



BLIGH TANNER

Drinking Water Quality Management Plan

Aurukun Shire Council

Date: 15 June 2023

DOCUMENT DETAIL

DOCUMENT:	Drinking Water Quality Management Plan	DATE:	15-06-2023
JOB NUMBER:	2022.1035		
PROJECT DETAIL:	Aurukun Shire Council DWQMP		

HISTORY

REVISION	DATE	PREPARED	CHECKED	APPROVED
1.0	May 2018	Travis Robinson	Michael Lawrence	
1.1	11 June 2018	Travis Robinson	Michael Lawrence	Perry Gould
1.2	6 September 2018	Michael Lawrence	Sean Hinton	Perry Gould
1.3	3 September 2019	Michael Lawrence	Sean Hinton	Gus Yates
1.4	15 April 2020	Michael Lawrence	Gus Yates	Gus Yates
2.0	23 May 2023	Joshua Frank	Michael Lawrence	
2.1	15 June 2023	Joshua Frank	Michael Lawrence	Dan Dixon

Aurukun Shire Council
39 Kang Kang Road Aurukun Qld 4892
T +61 7 4060 6191
SPID-5
council@aurukun.qld.gov.au

Bligh Tanner Pty Ltd
ABN 32 061 537 666
Level 9
269 Wickham Street
PO Box 612
Fortitude Valley Qld 4006
Australia
T +61 7 3251 8555
F +61 7 3251 8599
blightanner.com.au



CONTENTS

DOCUMENT DETAIL	2
HISTORY	2
INTRODUCTION	5
1.1 Registered service details	5
1.2 Aurukun Shire Council	5
COMMITMENT TO DRINKING WATER QUALITY MANAGEMENT	7
2.1 Regulatory and formal requirements	7
DETAILS OF DRINKING WATER SUPPLY	9
3.1 Aurukun Drinking Water Supply Scheme	9
HAZARD ANALYSIS AND RISK ASSESSMENT.....	15
4.1 Water quality assessment	15
4.2 Risk assessment team	19
4.3 Risk methodology	19
4.4 Risk assessment.....	20
RISK MANAGEMENT.....	26
5.1 Operational Control.....	26
5.2 Critical Control Points	27
5.3 Information management.....	30
INCIDENTS AND EMERGENCIES.....	31
6.1 Incident communications	33
6.2 Community notification.....	33
6.3 Staff training.....	34
OPERATIONAL AND VERIFICATION MONITORING	34
7.1 Groundwater monitoring.....	34
7.2 Operational monitoring.....	34
7.3 Verification monitoring	35
RISK MANAGEMENT IMPROVEMENT PROGRAM.....	36
REVIEW AND AUDIT	36
REFERENCES	37

Figures

Figure 1 Aurukun Shire Council Local Government Area ..	6
Figure 2 Aurukun Township.....	6
Figure 3 Aurukun regional rainfall data.....	9
Figure 4 Aurukun land use map with contours (10 m AHD).....	10
Figure 5 Aurukun township registered groundwater bores.....	11
Figure 6 Aurukun Drinking Water Scheme Schematic .	13
Figure 7 Free chlorine June 2017 – December 2022 .	16
Figure 8 Historical pH (external sampling) June 2017 – December 2022.....	17
Figure 9 Historical turbidity - external sampling June 2017 – December 2022	18
Figure 10 Council reporting lines	33
Figure 11 Infrastructure Overlay	41

Tables

Table 1 Registered service details	5
Table 2 Stakeholders.....	8
Table 3 Aurukun groundwater production bore details	12
Table 4 Aurukun groundwater production bore water quality results summary	15
Table 5 Aurukun treated water quality laboratory results from 06/2017 -03/2023.....	16
Table 6 Aurukun treated water quality field results	17
Table 7 Aurukun Snapshot Monitoring results	19
Table 8 Risk assessment team	19
Table 9 Risk matrix.....	20
Table 10 Uncertainty descriptors.....	20
Table 11 Unmitigated Risks	21
Table 12 Mitigated Risks.....	23
Table 13 ASC preventive measures (Operator Responsibilities).....	26
Table 14 Incident and Emergency Response Levels....	31
Table 15 Incident and Emergency Response summary of actions	32
Table 16 Groundwater monitoring.....	34
Table 17 Operational monitoring schedule.....	34
Table 18 Verification monitoring testing schedule	35

GLOSSARY

TERM	DEFINITION
ADWG	Australian Drinking Water Guidelines
CCP	Critical Control Point
DRDMW	Department of Regional Development Manufacturing and Water
DWQMP	Drinking Water Quality Management Plan
LRV	Log Reduction Value
NTU	Nephelometric turbidity units
QH	Queensland Health – regulator of public health
RMIP	Risk Management Improvement Program
SPID	Service Provider Identification Number
WSSRA	<i>Water Supply (Safety and Reliability) Act 2008</i>

INTRODUCTION

This Drinking Water Quality Management Plan (DWQMP) is for the potable water scheme managed by Aurukun Shire Council (Council). 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 Guideline for the preparation, review and audit of drinking water quality management plans (the Guideline) (V3, 1 Oct 2022, DRDMW).

1.1 Registered service details

Aurukun Shire Council is registered as a medium service provider (SPID 5), with details as per Table 1.

Table 1 Registered service details

Service Description - Aurukun	Details
Current Connected Population (2021)	1,101
Future Connected Population (2031)	771
Current Connections (approx.)	320
Current Demand (approx.) ML/a	511 ML/ annum; 1.4ML/day
Future Demand (2031) ML/a	357

Population in Aurukun is currently declining ~3% per annum. Demand forecasts based on current per capita consumption (projected to future population).

1.2 Aurukun Shire Council

Aurukun Shire Council operates the water supply and sewerage scheme in the Cape York community of Aurukun, Queensland (see Figure 1 and Figure 2).

Although the Aurukun Shire Council covers a significant land area of more than 7,500 km², the water supply services are largely only provided to the township of Aurukun, an area of less than 1 km².

Council is responsible for the sourcing, treatment and supply of drinking water to the community.



Figure 1 Aurukun Shire Council Local Government Area



Figure 2 Aurukun Township

COMMITMENT TO DRINKING WATER QUALITY MANAGEMENT

2.1 Regulatory and formal requirements

2.1.1 Regulatory scope

Aurukun Shire Council responsibilities related to the delivery of drinking water supply are administered under the following state legislation (and their associated regulations):

- *Public Health Act 2005 (Qld)*,
 - *Public Health Regulation 2018 (Qld)*,
- *Water Supply (Safety and Reliability) Act 2008 (Qld)*,
 - *Water Supply (Safety and Reliability) Regulation 2011 (Qld)*,

Other legislation not related to drinking water quality but relevant for the drinking water supplier include:

- *Work Health and Safety Act 2011 (Qld)*,
- *Environmental Protection Act 1994 (Qld)*,
- *Water Act 2000 (Qld)*,
- *Plumbing and Drainage Act 2002 (Qld)*,
 - *Standard Plumbing and Drainage Regulation 2003 (Qld)*,
- *Qld Plumbing and Wastewater Code*,
- Appropriate Australian Standards.

1.1.1 Employee responsibilities

The Director Technical Services is responsible for coordinating the implementation of the DWQMP.

Those employees within the water supply section with responsibilities directly related to water quality management have those requirements relevant to their position reflected in their position description.

1.2 Stakeholders

The following table includes the key stakeholders in the management of water. These include internal council contacts responsible for delivering safe water, regulatory contacts who are involved in the regulation of water supply and or the management of incidents, community stakeholders who may be consulted in the event of an incident, and the suppliers of services for operating the water treatment plant.

Table 2 Stakeholders

Type	Agency	Contact Details	Role
Aurukun Shire Council	Graham King	0427 430 825	A/Chief Executive Officer
	Alan Neilan	0428 852 472	Director Community Services
	Juanita Warner	0417 137 076	A/Director Corporate Services
	Dan Dixon	0427 606 800	Director Technical Services
	Paul Dodds	048 052 539	Plumbing Supervisor
	Ben Green	0447 171 108	A/Electrical Supervisor
Regulatory	Department of Regional Development Manufacturing and Water (DRDMW)	Incident reporting 1300 596 709	Sustainable use of water resources, drinking water quality incident reporting
	Tropical Public Health Services Cairns (Queensland Health)	07 4226 5555	Public Health Advice
	Department of Environment and Science (DES)	Pollution Hotline 1300 130 372	Environmental incident reporting
Community	Aurukun Airport	07 4060 6828	Water quality sample dispatch
	Aurukun Health Service	07 4060 6700	High risk customer
	Aurukun Island & Cape Supermarket	07 4060 6012	Food supplier
	Aurukun Primary Health Care Centre	07 4060 6133	High risk customer
	Aurukun Shire Council	07 4060 6800	Stakeholder information dissemination
	Aurukun State School	07 4083 4333	Vulnerable population
	Kang Kang Café and Bakery	0428 0457 393	Food supplier
	Kool Kan Early Childhood Centre & Family Support Hub	07 4060 6051	Vulnerable population
	Ma Min Eatery	07 4060 6831	Food supplier
	Wuungkam Lodge	07 4060 6814	Town accommodation
External Suppliers	Northern Water		Analyser service
	Northern Chemicals	07 4035 4622	Sodium hypochlorite supplier
	Northern Chemicals		Caustic Soda supplier

DETAILS OF DRINKING WATER SUPPLY

3.1 Aurukun Drinking Water Supply Scheme

The Aurukun township is located on the far west coast of Cape York near the mouth of the Archer, Watson and Ward Rivers.

Aurukun Shire Council sources raw water from five groundwater production bores. The raw water is pH adjusted and disinfected at the Aurukun Water Treatment Plant before being pumped to the supply scheme network.

3.1.1 Catchment characteristics

Geology: Aurukun is typically of the Gulf with the major geological units consisting of quaternary and tertiary aluminous laterites (effectively bauxite).

Topography: The area around Aurukun is very flat and sandy with large areas of wetlands. This reflects the typically shallow aquifer.

Climate: Rainfall data for the region demonstrates the extreme fluctuations in rainfall that occur in the region, with a defined wet season starting in December through to March, and a well-defined dry season lasting from April through to November. Mean rainfall in January and February is more than 470 mm per month, compared to mean monthly rainfall totals of less than 10 mm per month in June to September.

