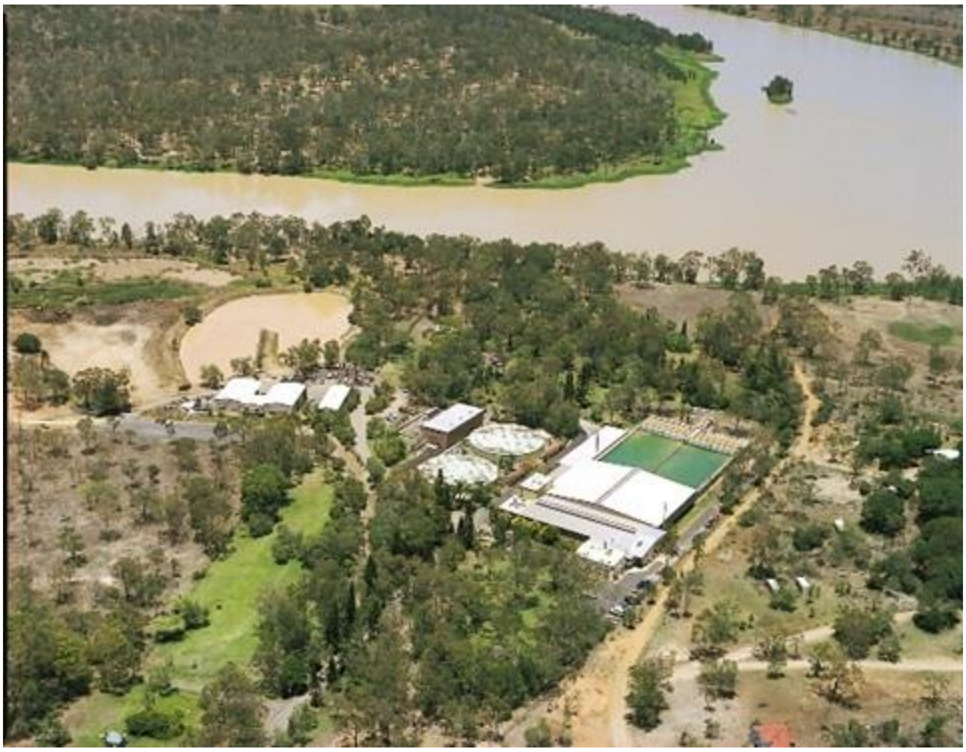
# Rockhampton Regional Council

Registered Service Provider No. SP493



## Drinking Water Quality Management Plan

2022-2023

**Version Control**

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# EXECUTIVE SUMMARY

In accordance with section 94 of the *Water Supply (Safety and Reliability) Act*, the purpose of the Drinking Water Quality Management Plan (DWQMP) is to protect public health through the comprehensive management of drinking water quality. The drinking water quality management provisions in Queensland follow a risk-based management approach and it is intended that this approach is documented in a plan that demonstrates effective management of drinking water services to ensure a safe and reliable supply of drinking water is provided.

The DWQMP is intended to be a living document that reflects the requirements of the water service provider and what needs to be actioned on a day to day basis now and into the future to ensure the supply of safe drinking water. In doing so, the DWQMP will then be used by the water service provider as a means of achieving drinking water quality outcomes in the short and long term through the demonstration that good drinking water quality management measures are in place. A thorough understanding, and effective management of, the drinking water infrastructure, water treatment processes, hazards and hazardous events, and the monitoring of operational processes and the quality of drinking water supplied to customers is therefore essential. Consequently, this DWQMP documents the information required in order to achieve the delivery of safe and reliable drinking water services.

The DWQMP also requires the generation and implementation of a Risk Management Improvement Program (RMIP). The purpose of the RMIP is to describe the management measures proposed for any unacceptable residual risk. The description of these measures must include the proposed measures, actions, strategies or processes, priorities and implementation timeframes. The RMIP included in the DWQMP is based on the following elements:

- Element 1 - Infrastructure Upgrades and Improved Infrastructure Performance
- Element 2 - Optimisation of Information Management and Reporting Capabilities
- Element 3 - Enhanced Engagement with Stakeholders Associated with Drinking Water Infrastructure Management
- Element 4 - Improved Service Through Staff Awareness and Training
- Element 5 - Enhanced Water Quality Performance

These five elements represent high priority action items for which completion is required in order to mitigate risks posed to drinking water quality. The timeframe for completion and availability of funding for completion of each element is provided.

# REGISTERED SERVICE DETAILS

## 1.1 Service Provider Name

Rockhampton Regional Council – SP493
Ph: 1300 22 55 77| Fax: 1300 22 55 79
Address: PO Box 1860, Rockhampton QLD 4700
Web: www.rockhamptonregion.qld.gov.au

## 1.2 Drinking Water Service Operator

Fitzroy River Water (a business unit of Rockhampton Regional Council)
Ph: 1300 22 55 77| Fax: 1300 22 55 79
Address: PO Box 1860, (Belmont Road), Rockhampton QLD 4700
Web: www.rockhamptonregion.qld.gov.au

## 1.3 Drinking Water Schemes Covered by this Plan

The following schemes are described or referred to in this DWQMP:

Rockhampton Water Supply Scheme (Rockhampton Regional Council)
Mount Morgan Water Supply Scheme (Rockhampton Regional Council)

For the purposes of the DWQMP, unless otherwise stated in the text, a scheme refers to the entire contiguous distribution system irrespective of the local government ownership of the various parts of the scheme.

## 1.4 Current Details for Location, Size and Demand of Drinking Water Schemes

Figure 1.1 provides an overview of the location of each of the drinking water schemes described in this DWQMP. Table 1.1 lists current information on the names of the communities, the population size, the number of connections and the average daily demand for each drinking water scheme. Table 1.2 provides an indication of the anticipated population, connections and demand for each of the schemes in the year 2031. The projections on the number of connections and average daily demand for 2031 are based on calculations using the Planning Assumption Model (PAM) projections developed within Rockhampton Regional Council (RRC) localities.

**Figure 1 1: Map showing the location of the two drinking water schemes (Rockhampton, Mount Morgan) operated by Fitzroy River Water and the neighbouring Council areas.**

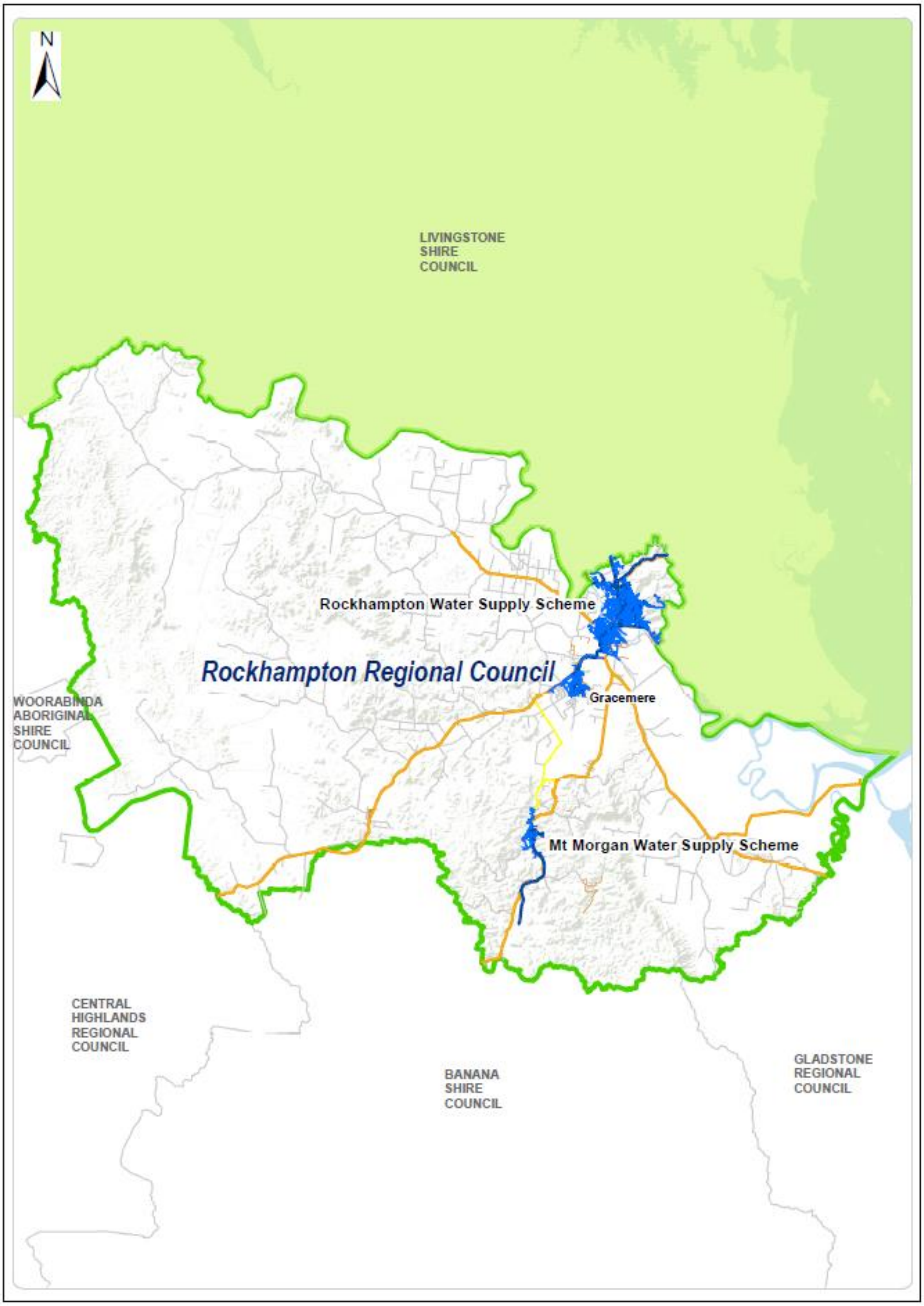


**Table 1.1: Current (2022) information for the communities fully or partially served by the water infrastructure operated by Rockhampton Regional Council, population, number of connections and demand for each drinking water supply scheme**

| Scheme | Communities Served | Population | Connections | Average Demand (ML/d)[d] |
|---|---|---|---|---|
| Rockhampton *(localities part of LSC's The Caves and Nerimbera Water Supply Schemes)* | Rockhampton, Gracemere, (*The Caves, Etna Creek, Glenlee, Glendale, Rockyview, Mt Charlton, Nerimbera*) | 92,372[b] (*3,713*[c]) | 30,848[a] (*1,485*[c]) | 47.20 (*5.10*) |
| Mount Morgan | Mount Morgan, Baree | 2,945[b] | 1,495[a] | 0.93 |

[a] Source: SWIM Reporting 2019
[b] Source: Australian Bureau of Statistics (2021 Census)
[c] Source: LSC's DWQMP 2021
[d] Source: Fitzroy River Water's operational data for 2018-19. Average demand indicated for the Capricorn Water Supply Scheme is based on the water supplied via Rockhampton to Yeppoon Water Supply Pipeline.

