DRINKING WATER QUALITY MANAGEMENT PLAN

2022

Mount Isa City Council

November 2022

Document Control

VERSION	AUTHOR	REVIEWED	APPROVED	DATE
1.0	Viridis Consultants	MICC	MICC	May 2012
1.1	Viridis Consultants	MICC	MICC	November 2012
2.0	Viridis Consultants	MICC	MICC	March 2013
3.0	Viridis Consultants	MICC	MICC	June 2015
4.0	Sean Hinton	Stephen Wagner, Andrea O'Hara, Mike Salmon	Stephen Wagner	June 2017
4.1	Sean Hinton	Michael Lawrence, Stephen Wagner, Andrea O'Hara	Stephen Wagner	August 2017
5.0	Sean Hinton	Michael Lawrence Chris Johnstone	*Feedback provided*	May 2020
5.1	Sean Hinton	Chris Johnstone	Chris Johnstone	July 2020
6.0	Stephen Jewell	Stephen Jewell	Renee Wallace	November 2022
6.1	Stephen Jewell	Stephen Jewell	Stephen Jewell	February 2023
6.2	Stephen Jewell	Stephen Jewell	Stephen Jewell	July 2023

Table of Contents

Document Control 2
Table of Contents 3
List of Figures 5
List of Tables 5
1. Introduction 1
1.1 Scope of the DWQMP 1
1.2 Registered Service Details 1
1.3 Mount Isa City Council 2
2. Commitment to Drinking Water Quality Management 3
2.1 Drinking Water Quality Policy 3
2.2 Regulatory and formal requirements 3
2.2.1 Regulatory scope 3
2.2.2 Employee responsibilities 3
2.2.3 Identifying and communicating regulatory changes 3
2.3 Engaging stakeholders 3
3. Details of Infrastructure for Providing the Service 5
3.1 Mount Isa 5
3.1.1 Catchment characteristics 5
3.1.2 Process and schematic 5
3.1.3 Asset details 6
3.2 Camooweal 11
3.2.1 Overview 11
3.2.2 Catchment characteristics 11
3.2.3 Process and schematic 12
3.2.4 Asset details 13
4. Hazard Analysis and Risk Assessment 15
4.1 Water quality assessment 15
4.1.1 Water quality data review 15
4.1.2 Customer complaints 15

4.2 Risk assessment team 16
4.3 Risk methodology 17
4.4 Risk assessment 18
5. Risk Management 20
5.1 Operational control 20
5.1.1 Existing preventive measures 20
5.1.2 Proposed preventive measures 21
5.1.3 Operation and maintenance procedures 21
5.1.4 Materials and chemicals 22
5.2 Information management 22
6. Incidents and Emergencies 24
6.1 Incident levels 24
6.2 Incident communications 26
6.3 Community notification 27
7. Operational and Verification Monitoring Programs 28
7.1 Sample locations 28
7.2 Operational monitoring 28
7.3 Verification monitoring 30
7.3.1 Laboratory testing 30
7.3.2 Customer complaint monitoring 32
8. Risk Management Improvement Program 33
8.1 Water Supply Regulator Audit 33
8.2 Regular External Audit of DWQMP 33
9. Review and Audit 37
10. References 38
Appendix A Drinking Water Quality Policy 39
Appendix B Legal and Other Requirements Register 41
Appendix C Stakeholder and Communication Register 43
Appendix D Emergency Contacts 45
Appendix E Water Quality Results 2012 – 2022 49
Appendix F Sampling Locations 53

Mount Isa 53
Camooweal 56
Appendix G Risk Management Improvement Plan 57
Appendix H Risk Register 67
Appendix I Maintenance and Operational Procedures 80
Emergency Drinking Water Trailer 80
QR codes 81
Appendix J Emergency Notification Templates 82

List of Figures

Figure 1 - Mount Isa City Council water supplies 2
Figure 2 - Mount Isa distribution system schematic 6
Figure 3 - Mount Isa reticulation 8
Figure 4 - Camooweal schematic 12
Figure 5 - CCP decision tree 21
Figure 6 - Incident and emergency levels 24
Figure 7 - MICC reporting lines 27
Figure 8 - 'Ned Kelly' sampling site 28
Figure 9 - Sampling locations in Mount Isa 53
Figure 10 – Sampling locations in Camooweal 56
Figure 11 - Emergency drinking water trailers 80
Figure 12 - QR code for in-system chlorinator 81
Figure 13 - Do not drink template 82
Figure 14 - E. coli alert template 83

List of Tables

Table 1 - Registered service details 1
Table 2 - Infrastructure details – pipelines 7
Table 3 - Mount Isa reservoir details 9
Table 4 - Bore details 13
Table 5 - Distribution and reticulation details 14
Table 6 - Reservoir storage 14
Table 7 - Risk review team 16
Table 8 - MICC water quality risk matrix 17
Table 9 - Consequence descriptors 17
Table 10 - Likelihood descriptors 18

Table 11 - Uncertainty descriptors 18
Table 12 - Existing preventive measures 23
Table 13 - Incident and emergency levels and descriptors 25
Table 14 - Incident and emergency actions 25
Table 15 - Operational monitoring schedule 29
Table 16 - Operational limits 29
Table 17 - Verification monitoring testing schedule 32
Table 18 - Source water monitoring parameters 32
Table 19 - Additions to Risk Management Improvement Program from 2021 audit 34
Table 20 - Legal and other requirements 41
Table 21 - Stakeholders Register 43
Table 22 - Internal contacts 45
Table 23 - External contacts 46
Table 24 - Sensitive receptors 47
Table 25 - Mount Isa water quality assessment 2012 - 2022 49
Table 26 - Camooweal water quality assessment 2012 - 2022 52
Table 27 - Mount Isa sampling locations – low-level zone 54
Table 28 - Mount Isa sampling locations – Breakaway 54
Table 29 - Mount Isa sampling locations – high-level zone 55
Table 30 – Camooweal sample locations 56
Table 31 – Mount Isa Unmitigated Hazard Assessment 67
Table 32 – Camooweal Unmitigated Hazard Assessment 71
Table 33 – Mount Isa Risk Register 74
Table 34 – Camooweal Risk Register 77
Table 35 – Whole of System Risk Register 79
Table 36 – Existing preventive measures 80

1. Introduction

This Drinking Water Quality Management Plan (DWQMP) is for the potable water schemes managed by Mount Isa City Council (MICC): Mount Isa and Camooweal.

This plan has been developed in accordance with the requirements of Section 93(3) of the Water Supply (Safety and Reliability) Act 2008 (the Act). The DWQMP addresses the content requirement of the Queensland Drinking Water Quality Management Plan Guideline (the Guideline, DNRME 2018).

This plan contains or references the policies, procedures, and registers that are required to maintain drinking water quality for the MICC water supply schemes.

1.1 Scope of the DWQMP

This DWQMP applies to the drinking water distribution service provided by MICC for Mount Isa and the entire supply scheme for Camooweal. MICC is a customer of the Mount Isa Water Board (MIWB) who supplies bulk water to a number of customers in the Mount Isa area, including potable water to MICC.

1.2 Registered Service Details

MICC is registered as a medium service provider, with details as per Table 1.

Table 1 - Registered service details

Service Description	Details	
Service Provider Identification Number (SPID)	91	
Service Provider Name and Contact Details	Mount Isa City Council 23 West Street Mount Isa QLD 4825 Tel: 07 4747 3200 Email: city@mountisa.qld.gov.au	
Schemes that the plan refers to	Mount Isa	Camooweal
Current Connected Population[1]	17,936	236
Future Connected Population (2032)[2]	17,936	236
Current Connections[3]	7,283	86
Current Demand (ML/a)[4]	7,194	129
Future Demand (2032) ML/a[5]	6,475	116

[1] Connected population for Mount Isa and Camooweal is based on the urban centre populations as reported in the latest census (ABS, 2021).
[2] Population estimates based on zero growth for Mount Isa and Camooweal. The latest ABS data shows a decrease for Mount Isa.
[3] Based on 2020-21 SWIM data
[4] Based on 2020-21 SWIM data
[5] Demand forecasts based on current total consumption, with a 10% saving presumed through water efficient appliances and improved water use habits.

1.3 Mount Isa City Council

MICC operates the water supply and sewerage schemes in Mount Isa and Camooweal, in Queensland's northwest (see Figure 1). Mount Isa is approximately equidistant between Brisbane and Darwin. MICC covers an area of 43,310 km2 and has a population of 18,727 (ABS, 2021).

MICC is responsible for the distribution of drinking water to the city of Mount Isa. This water is treated by MIWEB and provided in bulk to the city reservoirs. From here MICC distributes it to customers.

MICC is also responsible for the treatment and distribution of drinking water to Camooweal, a remote township 190 kms northwest of Mount Isa.

Water is pumped from two sub-artesian bores which are then injected with chlorine for disinfection before continuing on to the town reticulation.

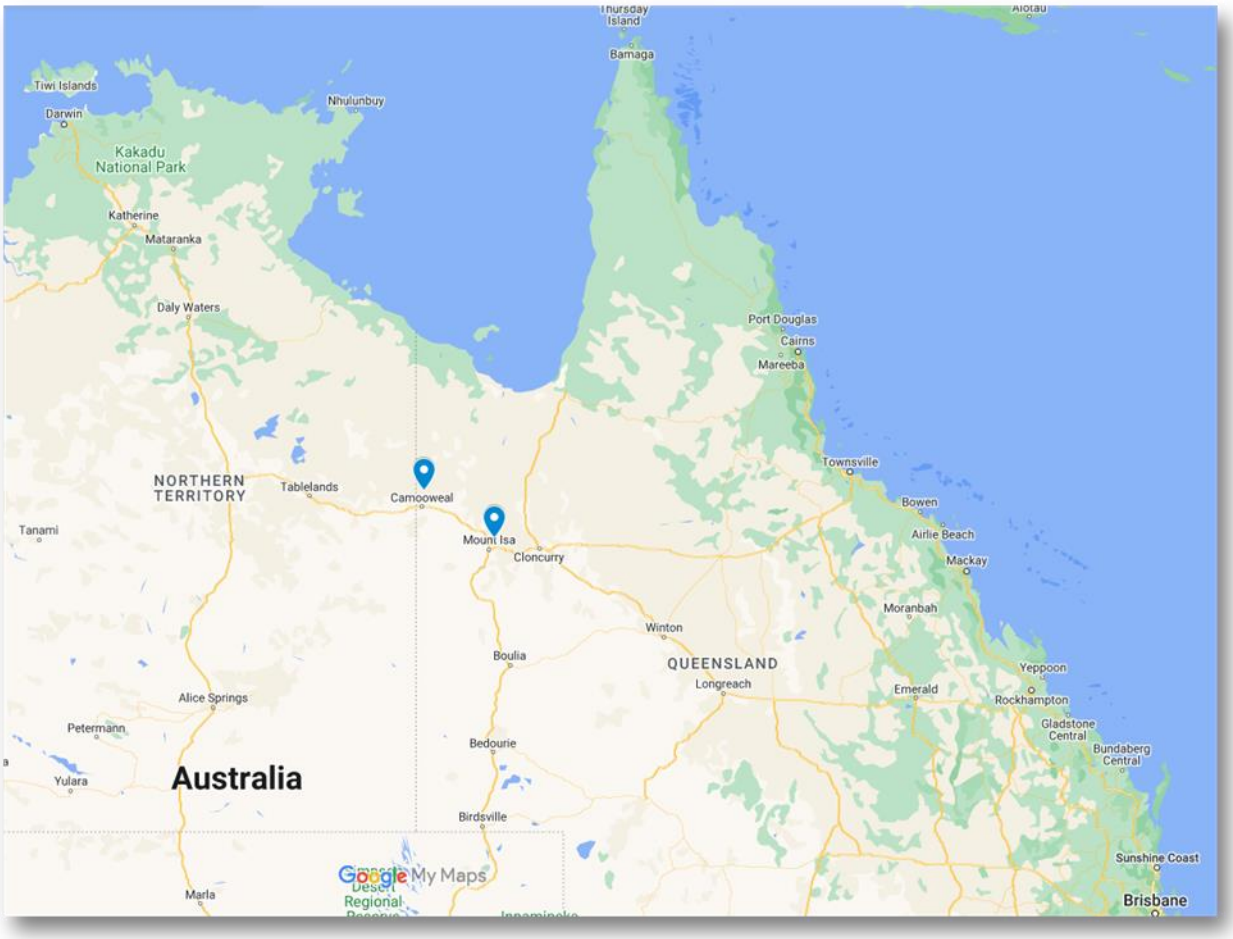


Figure 1 - Mount Isa City Council water supplies

The water and sewerage schemes are a part of MICC's long-term vision of adopting responsible environmental practices and developing a vibrant and healthy community.

2. Commitment to Drinking Water Quality Management

2.1 Drinking Water Quality Policy

MICC has a strong commitment to Drinking Water Quality Management. This is demonstrated by the Water Quality Policy, which is attached as Appendix A.

This policy has been communicated to all staff and is available in hardcopy to employees and in digital format on MICC's web site.

2.2 Regulatory and formal requirements

2.2.1 Regulatory scope

Details of relevant regulatory and other formal requirements relevant to MICC in addition to the Act are provided in the Legal and Other Requirements Register in Appendix B.

2.2.2 Employee responsibilities

The Manager Water and Sewer is responsible for coordinating the implementation of the DWQMP.

Other employees with responsibilities directly related to water quality management have those requirements relevant to their position reflected in their Position Description.

The Drinking Water Quality Policy provides a commitment to ensure that managers, employees and contractors are aware of their responsibility to implement this plan. This DWQMP states where there are relevant responsibilities.

2.2.3 Identifying and communicating regulatory changes

It is the responsibility of the Manager Water and Sewer to ensure regulatory compliance.

Changes to legislation and formal requirements are identified by notification from the Department of Regional Development, Manufacturing and Water. Changes to the Legal and Other Requirements Register are made accordingly.

If a change in legislation requires a change in practice, the owner of the relevant procedure is notified, and changes are made accordingly.

Any changes to this DWQMP due to regulatory and formal requirements are communicated to relevant managers, employees and contractors.

2.3 Engaging stakeholders

Stakeholders are any entity that could possibly increase/decrease water quality risks. Several aspects of drinking water quality management require involvement with other agencies and stakeholders.

Similarly, consultation with relevant health and other regulatory authorities is necessary for establishing many elements of a DWQMP, such as monitoring and reporting requirements, emergency response plans and communication strategies. This means establishing two-way communication paths with State Government Departments, MICC's customers, contractors and providers.

A Stakeholder and Communication Register has been developed (Appendix C), which identifies all stakeholders who could affect, or be affected by decisions or activities of MICC. The register lists each stakeholder's contact details, their commitment and involvement with water quality, the frequency of communication between parties and the method of communication. This register is maintained as required.

There are a number of stakeholders that are classed as sensitive receptors. These include such customers as the hospital and schools. These customers and their contact details are listed in Appendix D of this document.

3. Details of Infrastructure for Providing the Service

3.1 Mount Isa

To supply the city of Mount Isa, MICC receives treated water from MIWB before distributing to its approximately 18,000 consumers.

Water for the Mount Isa scheme is obtained from two storages – Lake Julius and Lake Moondarra – both on the Leichhardt River to the north of the city. Lake Moondarra is the primary source of water, with Lake Julius providing a backup supply. Lake Julius transfers water to the Clear Water Lagoon at Lake Moondarra when Lake Moondarra falls below 25% of FSL.

Water is pumped from Lake Moondarra by MIWB, treated (membrane filtration) and disinfected (chlorinated) before being supplied to Mount Isa City Council. From there, MICC is responsible for the distribution system and monitoring and maintain potable water quality throughout the network.

3.1.1 Catchment characteristics

MICC receives bulk treated water from MIWB hence details of the catchment are not described in this report. The catchment and treatment are managed by MIWB and not within the jurisdiction of MICC. Lake Julius is a remote lake that, although unprotected, has few water quality issues other than seasonal algal blooms.

Lake Moondarra has direct cattle access to the Lake and some recreational activities. Lake Moondarra is also periodically impacted by algae. Water is generally only sourced from Lake Julius when Lake Moondarra drops below 25% of FSL, although it can also be used if algal blooms in Lake Moondarra are impacting water quality.

Water is then transferred through Clear Water Lagoon. Algal blooms within Clear Water Lagoon resulted in MIWB introducing membrane filtration in 2016, which has dramatically improved the water quality delivered to MICC. Refer to the MIWB DWQMP for a detailed overview of the catchments.

3.1.2 Process and schematic

The distribution system is divided into a high-level zone serving the development on the hills in the south and east, and a low-level zone serving development in the north and central parts of the city. The two zones have separate supply mains from Mount Isa Terminal Reservoir (MITR) and reservoirs. The mains in each zone are interconnected at several locations but are normally isolated to prevent flow between zones.

Pumps at the interconnection points between the two zones were originally provided to boost flows from the low-level zone to the high-level zone. The subsequent construction of the separate supply from the MITR to the high-level service reservoirs has obviated the need for the booster pumps. These booster pumps have not been operated for over twenty years and are now obsolete and no longer in service. They are not shown in the schematic.

Reservoirs are equipped with permanent chlorine dosing facilities. An additional two chlorinators were installed in 2021. One was installed on the southern fringe of town, to try and improve the chlorine residuals in the Old Mica Creek Road area. The other was installed on the northern edge of town, to provide effective disinfection to the Ryan Road industrial area and the Moondarra Caravan Park.

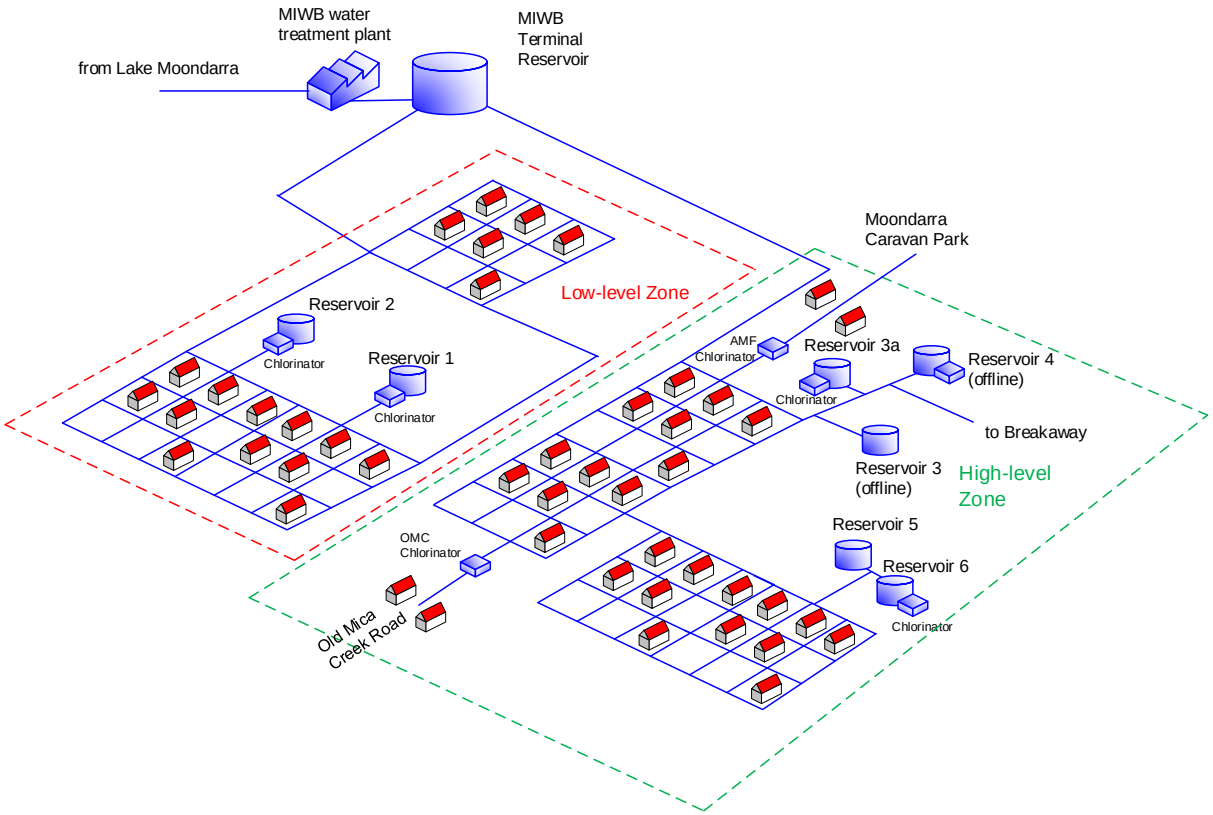


Figure 2 - Mount Isa distribution system schematic

3.1.3 Asset details

Comprehensive asset information was compiled in 2017 for the draft Long Term Asset Management Plan. This information has been updated and reviewed, and the current information used for the asset summaries provided below.

