Schematic

MORANBAH BOBY PLANT

Sodium hydroxide

Sodium hydroxide is dosed (when required) for pH adjustment before the flash mixer, shortly after the raw water pumps, near the inlet to the Boby Plant. Additionally, there is an optional dosing point after the filters. There is a single dosing pump for each of the two (2) locations with auto shut down on zero plant flow. Sodium hydroxide flow is not measured.

Chlorine oxidation

Chlorine gas can be doses as an oxidant prior to the flash mixer. Chlorine gas is dosed from two (2) drums in duty/standby configuration with auto change over and automatic shut down on zero plant flow.

PAC

PAC is dosed prior to the flash mixer. There are two (2) pumps in duty/standby configuration with auto shut down on zero plant flow. PAC flow measured but not configured to alarm or shutdown.

Coagulant

Coagulant (All Clear 300) is dosed into the top of the flash mixer. There are two (2) pumps in duty/standby configuration with auto shut down on zero plant flow. Coagulant flow not measured.

Polymer

Polymer is dosed into the top of the flash mixer using two (2) pumps in duty/standby configuration with auto shut down on zero plant flow. Polymer flow measured but not configured to alarm or shutdown.

Clarification

The Boby Plant has two (2) smaller clarifiers which each featuring a central flocculation chamber. After settling the flocs, the clarified water flows out through launders and proceeds into the filters via the outlet launder. To remove sludge, a de-sludge valve is employed at the bottom of the clarifiers. The sludge is then directed to the backwash holding tank before being discharged to sludge ponds/Finger Dam.

Filtration

Following the clarification process, the water flows into six (6) river sand filters. Filter backwashing is managed through a manually sequence initiated and controlled daily. The backwash water is captured in the two (2) backwash waste tanks and unused water discharged to the Finger Dam.

The Boby Plant is equipped with an air compressor, supplying air to the filter valve actuators. As both plants have their independent air compressors, these can be interconnected to provide a duty-standby arrangement to create equipment redundancy.

Wastewater and sludge handling

Backwash water from the filters is collected in the two (2) backwash tanks. From there the water can gravity flow into the 400 ML Turkey's Nest. Sludge from the clarifiers and sediment in the backwash tanks is sent to the sludge pond/finger dam.

Primary disinfection

Filtered water is disinfected with chlorine gas at the inlet to the clear water tank. Chlorine gas is dosed from two (2) drums in duty/standby configuration with auto change over and automatic shut down on zero plant flow.

Fluoride

Fluoride is dosed using duty/standby pumps with manual changeover and automatic shut down on zero plant flow.

RISK ASSESSMENT – MORANBAH BOBY PLANT

SCHEME MITIGATED RISK ASSESSMENT – MORANBAH BOBY PLANT

Table 93 Mitigated Risk Assessment – Moranbah Boby Plant

Ref	Treatment Stage	Primary Hazard	Other hazards managed by barrier	Hazardous Event	Unmitigated Risk	Control Measures in place	Comment	Mitigated Consequence	Mitigated Likelihood	Mitigated Risk	Uncertainty	Improvement Action Required - Immediate	Improvement Action Required ~ 2 years	Improvement Action Required - Long term
MBHB1	Raw Water Abstraction	Protozoa (Category 4)	Bacteria, Turbidity, cyanotoxins	Normal operation	Extreme 25	Full treatment plant, automated chemical dosing, online chlorine analysers. Coagulation, filtration.	Assumes treatment plant is operating within specification. However, there is an overall shortfall in treatment.	Catastrophic	Rare	Medium 6	Reliable	Review of BGA management plan (by Dec 2024)		
MBHB2	Backwash return	Protozoa (Category 4)		Recycling of protozoan pathogens	Extreme 25	Dilution into 400 ML raw water storage, undergoes full treatment. Coagulation, filtration.	Currently non-operational. Enters Turkey's nest. Dilution in 400 ML storage, but no drying bed Will go through pre dosing. There is some natural filtration of backwash water prior to return.	Catastrophic	Rare	Medium 6	Estimate			
MBHB3	Chemical Dosing - Sodium hydroxide	pH		Overdose (or underdose) of caustic impacting coagulation	Medium 9	This is an optional dosing point, not normally used.	Single dosing pump Auto shutdown on zero flow No alarms	Moderate	Rare	Low 3	Confident			
MBHB4	Chemical Dosing - Chlorine gas	Chlorine		Overdosing of chlorine	High 12	Dose rate target 0.3 mg/L Manually adjust dosing. Auto shutdown of dosing on no plant flow	Duty/standby Auto shutdown and changeover	Moderate	Rare	Low 3	Confident			
MBHB5	Chemical Dosing - Chlorine gas	Manganese surface water	Iron	Underdosing of chlorine	High 12	Dose rate target 0.3 mg/L Manually adjust dosing. Auto shutdown of dosing on no plant flow	Duty/standby Auto shutdown and changeover	Moderate	Unlikely	Medium 6	Reliable			
MBHB6	Chemical Dosing - Powdered Activated Carbon (PAC)	Cyanobacterial toxins	THMs, Taste and odour	Underdose of PAC	High 12	Typical dose rate 7mg/L	Duty/standby Auto shutdown on zero flow No alarms, Flow meter for PAC.	Moderate	Rare	Low 3	Reliable			
MBHB7	Chemical Dosing - Powdered Activated Carbon (PAC)	Turbidity		Overdose of PAC	High 10	Typical dose rate 7mg/L	Duty/standby Auto shutdown on zero flow No alarms	Minor	Unlikely	Low 4	Reliable			
MBHB8	Chemical Dosing - Aluminium Chlorohydrate (ACH)	Aluminium - coagulant	Aluminium	Overdose of coagulant	Medium 6	Jar testing as required (e.g. significant change in source water, or clarifier above 2 NTU). Daily grab sample from clarifier when plant running. Filtered water turbidity meter interlocked. Sludge bleed offs are operator selectable.	Dosed in top of FM Duty/standby.	Minor	Possible	Medium 6	Reliable		Consider online meters for clarified water	
MBHB9	Chemical Dosing - Polyelectrolyte	Protozoa (Category 4)	Turbidity	Underdose of Polymer	Extreme 25	0.15 mg/L typical dose rate, maximum dose of 2 mg/L. Coagulation, filtration.	Reactivator clarifier. Dosed in top of FM Duty/standby	Catastrophic	Rare	Medium 6	Reliable			
MBHB10	Chemical Dosing - Polyelectrolyte	Turbidity	acrylamide	Overdose polymer impacting filter run times and backwashing	High 10	0.15 mg/L typical dose rate, maximum dose of 2 mg/L	Dosed in top of FM Duty/standby. Flow switch for low flow.	Minor	Rare	Low 2	Reliable			
MBHB11	Clarification	Protozoa (Category 4)		Poor clarification process	Extreme 25	Jar testing as required (e.g. significant change in source water, or clarifier above 2 NTU). Daily grab sample from clarifier when plant running. Filtered water turbidity meter interlocked. Sludge bleed offs are operator selectable. Coagulation, filtration.	2 x clarifiers	Catastrophic	Unlikely	High 10	Reliable	Investigate improved automation of processes.	Consider online pH meter for clarified water	

Ref	Treatment Stage	Primary Hazard	Other hazards managed by barrier	Hazardous Event	Unmitigated Risk	Control Measures in place	Comment	Mitigated Consequence	Mitigated Likelihood	Mitigated Risk	Uncertainty	Improvement Action Required - Immediate	Improvement Action Required ~ 2 years	Improvement Action Required - Long term
MBHB12	Filtration - Media filtration	Protozoa (Category 4)	Turbidity	Filter breakthrough	Extreme 25	Daily grab sampling from individual filters, combined turbidity meter shuts down plant at 0.5 NTU. Alarm at 0.2 NTU. Coagulation, filtration.	Auto triggered on DP Wash and air scour Combined pH, CL2, NTU post TWT, but these can measure combined treatment plants. air actuated valves stick a lot	Catastrophic	Likely	Extreme 20	Estimate	Currently refurbishing filters at Boby treatment plant including filter replacement. Require online turbidity meters - include tappings for these meters in current project - need to investigate whether pairs of filters can be individual meters, or combined meter on pair.	Online turbidity meters for filtered water	UV disinfection required over time.
MBHB13	Filtration - Media filtration	Protozoa (Category 4)	Turbidity	Poor backwash	Extreme 25	Daily operator initiated backwash. Coagulation, filtration.	Auto triggered on DP Wash and air scour Combined pH, CL2, NTU post TWT air actuated valves stick a lot	Catastrophic	Unlikely	High 10	Estimate	Currently refurbishing filters at Boby treatment plant including filter replacement. Require online turbidity meters - include tappings for these meters in current project - need to investigate whether pairs of filters can be individual meters, or combined meter on pair.	Online turbidity meters for filtered water	UV disinfection required over time.
MBHB14	Chemical Dosing - Sodium hydroxide	pH		Over or underdose	Medium 9	Not normally used	Single dosing pump (second pump for alternate dosing point) Auto shutdown on zero flow No alarms	Moderate	Rare	Low 3	Confident			
MBHB15	Disinfection - chlorine gas	Bacteria/Virus		Underdose of chlorine	Extreme 25	daily inspections, daily measurement, online chlorine measurement after treated water pump station	Duty/standby Auto shutdown and changeover	Catastrophic	Unlikely	High 10	Estimate	Install tapping into Clear water to allow installation of online chlorine meter	Install chlorine meter on clear water tank as funds are available	
MBHB16	Disinfection - chlorine gas	Chlorine		Overdose of chlorine	High 12	daily inspections, daily measurement, online chlorine measurement after treated water pump station	Duty/standby auto shutdown	Moderate	Unlikely	Medium 6	Reliable			
MBHB17	Chemical Dosing - Fluoridation	Fluoride low		Underdose	Low 1	Manually selected dose rate, daily monitoring, flow switches.	Duty/standby auto shutdown - reports to QH if no dose for regulated time period.	Insignificant	Rare	Low 1	Reliable			
MBHB18	Chemical Dosing - Fluoridation	Fluoride		Overdose fluoride	Medium 9	Manually selected dose rate, daily monitoring, flow switches.	Duty/standby auto shutdown	Moderate	Unlikely	Medium 6	Reliable			
MBHB19	Disinfection - chlorine gas	Bacteria/Virus	Operator Error	Bypassing chlorine contact tank leading to inadequate C.t.	Extreme 25	Bypass is valved off, valve fails into closed position on power outage.	Valves to be labelled with "Do not operate" whilst RMIP is being implemented.	Catastrophic	Unlikely	High 10	Estimate	Investigate necessity of bypass, review options for improved management of risk (e.g., air gapping, installing a second valve, etc.)		

OPERATIONAL MONITORING- BOBY PLANT

Table 94 Moranbah Boby Plant - Operational Monitoring

PARAMETER	RAW WATER	RAW WATER – POST CHLORINE	CLARIFIED WATER	FILTERED WATER	CHLORINATED WATER	TREATED WATER	NETWORK WATER
Alkalinity	Weekly					Weekly	
Aluminium			Weekly			Weekly	
Free chlorine		Daily	Daily		Daily	Daily	Weekly
Fluoride	Weekly					Daily	Weekly
pH	Daily		Daily		Daily	Daily	Weekly
Temperature	Daily		Daily		Daily	Daily	Weekly
Tot. Hardness	Weekly					Weekly	
Tot. Iron	Weekly					Weekly	
Sol. Iron	Weekly						
Tot. Manganese	Weekly					Weekly	Weekly
Sol. Manganese	Weekly		Weekly				
True colour	Daily					Daily	Weekly
Turbidity	Daily, Online		Daily	Daily		Daily	Weekly
Sol. UVA_{254}	Daily		Daily				

Boby Plant unit samples to be collected only when Boby Plant is operational.

Monitoring in common streams such as the common raw water line and treated water is done as shown in Table 90 for the Moranbah Main WTP.

Response to out of specification results for relevant parameters are managed through CCPs, OCPs, and QCPs.

Operators check the calibration of online instruments with the results from their lab/benchtop analysis as part of the operational monitoring.

RAW WATER MONITORING

Raw water monitoring in Moranbah is undertaken based on the principles outlined in the overarching DWQMP or as described in the algal management plan.

Table 95 Raw Water Monitoring Parameters

PARAMETER	FREQUENCY
Algal	Seasonally
Radiological	2 – years
Pesticides	Quarterly

VERIFICATION MONITORING

Table 96 Verification Monitoring Parameters

PARAMETER	FREQUENCY	WTP	SAMPLE POINTS IN NETOWRK
E.coli	Weekly	No	SP 3, 5, 6
Fluoride	Weekly	Yes	Rotation SP 3, 5, 6
SWA	Monthly	Yes	Rotation SP 3, 5, 6
THMs	Quarterly	No	SP 6
Metals	Quarterly	Yes	Rotation SP 3, 5, 6

VERIFICATION MONITORING LOCATIONS

The monitoring locations in Moranbah are shown in Figure 35 and Table 97. These locations are spread throughout Moranbah and are representative of the water quality provided to the bulk of Moranbah's customers.

Table 97 Moranbah Monitoring Points

SAMPLE POINTS	NETWORK SAMPLING LOCATIONS	DESCRIPTION
5	[redacted]	[redacted]
3	[redacted]	[redacted]
6	[redacted]	

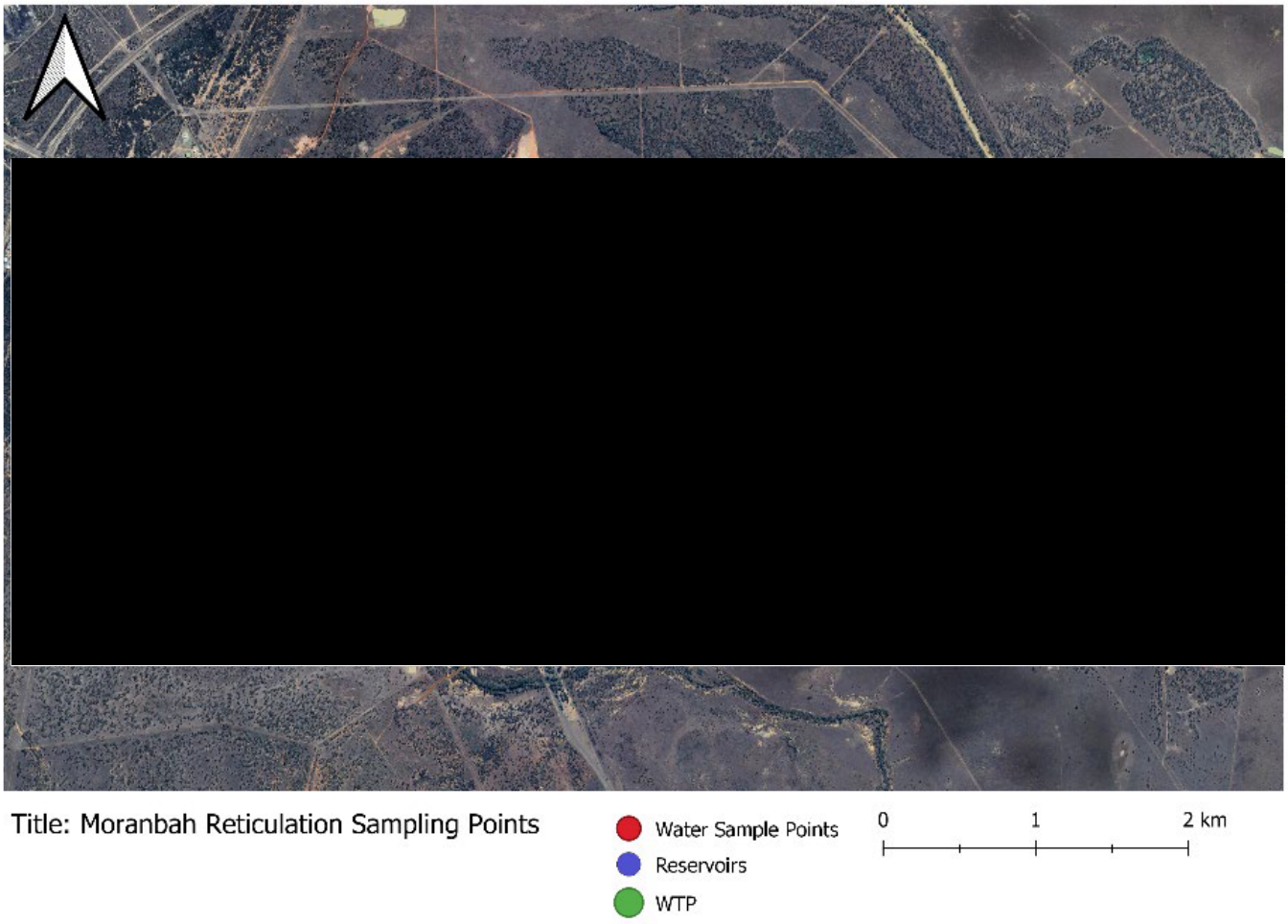


Figure 35 Moranbah Verification Monitoring Locations

Response to out of specification results

Data from the verification monitoring is s accessible via the Mackay Laboratory Monitor Pro Portal. The data is then transferred into SWIM and circulated amongst relevant persons. Refer to IRC Overarching DWQMP for Incident and Emergency Management.

APPENDIX 7

NEBO DRINKING WATER QUALITY MANAGEMENT PLAN

Nebo Drinking Water Quality Management Plan

Presented by: Water and Waste Directorate
Current as at: 22 August 2024

ISAAC REGION
HELPING TO ENERGISE THE WORLD

ISAAC.QLD.GOV.AU ISAAC REGIONAL COUNCIL ABN 39 274 142 600
P 1300 472 227 F 07 4941 8666 A PO Box 97 Moranbah QLD 4744
isaacregionalcouncil isaacregionalcouncil Isaacrcouncil

TABLE OF CONTENTS

OBJECTIVE

This plan details how Isaac Regional Council ensures the safety of drinking water for the Nebo community.