Summary statistics for all years

[Information about climate statistics](#)

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	470.4	467.7	332.2	92.4	13.1	3.0	0.9	1.5	2.3	16.0	6.4	47.1	1691.2
Lowest	137.4	117.4	13.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	599.0
5th %ile	179.0	160.0	113.4	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1119.8
10th %ile	248.7	210.0	118.6	10.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1224.1
Median	448.1	467.4	303.8	72.3	4.1	0.0	0.0	0.0	0.0	2.0	59.4	211.9	1652.2
90th %ile	785.7	749.8	573.7	187.6	30.5	6.4	2.8	3.0	5.8	49.3	146.2	400.3	2147.7
95th %ile	852.1	782.1	616.9	251.1	53.2	11.7	5.2	8.7	14.8	77.0	188.6	442.4	2267.6
Highest	991.9	1156.0	785.8	484.0	126.6	108.9	15.4	37.2	44.4	153.4	342.4	632.6	2633.1

Aurukun Shire Council (027000) 2021 Rainfall (millimetres)

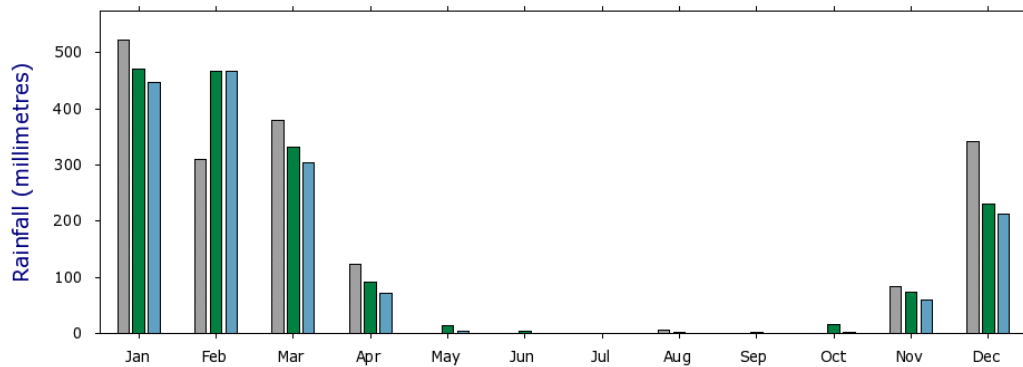


Figure 3 Aurukun regional rainfall data



Figure 4 Aurukun land use map with contours (10 m AHD)

Land Use: There is very little land use in the catchment with the Queensland Globe Land Use Mapping identifying all land areas within 50km of Aurukun as minimal use. (Aurukun township itself is residential, and the airport identified as “services”). Marshland is identified in pale blue.

Drinking Water Aquifer: Drinking water supply is sourced from five groundwater production bores located within or in close proximity to the township of Aurukun, and all at heights below the 10m AHD contour. In general, these bores are above flood levels, but rainfall can be extreme, and the flooding of the surrounding area sufficient to isolate the community is an annual event.

These aquifers are highly dynamic with standing water levels changing rapidly after rainfall. Due to the high ingress from surface water into the aquifers, the water source is considered unconfined, with direct connectivity to the surface. The aquifer also underlies the town’s sewerage network, and the water table has impacted depths of graves in the old cemetery. As such, the catchment is an unprotected, Category 4 catchment and this is reflected in the risk assessment. Nonetheless there are not regular microbial detections in the groundwater.

Groundwater bores: There are a number of groundwater bores registered by DRDMW within the Aurukun township, as is displayed below. Of these bores, five are used as production bores for drinking water supply. However, a number of these production bores have been re-drilled since they were originally developed, and although they are near the original boreholes, it is unclear if they have been developed to the same depth as the original bore reports. The original boreholes have now been capped to decommission.

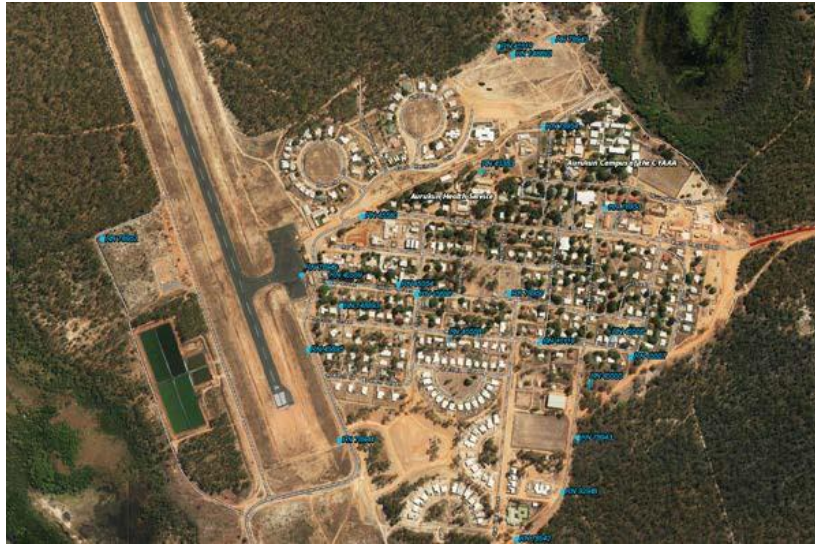


Figure 5 Aurukun township registered groundwater bores

3.1.2 Groundwater production bores

Groundwater is extracted from 5 shallow aquifer bores, which according to the original bore report data range in depth from 13.8 to 25.9 m below NSL. These boreholes rapidly recharge after rain, with historical groundwater levels in the bore located at the water treatment plant ranging from -2.52 to 9.31 m NSL, with an average depth of -6.34 m NSL (n=118 during 03/1983 to 03/1992).

Typically one to three bores are required to supply sufficient water for the township. The new SCADA system turns on the bore pumps based on the level in the clear water reservoir, however the pump rates are manually adjusted. The five bore pumps are rotated based on the SCADA system. Control options for borehole selection, as well as flow rate and groundwater level information, is supplied to SCADA.

A separate bore near Bore 3 has pipework connections fitted to enable the supply of untreated water to a below ground irrigation scheme for a sportsgrounds within the site. There is no connection for untreated water to the potable network.

The location of the five production groundwater bores is provided below.



Figure 6 Aurukun production groundwater borehole locations

Table 3 Aurukun groundwater production bore details

	Airport Bore	Alex Bore	Truck Fill Bore	Carpenter's Bore	Tower Bore
Number	1	2	3	4	5
Registration	RN148892	RN45118	-	RN45557	RN45554
GPS location	141.727315, -13.350987	141.728117, -13.357627	141.728783, -13.357769	141.730127, -13.357967	141.724776, -13.356342
Aquifer type	Bulimba formation	Unconfined	Unconfined	Bulimba formation	Bulimba formation
Date drilled	09/11/2011	21/11/1976	Unknown	21/04/1983	15/04/1983
Pump type	Grundfos submersible	Grundfos submersible	Grundfos submersible	Grundfos submersible	Grundfos submersible
Depth	24	24	24	21	21
Bore head details	Raised and sealed	Raised and sealed	Raised and sealed	Raised and sealed	Raised and sealed
Casing & material	PVC casing with stainless steel strainers	PVC casing with stainless steel strainers	PVC casing with stainless steel strainers	PVC casing with stainless steel strainers	PVC casing with stainless steel strainers

3.1.3 Process and schematic

The Aurukun water treatment plant is located on the corner of Ku and Pikkuw Streets in Aurukun.

3.1.3.1 Treatment process

As is common with bore water in bauxite rich areas, the groundwater is quite acidic, with incoming bore water pH ranging from 4.5 to 5.5. Each bore has a different flow rate ranging from 5l/s to 15l/s which is adjusted by the PLC to match the town's water demand. When the bores come on-line, bore water is tested for its pH level using an inlet analyser which, through the PLC, controls the dosing pumps. The caustic soda pumps are in a duty/assist configuration with automatic changeover based on the inlet flow and fully SCADA controlled. Caustic soda is delivered and stored in 1000L intermediate bulk containers (IBC). 1000L chemical at current usage lasts for about 20 days.

There is a second read-only analyser on the town water supply that monitors what is going to the community. The analyser sends out alarms to the operator to notify of a potential risk to the community.

Despite the drinking water bores used in Aurukun being near marine and estuarine environments, historical electrical conductivity values of the groundwater appear to be predominantly low (140 µS/cm), indicating the groundwater recharge source as fresh water.

Council ensures that the water is safe for consumption by disinfecting the water with liquid sodium hypochlorite to kill bacteria and viruses that could be in the bore water or contaminate the water within the network. The inlet analyser also sends a signal to the chlorine dosing pumps which operate in a duty/standby. The configurations are automatically controlled by SCADA.

Sodium hypochlorite is delivered and stored in IBCs holding 1000L each. The chemical received from the supplier is tested for its concentration upon receipt and diluted to 50% and stored in a closed, airconditioned room to extend its shelf life. Historic data shows usage of 3.3 L/h of diluted sodium hypochlorite while the plant is running. If the plant runs at maximum capacity (24h/d), a 1000L IBC delivery allows sufficient chemical on hand for 24 days, however as the plant usually doesn't run at maximum capacity for extended periods of time chemical storage is likely to last longer.

The plant is fully automatic and PLC controlled. Adjustments to set points can only be made by the SCADA. There are numerous systems in place to ensure resilience towards cyber attacks. The IT officer and Future Computers (3rd party IT support) have implemented a software strategy that includes firewalls to protect the ASC network, antivirus software (Endpoint detection, up-to-date), web filtering and a password policy. Further, the WTPs SCADA has no ethernet connectivity (i.e. any code changes must be done from site), SCADA access levels/permissions are granted based on the needs of the position and the onboarding process for new staff and disabling of accounts after staff departure is handled immediately. The WTP site has CCTV in some areas and is fully fenced.

3.1.3.2 Reservoirs

The drinking water scheme contains three clear water reservoirs, with all three reservoirs located in the water treatment plant compound. Reservoirs A and B are both 600 kL concrete tanks, with Tank C a 456 kL round steel tank. Tank levels and high and low-level alarm data for the three reservoirs is connected to the SCADA system for the site. Remote terminal unit (RTU) displays for the three reservoirs are located within the pressure pump building within the treatment plant.

The concrete reservoirs are roofed and vermin proofed.