3.1.3.1 Pipelines

There are 206.6 kms of water mains in Mount Isa. Details of the pipeline assets are shown in Table 2.

A large portion of the reticulation was constructed in the 1960s at a time when asbestos cement pipes were used in this type of network. The performance of asbestos cement pressure pipes has proven to be variable, and it is predominantly asbestos cement pipes that break.

Failure rates are low though, with only 1-2 breaks a month on average. The majority of failures in the system are ferrule and services.

Pipe renewal has concentrated on replacing asbestos cement pipes in the Soldiers Hill area. Despite the low breakage rates these pipes represent the highest breakage risk and are the oldest pipes in the system.

Table 2 - Infrastructure details – pipelines[6]

Distribution System		
Pipe material	asbestos cement	12.71 kms (6.2%)
	cast iron cement-lined	0.38 kms (0.2%)
	ductile iron cement-lined	12.73 kms (6.2%)
	polyethylene	2.46 kms (1.2%),
	PVC	178.29 kms (86.3%)
Pipe diameter	<100 mm	6.73 kms (3.3%)
	100 mm	98.48 kms (47.7%)
	150 mm	47.85 kms (23.2%)
	200 mm	10.96 kms (5.3%)
	250 mm	10.57 kms (5.1%)
	300 mm	10.08 kms (4.9%)
	>300 mm	21.89 kms (10.6%)
Age range	1960-present (majority 1960s)	
Approx. total length	206.6 kms	

3.1.3.2 Areas with long detention times

Mount Isa has a very elongated reticulation network, with the reservoirs located near the centre (low-level zone) and near the eastern edge (high-level zone). Areas to the far south and the far north of the city are dead ends and can have long detention times.

Flushing has proved inadequate to maintain residual disinfection in these areas. Two small booster chlorinators have been installed in the reticulation at the edges of the residential areas to try and maintain a residual in these areas.

[6] Lengths correct as at 7 November 2022.

Figure 3 - Mount Isa reticulation

All of the reservoirs have a common inlet and outlet pipe so water could potentially become aged within the reservoir. This has been overcome in the short term by the installation of mixers. All on-line reservoirs have a mixer installed.

The issue of the common inlet outlet is being addressed via a longer-term project, which also seeks to uncouple the delivery lines from the reticulation.

In the high-level zone, reservoirs 3, 3A and 4, and reservoir 5 and 6, will be operated as two groups. Reservoirs 1 and 2, servicing the low-level zone, are too widely separated to effectively operate in unison.

At present each operates individually, each is separately chlorinated, and each has a single inlet-outlet. The proposal is to gang these reservoirs, and to feed into the first reservoir, and out of the last reservoir, in order to obtain consistent turnover rates. The operating level can be adjusted as necessary to balance the storage with the turnover.

3.1.3.3 Storages

Water supplied from the MITR travels via two separate trunk mains. These trunk mains are interconnected to the reticulation, so water is distributed to reticulation before reaching the reservoirs.

The reservoirs serve as storage and provide pressure. There are seven reservoirs in total and it is estimated that there is in excess of a day's storage of water, as detailed in Table 3.

The Low Zone water supply contains Reservoirs 1 and 2 and is controlled by a level sensor in Reservoir 2. MIWB's control system operates the MITR pumps based on these settings.

The top water level in Reservoir 2 is lower than Reservoir 1. A hydraulic valve controls the level of Reservoir 2 to prevent it overflowing. This inlet valve shuts when the reservoir reaches full level and opens again when water drops to the designated low level.

The High Zone has Reservoirs 3, 3A, 4, 5 and 6, which all have the same Top Water Level (TWL). Water is distributed evenly to each of the reservoirs and is controlled by the high and low levels of Reservoir 4.

Reservoirs 3, 3A and 4 have a common inlet/outlet, which is not ideal for mixing and may increase water age. Reservoirs 1 and 2 operate similarly. All these reservoirs 'float on the system', only supplying water into town when the MIWB pumps are not operating.

Reservoirs 5 and 6 have separate inlet and outlet pipes which provides for more even distribution of the stored water. Mixers are now installed in all active reservoirs.

The reservoirs are fitted with metal sheeting roofs with box gutters to catch run-off, except for reservoir 3A which has a pitched roof that directs water to the edge, from where it cascades to the ground away from the reservoir. The box gutters in the other reservoirs are welded to the overflow pipe inside the reservoir, and roof water discharges to a stormwater drain.

Table 3 - Mount Isa reservoir details

Details	Res 1	Res 2	Res 3	Res 3A	Res 4	Res 5	Res 6
Capacity (ML)	7.7	8.5	6.8	7.0	9.1	1.1	1.25
Elevation (m)	382	375	400	398	405	405	406
Diameter (m)	37.8	32.1	32.1	32.4	36.4	13.8	14.5
Height (m)	7.5	11.2	9.4	9.1	9.4	8.1	8.1
Effective Depth (m)	6.7	9.7	7.9	8.5	7.9	7.3	7.3
Year constructed	1966	1968	1967	2018	1967	1972	2009
Roofed	Y	Y	Y	Y	Y	Y	Y
Vermin-proof	Y	Y	Y	Y	Y	Y	Y
Run-off directed off roof?	Y	Y	Y	Y	Y	Y	Y
Mixer	Y	Y	N	Y	N	Y	Y

Details	Res 1	Res 2	Res 3	Res 3A	Res 4	Res 5	Res 6
Chlorinator	Y[7]	Y	N	Y	Y	N	Y
Operational status	Online	Online	Offline	Online	Offline	Online	Online

3.1.3.4 Disinfection and chemical dosing

Sodium hypochlorite (liquid) is dosed into reservoirs 1, 2, 3a, 4 and 6 on a permanent basis, with automatic injection based on residual chlorine levels in the reservoirs (the residual is set at 0.5 mg/L).

Reservoir 4 is currently off-line. The target residual chlorine to the system is set to 0.5mg/L. Reservoir mixers are installed in reservoirs 1, 2, 3a, 4, 5 and 6.

3.1.3.5 Pump stations

There are two pumps – a large Thompson Lewis pump on Stanley Street and a smaller unit on East Street – each installed with non-return valves. The purpose of these pumps is to transfer water from the low-level zone to the high-level zone in the event of a loss of pressure in the high-level zone.

These pump stations have reportedly not been used since the 1990s and neither operated nor maintained since. These assets are obsolete and will most likely be decommissioned. They are not included in the system schematic.

3.1.3.6 Fittings

Valves are installed to isolate sections of the reticulation network to minimise the impact of pipe failure and facilitate network repairs.

A reflux valve is installed on the main at Buckley Street. This is the boundary between the high-pressure zone and the low-pressure zone. Under normal operation the associated sluice valve is open and the reflux valve is closed by high pressure. If the high-pressure zone loses water, the low-pressure zone can backfeed into the zone, maintaining some supply.

Hydrants are used to draw off water from water mains for fire-fighting purposes, flow testing, scouring pipes to remove sediments and to flush dead ends in the network when required.

Water meters measure the water flow for the purpose of monitoring water usage, water losses and water charges.

[7] Due to be installed in November 2022.

3.2 Camooweal

3.2.1 Overview

Camooweal currently has two reliable sub-artesian bores used as water sources. They were drilled in February 2012. Despite its small population, there is a high per-capita water consumption in Camooweal, at more than 800 L/person/day.

3.2.2 Catchment characteristics

Camooweal is situated 190 km north-west of Mount Isa on the Barkly Tablelands, in a geomorphological area known as the Camooweal karst area. Camooweal is located in a different catchment area to Mount Isa. It lies to the east of the Georgina River and is classed as arid to semi-arid, with some monsoonal influence.

Camooweal receives, on average, just over 400 mm of rainfall across the year most of which occurs during summer. Evaporation exceeds mean rainfall in every month of the year. The vegetation is a mosaic of treeless grasslands and low open savannah woodlands.

The Georgina River groundwater area covers an area of 54,440 km^2. There is no data for water allocation or water use, nor has a sustainable yield for the Georgina groundwater been quantified. However, it is estimated that the present abstraction levels are much less than maximum abstraction possible without any regional depletion of the groundwater resources.

Groundwater resources in the Georgina are contained within four aquifers. These are alluvial, porous rock, fractured rock and carbonate rock aquifers. The carbonate aquifers are important for groundwater resources with the two main ones being the Thorntonia Limestone and the Camooweal Dolomite.

The Camooweal Dolomite is extensive and the depth to the top of the aquifer varies from 64 m to 183 m. Bore yields of up to 7.5 L/s have been recorded however the average is 2 L/s. The two active Camooweal town bores tap into the same aquifer, Camooweal Dolomite at a depth of 76 m.

Groundwater recharge is highly localised and dependent on wet season rainfall events of sufficient intensity to cause surface runoff within the small cave catchment area. The general consensus is that the sub-artesian bore provides consistently good quality water.

The main land use in the area is cattle grazing. Bushfires are common in the areas surrounding Camooweal. A number of activities in the township have the potential, although small, to affect groundwater quality. There is an airstrip located to the north of town, a waste tip east of town, a diesel power station on the eastern side of town that contains three 55 kL diesel tanks and a service station and council machinery depot in the town. The risks from these are related to spills and potential groundwater infiltration.

Residents have septic systems connected to a central effluent collection system. Evaporation ponds, located approximately a kilometre north of the town centre, are used to dispose of the effluent. Water evaporates quickly in the dry heat, however in the winter months, the ponds fill up more rapidly due to the increase in tourists. It is not likely any infiltration occurs

that could affect the water quality of the aquifer. There are no known leakages of septic tanks. Floods in the area have never encroached on the evaporation ponds.

3.2.3 Process and schematic

The bore pumps deliver water which is injected with chlorine for disinfection before either continuing on to the header tanks or straight through to the town reticulation. Chlorination is undertaken using chlorine gas.

The header tanks have a low-level automatic switch which signals the bore pumps on, and a high level shut-off to stop the pumps when full. The bore pumps alternate on a weekly cycle, so each bore supplies the same volume of water to the scheme based on the current pumping rates. There are alarms for pump faults.

The reservoirs have a limited capacity and float on the system. When they reach a low level the bore pump operates, supplying water directly into town. The reservoirs refill when the pumps meet the demand from the town, with the excess water going into the reservoir.

If there is a high demand for water when the reservoir is low and the bore pumps are operating, water can potentially travel directly to town without going via the reservoirs. The required contact time for the nearest consumers is not met under these circumstances. This is being addressed through the installation of a small booster pump and reconfiguration of the reservoir pipework in the current (2022/23) financial year.

There are two large ground tanks in the compound, which are used for irrigation. These tanks are not part of the Camooweal water supply and are not included in the schematic shown in Figure 4.

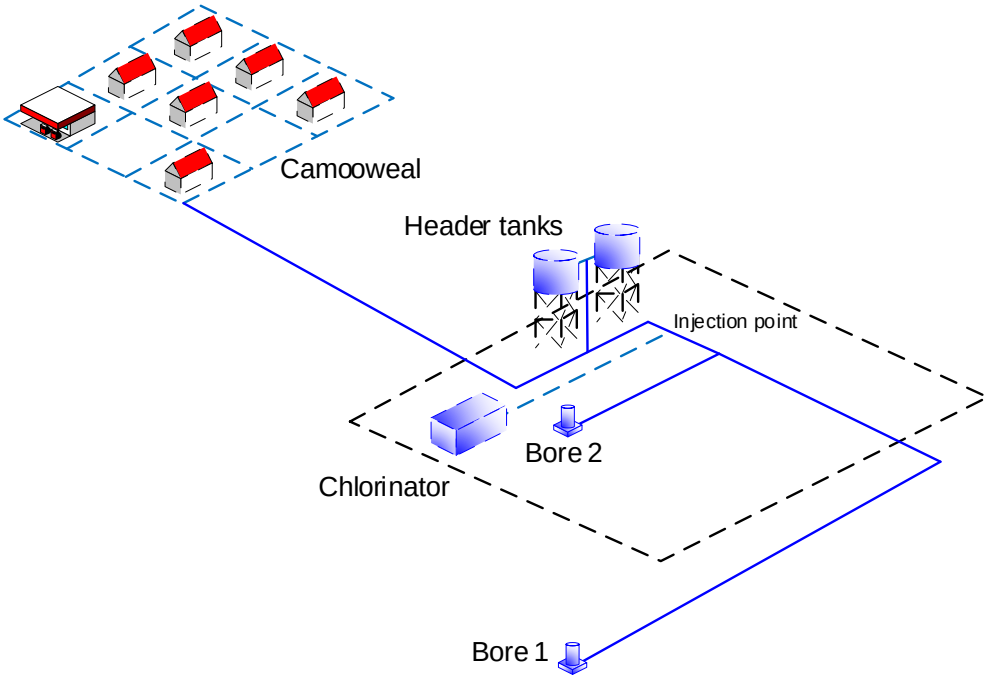


Figure 4 - Camooweal schematic

3.2.4 Asset details

3.2.4.1 Bores and pumps

Bore 1 was drilled by the State government while bore 2 was drilled by Norrie Drilling Services. The bore heads are raised above the ground level to provide protection from surface runoff. Local pooling or flooding is not considered an issue. The pressure pump system is subject to power outages and surges are common in the area. MICC has emergency generators and a mobile bore pump available in the case of power outages. Table 4 contains further details on the bores.

Table 4 - Bore details

Detail	Bore 1	Bore 2
Location	Water Compound	Camooweal Sports Ground
Drilled	2012	2012
Depth	102 m	96 m
Capacity	6 L/sec	6 L/sec
Aquifer	Confined sub-artesian	Confined sub-artesian
Casing depth	102 m	96 m
Material	PVC casing	PVC casing
Age	5 years	5 years
Contamination protection	Boreheads are well raised above ground, with concrete slab around the borehead	

3.2.4.2 Disinfection

A multistage Illawarra pump draws raw water from the main when the bore pump starts. This carrier water is chlorinated using a Prominent chlorinator and is injected back into the main prior to the elevated reservoir.

The chlorine cylinder stands on a set of scales. An alarm is generated when the cylinder nears empty, when it is manually changed over. There are two chlorine cylinders in the storage. Camooweal uses only two cylinders per year. If a complaint is received, then MICC adjusts the chlorine. A telemetry system with online alarms has been installed.

The dosing arrangement is fixed, but the dose rate can be adjusted as required, to ensure a free chlorine concentration of at least 0.2 mg/L is maintained in the reticulation.

3.2.4.3 Pipelines

Camooweal has 4.2 km of mains varying in size from 75 to 150 mm servicing a population of 236 people (see Table 5). It is believed that there are no areas of long detention in the reticulation because some residents leave taps continuously running. This means that there is a continuous turn-over of freshly pumped water and a good turnover in the reservoirs.

However, there are potential dead ends at Austral Street and Nowranie Street. Detention time for chlorination is an issue as the first customers to receive water are approximately 100 metres away from the injection point.

Table 5 - Distribution and reticulation details

Distribution System	Camooweal
Pipe material	MDPE, Steel
Age range	0-10, 70 years
Approx. total length	4.2 km of mains (~50% asbestos cement, ~10% older cast iron cement lined, ~40% newer PVC or polyethylene)
Areas with long detention times	Austral Street and Nowranie Street
Areas with low pressure	None

3.2.4.4 Storages

The details of the storage reservoirs are shown in Table 6Table 1, below.

Table 6 - Reservoir storage

Camooweal	Header Tanks
Capacity (kL)	22 (2 tanks, each ~3.7m diameter and 2.6m high)
Elevation (m)	18
TWL (m)	1.6
Roofed	Y
Vermin-proof	Y
Run-off directed off roof?	Y
Constructed	2009

4. Hazard Analysis and Risk Assessment

4.1 Water quality assessment

4.1.1 Water quality data review

A comprehensive summary of the past 10 years' data is provided in Appendix E.

Note, for Mount Isa, source water refers to the bulk water delivered by MIWB. For raw water quality information please refer to the MIWB DWQMP, or MIWB's DWQMP Annual Reports which are available on their website.

Some notable items are:

Mount Isa

- There have only been two recent detections of E. coli (1 mpn/100mL from a Reservoir 4 sample in March 2020 and 1 mpn/100mL from a Reservoir 2 sample in March 2021). Both failed to be confirmed during a resample.
- Turbidity was historically elevated within the Mount Isa system, however since microfiltration was introduced into MIWB's treatment process, results have significantly dropped.

Camooweal

- Turbidity has been elevated >1NTU in both bores, the header tanks, and the distribution system on infrequent occasions.
- All results have been less than 5 NTU the last five years.
- Hardness and total dissolved solids exceed ADWG aesthetic guidelines.
- THMs have been monitored since 2017 and are consistently very low (maximum result of 24 ug/L).
- Gross alpha and beta (K40 corrected) activity was detectable, but below the screening level outlined in the ADWG. Radioactivity is therefore not a concern.

4.1.2 Customer complaints

The previous two years of customer water quality complaint data were reviewed. No dirty water or taste/odour complaints have been recorded for either Camooweal or Mount Isa.

The rate of customer complaints (less than 1 per 1000 customers per year) is very low. Nevertheless, MICC's complaint management system is being reviewed and upgraded. The recording of complaints is rather haphazard and may not reflect the real level of complaints, albeit very low.

4.2 Risk assessment team

The team listed in Table 7 reviewed the existing risk register and revised the identified hazards and actions. The reviews were carried out on 22 and 28 June, 2022.

Table 7 - Risk review team

Name	Role	Experience
Stephen Jewell	Manager Water and Sewer	Managed various size water supplies and sewerage systems since 1987. Prepared risk management plans for over 40 towns in Victoria as part of the introduction of the Safe Drinking Water Act in 2004.
Shyam Swaminathan	Water and Sewer Engineer	Holds a Masters in environmental engineering, as well as being a qualified civil engineer
Alexandra Murray	Laboratory Technician	3 years' experience in water/wastewater sampling and testing
Adam Kleier	Team Leader Water and Sewer	Qualified plumber with over 10 years' experience operating and maintaining the Mount Isa and Camooweal water supplies
Madeline Marshall	Administration Water and Sewer	4 years' experience reviewing the DWQMP and preparing regulatory reports
Erik Bracchi	Leading Hand Water and Sewer	Qualified plumber with over 10 years' experience operating and maintaining the Mount Isa and Camooweal water supplies
Gary Cullen	Water and Sewer team member	Qualified plumber with over 15 years' experience operating and maintaining the Mount Isa and Camooweal water supplies
Ben Dresman	Sewage Treatment Plant Operator	Over 15 years' experience operating and maintaining the Mount Isa and Camooweal water supplies
Maurice Thompson	Environmental Services Co-ordinator	Over 20 years' experience in environmental management, especially biosecurity and land management
Stephen Richardson	Manager Finance & Information Technology	Over 40 years' experience in risk management and financial risk management
Graham Bebington	Manager Major Projects	Over 30 years' experience as a qualified engineer, including water and sewerage systems in Queensland

4.3 Risk methodology

Any risk that was assessed as high or above was deemed to be significant or unacceptable. Significant maximum risks require adequate risk mitigation to be in place and robust operational procedures. Unacceptable residual risks identify a gap in risk mitigation and require further risk treatments to bring the risk level down to acceptable. It should be noted that all unacceptable residual risks were assigned additional risk treatments, and form part of the Improvement Plan of the DWQMP.

Risk scores are assessed using a likelihood and consequence risk matrix (Table 8). The risk score is the intercept of likelihood and consequence.

Table 8 - MICC water quality risk matrix

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	Medium (E1)	High (E2)	Very High (E3)	Extreme (E4)	Extreme (E5)
Likely	Medium (D1)	High (D2)	Very High (D3)	Extreme (D4)	Extreme (D5)
Possible	Low (C1)	Medium (C2)	High (C3)	Very High (C4)	Extreme (C5)
Unlikely	Low (B1)	Low (B2)	Medium (B3)	High (B4)	Very High (B5)
Rare	Low (A1)	Low (A2)	Low (A3)	Medium (A4)	Medium (A5)

In assessing the risk score, the first step is to determine the consequence of the hazardous event. The consequence categories used are defined in Table 9.

