Hope Vale
Aboriginal Shire Council

Drinking Water Quality Management Plan

September 2020

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Hope Vale Aboriginal Shire Council

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Document Status					
Date	Revision	Description	Author	Checked	Approved
February 2020	1	For review	Updated by Brad Pinches		
February 2020	2	HVASC approval for submission to DNRME	Brad Pinches		Gene Brookes
July 2020	3	HVASC approval for submission to DNRME – including amendments	Brad Pinches, Gene Brookes		Gene Brookes

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Hope Vale Drinking Water Quality Management Plan

1. Registered Service Details

Service Provider: Hope Vale Aboriginal Shire Council

Contact details: Mr Gene Brookes, Operations Manager
Muni Street, Hope Vale 4875,
Phone: (07) 4060 9133; Fax: (07) 4060 9331; www.hopevale.qld.gov.au

SPID: 513

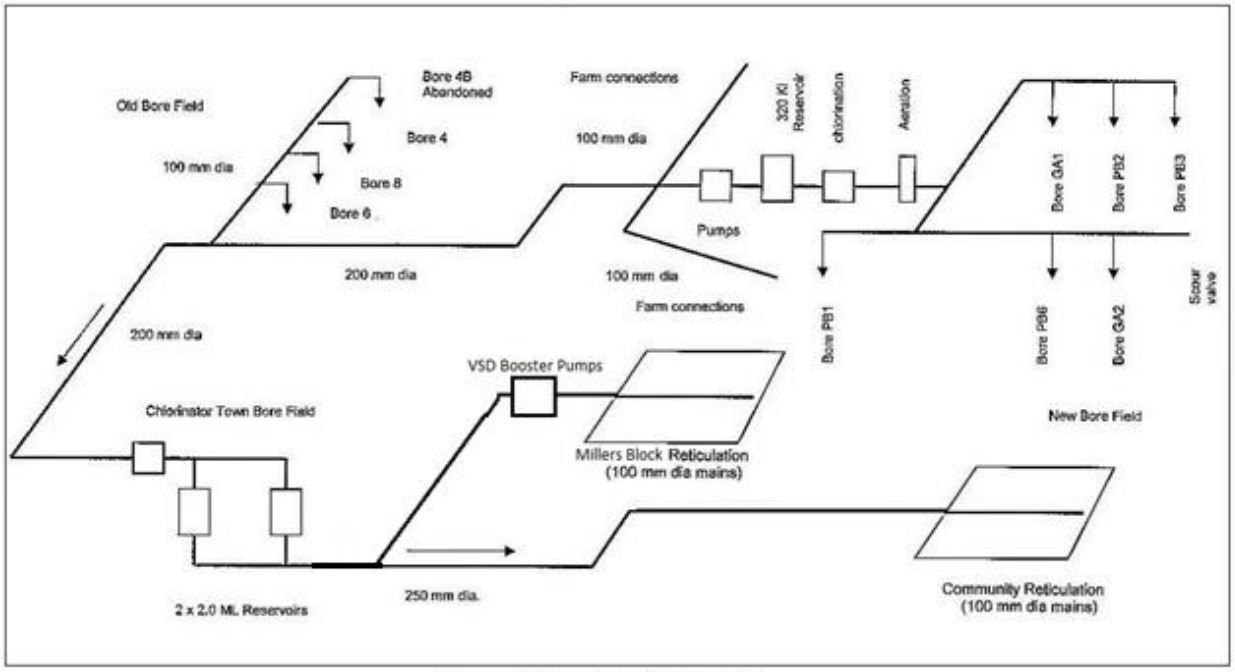
Service details:

Scheme name	Operator	Communities served	Current			Projected in 10 years		
			Population	Connections	Demand ML/d	Population	Connections	Demand ML/d
Hope Vale	Hope Vale Aboriginal Shire Council	Hope Vale	1020 *	350	.98	*1,243	426 *(est.)*	1.19 *(est.)*

[*Based on 2% annual growth]

2. Details of Infrastructure

2.1. Schematics



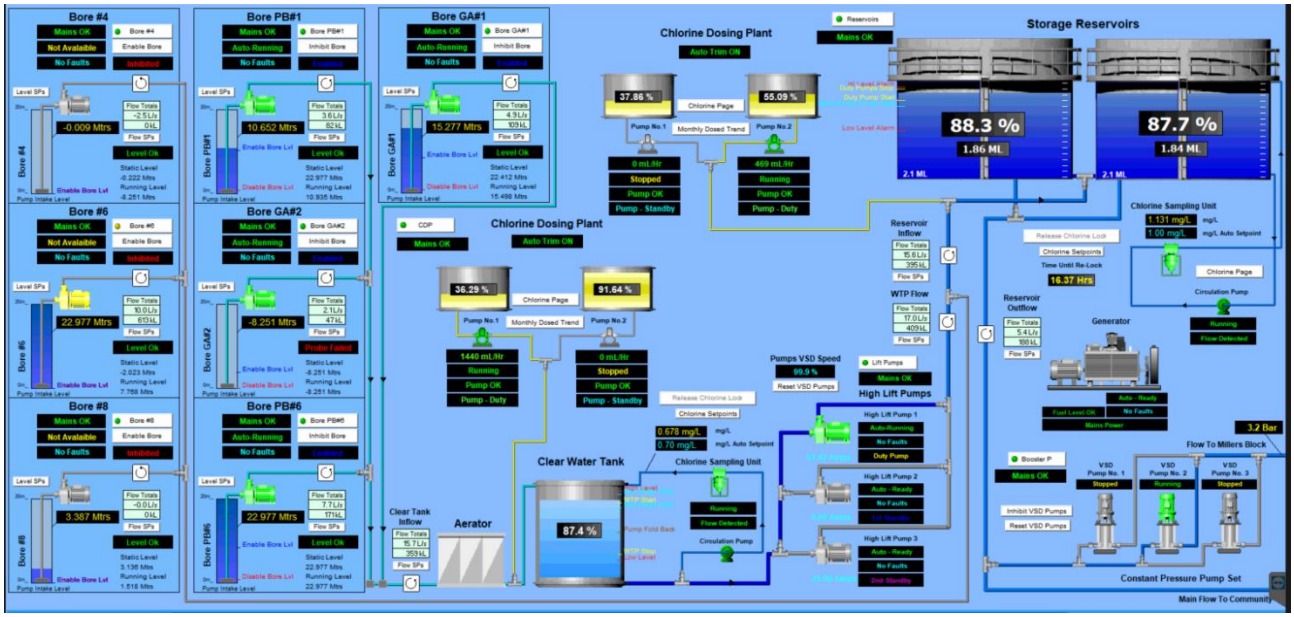
Hope Vale Water Supply Schematic

Hope Vale Aboriginal Shire Council is responsible for the provision, operation and maintenance of infrastructure used to source, treat and transport potable water to the community residents for domestic and community purposes.

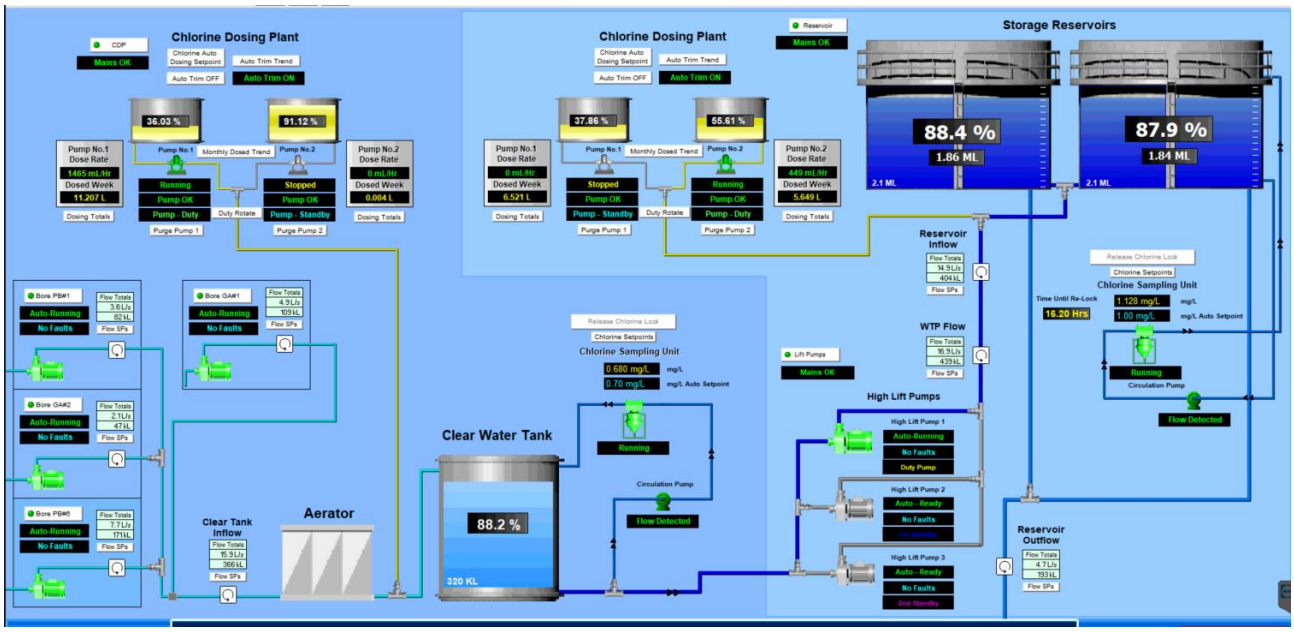
The schematic diagram shown in the figure above shows he general layout of the Hope Vale water supply. Note that PB2 and PB3 are not currently used because of turbidity issues. Bores 4, 6 and 8 are used as back up or alternate water supply, if the need arises. The reticulation has two lines as shown in the schematic layout. One is for the town which is gravity fed. The other is for Millers Block development which is pressurised by booster pumps.