Community usage is estimated to be approximately 1.4 ML/d, which equates to an approximate water usage of 995 L/p/d. However, this usage fluctuates dramatically throughout the year depending on seasonal demands. Taking into consideration this water usage rate, the reservoirs contain approximately one day's storage.

3.1.3.3 Pressure pumps

A bank of six Grundfos Blueflux pressure pumps are provided to maintain adequate water pressure throughout the network. These pumps are located within a designated building within the water treatment plant, with an RTU for the pumps showing pump status, pressure and pump rates also located within this building. This information is also connected to the system SCADA.

3.1.3.4 Pipe layout

The reticulation network with the current (07/09/2018) valving and pipe configuration for much of the network is shown in Appendix B. The configuration of the reservoirs, and their valving arrangements is unknown. A schematic for is shown below in Figure 6.

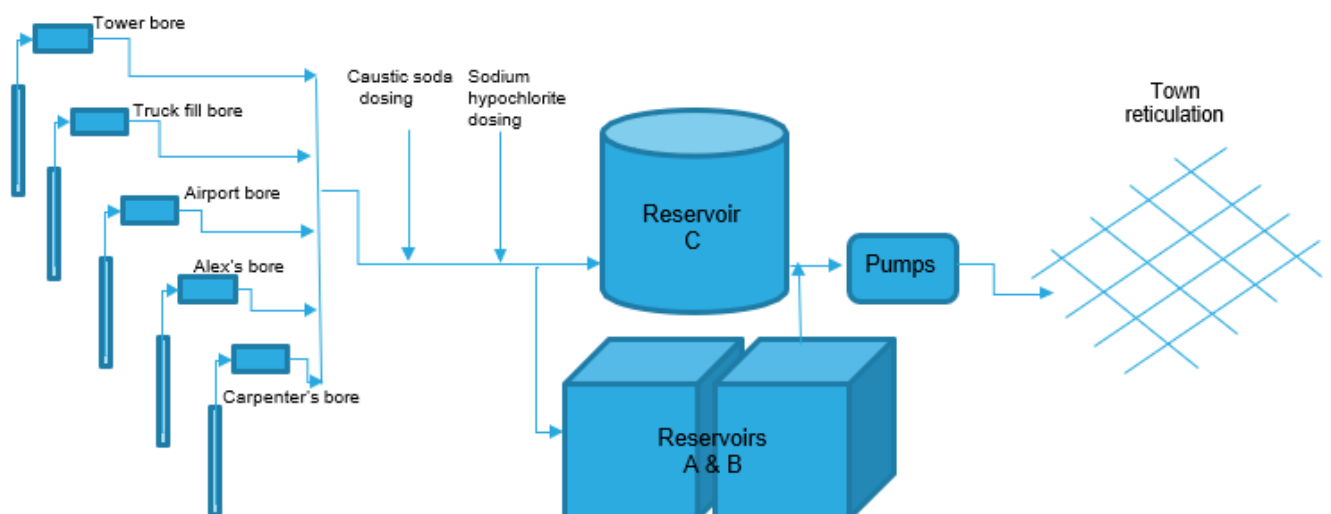


Figure 6 Aurukun Drinking Water Scheme Schematic

3.1.4 Distribution network asset details

3.1.4.1 Pipelines

Treated water from the reservoirs is pumped via the treatment plant pressure pumps throughout the distribution network.

The original supply network of asbestos cement was upgraded and now consists of Blue Brute PVC pipework. The network operates as a ring main to minimise the number of dead ends within the system. Water pressure is maintained throughout the network at 210 kPa.

3.1.4.2 Fittings

Valves have been installed to isolate sections of the reticulation network to minimise the impact of pipe failure and facilitate network repairs. However, the location and role of most valves within the network is not clear, with there being no design drawings available to identify pipework connections and valving.

HAZARD ANALYSIS AND RISK ASSESSMENT

4.1 Water quality assessment

An assessment of the available source and treated water quality data for the Aurukun Drinking Water Scheme is provided below.

4.1.1 Source water

Laboratory analysis is undertaken individually at all five bores throughout Aurukun and at the water treatment plant inlet that represents the mixed bore water coming from the online bores at the time of sampling.

Water quality data from 2017 to 2023 has been presented below. The groundwater data presented in Table 4 is a combined data set of the available data from the five groundwater production bores that form the source water of the Aurukun drinking water scheme. There was one occasion where *E. coli* was found in a sample from Bore 3 (April 2022).

Table 4 Aurukun groundwater production bore water quality results summary (<LOD shown as ½ LOD)

Raw Water	Units	Count	Min	Max	Average
Microbiological					
<i>E. coli</i>	cfu/100mL	935	<1	31	<1
Chemical					
Ammonia	mg-N/L	96	0.01	0.06	0.01
Aluminium	mg/L	96	0.0025	0.367	0.01
Copper	mg/L	96	0.008	0.107	0.02
Iron	mg/L	96	0.004	3.51	0.11
Lead	mg/L	96	0.0005	0.0242	0.005
Manganese	mg/L	96	0.001	0.204	0.01
Nickel	mg/L	96	0.00025	0.0182	0.003
Nitrate	mg/L	96	0.18	1.5	0.89
Nitrite	mg/L	96	0.005	0.01	0.005
pH	pH units	96	4.8	7.6	5.5

Orange – ADWG Aesthetic Guideline Exceedance

4.1.2 Treated water

The laboratory water quality data for the reticulated network in the Aurukun drinking water scheme has recently been sampled on a more frequent basis. The results of the treated water laboratory analysis are presented in Table 5.

The majority of the data set has been from sampling undertaken at the water treatment plant following treatment being undertaken, although the *E. coli* and free chlorine data have been taken from verification sampling points across the supply network as well as from the treatment plant.

The current verification sampling points for *E. coli* are as follows:

- Aurukun water treatment plant
- Aurukun hospital
- Aurukun Extra
- Aurukun Extra Boat Ramp

Historic (until Sep 2020) verification sample point in addition the treatment plant and hospital were:

- Community Centre Aurukun (formerly known as (Old) Tavern),
- 220 Kleidon Drive Aurukun,
- 413 Wuungkam Street Aurukun,

There have been no *E. coli* detections in the treated water.

Although the average pH value is 7.2 pH units, there are several occasions where pH is acidic and below the ADWG aesthetic guideline value of 6.5 pH units.

Turbidity results have also exceeded the aesthetic threshold of 5 NTU – although not since the reticulation network was replaced.

Table 5 Aurukun treated water quality laboratory results from 06/2017 -03/2023

Parameter	Units	Count	Min	Max	Average
Microbiological					
<i>E. coli</i>	cfu/100mL	353	<1	<1	<1
Physical/ Chemical					
Turbidity	NTU	354	<0.1	9.1	0.21
pH	pH units	129	5.4	8.2	7.2

Orange – exceeds ADWG Aesthetic Limit; **Yellow** – less than best practice

Chlorine results since 2017 are shown in the figure below.

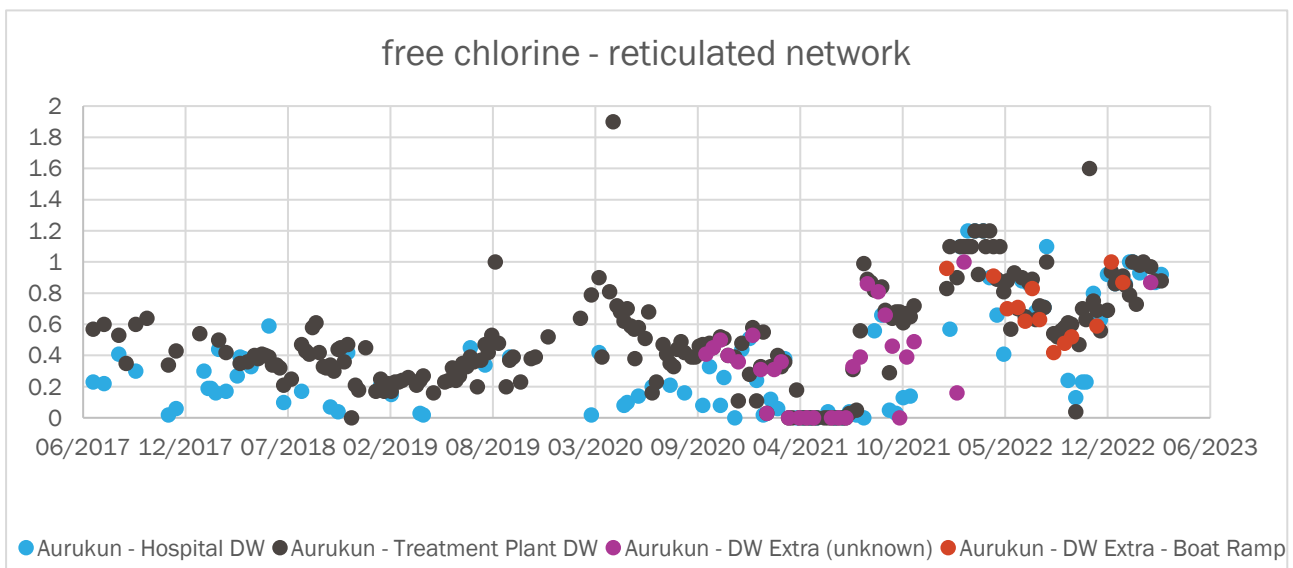


Figure 7 Free chlorine June 2017 – December 2022

A summary of the field water quality results for the Aurukun treated water from the drinking water supply network from 2017 to 2023 are presented in Table 6. From February 2018 to September 2021 there is only sporadic data available with significantly improved data quality from there onwards.

The field data indicates issues with the chlorination throughout 2021. Several samples at the treatment plant were below 0.3mg/L and 59 samples below 0.2 mg/L. These low chlorine results spread from March 2021 to August 2021 led to a boil water alert for the community in August 2021 which lasted several weeks. Field data from this time onwards improved significantly.