Table 9 - Consequence descriptors

Descriptor	Definition	Example
Insignificant	Insignificant impact, little disruption to normal operation, low increase in normal operation costs	Isolated exceedance of aesthetic parameter with little or no disruption to normal operation
Minor	Minor impact for small population, some manageable operation disruption, some increase in operating costs	Local aesthetic impact or isolated exceedance of chronic health parameter
Moderate	Minor impact for large population, significant modification to normal operation but manageable, operation costs increase, increased monitoring	Widespread aesthetic impact or repeated breach of chronic health parameter
Major	Major impact for small population, systems significantly compromised and abnormal operation if at all, high level of monitoring required	Potential acute health impact, single barrier failure and increased localised risk of pathogen contamination
Catastrophic	Major impact for large population, complete failure of systems	Potential acute health impact, loss of system control and the safety of a widespread area of the supply is compromised

Following the identification of the consequence, the likelihood of that consequence materialising was determined using the likelihood categories defined in Table 10.

Table 10 - Likelihood descriptors

Descriptor	Definition	Example
Rare	May occur only in exceptional circumstances	May occur less than or equal to once every 10 years
Unlikely	Could occur at some time	May occur more often than once every 10 years and up to once every 5 years
Possible	Might occur or should occur at some time	May occur more often than once every 5 years and up to once a year
Likely	Will probably occur in most circumstances	May occur more often than once per year and up to once per month
Almost Certain	Is expected to occur in most circumstances	May occur more often than once per month

Assessing uncertainty provides an indication of the need to undertake further work or gather more data to ensure that the risk assessment is accurate and reliable. This is addressed in risk treatment (improvements), and is included in the Improvement Plan, where relevant.

For each hazard and hazardous event assessment, the level of uncertainty in the assessment was identified using the definitions in Table 11.

Table 11 - Uncertainty descriptors

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

4.4 Risk assessment

To review the risk assessment, the following process was undertaken:

- Water quality hazards and hazardous events were reviewed, and consideration was given to whether any new hazards or hazardous events could be identified
- Maximum risk level was reviewed, and risk scoring re-evaluated (including uncertainty)

- Preventive measures were reviewed, to determine whether they were still relevant and/or if any new preventive measures existed
- Residual risk was reassessed, and risk scoring (including uncertainty) updated where relevant
- Risk management improvement items were identified to address unacceptable risks (see section 8).

The resulting risk registers for Mount Isa and Camooweal are provided in Appendix H.

5. Risk Management

5.1 Operational control

5.1.1 Existing preventive measures

A Critical Control Point (CCP) is defined as an activity, procedure or process at which control can be applied and which is essential to prevent a hazard or reduce it to an acceptable level. Not all activities are amenable to selection as critical control points. A CCP has several operational requirements, including:

- operational parameters that can be measured and for which critical limits can be set to define the operational effectiveness of the activity (e.g. chlorine residuals for disinfection)
- operational parameters that can be monitored frequently enough to reveal any failures in a timely manner (online and continuous monitoring is preferable)
- procedures for corrective action that can be implemented in response to deviation from critical limits.

The determination of CCPs was made using the decision tree in Figure 5 - CCP decision tree.

Preventive measures that manage a hazard with a significant risk were assessed to determine if they were a CCP for that hazard. There could be more than one CCP for a particular hazard. The identified CCPs are recorded in Table 17 overleaf.

CCPs are to be reassessed on the following triggers:

- if there is a significant change to the process
- if the risk assessment is changed
- if the review of CCP identifies the need.

For each identified CCP critical and alert limits were set. The critical limit is the point where, once exceeded, the treatment process is taken to be out of control. This may result in a non-compliant product being supplied, so action must be taken to bring the process back under control. Alert limits are set to raise the alarm before the critical limit is exceeded.

Existing preventive measures including CCPs are described in Appendix I.

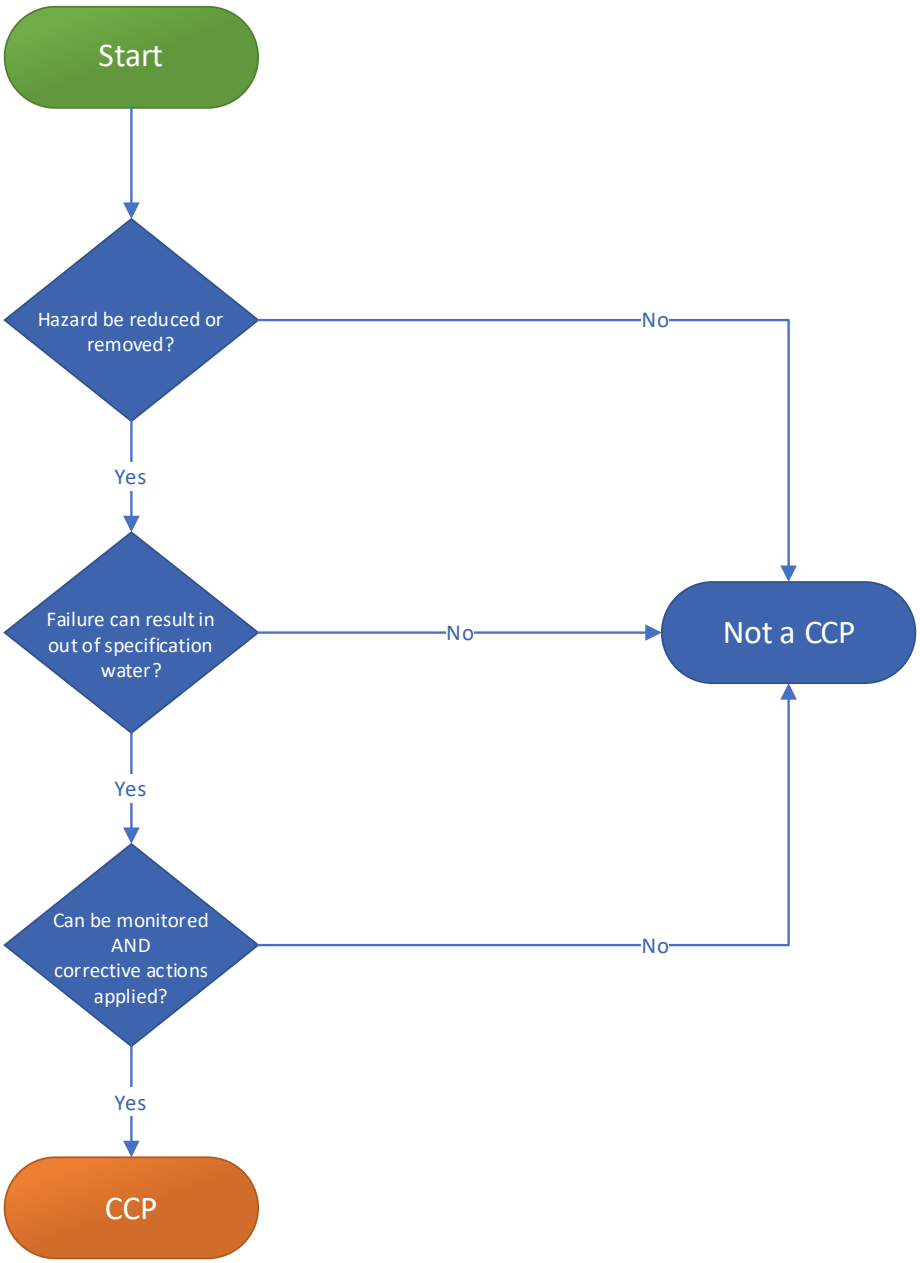


Figure 5 - CCP decision tree

5.1.2 Proposed preventive measures

Proposed preventive measures are included in the risk management improvement plan (see Section 8) along with timeframes and responsibilities for their implementation.

5.1.3 Operation and maintenance procedures

Operational procedures formalise the activities that are essential to ensure the provision of consistently good quality water. Detailed procedures are required for the operation of all processes and activities (both on-going and periodic), including preventive measures, operational monitoring and verification procedures, and maintenance requirements.

MICC has developed several significant standard operating procedures which were identified during the development of the original DWQMP. Water staff have also undergone training on use and implementation of the developed procedures.

The Manager Water and Sewer is responsible for the revision of procedures and documents, if procedures are changed or need to be upgraded.

All operations and maintenance procedures and documents are accessible by operational staff as hard copies available on-site, or via the Internet.

It the responsibility of the Team Leader Water and Sewerage to ensure that the procedures are understood and implemented by operational staff. The Team Leader ensures that procedures are followed and identifies any emerging issues. Staff members are trained in procedures relevant to their role through induction and on the job training.

Appendix I lists the set of procedures which are in place to reduce significant risks.

5.1.4 Materials and chemicals

The selection of materials and chemicals used in water systems is an important consideration as they have the potential to adversely affect drinking water quality.

MICC procures sodium hypochlorite and gaseous chlorine from reputable drinking water chemical providers (e.g. IXOM or Coogee Chemicals).

5.2 Information management

This DWQMP contains and identifies all documents and records that are required for the management of drinking water quality.

All employees receive on-the-job training to ensure that they understand operating procedures, document management and record keeping requirements in accordance with this DWQMP.

The Manager Water and Sewer is responsible for ensuring the periodic revision of procedures. Revisions are prompted when procedures are changed or need to be upgraded. The Team Leader is responsible for ensuring all staff are aware of and implement revised procedures.

MICC's documents and records are stored in a document management system (DMS). Monitoring data is recorded on spreadsheets and an SQL database, as collected.

MICC undertakes daily system backups to ensure the integrity of its corporate data. The risk of cyber security breaches is mitigated through the use of firewalls, antivirus software, web-filtering tools, network alerts, password policy, and the staff onboarding/offboarding process. SCADA is used only for monitoring, not control, and therefore the water supply system itself is not vulnerable to cyber threats.

These measures are detailed in the Cybersecurity Management Plan.

Table 12 - Existing preventive measures

Measure	What	How	Where	When	Who	Target	CCP?	Critical Limit	Corrective Action Procedure
Chlorine residual	Free chlorine	Grab samples	Reticulation and reservoirs	Weekly (monthly in Camooweal)	Laboratory Technician	0.5 mg/L	No	<0.1 or >4.5 mg/L (alert <0.2 or >3.5 mg/L)	Chlorine residual management
		Online monitoring	Chlorinators	Continuous			Yes		
Reservoir inspection	Reservoir integrity	Visual inspection	Reservoirs	6-monthly	Operators	No issues	No	N/A	Reservoir inspection
Flushing	Odour	Sensory	Mains	Following flushing, pipe repairs	Operators	No foul smell	No	N/A	Mains Flushing, Mains Repairs
	Chlorine	Grab samples				0.3-0.5 mg/L		N/A	
	Colour	Visual				Not dirty		N/A	
Plumbing code for backflow connections	Annual tests of backflow devices	Test report	At each individual device	Annually	Plumbing Inspector	Compliance	No	N/A	Improvement Plan
AS/NZS 4020	Assurance that product meets Standard	Specified in contract	N/A	On purchase or receipt	Team Leader	Watermark® compliance	No	N/A	Council policies
On the job training	Competency	Training register through HR, inspection of work	Onsite; human resources	Ongoing	Team Leader	Competency to undertake delegated tasks	No	N/A	Stated in DWQMP
Collar and casing on the bores (Camooweal)	Integrity	Visual inspection	Bores	6-monthly	Operators	No issues	No	N/A	Bore inspection

6. Incidents and Emergencies

Considered and controlled responses to incidents and emergencies that can compromise the safety of water quality are essential for protecting public health, as well as maintaining consumer confidence and the organisation's reputation.

Refer also to Appendix I for details of Council's emergency drinking water trailers.

6.1 Incident levels

Incidents and emergencies within MICC's drinking water schemes are grouped in four levels, with Level 1 being the least severe and complex in relation to response coordination. Figure 6 shows the levels and escalations of drinking water incidents and emergency, and linkages between the levels.

Table 19 describes the situations that would lead to classification against the various incident levels, and Table 20 describes the typical actions that would be undertaken.

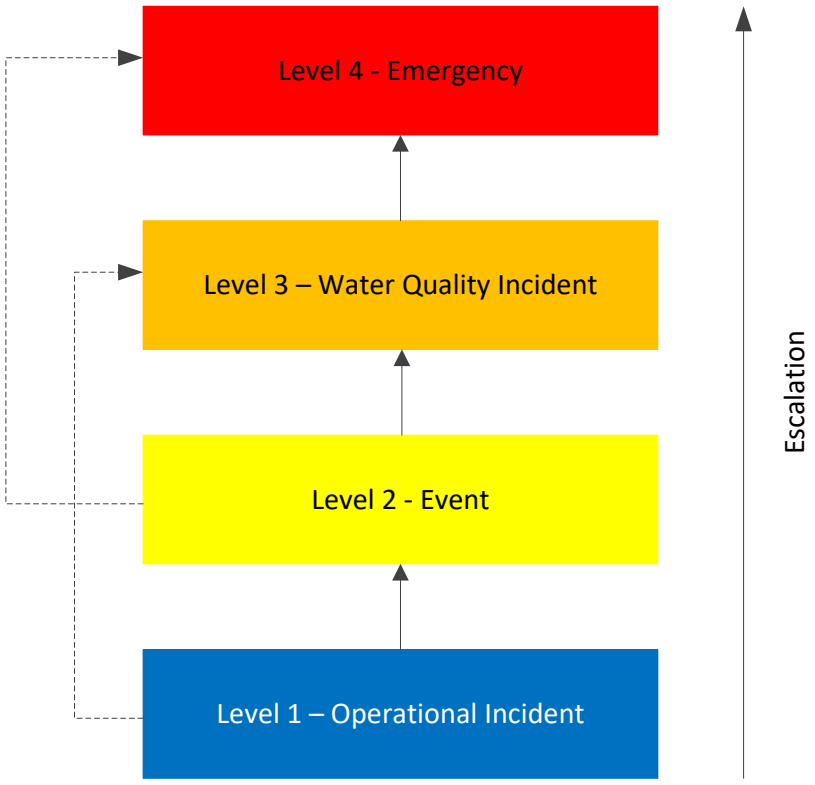


Figure 6 - Incident and emergency levels

Table 13 - Incident and emergency levels and descriptors

Incident/ Emergency Level	Description of Level
Level 1 (Operational incident)	Exceedance of operational limits as per the DWQMP. Includes customer complaints. There is no non-compliance against the water quality criteria to impact public health. Incident is managed within the operations team. The incident is managed in line with the DWQMP without any additional assistance.
Level 2 (Event)	Anything that has happened or is likely to happen, in relation to a drinking water service that may have an adverse effect on public health. Examples include flood, bushfire, contamination of source water, contamination of treated water, major mains breaks, terrorism, cyber-attacks, natural disaster, and treatment failure, including lower critical limit breach for chlorination CCP. Incident may require coordination across the Council departments and external resources and support, such as from DNRME or Queensland Health. It has the potential to create secondary issues more damaging than the actual incident.
Level 3 (Water quality incident)	There is a non-compliance against the water quality criteria (ADWG health guideline values). Includes upper critical limit exceedance for chlorination CCP. May result from escalation of a Level 1 or Level 2 event. Incident is managed within the team responsible for drinking water operations and management in line with the DWQMP. In some cases, it may require coordination across the Council departments and external resources and support, such as from the DNRME or Queensland Health.
Level 4 (Emergency)	There is an outbreak of waterborne disease or declared disaster situation by the Council or state/national government. May result from escalation of Level 2 or Level 3. Requires coordination across the Council departments and is likely to require external resourcing and support from agencies, such as the DNRME, Queensland Health, local disaster management groups, emergency responders QFRS and Police.

Table 14 - Incident and emergency actions

Incident Level	Actions to be taken	Person responsible
Level 1 (Operational incident)	Implement relevant standard operating procedure or the CCP procedure Undertake follow up sampling, as required Review operations and maintenance records for anomalies Commence investigation to determine cause and instigate immediate remediation actions In case of customer complaints, coordinate investigation and resolution, including obtaining water samples where required Ensure all preventive measures identified in the DWQMP are functioning effectively Increase operational monitoring frequency where required Fill in the appropriate form or the CCP reporting form, as required If necessary, conduct de-brief meeting for CCP alert exceedance If turbidity is measured >2.5NTU in Mount Isa and there is concern it is a bulk water quality issue, contact MIWB. Depending on the outcome of discussions, this may become a Level 2 Event.	Team Leader Water and Sewerage

Incident Level	Actions to be taken	Person responsible
Level 2 (Event)	Report incident to Regulator within the required timeframe, and to Queensland Health if MICC believes there may be a risk to public health For Mount Isa scheme - contact MIWB to inform them of the event Ensure all control measures identified in the DWQMP are functioning effectively Commence investigation to determine cause and instigate immediate remediation actions, including isolation of affected area where possible (e.g. if high turbidity in one of the Camooweal bores, isolate bore from service) Consider need to revise water restriction level, as necessary For cyber security breaches, undertake a risk assessment to consider implications of the theft or loss of operational information (if relevant) Follow any directives from Regulator or Queensland Health Drought Management Plan / Significant Service Failure Plan and Disaster Management Plan are on standby if the need arises	Manager Water and Sewer
Level 3 (Water quality incident)	Report incident to Regulator within the required timeframe Mount Isa - contact MIWB to investigate possible problem with bulk supply. If chlorine overdose – refer to CCP procedure. For non-compliance of bulk water supplied by MIWB at point of receipt, immediately notify MIWB and isolate supply if required Initiate follow up sampling, and instigate high-frequency sampling while the incident is being investigated (ideally daily) Review associated laboratory reports and operational records Ensure all control measures identified in the DWQMP are functioning effectively Commence investigation to determine cause and instigate immediate remediation actions, including isolation of affected area where possible Follow any directives from Regulator or Queensland Health regarding risk to public health, need for public warning and corrective actions Consider what community notification or messaging is needed (e.g. do not drink alert or boil water alert) in consultation with Regulator & Queensland Health. Boil Water and Do Not Drink templates are attached in Appendix E. Disaster Management Plan is on standby if the need arises	Manager Water and Sewer
Level 4 (Emergency)	Activate Council's Disaster Management Plan as required and undertake actions as per direction from the Disaster Management Group. Guidance may be taken from the above actions and this DWQMP as necessary.	Director Infrastructure

6.2 Incident communications

Effective communication is vital in managing incidents and emergencies. For water quality incidents of all levels, it will typically be the Manager Water and Sewer responsible for the initial incident classification and co-ordination of response actions (with the exception of Level 4 Emergencies).

Communication and reporting are undertaken as necessary, along the reporting line shown in Figure 7. Other Council staff will be engaged at the appropriate level (for example Communications & Marketing Officer if public notification is required).

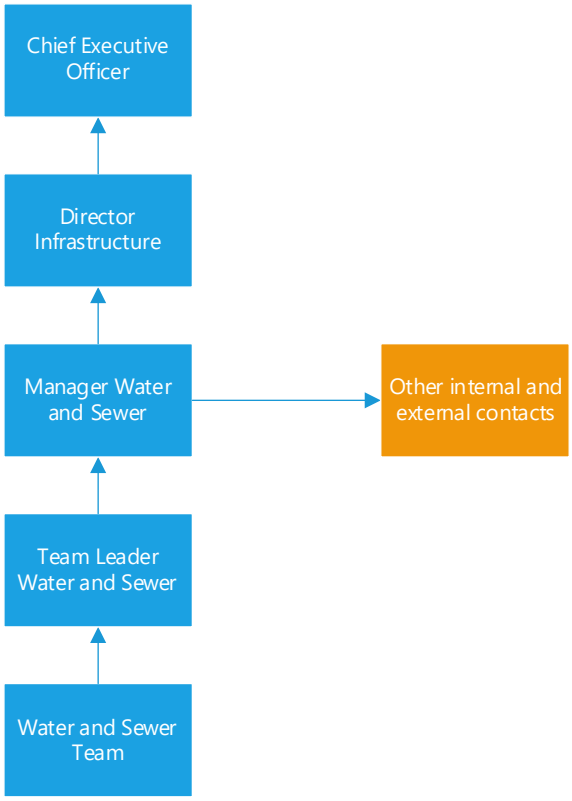


Figure 7 - MICC reporting lines

A contact list of key people, agencies and businesses is kept, to ensure the communication process is effective and efficient. Appendix D lists the key internal and external contacts for a drinking water incident or emergency.

The Team Leader Water and Sewer remains on call to attend to incident and emergency situations as required.

The Director Infrastructure delegates the responsibility for keeping the contacts list updated to Water and Sewer support staff.