The following figures show the SCADA screens representing the current installation:

Overview Schematic of Water Supply System from SCADA



Chlorine Treatment Overview



2.2. Water Supply Description

Water for Hope Vale is sourced from underground borefields. There are 6 bores in the new bore field, however, only 4 are currently operational. Two bores have been taken off line due to issues with high turbidity. The old bore field has 3 bores which serve as back up supply for emergency (new bore field failure) if required. The chance for this is low. However, the back up supply is tested and brought online regularly.

Water is pumped using submersible pumps from the bores. The main water supply has high iron content hence aeration is done to oxidise the iron and increase pH. Disinfection is done through chlorination. Primary disinfection is done prior to the clear water settling tank, followed by a re-dose at the reservoir inlet u

The primary dosing point is located at the water treatment plant. The level of residual chlorine is set to a level that is acceptable for immediate consumption as there are farm properties connected to the rising main, ie, before the main storage reservoirs. The chlorination setpoint is set through SCADA, read through an automatic chlorine analyser, and automatically dosed by the SCADA controlled dosing pumps.

Water is rechlorinated at the entry to the reservoirs. Additional rechlorination is required firstly to raise the chlorine level before entering the reservoirs to allow for the retention period, and also as an additional point due the backup bores not having a chlorine dosing point (ie when the main bores are offline, chlorinated water from the water treatment plant is temporarily not available).

The secondary chlorination acts as a trimming system whereby the chlorine level in the reservoir is automatically analysed at the reservoir chlorine circulation outlet by SCADA and subsequently dosed at the reservoir inlet

The infrastructure details and more information on the scheme are provided in the following tables.

3. Infrastructure details

3.1. Sources

The Hope Vale water supply is sourced from groundwater.

Main supply

	PB1	PB6	GA1	GA2
Aquifer type	Alluvium primarily related to sediments deposited by the Endeavour River. Good supply of water expected with reliable recharge due to reasonable rainfall and recharge over large areas[1].	Alluvium primarily related to sediments deposited by the Endeavour River. Good supply of water expected with reliable recharge due to reasonable rainfall and recharge over large areas[1].	Alluvium primarily related to sediments deposited by the Endeavour River. Good supply of water expected with reliable recharge due to reasonable rainfall and recharge over large areas[1].	Alluvium primarily related to sediments deposited by the Endeavour River. Good supply of water expected with reliable recharge due to reasonable rainfall and recharge over large areas[1].
% of supply	38.86	30.32	8.97	21.78
Reliability	Good usable source, capacity well in excess of demand. Has not run dry since commissioned.	Good usable source, capacity well in excess of demand. Has not run dry since commissioned.	Good usable source, capacity well in excess of demand. Has not run dry since commissioned.	Good usable source, capacity well in excess of demand. Has not run dry since commissioned.
Pump type	Submersible electric	Submersible electric	Submersible electric	Submersible electric
Capacity	9.1 L/s	7.1 L/s	5.1 L/s	2.1 L/s
Bore depth (m)	25 (approx)	25 (approx)	25 (approx)	25 (approx)
Bore head details	Raised head 1m above ground and with concrete slab around.	Raised head 1m above ground and with concrete slab around.	Raised head 1m above ground and with concrete slab around	Raised head 1m above ground and with concrete slab around.
Casing and material	Cased, PVC	Cased, PVC	Cased, PVC	Cased, PVC
Water quality issues	Iron bacteria, low pH <6.5 (snapshot monitoring)	Nothing of concern (snapshot monitoring)	Low pH <6.5 (snapshot monitoring), iron bacteria	Low pH <6.5 (snapshot monitoring)

[1] - Information obtained from Graham Herbert, Principal Project Officer Hydrology, Water Services, Ayr, Queensland Government.

Pump operation is controlled through SCADA in response to water levels in the Clear Water Tank.

Picture of GA1 showing the raised bore head, concrete slab and fencing.

Back up supply

	Bore 4	**Bore 6**	**Bore 8**
Aquifer type	Piebald Basalt. The aquifer consists of layers of vesicular basalt within a sheet of more massive material. Relatively small storage available, hence requiring careful management during dry seasons[1].	Piebald Basalt. The aquifer consists of layers of vesicular basalt within a sheet of more massive material. Relatively small storage available, hence requiring careful management during dry seasons[1].	Piebald Basalt. The aquifer consists of layers of vesicular basalt within a sheet of more massive material. Relatively small storage available, hence requiring careful management during dry seasons[1].
Reliability	Historically it has not run dry but possibility of de-watering during extended severe drought. Hence new bore filed put in place for water security.	Historically it has not run dry but possibility of de-watering during extended severe drought. Hence new bore filed put in place for water security.	Historically it has not run dry but possibility of de-watering during extended severe drought. Hence new bore filed put in place for water security.
Pump type	Submersible electric	Submersible electric	Submersible electric
Bore depth (m)	20 (approx)	20 (approx)	20 (approx)
Bore head details	Not raised	Not raised	Not raised
Casing and material	Cased, PVC	Cased, PVC	Cased, PVC
Water quality issues	None	None	None

[1] - Information obtained from Graham Herbert, Principal Project Officer Hydrology, Water Services, Ayr, Queensland Government.

Note: The back up bores are run (manually operated) for an hour every Monday.

3.2. Treatment

Name	Hope Vale Water Treatment Plant
Process	Aeration, chlorination
Design capacity	1.906 ML/d
Chemicals added	Sodium hypochlorite (chlorination) purchased as liquid.
Chlorine storage and turnover	Sodium hypochlorite is purchased as 10% w/v available chlorine. Generally more concentrated solutions (>13%) are instable and can form chlorate. The chlorine containers are stored indoors so that no direct sunlight hits the containers and in a bunding area. It is ensured that there is always sufficient stock available at hand. High quality chlorine is purchased from Elite Chemicals Company to ensure there are no or minimum impurities.
Bypass / variation	The aerator has bypass ability. It is used when the aerator is offline due to cleaning.

The main water supply undergoes the full aeration treatment process whereas the back up supply is only chlorinated. By-passing chlorination is not possible.

Picture showing the aerator used for iron control.

Clear Water Tank

Name	Clear water tank
Capacity	320 kL
Roofed	Yes
Vermin-proof	Yes
Runoff from roof	Directed away, opening on top has raised lip which is then securely covered.
Cleaning	Flushed every Monday to remove sludge. When aerator is cleaned the clear water tank is emptied and cleaned inside.
Filling	Controlled through SCADA (automatic) in response to levels in reservoirs.

Disinfection (Primary)

Location	At treatment plant
Type	Injection
Dose rate	10 to 30 ml per hour
Target residual level	>0.2mg/L - <5mg/L
Duty / standby	Yes (2 pumps)
Dosing arrangement	Automatically dosed through SCADA based on analysed chlorine level in clear water tank
Alarms	Alarmed - SCADA system in place for system failure and levels outside of tolerance . Alarms show up in Managers computer (HMI).

Disinfection (Re-dose Point 1)

Location	Reservoir inlet
Type	Injection
Dose rate	10 to 30 ml per hour
Target residual level	>0.2mg/L - <5mg/L
Duty / standby	Yes
Dosing arrangement	Automatically dosed through SCADA based on analysed chlorine level in reservoir
Alarms	Alarmed - SCADA system in place for system failure and levels outside of tolerance. Alarms show up in Managers computer (HMI).

Reservoirs

Name	Reservoir 1 and Reservoir 2
Capacity	Total 4 ML
Roofed	Yes
Vermin-proof	Yes
Runoff from roof	Directed away, opening on top has raised lip which is then securely covered.
Cleaning	Yearly
Filling	Controlled through SCADA (automatic). When level is low, the clear water tank pumps are activated.

Picture showing the two reservoirs.