Table 6 Aurukun treated water quality field results

	Water Treatment Plant			Works depot			Chivaree Centre			Community Centre			Airport Terminal		
	Cl (F)	Cl (T)	pH	Cl (F)	Cl (T)	pH	Cl (F)	Cl (T)	pH	Cl (F)	Cl (T)	pH	Cl (F)	Cl (T)	pH
Count	937	806	931	692	665	685	687	687	682	688	661	686	540	540	540
5 th Percentile	0.16	0.31	6.73	0.28	0.38	6.75	0.25	0.33	6.7	0.3	0.4	6.8	0.39	0.41	6.88
95 th Percentile	1.12	1.18	7.6	1	1.04	7.6	1.04	1.1	7.6	1.06	1.12	7.7	1.06	1.1	7.7
Avg	0.66	0.87	7.14	0.62	0.68	7.2	0.63	0.68	7.1	0.66	0.72	7.2	0.7	0.92	7.3

Yellow - less than best practice value of 0.2 mg/L. (F = free, T = Total)

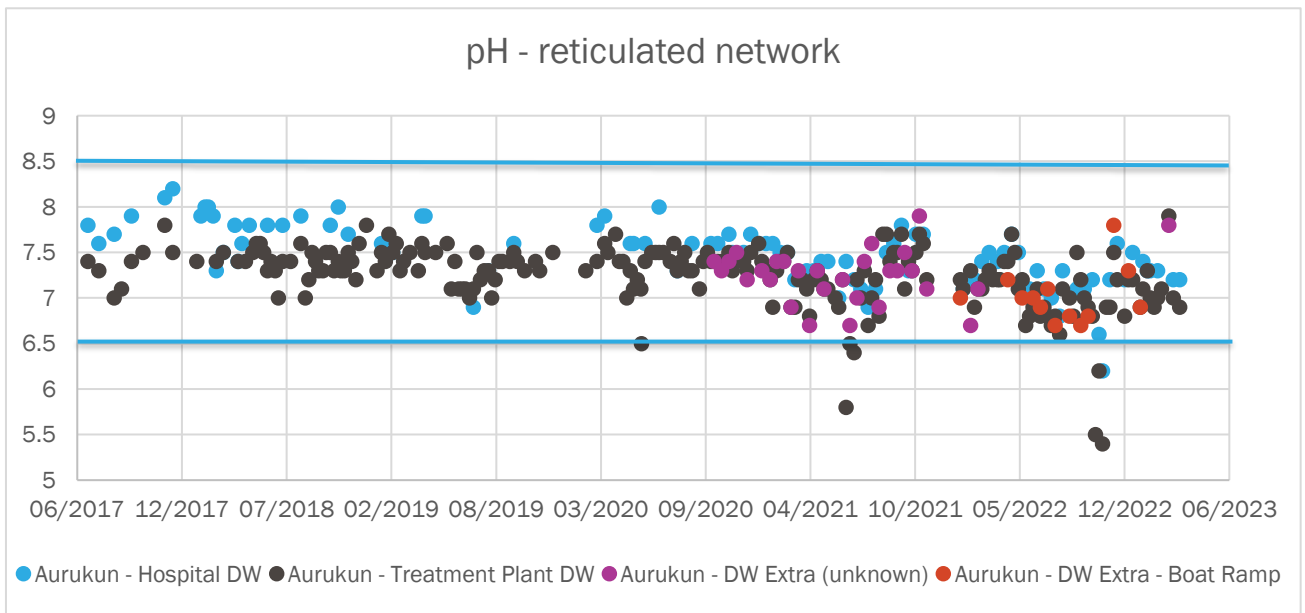


Figure 8 Historical pH (external sampling) June 2017 – December 2022

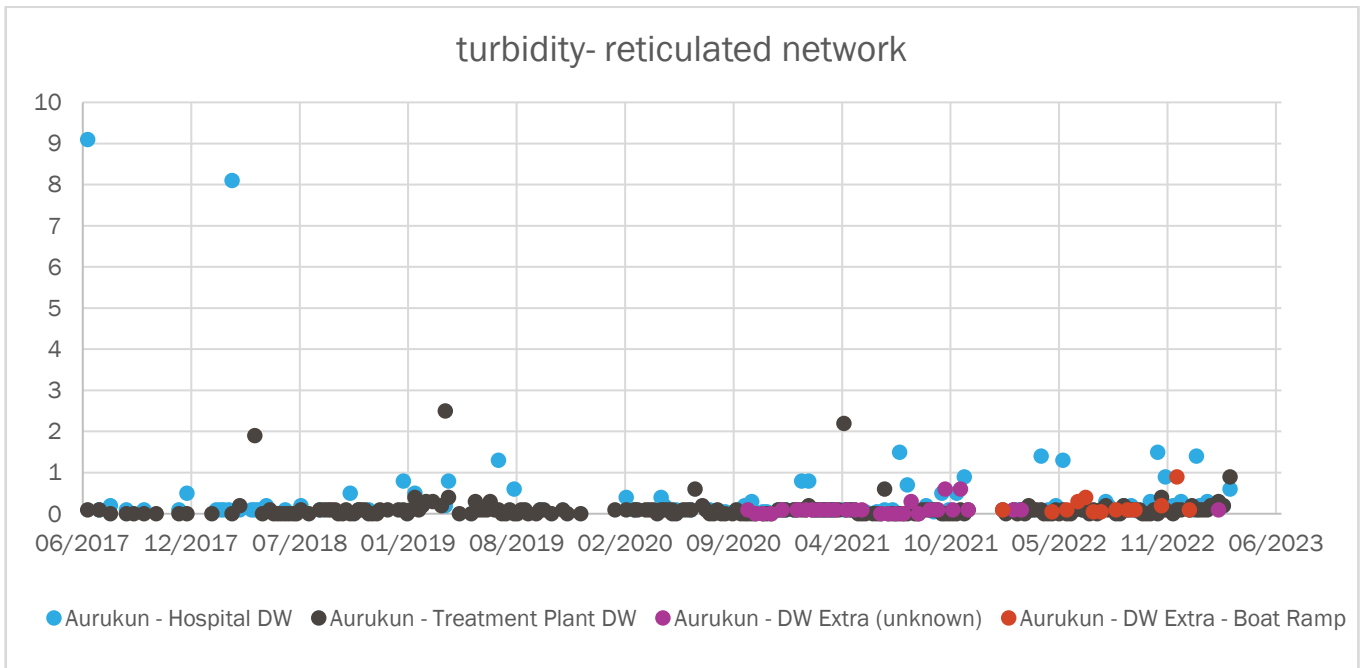


Figure 9 Historical turbidity - external sampling June 2017 – December 2022

Table 7 Aurukun Snapshot Monitoring results

Name	Sample Description	Collected Date	Bromate by											
			Chlorate by IC mg/L	IC mg/L	Aluminium mg/L	Antimony mg/L	Arsenic mg/L	Barium mg/L	Beryllium mg/L	Boron mg/L	Cadmium mg/L	Chromium mg/L	Cobalt mg/L	Copper mg/L
			0.8	0.02	0.2	0.003	0.01	2	0.06	4	0.002	0.05		2
AUR01 - Treated	S141 724 776 E13 356 342	08-Dec-11	0.51	< 0.01										
AUR01A - Treated	S141 724 776 E13 356 342	08-Dec-11			0.013	< 0.0001	< 0.0001	0.0036	< 0.0001	0.028	< 0.0001	0.0003	< 0.0001	0.009
AUR02 - Untreated	S141 724 887 E13 356 205	08-Dec-11												
Name	Sample Description	Collected Date	Bromate by											
			Iron mg/L	Lead mg/L	Manganese mg/L	Molybdenum mg/L	Nickel mg/L	Selenium mg/L	Silver mg/L	Strontium mg/L	Thallium mg/L	Titanium mg/L	Uranium mg/L	Vanadium mg/L
			0.3	0.01	0.5	0.05	0.02	0.01	0.1				0.017	
AUR01 - Treated	S141 724 776 E13 356 342	08-Dec-11												
AUR01A - Treated	S141 724 776 E13 356 342	08-Dec-11	0.01	0.0002	0.0012	< 0.0001	0.0011	< 0.0010	< 0.001	0.02	< 0.0001	< 0.001	< 0.0001	0.0001
AUR02 - Untreated	S141 724 887 E13 356 205	08-Dec-11												
Name	Sample Description	Collected Date	Bromate by											
			Zinc mg/L	Conductivity uS/cm	pH	Temperature deg C	Total Hardness mg/L as CaCO ₃	Temporary Hardness mg/L as CaCO ₃	Residual Alkalinity meq/L	Silica mg/L	Total Dissolved Ions mg/L	Total Dissolved Solids mg/L	True Colour Hazen	
			3		6.5-8.5						80		600	15
AUR01 - Treated	S141 724 776 E13 356 342	08-Dec-11												
AUR01A - Treated	S141 724 776 E13 356 342	08-Dec-11	0.015											
AUR02 - Untreated	S141 724 887 E13 356 205	08-Dec-11		166	5.47	23	14	3	3	0	12	87	97	2
Name	Sample Description	Collected Date	Bromate by											
			Turbidity NTU	pH (Saturation)*	Saturation Index	Mole Ratio	Sodium Absorption Ratio	Figure of Merit	Sodium mg/L	Potassium mg/L	Calcium mg/L	Magnesium mg/L	Hydrogen mg/L	Bicarbonate mg/L
			5							180				
AUR01 - Treated	S141 724 776 E13 356 342	08-Dec-11												
AUR01A - Treated	S141 724 776 E13 356 342	08-Dec-11												
AUR02 - Untreated	S141 724 887 E13 356 205	08-Dec-11	<1	10.8	-5.3	5.9	2.9	0.3	25	1.2	1.3	2.6	0	4
Name	Sample Description	Collected Date	Bromate by											
			Carbonate mg/L	Hydroxide mg/L	Chloride mg/L	Fluoride mg/L	Nitrate mg/L	Sulphate mg/L	Iron mg/L	Manganese mg/L	Zinc mg/L	Aluminium mg/L	Boron mg/L	Copper mg/L
					250	1.5	50	500	0.3	0.5	3	0.2	4	2
AUR01 - Treated	S141 724 776 E13 356 342	08-Dec-11												
AUR01A - Treated	S141 724 776 E13 356 342	08-Dec-11												
AUR02 - Untreated	S141 724 887 E13 356 205	08-Dec-11	0	0	35	<0.1	5.1	12.1	0.01	<0.01	0.05	<0.05	0.03	<0.03

4.2 Risk assessment team

The drinking water risk assessment update was undertaken in Aurukun on 20 April 2023 as part of the DWQMP review and to incorporate the changed WTP processes and associated risks. The risk assessment team and their role and experience is listed below:

Table 8 Risk assessment team

Name	Organisation	Position title	Role & Experience
Dan Dixon	Aurukun Shire Council	Director Technical Services	4 weeks at Aurukun, previous risk assessment of other council processes
Paul Dodds	Aurukun Shire Council	Plumbing Supervisor	3 years at Aurukun
Joshua Frank	Bligh Tanner	Process and Environmental Engineer	Risk review facilitator. Experienced in environmental and drinking water risk assessments.