6.3 Community notification

During an incident or emergency, MICC's Promotion and Development Coordinator and/or the Chief Executive Officer is the designated person/s to communicate to the community and media, if the need arises.

Community notification of key messages, such as 'boil water notice' (refer Appendix J), will be channelled through the Promotion and Development Coordinator and/or the Chief Executive Officer. The Manager Water and Sewer will consult with the Regulator to determine need for community notification such as boil water notice.

All employees are kept informed of any incident / emergency that requires community notification, as they provide informal points of contact for the community.

7. Operational and Verification Monitoring Programs

7.1 Sample locations

The locations at which operational and verification monitoring samples are collected are shown in Appendix F, along with a description of the sample locations.

The sites shown in Appendix F provide sufficient sample sites to ensure a comprehensive monitoring program. Random sites are selected for each sample run, to ensure that the water quality is effectively monitored across the entire system.

The list of sampling sites may be amended from time to time by adding new sites, or by discontinuing the use of existing sites, should this be deemed necessary. Not all of the sites will necessarily be used, depending on the random site selection and other requirements.

A 'Ned Kelly' installation has been provided at each sampling point, to facilitate sampling. These dedicated sampling points are based on a design by Townsville City Council.

The sampling points are installed in the service line, immediately prior to the water meter.

Figure 8 - 'Ned Kelly' sampling site

7.2 Operational monitoring

A key characteristic of operational monitoring is that it should provide an immediate indication of performance to prompt immediate short-term corrective actions and maintain drinking water quality. Furthermore, monitoring should be conducted with appropriate frequency to reveal any failures and allowing sufficient time to act.

Operational monitoring is detailed in Table 15, and performance criteria for the key parameters is provided in Table 16.

Table 15 - Operational monitoring schedule

Parameter	Mount Isa		Camooweal	
	Terminal Reservoir	Reservoirs	Bores[8]	Header Tank
Free chlorine	Weekly	Weekly	-	Monthly
E. coli	-	-	Monthly	-
Total coliforms	-	-	Monthly	-
HPC	Monthly	Monthly	-	Monthly
pH	Weekly	Weekly	Monthly	Monthly
Turbidity	Weekly	Weekly	Monthly	Monthly

Table 16 - Operational limits

Parameter	Mount Isa		Camooweal	
	Terminal Reservoir	Reservoirs	Bores	Header Tank
Free chlorine (mg/L))		0.2 – 2.0	-	0.2 – 2.0
Free chlorine (mg/L)	0.9			
E. coli (MPN/100mL)	-	-	0	-
HPC (cfu/mL)	>200	200	-	200
pH	6.5 – 8.5	6.5 – 8.5	6.5 – 8.5	6.5 – 8.5
Turbidity (NTU)	2.5	2.5	1.0	1.0

Fixed dose rates generally target 0.3 – 0.5mg/L to avoid overdosing, excess DBP formation, and customer complaints. The adjustment limit remains 0.2mg/L to ensure that low chlorine levels are addressed whenever possible.

Operational limits for turbidity in Mount Isa reflect the fact that MICC is not treating water for pathogen removal, with MIWB providing water treatment. Turbidity results in distribution system samples are generally an aesthetic issue caused by disturbed sediment.

In addition to grab samples, online instrumentation is used for monitoring free chlorine at the installed chlorinators. These instruments are connected to rudimentary SCADA.

[8] Also tested in response to events

7.3 Verification monitoring

Verification of drinking water quality provides an assessment of the overall performance of the system and the ultimate quality of the drinking water being supplied to customers. Verification incorporates monitoring drinking water quality as well as assessment of consumer satisfaction.

7.3.1 Laboratory testing

MICC has its own internal laboratory. located within the grounds of the Sewage Treatment Plant. The testing and sampling procedures are located on-line, and a copy held in a hard copy folder at the laboratory.

Analysis is undertaken using portable laboratory equipment for testing pH, turbidity and chlorine.

E. coli is analysed using a Tecta B16 automated microbiological machine. The Tecta B16 carries out the incubation and numeration of E. coli colonies automatically, notifying the lab technician by email of the total coliform and E. coli results, approx. 10 hours later.

This has removed the need to only conduct sampling from Monday to Thursday, as attendance at the laboratory is no longer required to determine the results. It has also removed the need to carry out the incubation and testing off site, to avoid the possibility of cross-contamination, as the samples are prepared at the sampling point and simply placed in the machine back at the laboratory.

Parameters which cannot be tested in-house (e.g. THMs, metals, pesticides) are sent to an external NATA accredited laboratory. Samples are also sent to the external NATA lab for E. coli analysis once per quarter, for verification of MICC's in house results.

Non-compliances are managed in accordance with standard operating procedures.

Results – including the sample number, date, time and location, and any comments – are recorded in a SQL database with full audit trail and access control.

Table 17 outlines the testing schedule for MICC's verification monitoring, and Table 18 summarises the source water monitoring parameters.

The location of the reticulation monitoring sites referred to in Table 17 are listed in Table 27 through Table 30 (Appendix F) on pp54-56.

As noted on page 28, only a subset of sites will be used in any given week, and not all of the sites may be selected within any twelve-month period. The selection is effectively randomized to ensure that the performance of the whole system is monitored, not fixed points.

Table 17 - Verification monitoring testing schedule

Parameter	Mount Isa			Camooweal	
	Terminal Reservoir	On-line Reservoirs	Reticulation	Bores	Reticulation
E. coli	Weekly	Weekly	Weekly	-	Monthly
Total coliforms	Weekly	Weekly	Weekly	-	Monthly
Free chlorine	Weekly	Weekly	Weekly	-	Monthly
pH	-	Weekly	Weekly	-	Monthly
Turbidity	-	Weekly	Weekly	-	Monthly
THMs	Quarterly	-	Quarterly		Quarterly
Iron	Quarterly	-	Quarterly	-	-
Source– Group 1	Yearly	-	-	Yearly	-
Source – Group 2	5-Yearly	-	-	5-Yearly	-

Table 18 - Source water monitoring parameters

Source Water Monitoring	Parameters		
Group 1 (Annual)	Nitrate Nitrite Aluminium Arsenic Barium Beryllium Boron Cadmium	Chromium Copper Iodide Iron Lead Manganese Mercury Molybdenum	Nickel Selenium Silver Zinc Fluoride Hardness Total Dissolved Solids
Group 2 (5-yearly)	Pesticides	Radionuclides	

7.3.2 Customer complaint monitoring

Monitoring of consumer comments and complaints can provide valuable information on potential problems that may not have been identified by performance monitoring of the water supply system.

Consumer satisfaction with drinking water quality is largely based on a judgment that the aesthetic quality of tap water is 'good', which usually means that it is colourless, free from suspended solids and has no unpleasant taste or odour.

Complaints from the general public go to MICC directly, as the supplier of drinking water to Mount Isa. Any complaints related to the MIWB's operations are forwarded to MIWB for action. All complaints are recorded in Council's CMS.

8. Risk Management Improvement Program

All unacceptable risks are required to be actioned over time to reduce the residual risk level to an acceptable level. Appendix G provides the current Risk Management Improvement Program (RMIP), including the status of all actions.

It is the responsibility of the Manager Water and Sewer to ensure that this document is communicated to relevant employees and operators. The support and commitment of council is essential for the continual improvement of the Council's activities related to drinking water.

All projects will be internally funded through either the Capital Program or the Operations and Maintenance budget, depending on the nature of the project and Council approval.

The progress against the improvement program actions will be recorded by the Administration Officer Water and Sewer. This program is to be reviewed as appropriate and at least annually during the preparation of the DWQMP annual report.

8.1 Water Supply Regulator Audit

An audit was undertaken of the Mount Isa and Camooweal drinking water supplies by the Water Supply Regulator between 26–29 October 2020. The Audit Report and the recommendations from this audit were provided to Council on 4 March 2020.

In response to the recommendations made in the Audit Report, Council provided a work schedule detailing tasks and priorities to rectify the issues noted and further improve Council's drinking water service. The issues were headed by the concerns with the low chlorine residual typically found in the Mount Isa reticulation network.

Quarterly reports on progress against the work schedule were made to the Regulator from July 2021 through to July 2022. Any residual items have been incorporated into the RMIP.

8.2 Regular External Audit of DWQMP

In October 2021, an external auditor conducted an audit of the MICC DWQMP. The final audit report was submitted to the Regulator on 10 December 2021.

There were a number of non-compliances identified, some of which related to the fundamental issue of disinfection. The continued low concentration of chlorine residual in the reticulation system has been an ongoing issue. The auditor noted that he observed a number of demonstrated improvements that have been implemented within the past 12 months to mitigate this issue.

The various opportunities for improvement and non-compliances noted by the auditor have been added to the RMIP.

A summary of the issues found is listed overleaf in Table 19. Full details are provided in Appendix G.

Table 19 - Additions to Risk Management Improvement Program from 2021 audit

Ref#	Action
67	Continue with the plan to add the 34 rotational sites to the sampling plan
68	Ensure that the chlorine residual is above 0.1 mg/L as stated in the DWQMP in both reticulation systems
69	Continue with the completion of the commissioning of the air mixers
70	Consider increasing the minimum residual to 0.2 mg/L in the reticulation systems in alignment with the ADWG
71	Furthermore, consider raising the minimum chlorine residual to 0.5 mg/L to control *Naegleria fowleri* and include it in the next DWQMP revision
72	Discuss with MIWB an increase in the minimum outlet chlorine residual, and include this in the MICC-MIWB Bulk Water Agreement. Alternatively, consider a MICC chlorine injection site at the point of supply.
73	Continue with plans to update the water model in consideration of the abovementioned water age issues.
74	Consider adding the suburb of Breakaway to the testing regime.
75	Move sample locations to the outside of property boundaries
76	Consider alternative sampling taps that are suitable for convenient and secure sampling in alignment with accepted industry practice.
77	Plan and undertake the training of employees to a certificate III level as a minimum appropriate to the type of work the client undertakes.
78	Create a procedure to check that the sample and the testing schedule have been completed by the lab and the results have been checked by the client.
79	Ensure that the filled-out sample submission forms are recorded in the council system upon sending these to the lab.
80	Continue with plans to move across to SWIMLocal.
81	It is suggested that the water sampling be undertaken before the wastewater sampling to further reduce the likelihood of false results.
82	Add all test result documents to MagiQ.
83	Create a procedure for internal reporting of test results and ensure that all test results are carbon copied to at least 2 persons in the MICC water and wastewater department including the manager, and it is suggested that the regulator also be copied in.
84	Ensure that all incidents are closed out in an appropriate timeframe
85	There is an opportunity to add all water quality incidents to the electronic management system in addition to the email system. This may avoid any action issues such as when someone leaves the business or is away.
86	Consider adding field temperature readings for verification sample sites where relevant to enable the client to pick up any seasonal trends in water quality.
87	Ensure that the 2019-2020 annual report is available for customers on the council website.
88	Inspect all reservoir rooves to determine if there are any vermin entry points.
89	Physically remove the Camooweal compound bypass valve, and install blanks to ensure that untreated water cannot leak into the town chlorinated supply

Ref#	Action
90	Update the DWQMP to include the information on the A3 schematic which was found on the wall inside the chlorine room.
91	Ensure that the chlorine instruments are working at Reservoir No.2 and Camooweal.
92	Update the weekly Compliance Sheet and undertake chlorine residual testing at Reservoir 3A whilst Reservoir 4 is offline.
93	Order new HPC tablets and ensure that are ordered in anticipation of their use-by date.
94	Create an instrument calibration register and program.
95	Undertake a regular check of operational calibration record checks to ensure that the instruments are being calibrated regularly and effectively.
96	Consider taking control over the MICCs reservoir assets in terms of water level control by introducing a dedicated inlet main and a separate outlet main.
97	Improve the customer management system to identify and track and close water quality related complaints.
98	Update procedures to include machinery disinfection prior to use in water management situations where cross contamination may be a risk.
99	Undertake extra training such as with WIOA.
100	Ensure that the existing procedures are followed for disinfection and flushing of mains after a repair has occurred, and add a hyperchlorination procedure
101	Investigate if NQWROC has a standard for mains repair protocols. If not introduce your own standard.
102	Create a flushing procedure and program.
103	Add a scenario for water treatment for the next mock emergency practice.
104	A procedure needs to be in place to ensure that all drinking water materials purchased are certified to Australian Standards or are WaterMark approved.
105	Continue with the plan to create a maintenance management system, including a condition inspection program such as that undertaken for a reservoir cleaning program.
106	Consider undertaking the maintenance items raised in this section.
107	Ensure the required documentation is completed by the due dates.
108	Ensure state government correspondence is stored in the client's document management system.
109	Consider having a quarterly meeting to manage all elements of the DWQMP framework.
110	Ensure that staff use the existing procedures and that they demonstrate system management and maintenance by filling out the forms contained in the DOMMs.
111	Ensure required procedures are created and prioritise their creation.
112	Provide training in the use of existing and proposed procedures.
113	Complete all RMIP actions that are outstanding or negotiate with the Regulator a change to the due dates.
114	Include actions from previous audits in the RMIP to ensure these are actioned.
115	Ensure that the DWQMP is accurate in terms of existing procedures.
116	Update the Camooweal schematic.
117	Ensure that the risk assessment includes any risks associated with the attached irrigation system.

Ref#	Action
118	Add the new infrastructure changes to the DWQMP risk assessment.
119	Describe in the next DWQMP and RMIP the proposed reservoir group pipework arrangements that are aimed at ensuring turnover.
120	Continue developing a strategy to resolve the chlorine residual issue.
121	Address the chlorate questions and actions from the 2020 state government audit.

9. Review and Audit

Reviews of water quality incidents, customer complaints, and RMIP progress are undertaken at least every 12 months, when the annual reports are prepared.

This DWQMP, and associated standard operating procedures, are formally reviewed every 2 years in line with the requirements of the Regulator, as outlined in the Guidelines.

A review is undertaken to ensure that the DWQMP is:

- accurate and up-to-date
- appropriate to managing risks to the supply
- functioning and working well

The DWQMP was formally reviewed in June 2022. Version 6 of the DWQMP (this document) was created as a result of the review.

External audits are undertaken every 4 years, also in line with the regulatory requirements.

The most recent audit was undertaken in October 2021. The findings of the audit have been incorporated into the RMIP (refer Appendix G).

10. References

Department of Natural Resources, Mines and Energy 2018, *Drinking Water Quality Management Plan Guideline*, Urban Water Policy and Management, Queensland Government.

Eberhard, S. 2003, *Nowranie Caves and the Camooweal Karst Area, Queensland: Hydrology, Geomorphology and Speleogenesis, with Notes on Aquatic Biota, Helictite*, Vol.38, No.2, Pp 27-38.

NHMRC & NRMMC 2011, *National Water Quality Management Strategy: Australian Drinking Water Guidelines. 6th Ed.*, National Health and Medical Research Council and Natural Resource Management Ministerial Council, Australian Government, Canberra.

Appendix A Drinking Water Quality Policy

STATUTORY POLICY

MOUNT ISA CITY COUNCIL

Drinking Water Quality Policy

RESOLUTION NO. OM09/11/19 VERSION V3

1. PURPOSE

Mount Isa City Council's ("Council") Drinking Water Quality Policy has been established to outline how Council will commit to the effective management of drinking water and the associated distribution system. This Policy forms part of the approved Drinking Water Quality Management Plan and therefore Council is obliged and required under the *Water Supply (Safety & Reliability) Act 2008* to act in accordance with this Policy.

2. COMMENCEMENT

This Policy will commence on and from 28 August 2019. It replaces all other policies or arrangements governing drinking water quality (whether written or not).

3. APPLICATION

This policy applies to all activities undertaken by Council associated with the supply of drinking water to water service areas of Mount Isa and Camooweal.

4. SCOPE

4.1 Council is committed to managing its water supply effectively to provide safe, sustainable and high-quality product that consistently meets the Australian Drinking Water Guidelines and other regulatory requirements and which meets the needs of our customers, stakeholders and communities.

To achieve this, in partnership with relevant stakeholders and regulatory agencies, Council will:

a) Distribute water from Councils service reservoirs to supply points for each customer reliably in sufficient quantity to meet normal peak demands in a manner which protects water from contamination.

b) Use a risk-based approach in which potential threats to water quality are identified and balanced.

c) Have in place appropriate contingency plans and incident emergency response processes to respond to and manage water quality incidents.

d) Routinely monitor the quality of drinking water and use effective reporting mechanisms to provide relevant and timely information and promote confidence in the water supply and its management.

e) Comply with the regulatory requirements of the *Water Supply (Safety and Reliability) Act 2008* (QLD) and aesthetic and health related criteria of the NHMRC/NRMMC Australian Drinking Water Guidelines 2011.

f) Provide training to all relevant employees to ensure that they are aware of this policy and are involved in the implementation of our Drinking Water Quality Management Plan.

g) Provide community and relevant stake holders with relevant and timely information; and

h) Openly communicate this policy to the community to encourage public awareness.

5. RESPONSIBILITIES

5.1. Council will implement and maintain a drinking water quality management system consistent with its approved Drinking Water Quality Management Plan (August 2017) and ensuring that our water services targets are met as per the Customer Service Standards (September 2015).

MOUNT ISA CITY COUNCIL STATUTORY POLICY Page 2 of 3

STATUTORY POLICY
MOUNT ISA CITY COUNCIL
Drinking Water Quality Policy
RESOLUTION NO. OM09/11/19 VERSION V3

5.2. All executive staff and employees involved in the supply of drinking water are responsible for understanding, implementing, maintaining and continuously improving the drinking water quality management system.

6. VARIATIONS

6.1 Council reserves the right to vary, replace or terminate this policy from time to time.

7. COMMUNICATION AND DISTRIBUTION

7.1. Council will make available to the public the Drinking Water Quality Policy on our website at www.mountisa.qld.gov.au.

7.2. The responsible officer shall liaise with the Training and Development Officer to ensure this Policy is included in employee inductions and regular refresher training to the following Council employees;

a) Compliance and Utilities Department

7.3. Employees involved in the implementation of the Drinking Water Quality Management Plan will be provided with regular and specific training required to ensure all requirements are followed.

7.4. Supervisors will ensure the policy is distributed as per the Distribution and Dissemination table on this policy.

8. DEFINITIONS

a) **Drinking Water** – Drinking water means water, for human consumption, intended primarily as water for drinking, whether or not the water is used for other purposes.

b) **Drinking Water Management System** – A Drinking Water Management System consists of documents, procedures and other supporting information that outlines the supplier's systems for the safe supply of drinking water.

ASSOCIATED DOCUMENTS

- Mount Isa City Council Drinking Water Quality Management Plan (August 2017)
- Customer Service Standards (September 2015)
- Queensland Drinking Water Quality Management Plan Guideline (September 2010)
- Australian Drinking Water Guidelines (2011) (NHMRC 2006)
- *Water Supply (Safety and Reliability) Act 2008*
- *Public Health Act 2005*
- *Public Health Regulation 2018*

MOUNT ISA CITY COUNCIL STATUTORY POLICY Page 3 of 3

Appendix B Legal and Other Requirements Register

Table 20 - Legal and other requirements[9]

Act or other requirement	Administering agency	Detail	MICC compliance	Responsibility
Environmental Protection Act 1994	Department of Environment and Science	Under the Act it is an offence to cause environmental harm. The Act states 'a person must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practicable measures to prevent or minimise the harm'.	MICC has site-based management plans for its landfill and sewage treatment plant and follows sound environmental management practices to minimise environmental impacts from its activities. Sewage assets are operated under an environmental authority.	Chief Executive Officer
Public Health Act 2005 and Regulation 2018	Queensland Health	Part 5A of the Act outlines provisions for drinking water, including offences for supplying unsafe drinking water. The Public Health Regulation 2018 §52 outlines standards for quality of drinking water. It specifies frequency of sampling and acceptable values for Escherichia coli in the reticulation system.	MICC reports any exceedances of the Public Health Act requirements (primarily E. coli) to DRDMW who then report to Queensland Health.	Chief Executive Officer

[9] This table will be updated as necessary and incorporated into a minor version update of the DWQMP.