SCOPE

This plan is the Site-specific Drinking Water Quality Management Plan that together with the Overarching Drinking Water Quality Management Plan makes up the complete plan for Nebo.

DEFINITIONS

TERM / ACRONYM	MEANING
ADWG	Australian Drinking Water Guidelines
CCP	Critical Control Point
DRDMW	Department of Regional Development Manufacturing and Water
DWQMP	Drinking Water Quality Management Plan
DWQMP Guideline	Guideline for the preparation, review and audit of drinking water quality management plans.
IRC	Isaac Regional Council
OCP	Operational Control Point
NTU	Nephelometric turbidity units
PHA	*Public Health Act 2005*
QH	Queensland Health – regulator of public health – may take lead on managing incidents
Regulator	In the context of the DWQMP, the Regulator is DRDMW
RMIP	Risk Management Improvement Program
SCADA	Supervisory Control and Data Acquisition
SPID	Service Provider Identification Number
WSSRA	*Water Supply (Safety and Reliability) Act 2008*
WTP	Water Treatment Plant

REFERENCES

ID	NAME
	DWQMP Document Register

INTRODUCTION

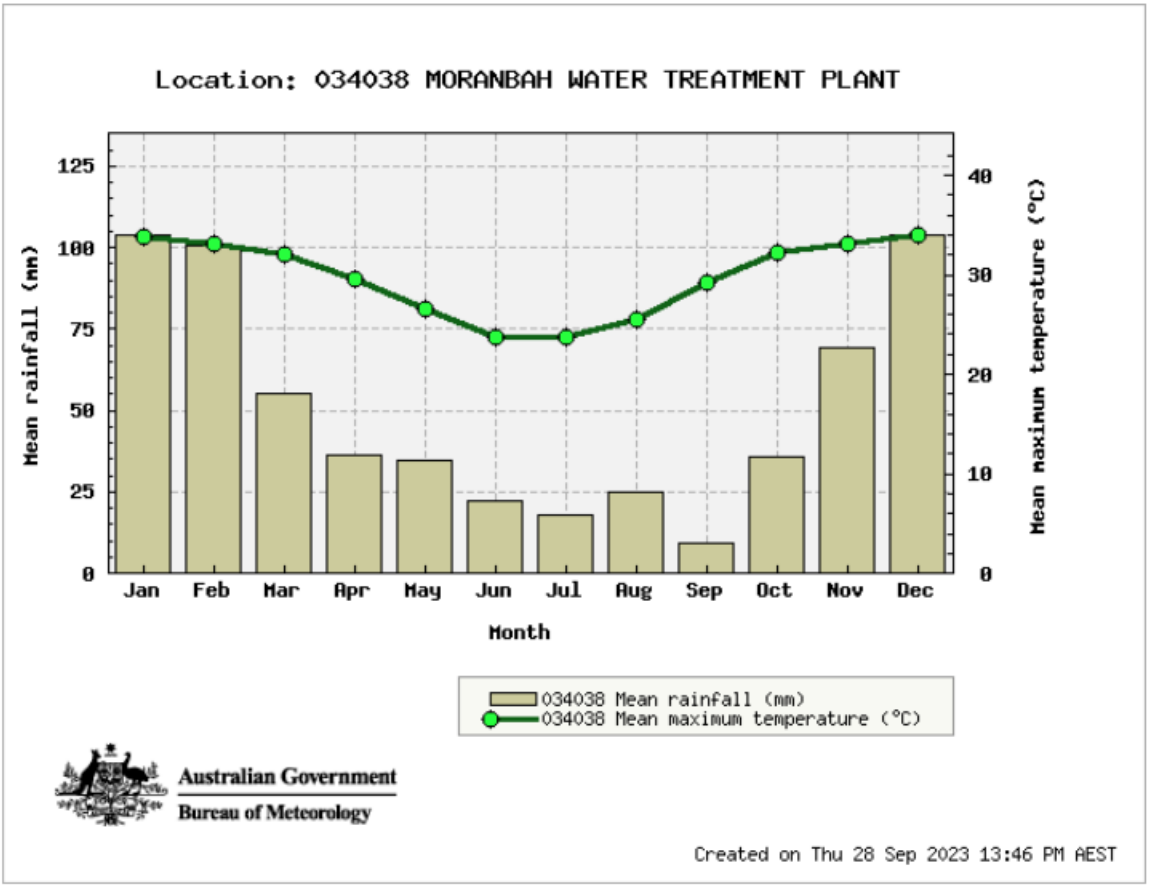
This site specific DWQMP documents the specific details of the Nebo drinking water scheme. It is intended to be an operational document that informs the operational staff.

OVERVIEW OF THE SUPPLY SCHEME

Nebo is a rural town of ~750 people located in central Queensland. Nebo is a major hub for several large coal mines in the region. The town is located ~100 km north-east of Moranbah. Drinking water for the community is sourced from several bores around the town which reach into the Nebo creek alluvium.

CLIMATE

The Nebo climate is characterised by a subtropical semi-arid climate. Rainfall (See Figure 36) within the catchment averages ~613 mm/year with more rain in summer than winter. The mean maximum temperature is 29.7 °C, with a mean max. above 30°C between October to March.



Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
Mean rainfall (mm) for years 1972 to 2012	103.8	100.7	55.4	36.4	34.5	22.1	18.0	25.0	9.1	35.7	69.3	103.9	613.0	39
Statistics	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**	**Years**
Mean maximum temperature (°C) for years 1986 to 2012	33.8	33.1	32.1	29.5	26.5	23.7	23.7	25.5	29.2	32.3	33.1	34.0	29.7	26

Figure 36 Rainfall and Temperature Data for Moranbah (closest to Nebo)

CATCHMENT CATEGORISATION

Nebo sources its water from bores located around the town. The recharge area experiences cattle grazing, some various agricultural activity, and some mining. Based on the observation that bore water levels rapidly refill after heavy rain events a connection between surface water to ground water cannot be excluded. However, the bore water always has high conductivity, and the turbidity remains low even after rain events, indicating any connection is decoupled from direct recharge from surface water. A review of the raw water monitoring showed that low levels of *E.coli* were detected in some samples prior to the improvements in bore head integrity, so these detections are potentially contamination through the bore head. The catchment is therefore provisionally characterised as a Category 2, but further consideration is required as the dataset becomes more comprehensive.

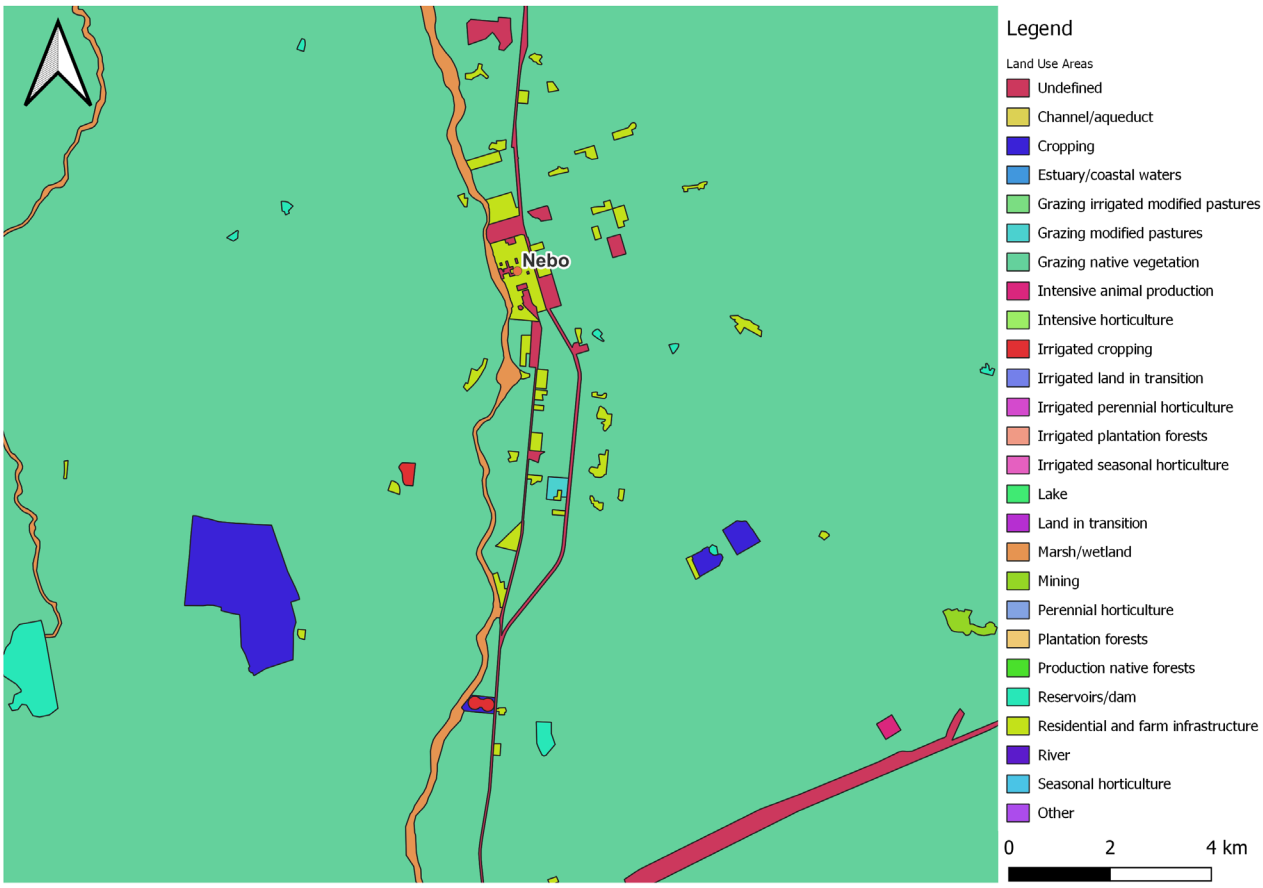


Figure 37 Land Use Map Nebo

Table 98 Nebo Bore Information

Bore #	RN	DEPTH	DATE DRILLED	AQUIFER DETAILS	LITHOLOGY	SEALED AND FENCED
2	[redacted]	18m	28.01.2019	Nebo creek alluvium	Sand and gravel	Y
3	[redacted]	22.5m	22.05.2019	Nebo creek alluvium	Sand and gravel	Y
4	[redacted]	23.7m	03.02.2019	Nebo creek alluvium	Clay, sand and gravel	Y
5	[redacted]	NA	01.06.1997	Nebo creek alluvium	unknown	Y
6	[redacted]	22m	29.05.1998	Nebo creek alluvium	Sand and gravel	Y
7	[redacted]	24.18m	19.07.2016	Nebo creek alluvium	Sand and gravel	Y

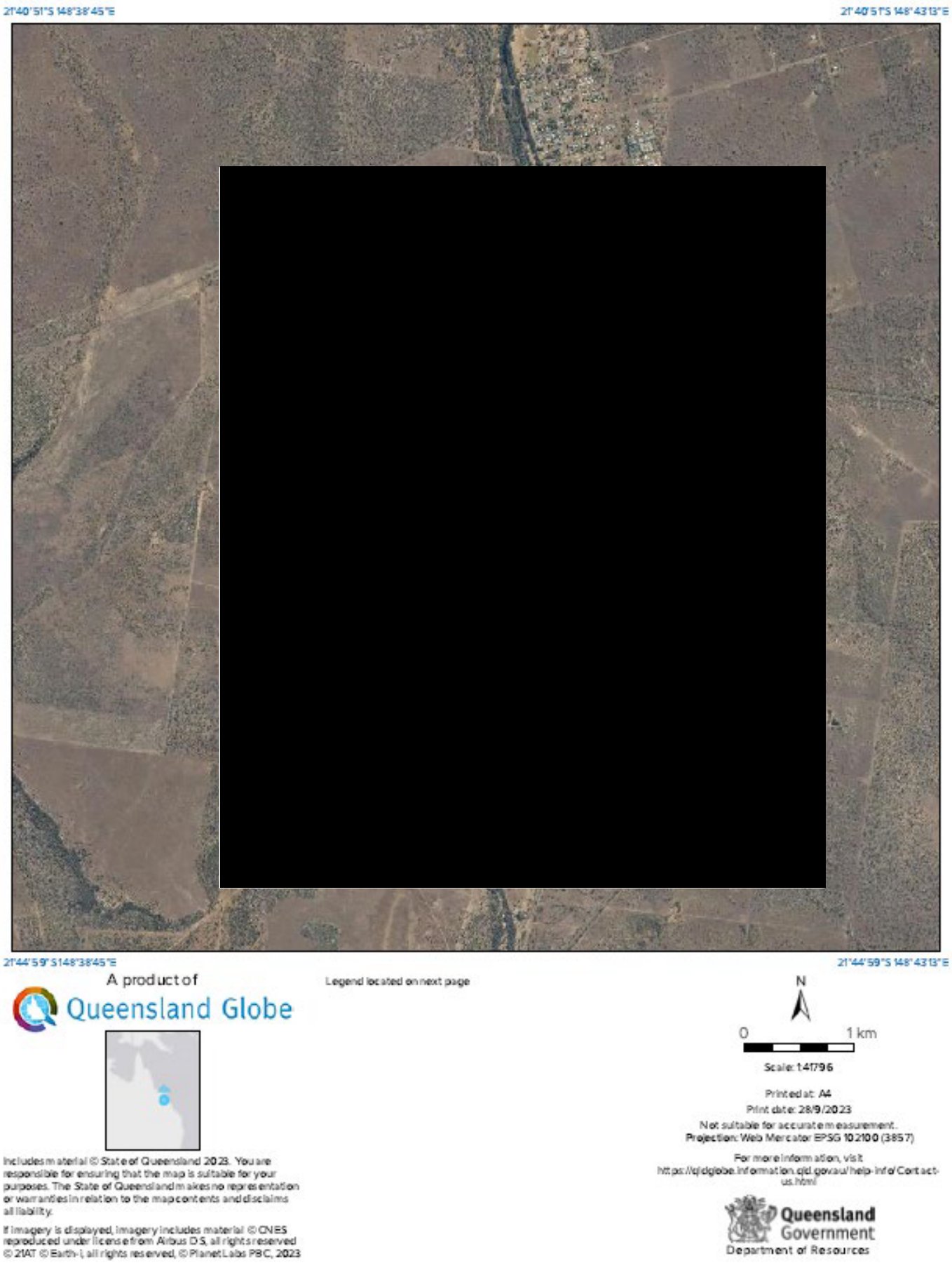


Figure 38 Location of Nebo Bores

TREATMENT PROCESS

OVERALL – CAPACITY

The Nebo WTP has a capacity of 25 L/s. Water production can commence at any time, but it is set to automatically start each morning and continue until the treated water reservoir is filled to capacity. The WTP initiates production based on the level in the Treated Water Storage Tank (<90%).

RAW WATER SOURCE

Nebo currently sources water from six (6) bores (numbered from #2 to #7); Bore #2, 3, and 4 have recently undergone refurbishment and were redrilled to enhance water quality and protect the bore infrastructure. Bore 1, which had been used in the past, has been decommissioned. The bores in Nebo are strategically grouped into two (2) categories, Bore Group 1 and Bore Group 2, which helps manage extraction allocations and water quality characteristics for treatment. Bore Group 1 comprises Bores #2, 4, and 6, while Bore Group 2 consists of Bores #3, 5, and 7. These groupings enable the control of hardness and the concentrations of metals like iron and manganese by adjusting blending ratios during the treatment process.

The total annual allocation of water from these bores stands at 400 ML per year. The pumping rates for Bores #2, 3, 6, and 7 are 8 L/s each while Bores #4 and 5 have a pump rate of 6 L/s. All bores source water from the Nebo Creek Aquifer.

These bores are strategically located on both sides of Nebo creek. Bores 2, 3, and 7 are situated on the eastern side of Nebo Creek, while Bores 4, 5, and 6 are located on the western side. During the wet season, the creek's water level can rise significantly, potentially cutting off access to Bores 4, 5, and 6, making inspection checks and maintenance activities challenging.

All the bores in the Nebo area are operated and rotated as needed to maintain consistent water quality in the WTP and to adhere to allocation limits.

Bores 2, 6, and 7 are situated within road reserves and are appropriately fenced. Bores 3, 4, and 5, have easements that pass through private properties. The operational staff from IRC ensure that all operating bore pumps are well-fenced to minimise the potential for contamination by farm animals.

CHLORINE OXIDATION

Chlorine gas can be dosed as an oxidant prior to the raw water tanks. Chlorine gas is dosed from two (2) 70 kg cylinders in duty/standby configuration with auto change over and automatic shut down on zero flow. There are two (2) additional spare chlorine cylinders kept onsite and each cylinder is replaced as it gets emptied.

RAW WATER TANKS

The incoming raw water is directed into two (2) interconnected raw water tanks (2 x 45kL), which can be configured to operate in either parallel or series, depending on the requirements. Raw water from the tanks can be used as waste dilution water.

FILTRATION

From the raw water tanks, the water is pumped to six (6) media filters, which form two (2) trains. Filtered water turbidity is monitored continuously in the combined filtered water for each filter train. The filter bed is designed as a dual media configuration, incorporating filter coal and glass media.

The initiation of filter backwash can be either manual, under operator control, or automatic, based on head loss and run time. The water only backwash sources its water from the soft water tank. Backwash wastewater is sent to the process waste tanks.

ION EXCHANGE (SOFTENING)

After passing through the media filters, the filtered water is goes through an ion exchange process to reduce hardness. There are three (3) ion exchange units in operation, running in parallel, with a maximum of two (2) units operational at any given time, contingent on the raw water quality and the degree of softening required.

To achieve the desired target water quality, a partial bypass of the ion exchange process diverts some of the filtered water directly to the combined ion exchange outlet. The ion exchange resin within the units is periodically regenerated using a brine solution to replenish the resin with sodium and chloride ions.

It's important to note that the resin beds are sensitive to damage from chlorine, so the operation of pre-chlorination practices must be carefully controlled and monitored.

SODIUM HYDROXIDE

Sodium hydroxide can be dosed (when required) into the softened water prior to the UV units. The chemical is dosed using duty/standby pumps with auto changeover and auto shut down on zero flow.