**Table 1.2: Estimated population, number of connections and demand for each drinking water scheme in 2031.**

| Scheme | Population | Connections | Average Demand (ML/d) |
|---|---|---|---|
| Rockhampton | 101,590[a] | 44,582[b] | 60.2[b] |
| Mount Morgan | 3,139[a] | 1,342[b] | 1.8[b] |

[a] Source: Australian Bureau of Statistics
[b] Source: RRC's Local Government Infrastructure Plan adopted March 2020
[c] Source: LSC's DWQMP 2021. Approximately 20-25% of the water demand in the Capricorn Coast Water Supply Scheme is anticipated to be supplied via the Rockhampton to Yeppoon Water Supply Pipeline.

# 2 DETAILS OF DRINKING WATER SCHEME INFRASTRUCTURE

## 2.1 Overview of Scheme Infrastructure

Tables 2.1 to 2.3 and Figures 2.1 to 2.3 provide summary information for the infrastructure and scheme layout for each drinking water scheme that is either fully or partially served by water infrastructure that is owned and operated by Rockhampton Regional Council (RRC). Only water source and treatment infrastructure that is owned and operated by RRC or is involved in supplying drinking water to RRC customers is described in detail in this DWQMP. In Figure 2.1 due to the size of the scheme and the number of WPS in this scheme, only bulk transfer WPS or those that supply to whole supply zones are shown.

A water grid-style connection exists between the Rockhampton and Capricorn Coast Water Supply Schemes. Figures 1.1, 2.1 and 2.2 show the location of this connection point. Although the Capricorn Coast Water Supply Scheme is owned and operated by Livingstone Shire Council (LSC), its distribution system is shown and described briefly to indicate the manner in which it is served by the Rockhampton Water Supply Scheme. Similarly, The Caves Water Supply Scheme located north of Ramsay Creek valve to Mt Charlton and Nerimbera Water Supply Scheme located east of Lakes Creek in North Rockhampton are part of the Livingstone Shire Council are described due to their direct physical link to the Rockhampton Water Supply Scheme despite their ownership by Livingstone Shire Council.

**Table 2.1: Summary of Infrastructure for the Rockhampton Water Supply Scheme**

| Rockhampton Water Supply Scheme | | |
|---|---|---|
| Source | | Fitzroy River 50,383 ML/annum. Surface Water (Unprotected) |
| Source Infrastructure | | Fitzroy Barrage and associated pondage |
| Treatment Plant | | Glenmore Water Treatment Plant<br>coagulation, flocculation, sedimentation, filtration, pH correction and disinfection<br>Treatment Capacity = 120 ML/d |
| Reservoirs | Number | 22 |
| | Capacity | 126.7 ML |
| Pump Stations | | 28 |
| Length of Mains and Common Services | | 774.9 km |
| No. of rechlorination sites | | 10 |

**Table 2.2: Summary of Infrastructure owned by Livingstone Shire Council[a]**

| Capricorn Coast Water Supply Scheme | | |
|---|---|---|
| Source | | Waterpark Creek 5,000 ML/annum Fitzroy River 50,383 ML/annum via the Rockhampton to Yeppoon Water Supply Pipeline. |
| Source Infrastructure | | Waterpark Creek Weir, Fitzroy Barrage, Kelly's Off-Stream Storage |
| Treatment Plant | | Glenmore Water Treatment Plant |
| Reservoirs | Number | 11 |
| | Capacity | 33.9 ML |
| Pump Stations | | >30 |
| Length of Mains and Common Services | | 450 km |
| No. of rechlorination sites | | 4 |
| **The Caves and Nerimbera Water Supply Schemes** | | |
| Source | | Fitzroy River 50,383 ML/annum |
| Source Infrastructure | | Fitzroy Barrage |
| Treatment Plant | | Glenmore Water Treatment Plant |

| | | |
|---|---|---|
| Reservoirs | Number | 3 |
| | Capacity | 9.2 ML |
| Pump Stations | | 1 |
| Combined Length of Mains | | 86 km |
| No. of rechlorination sites | | 1 |

Source: LSC's DWQMP 2021. There are no reservoirs or pump stations for Nerimbera Water Supply Scheme.