3.3. Distribution and Reticulation

Pipe material(s)	Mostly uPVC
Age range	Pipe aging is not a major issue at the moment as replacement date has been set for the year 2040.
Length of mains	31.186 km
Issues with dead ends	Yes, regular flushing done (monthly).
High pressure issues	Possible, pressure reduction valve after reservoir
Low pressure issues	No (No backflow issues)
Number of pump stations	2 (3 pumps from clear water tank – run on duty/standby, 3 booster pumps for reticulation to Millers block – future development sub-division)
Flushing	Monthly, to remove iron build up and rectify dead end main/pipe storage

3.4. Key Stakeholders

Organisation	Relevance	How the stakeholder is engaged
Hope Vale community	Consumers or customers	Informed of water quality issues when required. Small community hence all informed simultaneously including Health Clinic (vulnerable customer).
Elite Chemical Company	Good quality chemicals, availability and supply of stock	Provider has confidence in chemical supplier as it is a reputable company with good record.
Electricity company	For pumping water from bore fields	Ergon company agreement with Government for essential services.
Office of Water Supply Regulator (DNRME)	Regulator	Consulted during development of DWQMP, water quality incidents reported to DNRME
Council	Overall management, budget and finances	Kept up to date and informed of water operations. Approval for DWQMP.
QBuild	Consumer end plumbing	Responsible for plumbing issues inside households
Queensland Health	Health regulator	Provides advice for drinking water incidents when required.
Cairns Regional Council Water Lab	Verification testing	Provides results for verification monitoring. Samples collected and sent to them for analysis.

Note: The Health Clinic has its own filtration system to further treat the water supplied.

4. Identify Hazards and Hazardous Events

4.1. Water Quality Information

The following data is taken from Council records for the most recent financial year

Raw Water Combined (aerator inlet)

Parameter	Time period	No of samples	Min value	Max value	Average value	Comments
pH	July 2019 – June 2020	94	5.66	6.62	5.88	pH for raw water is naturally below neutral level however increases during aeration.
E. coli	July 2019 – June 2020	52	Absent			Not detected.
Turbidity	July 2019 – June 2020	96	3.06	5.91	4.66	Turbidity prior to entering aerator

Treated water (treatment plant outlet)

Parameter	Time period	No of samples	Min value	Max value	Average value	Comments
pH	July 2019 – June 2020	95	7.09	7.36	7.24	Operational monitoring. Average shows pH correction step is controlled (Readings recorded at aerator outlet).
E. coli	July 2019 – June 2020	52	Absent			Not detected.
Free chlorine	July 2019 – June 2010	364	0.63	.0.68	0.64	Stable chlorine levels prior to transfer to storage.
Turbidity	July 2019 – June 2010	256	1.84	4.00	2.67	Turbidity is generally low after passing through aerator and settling tank.

Treated water (reservoir outlet)

Parameter	Time period	No of samples	Min value	Max value	Average value	Comments
pH	July 2019 – June 2010	259	7.34	7.51	7.42	Average shows pH is acceptable
E. coli	July 2019 – June 2010	52	Absent			Not detected.
Free chlorine	July 2019 – June 2010	365	0.8	0.97	0.89	stable levels after chlorine trimming system.

Parameter	Time period	No of samples	Min value	Max value	Average value	Comments
Turbidity	July 2019 – June 2010	257	1.02	2.32	1.66	stable levels. Average is good at < 2 NTU.

Treated water (town)

Parameter	Time period	No of samples	Min value	Max value	Average value	Comments
pH	July 2019 – June 2010	517	7.34	7.51	7.4	Average shows pH is acceptable.
E. coli	July 2019 – June 2010	52	<1cfu/100mL	<1cfu/100mL	<1cfu/100mL.	Nil recent positive test results.
Free chlorine	July 2019 – June 2010	1,551	0.42	0.83	0.58	Residual chlorine levels are stable throughout the reticulated area
Turbidity	July 2019 – June 2010	516	1.02	3.01	1.81	Average is good at < 2 NTU. Reservoir cleaning routinely undertaken.

Incident History (reported to DNRME)

Nil test showing positive E.Coli within the past two years.

Snapshot Monitoring

The Snapshot Monitoring Program is being facilitated by DNRME to assist Providers gather source water quality information to assist in the identification of possible hazards from the catchment.

Hope Vale took part in the Program in September 2011, with the results shown in the tables below. The results indicate that some bores (PB1, GA1 and GA2) have low pH, <6.5 (not of health concern but is corrected for corrosion control); and GA1 and PB1 have high natural iron. The analysis of treated water for chlorate shows that chlorate production is under control.

The snapshot monitoring undertaken in 2011 is the most recent raw water quality analysis undertaken on all production and backup bores.

There are no issues with other trace metals of health concern (such as arsenic, fluoride, manganese) or with radionuclides.

Snapshot Monitoring Results (September 2011)

Name	Aluminium	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganes	Molybdenu	Nickel	Selenium	Silver
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
ADWG	0.2	**0.003**	**0.01**	**2**	**0.06**	**4**	**0.002**	**0.05**		**2**	0.3	**0.01**	**0.5**	**0.05**	**0.02**	**0.01**	**0.1**
B6	0.013	< 0.0001	< 0.0003	0.0072	< 0.0001	0.016	< 0.0001	0.0007	< 0.0001	0.002	0.14	0.0003	0.0051	< 0.0001	0.0008	< 0.0010	< 0.001
B4	< 0.003	< 0.0001	< 0.0003	0.0072	< 0.0001	0.024	< 0.0001	0.0003	< 0.0001	0.006	0.014	0.0004	0.003	< 0.0001	0.0011	< 0.0010	< 0.001
B8	0.005	< 0.0001	< 0.0003	0.0082	< 0.0001	0.018	< 0.0001	0.0003	< 0.0001	0.005	0.01	0.0012	0.0016	< 0.0001	0.0009	< 0.0010	< 0.001
GA2	< 0.003	< 0.0001	< 0.0003	0.085	< 0.0001	0.029	< 0.0001	0.0008	0.0004	0.008	0.015	0.0005	0.0056	< 0.0001	0.0014	< 0.0010	< 0.001
GA1	0.004	< 0.0001	< 0.0003	0.023	< 0.0001	0.036	< 0.0001	0.0023	0.0002	0.01	0.21	0.0006	0.037	< 0.0001	0.0011	< 0.0010	< 0.001
PB1	0.006	< 0.0001	< 0.0003	0.029	< 0.0001	0.028	< 0.0001	< 0.0001	< 0.0001	0.03	0.93	0.0071	0.024	< 0.0001	0.0003	< 0.0010	< 0.001
PB6																	

Name	Conductivit	pH	Temperatu	Total Hardn	Alkalinity	Silica	TDS	True Colou	Turbidity	Sodium	Potassium	Calcium	Magnesiun	Hydrogen	Bicarbonat	Carbonate	Hydroxide
	uS/cm		deg C	mg/L as Ca	mg/L CaC	mg/L	mg/L	Hazen	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
ADWG		6.5-8.5				80	600	15	5	180							
B6	214	6.84	22	72	87	63	172	<1	1	16	1.1	15	8.6	0	106	0	0
B4	219	7.35	22	72	86	59	170	2	<1	17	1.1	13	9.9	0	105	0.1	0
B8	238	6.99	22	82	95	57	177	2	<1	17	1.1	15	10	0	116	0.1	0
GA2	166	6.13	22	16	20	22	103	2	<1	24	0.7	1.8	2.8	0	24	0	0
GA1	173	6.04	22	15	17	22	107	2	1	27	0.5	1.5	2.6	0	21	0	0
PB1	133	6.45	22	12	28	17	85	2	8	21	1.6	1.6	1.8	0	34	0	0
PB6	239	6.92	22	28	68	16	139	<1	13	38	1.9	5.5	3.6	0	83	0	0

	Total Alpha Activity	Total Beta Activity	K40-Corrected Beta Activity
	Bq/L	Bq/L	Bq/L
Sample ID	PQ/GABW	PQ/GABW	PQ/GABW
B6	<0.09	<0.2	<0.2
B4	<0.09	<0.2	<0.2
B8	<0.09	<0.2	<0.2
GA2	<0.09	<0.2	<0.2
GA1	<0.09	<0.2	<0.2
PB1	<0.09	<0.2	<0.2
PB6	<0.09	<0.2	<0.2

Reticulated town water	**Chlorate (mg/L)**
Sample 1	0.08
Sample 2	0.13

4.2. Catchment Characteristics

Summary Description

Hope Vale catchment is mostly rural with residential houses. The bore fields (old and new) are relatively isolated from the houses with only a few houses within a 400 m radius of the bore field. The residential houses have septic tanks, which are emptied by a contractor when full.

The bore heads are all raised with about a 1 meter height concrete slab around the bores. All bores are fenced and locked. Round up is sprayed near the fences to control weeds.