ULTRAVIOLET DISINFECTION (UV)

For primary protozoan inactivation UV disinfection is used. There are two UV units in duty/standby configuration which are operationally rotated on a weekly basis or can be manually selected for operation. Continuous monitoring of UV Transmittance (UVT) and UV Intensity (UVI) controls the efficiency of this process. UVT and UV dose are operated based on the Critical Control Point procedures.

PRIMARY DISINFECTION

Chlorine gas is introduced into the treated water main after the UV units. Additionally, a recirculation line around the treated water reservoir is equipped with booster chlorine dosing to help maintain a target chlorine residual in the treated water storage tank, especially during periods of low water consumption in the town. Chlorine gas is dosed from two (2) 70 kg cylinders in duty/standby configuration with auto change over and automatic shut down on zero flow. There are two (2) additional spare chlorine cylinders kept onsite and each cylinder is replaced as it gets emptied. A chlorine residual analyser monitors chlorine concentration on the recirculation line.

WASTEWATER HANDLING

Wastewater generated from filter backwashing and ion exchange regeneration processes is collected in two (2) on-site tanks for high and low Total Dissolved Solids (TDS). While the low TDS water can be discharged to the sewer, the high TDS wastewater is disposed offsite by a registered waste contractor.

RESERVOIR

The treated water is pumped from the 2 ML Treated Water Storage Tank to the 250 kL water tower.

The clear water lift pumps at the WTP are active until the water tower reaches a high level, which serves as the stop level (60% low level).

RETICULATION

The current positioning of the water tower in Nebo is at a lower elevation within the distribution system. Consequently, there have been occasional challenges with maintaining water pressure in the higher areas of the town. The existing total reticulation (approximately 16 km) that services Nebo is made of Asbestos Cement, Poly and PVC (sizes include DN100, DN150 and DN200). A range of the pipe age can be seen in Table 100. There is no additional boosting pump station or supplementary disinfection point in the reticulation. All new reticulation in Nebo is specified to be Blue Brute.

The introduction of Smart Meters has also been implemented to gain better insights into water usage, losses, and to detect leaks and mains breaks more effectively.

Table 99 Pipe Materials and Length - Nebo

MATERIAL	DIAMETER [DN]	LENGTH [M]
Asbestos Cement	85	170
	100	3981
	150	1612
	200	1281
Poly	50	808
	65	76
	100	325
PVC	0	35
	50	96
	65	247
	100	814
	150	1244

MATERIAL	DIAMETER [DN]	LENGTH [M]
uPVC	50	25
	100	2819
	150	552
	200	444
HDPE	32	2
	63	29
	150	80
mPVC	150	208
	200	329
Unknown	0	405
	100	1631
	150	288

Table 100 Range of Pipe Age - Nebo

PIPE AGE	1-10 YEARS	11-20 YEARS	21-30 YEARS	31-40 YEARS	41-50 YEARS	51-60 YEARS	61-70 YEARS
Percentage of Network	19%	13%	31%	19%	8%	0%	9%

Nebo Overall Water Supply Scheme

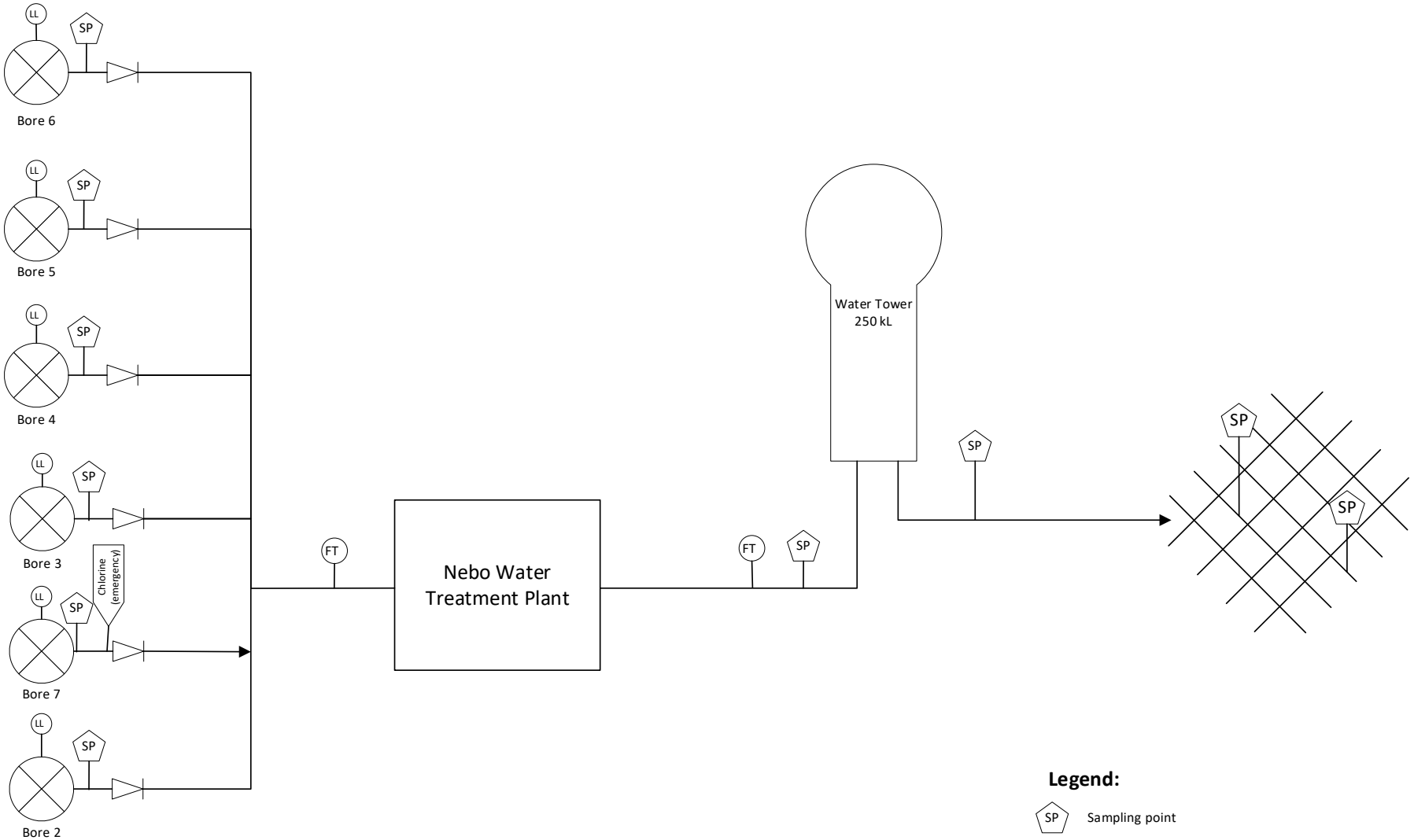


Figure 39 Nebo Catchment to Tap Schematic

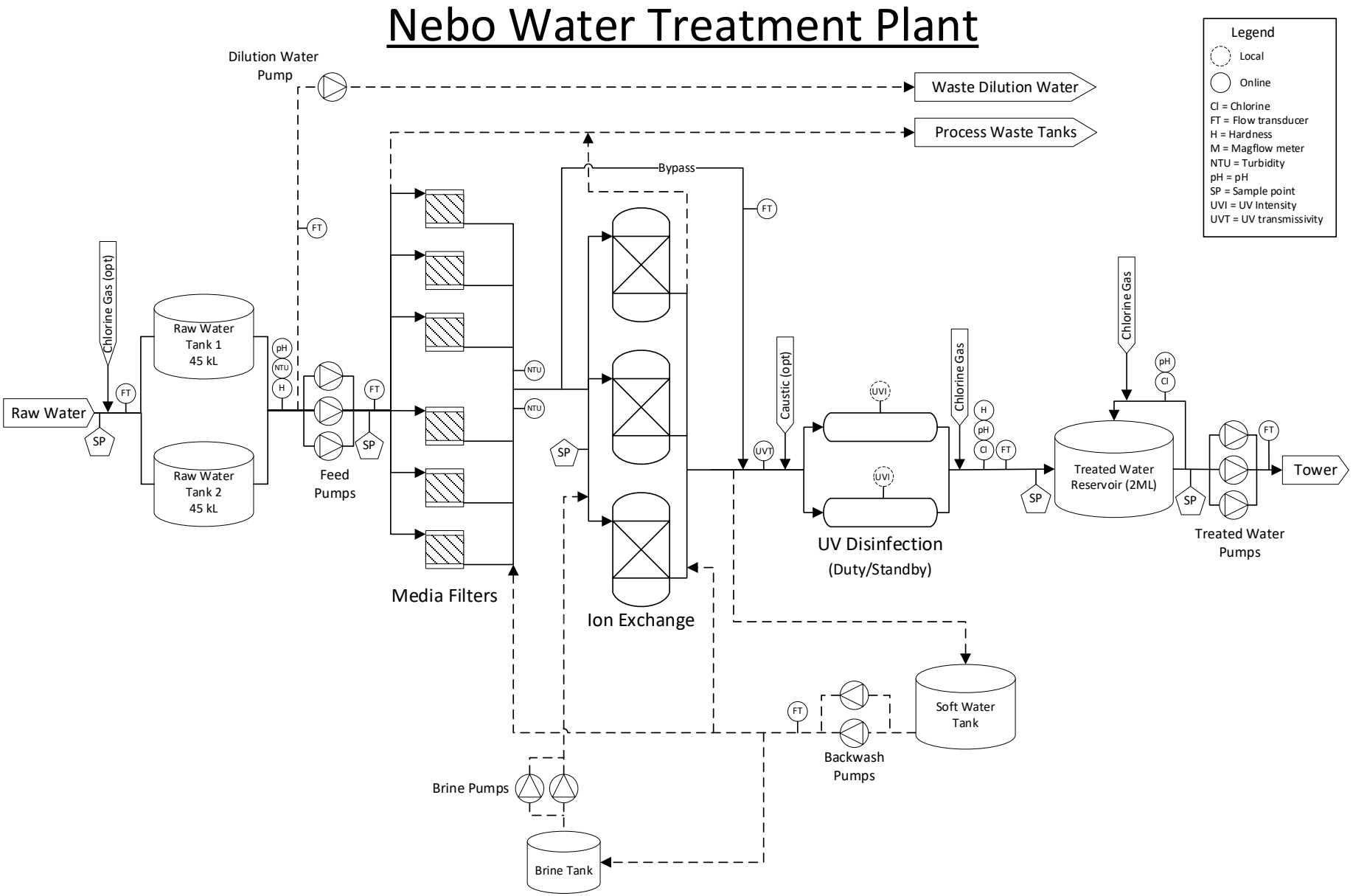


Figure 40 Nebo Treatment Plant Schematic

WATER QUALITY

RAW WATER

The source water shows occasionally elevated iron and manganese levels and some pH fluctuations. Alkalinity and hardness are elevated averaging around 200 and 300 mg $CaCO_3$/L, respectively. Some fluctuations can be seen for turbidity levels particularly during summer months which often correlate to heavier rain events. Confirming the surface water ingress into the aquifer can be seen in the occasional presence of *E.coli* in the raw water.

Table 101 Nebo Raw Water Monitoring (2020-2023)

	UNIT	# OF SAMPLES	MIN.	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Alkalinity	mg/L $CaCO_3$	1009	18	310	165	255	206	30
Conductivity	µS/cm	1001	7	1546	799	1222	1023	153
Hardness	mg/L $CaCO_3$	739	3.2	470	205	369	302	48
pH		1015	6.1	7.9	6.5	7.2	6.8	0.21
Tot. Iron	mg/L	822	0	0.16	0	0.06	0.019	0.019
Tot. Manganese	mg/L	960	0	0.5	0.001	0.01	0.0045	0.017
True Colour	HU	1009	0	25	0	0	0.3	1.8
Turbidity	NTU	984	0	0.72	0.01	0.29	0.12	0.1

TREATED WATER

Operational

The treatment process primarily softens the water reaching hardness levels of around 200 mg $CaCO_3$/L

In the past, issues with taste and odour have led to a small number of customer complaints. Historical problems also included elevated total aluminium concentrations which exceeded the ADWG aesthetic guideline several times.

Table 102 Summary Treated Water Monitoring (2020-2023)

	UNIT	# OF SAMPLES	MIN.	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Alkalinity	mg/L $CaCO_3$	1010	0.11	310	160	255	202	30
Conductivity	µS/cm	862	23	1400	868	1206	1048	116
Free Chlorine	mg/L	1024	0.82	2	1.1	1.6	1.4	0.16
Hardness	- mg/L $CaCO_3$	736	21	320	150	213	190	22
pH		1024	6.4	8.1	7.2	7.7	7.4	0.16
TDS	mg/L	31	21	29	22	28	24	1.7
Tot. Aluminium	mg/L	757	0	0.4	0.02	0.2	0.092	0.058
Tot. Iron	mg/L	825	0	0.2	0	0.06	0.02	0.021
Tot. Manganese	mg/L	958	0	0.16	0.002	0.009	0.0046	0.007
True Colour	HU	1011	0	35	0	0	0.5	2.9
Turbidity	NTU	1012	0	3	0.01	0.28	0.1	0.14

Verification

Verification monitoring data for Nebo is presented in Table 103. Chemical parameters with values under the limit of detection are presented as 0.5xLOD. Microbiological results under LOD are presented as 0.

Table 103 Verification Monitoring – Nebo (2014-2023)

	# OF SAMPLES	MIN.	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Aluminium (µg/L)	158	0.5	38	2.5	5.8	3	3
Arsenic (µg/L)	21	0.25	0.5	0.25	0.5	0.32	0.12
Barium (µg/L)	7	10	21	10	21	16	4.4
Beryllium (µg/L)	4	0.25	0.5	0.25	0.5	0.31	0.13
Boron (µg/L)	6	18	24	18	24	21	2.2
Bromate (µg/L)	112	2.5	25	5	25	8	5.5
Cadmium (µg/L)	16	0.05	0.5	0.05	0.5	0.11	0.15
Calcium (mg/L)	98	20	96	30	80	48	17
Chlorate (µg/L)	111	10	696	10	297	82	117
Chlorite (µg/L)	111	2.5	25	5	25	8.1	5.6

	# OF SAMPLES	MIN.	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Chromium (µg/L)	15	0.05	0.5	0.05	0.5	0.13	0.16
Colour - True (TCU)	142	0.5	7	0.5	3	0.99	1
Copper (µg/L)	16	4.9	40	4.9	40	13	9.2
Dissolved Oxygen (% Sat)	93	51	98	58	96	80	13
E. coli (MPN/100mL)	948	0	0	0	0	0	0
Fluoride (mg/L)	89	0.027	0.18	0.05	0.16	0.099	0.038
Formaldehyde (mg/L)	34	0.05	0.05	0.05	0.05	0.05	0
Free Chlorine Residual (Client tested) (mg/L)	693	0.01	2.7	0.43	1.7	1.1	0.39
Free Chlorine Residual (mg/L)	254	0.01	2.1	0.15	1.1	0.65	0.29
Gross alpha (Bq/L)	13	0.025	0.05	0.025	0.05	0.027	0.0069
Gross beta (Bq/L)	13	0.05	0.05	0.05	0.05	0.05	0
Hardness - Temporary (mg/L)	128	104	258	115	228	177	31
Hardness (mg/L)	252	42	551	145	354	215	64
Iodide (µg/L)	6	10	10	10	10	10	0
Iron (µg/L)	189	0.5	90	1	4.2	1.9	6.8
Lead (µg/L)	21	0.25	1.1	0.25	1.1	0.44	0.22
Magnesium (Total) (mg/L)	158	4.9	65	20	29	24	5
Manganese (µg/L)	190	0.5	4	0.5	2.4	0.73	0.63
Manganese (Total) (µg/L)	172	0.5	6.3	0.5	2.5	0.86	0.79
Mercury (µg/L)	19	0.025	0.25	0.025	0.25	0.2	0.094
Molybdenum (µg/L)	6	0.5	0.5	0.5	0.5	0.5	0
Nickel (µg/L)	16	0.25	1	0.25	1	0.36	0.23
Nitrate (mg/L)	140	0.096	6.3	0.46	5.3	2.3	1.4
Nitrite (mg/L)	140	0.002	0.2	0.002	0.2	0.08	0.096
pH (Client tested) (pH unit)	727	6.6	7.9	6.8	7.7	7.2	0.29
pH (pH unit)	172	6.7	7.6	6.8	7.3	7	0.15
Residual Alkalinity (mg/L)	68	0.05	0.05	0.05	0.05	0.05	0
Selenium (µg/L)	21	0.5	2.5	0.5	2.5	2	0.87
Silver (µg/L)	7	0.05	0.5	0.05	0.5	0.31	0.24
Sulphide (mg/L)	31	0.0025	0.006	0.0025	0.0039	0.0026	0.00063
Tin (µg/L)	7	0.5	0.86	0.5	0.86	0.59	0.16
Total Dissolved Solids (mg/L)	474	123	1108	276	755	544	152
Trihalomethanes (Total) (µg/L)	151	0.5	207	2.5	41	14	30
Trihalomethanes (Total)^ (µg/L)	46	0.5	19	0.5	12	4.2	3.7
Turbidity (Client tested) (NTU)	317	0.05	0.85	0.05	0.27	0.14	0.089

	# OF SAMPLES	MIN.	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Turbidity (NTU)	140	0.05	2.6	0.05	0.6	0.26	0.26
Uranium (µg/L)	7	0.25	0.5	0.25	0.5	0.39	0.13
Zinc (µg/L)	16	4.1	24	4.1	24	10	5.3

CUSTOMER COMPLAINTS

Most water quality customer complaints in Nebo are based on taste and odour of the water or without a recorded cause. In the recent FY 22/23 no customer complaints were recorded.