**Figure 2.1: Schematic of the Rockhampton Water Supply Scheme (Bulk WPS or WPS to whole supply zones shown only)**

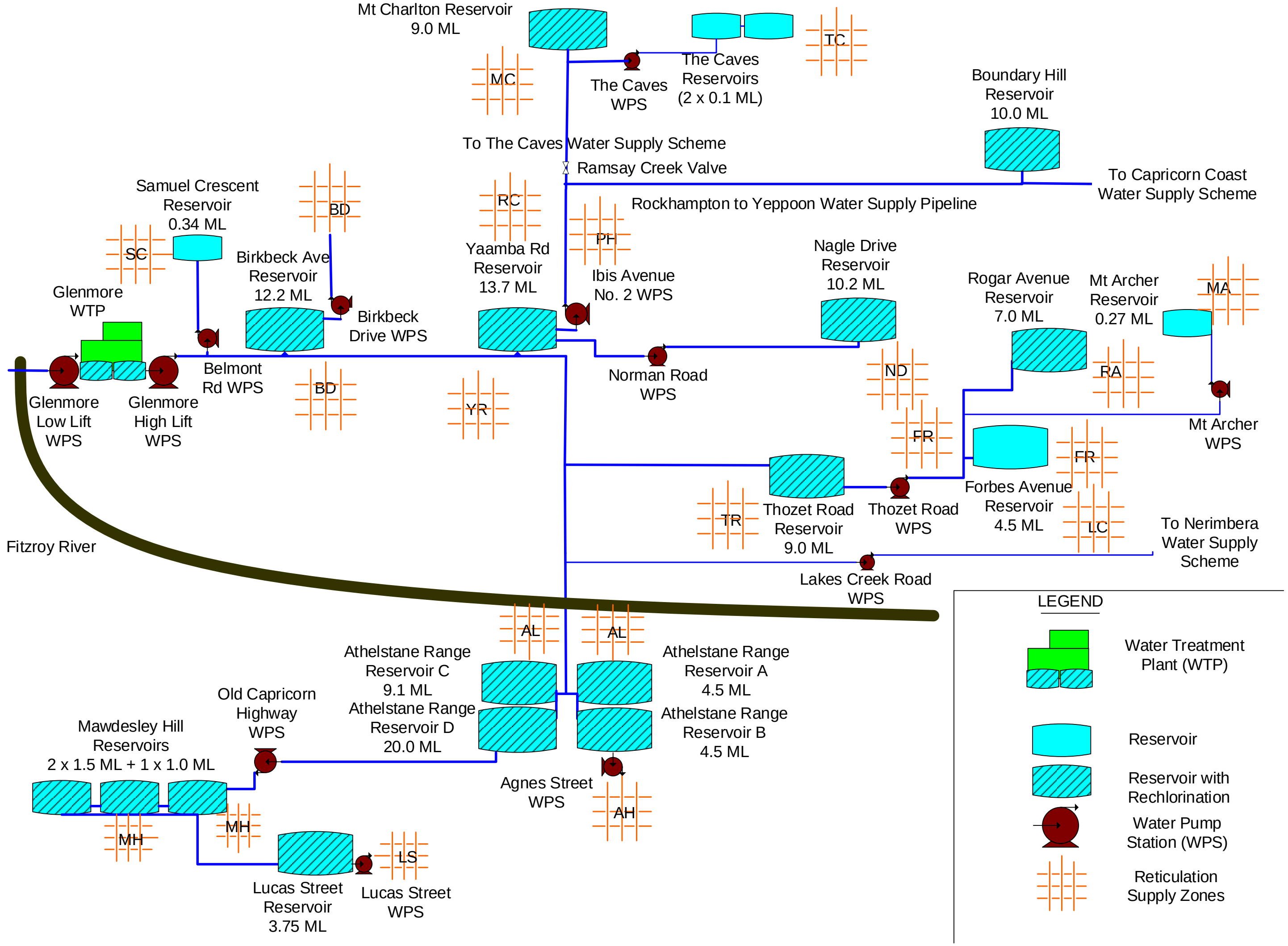


**Figure 2.2: Schematic of the Capricorn Coast Water Supply Scheme (Livingstone Shire Council Owned)**

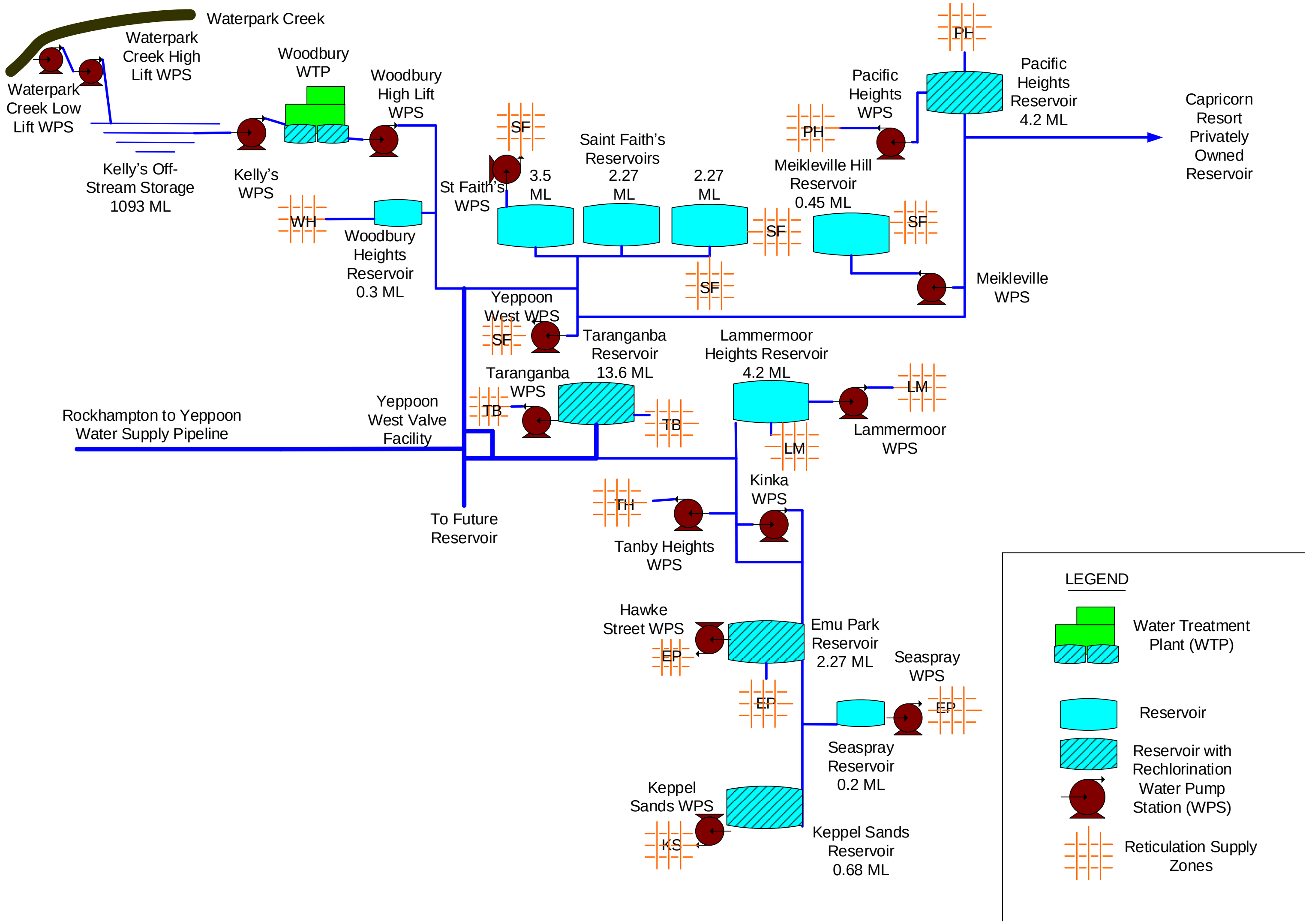
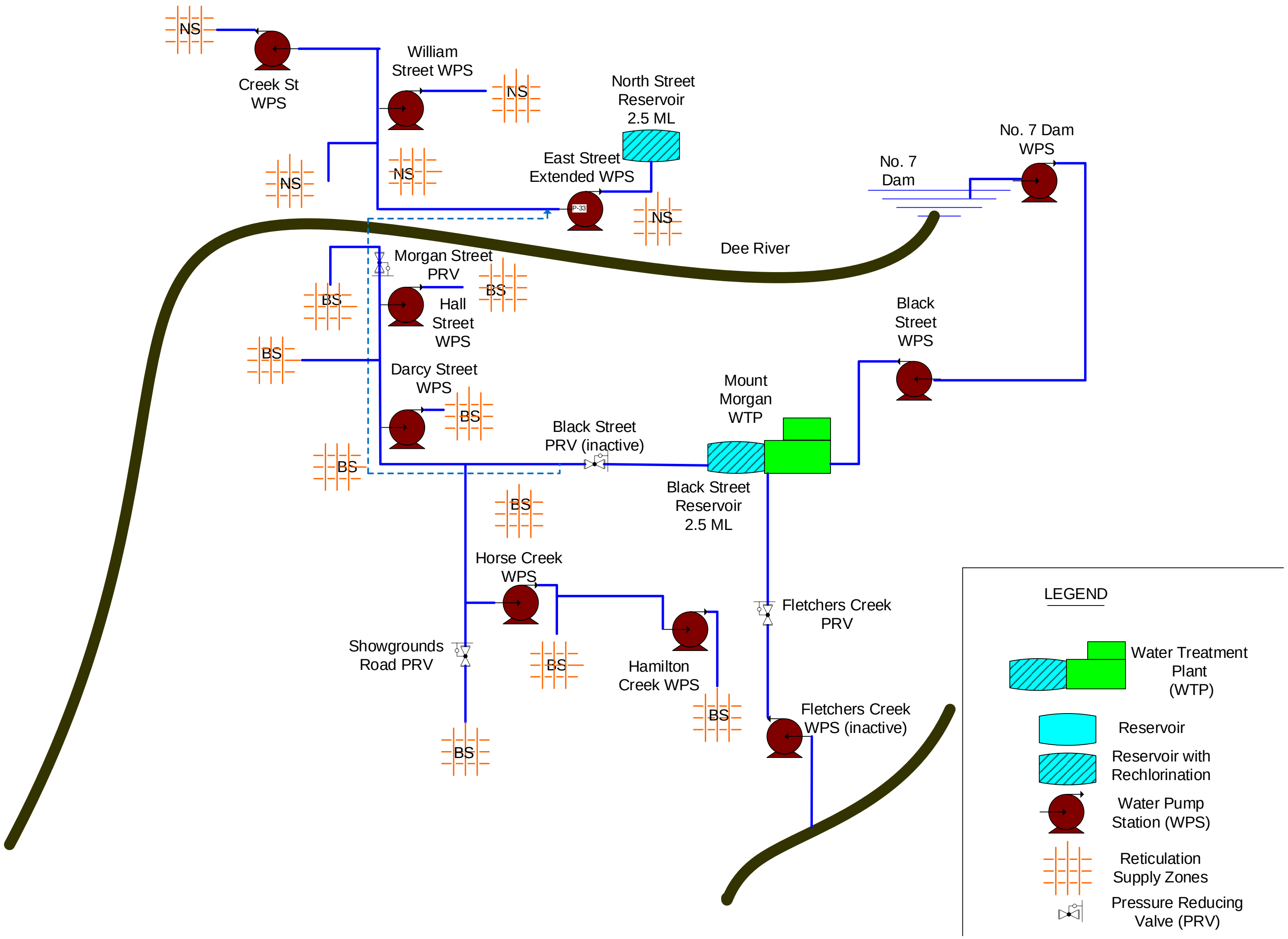


**Table 2.3: Summary of Infrastructure for the Mount Morgan Water Supply Scheme**

| Mount Morgan Water Supply Scheme | | |
|---|---|---|
| Source | | Dee River – No 7 Dam Council Allocation 584 ML/ annum |
| Treatment Plant | | Mount Morgan Water Treatment Plant coagulation, sedimentation, filtration, pH correction and disinfection<br>Treatment Capacity = 2.6 ML/d |
| Reservoirs | No. | 2 |
| | Capacity | 5.0 ML |
| Pump Stations | | 10 |
| Length of Mains and Common Services | | 72.9 km |
| No. of rechlorination sites | | 2 |

**Figure 2.3: Schematic of the Mount Morgan Water Supply Scheme**



## 2.2 Water Sources for Drinking Water Supply

### 2.2.1 Fitzroy River Barrage Storage

The Rockhampton, The Caves, Nerimbera and Capricorn Coast Water Supply Schemes are supplied with raw water drawn from RRC's 50,383 ML/year high priority water allocation, which is stored in an impoundment behind the Fitzroy River Barrage.

The Barrage sits at the bottom of the Fitzroy River Catchment which is the second largest in Australia covering in excess of 140,000 km$^2$. Due to the size of the catchment and the predominantly sub-tropical climate, the system is subject to highly variable but historically reliable flows with an average discharge between 5,000,000 and 6,000,000 ML/year. Fitzroy River Water (FRW) operates the Barrage in accordance with a Resource Operations Plan (ROP) which defines the requirement for storage management, environmental passing flows and water quality as well as other monitoring that is required to be performed. Releases from the Barrage impoundment are made by controlling the operation of 18 vertical lift gates that separate the freshwater from the downstream estuary using a fully automated control system.

FRW manages the storage of 11,583 ML/year of medium priority/high priority water for 299 licensed water allocation holders who draw water from the Barrage impoundment. These allocations are diverted by private infrastructure but FRW, as the delegate of the registered water service provider, oversees the process and ensures the objectives of the *Water Act 2000* are met as they affect the service provider.

The operating rules for the Barrage storage are entwined with the Eden Bann storage which stores a 24,000 ML/year high priority water allocation for the Stanwell Corporation. The Stanwell Corporation draws its water from the Barrage impoundment with water released from the Eden Bann storage into the Barrage by the Eden Bann operator as part of this supply arrangement.

The Barrage impoundment and upstream catchment are unprotected surface waters that are impacted by a multitude of different land use practices and industrial activities that occur in the various sub-catchments within the Fitzroy Basin. As such the raw water in the Barrage storage is subject to the potential impacts that occur within the catchment. Typical water quality issues that arise include cyanobacterial blooms, mine water discharges that alter water quality aesthetics and high flow or flooding events that lead to highly variable raw water quality e.g. rapid changes in turbidity, fluctuations in Fe and Mn concentration. The raw water contains a low concentration of fluoride at ~0.1 mg/L. A thorough review of the Fitzroy Basin, its characteristics, status and management framework is provided in the Fitzroy Basin Water Quality Improvement Report (2008) prepared by the Fitzroy Basin Association Incorporated.

The Glenmore Water Treatment Plant (WTP) intake structure is located approximately 5 km upstream of the Fitzroy Barrage. The intake is designed to provide four different depths from which water is pumped for treatment, from the surface to more than 5 m deep. Multiple high level intake structures provide the ability to pump raw water for treatment during high flow and flooding events. All

intake structures are designed to withstand damage from debris and high flows that occur during flooding events.
The Glenmore Low Lift Water Pump Station (WPS) contains four centrifugal pumps ranging in capacity from 270 L/sec to 715 L/sec. This WPS pumps raw water from the river intake into the inlet of the Glenmore WTP which is located about 250 m away from the riverbank. Combinations of these four pumps can be operated to meet the demand requirements and to balance the flow rate of raw water into the Glenmore WTP with the flow rate of drinking water out of the clear water storage reservoirs.

### 2.2.2 No.7 Dam and Fletchers Creek Weir

The Mount Morgan Water Supply Scheme obtains its water from the No.7 Dam (primary water source) when dam water quality allows. In an emergency or when the water from No. 7 Dam is deemed very low and/or of unacceptable quality which is the current conditions. Since April 2021 potable water has been carted to Mount Morgan from specified filling areas in the Rockhampton Water Supply Scheme and delivered to the Mount Morgan WTP for distribution to the Mount Morgan network.

The No.7 Dam is located on the Dee River which runs through the centre of Mount Morgan. The No.7 Dam was originally constructed in 1900 by the Mount Morgan Gold Mine Company and was later raised an additional 4.5 m in 1999. The total storage capacity of the dam is 2,800 ML.