Act or other requirement	Administering agency	Detail	MICC compliance	Responsibility
Water Act 2000	Department of Environment and Science	This Act provides for the sustainable management of water and other resources and the establishment and operation of water authorities.		Chief Executive Officer
Water Supply (Safety and Reliability) Act 2008 and Water Supply (Safety and Reliability) Regulation 2011	Department of Regional Development, Manufacturing and Water	This Act requires a water service provider to develop a drinking water quality management plan. Providers are also required to report annually against a suite of KPIs.	MICC is operating under an approved amended DWQMP, and reports against KPIs as required through the annual SWIMS data collection process.	Chief Executive Officer
Australian Drinking Water Guidelines (ADWG)		The ADWG provide a framework for good management of drinking water supplies. The ADWG are designed to provide an authoritative reference on what defines safe, good quality water, how it can be achieved and how it can be assured	The Water Supply (Safety and Reliability) Act 2008 references the ADWG guidelines as the standard to be achieved.	
Water Fluoridation Act 2008 and Regulation 2008	Queensland Health	The Act came into force in 2008, with the aim to have all public water supplies fluoridated by 2012.	Council has previously resolved not to introduce fluoride into the water supply.	

Appendix C Stakeholder and Communication Register

Table 21 - Stakeholders Register[10]

Organisation	Accountability / Responsibility	Commitment / Involvement	Reporting	Frequency	Method
Department of Regional Development, Manufacturing and Water	Regulator	Approve DWQMP and set key regulatory dates Set water quality criteria for parameters for which no standards have been set by Queensland Health Enforce notices and DWQMPs and undertaking investigations and compliance actions	DWQMP review	Every 2 years	Electronically
			External system audit	Every 4 years	Electronically
			E. coli detection	As required	Verbal communication within 3 hours and written confirmation within 24 hours. The regulator will notify Queensland Health.
			Detection of chemical value above ADWG guidelines	As required	Verbal communication within 3 hours and written confirmation within 24 hours. The regulator will notify Queensland Health.
			An event likely to affect drinking water quality	As required	Verbal communication immediately, followed by the completion of the incident form
			DWQMP Report	120 business days from EOFY	Electronic communication
Mount Isa Water Board	Upstream bulk water supplier	Water quality complaints, issues, incidents and emergencies, operations	Non-compliant water quality, operational issues	As required	Electronic, verbal, face-to-face Within 3 hours for water quality incidents reported to DNRME

[10] This table will be updated as necessary and incorporated into a minor version update of the DWQMP.

Organisation	Accountability / Responsibility	Commitment / Involvement	Reporting	Frequency	Method
Queensland Health	Public Health	Setting drinking water quality standards Issuing and enforcing improvement notices Issuing and enforcing public health orders	As required	As required	As required
MICC customers, especially sensitive receptors	Public Health	This group could be easily affected by poor water quality.	Any event that could have an immediate effect on this group	As required	As required

Appendix D Emergency Contacts

Table 22 - Internal contacts[11]

Contact	Details
Dale Dickson	Acting Chief Executive Officer Mount Isa City Council 0414 180 088
Stephen Jewell	Acting Director Infrastructure Mount Isa City Council 0456 211 884
Shyam Swaminathan	Acting Manager Water and Sewer Mount Isa City Council 0439 211 455
Adam Kleier	Team Leader Water and Sewerage Mount Isa City Council 0437 831 106
Madeline Marshall	Administration Officer Water and Sewer Mount Isa City Council 07 4747 4200
Maurice Thompson	Environmental Services Coordinator Mount Isa City Council 0429 478 305
Alexandra Murray	Laboratory Technician Mount Isa City Council 0439 286 088

[11] This table will be updated as necessary and incorporated into a minor version update of the DWQMP.

Table 23 - External contacts[12]

Contact	Phone
Department of Regional Development, Manufacturing and Water	1300 596 709
Queensland Health (North West Public Health Unit)	07 4744 7178
Mount Isa Water Board – Chief Executive Officer (Bill Esteves)	0413 637 723
Cairns Regional Council - Laboratory Services	1300 692 247
Mount Isa Police (Officer in charge)	07 4744 1111
Mount Isa Fire and Ambulance Service (Mount Isa SES)	07 4743 2601
State Emergency Service (Local Controller)	07 4743 2601
Telecoms service provider (Telstra - faults)	13 22 03
Electricity Provider (Ergon - faults)	13 22 96
Local radio (ABC News Radio)	13 99 94
Local Newspaper (North-West Star)	0449 561 033 0427 790 549 0476 813 587
Mount Isa Hospital	07 4744 4444

[12] This table will be updated as necessary and incorporated into a minor version update of the DWQMP.

Table 24 - Sensitive receptors[13]

Sensitive Receptor	Contact
Camooweal Health Centre	07 4748 2159
Camooweal State School	07 4748 2127
Happy Valley State School	07 4645 0333
Central State School	07 4437 3222
Sunset State School	07 4437 3444
Healy State School	07 4437 3555
Saint Joseph's Primary School	07 4743 4303
Good Shepherd Catholic College	07 4743 2509
Spinifex State College Junior Campus	07 4740 1111
Spinifex State College Senior Campus	07 4744 7222
Mount Isa State Special School	07 4745 0888
St Kieran's Catholic School	07 4744 9000
Townview State School	07 4745 4444
C&K Happy Valley Community Kindergarten	07 4743 2670
Barkly Highway State School	07 4437 3633
Mount Isa School of the Air	07 4744 8333
Good Start Early Learning - Mount Isa	07 4743 2400
Red Oasis Early Education and Care	07 4743 6311
St Paul's Lutheran Church Child Care Centre	07 4743 2859
C&K Sunset Community Kindergarten	07 4743 0357
Injilinji Pre-School & Kindergarten	07 4743 5359
Estelle Cardiff Community Kindergarten Assoc	07 4743 4718
Mount Isa Christian College	07 4743 4649

[13] This table will be updated as necessary and incorporated into a minor version update of the DWQMP.

Appendix E Water Quality Results 2012 – 2022

Table 25 - Mount Isa water quality assessment 2012 - 2022

Measure	Free Chlorine (mg/L)	pH	Turbidity (NTU)	Iron (mg/L)	THMs (µg/L)	E. Coli (mpn/100mL)	Total Coliforms (mpn/100mL)	HPC (CFU/100mL)
Terminal Reservoir								
Count	624	607	609	71	71	532	531	243
Minimum	0.00	6.33	0.06	0.00	0	0	0	0.0
Maximum	3.00	8.14	28.40	0.44	162	1	201	2419.6
Average	1.17	7.56	1.37	0.08	62	0	1	88.9
Standard Dev.	0.66	0.23	2.61	0.09	43	0	9	413.6
95th Percentile	2.25	7.88	4.23	0.30	126	1	1	475.1
5th Percentile	0.10	7.15	0.12	0.00	0	0	0	0.1
Reservoir 1								
Count	400	398	399	56	21	269	183	193
Minimum	0.01	6.46	0.02	0.00	32	0	0	0.0
Maximum	1.59	8.05	2.26	0.09	196	0	201	2419.6
Average	0.16	7.60	0.43	0.02	124	0	19	87.3
Standard Dev.	0.16	0.20	0.43	0.03	48	0	39	362.1
95th Percentile	0.30	7.90	1.51	0.07	192	0	128	258.3
5th Percentile	0.04	7.31	0.13	0.00	42	0	0	0.1
Reservoir 2								
Count	620	604	605	71	54	423	291	237
Minimum	0.00	6.48	0.02	0.00	83	0	0	0.0
Maximum	2.44	8.36	3.68	0.31	201	1	145	2419.6
Average	0.34	7.58	0.48	0.02	129	0	3	55.1
Standard Dev.	0.38	0.22	0.53	0.05	27	0	15	270.9
95th Percentile	1.11	7.90	1.60	0.10	177	0	12	73.8
5th Percentile	0.05	7.22	0.11	0.00	89	0	0	0.1
Reservoir 3								
Count	548	530	532	32	45	250	381	213
Minimum	0.00	4.53	0.06	0.00	71	0	0	0.0
Maximum	3.40	8.38	4.61	0.23	197	0	201	2419.6
Average	0.22	7.57	0.49	0.04	133	0	4	66.8
Standard Dev.	0.21	0.26	0.57	0.06	28	0	17	329.1

Measure	Free Chlorine (mg/L)	pH	Turbidity (NTU)	Iron (mg/L)	THMs (µg/L)	E. Coli (mpn/100mL)	Total Coliforms (mpn/100mL)	HPC (CFU/100mL)
95th Percentile	0.50	7.91	1.75	0.15	186	0	21	156.4
5th Percentile	0.05	7.22	0.12	0.00	96	0	0	0.1
Reservoir 3A								
Count	213	212	213	71	48	135	139	34
Minimum	0.00	7.01	0.08	0.00	105	0	0	0.0
Maximum	3.20	7.98	2.73	0.30	257	0	4	2419.6
Average	0.66	7.56	0.39	0.03	159	0	0	145.7
Standard Dev.	0.60	0.19	0.31	0.04	37	0	0	517.8
95th Percentile	1.96	7.87	0.89	0.09	229	0	0	762.4
5th Percentile	0.05	7.23	0.11	0.00	114	0	0	0.0
Reservoir 4								
Count	396	380	380		9	152	269	210.0
Minimum	0.05	6.42	0.06		103	0.00	0	0.0
Maximum	1.40	8.18	11.60		267	0.00	201	623.0
Average	0.18	7.62	0.59		182	0.00	22	15.9
Standard Dev.	0.14	0.21	0.98		46	0.00	55	56.9
95th Percentile	0.40	7.92	1.93		243	0.00	201	52.1
5th Percentile	0.10	7.37	0.10		113	0.00	0	0.1
Reservoir 5								
Count	512	496	496	69	43	248	379	230
Minimum	0.00	6.37	0.06	0.00	75	0	0	0.0
Maximum	3.00	8.14	2.96	0.30	214	0	201	2419.6
Average	0.20	7.61	0.46	0.03	146	0	13	42.1
Standard Dev.	0.21	0.21	0.53	0.05	33	0	39	248.3
95th Percentile	0.40	7.91	1.65	0.10	209	0	101	73.8
5th Percentile	0.05	7.30	0.11	0.00	107	0	0	0.1
Reservoir 6								
Count	627	611	612	71	186	281	412	243
Minimum	0.00	6.38	0.05	0.00	0	0	0	0.0
Maximum	2.86	8.09	4.97	0.26	217	1	201	2419.6
Average	0.38	7.58	0.47	0.02	41	0	14	38.2
Standard Dev.	0.39	0.21	0.54	0.04	69	0	42	235.1
95th Percentile	1.00	7.89	1.62	0.08	177	0	118	73.8
5th Percentile	0.10	7.25	0.11	0.00	0	0	0	0.1

Measure	Free Chlorine (mg/L)	pH	Turbidity (NTU)	Iron (mg/L)	THMs (µg/L)	E. Coli (mpn/100mL)	Total Coliforms (mpn/100mL)	HPC (CFU/100mL)
Reticulation								
Count	2429	2372	2376	483	345	2160	2159	573
Minimum	0.00	0.23	0.00	0.00	0	0	0	0.0
Maximum	4.00	8.43	64.00	0.66	220	9	387	2419.6
Average	0.30	7.53	0.58	0.03	123	0	4	346.4
Standard Dev.	0.42	0.30	1.90	0.07	36	0	24	791.0
95th Percentile	1.30	7.90	1.93	0.12	187	1	9	2419.6
5th Percentile	0.00	7.06	0.11	0.00	68	0	0	0.2

Table 26 - Camooweal water quality assessment 2012 - 2022

Measure	Free Chlorine (mg/L)	pH	Turbidity (NTU)	Iron (mg/L)	THMs (µg/L)	E. Coli (mpn/100mL)	Total Coliforms (mpn/100mL)	HPC (CFU/100mL)
Header Tank								
Count	262	255	254	45	39	223	77	131
Minimum	0.00	6.66	0.01	0.00	0	0	0	0.0
Maximum	7.20	7.98	4.89	1.00	5	4	43	738.0
Average	0.71	7.50	0.43	0.03	0	0	1	24.8
Standard Dev.	0.89	0.21	0.42	0.15	1	0	5	97.0
95th Percentile	2.60	7.82	0.99	0.05	5	0	0	110.5
5th Percentile	0.00	7.14	0.12	0.00	0	0	0	0.0
Bores								
Count	538	536				547	544	
Minimum	6.50	0.01				0	0	
Maximum	8.08	12.50				201	201	
Average	7.47	0.54				5	14	
Standard Dev.	0.21	0.75				28	47	
95th Percentile	7.80	1.28				5	165	
5th Percentile	7.15	0.11				0	0	
Reticulation								
Count	1138	1097	1101	170	188	1113	1113	234
Minimum	0.00	6.50	0.01	0.00	0	0	0	0.0
Maximum	5.00	8.30	67.50	1.60	107	95	2420	2419.6
Average	0.61	7.39	0.81	0.05	8	1	6	143.9
Standard Dev.	0.75	0.21	3.30	0.19	15	5	103	518.1
95th Percentile	1.81	7.71	1.76	0.37	39	1	6	1046.2
5th Percentile	0.00	7.10	0.10	0.00	0	0	0	0.2

Appendix F Sampling Locations

Mount Isa

Sampling locations are represented by the tap icons.

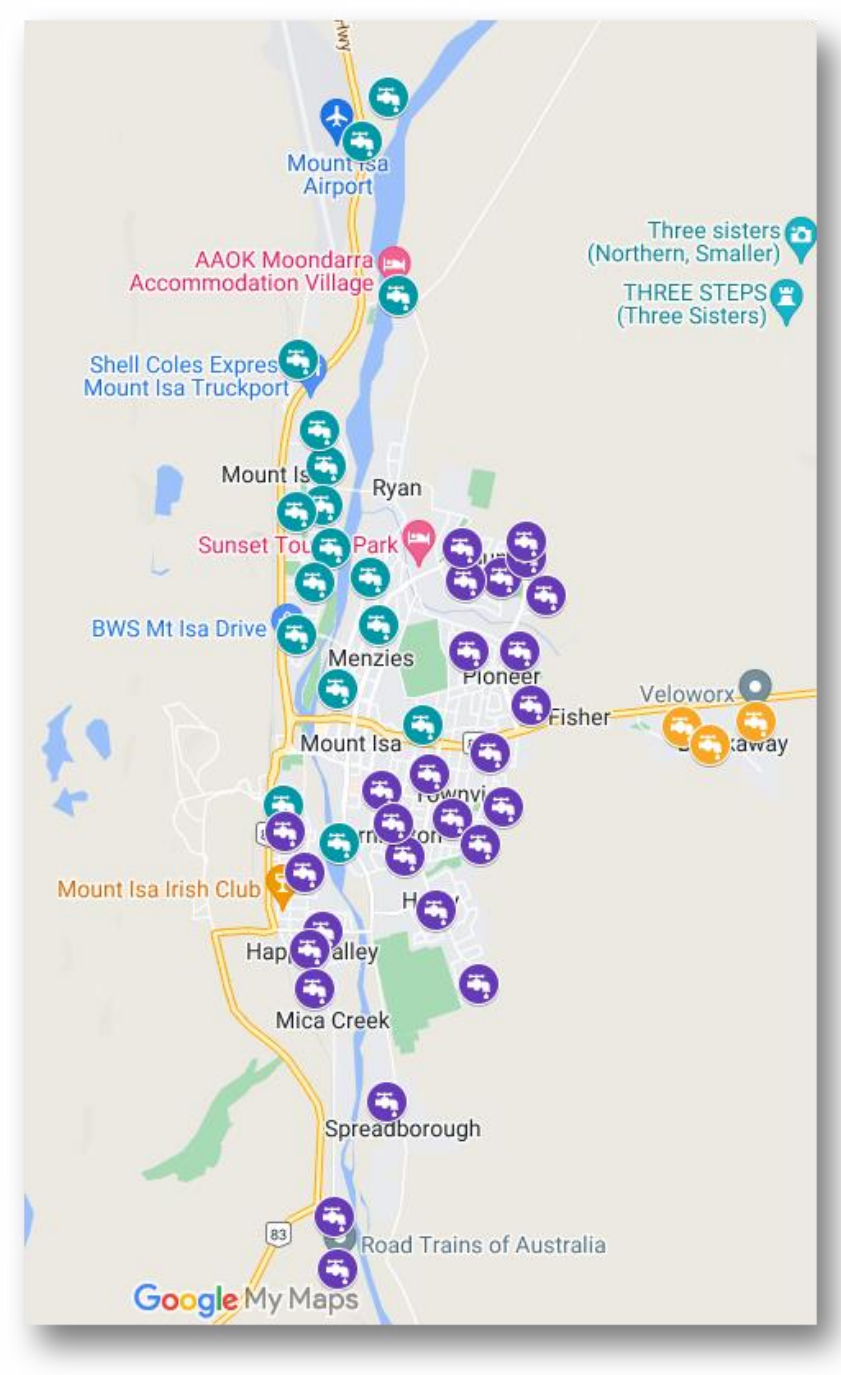


Figure 9 - Sampling locations in Mount Isa[14]

[14] These locations will be updated as necessary and incorporated into a minor version update of the DWQMP. The teal icons represent the low-level zone, the purple icons the high-level zone and the orange icons represent Breakaway.

The address of each sample point is given in the tables following.

Table 27 - Mount Isa sampling locations – low-level zone

Ref	Address
L01	12 Bululo Street
L02	15 Buna Street
L03	14 Kokoda Road
L04	26 Bougainville Street
L05	9 Charles Street
L06	7 Sulphide Street
L07	10 Buckley Avenue
L08	170 West Street
L09	62 West Street
L10	193 Camooweal Street
L11	37 Flynn Street
L12	5 Leila Street
L13	Moondarra Caravan Park
L14	Northridge Road
L15	22 Erap Street
L16	Mount Isa Airport
L17	Kolongo Crescent

Three sites from the Low-Level Zone will be tested each week, in conformance with ADWG recommendations.

Table 28 - Mount Isa sampling locations – Breakaway

Ref	Address
B01	13 Smyth Crescent
B02	22 Breakaway Drive
B03	8 Vaiente Parade

One site from Breakaway will be tested each week.

Table 29 - Mount Isa sampling locations – high-level zone

Ref	Address
H01	18 Judith Street
H02	37 Clarke Street
H03	10 Transfield Avenue
H04	49 Wright Road
H05	145 Abel Smith Parade
H06	35 Hercules Street
H07	97 Transmission Street
H08	29 Kaeser Road
H09	6 Joan Street
H10	33 Alice Street
H11	12 Barbara Street
H12	15 Nathan Drive
H13	16 Rebecca Street
H14	24 Indigo Crescent
H15	11 Epsilon Avenue
H16	7 Banks Crescent
H17	2 Flinders Way
H18	47 Darling Crescent
H19	107 Kookaburra Street
H20	5 Fifth Avenue
H21	16 Thirteenth Avenue
H22	43 Twenty Third Avenue
H23	52 Second Avenue
H24	185 Fourth Avenue
H25	175-177 Mount Isa Duchess Road
H26	116 Old Mica Creek Road
H27	150 Mica Creek Road

Three sites from the High-Level Zone will be tested each week, in conformance with ADWG recommendations.

Camooweal

Sampling locations are represented by the blue tap icons.

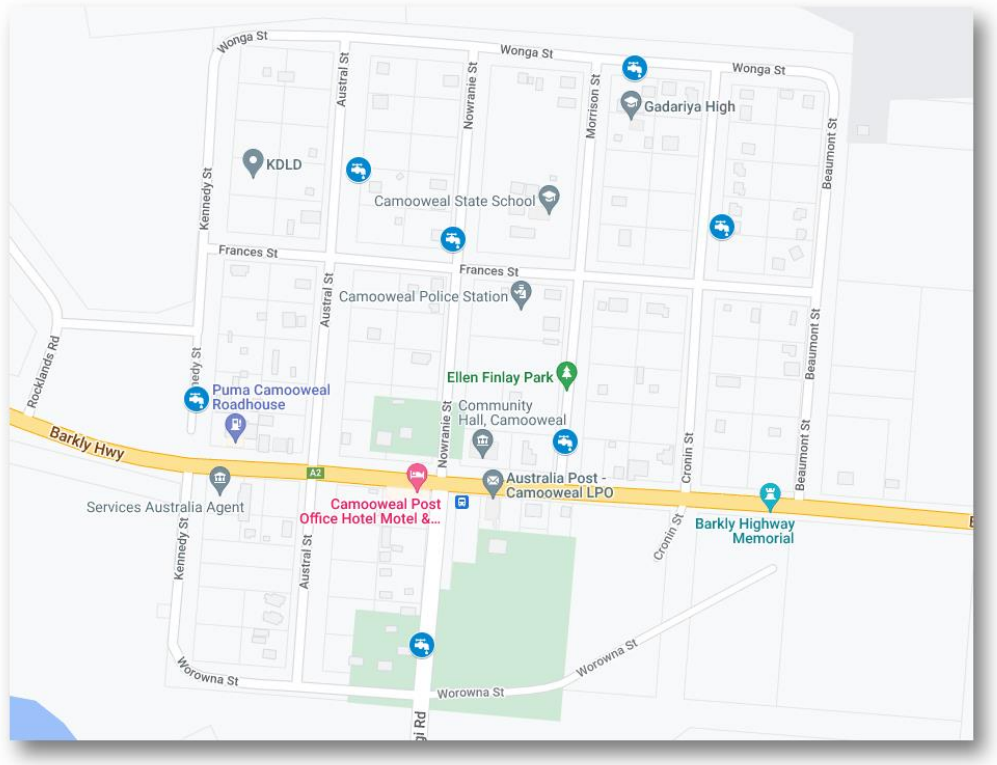


Figure 10 – Sampling locations in Camooweal[15]

The address of each sample point is given in Table 30 below.