4.3 Risk methodology

The risk methodology has been amended from the previous DWQMP. The methodology is described below. The risk assessment follows the following process:

- Review the schematics
- Identify the hazards
- Determine the unmitigated risks
- Identify the preventive measures,
- Determine the mitigated risks
- Identify the procedures used to ensure the preventive measures are effective
- Where mitigated risks are unacceptable, identify risk management improvements

4.3.1 Hazard identification

The hazards identified in the previous risk assessment, and any additional relevant hazards, were identified. The type of hazard is identified (biological, chemical, physical, whole of system), followed by identifying the sources for each of the hazards.

4.3.2 Unmitigated risk assessment

Unmitigated risk is determined by considering the consequence and likelihood of a hazard in the absence of any other controls.

The consequence and likelihood descriptors are included overleaf.

Once the consequence and likelihood are determined, the risk is read from the risk matrix.

For example, for most hazards, this is the risk of drinking raw water with no treatment. For chemicals that are added in the water treatment process (e.g., chlorine) the unmitigated risk assumes that chlorine has been added, but without any monitoring or control of the dose rate.

The uncertainty of the risk assessment is then determined, and any comments captured.

4.3.3 Mitigated risk assessment

The mitigated risk assessment is undertaken by considering the hazardous events that could lead to the hazard being present. The unmitigated risk is brought forward from the unmitigated risk assessment, and the barriers that prevent or minimise the risk of that hazard are identified.

Table 9 Risk matrix

Public Health Risk Matrix		Consequence	Insignificant	Minor	Moderate	Major	Catastrophic
			Isolated aesthetic exceedence - little operational disruption	Local aesthetic exceedence, potential isolated breach of chemical health parameter	Widespread aesthetic exceedences, or repeated breaches of chronic health guidelines	Potential acute health impact, no outbreak expected	Potential acute health impact, declared outbreak likely
Likelihood							
Almost Certain	Occurs daily to weekly		Medium 6	High 10	High 15	Extreme 20	Extreme 25
Likely	1-4 occurrences per month		Medium 5	Medium 8	High 12	High 16	Extreme 20
Possible	1-11 occurrences per year		Low 3	Medium 6	Medium 9	High 12	High 15
Unlikely	1 occurrence per 1-5 years		Low 2	Low 4	Medium 6	Medium 8	High 10
Rare	<1 occurrence per 5 years		Low 1	Low 2	Low 3	Medium 5	Medium 6

Barriers include the current treatment barriers (disinfection etc), but also include any actions that may minimise the hazard in the catchment (e.g. fencing around bores to exclude access). The effectiveness of these measures are then considered in the context of any recent incidents, and with water quality data where available.

Table 10 Uncertainty descriptors

Uncertainty Level	Uncertainty descriptor
Certain	The processes involved are thoroughly understood and supported by very extensive on site knowledge
Confident	The processes involved are well understood and supported by extensive on site knowledge
Reliable	There is a good understanding of the process which is supported by operational experience and periodic water quality data
Estimate	The process is somewhat understood, based on limited operational experience
Unreliable	The process is not well understood

4.4 Risk assessment

The outcomes of the Aurukun risk assessment workshop are provided in the following pages.

Table 11 Unmitigated Risks

Hazard	Type of Hazard	Sources of Hazard	Unmitigated Risk			Uncertainty	Comments
			Consequence	Likelihood	Risk		
Bacteria/ Virus (Source Water)	Biological	sewerage main breaks, waste dumping, illegal/cross connections, poorly sealed or uncapped bores, cemetery located below water table	Catastrophic	Unlikely	High 10	Confident	353 <i>E. coli</i> samples of bores over several years, and no positive <i>E. coli</i> result recorded. Currently sampling GW boreholes quarterly
Bacteria/ Virus (Reticulation)	Biological	faecal contamination into reservoirs or mains breaks, backflow	Catastrophic	Likely	Extreme 20	Confident	Steel reservoir integrity is poor.
Protozoa (Crypto/ Giardia) (Source Water)	Biological	sewerage main breaks, waste dumping, illegal/cross connections, poorly sealed or uncapped bores	Catastrophic	Unlikely	High 10	Confident	Sandy soils acting as sand filter
Protozoa (Crypto/ Giardia) (Retic)	Biological	faecal contamination into reservoirs or mains breaks, backflow	Catastrophic	Likely	Extreme 20	Confident	Historical connection between old and new reticulation network. This is now resolved. Other sources are still likely in absence of controls.
Protozoa (<i>Naeglaria</i>) (Retic)	Biological	faecal contamination into reservoirs or mains breaks, backflow	Major	Rare	Medium 5	Estimate	Water temp in retic approx 20° C in winter - unlikely to support <i>Naeglaria</i> year round.
Aluminium	Chemical	natural sources	Moderate	Unlikely	Medium 6	Estimate	96 samples, 1 exceedance of guideline value in 2019
Chlorine	Chemical	chemical overdose, operator error	Moderate	Likely	High 12	Reliable	Sodium hypochlorite dosing
Chlorate	Chemical	Breakdown of sodium hypochlorite	Moderate	Possible	Medium 9	Estimate	Chemical management
Copper	Chemical	corrosion of pipework	Moderate	Likely	High 12	Confident	Water at Aurukun is highly corrosive, corrodes infrastructure quickly
Disinfection byproducts	Chemical	elevated organics and long detention times, stagnation in low use pipelines	Moderate	Rare	Low 3	Reliable	Relatively short detention time in network, low organic matter in raw water.
Fluoride	Chemical	natural geology - not added	Moderate	Rare	Low 3	Confident	Fluoride dosing station not in use
Heavy metals/metalloids	Chemical	natural geology, chemical impurities, corrosion of assets, cattle dips, cleaning products	Moderate	Possible	Medium 9	Reliable	Copper main metal of concern.
Lead	Chemical	bore construction, illegal dumping	Moderate	Possible	Medium 9	Reliable	Lead may be present due to corrosion of valves, Lead above guideline value in ground water detected in 2 samples
Hydrocarbons	Chemical	bore contamination, mains contamination, fuel spills	Moderate	Possible	Medium 9	Reliable	Landfill may leach hydrocarbons, pond liners may not be effective. Car wrecks around which may leak fuels and oils.

Hazard	Type of Hazard	Sources of Hazard	Unmitigated Risk			Uncertainty	Comments
			Consequence	Likelihood	Risk		
Iron	Chemical	natural geology, sediment	Minor	Possible	Medium 6	Reliable	No visible iron/iron bacteria in groundwater bores when inspected, Few exceedances of guideline value in bores
Manganese	Chemical	natural geology	Moderate	Unlikely	Medium 6	Reliable	Single exceedance of manganese in groundwater
Pesticides	Chemical	Agriculture, horticulture, pest control around bores	Moderate	Unlikely	Medium 6	Reliable	Weed removal achieved by mechanical means
Taste and odour	Chemical	stagnating water in reticulation	Insignificant	Rare	Low 1	Reliable	Limited taste and odour complaints
Nitrate/Ammonia	Chemical	Sewerage main breaks, pump station overflow or sewage treatment plant seeping into shallow aquifer	Moderate	Unlikely	Medium 6	Reliable	Nitrate would be a good indicator for detecting if sewerage is infiltrating into the aquifer
Colour	Physical	naturally occurring	Insignificant	Rare	Low 1	Reliable	This has not been an issue in Aurukun
Hardness	Physical	local geology, cement lined pipes	Insignificant	Almost Certain	Medium 6	Reliable	Hardness is very low and water is aggressive
pH	Physical	source water changes, overdose/ underdose pH correction chemicals, degradation of mains	Moderate	Almost Certain	High 15	Confident	pH of the groundwater is ~4.5-5
TDS	Physical	aquifer geology	Minor	Rare	Low 2	Confident	Groundwater levels rarely drop even in dry seasons
Turbidity	Physical	ingress into aquifer. Ingress into redundant pipework	Minor	Unlikely	Low 4		Not noticed, even during rainfall events
Turbidity (Retic)	Physical	sloughing of biofilm, accumulation when dry, resuspension of sediment in reservoirs/mains, main break	Minor	Unlikely	Low 4	Confident	There has been instances of dirty water following mains breaks
Loss of Supply	Whole of System	Raw water supply compromised, power supply failure, infrastructure failure, sabotage, SCADA/IT failure, groundwater over-extraction, operator error	Major	Possible	High 12	Confident	Plumbing of 3 reservoirs is unknown, designer (Aurecon) have not provided construction drawings
Radioactivity	Radiological	Natural geology	Moderate	Rare	Low 3	Confident	Not expected in a bauxite aquifer
Natural disaster	Physical	Natural disaster, cyclone	Moderate	Rare	Low 3	Reliable	Boreholes located above flood level
All hazards	All	Any event	Catastrophic	Possible	High 15	Reliable	Main concerns - operator error, steel reservoir integrity
Cyber Security	Whole of System	Cyber attack on council infrastructure	Catastrophic	Rare	Medium 6	Estimate	