For many years long term water security in Mount Morgan has been an area of much attention. The area receives lower annual rainfall than the coastal parts of the region and the Dee River and Fletchers Creek catchments are quite small by comparison. Based on historical data, the 99.9% reliable supply from the No.7 Dam is 1.6 ML/d. Land use in the Dee River and Fletchers Creek catchments above the two storages is predominantly cattle grazing or undisturbed bushland, with each catchment an unprotected catchment. The two storages are upstream from the extensive gold and copper mining activities associated with Mount Morgan’s history. Water quality issues associated with these two storages include problems associated cyanobacterial blooms and occasional increases in the concentrations of iron and manganese in the raw water.

The raw water intake at the No.7 Dam is located approximately 15 m away from dam wall and approximately 20 m from the shore of the dam. An anchored pontoon provides the support for the raw water intake pipe which is supplied via a single submersible pump capable of pumping 24 L/sec located at a fixed depth (600 mm) in water with a maximum depth of 12 m. An identical submersible pump is available for rapid installation as a replacement in the event of a raw water pump failure.

## 2.3 Water Treatment Processes

Water treatment for each of the drinking water schemes is performed using slight variations of the same conventional coagulation, flocculation, sedimentation, filtration, pH correction and disinfection process. The individual treatment processes are described below for each water treatment plant.

### 2.3.1 Glenmore Water Treatment Plant

The Glenmore WTP in Rockhampton is the source of treated water supplied to residents in Rockhampton, Gracemere, north of Parkhurst in North Rockhampton, east of Lakes Creek in North Rockhampton and Capricorn Coast via the Rockhampton to Yeppoon Water Supply Pipeline. Commencing operation in 1971, the Glenmore WTP has a maximum capacity to treat 120 ML/d and the maximum demand recorded on the system was 114 ML/d, which was recorded in 2002/03 prior to the introduction of water meters in Rockhampton. Since consumption-based charging commenced in 2005, maximum demand on the Glenmore WTP has been approximately 100 ML/d.

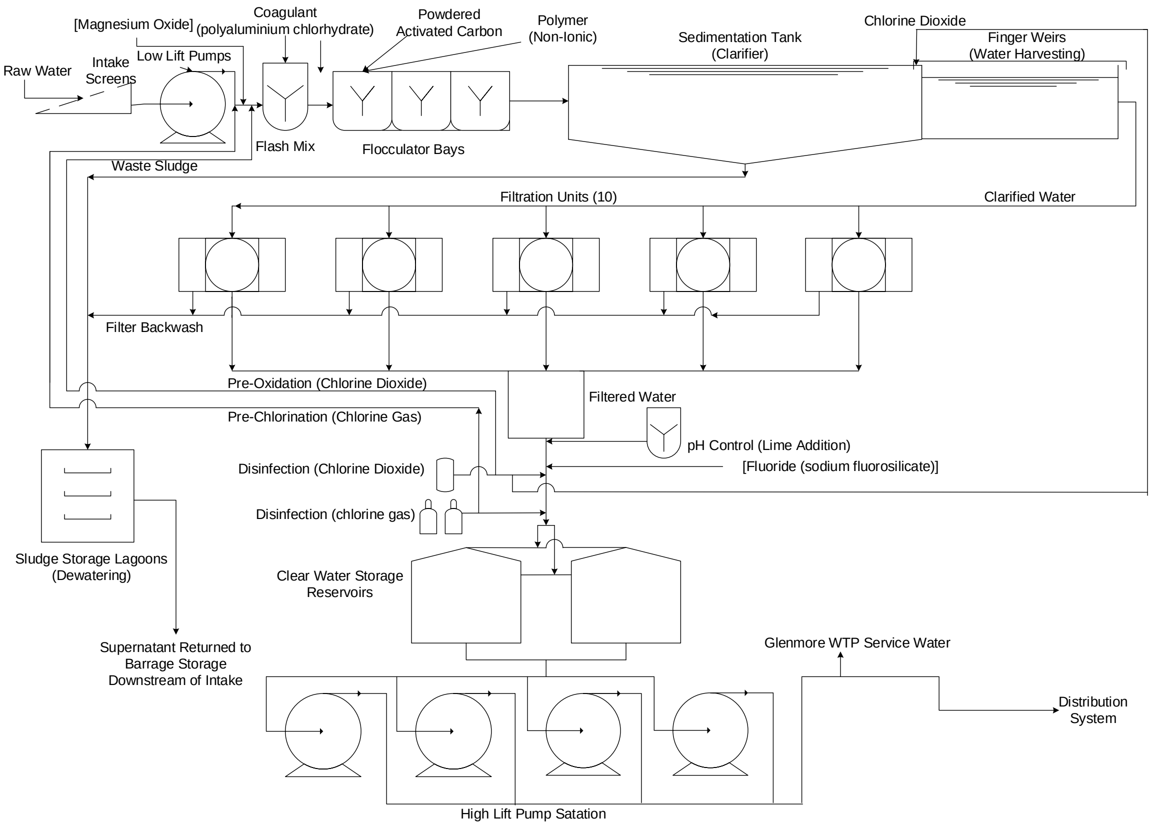
Design of the Glenmore WTP has been maximised to handle very high raw water turbidity with large rapid variations in raw water turbidity. There are no defined raw water turbidity operational limits for the operation of the WTP. The WTP has effectively treated raw water with turbidity in excess of 2000 NTU and is consistently capable of achieving more than 4-log removal of turbidity through its treatment stages. Operational performance is monitored using on-line and manual turbidity measurement to ensure the effectiveness of treatment barriers (see further descriptions below).

Figure 2.4 shows a schematic representation of the treatment processes used at the Glenmore WTP. Water flows through coarse mesh screens into the river inlet structure and gravitates to the low-lift pump station where it is pumped to the inlet of the WTP. Upon entry to the inlet of the WTP, the option exists for pre-oxidation using chlorine dioxide to oxidise manganese, iron and other oxidisable compounds, or to assist with the destruction and removal of cyanobacteria. The recently installed chlorine dioxide system will be used as the pre-treatment step due to its ability to oxidise organics and inorganics in the water while minimising the production of disinfection by-products. There is also an option to manually add magnesium oxide at the inlet of the WTP to increase alkalinity and adjust pH. The WTP inlet is designed to promote rapidly mixing conditions, and at this point the influent raw water is dosed with a coagulant (ACH Aluminium Chlorohydrate) using a duty/standby two pump set system. Coagulant-dosed raw water gravitates to two identical parallel train flocculation/sedimentation basins, each with a design capacity of 70 ML/d.

At the entry to the first bay of the flocculation tank powdered activated carbon (Acticarb PS1000 or equivalent) is dosed into the water using a duty/standby activated carbon dosing system, when required, to remove soluble organics. The flocculation tank is comprised of three bays that contain horizontal paddle mixers to provide gentle mixing to promote flocculation. Direction of flow through each bay is opposite to the previous bay. Upon entry to the second bay of each flocculation tank, the water is dosed with a polyacrylamide (Praestol DW20) as a water clarification aid.

Water containing well-formed floc particles leaves the flocculation tank and enters the sedimentation tank through a series of slots in the wall of the final flocculation bay. At this point the absence of mixing promotes the settling of the floc particles as the water passes through the sedimentation tank. The majority of the sedimentation process occurs within the first half of the sedimentation tank. A mechanical sludge scraper in each sedimentation tank is used to remove settled sludge through drains in the bottom of the sedimentation tank. Water treatment sludge is collected in on-site sludge holding lagoons. Gravity separation is used to separate the sludge from the supernatant which is then returned to the Fitzroy River Barrage impoundment. Strict discharge conditions require that the supernatant is of high quality and therefore poses no risk to the quality of raw water in the Fitzroy River Barrage storage. At the end of the first half of each sedimentation tank, water is able to be dosed with low levels of chlorine dioxide to oxidise residual organics and inorganics in the clarified water. The second half of each sedimentation tank contains a tube settler array to maximise sedimentation of fine floc particles. At this point, clarified top water (target turbidity of 1.0 to 1.5 NTU measured by a pre-filtration mid-tank on-line turbidity meter) is collected via finger weirs into collection channels which then transfer the clarified water to the sand filters.

**Figure 2.4: Schematic Representation of the Treatment Process at the Glenmore WTP.**




Filter Information

| CWT Media Design-Backwash 30m/h (453L/s) @ 25C with Triton Underdrains (1mm slots) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Parameter | Media Size | Size Unit | Media Depth, mm | Media L:d Ratio | Media and Filter EL, mm | Media Expansion | Expanded Media EL,mm | Launder Clearance, mm |
| Base of Launder | | | | | 1200 | | | 20 |
| Coal | 1 | ES | 500 | 500 | 1075 | 20% | 600 | |
| Sand | 0.6 | ES | 275 | 458 | 575 | 2% | 281 | |
| Garnet, top | 0.6 - 2 | NOM | 0 | | 300 | 0% | 0 | |
| Garnet mid | 1.2 - 2.4 | NOM | 75 | | 300 | 0% | 75 | |
| Garnett bottom | 2.4 - 4.8 | NOM | 75 | | 225 | 0% | 75 | |
| Tritan Underdrains | | | 150 | | 150 | | 150 | |
| Totals | | | 1075 | 958 | | | 1181 | |

Filters are automatically backwashed based on time, loss of head or turbidity triggers which are monitored in real-time by the Honeywell Programmable Logic Controller (PLC) and Experion PKS R511.3 Supervisory Control and Data Acquisition (SCADA) system. Backwashing is achieved using a duty/standby two pump set and a blower to wash and air scour each filter. Each filter contains a filter-to-waste function which enables poor quality filtered water to be wasted until the target water quality is achieved. Filters typically produce water with turbidity of <0.1 NTU, with 0.3 NTU used as a setpoint to trigger a backwash (as per the USEPA Long Term 2 Enhanced Surface Water Treatment Rule). Filter backwash or other waste waters are diverted to the sludge holding lagoons mentioned above and are treated and disposed of accordingly.

Filtered water passes through dual collection pipes which gravity transfer the water to the clear water reservoirs (2 x 2.2 ML reservoirs). Before reaching the clear water reservoirs, the dual collection pipes intersect at a pit designed to provide mixing, a water storage for the filter backwash pumps and also be used as a common dosing point for chlorine. An option also exists to dose chlorine dioxide into the pit as a disinfectant to minimise the production of disinfection by-products. Prior to entry into this pit filtered water is dosed with hydrated lime by one of two duty/standby lime feeding systems to correct pH (pH 7.8 target).