Characteristics	Details
Area	The exact area of the catchment is not known as information about the groundwater system is limited[1].
Topography	The bores are at a lower level than the town. However, they are a considerable distance away, with borehead well protected and secured from any ingress.
Soil Type and Geology[1]	Hodgkinson Formation. This formation consists of metamorphic rocks, usually greywacke (cooked up sandstone), mudstones and siltstones. These rocks underlie most other rock types in the Hope Vale area and are near the ground surface in low ridges to the north, west and south of Hopevale. Groundwater occurs in fractures within the rock matrix and as such storage and transmissivity of water can be limited. Dalrymple Sandstone. The formation is comprised mostly of clean sandstone which provides for good aquifer prospects in areas where the elevation, and associated rock exposure does not allow water to drain away rapidly after recharge. This formation occurs principally to the south of Hopevale and also in extensive areas to the west. As this formation does not occur in the immediate area of Hopevale it has limited value for town water supply purposes. but does support some outstations. Piebald Basalt. This formation underlies the Hopevale township and a significant area to the west. The aquifer consists of layers of vesicular basalt within a sheet of more massive material. This system, supplemented by water drawn from the underlying metamorphic rocks. Alluvium. This area is located to the east of Hopevale township and is primarily related to sediments deposited by the Endeavour River. There is not a great deal of information about this system.
Rainfall	Most rain occurs in the wet season Nov - Mar
Incidence of major flooding and bushfires	No incidences
Land use	Residential rural
Agriculture, industry, mining, farming	No
Potential sources of microbial and chemical contamination in the catchment	Microbial – septic tanks overflow, animal faeces. Chemical – Round up spraying

[1] - Information obtained from Graham Herbert, Principal Project Officer Hydrology, Water Services, Ayr, Queensland Government.

4.3. Hazard Identification and risk assessment team

Name	Position	Expertise and system knowledge
Tom Jones	Manager – Water and Waste	Overall understanding of system, hazards and hazardous events, and operational philosophy
Reggie Gilmartin and Lex Bowen	System operators	System operators each with over 12 years of experience. Understanding of operational philosophy.
Keenen Pearson	Co-worker (operations)	Junior person with the team.

5. Assessment of Risk

5.1. Methodology

The methodology used for the risk assessment has been adopted from the DNRME Preparing a Drinking Water Quality Management Plan Supporting Information (Sept 2010).

Maximum risk assumes no preventive measures in place (i.e. no treatment is done); and residual risk includes the existing preventive measures.

Likelihood	Descriptors
Rare	Occurs less than or equal to once every 5 years
Unlikely	Occurs more often than once every 5 years and up to once per year
Possible	Occurs more often than once per year and up to once a month (12/yr)
Likely	Occurs more often than once per month (12/yr) and up to once per week (52/yr)
Almost Certain	Occurs more often than once per week (52/yr)

Consequence	Descriptors
Insignificant	Isolatred exceedence of aesthetic parameter with little or no disruption to normal operation
Minor	Potential local aesthetic, isolated exceedence of chronic health parameter
Moderate	Potential widespread aesthetic impact or repeated breach of chronic health parameter
Major	Potential acute health impact, no declared outbreak expected
Catastrophic	Potential acute health impact, declared outbreak expected

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	Medium (6)	High (10)	High (15)	Extreme (20)	Extreme (25)
Likely	Medium (5)	Medium (8)	High (12)	High (16)	Extreme (20)
Possible	Low (3)	Medium (6)	Medium (9)	High (12)	High (15)
Unlikely	Low (2)	Low (4)	Medium (6)	Medium (8)	High (10)
Rare	Low (1)	Low (2)	Low (3)	Medium (5)	Medium (6)

Level of Uncertainty	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 good understanding of the processes involved.
Reliable	There is at least a year of continuous monitoring data available, which has been assessed; or There is reasonable understanding of the processes involved.
Estimate	There is limited monitoring data available; or There is limited understanding of the processes involved.
Uncertain	There is limited or no monitoring data available; or The processes are not well understood.

5.2. Acceptable Risk

Low residual risks are considered as acceptable risks, and have appropriate control measures to manage the risks for continuous improvement. Medium (and higher) risks have been associated with an Improvement action.

In addition, an improvement action has also been associated with places where the level of uncertainty is stated as uncertain or estimate.

A few low residual risks also have an improvement action where it was decided that the action would strengthen the performance of the existing control measures.

5.3. Hazard identification, risk assessment and uncertainty matrices

Catchment and source infrastructure

Hazard	Hazardous event	Max risk			Existing preventive measures / barriers	Res risk			Uncertainty	Risk management improvement action
		Consequence	Likelihood	Risk level		Consequence	Likelihood	Risk level		
Bacteria (harmful)	Local pooling or surface runoff (rainfall) washing overflowing septics	Catastrophic	Rare	Medium	Borehead raised 1m above ground level so no ingress. No residential blocks close to bores. Disinfection at three points.	Minor	Rare	Low	Confident	
	Animal access / runoff causing ingress of animal faeces	Catastrophic	Possible	High	Fenced. Weekly checks for fence integrity by operators. Borehead raised 1m above ground level so no ingress Disinfection.	Minor	Rare	Low	Confident	
	Effectiveness of casing	Moderate	Possible	Medium	PVC cased. Recently changed in 2000. Disinfection.	Minor	Rare	Low	Confident	
	Borehead design (not raised) – main supply	Moderate	Possible	Medium	Borehead raised 1m above ground level so no ingress. Disinfection at three points.	Minor	Rare	Low	Confident	
	Borehead design (not raised) – backup supply (3 bores at ground level)	Moderate	Possible	Medium	Disinfection (2 points). Back up source only. It is ensured that effective chlorine residual is always maintained	Minor	Unlikely	Low	Confident	
Protozoa (cyrpto and giardia)	Animal access / runoff causing ingress of animal faeces	Catastrophic	Possible	High	Fenced. Weekly checks for fence integrity.	Minor	Rare	Low	Confident	

Hazard	Hazardous event	Max risk			Existing preventive measures / barriers	Res risk			Uncertainty	Risk management improvement action
		Consequence	Likelihood	Risk level		Consequence	Likelihood	Risk level		
					Borehead raised 1m above ground level so no ingress Disinfection.					
	Effectiveness of casing	Moderate	Possible	Medium	PVC cased. Recently changed in 2000. Disinfection.	Minor	Rare	Low	Confident	
	Borehead design (not raised) – main supply	Moderate	Possible	Medium	Source water protection through fencing off animals. Borehead raised 1m above ground level so no ingress. Disinfection at three points for Giardia.	Minor	Rare	Low	Confident	
	Borehead design (not raised) – backup supply (3 bores at ground level)	Moderate	Possible	Medium	Source water protection through fencing off animals. Disinfection (2 points) for Giardia. Back up source only.	Minor	Unlikely	Low	Reliable	Comment: Only back up supply.
Pesticide residues	Spraying of Round up around bore fence	Moderate	Possible	Medium	Raised bore head, concreted around bore head. Moderate spraying done only to kill off weeds/grass around fence, not spraying done near borehead. Snapshot monitoring completed for future risk analysis.	Minor	Rare	Low	Estimate	

Hazard	Hazardous event	Max risk			Existing preventive measures / barriers	Res risk			Uncertainty	Risk management improvement action
		Consequence	Likelihood	Risk level		Consequence	Likelihood	Risk level		
Nitrate	Surface runoff (rainfall) washing overflowing septics	Moderate	Possible	Medium	Borehead raised 1m above ground level so no ingress. No residential blocks close to bores.	Minor	Rare	Low	Reliable	
Turbidity	Natural	Moderate	Possible	Medium	Settling in reservoirs. Disinfection.	Minor	Rare	Low	Uncertain	Council to investigate further filtration at bores to improve turbidity before processing and disinfection.
Iron (aesthetic) – GA1 and PB1	Natural geology	Moderate	Almost certain	High	Aeration to remove/reduce iron levels. Flushing (monthly). Chemical clean of bores (yearly). Cleaning of reservoirs every 2 years.	Minor	Possible	Low	Estimate	
No water	Electrical failure	Moderate	Rare	Low	Sufficient reservoir storage to last until fault is rectified. Disaster management plan. Automated back up generators at bores and treatment plant.	Minor	Rare	Low	Confident	
	Pump failure	Moderate	Possible	Medium	4 bores and pumps in use. Emergency back up supply.	Minor	Unlikely	Low	Confident	
	Bore field failure	Catastrophic	Possible	High	Two bore fields (new - main supply and old - back up supply)	Minor	Unlikely	Low	Confident	