Table 12 Mitigated Risks

Process Step	Primary hazard	Other hazards managed by same barriers	Source of Hazard/Event	Maximum Risk	Primary Preventive Measure	Other Preventative Measures	Residual Risk				Documented Procedure	Improvement Program			Comments
							Consequence	Likelihood	Risk Level	Uncertainty		Immediate	Short Term	Long Term	
Water Sourcing	Loss of Supply		Bore pump failure	High 12	Five production bores	Two spare pumps	Catastrophic	Rare	Medium 6	Certain			Investigate future increases /decreases in population impact on drinking water demand and supply requirements	Old bores were capped in 2020	
	Bacteria/ Virus (Source Water)		Ingress into borehead	High 10	Boreheads sealed	Chlorination	Catastrophic	Rare	Medium 6	Certain	CCP			New cemetery has been established away from shallow groundwater	
	Bacteria/ Virus (Source Water)		Ingress into aquifer through abandoned bores	High 10	Active Boreheads sealed	Chlorination	Catastrophic	Rare	Medium 6	Certain	CCP			Old bores were capped in 2020	
	Protozoa (Crypto/ Giardia) (Source Water)		Ingress into aquifer through abandoned bores	High 10	Active Boreheads sealed	Old bores have been capped to decommission	Catastrophic	Rare	Medium 6	Certain				Old bores were capped in 2020	
	Protozoa (Crypto/ Giardia) (Source Water)	Turbidity, Hydrocarbons, pesticides	Ingress into borehead	High 10	Boreheads sealed	Water sourced from groundwater, sandy aquifer may remove surface derived protozoa	Catastrophic	Rare	Medium 6	Estimate				E. coli detected in raw water on 2 occasions, remains limited likelihood of contamination pathway	
	Protozoa (Crypto/ Giardia) (Source Water)		Sewage leaks into aquifer	High 10	Fix sewer mains breaks when identified	Quarterly nitrate and ammonia measurements	Catastrophic	Unlikely	High 10	Estimate			Multibarrier drinking water treatment is required to mitigate this risk. This will require extensive lobbying of State and Federal government for full financial support including ongoing operational costs.	The location of sewerage assets near the water treatment bores means that there is a possibility of a sewerage break contaminating the aquifer. This would only be able to be identified by monitoring.	
	Aluminium	Iron	Naturally present	Medium 6			Minor	Possible	Medium 6	Confident				1 exceedance of guideline value in 2019	
pH adjustment	Heavy metals/metalloids		Contaminated chemicals	Medium 9	Bulk caustic soda procured from reputable supplier		Moderate	Rare	Low 3	Confident	Council procurement policy			Low doses used in normal operation. Would require significant chemical contamination for this to result in ADWG Health guideline value exceedance	
	pH	Copper, Heavy metals	Underdose of caustic soda leading to low pH water	High 15	Daily pH check and adjustment	1.5 days storage in reservoirs, spare pump kept on-site. Online instrumentation measures pH, SCADA sends alarms, and allows for control	Moderate	Possible	Medium 9	Confident	CCP	Develop reorder trigger and schedule. Arrange for at least annual external instrument calibration. Develop SOPs for calibration, chemical handling		Daily data since July 2017 indicates average pH around 7. SCADA update allows for pH monitoring and control.	
	Heavy metals/metalloids	Turbidity, Hydrocarbons	Corrosion of metal fittings	Medium 9	Replacing brass fittings		Moderate	Possible	Medium 9	Estimate	CCP		Consider addressing corrosivity of water	Incorrect valve materials used in reticulation upgrade, and there are significant corrosion issues	
	pH		Overdose of caustic soda, resulting in customer complaints	High 15	Daily pH check and adjustment	1.5 days storage in reservoirs, spare pump kept on-site. Online instrumentation measures pH, SCADA sends alarms, and allows for control.	Moderate	Rare	Low 3	Confident	CCP	Arrange for at least annual external instrument calibration.		Pump capacity not believed capable of achieving significant overdosing at full water production flow (3 bores online)	

Process Step	Primary hazard	Other hazards managed by same barriers	Source of Hazard/Event	Maximum Risk	Primary Preventive Measure	Other Preventative Measures	Residual Risk				Documented Procedure	Improvement Program			Comments
							Consequence	Likelihood	Risk Level	Uncertainty		Immediate	Short Term	Long Term	
Chlorination	Bacteria/ Virus (Source Water)		Failure to dose/ underdose	High 10	Sodium hypochlorite disinfection, Chlorine analyser used to control set-point, Duty/ standby pumps,	daily monitoring and response to low dose	Catastrophic	Unlikely	High 10	Reliable	CCP	Develop reorder trigger and schedule. Arrange for at least annual external instrument calibration. Develop SOPs for calibration, chemical handling			Chlorine dosing levels controlled in SCADA C.t. calculated based on set of assumptions and WSAA protocol.
	Bacteria/ Virus (Source Water)		Overdose of caustic soda, impacting disinfection	High 10	Daily pH check and adjustment		Catastrophic	Rare	Medium 6	Reliable	CCP			Overdose to the point that disinfection is ineffective is not considered realistic	
	Chlorine		Overdose of chlorine	High 12	Low level alarm in SCADA. Daily chlorine check and adjustment	Buffer in reservoir	Moderate	Possible	Medium 9	Reliable	CCP	Arrange for at least annual external instrument calibration.			Chlorine testing has demonstrated consistent chlorine across network. Current verification focusses on treatment plant and one site in community (Hospital)
	Chlorate	Efficacy of disinfection	Breakdown of sodium hypochlorite	Medium 9	Chemical turnover	Storage conditions (AC, indoors, dilution, monitoring)	Moderate	Unlikely	Medium 6	Estimate	CCP	Develop chemical handling procedure			
Reservoirs & Distribution	Disinfection by-products		Overdose of chlorine reacting with organics	Low 3	Set-point chlorine dosing		Moderate	Rare	Low 3	Reliable					Groundwater source is expected to have very low TOC, very high water use means low water age, and chlorine target is low.
	Bacteria/ Virus (Reticulation)		Human access, vandalism, sabotage, animals, ingress, broken mains, biofilm shearing, sediment disturbance	Extreme 20	Exclusion fencing	Ladders removed, hatches locked, broken infrastructure replaced, f/n flushing, chlorine dosing	Catastrophic	Unlikely	High 10	Reliable		Flushing SOP, Reservoir inspection program procedure			
	Bacteria/ Virus (Reticulation)		Mains break	Extreme 20	Chlorine maintained in reticulation	New reticulation completed in 2014	Catastrophic	Rare	Medium 6	Estimate			Mains break SOP		
	Bacteria/ Virus (Reticulation)		New mains	Extreme 20	Chlorine maintained in reticulation		Catastrophic	Rare	Medium 6	Estimate		Commissioning new mains SOP			
	Protozoa (Crypto/ Giardia) (Retic)	Turbidity (Retic)	Vermin ingress, human access to reservoirs	Extreme 20	Isolate access to reservoirs	Periodic inspections	Catastrophic	Rare	Medium 6	Reliable					
	Taste and odour		stagnation in low use pipelines	Low 1	F/n flushing		Insignificant	Rare	Low 1	Confident					This has not been an issue historically
Whole of System	Loss of Supply		Power failure	High 12	Back-up generators on 4 bores, generator at WTP	Regular testing of generators	Catastrophic	Rare	Medium 6	Confident		Develop testing schedule			

Process Step	Primary hazard	Other hazards managed by same barriers	Source of Hazard/Event	Maximum Risk	Primary Preventive Measure	Other Preventative Measures	Residual Risk				Documented Procedure	Improvement Program			Comments	
							Consequence	Likelihood	Risk Level	Uncertainty		Immediate	Short Term	Long Term		
Whole of System	Loss of Supply		Aging infrastructure	High 12	Inspections of reservoirs		Catastrophic	Unlikely	High 10	Estimate		Old steel reservoir requires condition inspection/decommissioning/replacement.		Undertake lifecycle assessment of water supply scheme and investigate future replacement options/strategies	Old steel reservoir based on the 2009 Indigenous Environmental Health Infrastructure Program currently 10 years over expected asset life. Capacity would be an issue if old reservoir goes off-line. Location and routing of pipework within reservoirs unknown.	
	All hazards		Sabotage	High 15	Security fencing at bores and at treatment plant		Catastrophic	Rare	Medium 6	Confident						
	All hazards		Inappropriately skilled operators	High 15	Train new operators		Major	Possible	High 12	Confident				Investigate possibilities of other options to train local personnel	Staff turnover is high, difficult to put all staff through training	
	All hazards		Staff turnover – loss of knowledge	High 15			Catastrophic	Possible	High 15	Estimate			Allow for overlap between staff leaving and coming for knowledge transfer	Backup for critical roles - knowledge for critical processes retained in multiple operators		
	All hazards		operator error	High 15	On the job training		Major	Possible	High 12	Reliable		Develop SOPs for instrument calibration, chemical handling mains break repair, reservoir inspection, recording operational data, sampling/testing		Investigate possibilities of other personnel within council to undertake aspects of sampling		
	All hazards		Natural disaster	High 15	Response to incidents		Major	Possible	High 12	Estimate			Ensure sufficient staff training in incident response		Local government disaster management procedure recently tested (due to cyclone)	
	Cyber Security		Cybersecurity breach results in contamination or chemical over/under dose into the water supply	Medium 6	Remote location	Cyber security protection in place	Catastrophic	Rare	Medium 6	Estimate						
	All hazards		Contractors work practices introduce hazards	High 15	Procurement procedure		Major	Possible	High 12	Confident		Contractor management procedure				Ensure suitable close out procedures for all major works.

RISK MANAGEMENT

5.1 Operational Control

5.1.1 Existing preventive measures

Preventive measures that are in place are identified in the risk register (Primary preventive measure, and Other Preventive Measures columns). Applicable limits and corrective actions are identified below.

Table 13 ASC preventive measures (Operator Responsibilities)

Measure	How	Where	When	Target	Operating Limit	Corrective Action
pH	pH in-line and benchtop analyser, caustic soda dosing	WTP	Continuous online/ daily	See CCP	See CCP	Adjust caustic soda dosing – See CCP
Free Chlorine residual	Free chlorine in-line and benchtop analyser, chlorine dosing	WTP	Continuous online/ daily	See CCP	See CCP	Adjust chlorine dosing – incident if no dosing – See CCP
Reservoir integrity	Visual inspection	Reservoirs	6-monthly	No issues	Breach	Correct breach
Flushing	Chlorine	Grab samples	After flushing/ Main break	0.3-0.5 mg/L	>0.3 mg/L	Sanitary repair, ensure residual after repair/ flushing
	Turbidity	Visual		Mains	Clear water	
Bore Integrity	Visual inspection	Bores	Monthly	No issues		Seal any holes

These processes have not previously been documented / or where documents were previously developed these were not used and are outdated. The RMIP has identified the need to formalise and implement procedures. The key procedures to be developed are:

- Calibration of chlorine dosing system
- Bore Inspections
- Reservoir Inspections
- Contractor Management
- Mains flushing and repair
- Water quality monitoring and testing
- Customer complaints

Following the next formal review of the plan, this list will be reconsidered, and further procedures developed as required.