Disinfection is achieved by adding chlorine gas into the pit via one of two duty/standby Siemens gas feed chlorinators. The chlorine gas storage room is designed to allow four cylinders containing 920 kg each to be connected for use at any time. A free chlorine residual setpoint of 1.0 mg/L is used for the final water, and this is achieved using flow-paced dosing at rates of between 4 and 8 kg/h of chlorine gas required to achieve the free chlorine residual setpoint. An option also exists to dose chlorine dioxide into the pit as a disinfectant to minimise the production of disinfection by-products. Water from the clear water reservoirs is then pumped to the distribution system using the High Lift Pump Station on site. Alarm setpoints for low, low low, high and high high alarms for the free chlorine residual are in place to detect excursions outside of a target range (0.5 to 1.5 mg/L of free chlorine) and the Glenmore WTP PLC is programmed to automatically shutdown the WTP and High Lift Pump Station if the free chlorine residual exceeds 1.8 mg/L for more than 15 minutes or if free chlorine residual exceeds 1.5 mg/L for 60 minutes. If the free chlorine residual triggers a low level alarm, urgent action is taken to address the cause of the excursion via the attendance to site of suitably qualified reactive maintenance staff. If required the WTP will be shutdown to prevent the distribution of non-disinfected water to customers.

As indicated above, the Glenmore WTP has a maximum treatment capacity of 120 ML/d. This maximum capacity is based on the recorded peak operating rate used in the early 2000s when demand before the implementation of water meters in Rockhampton was significantly higher than it is currently. Each sedimentation tank is capable of achieving effective clarification of raw water at a rate of 70 ML/d. The 10 rapid sand filters are capable of achieving effective filtration of clarified water at a flow rate of 120 ML/d. The chlorine gas disinfection system is capable of achieving. effective disinfection up to at least 120 ML/d.

Despite these stated maximum capacity rates, a safe working maximum treatment capacity of 115 ML/d has been adopted as the normal maximum flow rate through the Glenmore WTP. Therefore, current maximum loadings are well beneath the known effective capacity of the sedimentation tanks, filters and disinfection process steps and no bypasses for any of these steps exists in the WTP process design. This rate has been determined based on its suitability over a range of differing raw water quality conditions. If required to meet high demand or maximise the cost effectiveness of operating during the off-peak electricity period, the Glenmore WTP is operated at the 115 ML/d flow rate, however, much of the time when demand is low, the flow rate through the Glenmore WTP ranges between 60 and 85 ML/d.

The Glenmore WTP is attended by at least one operator all day every day in order to closely monitor and operate (if required) the Glenmore WTP as well as to perform a range of water quality and process performance tests and checks.

### 2.3.2 Mount Morgan Water Treatment Plant

NB Because of the low quality of source water and low level,No. 7 Dam is currently unavailable to supply source water for the treatment and supply of drinking water to the Mount Morgan Water Supply Scheme. Treated water from the Glenmore WTP Supply Scheme is transported in bulk water carriers to the clear water reservoir at (Black St Reservoir) at Mount Morgan WTP.

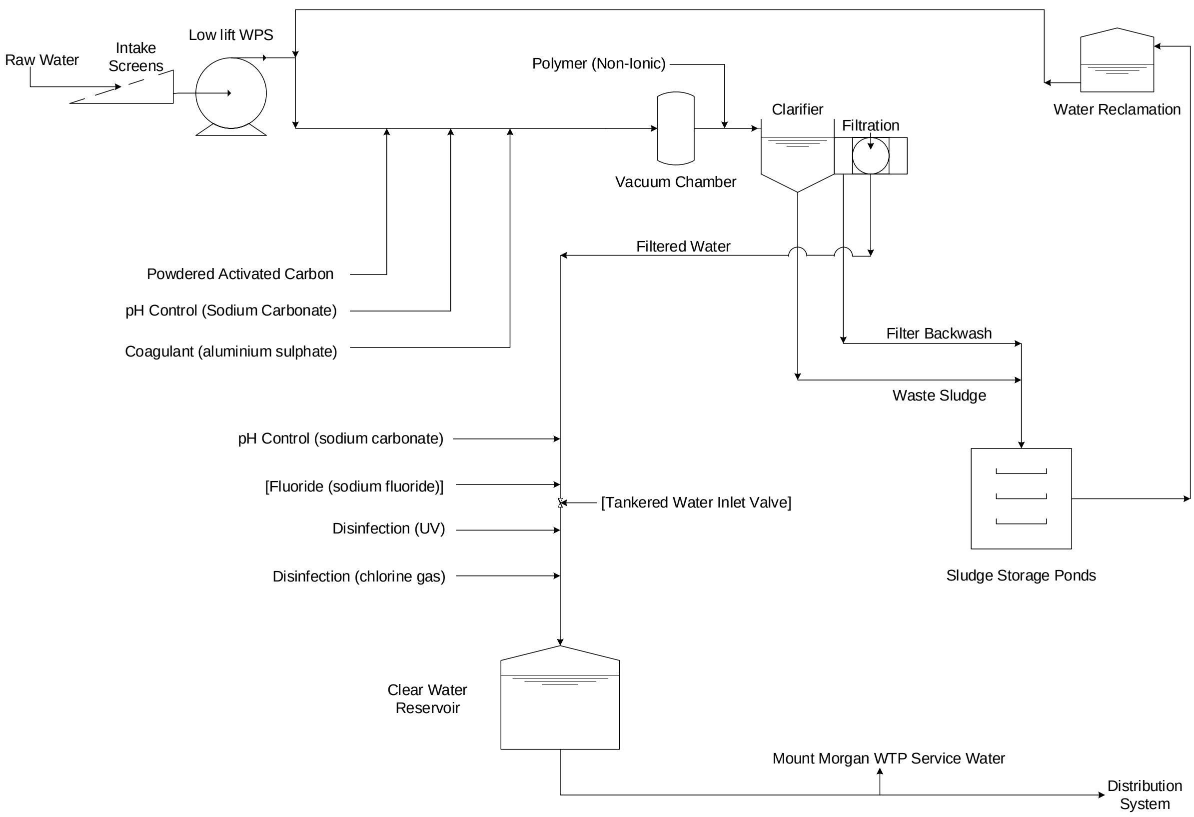
Immediately downstream of the de-commissioned fluoride dosing point is a butterfly valve that is used as a filling point for tankered potable water. Filtered water is then gravity fed to the on-site clear water reservoir (2.5 ML total storage volume). The water is chlorinated using chlorine gas as it enters the clear water reservoir (Black St Reservoir) which also provides half of the service reservoir storage for the Mount Morgan Water Supply Scheme. The Siemens chlorinator is designed to dose chlorine gas at the rate required to achieve a free chlorine residual of 1.0 mg/L in the clear water reservoir. The dosing is flow paced and also includes dosing control based on the on-line measurement of free chlorine residual.

Alarm setpoints for low, low low, high and high high alarms for the free chlorine residual are in place to detect excursions outside of a target range. A number of process interlocks have been implemented to stop the WTP in the event of high free chlorine residual (>1.8 mg/L for 15 min), low free chlorine residual (<0.5 mg/L for 15 min), high clear well turbidity (>1 NTU for 15 min), high filtered water turbidity (>1 NTU for 15 min). Two other interlocks in the event of faults with the chlorine dispersion pump or chlorine dosing valve, and another interlock in the event of an alum pump fault also stop the WTP operation.

The plant operation is currently controlled by an Allen Bradley Compact Logix PLC that provides automated operation of plant starting and stopping, filter backwashing and de-sludging processes. On-line monitoring of a number of water quality parameters are monitored at the Mount Morgan WTP with pH, turbidity and electrical conductivity monitored in raw water, filtered water and final water.

The Mount Morgan WTP is attended by an operator for at least four hours each day in order to closely monitor and operate (if required) the Mount Morgan WTP as well as to perform a range of water quality and process performance tests and checks.

**Figure 2.5: Schematic Representation of the Treatment Process at the Mount Morgan WTP.(WTP offline since April 2021 due to poor quality and low level of No 7 Dam)**




## 2.4 *Availability of Equipment and Critical Spares*

For all WTP and water distribution infrastructure an extensive inventory of equipment and critical spares is kept locally for most of the components of existing water treatment and distribution infrastructure. Table 2.4 provides an indication of the spares kept and provides a description of the type or function of the components.

Standard designs and equipment specifications have been adopted where possible to improve the consistency of processes, and to reduce the number of spares that need to be kept to satisfy maintenance demands. Critical equipment such as on-line and bench-top water quality monitoring instrumentation, chemical dosing pumps, flow meters, ultrasonic level indicators, PLCs and radio telemetry systems are among the items for which standard design and equipment specifications have been adopted. Future infrastructure upgrades are planned in accordance with these adopted specifications.

A significant amount of redundancy has been designed into the WTPs. Items or equipment such as air compressors, chemical storage tanks, chemical batch tanks, mixers and dosing pumps, flow meters and flow switches have been installed in either duty/standby or in an arrangement which provides a level of backup redundancy to help ensure continuity of operation.

**Table 2.4: Critical Spares Kept for Water Treatment and Distribution Infrastructure**

| Equipment Category | Type of Equipment/Parts in Each Category |
|---|---|
| Mechanical | Compressor and pneumatic system spares<br>Pumps and pumpheads for process sampling or chemical dosing<br>Backup generator set spares<br>Mixers for chemical batching tanks<br>Valves and valve actuator spares |
| Electrical | Switching gear and spares for high lift and low lift pump stations<br>Programmable Logic Controller spares<br>Electrical components, contactors, flow switches, circuit breakers<br>Radio telemetry equipment and spares<br>Variable speed drives and spares |
| Process Control | SCADA servers and spares<br>Flow meters, flow meter head units, flow sensors<br>On-line instrument probes, ultrasonic level indicators |

## 2.5 Water Distribution and Reticulation Infrastructure

A summary of the operation and flow regime through the water distribution system is provided below for each of the five water supply schemes that are supplied fully or partially with water by Fitzroy River Water. Except for Nerimbera Water Supply Scheme, all drinking water schemes are comprised of a range of different assets that are used to store, re-chlorinate and distribute water to customers. In all schemes a combination of gravity and pumped distribution mains are used to ensure flow and pressure requirements are met. A detailed description of the below ground pipe infrastructure, the above ground reservoirs and re-chlorination facilities, and water pump stations that are required to transport water and pressurise supply zones is also provided. Specific details of these assets in each scheme are provided in Tables 2.5 to 2.8. Appendix D provides an overview of the reservoir supply zones in the Rockhampton and Mount Morgan Water Supply Schemes.