Table 30 – Camooweal sample locations

Ref	Address
C01	43 Austral Street
C02	23 Nowraine Street
C03	Camooweal Health Centre
C04	43 Nowraine Street
C05	48 Cronin Street
C06	40 Kennedy Street
C07	23 Austral Street

Two sites from Camooweal will be tested each month, in conformance with ADWG recommendations.

[15] These locations will be updated as necessary and incorporated into a minor version update of the DWQMP.

Appendix G Risk Management Improvement Plan

Mount Isa Drinking Water Service Audit 2020

Ref	Recommendation/Action	Responsibilty	Due Date	Status	Comment
26	Develop and implement a drinking water service asset management plan and infrastructure/equipment specific maintenance programs Include Council's asset management plan and maintenance programs in its next amended DWQMP.	Manager Water and Sewer	30-Sep-23	In Progress	The development of infrastructure/equipment specific maintenance plans is still progressing.
41	Conduct a Regional Water Supply Security Assessment and develop a Regional Water Supply Strategic Plan.	Manager Water and Sewer	30-Jun-24	Not Started	A regional water supply security assessment for Mount Isa was prepared in 2018. It is due to be updated by 2023. A regional water supply security strategy is due by 2024.
42	Implement Council's Regional Water Supply Strategic Plan.	Manager Water and Sewer	30-Jun-25	Not Started	A regional water supply security assessment for Mount Isa was preapred in 2018. It is due to be updated by 2023. A regional water supply security strategy is due by 2024.

Grenof Condition Assessment and System Review 2020

Ref	Recommendation/Action	Responsibilty	Due Date	Status	Comment
51	Align water management practices to the HACCP standard with a view to achieving accreditation to the standard.	Manager Water and Sewer	30-Jun-23	In Progress	

External DWQMP Audit 2021

Ref	Recommendation/Action	Responsibilty	Due Date	Status	Comment
70	Consider increasing the minimum residual to 0.2 mg/L in the reticulation systems in alignment with the ADWG	Manager Water and Sewer	30-Jun-23	In Progress	Noted. To be reviewed during 2023.
71	Furthermore, consider raising the minimum chlorine residual to 0.5 mg/L to control Naegleria fowleri and include it in the next DWQMP revision	Manager Water and Sewer	30-Jun-24	In Progress	Noted. Will be reviewed in line with item #70.
72	Discuss with MIWB an increase in the minimum outlet chlorine residual, and include this in the MICC-MIWB Bulk Water Agreement. Alternatively, consider a MICC chlorine injection site at the point of supply.	Manager Water and Sewer	30-Jun-23	Not Started	This item will await the completion of the network reconfiguration project, when it is no longer expected to be needed. To be taken up with MIWB and resolved at a future operational meetings.
73	Continue with plans to update the water model in consideration of the abovementioned water age issues.	Manager Water and Sewer	30-Jun-23	In Progress	Consultants Cardno (Stantec) are presently undertaking a revision of the Mount Isa hydraulic model.
77	Plan and undertake the training of employees to a certificate III level as a minimum appropriate to the type of work the client undertakes.	Manager Water and Sewer	30-Jun-24	In Progress	Noted. Council presently has 4 plumbers completing Cert III and Cert IV qualifications. A source of training for Water Industry Worker Cert III is being sought, after Qld TAFE withdrew from the industry in 2022.

External DWQMP Audit 2021

Ref	Recommendation/Action	Responsibilty	Due Date	Status	Comment
78	Create a procedure to check that the sample and the testing schedule have been completed by the lab and the results have been checked by the client.	Manager Water and Sewer	30-Jun-23	In Progress	Noted. Preparation of procedure is underway.
82	Add all test result documents to MagiQ.	Manager Water and Sewer	30-Jun-23	In Progress	Noted. All forms and other correspondence are captured in Council's document management system.
83	Create a procedure for internal reporting of test results and ensure that all test results are carbon copied to at least 2 persons in the MICC water and wastewater department including the manager, and it is suggested that the regulator also be copied in.	Manager Water and Sewer	30-Jun-23	In Progress	Noted. A procedure will be prepared.
85	There is an opportunity to add all water quality incidents to the electronic management system in addition to the email system. This may avoid any action issues such as when someone leaves the business or is away.	Manager Water and Sewer	30-Jun-23	In Progress	Noted. The current procedure will be revised.

External DWQMP Audit 2021

Ref	Recommendation/Action	Responsibilty	Due Date	Status	Comment
86	Consider adding field temperature readings for verification sample sites where relevant to enable the client to pick up any seasonal trends in water quality.	Manager Water and Sewer	30-Jun-23	In Progress	Noted. The current procedure will be revised.
89	Physically remove the Camooweal compound bypass valve, and install blanks to ensure that untreated water cannot leak into the town chlorinated supply	Manager Water and Sewer	30-Jun-23	Not Started	Noted. This valve will be removed.
91	Ensure that the chlorine instruments are working at Reservoir No.2 and Camooweal.	Manager Water and Sewer	30-Jun-23	In Progress	Procedure to be prepared for routine maintenance and calibration.
94	Create an instrument calibration register and program.	Manager Water and Sewer	30-Jun-23	In Progress	Noted. A procedure and program will be prepared.
95	Undertake a regular check of operational calibration record checks to ensure that the instruments are being calibrated regularly and effectively.	Manager Water and Sewer	30-Jun-23	In Progress	Noted. Procedure to be prepared.

External DWQMP Audit 2021

Ref	Recommendation/Action	Responsibilty	Due Date	Status	Comment
96	Consider taking control over the MICCs reservoir assets in terms of water level control by introducing a dedicated inlet main and a separate outlet main.	Manager Water and Sewer	30-Jun-24	In Progress	Noted. A consultant is currently working on designs to bring this into effect. This is being addressed as part of the network reconfiguration project.
97	Improve the customer management system to identify and track and close water quality related complaints.	Manager Water and Sewer	30-Jun-23	In Progress	This will improve with the implementation of the new ERP in May 2023. The new ERP promises a much better CMS which should allow for better interrogation and enhanced decision making.
98	Update procedures to include machinery disinfection prior to use in water management situations where cross contamination may be a risk.	Manager Water and Sewer	30-Jun-23	Not Started	Noted. The current procedure will be revised.
99	Undertake extra training such as with WIOA.	Manager Water and Sewer	30-Jun-24	In Progress	Noted.
100	Ensure that the existing procedures are followed for disinfection and flushing of mains after a repair has occurred, and add a hyperchlorination procedure	Manager Water and Sewer	30-Jun-23	In Progress	Noted. The current procedure will be reinforced. All operational staff have undertaken the Aqua Card training provided by the Queensland Water Directorate.

External DWQMP Audit 2021

Ref	Recommendation/Action	Responsibilty	Due Date	Status	Comment
101	Investigate if NQWROC has a standard for mains repair protocols. If not introduce your own standard.	Manager Water and Sewer	30-Jun-23	In Progress	Noted. The current procedure will be revised.
102	Create a flushing procedure and program.	Manager Water and Sewer	30-Jun-24	In Progress	Noted. Program to be prepared in conjunction with 2023-24 budget.
103	Add a scenario for water treatment for the next mock emergency practice.	Manager Water and Sewer	30-Jun-23	Not Started	Noted.
104	A procedure needs to be in place to ensure that all drinking water materials purchased are certified to Australian Standards or are WaterMark approved.	Manager Water and Sewer	30-Jun-23	In Progress	Noted. The current procedure will be revised. All materials are purchased from reputable retailers and from reputable manufacturers.
106	Consider undertaking the maintenance items raised in this section.	Manager Water and Sewer	30-Jun-23	In Progress	Noted. This will be included in revised procedures and 2023/24 budget.
109	Consider having a quarterly meeting to manage all elements of the DWQMP framework.	Manager Water and Sewer	30-Jun-23	In Progress	Quarterly meetings will commence in January 2023.

External DWQMP Audit 2021

Ref	Recommendation/Action	Responsibilty	Due Date	Status	Comment
110	Ensure that staff use the existing procedures and that they demonstrate system management and maintenance by filling out the forms contained in the DOMMs.	Manager Water and Sewer	30-Jun-23	In Progress	Noted. A mobile-based app is being used to enhance data collection and compliance with procedures. This has expanded from a single user to 25 users, and from a single form to 16 forms bewteen November 2021 and November 2022.
111	Ensure required procedures are created and prioritise their creation.	Manager Water and Sewer	30-Jun-23	In Progress	Noted.
112	Provide training in the use of existing and proposed procedures.	Manager Water and Sewer	30-Jun-23	In Progress	Noted. Training will take place at the monthly staff meetings.
113	Complete all RMIP actions that are outstanding or negotiate with the Regulator a change to the due dates.	Manager Water and Sewer	30-Jun-23	In Progress	Noted. The majority of the items from the 2020 version of the DWQMP have been completed. Changes in the due dates will be negotiated as part of the 2022 DWQMP Amendment application.
120	Continue developing a strategy to resolve the chlorine residual issue.	Manager Water and Sewer	30-Jun-24	In Progress	The central plank of this strategy is disconnecting the reticulation from the bulk delivery lines. The present arrangement results in a dynamic change in chlorine levels, depending on whether the pumps are operating.

RMIP Actions from 2020 DWQMP

Ref	Recommendation/Action	Responsibilty	Due Date	Status	Comment
122	Implement backflow program	Manager Water and Sewer	30-Jun-24	In Progress	Previous item WQ3. This has not been progressed. The recent resignation of the Plumbing Inspector will allow for the role to be reviewed and a suitable appointment made.
125	Undertake hydraulic modelling of network in collaboration with MIWB and reconfigure network to improve water circulation and decrease water age.	Manager Water and Sewer	30-Jun-24	In Progress	Previous item WQ13. Cardno (Stantec) are currently revising the Mount Isa hydraulic model and building a model for Camooweal. This work will be completed in mid-2023.
129	Review procedure implementation (mains repairs and hygiene) and provide training	Manager Water and Sewer	30-Jun-23	In Progress	Previous item WQ17. Aquacrad training has been provided to all Water and Sewer department employees.
134	Development of a new training & competency plan around drinking water management	Manager Water and Sewer	30-Jun-23	In Progress	Former item WQ25. All Water and Sewer staff have undertaken the qldwater Aqua card training. This is part of the requirement and induction for new starters.
135	Undertake capital works to repair Reservoir 4	Manager Water and Sewer	30-Jun-25	Not Started	Previous item WQ26. The fate of reservoir 4 has not been determined. It is not needed for water security, and only serves to increase water age.

RMIP Actions from 2020 DWQMP

Ref	Recommendation/Action	Responsibilty	Due Date	Status	Comment
138	Consider internal DWQMP audit program	Manager Water and Sewer	30-Jun-24	Not Started	Previous item WQ29. Council has had three external audits and/or reviews in 2020 and 2021. This will not be actioned until at least the 2024 FY.
140	Consider whether additional treatment is warranted at Camooweal	Manager Water and Sewer	30-Jun-23	In Progress	Previous item WQ31. Tenders for the investigation and design of a suitable water treatment plant for Camooweal were released in late 2022.

Appendix H Risk Register

Table 31 – Mount Isa Unmitigated Hazard Assessment

Hazard	Impact	Source(s)	Notes	Consequence	Likelihood	Risk	Uncertainty	Comment
Biological								
Bacteria	H	• Back flow • Ingress • Main breaks • Maintenance work • Cross contamination • Change of flow in a main or scouring a reservoir	Water quality data analysis: One E. coli detection in Reservoir 2 in 2021 Some low detections of HPC and total coliforms. Supply from MIWB is filtered as of 2015.	Major	Possible	**Very High (C4)**	Confident	• Mount Isa Water Board is using membrane filtration and is chlorinating the final water • Additional chlorine is added to system at town reservoirs • Reservoir configuration to be changed in 22/23 and 23/24 • In-system dosing installed at selected locations during 2021/22 • Online monitoring to be installed with new disinfection dosing facilities • Verification monitoring will continue to ensure any systemic issues are identified • New sampling locations proposed for 2022/23 and beyond
Cyanotoxins	H	• MIWB Raw Water	Readily inactivated by chlorine in MIWB disinfection process	Moderate	Unlikely	**Medium (B3)**	Confident	• Mount Isa Water Board is using membrane filtration and is chlorinating the water prior to supply to Mount Isa • No additional measures proposed
Opportunistic Pathogens (Naegleria & Legionella)	H	• Detention time • Temperature >25°C • Backflow	Temperatures can become >25°C in reservoirs.	Major	Possible	**Very High (C4)**	Reliable	• Additional chlorine is added to system at reservoirs • Reservoir configuration to be changed in 22/23 and 23/24 • In-system dosing installed at selected locations during 2021/22
Problem alga/ bacteria/ macrophytes	A	• None	All of the MICC system is sealed and covered.	Insignificant	Rare	**Low (A1)**	Confident	• Reticulation to be extensively cleaned (air scouring or similar) during 22/23 and 23/24
Protozoa	H	• Maintenance work Ingress through low-pressure zone or air valves in mains • Main breaks.	Contamination of tools Possible ingress through air valve pits and main breaks, especially if it is adjacent to a sewer main.	Major	Unlikely	**High (B4)**	Reliable	• Mount Isa Water Board is now using membrane filtration, greatly reducing the likelihood of the catchment contributing protozoa into the Mount Isa reticulation • No additional measures proposed
Viruses	H	• Maintenance work Main breaks.	Possible ingress through air valve pits and main breaks, especially if it is adjacent to a sewer main. Contamination of tools.	Major	Possible	**Very High (C4)**	Reliable	• Mount Isa Water Board is using membrane filtration, greatly reducing the likelihood of viruses in the reticulation in Mount Isa • The reservoirs provide sufficient detention time to deactivate most viruses • No additional measures proposed
Chemical								
Aluminium	H	• None	No sources in the MICC system.	Minor	Unlikely	**Low (B2)**	Confident	• No coagulants are used by Mount Isa Water Board and aluminium is unlikely to be an issue • Aluminium is tested for on a six-monthly basis as part of the water sampling/testing program • Verification monitoring will continue to ensure any systemic issues are identified
Arsenic	H	• Mains break • Maintenance work	Naturally occurring in the geology.	Minor	Unlikely	**Low (B2)**	Reliable	• Arsenic is tested for on a six-monthly basis as part of the water sampling/testing program • Verification monitoring will continue to ensure any systemic issues are identified

Hazard	Impact	Source(s)	Notes	Consequence	Likelihood	Risk	Uncertainty	Comment
Chlorine	H	• Chemical addition	Addition of chlorine to reservoirs.	Minor	Possible	**Medium (C2)**	Reliable	• The chlorine residuals are presently analysed across the system three times a week • Verification monitoring will continue to ensure any systemic issues are identified • New sampling locations proposed for 2022/23 and beyond
Disinfection by-products (e.g. THMs, HAAs)	H	• Chemical addition • Detention time • Ingress of non-potable water (organic matter).	Addition of chlorine to reservoirs.	Moderate	Possible	**High (C3)**	Reliable	• Disinfection by-products are presently tested for on a weekly basis • Verification monitoring will continue to ensure any systemic issues are identified • New sampling locations proposed for 2022/23 and beyond
Fluoride	H	• None	Not added to Mount Isa water supply.	Minor	Rare	**Low (A2)**	Confident	• Fluoride is not added to the Mount Isa water supply • The presence of fluoride from other sources is tested for on a six-monthly basis as part of the water sampling/testing program • Verification monitoring will continue to ensure any systemic issues are identified
Cadmium	H	• None	No sources in the MICC system.	Minor	Rare	**Low (A2)**	Confident	• The presence of cadmium is tested for on a six-monthly basis as part of the water sampling/testing program • Verification monitoring will continue to ensure any systemic issues are identified
Zinc	A	• Mains break • Maintenance work	Naturally occurring in the geology.	Minor	Rare	**Low (A2)**	Confident	• The presence of zinc is tested for on a six-monthly basis as part of the water sampling/testing program • Verification monitoring will continue to ensure any systemic issues are identified
Nickel	H	• None		Minor	Rare	**Low (A2)**	Confident	• The presence of nickel is tested for on a six-monthly basis as part of the water sampling/testing program • Verification monitoring will continue to ensure any systemic issues are identified
Copper	H	• Mains break • Maintenance work	Naturally occurring in the geology.	Minor	Rare	**Low (A2)**	Confident	• The presence of copper is tested for on a six-monthly basis as part of the water sampling/testing program • Verification monitoring will continue to ensure any systemic issues are identified
Lead	H	• Mains break • Maintenance work	Naturally occurring in the geology.	Minor	Unlikely	**Low (B2)**	Confident	• The presence of lead is tested for on a six-monthly basis as part of the water sampling/testing program • Verification monitoring will continue to ensure any systemic issues are identified
Mercury	H	• None	No sources in the MICC system.	Minor	Unlikely	**Low (B2)**	Confident	• The presence of mercury is tested for on a six-monthly basis as part of the water sampling/testing program • Verification monitoring will continue to ensure any systemic issues are identified
Hydrocarbons	H	• Incorrect materials	It is possible that hydrocarbons could leach out of materials used in the water system, if not correctly selected.	Minor	Possible	**Medium (C2)**	Confident	• The presence of hydrocarbons is tested for on a twelve-monthly basis as part of the annual water sampling/testing program • Verification monitoring will continue to ensure any systemic issues are identified
Hydrogen sulphide/sulphide	A/H	• None	No sources in the MICC system.	Insignificant	Rare	**Low (A1)**	Confident	• The presence of sulphides is tested for on a twelve-monthly basis as part of the annual water sampling/testing program

Hazard	Impact	Source(s)	Notes	Consequence	Likelihood	Risk	Uncertainty	Comment
								• Verification monitoring will continue to ensure any systemic issues are identified
Iron	A	• Main breaks • Maintenance work • Sloughing.	Build up in the mains can be dislodged from change in flow.	Moderate	Unlikely	**Medium (B3)**	Reliable	• The presence of iron is tested for on a weekly basis as part of the water sampling/testing program • Verification monitoring will continue to ensure any systemic issues are identified
Manganese	A/H	• Main breaks • Maintenance work • Sloughing	Build up in the mains can be dislodged from change in flow.	Moderate	Unlikely	**Medium (B3)**	Reliable	• The presence of manganese is tested for on a twelve-monthly basis as part of the annual water sampling/testing program • Verification monitoring will continue to ensure any systemic issues are identified
Nitrate & nitrite	H	• None	No sources in the MICC system.	Insignificant	Rare	**Low (A1)**	Confident	• The presence of nitrates is tested for on a monthly basis • Verification monitoring will continue to ensure any systemic issues are identified
Pesticides	H	• Main break	Household and farm spraying.	Minor	Rare	**Low (A2)**	Confident	• The presence of pesticides is tested for on a twelve-monthly basis as part of the annual water sampling/testing program • Verification monitoring will continue to ensure any systemic issues are identified
Pharmaceuticals and EDCs	H	• None	No sources in the MICC system.	Insignificant	Rare	**Low (A1)**	Confident	• The presence of pharmaceuticals is tested for on a twelve-monthly basis as part of annual the water sampling/testing program • Verification monitoring will continue to ensure any systemic issues are identified
Sodium	A	• None	No sources in the MICC system.	Insignificant	Rare	**Low (A1)**	Confident	• The presence of sodium is tested for on a twelve-monthly basis as part of the annual water sampling/testing program • Verification monitoring will continue to ensure any systemic issues are identified
Sulphate	H	• None	No sources in the MICC system.	Insignificant	Rare	**Low (A1)**	Confident	• The presence of sulphate is tested for on a twelve-monthly basis as part of the annual water sampling/testing program • Verification monitoring will continue to ensure any systemic issues are identified
Toxins	H	• Wilful contamination	Intentional contamination of the water supply.	Catastrophic	Rare	**Medium (A5)**	Reliable	• The presence of toxins is tested for on a twelve-monthly basis as part of the annual water sampling/testing program • Verification monitoring will continue to ensure any systemic issues are identified
Physical								
Colour	A	• Main breaks • Maintenance work • Change of flow in a main or scouring a reservoir.	Build up in the mains can be dislodged from change in flow. Scouring in reservoirs could occur if water is dropped down too fast during maintenance.	Minor	Unlikely	**Low (B2)**	Reliable	• The presence of colour is indicative of dissolved organic carbon in the water, and hence impacts disinfection efficacy • Colour is presently not tested for • The frequency of testing will be changed to weekly with the purchase of new equipment • The frequency of testing will be reviewed after a full quarter of weekly results
DO	A	• Main breaks • Maintenance work • Change of flow in a main or scouring a reservoir.	Scouring in reservoirs could occur if water is dropped down too fast during maintenance. This	Minor	Possible	**Medium (C2)**	Reliable	• Dissolved oxygen is presently not tested for • Weekly testing will be undertaken to determine base levels and variability • The frequency of testing will be reviewed after a full quarter of weekly results