Hazard	Hazardous event	Max risk			Existing preventive measures / barriers	Res risk			Uncertainty	Risk management improvement action
		Consequence	Likelihood	Risk level		Consequence	Likelihood	Risk level		
Heavy metals of concern (As, F)	Natural geology	Minor	Rare	Low	Not naturally present as from snapshot monitoring data.	Minor	Rare	Low	Estimate	
Radionuclides	Natural geology	Minor	Rare	Low	Not naturally present as from snapshot monitoring data.	Minor	Rare	Low	Estimate	

Treatment process

Hazard	Hazardous event	Max risk			Existing preventive measures / barriers	Res risk			Uncertainty	Risk management improvement plan
		Consequence	Likelihood	Risk level		Consequence	Likelihood	Risk level		
Aeration										
Iron (aesthetic)	Iron build up causing blockage / Iron breakthrough / Aerator efficiency	Moderate	Possible	Medium	Regular cleaning of aerators based on visual checks by operators and decrease in flow rate.	Minor	Unlikely	Low	Confident	Building proper clean up deck for ease and safety of cleaning

Disinfection process

Hazard	Hazardous event	Max risk			Existing preventive measures / barriers	Res risk			Uncertainty	Risk management improvement plan
		Consequence	Likelihood	Risk level		Consequence	Likelihood	Risk level		
Primary dose point										
Chlorine	Over dosing	Moderate	Possible	Medium	Daily chlorine testing results. Visual checks by operators and manual adjustments. Experience and on the job training. Automated dosing has a cut-off inside SCADA that shuts down the entire system until the fault is resolved.	Minor	Unlikely	Low	Certain	

Hazard	Hazardous event	Max risk			Existing preventive measures / barriers	Res risk			Uncertainty	Risk management improvement plan
		Consequence	Likelihood	Risk level		Consequence	Likelihood	Risk level		
Bacteria (harmful)	Under dose of chlorine / no chlorine caused by pipe burst (injector line) and equipment breakdown. High turbidity	Catastrophic	Possible	High	2 pumps available. Daily chlorine testing results. Visual checks by operators and manual adjustments. Two more re-dose points further downstream. Automated dosing has a cut-off inside SCADA that shuts down the entire system until the fault is resolved.	Moderate	Rare	Low	Confident	
	Insufficient contact time	Major	Possible	High	Sufficient mixing and contact time available through presence of clear water tank and 2 reservoirs. > 30 minutes before water reaches first customer.	Minor	Unlikely	Low	Confident	
Re-dose points										
Chlorine	Over dosing	Moderate	Possible	Medium	Daily chlorine testing results. Visual checks by operators and manual adjustments. Experience and on the job training.	Minor	Unlikely	Low		
Bacteria (harmful)	Under dose of chlorine / no chlorine caused by pipe burst (injector line) and equipment breakdown.	Catastrophic	Possible	High	2 pumps available. Daily chlorine testing results. Visual checks by operators and manual adjustments.	Moderate	Rare	Low	Confident	

Hazard	Hazardous event	Max risk			Existing preventive measures / barriers	Res risk			Uncertainty	Risk management improvement plan
		Consequence	Likelihood	Risk level		Consequence	Likelihood	Risk level		
	High turbidity				Two more re-dose points further downstream. Automated dosing has a cut-off inside SCADA that shuts down the entire system until the fault is resolved.					
	Insufficient contact time	Major	Possible	High	Sufficient mixing and contact time available through presence of clear water tank and 2 reservoirs. > 30 minutes before water reaches first customer.	Minor	Unlikely	Low	Confident	
Disinfection by-products (THM)	High organic content in raw water	Moderate	Possible	Medium	High organic load not suspected in groundwater. Two high turbidity bores taken off line.	Minor	Unlikely	Low	Reliable	
Chlorate	Chlorine stock storage and turnover	Moderate	Possible	Medium	Sodium hypochlorite is purchased as 10% w/v available chlorine. The chlorine containers are stored indoors so that no direct sunlight hits the containers and in a bunding area. High quality chlorine is purchased from Elite Chemicals Company to ensure there are no or minimum impurities.	Minor	Unlikely	Low	Estimate	*Comment: Snapshot monitoring data shows that chlorate production is under control. Action to reduce chlorate is being done to the best possible and practical means. It is realised that disinfection should not be compromised, as non-disinfected water poses significantly greater risk than chlorate.*

Clear Water tank

Hazard	Hazardous event	Max risk			Existing preventive measures / barriers	Res risk			Uncertainty	Risk management improvement plan
		Consequence	Likelihood	Risk level		Consequence	Likelihood	Risk level		
Bacteria (harmful)	No cover / not vermin proofed (overflow pipes)	Major	Possible	High	Well covered and sealed. 2 chlorine re-dose points after clear water tank. Flushed every Monday. Inside thoroughly cleaned at least twice a year.	Minor	Unlikely	Low	Confident	
	Roof runoff seepage through roof cover	Major	Possible	High	Well covered and sealed. 2 chlorine re-dose points after clear water tank.	Minor	Unlikely	Low	Confident	
	Tank condition and integrity (cracks) enabling ingress.	Major	Possible	High	Tank in very good condition. 2 chlorine re-dose points after clear water tank.	Minor	Rare	Low	Confident	
Turbidity	No periodic cleaning (sludge layer) / High chlorine demand	Major	Possible	High	Flushed every Monday. Inside thoroughly cleaned at least twice a year. 2 chlorine re-dose points after clear water tank.	Minor	Unlikely	Low	Confident	

Reservoir – storage tanks

Hazard	Hazardous event	Max risk			Existing preventive measures / barriers	Res risk			Uncertainty	Risk management improvement plan
		Consequence	Likelihood	Risk level		Consequence	Likelihood	Risk level		
Bacteria (harmful)	No cover / not vermin proofed (overflow pipes)	Major	Possible	High	Well covered and sealed. Chlorine re-dose point after reservoirs.	Minor	Unlikely	Low	Confident	
	Seepage through roof cover	Major	Possible	High	Entry point with raised lip and secured cover. Chlorine re-dose point at reservoir outlet.	Minor	Unlikely	Low	Confident	
	Reservoir condition and integrity (cracks) enabling ingress	Major	Possible	High	Reservoirs in very good condition. Chlorine re-dose point at reservoir outlet.	Minor	Rare	Low	Confident	
Turbidity (can lead to bacterial shielding from chlorine)	No periodic cleaning (sludge layer) / High chlorine demand	Major	Possible	High	Chlorine re-dose at reservoir outlet. Reservoirs cleaned every 2 years.	Moderate	Possible	Low	Confident	
No water	Pump failure at Clear Water Tank.	Moderate	Possible	Medium	3 pumps available. SCADA controlled and alarmed to show failures for fixing.	Minor	Rare	Low	Confident	

Reticulation

Hazard	Hazardous event	Max risk			Existing preventive measures / barriers	Res risk			Uncertainty	Risk management improvement plan
		Consequence	Likelihood	Risk level		Consequence	Likelihood	Risk level		
Bacteria (harmful)	Pipe breaks / main breaks (age, pressure). Dead end / long detention time	Major	Possible	High	All digging or excavation authorised by water supplier. Reactive maintenance. Monthly flushing using a flushing schedule.	Minor	Unlikely	Low	Reliable	
	Low or negative pressure / backflow	Major	Possible	High	System is always pressurised (no history of issues).	Minor	Rare	Low	Confident	
Turbidity	Pipe breaks / main breaks (age, pressure). Dead end / long detention time	Moderate	Possible	Medium	All digging or excavation authorised by water supplier. Reactive maintenance. Monthly flushing using a flushing schedule.	Minor	Unlikely	Low	Reliable	
Metals – copper (leaching due to low pH)	Leaching from joints/solders – households	Moderate	Possible	Medium	Daily pH tests to guide corrective actions.	Minor	Unlikely	Low	Confident	
No water	Pipe breaks / main breaks (age, pressure)	Moderate	Possible	Medium	All digging or excavation authorised by water supplier. Reactive maintenance.	Minor	Unlikely	Low	Confident	

Whole of Service

Hazard & Hazardous event	Max risk			Existing preventive measures / barriers	Res risk			Uncertainty	Risk management improvement plan
	Consequence	Likelihood	Risk level		Consequence	Likelihood	Risk level		
Bad or poor chemical (chlorine) quality - ineffective disinfection leading to presence of harmful bacteria	Major	Rare	Medium	Chemical purchased from reputable company in Cairns, with good record. Provider has confidence in chemical supplier.	Insignificant	Rare	Low	Almost certain	
No chemical - no disinfection leading to presence of harmful bacteria	Major	Rare	Medium	Visual checks for stock at hand guiding the ordering. Inventory stock take schedule in place.	Insignificant	Rare	Low	Confident	
Untrained staff (formally) - no or poor water treatment leading to presence of harmful bacteria and water of poor aesthetic quality	Catastrophic	Possible	High	On the job training. Experience. Supervision and guidance by Manager.	Minor	Possible	Medium	Confident	Investigate possible opportunity for formal training for existing staff.
No standard operating procedures - poor operation of plant and treatment processes leading to presence of harmful bacteria, water of poor aesthetic quality and no water.	Major	Likely	High	On the job training. Experience. Supervision and guidance by Manager. SOPs in place.	Moderate	Possible	Medium	Confident	Continually update SOPs for all relevant procedures and operational philosophy.
Vandalism and terrorism - introduction of harmful bacteria or toxic chemicals	Major	Rare	Medium	Well fenced and secured bores and treatment plant facility. Visual checks by operators. .	Minor	Rare	Low	Confident	
Electricity shut down - no water and treatment process	Moderate	Rare	Low	Ergon company agreement with Government for essential services. 2 large reservoirs providing relief for short term. Automated generators in place at bores and WTP.	Minor	Rare	Low	Confident	