Table 104 Summary of Customer Complaints - Nebo

Year	No of Water Quality Complaints	Main Reasons for Complaints	Likely Sources / Causes of Problems	Resolution of Problem
2013-14	1	Unknown	No information recorded to indicate the cause of complaint.	
2017-18	3	Unknown/ Odour	No information recorded to indicate the cause of complaint.	
2018-19	1	Unknown	No information recorded to indicate the cause of complaint.	
2019-20	4	Taste	Cause of the complaint not known. Samples taken within ADWG	WTP processes reviewed.
2020-21	1	Other	Water hardness deposits on vehicle after washing	Dry vehicle with chamois rather than air-dry. Customer satisfied.

INCIDENTS

There was one (1) reportable incident in Nebo between 2017 and 2023, which was an *E.coli* detection.

Table 105 Summary of Incidents - Nebo

INCIDENT DATE	REFERENCE	LOCATION	PARAMETER	DESCRIPTION OF EVENT	IMPROVEMENT
19/07/2023	DWI-486-23-10333	Network water	*E. coli* (1 MPN/100 ml)	*E. coli* was detected in a network sample	New fit for purpose sample tap installed.

RISK ASSESSMENT

SCHEME MITIGATED RISK ASSESSMENT

Table 106 Mitigated Risk Assessment - Nebo

Ref	Treatment Stage	Primary Hazard	Other hazards managed by barrier	Hazardous Event	Unmitigated Risk	Control Measures in place	Comment	Mitigated Consequence	Mitigated Likelihood	Mitigated Risk	Uncertainty	Improvement Action Required - Immediate	Improvement Action Required ~ 2 years	Improvement Action Required - Long term
NBO1	Raw Water Abstraction	Protozoa (Nebo Bores)	Bacteria and viruses in bore	Normal operation	High 10	Filtration, high dose UV disinfection, and chlorination.	Bores and catchment categorisation. Currently provisional Cat 3 due to some historical E. coli, conductivity suggests lower connectivity, but bores are shallow.	Catastrophic	Rare	Medium 6	Confident			
NBO2	Chemical Dosing - Chlorine gas	Manganese bores	Iron	Underdose chlorine	Medium 9	Not typically used	Duty/standby Auto shutdown and changeover Downstream chlorine disinfection	Moderate	Unlikely	Medium 6	Confident			
NBO3	Chemical Dosing - Chlorine gas	Chlorine		Overdose chlorine	High 12	Not typically used	Duty/standby Auto shutdown and changeover Chlorine disinfection, and online monitoring. Could consider low dose for manganese and iron reduction - noting ion exchange is not tolerant to high levels of chlorine.	Moderate	Unlikely	Medium 6	Reliable			
NBO4	Filtration - Media filtration	Protozoa (Nebo Bores)	turbidity	Breakthrough through filters	High 10	Filtration, high dose UV disinfection,	6 filters 2 trains Glass media combined NTU, but UV post filtration. Annual external calibration and maintenance.	Catastrophic	Rare	Medium 6	Confident			
NBO5	Filtration - Media filtration	Protozoa (Nebo Bores)		Poor backwash	High 10	Backwash every 60 hours or on DP, Filtration, high dose UV disinfection,	6 filters 2 trains Glass media combined NTU, but UV post filtration. Annual external calibration and maintenance.	Catastrophic	Rare	Medium 6	Confident	Initiate backwash on turbidity trigger.		
NBO6	Ion exchange	Hardness (Nebo)	sodium	Bypass of ion exchange	High 15	Automatically regenerated through SCADA program	Partial bypass used to run Runs in parallel	Moderate	Rare	Low 3	Confident			
NBO7	Chemical Dosing - Sodium hydroxide	pH		Overdose of sodium hydroxide	Medium 9	Has capacity to dose, but not used	Duty/standby Auto shutdown and changeover	Moderate	Rare	Low 3	Confident			
NBO8	Chemical Dosing - Sodium hydroxide	pH		Underdose	Medium 9	Has capacity to dose, but not used	Duty/standby Auto shutdown and changeover	Moderate	Rare	Low 3	Confident			
NBO9	Ultraviolet Disinfection	Protozoa (Nebo Bores)	Bacteria	Underdose of UV	High 10	Critical limit of 60 mJ/cm^2, Target 80 mJ/cm^2	Dose provides > 4 LRV protozoan reduction. Duty standby reactors.	Catastrophic	Rare	Medium 6	Confident	Confirm that UV changes over on failure to meet dose.		
NBO10	Ultraviolet Disinfection	Virus (Nebo)		Underdose of UV	High 15	Critical limit of 60 mJ/cm^2, Target 80 mJ/cm^3	Dose provides 1 LRV Virus at critical limit, and target is 1.5 LRV providing total treatment surplus in normal conditions.	Catastrophic	Rare	Medium 6	Confident			
NBO11	Disinfection - chlorine gas	Chlorine		Overdose of chlorine	High 12	Chlorine CCP, daily monitoring.	Has booster line around TWR Duty/standby Auto shutdown and changeover. Annual external calibration and maintenance of online meters	Moderate	Rare	Low 3	Confident			
NBO12	Disinfection - chlorine gas	Virus (Nebo)		Underdose of chlorine	High 15	UV disinfection, and chlorination CCP. Daily testing.,	Has booster line around TWR Duty/standby Auto shutdown and changeover, alarms to operator.	Catastrophic	Rare	Medium 6	Confident			

OPERATIONAL MONITORING

Table 107 Nebo Operational Monitoring

PARAMETER	RAW WATER	FILTERED WATER	SOFTENED WATER	CHLORINATED WATER	TREATED WATER (POST TWR)	NETWORK WATER
ALKALINITY	Weekly				Weekly	
CONDUCTIVITY	Daily, Online					
pH	Daily, Online			Online	Daily, Online	Weekly
FREE CHLORINE				Daily, Online	Daily, Online	Weekly
TOT. HARDNESS	Daily, Online				Daily, Online	
TOT. IRON	Daily				Weekly	
TOT. MANGANESE	Daily				Weekly	
TRUE COLOUR	Daily				Daily	Weekly
TURBIDITY	Daily, Online	Online			Daily	Weekly
UVT			Online			

Response to out of specification results for relevant parameters are managed through CCPs and OCPs.

Operators check the calibration of online instruments with the results from their lab/benchtop analysis as part of the operational monitoring.

CRITICAL CONTROL POINTS

CRITICAL CONTROL POINTS

The critical control points (CCPs) for the scheme were identified in the risk assessment process, and include:

- Filtration
- UV – Disinfection
- Chlorination Disinfection

The CCP procedures are included in the following pages. These are presented as traffic lights and identify the location, monitoring, performance, and validation of the process. The traffic lights are aligned to SCADA where the low and high limits match the adjustment level and (as appropriate) the high and low alarms match the critical limit.

OPERATIONAL CONTROL POINTS

Nebo WTP has three (3) operational control points (OCPs) for the following process.

- Oxidation – treated water manganese
- Chlorination – chlorinated water free chlorine
- Disinfection – treated water pH

An OCP exceedance is generally not reportable to the regulator except if it is an event that requires reporting. Incident reporting to the regulator is based on CCPs or exceedances of ADWG health guidelines.

Filtration

What is measured	Where is it measured	When is it measured	What is the control point	What are the hazards	Record Keeping
Turbidity	Post filtration	Online continuous and workday grab	Filtration	Protozoa, turbidity	Operator Log Sheets

Critical Limit
>0.15 NTU
For more than 15 minutes

- Confirm result with grab samples
- Breach of CCP is continued supply of water to customers above the Critical Limit
- Operator to contact Supervisor/ Coordinator or Manager
- Supervisor/Coordinator or Manager to inform Compliance & IMS team on [redacted]
- If operator unable to contact chain of command, report directly to Compliance & IMS Team
- Compliance & IMS to contact DRDMW on 1300 596 709 as required
- If health advice required, Compliance & IMS or Manager to contact Mackay PHU on 4885 5800

Adjustment Limit
>0.1 NTU

- Check turbidity meter, clean and calibrate to confirm results
- Check raw water turbidity for changes
- Backwash filters
- Take filter offline if turbidity still above Adjustment Limit after multiple backwashes.
- Rectify any dosing issues and escalate to supervisor

Target
<0.1 NTU

- When attending plant, inspect process for any visual signs of process failure
- Test the water as per DWQMP
- Record results
- Check raw water turbidity regularly
- Complete routine cleaning and calibration of online meters
- Check SCADA trend for normal operation
- Ensure backwashes are undertaken and effective

Ultraviolet Disinfection

What is measured	Where is it measured	When is it measured	What is the control point	What are the hazards	Record Keeping
UV dose rate	In UV reactor	Continous online	Disinfection	Protozoa, Bacteria, Viruses	Operator Log Sheets

Critical Limit
<60 mJ/cm²

- Breach of CCP is continued supply of water to customers above the Critical Limit
- Operator to contact Supervisor/Coordinator or Manager
- Supervisor/Coordinator or Manager to inform Compliance & IMS team on [redacted]
- If operator unable to contact chain of command report directly to Compliance & IMS Team.
- Compliance & IMS to contact DRDMW on 1300 596 709 as required
- If health advice required, Compliance & IMS or Manager to contact Mackay PHU on 4885 5800

Adjustment Limit
<80 mJ/cm²

- Check UV meter, clean and calibrate to confirm results
- Check transmissivity and lamps are normal and in working orderl
- Clean or replace lamps as necessary
- Change duty UV to alternate reactor if dose unable to be achieved
- Rectify any issues and escalate to supervisor
- Take WTP offline or reduce plant flow as required

Target
>80 mJ/cm²

- Visual inspection of plant
- Ensure dose rate is above target
- Ensure UVT is >80%

Disinfection

What is measured	Where is it measured	When is it measured	What is the control point	What are the hazards	Record Keeping
Free Chlorine	Online monitoring of clearwater tank and workday grab sample	Online continous, workday grab sample	Disinfection	Bacteria, viruses, chlorine	Operator Log Sheets

Critical Limit
>3.0 mg/L
<1.0 mg/L

- Confirm result with grab samples
- Operator to contact Supervisor/Coordinator or Manager
- If low chlorine, Supervisor/Coordinator and/or Manager to ensure sufficient chlorine contact time for disinfection with actual operational parameters.
- If water with < 15 mg.min/L is supplied to customers this is a reportable event
- If chlorine is > 5 mg/L this is reportable as an incident
- Supervisor/Coordinator or Manager to inform Compliance & IMS Team on [redacted]
- If operator unable to contact chain of command, report directly to Compliance & IMS Team

Adjustment Limit
>2.0 mg/L
<1.3 mg/L

- Confirm result with grab sample
- Check chlorine meter, clean and calibrate to confirm result
- Check dosing system for any issues or air locks
- Rectify any dosing issues
- Take WTP offline or reduce plant flow as required

Target
>1.3 mg/L
<2.0 mg/L

- When attending plant, inspect process for any visual signs of process failure
- Check cylinder weights and change empty cylinders as required
- Complete routine calibrations of online instruments to ensure accuracy

Validation: The clearwater tank has a volume of 2 ML, a minimum operational volume of 50% (Baffle factor 0.1). The maximum plant flow rate is 60 L/s. At the minimum chlorine residual of 1 mg/L out of the clearwater tank, the Nebo WTP achieves 27.8mg.min/L CT.

Table 108 Operational Control Points - Nebo WTP

PROCESS	PARAMETER	WHERE IS IT MEASURED	HAZARD	WHEN IS IT MEASURED	TARGET	ADJUSTMENT LIMIT	ACTION IF ADJUSTMENT LIMIT EXCEEDED	ALERT LIMIT	ACTION IF ALERT LIMIT EXCEEDED	REPORTING
Oxidation	Total Manganese	Treated water	Manganese	Weekly	<0.1 mg/L	>0.1 mg/L	Confirm manganese reading, Check soluble manganese in treated water and free chlorine, Consider using chlorine peroxidation before raw water tank	>0.5mg/L	Confirm manganese reading, Check chlorine dosing system, Check treated water free chlorine, Check network total and soluble manganese, free chlorine and colour, Shutdown if uncertain of cause, Operator to notify Supervisor/Coordinator/ Manager Consider treated water reservoir drain down and network flushing,	Operator to contact Supervisor/Coordinator and/or Manager as total manganese in treated water > 0.5 mg/L is a reportable event. Assess closely related reportables such as effective disinfection, treated water colour and network turbidity.
Chlorination	Free Chlorine	Chlorinated Water	Bacteria, Viruses	Online, Daily	>1.3 mg/L and <2.0 mg/L	<1.3 mg/L and >2.0 mg/L	Confirm free chlorine reading, Check chlorine dosing, Adjust dosing rate and monitor	< 1mg/L or > 3mg/L	Confirm free chlorine reading, Check chlorine dosing, Adjust dosing rate and monitor, Operator to notify Supervisor/Coordinator/ Manager	Internal reporting, Further see Disinfection CCP. Confirm CT is adequate
Disinfection	pH	Treated Water	pH, Bacteria, Viruses,	Online, Daily	>7.0, <7.5	<7.0, >7.5	Confirm pH reading, Calibrate online meter if necessary. Check dosing system, Adjust dosing rate	>8.5, <6.5	Confirm pH reading, Check dosing system, Adjust dosing rate, Operator to notify Supervisor/Coordinator/ Manager	Internal reporting
OCP EXCEEDANCES ARE GENERALLY NOT REPORTABLE TO THE REGULATOR EXCEPT IF IT IS AN EVENT OR REPORTABLE HEALTH LIMIT										

RAW WATER MONITORING

Raw water monitoring in Nebo is undertaken based on the principles outlined in the overarching DWQMP.

Table 109 Raw Water Monitoring - Nebo

PARAMETER	FREQUENCY
E. coli	Monthly
Radiological	2 – years
Pesticides	Quarterly

VERIFICATION MONITORING

Table 110 Verification Monitoring - Nebo

PARAMETER	FREQUENCY	WTP	SAMPLE POINTS IN NETWORK
E. coli	Weekly	No	SP 1-2
SWA	Monthly	Yes	Rotation SP 1-2
Trihalomethanes	Quarterly	No	SP 2
Metals	Quarterly	Yes	Rotation SP 1-2

VERIFICATION MONITORING LOCATIONS

The monitoring locations in Nebo are shown in Figure 41 and Table 111. These locations are spread throughout Nebo and are representative of the water quality provided to the bulk of Nebo's customers.

Table 111 Nebo Monitoring Points

SAMPLE POINTS	NETWORK SAMPLING LOCATIONS	DESCRIPTION
1	[redacted]	[redacted]
2	[redacted]	[redacted]

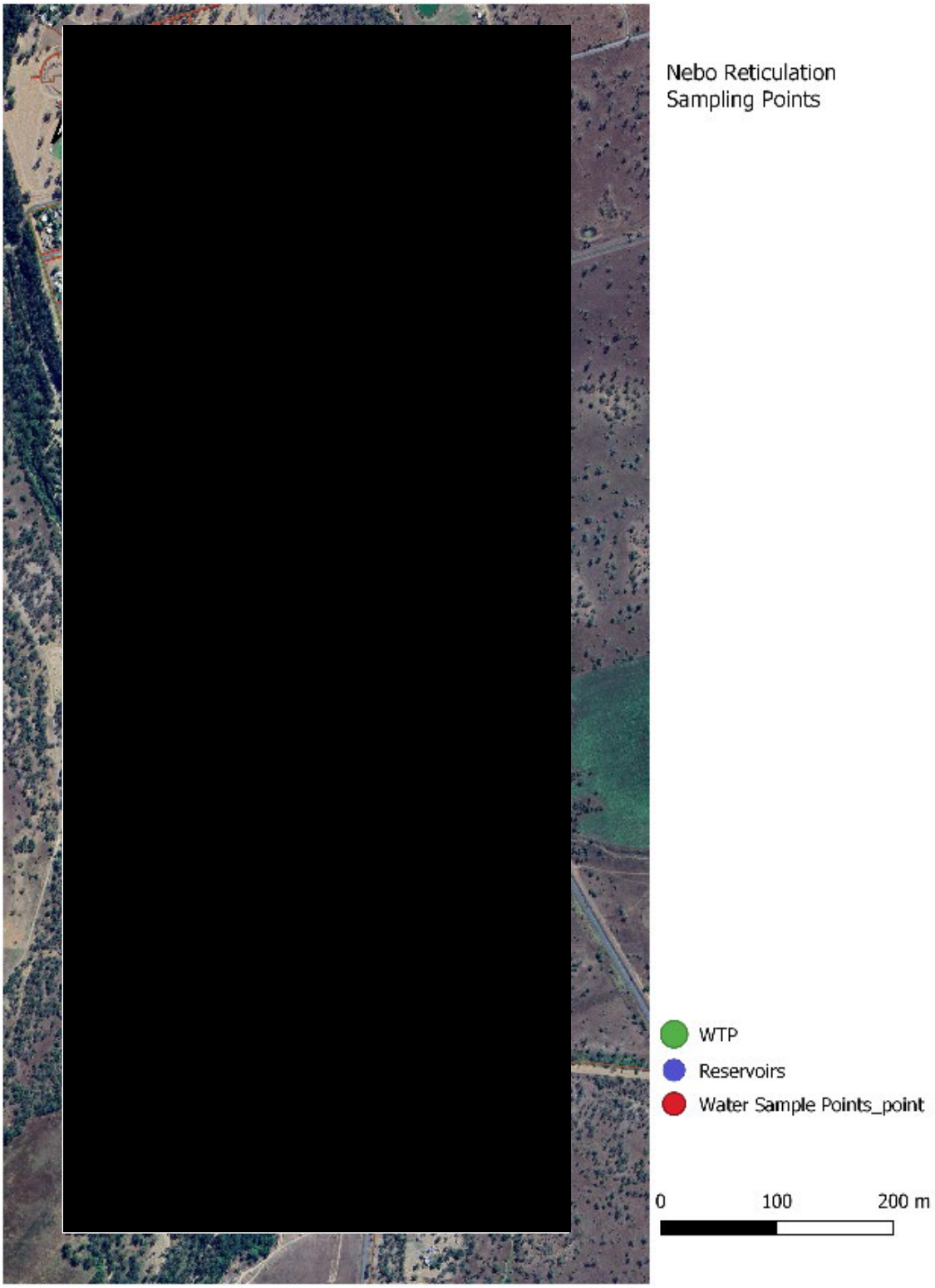


Figure 41 Nebo Verification Monitoring Locations

Response to out of specification results

Data from the verification monitoring is accessible via the Mackay Laboratory Monitor Pro Portal. The data is entered into spreadsheet records and the files on the share drive are accessible to all IRC Water and Wastewater Operational Staff. Refer to IRC Overarching DWQMP for Incident and Emergency Management.