Hazard	Impact	Source(s)	Notes	Consequence	Likelihood	Risk	Uncertainty	Comment
			suspension would consume available DO.					
Hardness	A	• None	No sources in the MICC system.	Insignificant	Rare	**Low (A1)**	Confident	• Hardness is tested for on a monthly basis • Verification monitoring will continue to ensure any systemic issues are identified
pH	A/H	• Chemical addition	Addition of chlorine to reservoirs.	Minor	Possible	**Medium (C2)**	Confident	• The pH is tested for on a weekly basis • Online monitoring will be introduced with new disinfection dosing facilities • • Verification monitoring will continue to ensure any systemic issues are identified
Radiological	H	• None	No sources in the MICC system.	Insignificant	Rare	**Low (A1)**	Confident	• The Mount Isa water supply is tested on a 5-yearly basis to determine the level of radiological isotypes present in the water • • Verification monitoring will continue to ensure any systemic issues are identified
Supply	L	• Mains break • Maintenance work	If not attended to, could lead to a loss of supply.	Minor	Unlikely	**Low (B2)**	Reliable	• Supply security is managed by Mount Isa Water Board and is not a hazard to the water quality • • No additional measures are proposed
Taste and odour	A	• Overdosing of chlorine • Detention time.	Council manages all water quality complaints.	Minor	Unlikely	**Low (B2)**	Reliable	• Taste and odour are monitored through the medium of customer complaints • No additional measures are proposed
Total dissolved solids	A	• None	No sources in the MICC system.	Moderate	Rare	**Low (A3)**	Confident	• TDS cannot be reduced without further water treatment, which is the province of Mount Isa • Water Board • TDS is monitored on a monthly basis • No additional measures are proposed
Turbidity	A	• Main breaks • Maintenance work • Change of flow in a main or scouring a reservoir.	Builds up in the mains, can be dislodged from change in flow. Scouring in reservoirs could occur if water is dropped down too fast during maintenance.	Minor	Possible	**Medium (C2)**	Confident	• Turbidity is tested for on a weekly basis • Verification monitoring will continue to ensure any systemic issues are identified

Table 32 – Camooweal Unmitigated Hazard Assessment

Hazard	Impact	Source(s)	Notes	Consequence	Likelihood	Risk	Uncertainty	Comment
Biological								
Bacteria	H	• Cattle grazing • Sewage Treatment Plant • Rubbish tip (and illegal dumping) • Back flow • Ingress through reservoir roof • Main breaks • Maintenance and/or cross contamination	No detections of E. coli in the past 6 years.	Major	Possible	**Very High (C4)**	Confident	• Online monitoring installed with new disinfection dosing facilities • Verification monitoring will continue to ensure any systemic issues are identified • New sampling locations proposed for 2022/23 and beyond
Opportunistic Pathogens (Naegleria & Legionella)	H	• Environmental • Temperature >25°C • Ingress of non-potable water	Not considered to be an issue.	Major	Unlikely	**High (B4)**	Reliable	• Chlorine is added to system at header tanks • No additional measures proposed
Problem alga/ bacteria/ macrophytes	A	• None	All of the MICC system is sealed and covered.	Insignificant	Rare	**Low (A1)**	Confident	• Reticulation to be extensively cleaned (air scouring or similar) during 22/23 and 23/24
Protozoa	H	• Cattle grazing • Sewage Treatment Plant • Illegal tipping • Maintenance • Main breaks.	Old bore 1, which has some issues identified during previous risk assessments, is not in use. Deep bores ~100m	Major	Unlikely	**High (B4)**	Estimate	• Periodic testing for protozoa is not presently carried out • No additional measures proposed
Viruses	H	• Sewage Treatment Plant • Illegal tipping • Maintenance work • Main breaks.	No detections of E. coli in the past 6 years.	Major	Possible	**Very High (C4)**	Estimate	• The reservoirs provide sufficient detention time to deactivate most viruses • No additional measures proposed
Chemical								
Aluminium	H	• None	No sources in the catchment.	Insignificant	Rare	**Low (A1)**	Reliable	• Aluminium is tested for on a six-monthly basis as part of the water sampling/testing program • Verification monitoring will continue to ensure any systemic issues are identified
Arsenic	H	• None	No sources in the catchment.	Insignificant	Rare	**Low (A1)**	Reliable	• Arsenic is tested for on a six-monthly basis as part of the water sampling/testing program • Verification monitoring will continue to ensure any systemic issues are identified
Chlorine	H	• Chemical addition	Addition of chlorine to reservoirs.	Minor	Possible	**Medium (C2)**	Reliable	• The chlorine residuals are presently analysed across the system at least once a month • Verification monitoring will continue to ensure any systemic issues are identified • New sampling locations proposed for 2022/23 and beyond
Disinfection by-products (e.g. THMs, HAAs)	H	• Chemical addition • Ingress of non-potable water (organic matter).	Addition of chlorine to reservoirs.	Moderate	Possible	**High (C3)**	Reliable	• Disinfection by-products are presently tested for on a quarterly basis • Verification monitoring will continue to ensure any systemic issues are identified

Hazard	Impact	Source(s)	Notes	Consequence	Likelihood	Risk	Uncertainty	Comment
Fluoride	H	• None	Not added to Camooweal water supply.	Insignificant	Rare	**Low (A1)**	Reliable	• Fluoride is not added to the Camooweal water supply • The presence of fluoride from natural sources is tested for on a six-monthly • basis as part of the water sampling/testing program • Verification monitoring will continue to ensure any systemic issues are identified
Cadmium	H	• None	No sources in the catchment.	Insignificant	Rare	**Low (A1)**	Reliable	• The presence of cadmium is tested for on a six-monthly basis Verification monitoring will continue to ensure any systemic issues are identified
Zinc	A	• Mains break • Maintenance work	No sources in the catchment.	Insignificant	Rare	**Low (A1)**	Reliable	• The presence of zinc is tested for on a six-monthly basis Verification monitoring will continue to ensure any systemic issues are identified
Nickel	H	• None	No sources in the catchment.	Insignificant	Rare	**Low (A1)**	Reliable	• The presence of nickel is tested for on a six-monthly basis • Verification monitoring will continue to ensure any systemic issues are identified
Copper	H	• Mains break • Maintenance work	No sources in the catchment.	Insignificant	Rare	**Low (A1)**	Reliable	• The presence of copper is tested for on a six-monthly basis • Verification monitoring will continue to ensure any systemic issues are identified
Lead	H	• Mains break • Maintenance work	No sources in the catchment.	Insignificant	Rare	**Low (A1)**	Reliable	• The presence of lead is tested for on a six-monthly basis • Verification monitoring will continue to ensure any systemic issues are identified
Mercury	H	• None	No sources in the catchment.	Insignificant	Rare	**Low (A1)**	Reliable	• The presence of mercury is tested for on a six-monthly basis • Verification monitoring will continue to ensure any systemic issues are identified
Hydrocarbons	H	• Three fuel sources in town • Illegal tipping • Back flow	Service stations have underground tank.	Minor	Unlikely	**Low (B2)**	Reliable	• The presence of hydrocarbons is tested for on a twelve-monthly basis • Verification monitoring will continue to ensure any systemic issues are identified
Hydrogen sulphide/sulphide	A/H	• None	Not considered to be an issue No reports from consumers of any odours	Insignificant	Rare	**Low (A1)**	Reliable	• The presence of sulphides is tested for on a twelve-monthly basis • Verification monitoring will continue to ensure any systemic issues are identified
Iron	A	• Natural geology • Main breaks • Maintenance work	Water quality data analysis shows no issues.	Insignificant	Rare	**Low (A1)**	Reliable	• The presence of iron is tested for on a monthly basis as part of the water sampling/testing program • Verification monitoring will continue to ensure any systemic issues are identified
Manganese	A/H	• Natural geology	Water quality data analysis shows no issues.	Insignificant	Rare	**Low (A1)**	Reliable	• The presence of manganese is tested for on a twelve-monthly basis • Verification monitoring will continue to ensure any systemic issues are identified
Nitrate & nitrite	H	• None	No sources in the catchment.	Insignificant	Rare	**Low (A1)**	Reliable	• The presence of nitrates is tested for on a twelve-monthly basis • Verification monitoring will continue to ensure any systemic issues are identified
Pesticides	H	• Main break	Household and farm spraying.	Insignificant	Rare	**Low (A1)**	Reliable	• The presence of pesticides is tested for on a twelve-monthly basis • Verification monitoring will continue to ensure any systemic issues are identified
Pharmaceuticals and EDCs	H	• None	No sources in the catchment.	Insignificant	Rare	**Low (A1)**	Reliable	• The presence of pharmaceuticals is tested for on a twelve-monthly basis • Verification monitoring will continue to ensure any systemic issues are identified
Sodium	A	• None	No sources in the catchment.	Insignificant	Rare	**Low (A1)**	Reliable	• The presence of sodium is tested for on a twelve-monthly basis • Verification monitoring will continue to ensure any systemic issues are identified
Sulphate	H	• None	No sources in the catchment.	Insignificant	Rare	**Low (A1)**	Reliable	• The presence of sulphate is tested for on a twelve-monthly basis • Verification monitoring will continue to ensure any systemic issues are identified
Toxins	H	• Illegal tipping • Wilful contamination	Intentional contamination of the water supply.	Catastrophic	Rare	**Medium (A5)**	Reliable	• The presence of toxins is tested for on a twelve-monthly basis • Verification monitoring will continue to ensure any systemic issues are identified

Hazard	Impact	Source(s)	Notes	Consequence	Likelihood	Risk	Uncertainty	Comment
Physical								
Colour	A	• Main breaks • Maintenance work •	Not considered to be an issue	Minor	Possible	**Medium (C2)**	Reliable	• Colour is presently not tested for
DO	A	• Main breaks • Maintenance work	Not considered to be an issue	Minor	Possible	**Low (A1)**	Reliable	• Dissolved oxygen is presently not tested for
Hardness	A	• Dolomite geology	Hardness exceeds ADWG aesthetic limit	Minor	Almost certain	**High (E2)**	Reliable	• Hardness is tested for on a monthly basis • Water treatment options are being reviewed in 2022/23
pH	A/H	• None	Not considered to be an issue	Insignificant	Rare	**Low (A1)**	Confident	• The pH is tested for on a weekly basis • Online monitoring will be introduced with new disinfection dosing facilities • Verification monitoring will continue to ensure any systemic issues are identified
Radiological	H	• Natural geology	No sources in the MICC system.	Insignificant	Rare	**Low (A1)**	Confident	• The Mount Isa water supply is tested on a 5-yearly basis to determine the level of radiological isotypes present in the water • Verification monitoring will continue to ensure any systemic issues are identified
Supply	L	• Mains break • Bore issues	2 bores used	Minor	Unlikely	**Low (B2)**	Reliable	• No additional measures are proposed
Taste and odour	A	• Dolomite geology	Water has a mineral taste, resulting in very little actually being drunk.	Minor	Possible	**Medium (C2)**	Reliable	• Taste and odour are monitored through the medium of customer complaints • No additional measures are proposed
Total dissolved solids	A	• Dolomite geology	TDS exceeds ADWG aesthetic limit	Minor	Almost certain	**High (E2)**	Confident	• Water treatment options are being reviewed in 2022/23
Turbidity	A	• Main breaks • Maintenance work • Natural cources	Turbidity from bores is below ADWG aesthetic limit	Minor	Possible	**Medium (C2)**	Confident	• Turbidity is tested for on a weekly basis • Verification monitoring will continue to ensure any systemic issues are identified

Table 33 – Mount Isa Risk Register

Hazardous Event	Potential Hazard		Limiting Hazard/s	Maximum Risk	Preventive Measures	Monitoring	Event Consequence	Event Likelihood	Event Risk	Level of Uncertainty	Risk Treatments	Comments
Bulk Water												
Receipt of out-of-specification treated water	Receipt of contaminated water into the supply system.	ADWG parameters	Bacteria	**High (C3)**	• Incident reporting procedures • Regular communication between MIWB and MICC	Verification monitoring	Moderate	Rare	**Low (A3)**	Confident	MIWB chlorinates the water at source and delivers it at 1 mg/L.	
Reservoirs												
Deterioration of water quality in reservoirs as a result of variable residence times	Variable residence time may cause a loss of the disinfection residual. The system is not operated to manage retention times.	Bacteria Turbidity Taste and odour	DBP	**High (C3)**	• Chlorine residual • Management of levels in reservoirs • Auto chlorine dosing in reservoirs • Mixers in reservoirs	Chlorine residual Biological monitoring.	Moderate	Possible	**High (C3)**	Confident	Dosing and mixing to be installed in all Mount Isa reservoirs, with alarms for dosing failure or faults. Consider operational philosophy to improve water turnover in Mount Isa (i.e. review reservoir levels, undertake periodic draw down of Reservoir levels) Begin measurement of Haloacetic Acids and review frequency of THM monitoring	All reservoirs except for 1 and 5 have chlorine dosing. Dosing will be installed in Reservoir 1 early in 2023. Reservoir 5 will be ganged with Reservoir 6, so will not require dosing. Reservoirs 3 and 4 are offline, which has greatly improved the turnover in storage. There is only around one day's storage in the network, which should result in an acceptable water age. HAAs are now being measured quarterly.
Poor mixing within reservoir	Poor mixing in a reservoir leading to pockets of reduced quality water.	Bacteria Opportunistic pathogens Turbidity DBPs	Opportunistic pathogens	**Very High (C4)**	• Management of levels in reservoirs • Mixers in all active reservoirs	Verification monitoring	Major	Rare	**Medium (A4)**	Reliable	All reservoirs have a common inlet/outlet.	All active reservoirs have mixers installed. A project is underway to separate the inlet and outlet
Vandalism or wilful contamination	Access by humans and wilful contamination leading to poor quality water.	Bacteria Viruses Protozoa Toxins	Bacteria	**Very High (C4)**	• Chlorine residual • Security fences • Removal of access ladders • Locks on hatches	Visual inspections Chlorine residual	Major	Rare	**Medium (A4)**	Confident	n/a	
Disturbance of Sediment	Stirring of foreign matter leading to a deterioration in water quality.	Bacteria Viruses Protozoa Turbidity Taste and odour Colour	Bacteria	**Very High (C4)**	• Managing tank levels • Chlorine residual • Formalised reservoir inspection and cleaning program.	Verification monitoring	Major	Rare	**Medium (A4)**	Reliable	n/a	Reservoirs are cleaned at least every 5 years.
External contaminant ingress including vermin and/or wash-in of contaminated water	Ingress of animals faecal matter and leaf litter via roof drainage leading to: • Microbiological contamination,. • Loss of disinfection residual	Bacteria Viruses Protozoa Turbidity Taste and odour Colour	Bacteria	**Very High (C4)**	• Chlorine residual (all reservoirs being dosed with chlorine) • Roofed and vermin-proofed storages • Formalised reservoir inspection program (six-monthly).	Visual inspections	Major	Possible	**Very High (C4)**	Estimate	Dosing and mixing to be installed in all Mount Isa reservoirs, with alarms for dosing failure or faults.	Reservoir inspections are implemented. Reservoir inspection procedure has been developed.

Hazardous Event	Potential Hazard		Limiting Hazard/s	Maximum Risk	Preventive Measures	Monitoring	Event Consequence	Event Likelihood	Event Risk	Level of Uncertainty	Risk Treatments	Comments
Overdosing of chlorine	Chlorine dosing system malfunction or incorrect dose pump setting leads to overdose	Chlorine	Chlorine	**Medium (C2)**	• Automated chlorine dosing at reservoirs, with cut off • Customer complaint monitoring • Weekly dosing system checks when samples collected	Verification monitoring	Minor	Unlikely	**Low (B2)**	eliable	n/a	No chlorine overdosing events in recent history.
Underdosing or Failure to Dose of chlorine	Reduced barrier to a subsequent contamination event	Bacteria	Opportunistic Pathogens (Naegleria & Legionella)	**Very High (C4)**	• Automated chlorine dosing at reservoirs, with SCADA • Daily online check of dosing	Verification monitoring	Major	Rare	**Medium (A4)**	Reliable	n/a	Note – underdosing of chlorine is not in itself a hazard. Another contamination event has to occur to result in a public health risk.
Reticulation												
Ingress of non-potable water	Ingress caused by loss of pressure in mains during: • Pipe repairs • High flows (e.g. firefighting)	Bacteria Taste & odour Colour Turbidity Protozoa Viruses Toxic metals Hydrocarbons Toxins	Protozoa	**High (B4)**	• Mains repairs and hygiene procedures • On-the-job staff training • Chlorine residual	Verification monitoring	Major	Unlikely	**High (B4)**	Reliable	Review scheduling for mains replacement program Review procedure implementation (mains repairs and hygiene) and provide training	On average, there are only 2-3 mains breaks per month (not including service lines, broken ferrules, etc). The same crews operate on water and sewer, but there are only ever a handful of sewer blockages in a day, and a crew would never work on one, then attend another.
Backflow	• Illegal connection • Pump start/stop causing negative pressures	Bacteria Opportunistic pathogens Protozoa Viruses Hydrocarbons Taste and odour Pesticides Fertilisers Toxins	Bacteria	**Very High (C4)**	• Plumbing code for backflow connections • Vacuum breakers on hose lines	No program currently in place	Major	Almost certain	**Very High (C4)**	Reliable	Investigate and identify customers that may be of potential concern or backflow Check backflow requirements and gaps Maintain backflow register and enforce council backflow policy.	Domestic issues are considered to be the greatest risk. Although the limiting hazard is bacteria, the risk can also be from toxins, other pathogens hence risk is high. The MIWB pumps are creating negative pressures with every shutdown, allowing backflow to take place 2-3 times a day. The rollout of the new smart meters will address the issue of removed backflow devices.
High flow or changes in flow rate or direction in pipelines	High flow and rapid changes in flow rate in pipelines leading to scouring and sloughing of slimes and sediment.	Turbidity Taste & odour Bacteria Toxic metals Colour Viruses Protozoa Aluminium Iron Manganese	Turbidity	**Medium (C2)**	None	Verification monitoring	Minor	Unlikely	**Low (B2)**	Confident	n/a	Maintenance activities could cause a change in direction or flow rate when systems are isolated. The turbidity is generally caused by sloughing.

Hazardous Event	Potential Hazard		Limiting Hazard/s	Maximum Risk	Preventive Measures	Monitoring	Event Consequence	Event Likelihood	Event Risk	Level of Uncertainty	Risk Treatments	Comments
Stagnant water	Stagnant water in pipelines caused by: • dead ends • low-water demands	Bacteria Iron Manganese Colour Dissolved oxygen Taste and odour Turbidity	Turbidity	**Medium (C2)**	• Flushing program	Targeted monitoring of dead ends	Minor	Possible	**Medium (C2)**	Confident	n/a	Remove dead ends when pipe replacements are done.
Formation of Disinfection By-products	The reaction of chlorine with organic material to create DBPs.	Disinfection by-products	Disinfection by-products	**High (C3)**	• Managing reservoir levels to reduce water age • Procedures to prevent ingress of non-potable water	Verification monitoring	Moderate	Possible	**High (C3)**	Confident	Consider operational philosophy to improve water turnover (i.e. review reservoir levels, undertake periodic draw down of reservoir levels)	Monitoring results show that THMs have not exceeded the ADWG guideline value. New sampling points have been installed, as shown in Appendix F.