Staff safety (chemical handling) - injured staff or absent staff leading to poor operation of plant and treatment processes causing presence of harmful bacteria, water of poor aesthetic quality and no water.	Major	Rare	Medium	Safety equipment (PPE) used by staff. On the job training. Staff experience.	Minor	Rare	Low	Confident	Investigate possible opportunity for formal training for existing staff.
Interference/disruption of SCADA unintentional, including hardware failure	Major	possible	High	System backups and access to external experts	Moderate	Possible	Medium	Reliable	Develop systems to ensure backup and recovery is available
Interference /disruption of SCADA through internal intentional malice	Major	unlikely	Medium	Simple password and access levels system	Moderate	Unlikely	Medium	Reliable	Develop secure system to protect SCADA from internal intentional malice including login tracking systems
Interference/disruption of SCADA through unauthorised external access	Major	Possible	High	Limited prevention other than simple password systems	Moderate	Unlikely	Medium	Reliable	Develop secure system to protect SCADA from external threat including and to provide recovery if security has been breached

6. Managing Risks

6.1. Risk Management Improvement Program

The risk management improvement actions from the hazard identification and risk assessment matrices have been reproduced below to formulate a risk management improvement program.

The priority level has been stated as low, medium or high. High priority has been assigned to a hazard that can have immediate impact on public health (so basically harmful bacteria). Low priority has been assigned to infrastructure improvements (budget implications). Low priority has also been given to snapshot monitoring as it is an external activity which Hope Vale Provider will participate in, but will benefit from. Medium priority has been given to operational improvements such as developing SOPs, monitoring and investigative actions. The timeframe for activities is related to available resources (budget and staff time) balanced against public health implications. However, high priority items will be addressed immediately.

Catchment and source infrastructure

Hazard	Hazardous event	Risk management improvement action	Priority	Timeframe	Responsibility
Pesticide residues	Spraying of Round up around bore fence	Participate in the snapshot monitoring program in 2012 to gather data to review risk level later.	Low	Completed	
Turbidity	Natural	Implement the monitoring of turbidity at inlet to treatment plant. Undertake investigations for further filtration possibilities at bores.	High	Currently being routinely undertaken, investigations underway inside the 2019/21 ICCIP funding program. Estimated completion June 2021.	Tom, Ops Manager
Iron (aesthetic) – GA1 and PB1	Natural geology	Participate in the snapshot monitoring program to gather more data to review risk level later.	Low	Completed	
No water	Electrical failure	Electrical upgrade at bores for generator plug in.	Low	Completed	
Heavy metals of concern (As, F)	Natural geology	Participate in the snapshot monitoring program to gather more data to review risk level later.	Low	Completed	
Radionuclides	Natural geology	Participate in the snapshot monitoring program to gather more data to review risk level later.	Low	Completed	

Treatment process

Hazard	Hazardous event	Risk management improvement action	Priority	Timeframe	Responsibility
Iron (aesthetic) – aeration	Iron build up causing blockage / Iron breakthrough / Aerator efficiency	Building proper clean up deck for ease and safety of cleaning	Low	Completed	
Iron (aesthetic) – aeration	No SOP	Development of relevant SOP	Medium	Completed	Tom
Optimal pH	No SOP	Development of relevant SOP	Medium	Completed	Tom

Disinfection process

Hazard	Hazardous event	Risk management improvement action	Priority	Timeframe	Responsibility
Chlorine (over dose)	No SOPs	Development of relevant SOP	Medium	Completed	Tom
Bacteria (harmful)	Under dose of chlorine / no chlorine caused by pipe burst (injector line) and equipment breakdown. High turbidity	Replace pumps. Reconnect to SCADA to control operation.	High	Completed	

Reservoir – storage tanks

Hazard	Hazardous event	Risk management improvement action	Priority	Timeframe	Responsibility
Turbidity (can lead to bacterial shielding from chlorine)	No periodic cleaning (sludge layer) / High chlorine demand	Investigate cleaning program for reservoirs.	Medium	Now routinely undertaken	

Whole of Service

Hazard and Hazardous event	Risk management improvement action	Priority	Timeframe	Responsibility
No chemical	Develop chemical inventory log sheet for improved management.	Medium	completed	
Untrained staff (formally)	Investigate possible opportunity for formal training for existing staff.	Medium	ongoing	Tom
No standard operating procedures	Develop SOPs for all relevant procedures and operational philosophy	Medium	completed	Tom
Electricity shut down	Carry out electrical upgrade at bores for generator plug in.	Low	completed	
Staff safety - chemical handling	Investigate possible opportunity for formal training for existing staff.	Medium	ongoing	
Emergency situation communications	Develop community notification / messaging e.g. boil water alert template.	Medium	completed	Gene
SCADA hardware failure or untintentional program interference	Develop system of backup and recovery	High	Underway/to be completed Dec 2020	Tom/Gene/HVAC IT
Cyber Security Event affecting SCADA - internal	Develop system to prevent, detect and recover from internal cyber attacj	High	Underway/to be completed Dec 2020	Tom/Gene/HVAC IT
Cyber Security Event affecting SCADA - external	Develop systems to prevent, detect and recover from external cyber attack	High	Underway/to be completed Dec 2020	Tom/Gene/HVAC IT

Note: For the development of standard operating procedures the timeframe indicates by when all SOPs will be developed. However, DNRME will be informed annually of SOPs which are developed towards the completion of the Improvement Plan action. SOPs have been developed for all water testing equipment operations.

6.2. Operation and maintenance procedures

Written operations and maintenance procedures are being developed on a priority basis.
In particular the main procedures undertaken include:

- Water sampling and in-house testing

Some of the procedures to be further developed include:

- Flushing of mains (dead ends) and storage/reservoirs
- Cleaning of storage tanks
- Repair of mains/pipes for leaks and breakages

The recording logs or documents that are currently used include:

Log	Version	Next revision date
Daily testing log for chlorine, pH and turbidity	June 2017	As per need when changes are necessary, determined by Manager Water and Waste.
Water main flushing schedule	April 2020	As per need when changes are necessary, determined by Manager Water and Waste.
Daily treatment log (operations check)	Jan 2018	As per need when changes are necessary, determined by Manager Water and Waste.
Bore water level	Sept 2018	As per need when changes are necessary, determined by Manager Water and Waste.

The daily testing and treatment logs are electronic Excel spreadsheets which are accessible in the computer in the office to all operations staff for entering the data.

The water mains flushing schedule is printed in hard copies and filled in the field by operations staff noting the flushing duration, colour of water and general comments.

The Manager Water and Waste is responsible for filing all records.

Process for implementing operational procedures

Although some operational procedures have not been finalised, the Hope Vale Provider follows operational procedures. Ensuring that operational procedures are carried out appropriately is the responsibility of the operators and the Manager. Operators are trained on the job in procedures relevant to their role by the Manager, upon employment and then through continuous interactions.

It the responsibility of the Manager to ensure that the procedures are understood and implemented by operational staff. This is done through on the job guidance and training. To ensure staff understand and adhere to procedures, the Manager undertakes visits to inspect work and ask questions.

The site inspections are done to check and ensure that procedures are been followed and to identify any emerging issues.

6.3. Management of incidents and emergencies

The process for managing drinking water incidents and emergencies are described in the tables below. The first table provides the overview (alert level, description, key response and positions responsible). The second table gives the summary of actions and procedures.

All level 2 and 3 alerts are notified to the Manager – Water and Waste, who remains on call by mobile phone on 0427732203.

The water staff have received on the job training on incident protocols in order to operate as required. Actions to be taken for incidents are presented in the Operational and Verification Monitoring section of the DWQMP.

During an emergency situation, the CEO takes the lead. The Manager Water and Waste is part of the emergency response team, and coordinates the water (and wastewater) activities for his staff. Fortunately, there has not been a need to activate the emergency protocols.