As the plumbing and connections within/between the reservoirs are unknown the chlorine contact time cannot be accurately determined. Based on the Waterval protocol using the parameters pH (<8), Temperature (>20 °C) and turbidity (<2 NTU) a CT of 8 minutes would be required to achieve a LRV of 4 for viruses.

For a CT calculation only the two concrete reservoirs (1200 kL) were used assuming that the steel reservoir is decommissioned in the medium term. Further, a reservoir low level of 50% is used based on the low level alarm in SCADA and a baffle factor of 0.1 is applied. The minimum chlorine concentration of 0.3 mg/L is based on the SCADA low level alarm. As the max. flow rate out of the reservoirs into the town is unknown, the highest observed flow rate into the reservoirs of 32 L/sec was used. A contact time of 9.4 mg.min/L was calculated which is adequate.

All chemicals are deemed suitable for use in drinking water treatment as per Table 8.2 of the Australian Drinking Water Guidelines 2011.

5.2 Critical Control Points

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

- 1) Caustic Soda dosing
- 2) Chlorine Disinfection

CCP - Caustic Soda dosing

What is measured	Where or how is it measured	Additional monitoring	What is the control point	What are the hazards	Record Keeping
pH	Continuous online monitoring at WTP AND daily grab sample at WTP	Grab samples at Chivaree Centre, Community Centre, Works depot, Airport,	Caustic soda dosing	Ineffective disinfection (high pH) or corrosion (low pH)	Results handwritten on daily check sheet and entered into SWIMlocal weekly

Critical Limit
pH less than
6.5
Or pH more than
8.5

Alert
pH less than
6.8
pH more than
8.0

Target
pH between
7 - 7.5

<p>Low pH</p> <ul style="list-style-type: none"> + Repeat measurement to confirm result + Check there are no blockages/ broken tubing/ enough caustic soda in dosing tank. Fix any problems. + If working normally, but low, increase dosing + Contact Works Supervisor and follow instructions 	<p>High pH</p> <ul style="list-style-type: none"> + Turn off caustic soda dosing + Contact Works Supervisor and follow instructions
--	--

- + Repeat measurement to confirm result
- + Check online instrument calibration against field test
- + Check caustic soda dosing lines to ensure no blockages
- + Ensure caustic soda is left in dosing tank
- + Advise Works Supervisor and follow instructions
- + Record actions taken in plant diary

- + Visual inspection of dosing system
- + Add more refill or replace dosing tank as needed
- + Daily pH tests
- + Calibrate analyser as required (only if bores are pumping)
- + 6 monthly external calibration of online instrument

CCP - Chlorination

What is measured	Where or how is it measured	Additional monitoring	What is the control point	What are the hazards	Record Keeping
Free Chlorine	Continuous online monitoring at WTP AND daily grab sample at WTP	Grab samples at Chivaree Centre, Community Centre, Works depot, Airport,	Chlorine dosing point	Bacteria and viruses, chlorine overdosing	Results handwritten on daily check sheet and entered into SWIMlocal weekly

Critical Limit
Less than
0.3 mg/L
or more than
5 mg/L

Alert
Less than
0.6mg/L
Or more than
2 mg/L

Target
Free Chlorine
between
0.7 – 1.2 mg/L

<p>Low Chlorine</p> <ul style="list-style-type: none"> + Repeat measurement to confirm result + Compare online instrument reads to field instrument. Arrange for recalibration if needed. + Check if chlorine dosing tank is full, refill if needed + Check the dosing lines aren't broken + Check chlorine level at Chivaree Centre to see if chlorine is low in town + Contact Works Supervisor and follow instructions 	<p>High Chlorine</p> <ul style="list-style-type: none"> + Repeat measurement to confirm result + Check online instrument reads the same. Recalibrate if needed. + If Palintest result outside limits contact Works Supervisor and follow instructions + Check chlorine level at HACC to see if chlorine is high in town
--	--

<p>Low Chlorine</p> <ul style="list-style-type: none"> + Repeat measurement to confirm result + Check online instrument reads the same. Recalibrate if needed (only if bores are pumping). + Turn up the chlorine dose 	<p>High Chlorine</p> <ul style="list-style-type: none"> + Repeat measurement to confirm result + Check online instrument reads the same. Recalibrate if needed (only if bores are pumping). + Turn down the chlorine dose
--	---

<p>At WTP</p> <ul style="list-style-type: none"> + Visual inspection of dosing system + Check chlorine dosing tank level, refill if needed + Check chlorine storage quantity and follow chemical procurement plan accordingly + Daily free chlorine tests (Palintest) + Calibrate analyser if needed (only if bores are pumping) + If result is in between target and alert level – adjust dose to bring levels back to target 	<p>Chivaree Centre Daily Testing</p> <ul style="list-style-type: none"> + Measure chlorine at Chivaree Centre – should be more than 0.3 mg/L + If chlorine at plant is OK, but low at Chivaree Centre, flush the mains (ring and off-ring)
---	---

5.2.1 Operation and maintenance procedures

Council is in the process of developing standard operating procedures which were identified during the development of the DWQMP. The intention is that currently trained operators establish procedures to enable new water staff training during times of high staff turnover or unexpected situations. Procedure development is planned to be done closely together with Queensland Health for ongoing support.

The Plumbing Supervisor identifies if procedures need to change. The Director Technical Services will be responsible for the revision of procedures and documents if procedures are changed or need to be updated.

It is the responsibility of the Plumbing Supervisor to ensure that the procedures are understood and implemented by operational staff. The Plumbing Supervisor will also ensure that procedures are followed and identify any emerging issues. Staff members will be trained in procedures relevant to their role through induction and on the job training.

5.3 Information management

This DWQMP contains and identifies all documents and records that are required for the management of drinking water quality. All employees will receive on-the-job training to ensure that they understand operating procedures, document management and record keeping requirements in accordance with this DWQMP.

The Director Technical Services is responsible for the development and review of drinking water management documentation, as well as the recording of all drinking water related information.

The management and recording of data undertaken as part of this DWQMP includes:

- Standard Operating Procedures (including their review and updating),
- Water quality data (including the entry and recording of this data in electronic form),
- Field data sheets (including the collection and input and saving of this data in electronic form),
- Laboratory documentation (including water quality results),
- Incident reporting forms and register.

The Plumbing Supervisor is responsible for ensuring all staff are aware of and implement revised procedures. All CCP and SOP documents are to be kept at the water treatment plant, with electronic copies of the latest document versions made available to all drinking water staff.

Documents and records are stored on the Council hard drive electronic filing system. Incoming documents are scanned and filed electronically, and hard copies are filed in the relevant departments. Monitoring data is recorded in a digital format on an Excel spreadsheet weekly and emailed to the Plumbing Supervisor for review. All staff, including operators, can access the electronic data.

5.3.1 Information Technology

Aurukun Council currently utilises Telstra Cloud Operations to host its server infrastructure, availing of Telstra's IPSEC and SSL VPN, Web and Mail Internet Protection, Intrusion Prevention, Firewall and Avamar cloud server backup systems.

Server backups are performed nightly at 6pm and are available in the cloud for later retrieval and restoration when required. User access to the ASC network is restricted to authorised staff and consultants via Active Directory logins and passwords using industry recognised Best Practice for password complexity and renewal.

INCIDENTS AND EMERGENCIES

Incidents and emergencies are managed as per the tables below

Table 14 Incident and Emergency Response Levels

Alert Level	Description	Key management response(s)	Position(s) responsible
High: Emergency	<ul style="list-style-type: none"> outbreak of waterborne disease declared disaster or emergency by the Council or state/national government <p>Requires coordination across the provider (Council) departments and is likely to require external resourcing and support from agencies, such as Water Supply Regulation, Queensland Health, local disaster management groups, emergency responders QFRS, Police</p>	<p>Activate emergency response plan / disaster management plan</p> <p>Refer to summary of actions and procedures</p>	CEO (advised by Director Technical Services or Plumbing Supervisor)
Medium: Incident	<ul style="list-style-type: none"> non-compliance with water quality criteria (Detection of <i>E. coli</i> or exceed other ADWG Health guideline) 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 – including identified Backflow events). Cyber security breach that potentially impacts water quality <p>Incident managed by Plumbing Supervisor and Director Technical Services. In some cases, it may require coordination across the different Council departments and external resources and support, such as from DNRME, Queensland Health. Possible customer complaints.</p>	<p>Activate drinking water incident response and reporting protocols.</p> <p>1300 596 709</p> <p>Ensure all control measures identified in the DWQMP are functioning effectively.</p> <p>Refer to summary of actions and procedures</p>	Director Technical Services
Low: Operational exceedance	<ul style="list-style-type: none"> Exceedances of operational limits <p>Managed by Operators or Plumbing Supervisor.</p>	<p>Ensure all operational steps identified in the DWQMP are functioning effectively.</p> <p>Check and act upon operations and maintenance records and procedures.</p> <p>Incident response and reporting protocols on standby.</p> <p>Refer to summary of actions and procedures</p>	Plumbing Supervisor

Table 15 Incident and Emergency Response summary of actions

Alert Level	Key management response(s)	Brief summary of actions	Documented Plans & Procedures
High: Emergency	Activate emergency response plan / disaster management plan	<ul style="list-style-type: none"> • Notify CEO and internal communications department • Coordinate notification, investigation and response of water related aspects • Consider what community notification / messaging is needed (e.g. do not drink alert, boil water alert or bottled/emergency water distribution) • Coordinate community messaging, for e.g. boil water alert, do not drink alert as required • Notify DNRME as soon as practicable 	Disaster management plan, including communications protocols, alert templates (boil water as applicable).
Medium: Incidents	<p>Activate drinking water incident response and reporting protocols.</p> <p>Ensure all control measures identified in the DWQMP are functioning effectively.</p>	<ul style="list-style-type: none"> • Notify Director Technical Services and Plumbing Supervisor. • Report incident to DRDMW 1300 596 709 within the required timeframe • Contact PHU if health advice required • Ensure all control measures identified in the DWQM Plan are functioning effectively. • Commence investigation to determine cause if not traceable through the DWQM Plan • Arrange for re-samples to be taken where required • Instigate immediate remediation actions, including isolation of affected area where possible • Review associated laboratory reports and operational records. • In case of customer complaints, coordinate investigation and resolution, including obtaining water samples where required • Ensure emergency response plan / disaster management plan is on standby if the need arises. 	<p>Incident response and reporting protocols.</p> <p>DEWS Water Quality and Reporting Guideline.</p> <p>Community messaging may be required (e.g. Boil Water Alerts)</p>
Low: Operational exceedance	<p>Ensure all operational steps identified in the DWQM Plan are functioning effectively.</p> <p>Check and act upon operations and maintenance records and procedures.</p>	<ul style="list-style-type: none"> • Notify Plumbing Supervisor • Review operations and maintenance records for anomalies • Instigate immediate remediation actions • Ensure all control measures identified in the DWQMP are functioning effectively. 	Operation and maintenance procedures.