APPENDIX 8

ST LAWRENCE DRINKING WATER QUALITY MANAGEMENT PLAN

St Lawrence Drinking Water Quality Management Plan

Presented by: Water and Waste Directorate
Current as at: 22 August 2024

ISAAC REGION
HELPING TO ENERGISE THE WORLD

ISAAC.QLD.GOV.AU ISAAC REGIONAL COUNCIL ABN 39 274 142 600
P 1300 472 227 F 07 4941 8666 A PO Box 97 Moranbah QLD 4744
isaacregionalcouncil isaacregionalcouncil Isaacrcouncil

TABLE OF CONTENTS

OBJECTIVE

This plan details how Isaac Regional Council ensures the safety of drinking water for the St Lawrence community.

SCOPE

This plan is the Site-specific Drinking Water Quality Management Plan that together with the Overarching Drinking Water Quality Management Plan makes up the complete plan for St Lawrence.

DEFINITIONS

TERM / ACRONYM	MEANING
ADWG	Australian Drinking Water Guidelines
CCP	Critical Control Point
DRDMW	Department of Regional Development Manufacturing and Water
DWQMP	Drinking Water Quality Management Plan
DWQMP Guideline	Guideline for the preparation, review and audit of drinking water quality management plans.
IRC	Isaac Regional Council
OCP	Operational Control Point
NTU	Nephelometric turbidity units
PHA	*Public Health Act 2005*
QH	Queensland Health – regulator of public health – may take lead on managing incidents
Regulator	In the context of the DWQMP, the Regulator is DRDMW
RMIP	Risk Management Improvement Program
SCADA	Supervisory Control and Data Acquisition
SPID	Service Provider Identification Number
WSSRA	*Water Supply (Safety and Reliability) Act 2008*
WTP	Water Treatment Plant

REFERENCES

ID	NAME
	DWQMP Document Register

INTRODUCTION

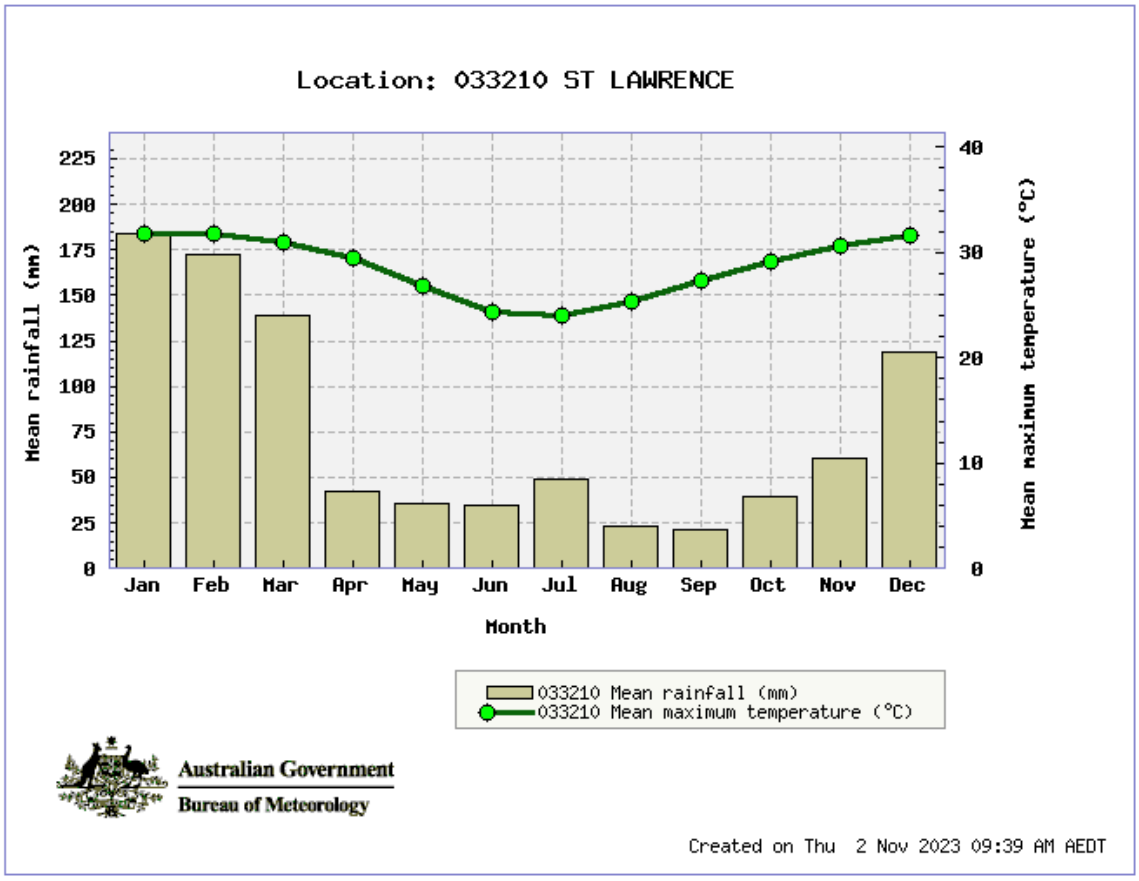
This site specific DWQMP documents the specific details of the St Lawrence drinking water scheme. It is intended to be an operational document that informs the operational staff.

OVERVIEW OF THE SUPPLY SCHEME

St Lawrence is a rural town and coastal locality of ~235 people. Due to the coastal position, St Lawrence is a holiday destination which significantly increases the population during the local holiday season (winter). The town is located ~160 km south of Mackay and ~240km east southeast of Moranbah. Drinking water for the community is sourced from the St Lawrence Creek.

CLIMATE

The St Lawrence climate is characterised by a subtropical semi-arid climate with coastal influence. Rainfall (See Figure 42) within the catchment averages ~912 mm/year with more rain in summer than winter. The mean maximum temperature is 28.6 °C, with a mean max. above 30°C between November to February.



Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
Mean rainfall (mm) for years 2004 to 2023	183.9	172.6	138.6	42.1	35.7	35.1	48.6	23.0	21.6	39.8	60.3	118.5	912.2	19
Statistics	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**	**Years**
Mean maximum temperature (°C) for years 2004 to 2023	31.8	31.8	31.0	29.4	26.8	24.4	24.1	25.3	27.3	29.2	30.6	31.6	28.6	19

Figure 42 Rainfall and Temperature Data for St Lawrence

CATCHMENT CATEGORISATION

There are some recreational fishing activities in the area. A variety of farming activity can be found along the catchment including cattle farming and cropping. Based on the activity in the catchment area and the unprotected nature of the creek the raw water is characterised as a Category 4 catchment.

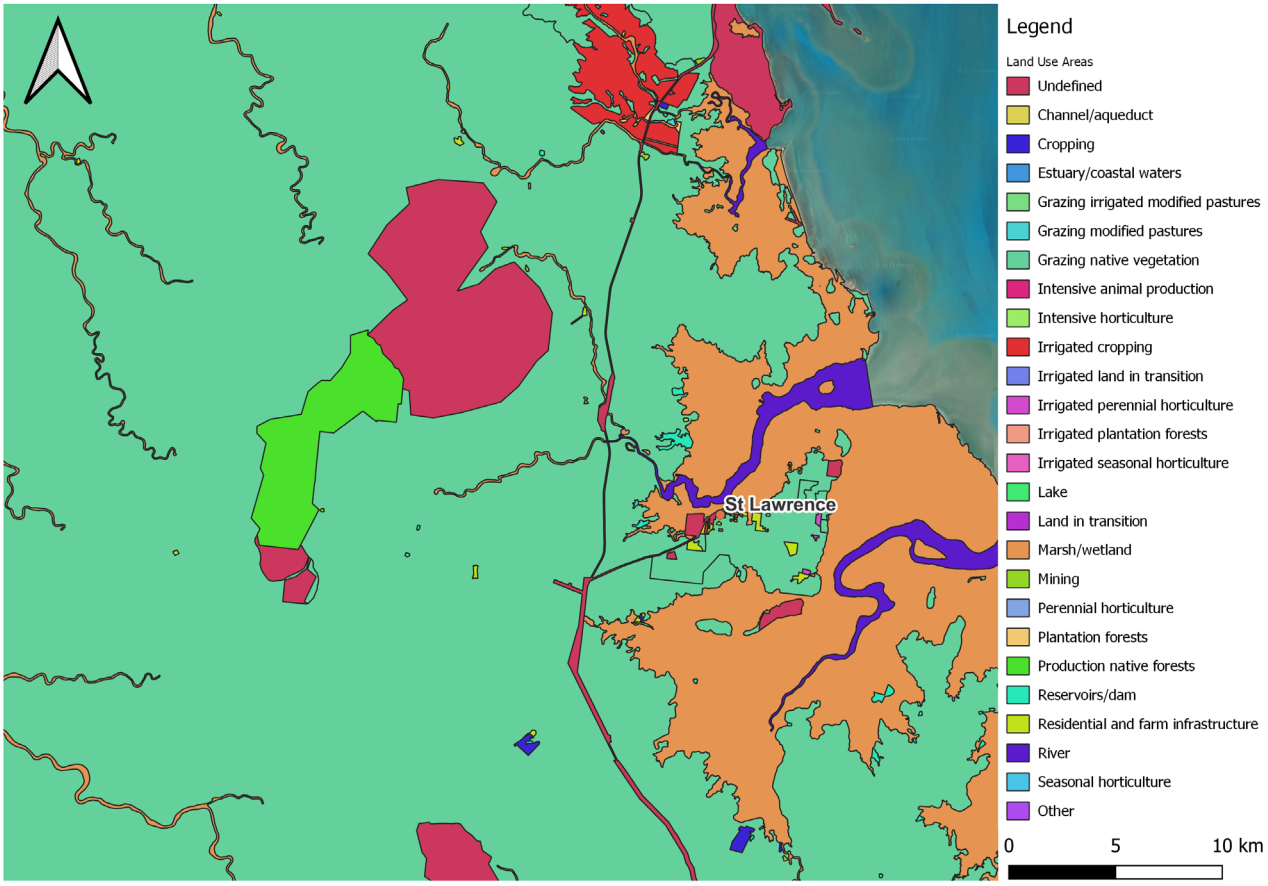


Figure 43 Land Use Map St Lawrence

TREATMENT PROCESS

OVERALL – CAPACITY

The St Lawrence WTP is a conventional treatment plant with a capacity of 5 L/s (360 kL/day).

RAW WATER SOURCE

The St Lawrence Water Scheme sources its raw water from a take-off point in the St Lawrence Creek situated approximately [redacted]. The weir functions as both a tidal barrier and a reservoir with a total storage capacity of 210 ML. The lower St Lawrence Creek experiences pronounced tidal fluctuations, leading to substantial water level variations. During extreme high tides, there is a risk of saline water overflow into the upper weir and raw water storage reservoir.

RAW WATER PUMPING

Two (2) high lift pumps are employed in a duty/standby configuration, started and stopped by control levels within the final reservoir with call out alarms. The pumps are set at varying heights for raw water abstraction.

The raw water pump station and the St Lawrence WTP are connected using a combination of 100 mm Asbestos Cement (AC), PVC and HDPE rising main.

POTASSIUM PERMANGANATE DOSING

Potassium permanganate is dosed into the raw water line prior to the floc zone. There is a single dosing pump with auto shut down on zero plant flow, there are no alarms.

COAGULANT DOSING

Aluminuim Chlorohydrate ACH coagulant (All Clear 300) is dosed into the raw water pipe prior to the floc zone. There is a single dosing pump with auto shut down on zero plant flow, there are no alarms.

SODA ASH DOSING

Soda ash is dosed (when required) for pH correction before the water enters the floc zone. There is a single dosing pump with auto shut down on zero plant flow, but there are no alarms.

POWDERED ACTIVATED CARBON (PAC) DOSING

PAC is dosed (when required) into the floc zone using a single dosing pump with auto shut down on zero plant flow, there are no alarms.

FLOCCULATION - CLARIFICATION

The water flows into the floc zone where it is mixed then enters the upflow clarifier. Sludge is removed to the sludge drying beds based on time, or by manual operator intervention. Clarified water flows to the glass media filter.

FILTRATION

The filter operates on water level - when the water level reaches the set point the filtered water outlet valve opens. The media filter is backwashed based on head loss.

The clarifier and filter receive full drain out periodically.

The filtered water initially flows into the backwash tank until it reaches full capacity, after which it continues on to the final reservoir.

WASTEWATER AND SLUDGE HANDLING

Sludge from the clarifier and backwash from the glass media filter enter sludge drying beds. No water is returned to the process from drying ponds.

PRIMARY DISINFECTION

Calcium hypochlorite (2%) is manually batched, supplied from one (1) tank and dosed (single dosing pump) into the filtered water prior to the backwash tank.

CLEARWATER TANK AND TREATED WATER RESERVOIR.

Treated water from the filters flows to the backwash tank which then flows into the final reservoir (300 kL). From this reservoir, the water is distributed to the residents of St Lawrence through a gravity-based reticulation network.

RETICULATION

Water from the treated water reservoir is gravity fed to the St Lawrence reticulation network. The reticulation pipework was installed in 1965, and most of the original pipework has been retained. A secondary twin main between the final reservoir and St Lawrence was installed in 2018 for a length of 1000 M. A range of pipe ages can be seen in Table 113. The reticulation mains are ~18km long and mainly constructed of AC, however most pipework is not well documented.

The introduction of Smart Meters has also been implemented to gain better insights into water usage, losses, and to detect leaks and mains breaks more effectively.

Table 112 Pipe Materials and Length

MATERIAL	DIAMETER [DN]	LENGTH [M]
Asbestos Cement	Unknown	1901
Poly	110	151
PVC	150	129
	225	219
HDPE	150	1016
Steel	Unknown	920
Unknown	Unknown	2196
	32	89
	63	119
	100	3428

Table 113 Range of Pipe Age - St Lawrence

PIPE AGE	1-10 YEARS	11-20 YEARS	21-30 YEARS	31-40 YEARS	41-50 YEARS	51-60 YEARS	61-70 YEARS
Percentage of Network	6%	4%	0%	37%	0%	53%	0%

St Lawrence Water Treatment Plant

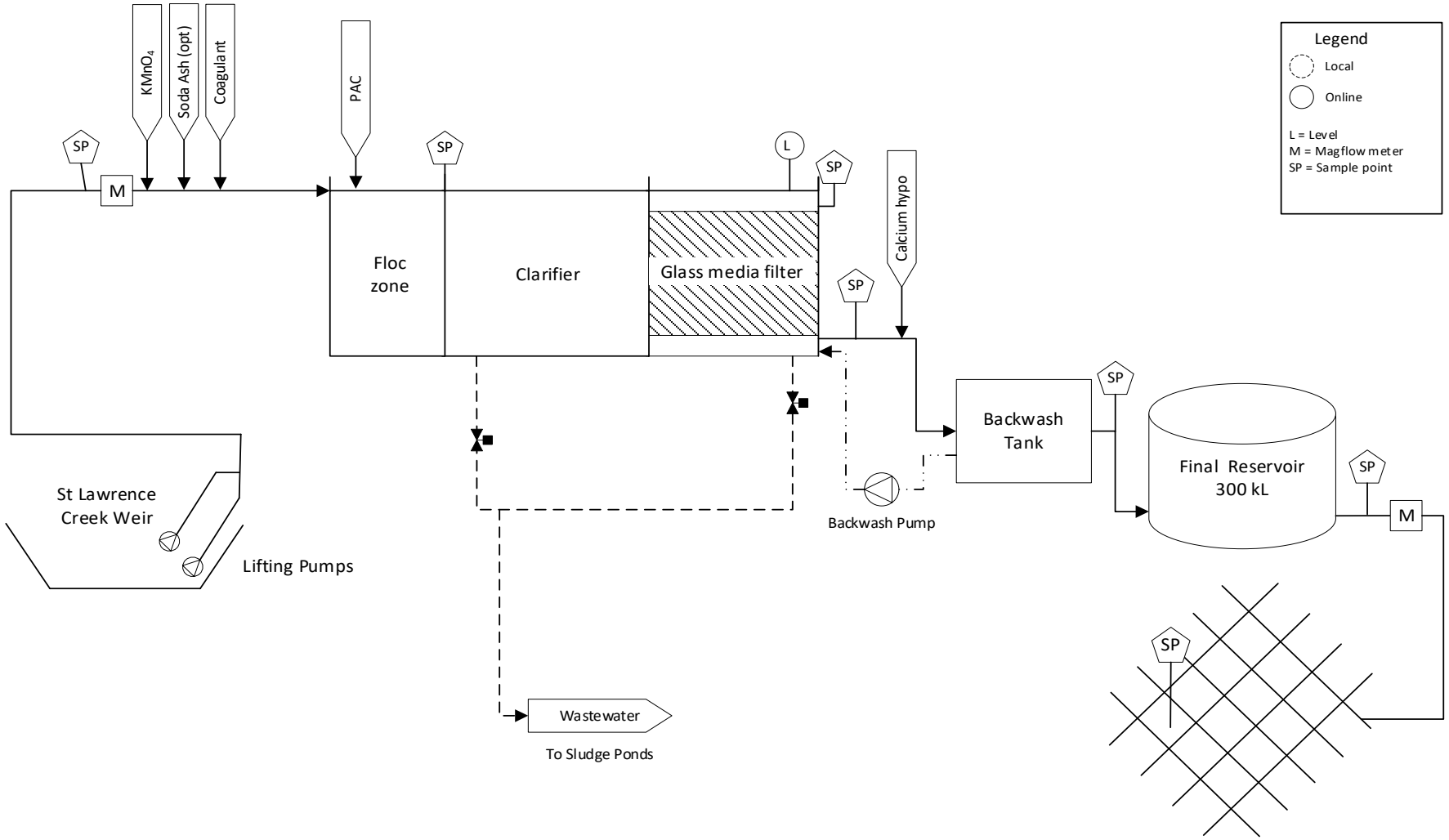


Figure 44 St Lawrence Catchment to Tap and Treatment Plant Schematic

WATER QUALITY

RAW WATER

The raw water from St Lawrence creek shows significant turbidity fluctuations which appear seasonal. Additionally, the water shows variations in alkalinity, hardness iron, manganese and true colour.