Management of Incident and Emergency Levels – Overview

Alert Level	Description	Key management response(s)	Position(s) responsible
Level 3: Emergency	• outbreak of waterborne disease • declared disaster or emergency situation by the Council or state/national government *Requires coordination across the Council departments and is likely to require external resourcing and support from agencies, such as Office of the Water Supply Regulator, Queensland Health, local disaster management groups, emergency responders QFRS, Police*	Activate disaster management plan *Refer to summary of actions and procedures*	CEO. Manager Water and Waste is part of the response team.
Level 2: Incident	• non-compliance (typically against the ADWG values) • 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 natural disaster (flood, drought), bushfire, inability to operate system within acceptable operational limits, contamination of source water, contamination of treated water, terrorism. *Incident is managed within the team responsible for drinking water operations and management in line with the Hope Vale DWQM Plan. In some cases, it may require coordination across the Council departments and external resources and support, such as from DNRME, Queensland Health.*	Activate drinking water incident response and reporting protocols. Ensure all control measures identified in the DWQM Plan are functioning effectively. Disaster management plan on standby. *Refer to summary of actions and procedures*	Manager – Water and Waste
Level 1: Operational exceedence	• Exceedences of operational limits (as per the operational monitoring section of the Plan). *Incident is managed within the water operations team. An incident is not declared and the issue can be managed in line with the DWQM Plan.*	Ensure all operational steps identified in the DWQM Plan are functioning effectively. Check and act upon operations records. Incident response and reporting protocols on standby. *Refer to summary of actions and procedures*	System operator under guidance from Manager – Water and Waste

Management of Incident and Emergency Levels – Summary of Actions and Procedures

Alert Level	Key management response(s)	Brief summary of actions	Documented Plans & Procedures
Level 3: Emergency	Activate disaster management plan	• Notify Council. • 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. Community notification / messaging e.g. boil water alert needs to be developed (added to the Improvement Program).
Level 2: Incidents	Activate drinking water incident response and reporting protocols. Ensure all control measures identified in the DWQM Plan are functioning effectively. Disaster management plan on standby.	• Notify Manager - Water and Waste. • Report incident to DNRME within the required timeframe • 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 • Disaster management plan is on standby if the need arises.	Incident response and reporting protocols (i.e. DNRME Water Quality and Reporting Guideline). Hope Vale DWQM Plan.
Level 1: Operational exceedence	Ensure all operational steps identified in the DWQM Plan are functioning effectively. Check and act upon operations and maintenance records. Incident response and reporting protocols on standby.	• Notify System Operator and Manager - Water and Waste. • Review operations and maintenance records for anomalies • Commence investigation to determine cause, if not identifiable through operational records • Instigate immediate remediation actions • Ensure all control measures identified in the DWQM Plan are functioning effectively. • Increase operational monitoring frequency where required • Ensure incident response and reporting protocols are on standby if the need arises.	Operations and maintenance procedures (these are not documented so are part of the Improvement Plan). Hope Vale DWQM Plan.

6.4. Service Wide Support – Information Management

Water Quality Information

Daily water quality measurements are undertaken by the Hope Vale Water Officers and initially recorded on hardcopy daily log sheets. The quality measurements are taken at the locations noted in the Tables in Section 7.1. The hardcopy daily sheets are stored in the Water Treatment Plant Office

The daily readings are transferred to the Daily Water Reading Log Sheets spreadsheet located on the Water Treatment Plant Operations Computer. Any readings which fall outside the operational limits automatically appear in warning colours and the Water Officers will advise the Water and Waste Manager for action if required. This may include advising the Operations Manager.

On a monthly basis, the completed monthly totals are presented to the Operations Manager via the transfer of the Daily Water Reading Log Sheet.

On a yearly basis, the summary yearly totals derived from the Daily Water Reading Log Sheets are compiled by the Operations Manager and sent to DNRME as a a component of the DWQMP Yearly Report. All digital spreadsheet files are maintained by Council and backups are routinely made as per Councils IT management system.

Incident reporting protocol

The incident reporting protocols (mentioned earlier under the management of incident and emergencies section) have been adopted from the DNRME Drinking Water Service Provider Monitoring and Reporting Requirement guidelines.

This is summarised as below:

Incident	**Reporting requirements (to DNRME)**
Detection of *E. coli*, detection of a pathogen, failure to meet ADWG health guideline values	By telephone within 3 hours of receipt of test results
Radiological (exceed levels described in the notice)	By telephone within 3 hours of receipt of test results
Parameters with no ADWG guideline value	Written confirmation within 24 hours
An event likely to affect water quality	By telephone as soon as practicable

The Manager Water and Waste is responsible for reviewing data for incident reporting, following up on incident resolution and closure.

7. Operational and Verification Monitoring

7.1. Operational Monitoring

.
The operational monitoring for Hope Vale contains a planned sequence of measurements and observations to ensure that the system is operating within the set performance limits and the process elements are functioning optimally to achieve safe drinking water.

The process step where testing is done, the parameter tested and the logic for testing the parameter is stated below:

Operational monitoring of the water system at Hope Vale includes a continuous monitoring system via a supervisory control and data acquisition (SCADA) system and through a physical on-site sampling program.

SCADA

The SCADA systems analyses and records critical characteristics which are monitored by the operators. The monitoring system is alarmed so that the operators are alerted promptly of adverse results.

The SCADA system is available to monitor a number of critical items in the Hope Vale system, including:

- Bore running status, flowrate, fault status and bore water level
- Raw and treated water flowrates
- Clearwater tank and main reservoir water levels
- Free chlorine readings and chlorine tank levels
- Automated Chlorine pumping status, flowrate and fault status
- Transfer pump running status, flowrates and fault status

Operators have the ability to remotely adjust setpoints and operate pumps and bores if necessary

Sampling

The Hope Vale operational monitoring system includes the sampling and recording of the following characteristics:

- Free Chlorine
- pH
- Turbidity, and
- E. Coli

The table below summarises the operational monitoring schedule, with target and critical limits for the various parameters and how excursions are managed.

Process step / location in system	Parameter	Associated hazard	Sampling			Target limit	Action if target limit is not met	Critical limit	Action if critical limit is exceeded
			Frequency	Method	Analysis				
Aerator inlet	pH	Optimum pH	Daily	Eutech Hand held Analyser pH 150	In-house	NA (monitoring only)			
	E. coli	Bacteria (harmful)	Weekly	Colilert	In-house	0 MPN/100ml	Re-test. Isolate targetted bore and re-test	0 MPN/100ml	Report to DNRME within 3 hours
	Turbidity	Turbidity	Weekly	HACH 2100Q Turbidimeter	In-house	NA (monitoring only)			
Aerator outlet	pH	Optimum pH	Daily	Eutech Hand held Analyser pH 150	In-house	6.5-8.0	Inspect aerator for correct operation	<6.5, >8.5	Clean aerator plates. Ensure free chlorine level is within target range.
Plant outlet	Free chlorine	Bacteria (harmful) and chlorine	Daily	Palintest Chlorometer	In-house	>0.2 mg/L, <2mg/L	Confirm correct analyser calibration and SCADAis operational	<0.2mg/L, >5mg/L	Confirm correct SCADA operation after automatic system shutdown. Correct fault. If fault cannot be corrected override SCADA and adjust setpoint manually until SCADA is operational
	Turbidity	Turbidity	Daily	HACH 2100Q Turbidimeter	In-house	As low as possible, preferably < 5NTU.	Confirm cleanliness of settling tank	>10NTU	.Investigate settling tank and clean if necessary
	pH	Optimum pH	Daily	Palintest 7100 Photometer	In-house	6.5-8.0	Inspect aerator for correct operation	<6.5, >8.0	Clean aerator plates. Ensure free chlorine level is within target range.

Process step / location in system	Parameter	Associated hazard	Sampling			Target limit	Action if target limit is not met	Critical limit	Action if critical limit is exceeded
			Frequency	Method	Analysis				
Reservoir outlet after chlorinator	Free chlorine	Bacteria (harmful) and chlorine	Daily	Palintest Chlorometer	In-house	>0.5 mg/L, <2 mg/L	Confirm correct analyser calibration and SCADA is operational	<0.2mg/L and >5mg/L	Confirm correct SCADA operation after automatic system shutdown. Correct fault. If fault can not be corrected override SCADA and adjust setpoint manually until SCADA is operational. Notify the Regulator if limits are exceeded
	Turbidity	Turbidity	Daily	HACH 2100Q Turbidimeter	In-house	As low as possible, preferably < 5NTU.	Confirm cleanliness of storage tank.	>10NTU	Investigate contamination and clean tank if necessary.
	pH	Optimum pH	Daily	Palintest 7100 Photometer	In-house	6.5-8.0	Inspect aerator for correct operation	<6.5, >8.0	Clean aerator plates. Blend water from town bores Ensure free chlorine level is within target range.
	E. coli	Bacteria (harmful)	Weekly	Colilert	In-house	0 MPN/100ml	Re-test	0 MPN/100ml	Report to DNRME within 3 hours
Town (4 sites) on a rotational basis. Refer Sampling Location Table below	Turbidity	Turbidity	Daily	HACH 2100Q Turbidimeter	In-house	As low as possible, preferably < 5NTU.	Inspect reticulation lines for beakage or contamination	>10NTU	Check to ensure there are no mains / pipe breaks and repair.