Table 34 – Camooweal Risk Register

Hazardous Event	Potential Hazard		Limiting Hazard/s	Maximum Risk	Preventive Measures	Monitoring	Event Consequence	Event Likelihood	Event Risk	Level of Uncertainty	Risk Treatments	Comments
Bores												
Surface water infiltration	Stormwater runoff ingress through bore casing and insecure borehead.	Viruses Bacteria Protozoa Hydrocarbons Turbidity Colour	Bacteria	**Very High (C4)**	• Collar and casing on the bore • Borehead raised well above the ground with concrete slab around.	*E. coli* monitoring	Major	Unlikely	**High (B4)**	Estimate	Improve visibility of Camooweal chorination system operation & performance (SCADA) Upgrade to Camooweal chlorination system (e.g. dual cylinder, auto-changeover) Consider whether additional treatment is warranted	STP and dump is located away from proximity of bores hence no potential for contamination at point of abstraction. The chlorinator has been upgraded and the chlorine cylinders sit on scales, with automatic changeover. Water treatment of the Camooweal water supply will be investigated in 2023.
Surface water infiltration through recharge	Contaminated surface water may negatively impact water in the aquifer. Dumping of rubbish in surrounding caves could lead to groundwater contamination after rainfall event (see Eberhard 2003).	Viruses Bacteria Protozoa Hydrocarbons Turbidity Colour	Bacteria	**Very High (C4)**	• Site inspections of cave entrances, especially Niggle • Cave and Tar Drum Sink	Verification monitoring	Major	Rare	**Medium (A4)**	Estimate	Improve visibility of chlorination system operation & performance (SCADA)	The chlorination system has SCADA and can be monitored from Mount Isa.
Surface water infiltration through recharge	Contaminated surface water may negatively impact water in the aquifer.	Viruses Bacteria Protozoa Hydrocarbons Turbidity Colour	Protozoa	**High (B4)**	• Deep bores	None	Major	Rare	**Medium (A4)**	Estimate		
Disinfection												
Failure of chlorination system	Pathogens in final water	Bacteria Virus	Bacteria	**Very High (C4)**	• Security fence to avoid vandalism of dosing equipment • Training and procedures.	Regular inspections including checking weight of chlorine bottle Verification monitoring	Major	Unlikely	**High (B4)**	Estimate	Improve visibility of chlorination system operation and performance (SCADA)	The bore pumps are at a fixed speed, and the injector pump is also at a fixed speed. Need to make sure chlorinator is on the right set point. The performance of the chlorinator is visible via SCADA.
Insufficient chlorine contact time	During periods of high demand water bypasses the Header Tanks and goes directly to town. First properties located ~100m away.	Viruses Bacteria Protozoa Hydrocarbons Turbidity Colour	Bacteria	**Very High (C4)**	• Some disinfection provided – dependent on flow rate	Verification monitoring	Major	Unlikely	**High (B4)**	Estimate	Revise pipework to ensure that water goes via header tank and that this is where the chlorine is added	Residual risk able to be lowered as the impact is limited to the properties closest to the compound, and there is likely 1-2 log virus kill under high flow rates
Overdosing of Chlorine	Cl2 outside ADWG Health limit Taste and odour complaints.	Taste and odour	Chlorine	**Medium (C2)**	• Training and procedures • Fixed dose rate • Monitoring via SCADA, with automatic shutdown	Verification monitoring	Minor	Unlikely	**Low (B2)**	Confident	Monitoring via SCADA, with automatic shutdown	High chlorine could be caused by vandalism or operator error, although chlorine failures are most likely to be under dosing.

Hazardous Event	Potential Hazard		Limiting Hazard/s	Maximum Risk	Preventive Measures	Monitoring	Event Consequence	Event Likelihood	Event Risk	Level of Uncertainty	Risk Treatments	Comments
Header Tanks												
Stagnant water	Long residence time may cause a loss of the disinfection residual.	Bacteria Turbidity Taste and odour	DBP	**Very High (C4)**	• Management of levels in reservoirs • Auto chlorine dosing in reservoirs	Verification monitoring	Major	Rare	**Medium (A4)**	Reliable	Change pipework to make the reservoirs active in the system and install a pressure pump to provide pressure for the town, rather than using the bore pumps	Reconfiguration of the pipework is in the 2022-23 budget.
External contaminant by vermin	Ingress of vermin leading to microbiological contamination	Bacteria	Bacteria	**Very High (C4)**	• Roofed and vermin-proofed storages • Formalised reservoir inspection program (six-monthly).	Verification monitoring Visual inspections	Major	Rare	**Medium (A4)**	Reliable	None	
Reticulation												
Ingress of non-potable water	Ingress caused by loss of pressure in mains during: • Pipe repairs • High flows (e.g. firefighting)	Bacteria Taste & odour Colour Turbidity Protozoa Viruses Toxic metals Hydrocarbons Toxins	Bacteria	**Very High (C4)**	• Mains repairs and hygiene procedures • Staff training • Chlorine residual	Verification monitoring	Major	Rare	**Medium (A4)**	Reliable	Review procedure implementation (mains repairs and hygiene) and provide training	Most of the town has been re-laid in PVC. Normally, there are minimal main breaks in the Camooweal system (1-2 per annum).
Backflow	• Illegal connections • Unmetered connections	Bacteria Opportunistic pathogens Protozoa Viruses Hydrocarbons Taste and odour Pesticides Fertilisers Toxins	Bacteria	**Very High (C4)**	• Plumbing code for backflow connections • Vacuum breakers on hose lines	No program currently in place	Major	Unlikely	**High (B4)**	Reliable	Investigate and identify customers that may be of potential concern or backflow Check backflow requirements and gaps Maintain backflow register and enforce council backflow policy.	Although the limiting hazard is bacteria, the risk can also be from toxins, other pathogens hence risk is high.
Stagnant water	Stagnant water in pipelines caused by: • dead ends • low-water demands	Bacteria Iron Manganese Colour Dissolved oxygen Taste and odour Turbidity	Turbidity	**Medium (C2)**	• Flushing program	Targeted monitoring of dead ends	Minor	Possible	**Medium (A2)**	Confident	n/a	Remove dead ends when pipe replacements are done. Austral and Nowrani Streets are dead ends. The relatively high flows in Camooweal prevent stagnant water issues.
Formation of Disinfection By-products	The reaction of chlorine with organic material to create DBPs.	Disinfection by-products	Disinfection by-products	**High (C3)**	• None	Verification monitoring	Moderate	Possible	**High (B4)**	Confident	Ground water has very low organic load hence low risk from formation of DBPs.	Monitoring results show that THMs have not exceeded the ADWG guideline value.

Table 35 – Whole of System Risk Register

Hazardous Event	Potential Hazard		Limiting Hazard/s	Maximum Risk	Preventive Measures	Monitoring	Event Consequence	Event Likelihood	Event Risk	Level of Uncertainty	Risk Treatments	Comments
Incompatible materials	Use of incompatible materials may cause release into water supply	Toxins	Toxins	**Medium (A5)**	• Council specifies materials must meet standard AS/NZS 4020:2018 • Use of suitably experienced and qualified contractors	None	Minor	Unlikely	**Low (B2)**	Confident	Specifications and contracts to require use of Watermark approved materials Checking and testing of materials to ensure compliance	
Malicious contamination	The intentional contamination of the water supply	Toxins Hydrocarbons Bacteria Protozoa Viruses Taste and odour Pesticides	Toxins	**Medium (A5)**	• Security fences • Locked hatches • Cameras	Routine monitoring	Major	Rare	**Medium (A4)**	Reliable	Upgrade locks to electronic security	There are an unknown number of water master keys issued to past personnel and contractors
Lack of resources	Loss of system knowledge and the inability to recruit skilled operators leading to inappropriate decision making, lack of/insufficient training, reduced knowledge and lack of maintenance of the system.	Turbidity Bacteria Protozoa Toxic Metals	Protozoa	**High (B4)**	• On-the-job training • Training on chlorination • Operation manuals • Procedures • Ad-hoc assistance from MIWB • Progress North West Water	None	Major	Unlikely	**High (B4)**	Estimate	Progress North West Water to pride additional resilience	MICC has a very high turnover of staff. This will continue to be a risk.
Loss of power	Loss of treatment and water supply	Reduced output volume	Reduced output volume	**Low (B2)**	• Backup generators able to be deployed	None	Minor	Unlikely	**Low(B2)**	Reliable	MIWB has now installed a generator and diesel pump to ensure constant supply of filtered and chlorinated water to the reservoirs	Ergon maintains the electricity supply. The number of outages is very low, perhaps one every 3 years exceeding 5 hours in duration
Cybersecurity	Unauthorised access to Council information	Any hazard	Bacteria	**Very High (C4)**	• Firewall • Antivirus software • Web filtering • System alerts reviewed by Systems Administrators • Password policy • Site security • System backups nightly & weekly • Onboarding/offboarding process for new staff and disabling of accounts for departing staff	Network monitoring	Major	Unlikely	**High (B4)**	Reliable	Upgrade SCADA network to include water assets	SCADA is being upgraded, hence the heightened risk
Failure to implement Drinking Water Quality Management Plan	Community illness caused by breakdown in process	Any hazard	Bacteria	**Very High (C4)**	• DWQMP Annual Reports • Biennial DWQMP reviews	Operational and verification monitoring programs	Major	Rare	**Medium (A4)**	Confident	Development of a new training & competency plan around drinking water management	Aqua card is the basis for this.

Appendix I Maintenance and Operational Procedures

Table 36 – Existing preventive measures

Title	Status	Last Revision
Mains hygiene	Existing	2017
Mains flushing	Existing	2017
Reservoir and bore Inspections	Existing	2017
Reservoir cleaning	Existing	2017
Management of reservoirs	Existing	2017
Chlorine residual management	Existing	2017
Response to water quality complaints	Existing	2017
Response to customer complaints	Existing	2017
Water quality monitoring and testing	Existing	2021
Disinfection By-Product monitoring and management	New	2022
Emergency water trailer deployment	New	2022
Cybersecurity management plan	New	2022

Emergency Drinking Water Trailer

Council purchased two 900-litre water tank trailers, as shown at time of delivery in Figure 11 below. These have been fitted out with food grade hosing, a generator and electric pressure pump, in lieue of the equipment shown below.

Figure 11 - Emergency drinking water trailers

The trailers were designed to be deployed in the event of a water outage to support any critical or sensitive customers impacted.

The trailers have been deployed on several occasions. One learning is that the 900-litre tank is insufficient to provide for the ongoing needs of schools. In practice this short coming has been mitigated by refilling the trailer form a tanker. The purchase of a larger trailer is being considered, in the order of 3000 litres.

The trailer is flushed with a hypochlorite solution and fresh water prior to being deployed, although bottled water is usually provided in conjunction with the trailer.

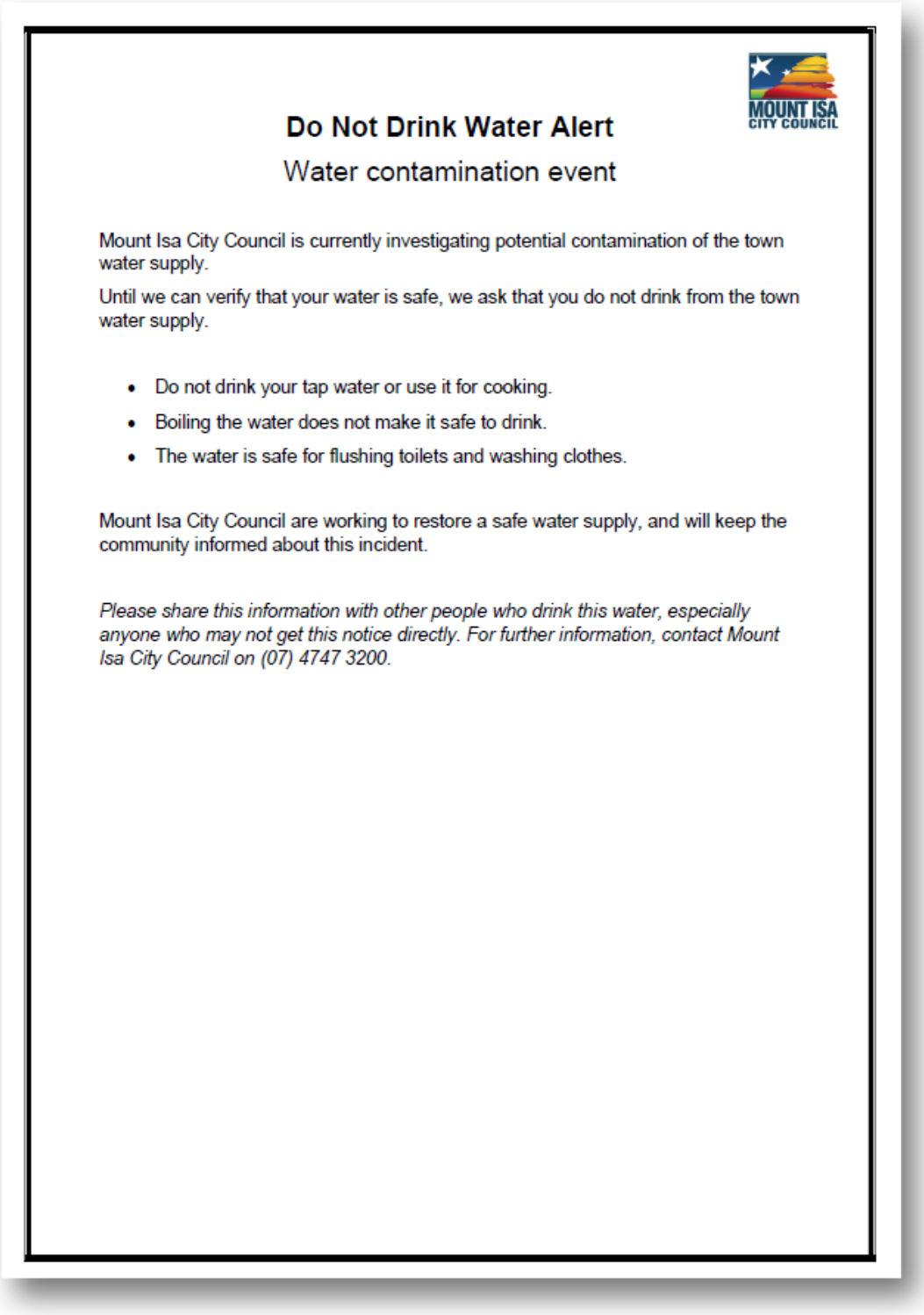
QR codes

Plant and equipment is gradually being tagged with QR codes, similar to that shown in Figure 12 below.

The codes link to the appropriate procedures, manuals and safety information on the Internet. The information is presently stored on a website outside of the Council corporate system, to facilitate access by contractors and staff who do not have access to the corporate system.

Figure 12 - QR code for in-system chlorinator

Appendix J Emergency Notification Templates



Do Not Drink Water Alert

Water contamination event

Mount Isa City Council is currently investigating potential contamination of the town water supply.

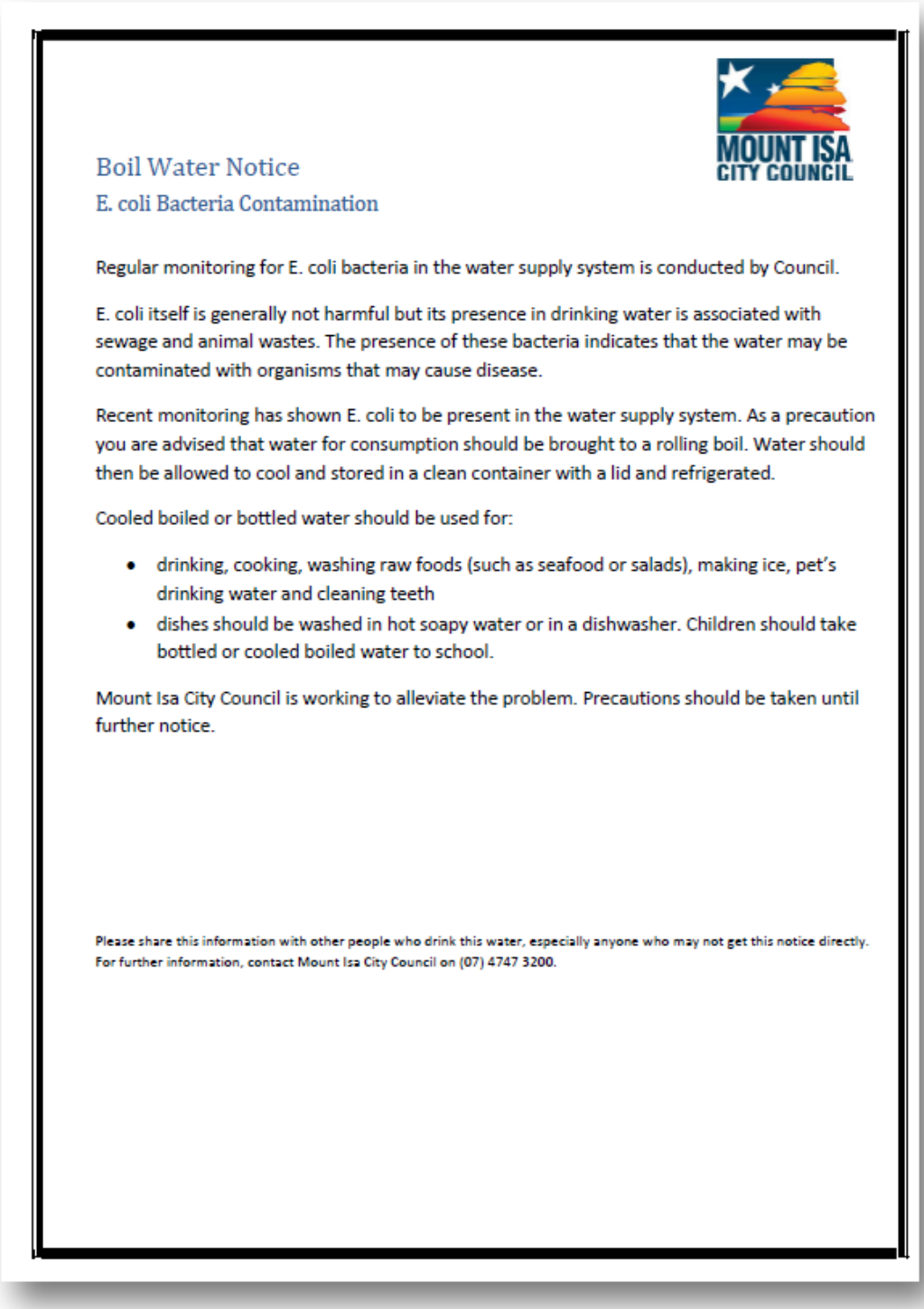
Until we can verify that your water is safe, we ask that you do not drink from the town water supply.

- Do not drink your tap water or use it for cooking.
- Boiling the water does not make it safe to drink.
- The water is safe for flushing toilets and washing clothes.

Mount Isa City Council are working to restore a safe water supply, and will keep the community informed about this incident.

Please share this information with other people who drink this water, especially anyone who may not get this notice directly. For further information, contact Mount Isa City Council on (07) 4747 3200.

Figure 13 - Do not drink template



Boil Water Notice

E. coli Bacteria Contamination

Regular monitoring for E. coli bacteria in the water supply system is conducted by Council.

E. coli itself is generally not harmful but its presence in drinking water is associated with sewage and animal wastes. The presence of these bacteria indicates that the water may be contaminated with organisms that may cause disease.

Recent monitoring has shown E. coli to be present in the water supply system. As a precaution you are advised that water for consumption should be brought to a rolling boil. Water should then be allowed to cool and stored in a clean container with a lid and refrigerated.

Cooled boiled or bottled water should be used for:

- drinking, cooking, washing raw foods (such as seafood or salads), making ice, pet's drinking water and cleaning teeth
- dishes should be washed in hot soapy water or in a dishwasher. Children should take bottled or cooled boiled water to school.

Mount Isa City Council is working to alleviate the problem. Precautions should be taken until further notice.

Please share this information with other people who drink this water, especially anyone who may not get this notice directly. For further information, contact Mount Isa City Council on (07) 4747 3200.

Figure 14 - E. coli alert template