Table 114 St Lawrence Raw Water Monitoring (2020-2023)

	UNIT	# OF SAMPLES	MIN.	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Alkalinity	mg/L $CaCO_3$	467	0	200	32	100	58	23
Hardness	mg/L $CaCO_3$	328	20	155	20	70	46	20
pH		1280	0	9.8	6.7	7.3	6.9	0.34
Sol. Iron	mg/L	116	0	3.7	0.018	1.7	0.55	0.59
Sol. Manganese	mg/L	110	0	0.68	0.012	0.43	0.17	0.13
Tot. Aluminium	mg/L	10	0	0.24	0	0.24	0.13	0.086
Tot. Iron	mg/L	1239	0	8.4	0.04	1.7	0.62	0.62
Tot. Manganese	mg/L	1234	0	6.8	0.06	1.4	0.51	0.61
True Colour	HU	888	5	1180	13	516	124	175
Turbidity	NTU	1207	0	579	1.2	61	16	36
Sol. UVA_{254}	Abs	23	0.36	0.53	0.36	0.53	0.43	0.042

TREATED WATER

Treated water quality is often highly variable with turbidity events as well as elevated iron, manganese and iron. These go in hand with occasional elevated colour events. Free chlorine is variable.

Table 115 Summary Treated Water Monitoring (2017-2023)

	UNIT	# OF SAMPLES	MIN.	MAX.	5TH %ILE	95TH %ILE	MEAN	STD. DEVIATION
Alkalinity	mg/L $CaCO_3$	426	30	185	40	115	70	24
Free Chlorine	mg/L	1383	0.1	4.9	1.3	3.1	2.5	0.64
Hardness	mg/L $CaCO_3$	347	10	110	25	90	47	18
pH		1385	7	8.5	7.2	7.9	7.5	0.2
Tot. Aluminium	mg/L	479	0	0.45	0.007	0.15	0.066	0.052
Tot. Iron	mg/L	564	0	0.91	0	0.1	0.028	0.084
Tot. Manganese	mg/L	599	0	0.9	0	0.19	0.035	0.087
True Colour	HU	1049	0	37	0	3	1.3	2.3
Turbidity	NTU	1332	0	8.2	0.07	1	0.28	0.44
Sol. UVA_{254}	Abs	182	0.019	0.98	0.029	0.17	0.095	0.084

Verification

Verification monitoring data for St Lawrence is presented in Table 116. Chemical parameters with values under the limit of detection are presented as 0.5xLOD. Microbiological results under LOD are presented as 0.

Table 116 Verification monitoring – St Lawrence (2014-2023)

	# OF SAMPLES	MIN.	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Alkalinity - Residual (mq/L)	24	-0.019	0.05	-0.019	0.05	0.04	0.023
Alkalinity (mg/L)	97	11	230	35	97	62	26
Aluminium (µg/L)	147	2.5	176	8.6	116	48	32
Ammonia (mg/L)	38	0.0025	0.026	0.0025	0.014	0.0057	0.0037
Arsenic (µg/L)	17	0.25	0.5	0.25	0.5	0.31	0.11
Barium (µg/L)	4	13	15	13	15	14	0.98
Beryllium (µg/L)	4	0.25	0.5	0.25	0.5	0.31	0.13
Boron (µg/L)	4	20	25	20	25	23	2.4
Bromate (µg/L)	104	2.5	25	5	25	7.7	5.2
Bromate^ (µg/L)	2	25	25	25	25	25	0
Cadmium (µg/L)	12	0.05	0.5	0.05	0.5	0.096	0.13
Calcium (mg/L)	67	6.1	21	6.4	15	9.5	2.6
Chlorate (µg/L)	103	10	4761	32	2289	602	777
Chlorate^ (µg/L)	2	622	849	622	849	736	160
Chlorite (µg/L)	103	2.5	32	5	25	8.1	5.8
Chlorite^ (µg/L)	2	25	25	25	25	25	0
Chromium (µg/L)	12	0.05	0.5	0.05	0.5	0.11	0.13
Colour - True (TCU)	98	0.5	10	0.5	4.1	1.2	1.4
Conductivity (µS/cm)	433	97	917	184	376	262	64
Copper (µg/L)	12	0.5	3.4	0.5	3.4	1.5	0.98
Dissolved Oxygen (% Sat)	86	34	116	65	106	89	12
E. coli (MPN/100mL)	821	0	1	0	0	0.0012	0.035
Fluorene (µg/L)	19	0.00005	0.00005	0.00005	0.00005	0.00005	0
Formaldehyde (mg/L)	39	0.05	0.05	0.05	0.05	0.05	0
Free Chlorine Residual (Client tested) (mg/L)	668	0.03	5.8	0.18	2.7	1.2	0.93
Free Chlorine Residual (mg/L)	155	0.05	8.8	0.28	2	1.1	0.87
Gross alpha (Bq/L)	10	0.025	0.025	0.025	0.025	0.025	0
Gross beta (Bq/L)	10	0.05	0.14	0.05	0.14	0.059	0.028
Hardness - Temporary (mg/L)	88	28	230	36	99	60	26
Hardness (mg/L)	96	23	80	28	74	41	12
Iodide (µg/L)	6	10	10	10	10	10	0
Iron (µg/L)	159	1	134	1	16	4.5	12
Lead (µg/L)	17	0.25	0.5	0.25	0.5	0.29	0.098

	# OF SAMPLES	MIN.	MAX.	5TH %TILE	95TH %TILE	MEAN	STD. DEVIATION
Magnesium (mg/L)	67	2.2	7.9	2.3	5	3.8	0.88
Manganese (µg/L)	159	0.5	233	0.5	127	17	41
Mercury (µg/L)	17	0.025	0.25	0.025	0.25	0.22	0.074
Molybdenum (µg/L)	4	0.5	0.5	0.5	0.5	0.5	0
Nickel (µg/L)	12	0.25	0.5	0.25	0.5	0.27	0.072
Nitrate (mg/L)	97	0.0075	2.7	0.0075	0.97	0.33	0.36
Nitrite (mg/L)	97	0.002	0.2	0.002	0.2	0.065	0.093
pH (Client tested) (pH unit)	668	6.9	8	7.2	7.9	7.5	0.21
pH (pH unit)	155	6.6	8	7.1	7.7	7.4	0.2
Residual Alkalinity (mg/L)	56	0.05	0.05	0.05	0.05	0.05	0
Selenium (µg/L)	17	0.5	2.5	0.5	2.5	2.2	0.7
Silver (µg/L)	4	0.05	0.5	0.05	0.5	0.16	0.23
Sulphide (mg/L)	27	0.0025	1	0.0025	0.61	0.04	0.19
Tin (µg/L)	4	0.5	0.85	0.5	0.85	0.59	0.17
Total Dissolved Solids (mg/L)	433	58	550	110	226	157	38
Trihalomethanes (Total) (µg/L)	155	2.5	341	29	213	105	61
Trihalomethanes (Total)^ (µg/L)	53	0.5	458	4.9	251	80	79
Turbidity (Client tested) (NTU)	298	0.05	1.9	0.05	0.8	0.24	0.25
Turbidity (NTU)	114	0.05	2.1	0.05	1.1	0.41	0.31
Uranium (µg/L)	4	0.25	0.5	0.25	0.5	0.31	0.13
Zinc (µg/L)	12	0.5	13	0.5	13	4.1	3.5

CUSTOMER COMPLAINTS

There were three (3) customer complaints in FY 22/23 mostly relating to milky or discoloured water. This was also reflected in the incident reported in the same period. Historically there were only few customer complaints totalling three (3) between 2017 and 2021 (see Table 117), all relating to discoloured water.

Table 117 Summary of Customer Complaints - St Lawrence

Year	No of Water Quality Complaints	Main Reasons for Complaints	Likely Sources / Causes of Problems	Resolution of Problem
2017-18	2	Discoloured water	No information recorded to indicate the cause of complaint.	Localised and mains flushing performed. WTP processes reviewed.
2019-20	1	Discoloured water	Cause of the complaint not known. Samples taken within ADWG	Localised and mains flushing performed.

INCIDENTS

There were twelve (12) incidents reported in St Lawrence between 2017-2023. Most related to turbidity, manganese and THMs.

Table 118 Summary of Incidents in St Lawrence (2017-2023)

INCIDENT DATE	Date/ Reference	Location	Parameter	Description of event	Improvement
07/03/2018	-	Network	THM (0.275 mg/L)		
05/05/2021	DWI-486-22-09510	Ex-clear well	THM (0.341 mg/L)		Changeover to potassium permanganate for pre-oxidation complete – now being validated
20/04/2022	DWI-486-22-09591	Treated water	Manganese (0.572 mg/L)	There was an increase in raw water manganese and the potassium permanganate dosing was not increased adequately. A calculation tool for the minimum potassium permanganate dose was introduced.	The flowrate was decreased, and the potassium permanganate solution was reduced to 0.5% to improve the reaction. Capital improvements planned for filter media, online turbidity meters and chemical dosing.
10/05/2022	DWI-486-22-09613	Raw water	Pipe break	The raw water supply pipe to the treatment plants failed and access for repairs was not possible for an extended period due to the wet ground.	Drinking water was brought in via tanker, supplied into the treated water reservoir. Capital improvements will replace the raw water supply line.
18/05/2022	NA	*Treated Water*	*Turbidity (1.2 NTU)*	*Treated water turbidity was measured at 1.2 NTU against a limit in IRC DWQMP of 1 NTU*	*Internal reporting Configuration of automated breach emails*
26/06/2022	DWI-486-22-09665	Network	Turbidity (83.9 NTU)	Elevated chlorine in the treated water mobilised manganese in the network pipes. The network was flushed, and chlorine returned to target limits	Operational awareness of upper limits of CCPs. Capital improvements planned for online analyser for chlorine measurement with automated shutdown. Scouring of the network pipelines has been scheduled for 2023.
21/12/2021	DWI-486-21-09397	Treated water	Manganese (0.833 mg/L)	An increase in raw water manganese was not detected. An investigation highlighted the test method utilised at the time did not identify elevated residual manganese. Subsequently the raw water was determined to be too variable for the water treatment plant capability	Drinking water was brought in via tanker, supplied into the treated water reservoir
21/12/2021	NA	*Network*	*Free chlorine (0.09 mg/L)*	*A network sample in St Lawrence measured less than 0.2 mg/L free chlorine, the lower limit nominated within IRC DWQMP.*	*Internal reporting Configuration of automated breach emails*
29/12/2021	NA	*Network*	*Free chlorine (0.15 mg/L)*	*A network sample in St Lawrence measured less than 0.2 mg/L free chlorine, the lower limit nominated within IRC DWQMP.*	*Internal reporting Configuration of automated breach emails*
15/12/2021	NA	*Network*	*Free chlorine (0.14 mg/L)*	*A network sample in St Lawrence measured less than 0.2 mg/L free chlorine, the lower limit nominated within IRC DWQMP.*	*Internal reporting Configuration of automated breach emails*
8/12/2021	NA	*Network*	*Free chlorine (0.12 mg/L)*	*A network sample in St Lawrence measured less than 0.2 mg/L free chlorine, the lower limit nominated within IRC DWQMP.*	*Internal reporting Configuration of automated breach emails*
25/06/2023	DWI-486-23-10315	Treated water	Turbidity (1.28 NTU)	Treated water turbidity was measured at 1.28 NTU against the DWQMP CCP critical limit of 1 NTU.	

RISK ASSESSMENT

SCHEME MITIGATED RISK ASSESSMENT

Table 119 Mitigated Risk Assessment - St Lawrence

Ref	Treatment Stage	Primary Hazard	Other hazards managed by barrier	Hazardous Event	Unmitigated Risk	Control Measures in place	Comment	Mitigated Consequence	Mitigated Likelihood	Mitigated Risk	Uncertainty	Improvement Action Required - Immediate	Improvement Action Required ~ 2 years	Improvement Action Required - Long term
STL1	Raw Water Abstraction	Protozoa (Category 4)	Bacteria and virus, turbidity	Normal operation	Extreme 25	Conventional filtration and chlorine disinfection	Cat 4 Tidal flow can enter weir pool	Catastrophic	Possible	High 15	Estimate	Consider ability to install turbidity meter and plant shut down on poor water quality	SCADA upgrades on all treatment plants over 5 years	UV disinfection required over time.
STL2	Raw Water Abstraction	Intake failure	Loss of supply	Flooding of raw water main/ main break.	Medium 5	Class 18 mains in area subject to flooding.	Can tanker into St Lawrence if required.	Major	Unlikely	Medium 8	Confident			
STL3	Whole of system	Fire		Fire impacting treatment plant	High 10	Disaster Management Plan		Catastrophic	Rare	Medium 6	Estimate			
STL4	Chemical Dosing - Potassium permanganate	Manganese - dosing		Overdose of potassium permanganate	High 12	Manually selected dose rate, regular monitoring of treated water.	Single dosing pump Auto shutdown on zero flow No alarms, some variability in manganese, iron and organics.	Moderate	Possible	Medium 9	Reliable	Planning for ~0.5 ML raw water tank to smooth out variability in raw water		
STL5	Chemical Dosing - Potassium permanganate	Manganese surface water		Underdose of potassium permanganate	High 12	Manually selected dose rate, regular monitoring of treated water.	Single dosing pump Auto shutdown on zero flow No alarms, some variability in manganese, iron and organics.	Moderate	Possible	Medium 9	Estimate	Planning for ~0.5 ML raw water tank to smooth out variability in raw water		
STL6	Chemical Dosing - Soda Ash	pH		Overdose of soda ash resulting in high pH to community	Medium 9	Single dosing pump Auto shutdown on zero plant flow	Single dosing pump Auto shutdown on zero flow No alarms, require tight pH control to get effective Mn removal and coagulation. raw water pH ~6.8. Chlorination increases pH.	Moderate	Possible	Medium 9	Reliable			
STL7	Chemical Dosing - Soda Ash	Protozoa (Category 4)	pH, manganese	Underdose of soda ash resulting in coagulation failure	Extreme 25	Single dosing pump Auto shutdown on zero plant flow. Filtration, high dose UV disinfection,	Single dosing pump Auto shutdown on zero flow No alarms, require tight pH control to get effective Mn removal and coagulation	Catastrophic	Possible	High 15	Estimate	Consider ability to install turbidity meter and plant shut down on poor water quality		
STL8	Chemical Dosing - Aluminium Chlorohydrate (ACH)	Protozoa (Category 4)	Turbidity	Underdose of coagulant	Extreme 25	Single dosing pump Auto shutdown on zero plant flow. Filtration, high dose UV disinfection,	All Clear 300. Single dosing pump Auto shutdown on zero flow No alarms	Catastrophic	Possible	High 15	Estimate	Consider ability to install turbidity meter and plant shut down on poor water quality		
STL9	Chemical Dosing - Aluminium Chlorohydrate (ACH)	Aluminium - coagulant	Turbidity	Overdose of coagulant	Medium 6	Single dosing pump Auto shutdown on zero plant flow	All Clear 300. Single dosing pump Auto shutdown on zero flow No alarms. Total aluminium is near 0.2 mg/L, but consistently below.	Minor	Unlikely	Low 4	Reliable			
STL10	Chemical Dosing - Powdered Activated Carbon (PAC)	Taste and odour	Organics, pesticides	Underdose	Medium 8	Dosing of PAC, monitored visually, coagulation and filtration	Single dosing pump Auto shutdown on zero flow No alarms	Minor	Unlikely	Low 4	Reliable			
STL11	Chemical Dosing - Powdered Activated Carbon (PAC)	Turbidity		Overdose of PAC	High 10	Coagulation and filtration	Single dosing pump Auto shutdown on zero flow No alarms, could cause operational issues	Minor	Unlikely	Low 4	Reliable			
STL12	Clarification	Protozoa (Category 4)	Turbidity	Failure of flash mixer	Extreme 25	Regular maintenance. Filtration, high dose UV disinfection,	Visual inspection when plant operating	Catastrophic	Rare	Medium 6	Reliable			
STL13	Filtration - Media filtration	Protozoa (Category 4)	Turbidity	Filter breakthrough	Extreme 25	Daily grab sample when plant operating. Filtration, high dose UV disinfection,	No turbidity meter, level controlled	Catastrophic	Possible	High 15	Estimate	Consider ability to install turbidity meter and plant shut down on poor water quality	SCADA upgrades on all treatment plants over 5 years	UV disinfection required over time.