Process step / location in system	Parameter	Associated hazard	Sampling			Target limit	Action if target limit is not met	Critical limit	Action if critical limit is exceeded
			Frequency	Method	Analysis				
	pH	Optimum pH	Daily	Palintest 7100 Photometer	In-house	6.5-8.0	Inspect aerator for correct operation	<6.5, >8.0	Clean aerator plates. Blend water from town bores Ensure free chlorine level is within target range.
	Free chlorine	Bacteria (harmful) and chlorine	Daily	Palintest Chlorometer	In-house	>0.5 mg/L, <2 mg/L	Re-adjust the dose rate via SCADA	<0.2mg/L and >5mg/L	Re-adjust the dose rate at plant and at the re-dose point via SCADA. Ensure free chlorine level is within target range. Notify the Regulator if limits are exceeded
	E. coli	Bacteria (harmful)	Weekly	Colilert	In-house	0 MPN/100ml	Re-test	0 MPN/100ml	Report to DNRME within 3 hours

The sampling locations relating to the Operation Monitoring Schedule are listed in the following table:

Sampling Name	Sampling Location	LAT	Long
Aerator Inlet	Aerator Inlet at Water Treatment Plant Elim Road	-15.280943	145.141968
Aerator Outlet	Aerator Outlet at Water Treatment Plant Elim Road	-15.280943	145.141968
Plant Outlet	Laboratory Sink at Water Treatment Plant	-15.281085	145.141891
Reservoir Outlet	Laboratory Sink at Main Reservoir Site	-15.301223	145.095324
Town Site 1	3 Bayanbi Street Millers Block	-15.294662	145.086304
Town Site 2	2 Alec Cameron Drive	-15.293377	145.104141
Town Site 3	13D North Street	-15.293264	145.112869

Town Site 4	121 Link Road	-15.299823	145.111710
Administration	35 Muni Street	-15.293940	145.106033

Visual Checks, Observations and Inspections:

Visual inspections and checks (observations) are also conducted as part of the operational monitoring to ensure that preventive measures function as required and that total reliance is not only on water quality testing.

The visual checks and inspections done include:

- Fence integrity around bores - weekly by operations team.
- All chlorinators dosing pumps are working properly - daily by operations team.
- Aerator flow rate - daily by operations team
- Reservoir levels - daily by operations team
- Bore pumps - weekly by operations team
- Clear Water Tank pumps - daily by operations team

Any issues or problems are notified to the Manager Water and Waste immediately and corrective actions taken to resolve the matter.

Appropriateness of Program

The operational program is appropriate to confirm and maintain the effective operation of the preventative measures due to the real-time SCADA monitoring/alarms and the broad spectrum of sampling sites throughout the community. These parameters will help ensure that the treatment and distribution operational measures are working appropriately in order to minimise risks and to provide early indication of potential items that might require action from the Hope Vale operators.

The appropriateness of each monitored item (as per the tabled monitoring program) is detailed as follows:

<u>Aerator inlet:</u>
pH - Source water (combined sources) is measured to observe changes over time.
E. coli - Source water is monitored to check for bore water contamination
Turbidity - testing undertaken to record source water characteristics and changes over time.

<u>Aerator outlet:</u>
pH – Measured to observe the effect from aeration and to ensure that the aeration plant is operating as expected

<u>Treatment Plant Outlet:</u>
Free chlorine - ensure that chlorinator and SCADA dosing is working properly and effective disinfection is done to kill any harmful bacteria. Observation of free chlorine levels can be undertaken early and allow for corrections to be made before the treated water is transferred to the main reservoir
pH - ensure that pH is within range after initial chlorination.
Turbidity - ensure that it does not exceed operational limits and affect effective chlorination. Increased turbidity might indicate contamination of the balance/settling tank

<u>Reservoir outlet after chlorinator:</u>
Free chlorine - check chlorine levels to confirm SCADA is correctly trimming the dosing rate, ensure that chlorinator is working properly, ensure reservoir is not causing high chlorine demand.
pH - check pH levels are optimal after chlorination
Turbidity - ensure reservoir is not introducing turbidity.
E. coli – treated water is tested to ensure that no contamination has occurred within the main storage reservoirs

<u>Town:</u>
Turbidity - ensure it is within aesthetic limits or if high, investigate a physical breakage or interruption in the reticulation system.
pH - check pH levels are optimal after passing through the storage and reticulation pipework
Free chlorine – residual levels are taken from various sites around the town on a planned rotational basis to ensure that all areas have appropriate chlorine levels. The levels are recorded to ensure that areas of low flow still have a residual level above the minimum target. Consistent low levels would indicate the possible requirement for revised network flow or regular line scouring.

E-Coli – A positive recording would indicate a breakdown in the chlorinated supply requiring an immediate notification to the Regulator

7.2. Verification Monitoring (Reportable to DNRME)

The verification monitoring for Hope Vale is used to confirm that safe water is delivered to customers in compliance with the ADWG and Public Health Act. The verification monitoring also verifies that the preventive measures stated in the DWQMP are functioning effectively.

The parameter tested and the logic for testing the parameter is stated below:

- *E. coli* - indicator for recent faecal contamination (harmful bacteria), treatment efficiency and product quality.
- Total Coliforms - indicates system integrity, treatment effectiveness or post treatment ingress.
- Heterotrophic plate counts - indicates system cleanliness, post treatment ingress or presence/formation of biofilms.
- Chlorine - added for disinfection, health concern above 5 mg/L.

Verification monitoring is provided for chemical parameters from water samples extracted from the bores and microbial parameters from water samples extracted from reticulation sites in the town area. The verification results for the microbial parameters are confirmed on a monthly basis using the results from a NATA accredited laboratory. Hope Vale Aboriginal Shire Council uses the Cairns Regional Council Laboratory Services to undertake the validation monitoring.

The procedure to utilise the services of the Cairns Regional Council Laboratory Services to undertake the laboratory testing of the microbial samples is considered the most appropriate way to verify that the drinking water complies with the accepted water quality criteria and that the systems are operating effectively.

The laboratory provides an independent and accredited service and is authorised to immediately advise Council if any of the measured parameters have fallen outside of the Australian Drinking Water Guideline accepted limits

The table below summarises the verification monitoring, with target and critical limits and how excursions are managed.

Parameter	ADWG or regulation value	Associated Hazard	Frequency			Analysing authority	Response to exceedances
			Treatment plant outlet	Reservoir outlet	Town		
E. coli	< 1 cfu/100mL	Bacteria (harmful)	Monthly	Monthly	Monthly	Cairns Regional Council Water Lab	Report to DNRME. Re-sample. Investigate cause and rectify. Adjust chlorine dose rate as required.
E. Coli	Not present (Colilert P/A test)	Bacteria (harmful)	Weekly	Weekly	Weekly	In-house	Report to DNRME. Re-sample. Investigate cause and rectify. Adjust chlorine dose rate as required.
Total coliforms	NA	System integrity, treatment effectiveness, post treatment ingress	Monthly	Monthly	Monthly	Cairns Regional Council Water Lab	Investigate cause and rectify. Adjust chlorine dose rate as required.
Heterotrophic plate counts	NA	System cleanliness, post treatment ingress, biofilms	Monthly	Monthly	Monthly	Cairns Regional Council Water Lab	Investigate cause and rectify. Adjust chlorine dose rate as required.
Free chlorine	5 mg/L	Chlorine	-	-	Daily	In-house	Report to DNRME. Re-sample. Investigate cause and rectify. Adjust chlorine dose rates.

7.3. Water Sampling and Result Analysis

All operational monitoring is done by the operations team in-house using field kits for chlorine, pH and turbidity and the IDEX Colilert presence/absence test for *E. coli*. The operations team collect water samples for *E. coli* testing using the IDEXX method. All testing is done on grab samples. The in-house testing equipment are calibrated weekly by the operations team and recording in the treatment log.

The verification monitoring is also done by operations team. The samples for *E. coli* testing (colony counting) are collected and transported to the Cairns laboratory (which is NATA accredited) in eskys with ice bricks every month.

The operations team act upon the operational monitoring parameters as described above (action if critical limit is exceeded). The Manager - Water and Waste assesses and analyses the water quality results for the verification monitoring as they become available, while keeping an overview of all monitoring results and excursions.

Operations staff have received on the job training on proper sampling, analysis and testing procedures by the Manager - Water and Waste. Written procedures around these will be developed and have been stated in the Improvement Program.