### 2.5.1 Overview of Operation – Rockhampton Water Supply Scheme

The Glenmore high-lift water pump station (WPS) pumps water from the WTP through a network of trunk distribution mains to fill the Birkbeck Avenue, Yaamba Road, Thozet Road and Athelstane Range Reservoirs (see Figure 2.1). Birkbeck Avenue, Yaamba Road and Thozet Road Reservoirs gravity feed water to the surrounding reticulation networks in North Rockhampton while Athelstane Range Reservoirs gravity feed water to the surrounding networks in South Rockhampton and West Rockhampton. The Belmont Road WPS lifts water to the Samuel Crescent Reservoir which then gravity feeds a small reticulation network near the Glenmore WTP.

The Norman Road WPS is used to fill the Nagle Drive Reservoir which gravity feeds the Norman Gardens reticulation zone in North Rockhampton. The Thozet Road WPS lifts water from the Thozet Road Reservoir to fill the Forbes Avenue and Rogar Avenue Reservoirs which then gravity feeds water to the surrounding reticulation that serves the Frenchville area of North Rockhampton. A series of four small WPS are used to lift water to the Mt Archer Reservoir (approximately 600 m elevation) which then gravity feeds a small reticulation system on the top of Mt Archer. To the south-east of the Thozet Road Reservoir is Lakes Creek Road WPS which supplies water to a privately owned and operated reservoir and the surrounding reticulation network. East of Lakes Creek in North Rockhampton is LSC’s Nerimbera Water Supply Scheme which is supplied with water via gravity or Lakes Creek Road WPS. Nerimbera Water Supply Scheme which supplies water to Nerimbera and another privately owned and operated reservoir does not have a reservoir or disinfection facility.

The Athelstane Range Reservoir Complex gravity feeds water to the South Rockhampton and West Rockhampton reticulation networks as well as supply water along a gravity trunk main to the town of Gracemere where the Old Capricorn Highway WPS lifts the water to fill the Mawdesley Hill Reservoirs. Water is then gravity fed from the Mawdesley Hill Reservoirs to the surrounding reticulation system and to the Lucas Street Reservoir which supplies the reticulation system on the south-western side of Gracemere.

The Yaamba Road Reservoir supplies water via gravity or Ibis Ave WPS to the Parkhurst, Park Avenue and Kawana areas. Ibis Ave No. 2 WPS supplies water to Mt Charlton and the Caves Reservoirs to meet demand of the localities in The Caves Water Supply Scheme located north of Ramsay Creek valve including Glenlee, Glendale, Rockyview and Etna Creek areas All these localities to the north of Parkhurst in North Rockhampton are part of Livingstone Shire Council which owns and operates the water distribution infrastructure in these areas. The Caves and Mt Charlton Reservoirs can also gravity feed in some areas in Parkhurst when Ibis Ave No. 2 WPS is not pumping into Mt Charlton Reservoir.

The Ibis Ave No. 2 WPS also pumps water to the Boundary Hill Reservoir via the Rockhampton to Yeppoon Water Supply Pipeline. Boundary Reservoir which is located halfway between Rockhampton and Yeppoon then gravity fed water through the Yeppoon West Valve Facility to either the St Faith’s or Taranganba Reservoirs in the Capricorn Coast Water Supply Scheme. The Boundary Hill Reservoir is owned by Rockhampton Regional Council and operated by Fitzroy River Water and the pipeline infrastructure on the Yeppoon side of the Boundary Hill Reservoir is owned and operated by Livingstone Shire Council. All arrangements relating to the supply of this water are as per the Operating Protocol which forms part of the commercial water supply agreement between Rockhampton Regional Council and Livingstone Shire Council. A copy of this Operating Protocol is provided in Appendix E.

Details of the material type, age and length of water distribution pipes is provided in Table 2.5 below. The water distribution pipe infrastructure includes a range of different material types and ages. Details of the service reservoirs used to supply the distribution and reticulation systems are provided in Table 2.6.

Drinking water is rechlorinated at a number of locations throughout the distribution system. A list of rechlorination facilities and details of their design is provided in Table 2.7. All rechlorination facilities are monitored using the SCADA system through a radio telemetry network.

Details of the location, purpose and design of WPS are provided in Table 2.8.

### 2.5.1 Overview of Operation – Mount Morgan Water Supply Scheme

Drinking water tankered to the MMWTP is gravity fed into the Black Street Reservoir which also serves as the clear water reservoir for the WTP. From here the water is gravity fed to the reticulation system in the Mount Morgan and Baree areas. Water is pumped by the East Street Extended WPS to fill the North Street Reservoir. These two 2.5 ML reservoirs are typically used to supply the northern and southern parts of the reticulation respectively. A number of pressure reducing valves and booster WPS are used to maintain appropriate water pressure in low and high elevation areas within the Mount Morgan Water Supply Scheme. The use of pressure reducing valves is needed to cater for the range of changes in elevation throughout the distribution network and also to avoid over-pressuring of some relatively old underground assets to prevent pipe breaks.

Details of the material type, age and length of water distribution pipes is provided in Table 2.5 below. The water distribution pipe infrastructure includes a range of different material types and ages. Details of the service reservoirs used to supply the distribution and reticulation systems are provided in Table 2.6.

Drinking water is re-chlorinated at the North Street Reservoir. Details of the design of this re-chlorination facility are provided in Table 2.7. This re-chlorination facility is monitored using the SCADA system through a radio telemetry network.

Details of location, purpose and design of WPS are provided in Table 2.8.

### 2.5.2 Overview of Operation – Capricorn Coast Water Supply Scheme

Drinking water is supplied to the Capricorn Coast Water Supply Scheme from the Glenmore WTP via the Boundary Hill Reservoir as described in the overview for the Rockhampton Water Supply Scheme above, from the Woodbury WTP or through the combination of supply from each of these two WTPs.

Currently, approximately 20-25% (usually a minimum of 3 ML per day) of the Capricorn Coast Water Supply Scheme demand is supplied with water from the Glenmore WTP via the Rockhampton to Yeppoon Water Supply Pipeline with the remaining supply coming from the Woodbury WTP. The existing infrastructure allows for a number of supply permutations with varied contributions from each source and associated WTP. Figure 2.6 provides a schematic overview of the main options including the current split scheme operating arrangement for supply to the Capricorn Coast Water Supply Scheme. As indicated above, the supply of water by Rockhampton Regional Council to Livingstone Shire Council is carried out in accordance with agreed terms and conditions as specified in the current commercial water supply agreement. A copy of the Operating Protocol included in this agreement is provided in Appendix E. Once the water is supplied to Livingstone Shire Council from the Boundary Hill Reservoir, it is supplied to the various parts of the Capricorn Coast Water Supply Scheme according to the operating regime that is implemented and controlled by Livingstone Shire Council.

The existing infrastructure enables the Capricorn Coast Water Supply Scheme to be supplied either solely by the Glenmore WTP, solely by the Woodbury WTP or via a split scheme arrangement where the Glenmore WTP and Woodbury WTP supply water to the northern and southern part of the scheme respectively. The management of the distribution of water supplied by each of the Woodbury and Glenmore WTPs is the responsibility of Livingstone Shire Council. As required though, the Livingstone Shire Council will take as much water from the Boundary Hill Reservoir as they require, to meet demand during periods where either demand exceeds the supply capacity of the Woodbury WTP or when the operation of the Woodbury WTP is suspended for the completion of maintenance.

Specific details of pipe materials, reservoirs and water pump stations are not provided in Tables 2.5 to 2.8 as these details are not part of the responsibility of Fitzroy River Water with these assets owned by Livingstone Shire Council.