6.1 Incident communications

For water quality incidents of all levels, it will typically be the Director Technical Services responsible for the reporting the incident upwards internally – however the Plumbing Supervisor may also report if necessary.

Council management are informed as required, along the reporting line shown in Figure 9. Other Council staff will be engaged at the appropriate level (for example for communicating incident response actions for public notification as required).

The Director Technical Services will ensure regulatory reporting occurs, and external agencies are involved where necessary (e.g. DRDMW, QLD Health).

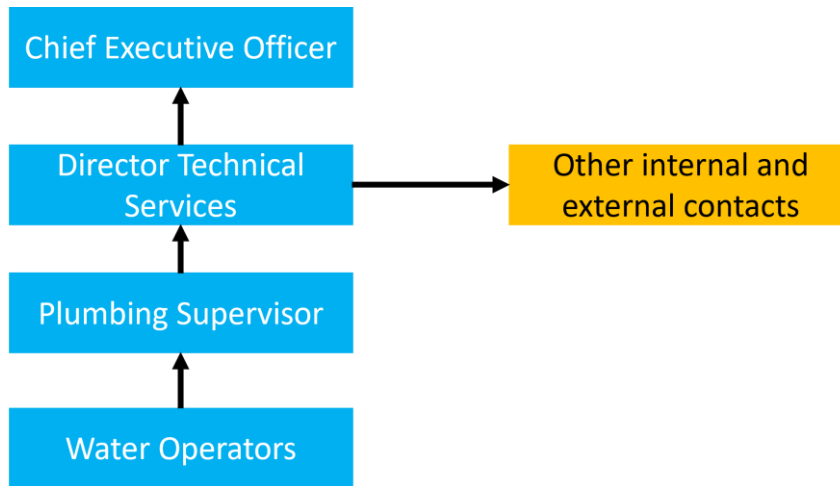


Figure 10 Council reporting lines

6.1.1 Emergency Contacts

The stakeholder list in Table 2 also serves as the emergency contact list.

The Plumbing Supervisor remains on call to attend to incident and emergency situations as required. The Director Technical Services is responsible for keeping the contacts list updated.

6.2 Community notification

During an incident or emergency, Council's Director Technical Services and/or the Chief Executive Officer is the designated person/s to communicate to the community and media, if the need arises.

Community notification or key messages such as 'boil water notice', 'do not drink water' etc. (if required), will be channelled through Council's administration staff and/or the Chief Executive Officer. The Director Technical Services will consult with the Queensland Health PHU to determine need for community notification such as a Boil water notice – A BWA template is included in the Appendix to the DWQMP.

Community notification will involve a notice on social media platforms, notices placed at the Council office, supermarket and food outlets within the community, and a notice broadcast via the local community radio-station.

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

6.3 Staff training

Internal training for operational staff is conducted by way of Toolbox Talks. These are short group information sessions that ensure staff know their responsibilities and are made aware of any changes that affect their daily work processes and tasks.

Council aims at having at least 1-2 staff trained at Cert 3 level available to operate the WTP.

Council maintains a list of the relevant qualifications and certifications of operational staff and provides further formalised training and/or refresher programs to water staff as required.

OPERATIONAL AND VERIFICATION MONITORING

7.1 Groundwater monitoring

Groundwater levels and flow data is recorded in the SCADA system. There is limited water quality data so Council will undertake the following sampling summarised in Table 17. Either an *E. coli* result > 100 MPN/ 100mL or nitrate levels >5 mg/L would trigger reporting of an incident as an “event likely to impact public health”. (Historical levels (NO₃⁻) are <1.3 mg/L).

Table 16 Groundwater monitoring

Location	Frequency	Analytical Suite (CRC Laboratory)
Bores 1-5	Quarterly	<ul style="list-style-type: none"> ▪ <i>E. coli</i>, ▪ pH, ▪ Ammonia, Nitrate, Nitrite, TON, ▪ Metals (Aluminium, Copper, Iron, Lead, Manganese, Nickel)
Combined bores	Weekly	<ul style="list-style-type: none"> ▪ <i>E. coli</i> at inlet to WTP (will be a mixture of bores operating at the time) ▪ Nitrate, Nitrite, TON

7.2 Operational monitoring

Operational monitoring is the monitoring that the operators undertake to ensure that the treatment process is working.

Table 17 Operational monitoring schedule

Parameter	Treatment Plant	Reticulation (Chivaree Centre, Airport, Community Centre, Works Depot)
Water pressure (pumps)	Continuous	> 210 kPa
Free chlorine	Continuous, Daily	Daily
pH	Continuous, Daily	Daily
Turbidity	Weekly	-

Water pressure monitored downstream of the water pressure pumps at the treatment plants is currently connected to the SCADA system for the site.

Online instrumentation at the treatment plant also monitors water pH and free chlorine levels, with automatic monitoring and control. The treatment plant is fully connected to SCADA, with settings adjustable remotely, data visible, and alarm send to mobile phones. At least one operator is always on call to react to alarms as required.

Operators take grab samples daily to check pH and free chlorine levels in the plant – where required dose rates are adjusted. The controller is re-calibrated as required externally.

7.3 Verification monitoring

Verification of drinking water demonstrates that the water supplied was safe.

Samples are obtained from two representative sites within the network – the treatment plant (after the reservoirs) and the Aurukun Hospital.

Both weekly samples are analysed for *E. coli* to comply with the *Public Health Regulation 2018* drinking water quality testing requirements for populations of between 1,000 and 5,000 people. Additional samples may be collected from various other locations.

The Director Technical Services and Plumbing Supervisor receive notification (electronic copies) of the verification testing results, and the results are reviewed within 24 hours of receiving the laboratory reports.

Any exceedances are managed as a Medium Incident (refer section 6).

Table 18 Verification monitoring testing schedule

Parameter	Treatment Plant	Reticulation (Aurukun Hospital)
<i>E. coli</i>	Weekly	Fortnightly
Free Chlorine	Weekly	Fortnightly
Turbidity	Weekly	Fortnightly
pH	Weekly	Fortnightly
Chlorate	Quarterly	

This sampling regime is appropriate because the risks of bacterial and viral contamination of the water supply are managed by the addition of (Target 0.7-1.2 mg/L) chlorine. This barrier is then ensured to be effective by routine (daily) operational monitoring. If the reticulation chlorine levels are low, the operator attends the WTP to ensure correct chlorine dosing, and may initiate flushing if required. By maintaining chlorine, there is a high level of assurance that bacterial and viral pathogens are disinfected.

A sample for chlorate is send to the lab periodically to monitor concentrations in the reticulated network. Council will report to the regulator if chlorate concentrations above 0.8 mg/L are identified as we understand this is the limit imposed on other providers.

RISK MANAGEMENT IMPROVEMENT PROGRAM

All unacceptable risks are required to be actioned over time to reduce the residual risk level to an acceptable level. The three RMIP columns in the Risk Register provides the current Risk Management Improvement Program (RMIP) for the supply scheme.

The RMIP examines improvement actions for the drinking water scheme hazards, with a particular focus on those hazards with high residual risks. The timeframes for each improvement action are:

- **Immediate actions:** improvement actions will be completed within current financial year (2023/2024),
- **Short term actions:** will be submitted for consideration in the Council budget in 2023/2024. Commencement of these activities depends on the availability of funds. However, it is intended that these improvement actions to be addressed within 2-3years,
- **Long term actions:** lower priority or unfunded actions, intended to be addressed over a 5 year timeframe.

It is the responsibility of the Director Technical Services to ensure that this document is communicated to relevant employees and operators.

The support and commitment of council is essential to ensure continual improvement of the drinking water supply.

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 implementation of the program will be communicated least annually with the DWQMP annual report and will be reviewed in line with regulatory requirements.

REVIEW AND AUDIT

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

This DWQMP will be formally reviewed in accordance with DRDMW requirements as stated within the information notice for the decision.

External audits are undertaken in line with the regulatory requirements.

REFERENCES

Department of Regional Development Manufacturing and Water 2022, *Guideline for the preparation, review and audit of drinking water quality management plans*, Version 3 Queensland Government.

NHMRC & NRMCC 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.

A1. BOIL WATER ALERT TEMPLATE

Boil Water Alert – detection of *E. coli*

[DATE IN EFFECT]

Boil all drinking water before drinking until further notice.

We have detected *E. coli* bacteria in the water supply. *E. coli* is generally not harmful, but its presence does indicate that the water supply *could* make you sick. If you are sick go to the doctor.

All water for drinking should be brought to the boil (for example in a kettle). Cool the water before using.

Boiled or bottled water should be used for:

- Drinking
- Preparing or cooking food or drinks
- Making baby formula
- Making ice
- Brushing teeth
- Babies and toddlers should be sponge bathed
- Children should take boiled or bottled water to school

Unboiled water may be used for:

- Showering and bathing (don't swallow water)
- Washing dishes by hand or in a dishwasher – dry before using
- Washing clothes
- Flushing toilets
- Garden watering

Be careful to avoid being scalded when handling hot water.

Please tell your neighbours know to boil water.

Aurukun Shire Council is working with Queensland Health to fix the problem. We will let you know when you can stop boiling water.

A2. AURUKUN TOWNSHIP INFRASTRUCTURE OVERLAY



Figure 11
Infrastructure
Overlay

Bligh Tanner Pty Ltd

ABN 32 061 537 666

blightanner@blightanner.com.au

blightanner.com.au

Brisbane

Level 9

269 Wickham Street

PO Box 612

Fortitude Valley Qld 4006

Australia

T +61 7 3251 8555

F +61 7 3251 8599

Sydney

Suite 3.02, Level 3

32 Walker Street

North Sydney

NSW 2060 Australia

F +61 2 9170 3777

**BLIGH
TANNER**