Ref	Treatment Stage	Primary Hazard	Other hazards managed by barrier	Hazardous Event	Unmitigated Risk	Control Measures in place	Comment	Mitigated Consequence	Mitigated Likelihood	Mitigated Risk	Uncertainty	Improvement Action Required - Immediate	Improvement Action Required ~ 2 years	Improvement Action Required - Long term
STL14	Filtration - Media filtration	Protozoa (Category 4)		Poor backwash	Extreme 25	Backwash daily on volume. Filtration, high dose UV disinfection,	No turbidity meter, level controlled	Catastrophic	Possible	High 15	Estimate	Consider ability to install turbidity meter and plant shut down on poor water quality. Manual diversion of ripening water to waste.	SCADA upgrades on all treatment plants over 5 years	UV disinfection required over time.
STL15	Disinfection - calcium hypochlorite	Bacteria/Virus		Failure of chlorine dosing resulting in undisinfected water to community	Extreme 25	Chlorine CCP, daily monitoring.	Manually batched Single dosing pump, spare on site. Typically greater than 2 days of water in final reservoir. Long main to town which would provide CT if there was >0.2 mg/L chlorine in the treated water tank. That is, dosing could fail, but water would be appropriately disinfected for at least 2 days.	Catastrophic	Rare	Medium 6	Estimate		Chlorine meter to be installed, ideally recirculating in clearwater tank, low critical limit to shut plant down.	
STL16	Chemical Dosing - Calcium hypochlorite	Chlorine		Overdose of chlorine	High 12	Manually batched, operational monitoring, and plant inspections.	Batch tank 450 L of 2% solution.	Moderate	Rare	Low 3	Reliable			
STL17	Chemical Dosing - Calcium hypochlorite	DBPs		Reaction of chlorine with organics	Medium 9	Now using permanganate instead of prechlorine oxidation. PAC. Singel dosing pump, operator monitoring and plant inspections.	Historical THM issues, but were predosing chlorin.	Moderate	Unlikely	Medium 6	Reliable			
STL18	Chemical Dosing - Calcium hypochlorite	Chlorate		Degradation of calcium hypochlorite	Medium 9	Batch tank 450 L of 2% solution.	Manually batched Single dosing pump	Moderate	Unlikely	Medium 6	Confident			

OPERATIONAL MONITORING

Operational monitoring is undertaken to assess and confirm that individual barriers and preventive strategies for controlling hazards are functioning properly and effectively. Frequencies are based on the risk of each parameter to significantly change. As St Lawrence WTP is not operational every day of the year, the monitoring frequency “daily” is considered as “daily when plant is operational”. For an informed comparison of samples taken and operational days the daily log sheet records whether the plant was operational.

Table 120 St Lawrence Operational Monitoring

PARAMETER	RAW WATER	POST FLASH MIXER	CLARIFIED WATER	FILTERED WATER	CHLORINATED WATER	TREATED WATER	NETWORK WATER
Alkalinity	Weekly					Weekly	
Aluminium			Weekly			Weekly	
pH	Daily	Daily				Daily	Weekly
Free Chlorine					Daily	Daily	Weekly
Temperature	Daily					Daily	Weekly
Tot. Hardness	Weekly					Weekly	
Tot. Iron	Weekly					Weekly	
Sol. Iron	Daily		Weekly				
Tot. Manganese	Weekly					Weekly	Weekly
Sol. Manganese	Daily		Weekly				
True colour	Daily					Daily	Weekly
Turbidity	Daily		Daily	Daily	Daily	Daily	Weekly
Sol. UVA_{254}	Daily		Weekly				

Response to out of specification results for relevant parameters are managed through CCPs, OCPs and QCPs.

Operators check the calibration of online instruments with the results from their lab/benchtop analysis as part of the operational monitoring.

CRITICAL CONTROL POINTS

CRITICAL CONTROL POINTS

The critical control points (CCPs) for the scheme were identified in the risk assessment process, and include:

- Filtration – filtered water turbidity
- Chlorination – treated water free chlorine

The CCP procedures are included in the following pages. These are presented as traffic lights and identify the location, monitoring, performance, and validation of the process. The traffic lights are aligned to SCADA where the low and high limits match the adjustment level and (as appropriate) the high-high and low-low alarms match the critical limit.

OPERATIONAL CONTROL POINTS

St Lawrence WTP has four (4) operational control points (OCPs) for the following processes.

- Oxidation – treated water total manganese
- Coagulation – clarified water turbidity
- Chlorination – chlorinated water free chlorine
- Disinfection – treated water pH

An OCP exceedance is generally not reportable to the regulator except if it is an event that requires reporting (such as failure in coagulation, noted by clarified water turbidity >5 NTU). Incident reporting to the regulator is based on CCPs or exceedances of ADWG health guidelines.

QUALITY CONTROL POINTS

St Lawrence WTP has three (3) quality control points (QCPs) for the following processes.

- Oxidation (Potassium Permanganate) – clarified water, soluble iron, manganese, and UVA
- Coagulation – dosed water, post floc zone pH
- Coagulation – clarified water aluminium

The CCPs, OCPs and QCPs can be found below.

CRITICAL CONTROL POINT PROCEDURE – ST LAWRENCE

Filtration

What is measured	Where is it measured	When is it measured	What is the control point	What are the hazards	Record Keeping
Turbidity	Grab sample post filtration	Daily	Filtration	Protozoa, turbidity	Operator Log Sheets

Critical Limit
>0.5 NTU

- Confirm result with grab samples
- Breach of CCP is continued supply of water to customers above the Critical Limit
- Operator to contact Supervisor/Coordinator or Manager
- Supervisor/Coordinator or Manager to inform Compliance & IMS team on [redacted]
- If operator unable to contact chain of command, report directly to Compliance & IMS Team
- Compliance & IMS to contact DRDMW on 1300 596 709 as required
- If health advice required, Compliance & IMS or Manager to contact Mackay PHU on 4885 5800

Adjustment Limit
>0.2 NTU

- Check turbidity meter, clean and calibrate to confirm results
- Check raw water turbidity for changes since last dose rate change.
- Check clarified water pH and turbidity and adjust dosing as necessary
- Check coagulation dosing system, drop test to validate dose rate, jar test if required.
- Backwash filters if coagulation process is effective
- Take filter offline if turbidity still above Adjustment Limit after multiple backwashes.
- Rectify any dosing issues and escalate to supervisor/coordinator

Target
<0.2 NTU

- When attending plant, inspect process for any visual signs of process failure
- Test the water as per DWQMP
- Record results
- Check raw water turbidity regularly and adjust coaguation dose rates as required (jar test as required)
- Complete routine cleaning and calibration of online meters
- Check SCADA trend for normal operation
- Ensure backwashes are undertaken and effective

CRITICAL CONTROL POINT PROCEDURE – ST LAWRENCE

Disinfection

What is measured	Where is it measured	When is it measured	What is the control point	What are the hazards	Record Keeping
Free Chlorine	Grab sample from treated water	Daily	Disinfection	Bacteria, viruses, chlorine	Operator Log Sheets

Critical Limit
>3.5 mg/L
<1.2 mg/L

- Confirm result with grab samples
- Operator to contact Supervisor/Coordinator or Manager
- If low chlorine, Supervisor/Coordinator and/or Manager to ensure sufficient chlorine contact time for disinfection with actual operational parameters.
- If water with < 15 mg.min/L is supplied to customers this is a reportable event
- If chlorine is > 5 mg/L this is reportable as an incident
- Supervisor/Coordinator or Manager to inform Compliance & IMS Team on [redacted]
- If operator unable to contact chain of command, report directly to Compliance & IMS Team
- Compliance & IMS to contact DRDMW on 1300 596 709 as required
- If health advice required, Compliance & IMS or Manager to contact Mackay PHU on 4885 5800

Adjustment Limit
>2.7 mg/L
<1.5 mg/L

- Confirm result with grab sample
- Check handheld chlorine meter, clean and calibrate to confirm result
- Check dosing system for any issues or air locks
- Rectify any dosing issues
- Take WTP offline or reduce plant flow as required

Target
>1.5 mg/L
<2.7 mg/L

- When attending plant, inspect process for any visual signs of process failure
- Check chemical stock and make new CaOCl solution as required
- Complete routine calibrations of online instruments to ensure accuracy

Validation: The reservoir has a volume of 300 kL, a minimum operational volume of 65% and is not baffled (Baffle factor 0.1). The maximum flow, assumed from current demand with peaking factor, is 2.6 L/s. Chlorine residual of 1.2 mg/L out of the reservoir achieves 12.5mg.min/L CT. The >4km long pipeline into town offers additional Ct of 41.6 mg.min/L.

Table 121 Operational Control Points - St Lawrence WTP

PROCESS	PARAMETER	WHERE IS IT MEASURED	HAZARD	WHEN IS IT MEASURED	TARGET	ADJUSTMENT LIMIT	ACTION IF ADJUSTMENT LIMIT EXCEEDED	ALERT LIMIT	ACTION IF ALERT LIMIT EXCEEDED	REPORTING
Oxidation	Total Manganese	Treated water	Manganese	Weekly	<0.1 mg/L	>0.1 mg/L	Confirm manganese reading, Check soluble manganese in treated water and free chlorine, Check clarifier total and soluble manganese, Adjust dosing rate	>0.5 mg/L	Confirm manganese reading, Divert the clarifier water, Check permanganate dosing system, Shutdown if uncertain of cause, Check treated water free chlorine, Check network total and soluble manganese, free chlorine and colour, Operator to notify Supervisor/Coordinator/Manager Consider treated water reservoir drain down and network flushing, Assess permanganate dosing through jar testing	Operator to contact Supervisor/Coordinator and/or Manager as total manganese in treated water > 0.5 mg/L is a reportable event. Assess closely related reportables such as effective disinfection, treated water colour and network turbidity.
Coagulation	Turbidity	Clarified Water	Protozoa, Turbidity	Daily	< 1 NTU	> 2 NTU	Confirm turbidity reading, Check raw water turbidity, Check coagulation dosing system, drop test to validate dose rate.	>5 NTU	Confirm turbidity reading, Check dosing system, Adjust dosing rate, Operator to notify Supervisor/Coordinator/Manager	Operator to contact Supervisor/Coordinator and/or Manager as failure to coagulate effectively is a reportable event
Chlorination	Free chlorine	Chlorinated water	Bacteria and viruses	Daily	>1.5 mg/L and <3 mg/L	<1.5 mg/L and >3 mg/L	Confirm free chlorine reading, Check chlorine dosing, Adjust dosing rate and monitor	<1 mg/L Or >3.5 mg/L	Confirm free chlorine reading, Check chlorine dosing, Adjust dosing rate and monitor, Operator to notify Supervisor/Coordinator/Manager	Internal reporting, Further see Disinfection CCP. Confirm CT is adequate
Disinfection	pH	Treated Water	pH, bacteria, and viruses	Daily	>7.2 <7.8	>7.8 <7.2	Confirm pH reading, Check dosing system, Adjust dosing rate	>8 <7.0	Confirm pH reading, Check dosing system, Adjust dosing rate, Operator to notify Supervisor/Coordinator/Manager	Internal reporting, Further see Coagulation OCP and Filtration CCP
OCP EXCEEDANCES ARE GENERALLY NOT REPORTABLE TO THE REGULATOR EXCEPT IF IT IS AN EVENT OR REPORTABLE HEALTH LIMIT										

Table 122 Quality Control Points

PROCESS	PARAMETER	WHERE IS IT MEASURED?	HAZARD	WHEN IS IT MEASURED	TARGET	ACTION IF TARGET LIMIT EXCEEDED	REPORTING
Oxidation Potassium permanganate	Soluble Manganese Soluble Iron Soluble UVA	Clarified water	Manganese and Iron	Weekly	Soluble Mn <0.03 mg/L Soluble Fe <0.05 mg/L Soluble UVA < 0.06	Confirm manganese, iron and UVA readings, Check permanganate dosing system and adjust dosing if required, Assess dosing rate of PAC for organic removal	Operator to notify Supervisor/Coordinator/Manager
Coagulation	pH	Post Floc Zone Post Flash Mixer	Protozoan / Turbidity	Daily	7.4 to 7.6	Confirm pH reading Check coagulation performance, Adjust dosing rate of alkali chemical, Refer to Filtration CCP	Operator to notify Supervisor/Coordinator/Manager
Coagulation	Aluminium	Clarified water	0	Weekly	<0.1 mg/L	Confirm Aluminium reading, Check coagulation performance and adjust dosing if required.	Operator to notify Supervisor/Coordinator/Manager
QCP EXCEEDANCES ARE GENERALLY NOT REPORTABLE TO THE REGULATOR EXCEPT IF THIS RESULTS IN ADWG (HEALTH) OR CCP EXCEEDANCE							

RAW WATER MONITORING

Raw water monitoring in St Lawrence is undertaken based on the principles outlined in the overarching DWQMP.

Table 123 Raw Water Monitoring Parameters

PARAMETER	FREQUENCY
Algal	Seasonally
Radiological	2 – years
Pesticides	Quarterly

VERIFICATION MONITORING

Table 124 Verification Monitoring Parameters

PARAMETER	FREQUENCY	WTP	SAMPLE POINTS IN NETWORK
E.coli	Weekly	No	SP 1
SWA	Monthly	Yes	SP 1
THMs	Quarterly	No	SP 1
Oxyhalides	Quarterly	Yes	SP 1
Metals	Quarterly	Yes	SP 1

VERIFICATION MONITORING LOCATIONS

The monitoring location in St Lawrence is shown in Figure 45 and Table 125. This sample point (SP) is located central in St Lawrence and represents the majority of the water quality provided to St Lawrence's customers. Trihalomethanes (THMs) should be tested at a representative location with the highest water age. Due to the size of St Lawrence the [redacted] can be used for THM monitoring as well.

Table 125 St Lawrence Monitoring Points

SAMPLE POINTS	NETWORK SAMPLING LOCATIONS	COMMENT
1	[redacted]	[redacted]

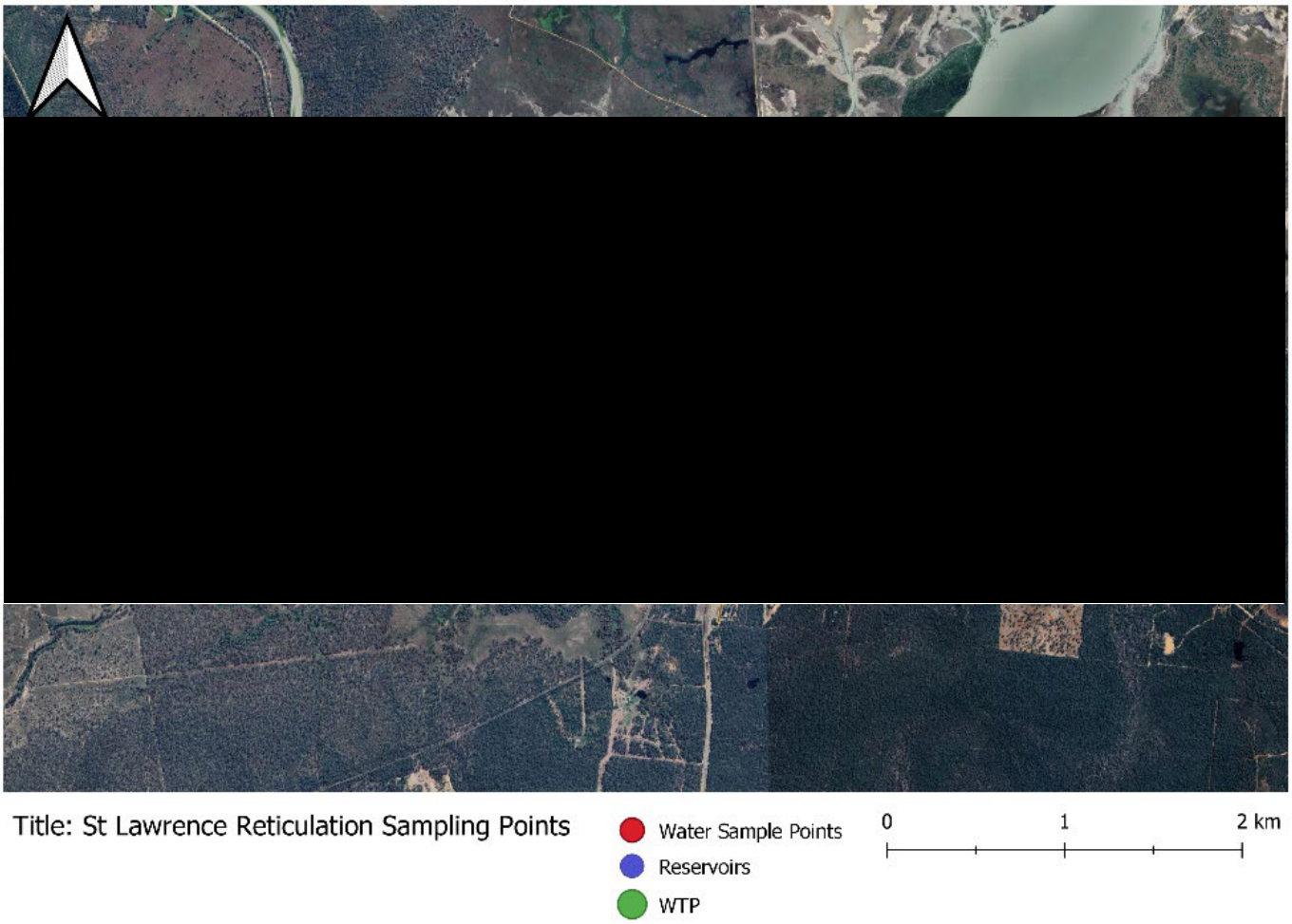


Figure 45 St Lawrence Verification Monitoring Locations

Response to out of specification results

Data from the verification monitoring is accessible via the Mackay Laboratory Monitor Pro Portal. The data is entered into spreadsheet records and the files on the share drive are accessible to all IRC Water and Wastewater Operational Staff. Refer to IRC Overarching DWQMP for Incident and Emergency Management.