**Figure 2.6: Overview of Supply Scenarios for Supplying Water to the Capricorn Coast Water Supply Scheme.**

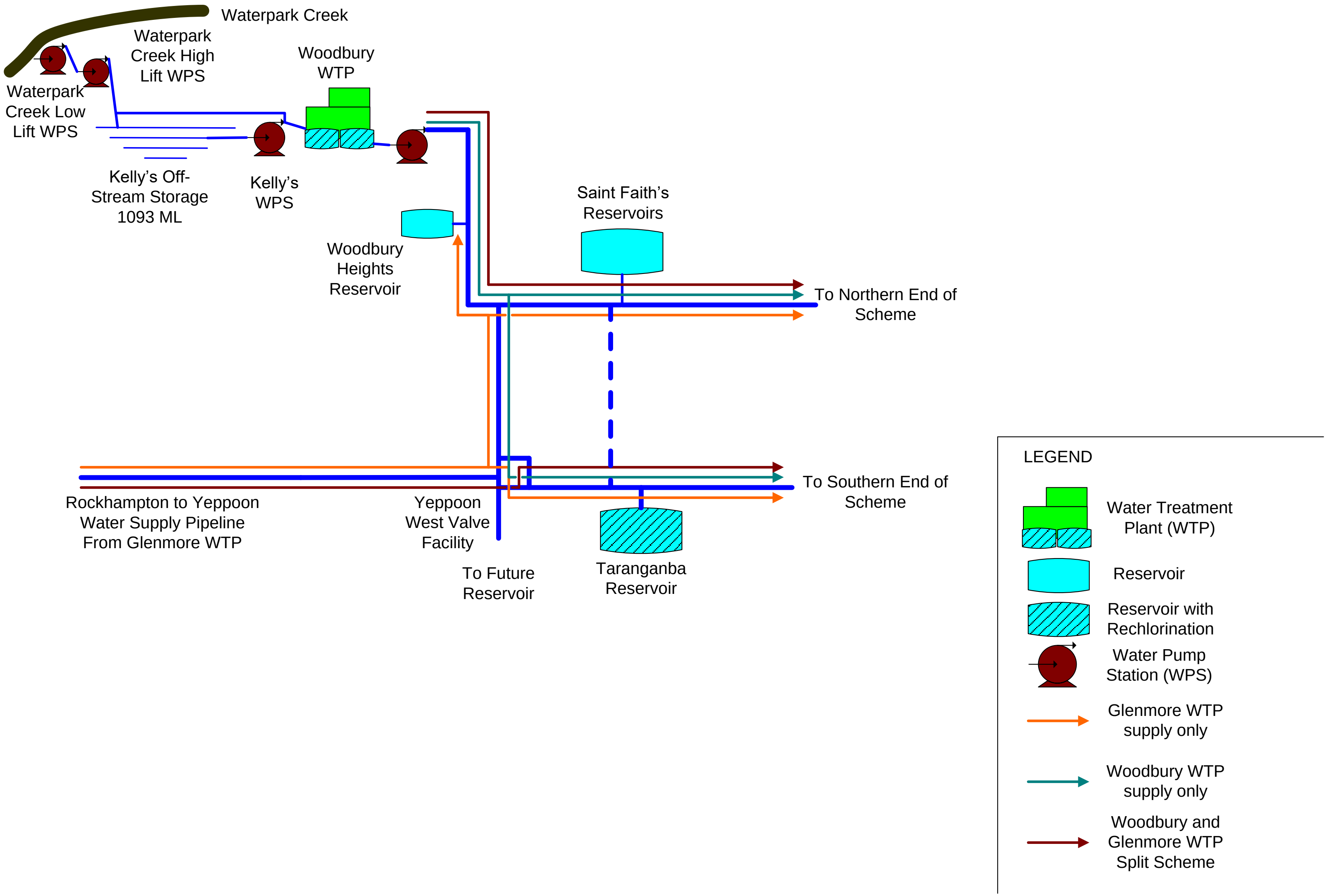


**Table 2.5: Details of Pipeline Infrastructure in each Drinking Water Supply Scheme**

| Material | Length (km) | Year Constructed |
|---|---|---|
| **Rockhampton Water Supply Scheme** | | |
| AC | 155.2 | 1920-1986 |
| CI | 17 | Prior 1930 |
| CICL | 48.7 | 1930-1970 |
| PE | 56.6 | 1970-2023 |
| mPVC | 286.2 | 2002-2023 |
| uPVC | 179.1 | 1970-2002 |
| MSCL | 28.9 | 1920-2022 |
| DICL | 19.8 | 1980-2023 |
| oPVC | 11.4 | 2008-2023 |
| GI | 2.1 | 1920-1980 |
| **Mount Morgan Water Supply Scheme** | | |
| AC | 7.2 | 1948 |
| CICL | 8.09 | 1948-1952 |
| uPVC | 9.2 | 1992-2002 |
| mPVC | 32 | 2008-2023 |
| MSCL | 8.2 | 1952 |
| PE | 7.73 | 1970-2009 |
| GI | 0.225 | 1975 |
| DICL | 0.07 | 2019 |

AC = asbestos cement, CI = cast iron, PE = polyethylene, mPVC = modified polyvinyl chloride, uPVC = unplasticised polyvinyl chloride, MSCL = mild steel cement lined, DICL = ductile iron cement lined, oPVC = oriented polyvinyl chloride, CICL = cast iron cement lined, GI = galvanised,

**Table 2.6: Details of Drinking Water Reservoirs in each Water Supply Scheme**

| Reservoir Name | Year Built | Capacity (ML) | Type/Design | Roof |
|---|---|---|---|---|
| **Rockhampton Water Supply Scheme**[a] | | | | |
| Clear Water 1&2 | 1971 | 2 x 2.2 | 2 x Concrete circular reservoir | Fully enclosed concrete |
| Birkbeck Ave. | 1999 | 12.2 | Concrete circular reservoir | Fully enclosed metal sheet |
| Samuel Crescent | 1993 | 0.34 | Steel panel circular reservoir | Fully enclosed metal sheet |
| Yaamba Rd | 1974 | 13.7 | Concrete circular reservoir | Fully enclosed metal sheet |
| Nagle Drive | 1986 | 10.2 | Concrete circular reservoir | Fully enclosed metal sheet |
| Thozet Rd | 1963 | 9.0 | Steel plate circular reservoir | Fully enclosed metal sheet |
| Forbes Ave | 1976 | 4.5 | Concrete circular reservoir | Fully enclosed metal sheet |
| Rogar Ave | 2004 | 7.0 | Concrete circular reservoir | Fully enclosed concrete |
| Mt Archer | 1974 | 0.27 | Concrete circular reservoir | Fully enclosed concrete |
| Athelstane A | 1958 | 4.5 | Concrete circular reservoir | Fully enclosed metal sheet |
| Athelstane C | 1932 | 9.1 | Concrete rectangular reservoir | Fully enclosed fibro sheet |
| Athelstane D | 1996 | 20.0 | Concrete circular reservoir | Fully enclosed metal sheet |
| Mawdesley Hill 1 | 1986 | 1.5 | Concrete circular reservoir | Fully enclosed metal sheet |
| Mawdesley Hill 2 | 1993 | 1.5 | Concrete circular reservoir | Fully enclosed metal sheet |
| Mawdesley Hill 3 | 1972 | 1.0 | Concrete circular reservoir | Fully enclosed metal sheet |
| Lucas St | 2004 | 3.75 | Concrete circular reservoir | Fully enclosed metal sheet |
| Boundary Hill | 2010 | 10 | Concrete circular reservoir | Fully enclosed concrete |
| **Mount Morgan Water Supply Scheme** | | | | |
| Black St | 1955 | 2.5 | Concrete circular reservoir | Fully enclosed metal sheet |
| North St | 1993 | 2.5 | Concrete circular reservoir | Fully enclosed metal sheet |

[a] Note that the Mt Charlton and The Caves reservoirs are owned and operated by Livingstone Shire Council.

**Table 2.7: Reservoir Re-chlorination Facilities and Details of the Disinfection System at each Site**

| Reservoir Name | Disinfectant Type | Year Installed | Dosing Mode/Design | Target Residual (mg/L)* | Monitoring/Alarms | Pump Setup |
|---|---|---|---|---|---|---|
| **Rockhampton Water Supply Scheme** | | | | | | |
| Birkbeck Ave | Sodium hypochlorite | 1999 | Inlet flow paced, Cl analyser, Overdose auto shut-off, Telemetry to SCADA | 1.0 | Residual & Hypo tank level Low, Lo Low, High, Hi High, | Single Dosing Pump, Recirculation Pump |
| Yaamba Rd | Chlorine gas | 1993 | Inlet flow paced, Cl analyser, High dose auto shut-off, Telemetry to SCADA | 1.0 | Residual & Gas Weight Low, Lo Low, High, Hi High, | Not applicable |
| Nagle Drive | Sodium hypochlorite | 2011 | Inlet flow paced, Cl analyser, High dose auto shut-off, Telemetry to SCADA | 1.0 | Residual & Hypo tank level Low, Lo Low, High, Hi High | Single Dosing Pump, Recirculation Pump |
| Thozet Rd | Sodium hypochlorite | 1993 | Inlet flow paced, Cl analyser, High dose auto shut-off, Telemetry to SCADA | 1.0 | Residual & Hypo tank level Low, Lo Low, High, Hi High | Single Dosing Pump, Recirculation Pump |
| Rogar Ave | Sodium hypochlorite | 2017 | Inlet flow paced, Cl analyser, High dose auto shut-off, Telemetry to SCADA | 1.0 | Residual & Hypo tank level Low, Lo Low, High, Hi High | Single Dosing Pump, Recirculation Pump |
| Athelstane | Sodium hypochlorite | 1992 | Inlet flow paced, Cl analyser, High dose auto shut-off, Telemetry to SCADA | 1.0 | Residual & Hypo tank level Low, Lo Low, High, Hi High | Single Dosing Pump, Recirculation Pump |
| Mawdesley Hill | Sodium hypochlorite | 2007 | Inlet flow paced, Cl analyser, High dose auto shut-off, Telemetry to SCADA | 1.0 | Residual & Hypo tank level Low, Lo Low, High, Hi High | Single Dosing Pump, Recirculation Pump |
| Lucas St | Sodium hypochlorite | 2004 | Inlet flow paced, Cl analyser, High dose auto shut-off, Telemetry to SCADA | 1.0 | Residual & Hypo tank level Low, Lo Low, High, Hi High | Single Dosing Pump, Recirculation Pump |
| Boundary Hill | Sodium hypochlorite | 2010 | Inlet flow paced, Cl analyser, High dose auto shut-off, Telemetry to SCADA | 1.0 | Residual & Hypo tank level Low, Lo Low, High, Hi High | Duty/Standby Dosing Pump, Recirculation Pump |
| **Mount Morgan Water Supply Scheme** | | | | | | |
| North St | Sodium hypochlorite | 2014 | Inlet flow paced, Cl analyser, High dose auto shut-off, Telemetry to SCADA | 1.0 | Residual & Hypo tank level Low, Lo Low, High, Hi High | Single Dosing Pump, Recirculation Pump |

* Target residual may be varied depending on factors like seasonal demand, customer feedback or in response to a drinking water quality non-compliance.

^ Mt Charlton reservoir is owned and operated by Livingstone Shire Council. Target residual is current Set Point.

**Table 2.8: Details of Water Pump Stations within Drinking Water Supply Schemes**

| Pump Station Name | Purpose | Pump Capacity L/sec | Pump Station Design# |
|---|---|---|---|
| **Rockhampton Water Supply Scheme** | | | |
| Glenmore Low Lift | Supply raw water to the Glenmore WTP | 715, 270, 270, 560 | 4 Centrifugal pumps, SCADA monitored |
| Glenmore High Lift | Supply potable water to RWSS | 540, 540, 540, 540 | 4 Centrifugal pumps, SCADA monitored |
| Agnes St | Boost pressure to high zone | 270, 110, 190 | 3 centrifugal pumps, SCADA monitored |
| Birkbeck Drive | Supply water to Edenbrook Estate | 30, 30, 30, 30 | 4 centrifugal pumps, SCADA monitored |
| Everingham Ave | Boost pressure to high zone | 11, 11, 11, 11 | 4 centrifugal pumps, SCADA monitored |
| Frenchville Rd | Boost pressure to high zone | 1, 1, 1 | 3 centrifugal pumps, SCADA monitored |
| Mt Archer 1,2,3,4 | Lift water to Mt Archer (~600m elevation) | All 3.4 | 2 centrifugal pumps, SCADA monitored |
| Norman Rd | Fill Nagle Drive Reservoir | 57, 57 | 2 centrifugal pumps, SCADA monitored |
| Ridgedale Ave | Boost pressure to high zone | 4 | 1 centrifugal pump, not monitored |
| Samuel Crs. | Boost pressure to high zone | 11,11,11 | 3 centrifugal pumps, SCADA monitored |
| Africander Ave | Boost pressure to high zone | 4 | 1 centrifugal pump, not monitored |
| Ibis Ave No. 2 | Supply water to Boundary Hill and Mt Charlton Reservoirs | 260, 260 | 2 centrifugal pumps, SCADA monitored |
| Belmont Rd | Fill Samuel Crs Reservoir | 11, 11, 11 | 3 centrifugal pumps, SCADA monitored |
| Braddy St | Boost pressure to high zone | 29, 53 | 2 centrifugal pumps, SCADA monitored |
| The Caves^ | Fill The Caves Reservoir | 5, 5 | 2 centrifugal pumps, SCADA monitored |
| Forbes Ave | Boost pressure to high zone | 20, 20 | 2 centrifugal pumps, SCADA monitored |
| Ibis Ave No. 1 | Boost pressure to high zone | 6.5, 6.5, 6.5, 6.5 | 4 centrifugal pumps, SCADA monitored |
| Lakes Ck Rd | Fill third party Reservoir, Supply to reticulation | 30, 30 | 2 centrifugal pumps, SCADA monitored |
| Rockonia Rd | Boost pressure to high zone | 25, 25 | 2 centrifugal pumps, SCADA monitored |