APPENDIX 9

DWQMP DOCUMENT REGISTER

Water Treatment Plant Document Register

DOCUMENT NUMBER	DOCUMENT TITLE	TYPE	DATE CREATED	DATE EFFECTIVE	DOCUMENT SET ID	VERSION NUMBER	STATUS
WW-POL-046	Concealed Leak Remission Policy	Policy	29/11/2018	14/12/2022	3657145	3	Endorsed by Council. Resolution No. 8165
WW-POL-108	Water & Waste Service Complaints	Policy	18/11/2020	18/11/2020	3536163	4	In review. Needs to go to ELT 2023
CORP-POL-085	Water and Sewerage Connections and Disconnections Policy	Policy	23/09/2020	23/09/2020	3536127	1	In review. Needs to go to ELT 2023
STAT-POL-033	Water Restrictions Policy	Policy	25/09/2018	25/08/2021	3614119	2	Endorsed by Council 24/08/2021. Resolution No. 7466
WW-POL-084	Water Meter Reading and Billing Policy	Policy	24/06/2020	16/11/2022	4612292	2	Endorsed by Council 16/11/2022. Resolution No. 8123
ADM-POL-036	Disaster and Emergency Management	Policy		20.11.2018	3643301	1	Endorsed by Council 20.11.2018 Resolution No. 5723
WW-PRO-004	Concealed Leak Remission	Procedure		14/12/2022	3559376	5	Endorsed by Council 23/09/2020 Resolution No.8165
WW-PRO-090	Treatment of High Turbid Water During Rain Season at Clermont	Procedure		12/6/20202	4618422	1	Approved by Director W&W
CORP-PRO-090	Consultation and Communication Procedure	Procedure		13/11/2018	3642783	2	Approved
CORP-PRO-037	Harzardous Chemical Management	Procedure		5/02/2019	3660308	1	Approved
CORP-PRO-047	Monitoring & Measurement	Procedure		30/05/2019	4350583	1	Approved
CORP-PRO-064	Non Conformance & Corrective Actions	Procedure		1/05/2019	36830322	1	Approved
CORP-PRO-060	Working Alone or Remotely	Procedure		14/02/2019	3666914	1	Approved

CORP-PRO-050	Compliants Management Process	Procedure		8/09/2017	4585059	2	Approved
CORP-PRO-030	Water Restrictions	Procedure		25/08/2021	4768837	1	Endorsed by Council
CORP-PRO-022	Emergency, Disaster and Business Continuity Management	Procedure		18/10/2022	3610805	6	Approved
CORP-PRO-001	Document Control	Procedure		22/03/2021	3551367	4	Approved
WW-PRO-105	Demand Management Plan	Plan	17/12/2018	19/01/2019	3657237	1	Endorsed by Council 29.01.2020. Resolution No. 5825
WW-PLN-019	System Leakage Management Plan	Plan	22/02/2019	26/03/2019	3677129	1	Endorsed by Council 26.02.2019. Resolution No. 5936
WW-PLN-017	Strategic Asset Management Plan Water & Wastewater	Plan	30/08/2018	25/09/2018	3673131	1	Approved
CORP-MISC-118	Strategic Asset Management Plan	Plan	16/12/2020	16/12/2020	4697419	1	Endorsed by Council 16.12.2020. Resolution No. 7025
WW-PLN-074	Drinking Water Quality Management Plan (DWQMP)	Plan	20.4.2020	14/12/2021	4859276	H	Approved
WW-PLN-066	Drinking Water Blue-Green Algae Management Plan (DWBGAMP)	Plan	24/02/2021	24/02/2021	4704813	1	Endorsed by Council 24.02.2021. Resolution No. 7120
	Traffic Management Plan - Glenden WTP	Plan	29.1.2020	12.1.2023	4561044	2	Approved
	Traffic Management Plan - Dysart WTP	Plan	29.1.2020	6.1.2023	4561043	2	Approved
	Traffic Management Plan - Clermont WTP	Plan	23.1.2020	6.1.2023	4561039	4	Approved
	Traffic Management Plan - Moranbah WTP	Plan	29.1.2020	6.1.2023	4561034	3	Approved
	Traffic Management Plan - Middlemount WTP	Plan	23.1.2020	6.1.2023	4561037	2	Approved
	Traffic Management Plan - St Lawrence WTP	Plan	20.01.2023	20.01.2023	5037654	1	Approved
	Traffic Management Plan - Carmila WTP	Plan	20.01.2023	20.01.2023	5037653	1	Approved

CORP-PLN-021	Emergency and Business Continuity Management Plan	Plan		10/10/2023	3634083	8	Approved
WW-PLN-009	Demand Management Plan Strategy	Strategy	08.08.2018	08.08.2020	3607866	1	Under Review. Endorsed by Council 28.08.2018. Resolution No. 5579
WW-PLN-010	System Leakage Management Plan - Strategy	Strategy	29.08.2018	29.08.2020	3607869	1	Under Review Endorsed by Council 26.06.2018. Resolution No. 5446
WW-FLW-030	Breakdown & Maintenance Flowchart	Flowchart	29/09/2018	29/09/2020	3612615	1	Approved
WW-FLW-041	W&WW Operators' Internal Communication Flowchart	Flowchart	23/11/2022	23/11/2024	4778487	2	Approved
WW-FLW-051	Repair Work Order Form Flowchart	Flowchart	31/05/2022	31/05/2024	4932713	1	Approved
WW-FLW-062	Water and Waste Departmental Document Consultation Process Flowchart	Flowchart	6/10/2022	6/10/2024	4994928	1	Approved
WW-WI-103	Calibration of TPS PH Meter	Work Instruction	8/02/2019	8/02/2021	3660135	1	Approved
WW-WI-104	Calibration Testing Fluoride	Work Instruction	8/02/2019	8/02/2021	3660133	1	Approved
WW-WI-105	Change of Water Source Moranbah	Work Instruction	8/02/2019	8/02/2021	3660134	1	Approved
WW-WI-106	Chemical Handling and Storage	Work Instruction	8/02/2019	8/02/2021	3660136	1	Approved
WW-WI-107	Chlorine Gas Connection and Disconnection	Work Instruction	30.6.2020	30.6.2022	3660123	2	Approved
WW-WI-092	Cleaning Backwash Tanks	Work Instruction	8/02/2019	8/02/2021	3660124	1	Approved
WW-WI-093	Cleaning Clarifier Launder Troughs	Work Instruction	8/02/2019	8/02/2021	3660126	1	Approved
WW-WI-094	Cleaning Clarifier	Work Instruction	8/02/2019	8/02/2021	3660122	1	Approved

WW-WI-095	Dam Operations Moranbah	Work Instruction	8/02/2019	8/02/2021	3660121	1	Approved
WW-WI-096	Grit Channel Cleaning	Work Instruction	8/02/2019	8/02/2021	3660125	1	Approved
WW-WI-101	Suspected Overdose of Fluoride	Work Instruction	8/02/2019	8/02/2021	3660132	1	Approved
WW-WI-097	Onsite Laboratory Testing	Work Instruction	8/02/2019	8/02/2021	3660128	1	Approved
WW-WI-098	Liquid Aluminium & Sodium Hydroxide Delivery	Work Instruction	8/02/2019	8/02/2021	3660129	1	Approved
WW-WI-099	Mechanical Electrical Instrumentation Maintenance Scheduling	Work Instruction	8/02/2019	8/02/2021	3660127	1	Approved
WW-WI-100	Ordering and Receiving a shipment of Fluoride	Work Instruction	8/02/2019	8/02/2021	3660130	1	Approved
WW-WI-033	Drinking Water Compliance Sample Process	Work Instruction	31/08/2021	31/08/2023	3616223	2	Approved
WW-WI-012	Camilia WTP Process Workflow	Work Instruction	13.9.2018	13/09/2020	3609406	1	Approved
WW-WI-013	Clermont WTP Process Workflow	Work Instruction	13.9.2018	13/09/2020	3609411	1	Approved
WW-WI-015	Dysart WTP Process Workflow	Work Instruction	13.9.2018	13/09/2020	3609407	1	Approved
WW-WI-017	Glenden WTP Process Workflow	Work Instruction	18.9.2018	18/09/2020	3609409	1	Approved
WW-WI-019	Middlemount WTP Process Workflow	Work Instruction	18.9.2018	18/09/2020	3609414	1	Approved
WW-WI-021	Moranbah WTP Process Workflow	Work Instruction	18.9.2018	18/09/2020	3609416	1	Approved
WW-WI-024	St Lawrence WTP Process Workflow	Work Instruction	18.9.2018	18/09/2020	3609418	1	Approved

WW-WI-127	Weekly Fluoride Switch Check Moranbah WTP	Work Instruction	25.02.2020	25/02/2022	4569816	1	Approved
WW-WI-136	Chlorine Gas Requirements	Work Instruction	30.6.2020	30/06/2022	4620981	1	Approved
WW-WI-135	Use of Self-Contained Breathing Apparatus	Work Instruction	30.6.2020	30/06/2022	4620982	1	Approved
WW-WI-140	Nebo WTP Chlorine Cylinder Changeover	Work Instruction	11.09.2020	11/09/2022	4658769	1	Approved
WW-WI-141	Nebo WTP Air Compressor Maintenance	Work Instruction	11.09.2020	11/09/2022	4658767	1	Approved
WW-WI-142	Nebo WTP Air Valve Maintenance	Work Instruction	11.09.2020	11/09/2022	4658762	1	Approved
WW-WI-143	Nebo WTP Bulk Salt Handling	Work Instruction	11.09.2020	11/09/2022	4658763	1	Approved
WW-WI-144	Nebo WTP Bulk Sodium Hydroxide Handling	Work Instruction	11.09.2020	11/09/2022	4658761	1	Approved
WW-WI-145	Nebo WTP Chemical Delivery	Work Instruction	11.09.2020	11/09/2022	4658766	1	Approved
WW-WI-146	Nebo WTP Manual Adjustment of Chlorine Dose Rate	Work Instruction	11.09.2020	11/09/2022	4658764	1	Approved
WW-WI-147	Nebo WTP Operator Daily Checks	Work Instruction	11.09.2020	11/09/2022	4658765	1	Approved
WW-WI-148	Nebo WTP Standby Generator Maintenance	Work Instruction	11.09.2020	11/09/2022	4658768	1	Approved
WW-WI-149	Nebo WTP Analyser Maintenance	Work Instruction	25.02.2021	25/02/2023	4664192	1	Approved
WW-WI-203	W&WW High Risk Works	Work Instruction	25/08/2021	25/08/2023	4818185	1	Approved
WW-WI-207	Carmila Bore Water Level Measurement	Work Instruction	15/09/2021	15/09/2023	4827478	1	Approved

WW-WI-208	St Lawrence Water Level Measurement	Work Instruction	15/09/2021	15/09/2023	4827477	1	Approved
WW-WI-123	Sediment Sample Collection at Theresa Creek Dam	Work Instruction	18/02/2020	18/02/2022		1	Approved
WW-WI-245	Manganese low range test method using Merck reagents in Hach DR3900	Work Instruction	16/12/2022	16/12/2024	5020384	1	Approved
WW-WI-229	Hach EZ Mn and Fe Online Analyser	Work Instruction	28/09/2022	28/09/2024	4989022	1	Approved
WW-WI-248	Maintaining Middlemount Network Free Chlorine During Summer	Work Instruction	1/03/2023	1/03/2025	5047240		Approved
WW-FRM-126	Exemption Application for mobile water tanker to take water out of standpipes during water restrictions	Forms	19/09/2022	19/09/2024	3607637	6	Approved
WW-FRM-137	Application for Exemption Residential & Commercial Users in Water Restrictions	Forms	29/10/2021	29/10/2023	3612542	5	Approved
WW-FRM-300	Water by Standpipe Sales Form	Checklist	13/12/2022	13/12/2024	4569717	3	Approved
CORP-FRM-355	Water & Waste Site Specific Induction Form	Checklist	17/11/2021	17/11/2023	4618423	3	Approved
WW-FRM-365	Water & Wastewater Repair Work Order Form	Checklist	23/08/2022	23/08/2024	4791990	5	Approved
WW-CLT-087	Nebo WTP Weekly Task Checklist	Checklist	1/02/2021	1/02/2023	4676983	2	Approved
WW-CLT-086	Nebo WTP Monthly Task Checklist	Checklist	15/10/2020	15/10/2022	4676982	1	Approved
WW-CLT-112	Carmila WTP Monthly Task Checklist	Checklist	5/08/2021	5/08/2023	4810370	1	Approved
WW-CLT-109	Carmila WTP Weekly Task Checklist	Checklist	5/08/2021	5/08/2023	4810361	1	Approved
WW-CLT-111	St Lawrence WTP Monthly Task Checklist	Checklist	5/08/2021	5/08/2023	4810354	1	Approved

WW-CLT-110	St Lawrence WTP Weekly Task Checklist	Checklist	5/08/2021	5/08/2023	4810363	1	Approved
WW-CLT-119	Theresa Creek Dam Routine Inspection Checklist	Checklist	25/10/2021	25/10/2023	4839998	1	Approved
WW-GDS-093	Water & Wastewater Maintenance & Calibration Guideline	Guideline	28/07/2022	28/07/2024	4349666	3	Approved
WW-GDS-091	Water & Waste Design Process Guideline	Guideline	24/05/2019	24/05/2021	4349635	1	Approved
WW-GDS-064	Carmila Network and WTP Sample Collection Points Guideline	Guideline	12/07/2021	12/07/2023	3850607	2	Approved
WW-GDS-065	St Lawrence WTP and Network Sample Collection Points Guideline	Guideline	12/07/2021	12/07/2023	3850626	2	Approved
WW-GDS-066	Moranbah Water Network Sample Collection Points Guideline	Guideline	30/04/2019	30/04/2021	3850620	1	Approved
WW-GDS-067	Glenden Water Network Sample Collection Points Guideline	Guideline	30/04/2019	30/04/2021	3850614	1	Approved
WW-GDS-068	Clermont Water Network Sample Collections Point Guideline	Guideline	30/04/2019	30/04/2021	3850608	1	Approved
WW-GDS-069	Dysart Water Network Sample Collection Points Guideline	Guideline	30/04/2019	30/04/2021	3850611	1	Approved
WW-GDS-070	Middlemount Water Network Sample Collection Points Guideline	Guideline	30/04/2019	30/04/2021	3850617	1	Approved
WW-GDS-071	Nebo Water Network Sample Collection Points Guideline	Guideline	30/04/2019	30/04/2021	3850624	1	Approved
WW-GDS-074	Moranbah WTP Sample Collection Points Guideline	Guideline	30/04/2019	30/04/2021	3850621	1	Approved
WW-GDS-075	Glenden WTP Sample Collection Points Guideline	Guideline	30/04/2019	30/04/2021	3850615	1	Approved

WW-GDS-076	Clermont WTP Sample Collection Points Guideline	Guideline	30/04/2019	30/04/2021	3850609	1	Approved
WW-GDS-077	Dysart WTP Sample Collection Points Guideline	Guideline	30/04/2019	30/04/2021	3850612	1	Approved
WW-GDS-078	Middlemount WTP Sample Collection Points Guideline	Guideline	30/04/2019	30/04/2021	3850618	1	Approved
WW-GDS-079	Nebo Raw Water Sample Collection Points Guideline	Guideline	30/04/2019	30/04/2021	3850623	1	Approved
CORP-TMP-056	Emergency Management Committee (EMC) Triggers and Activations Response	Guideline		29/08/2022	4827821	2	Approved
CORP-GDS-031	Operational Incident Emergency Notification Guide	Guideline		2023		1	Approved
CORP-GDS-089	PLC Failure - all Water & Wastewater Sites	Guideline	20/02/2020	20/02/2022	4348378	2	Approved
CORP-GDS-090	Power Failure - all Water & Wastewater Sites	Guideline	21/05/2019	23/09/2021	4348379	3	Approved
CORP-GDS-012	Chlorine Gas Emergency Response	Guideline	14/02/2020	14/02/2022	3599664	4	Approved
CORP-GDS-016	Hazardous Substances Spill Response	Guideline		14/10/2022	3599669	3	Approved
CORP-GDS-228	Exposure to Live Electricity Response	Guideline		27/01/2023	5034549	1	Approved
WW-DRW-001	Carmila WTP Process Map	Drawing	12.9.18	12.9.2020	3607740	1	Approved
WW-DRW-002	Clermont WTP Process Map	Drawing	12.9.18	12.9.2020	3607741	1	Approved
WW-DRW-004	Dysart WTP Process Map	Drawing	12.9.18	12.9.2020	3607743	1	Approved
WW-DRW-006	Glenden WTP Process Map	Drawing	12.9.18	12.9.2020	3607745	1	Approved
WW-DRW-008	Middlemount WTP Process Map	Drawing	12.9.18	12.9.2020	3607747	1	Approved
WW-DRW-010	Moranbah WTP Process Map	Drawing	12.9.18	12.9.2020	3607749	1	Approved
WW-DRW-013	St Lawrence WTP Process Map	Drawing	12.9.18	12.9.2020	3607752	1	Approved
	Clermont WTP Hazchem Map PDF	Drawing	5/06/2020	5/06/2022	3681489	4	Approved

	Middlemount WTP Hazchem Map PDF	Drawing	5.6.2020	5.6.2022	3681487	4	Approved
	Dysart WTP Hazchem Map PDF	Drawing	5.6.2020	5.6.2022	3681486	2	Approved
	Glenden WTP Hazchem Map PDF	Drawing	5.6.2020	5.6.2022	3681485	2	Approved
	Moranbah WTP Hazchem Map PDF	Drawing	8.9.2021	8.9.2023	3681484	3	Approved
	St Lawrence WTP Hazchem Map PDF	Drawing	6.2.2019	6.2.2021	3681483	2	Approved
	Nebo WTP Hazchem Map PDF	Drawing	5.6.2020	5.6.2022	4587259	1	Approved
	Carmila WTP Hazchem Map PDF	Drawing	23.4.2019	23.4.2021	3681478	5	Approved
	Water Service Area Map - Moranbah	Drawing	26.09.2017		1408405	1	Endorsed by Council 28.04.2020 Resolution No. 6592
	Water Service Area Map - Clermont	Drawing	26.09.2017		1408411	1	Endorsed by Council 28.04.2020 Resolution No. 6593
	Water Service Area Map - Dysart	Drawing	26.09.2017		1408412	1	Endorsed by Council 28.04.2020 Resolution No. 6594
	Water Service Area Map - Middlemount	Drawing	26.09.2017		1408408	1	Endorsed by Council 28.04.2020 Resolution No. 6595
	Water Service Area Map - St Lawrence	Drawing	26.09.2017		1408409	1	Endorsed by Council 28.04.2020 Resolution No. 6596
	Water Service Area Map - Nebo	Drawing	26.09.2017		1408407	1	Endorsed by Council 28.04.2020 Resolution No. 6597
	Water Service Area Map - Carmila	Drawing	26.09.2017		1408410	1	Endorsed by Council 28.04.2020 Resolution No. 6598