| Pump Station Name | Purpose | Pump Capacity L/sec | Pump Station Design# |
|---|---|---|---|
| Selwyn Crs | Boost pressure to high zone | 1, 1 | 2 centrifugal pumps, not monitored |
| Sleipner St | Boost pressure to high zone | 1.7 | 1 centrifugal pump, not monitored |
| Thozet Rd | Fill Forbes and Rogar Reservoirs | 120, 120 | 2 centrifugal pumps, SCADA monitored |
| Wehmeier Ave | Boost pressure to high zone | 20 | 1 centrifugal pump, SCADA monitored |
| Whiteley St | Boost pressure to high zone | 0.5 | 1 centrifugal pump, not monitored |
| Lucas St | Boost reticulation pressure | 75, 75, 75, 75 | 4 centrifugal pumps, SCADA monitored |
| Old Capricorn Hwy | Fill Mawdesley Hill Reservoir | 115, 115 | 2 centrifugal pumps, SCADA monitored |
| **Mount Morgan Water Supply Scheme** | | | |
| No. 7 Dam | Supply raw water to Black St WPS | 24, 24 | 2 submersible pumps, SCADA monitored |
| Black St | Supply raw water to MMWTP | 24, 24 | 2 centrifugal pumps, SCADA monitored |
| Creek St | Boost pressure to high zone | 5 | 1 centrifugal pump, not monitored |
| Darcy St | Boost pressure to high zone | 5 | 1 centrifugal pump, not monitored |
| East St Extended | Fill North St Reservoir | 8 | 1 centrifugal pump, SCADA monitored |
| Hall St | Boost pressure to high zone | 5 | 1 centrifugal pump, not monitored |
| Horse Ck | Boost pressure to high zone | 6 | 1 centrifugal pump, not monitored |
| Hamilton Ck | Boost pressure to high zone | 3 | 1 centrifugal pump, not monitored |
| William St | Boost pressure to high zone | 5 | 1 centrifugal pump, not monitored |

# All pump stations with multiple pumps operate as Duty/Standby pumps except the Low Lift and High Lift WPS in the Rockhampton Water Supply Scheme
^ The Caves WPS is owned and operated by Livingstone Shire Council.

### 2.5.3 Known Areas of Low Pressure within Distribution Systems

Due to recent improvements in pressure management in Mount Morgan there are no significant portions of this distribution system which possess less than the minimum service pressure standard of 220 kPa.

### 2.5.4 Known Areas of Long Detention Time within Distribution Systems

There are two locations within the drinking water schemes where Fitzroy River Water is involved partially or fully in the management of water quality, where the size and length of water supply pipelines leads to long detention times that result in a drinking water age in excess of 5 days.

The most significant of these is the Rockhampton to Yeppoon Water Supply Pipeline which is comprised of approximately 40 km of 600 mm or 750 mm diameter water trunk infrastructure. The Boundary Hill Reservoir (10 ML) is located at close to the mid-point of this length of pipeline. The combined storage capacity of the pipeline and the reservoir is approximately 24 ML. The daily volume of supply from the Glenmore WTP along the pipeline to the Capricorn Coast Water Supply Scheme is usually between 3 and 5 ML. Based on this rate of supply the water may take in excess of 5 days before it travels from the WTP to the first customer’s tap.

Secondly, the rising main between Ramsay Creek valve and the Mt Charlton Reservoir to the north is another area where due to the length (~18 km) and diameter of the pipe (~600 mm), distributed water can have a relatively long detention time depending on demand. The overall operation of this part of the Rockhampton Water Supply Scheme north of Ramsay Creek valve is the responsibility of Livingstone Shire Council.

## 2.6 Stakeholders Involved in Managing Drinking Water Infrastructure

Apart from FRW employees, other groups, companies and organisations are involved in the management of the infrastructure and water quality associated with drinking water services provided by RRC. Table 2.9 contains a list of these stakeholders, the infrastructure they are involved in managing and their contribution as a stakeholder.

**Table 2.9:Stakeholders Involved in the Management of Drinking Water Quality and Infrastructure**

| Name of Stakeholder | Infrastructure Involved | Stakeholder Contribution |
|---|---|---|
| **All Water Supply Schemes** | | |
| Department of Regional Development, Manufacturing and Water | Water sources and catchments; All of scheme infrastructure | Water quality and quantity monitoring and management; Regulator of drinking and recycled water schemes, incident management |
| Department of Environment and Science | Water sources and receiving environments and associated catchments | Regulator for protection of the environment. |
| Queensland Health | All of scheme infrastructure | Primary responsibility for public health, incident management |
| Various commercial and industrial customers | All of scheme infrastructure | Recipients of water quality reports |
| **Rockhampton Water Supply Scheme** | | |
| Fitzroy Basin Association Incorporated | Fitzroy Basin upstream catchment | Catchment management and water quality monitoring |
| Fitzroy Partnership for River Health | Water sources and catchments | Water quality monitoring and reporting. |
| Teys Australia Pty Ltd | Reticulation supply to abattoir | Major commercial customer |
| SunWater | Eden Bann Weir and other upstream storages | Management of catchment and storage releases |
| **Capricorn Coast, The Caves and Nerimbera Water Supply Schemes** | | |
| Livingstone Shire Council | All of scheme infrastructure | All aspects of water service provision |
| Fitzroy River Water | All of scheme infrastructure | Bulk supply of drinking water from the Glenmore WTP |
| **Mount Morgan Water Supply Scheme** | | |
| Smalls Egg Farm | Reticulation to Egg Farm | Major commercial customer |
| **External Contractors/Suppliers** | | |
| Ixom | WTPs and Reservoir Disinfection | Chlorine gas and sodium chlorite supplier |
| Omega Chemicals, Orica | WTPs | Coagulant chemical supplier |
| Redox | WTPs | Treatment chemical supplier |
| Coogee QCA Pty Ltd | WTPs and Reservoir Disinfection | Sodium hypochlorite supplier |
| Nalco, Chemiplas, QMAG | WTPs | Treatment chemical supplier |
| Activated Carbon Technologies, Filchem | WTPs | Activated carbon supplier |
| Grenof Pty Ltd | WTPs | Calcium hydroxide supplier |
| **Internal Contractors/Suppliers** | | |
| Logistics | All infrastructure | Assisting with procurement and logistics for all water operations |
| Business Services Team | All infrastructure | Assist with business management |
| Records Management | All infrastructure | Assist with data archiving |
| Customer Service Team | All infrastructure | Assist with customer interactions |
| Corporate Compliance | All infrastructure | Assist with Corporate reporting. |

# 3 CATCHMENT AND WATER QUALITY INFORMATION

## 3.1 Catchment Characteristics

The five drinking water supply schemes described above that are either fully or partially supplied by Fitzroy River Water are supplied by a total of five surface water catchment systems. These catchments differ considerably with respect to size, flow volume, topography, geology, vegetation, climate and land use. The surface water sources that are owned and operated by Fitzroy River Water are described below.

### 3.1.1 Fitzroy River Basin

The Fitzroy River Basin is an extensive and diverse catchment. It covers an area of approximately 142,000 $km^2$ and consists of six major sub-catchments: Isaac/Connors, Nogoa, Comet, Mackenzie, Dawson and Fitzroy. A detailed description of the Fitzroy River Basin is provided in the Fitzroy Basin Water Quality Improvement Report published by the Fitzroy Basin Association in 2008. The topography, geology, vegetation, climate and land use within the Fitzroy River Basin vary considerably.

Based on area, the predominant vegetation type is brigalow scrub (28%) which is characterised by a range of different softwood species which thrive on a variety of clay or loam soil types. Next most abundant (24%) is mountain and range topography which consists of medium to tall hardwood forests on the rocky more elevated terrain. Eucalypt woodlands (22%) are the next most abundant vegetation type and exist on a mix of sandy or loamy tableland or clay areas dominated by ironbark or related eucalypt species. Alluvial deposits covered by ‘true gum’ species such as blue gums and red gums as well as some poplar box and brigalow scrub cover 16% of the catchment. The remaining 10% is covered by bluegrass downs with open woodlands (7%), sandy areas dominated by cypress, shrubby and heath species (2%), and the coastal sandy margins that include eucalypt, tea tree, sand dune and marine vegetation types (1%).

Average annual rainfall across the catchment ranges between 600 mm in the west, 800 mm in the east and 1000 mm in the north. Despite these rainfall averages, seasons are highly variable with long dry periods usually punctuated by short periods of high rainfall (usually in the summer months) which results in high flows and flooding events. In some parts of the basin drought occurs on average every three years. As a result, 29 dams and weirs have been constructed throughout the basin to improve water availability for agriculture, industrial and urban uses. Isolated bushfires are common during dry periods and occur especially during late winter and early spring before the onset of summer rainfall.

Land use across the basin includes livestock grazing (81%), cropping (6%), conservation (6%), forestry (5%), urban (1%), mining (0.5%) and irrigation (0.5%). Grazing activities are widespread throughout the catchment including within a few kilometres of the Glenmore WTP along the banks of the Fitzroy River. Mining activities include the activities throughout the Bowen Basin to the west and north of the basin as well as in the lower parts of the Dawson River valley. Currently at least 46 coal mine operations exist within the basin. Mining activities are expected to increase over time with the establishment of new coal mines or coal seam gas operations within the basin. The increased mining activities will inevitably lead to increased impacts on water quality in the basin. The extreme example of this impact was the release of mine-associated water from the Ensham Mine during 2008 under an emergency release arrangement. This emergency release led to sodium concentrations in excess of 100 mg/L in the Fitzroy Barrage Storage. It is estimated that coal mine water discharges contributed to between 18 and 25% of salinity loadings into the Fitzroy Basin at different times during 2011. Increased levels of total dissolved solids (TDS) have the potential to negatively impact water aesthetics.

Rockhampton is the largest urban development in the basin. The towns of Emerald and Blackwater to the west of Rockhampton and the townships along the Dawson River and Isaac River are amongst the more developed areas of the basin. Urban development is expected to grow in response to increased mining activities in the region and the future construction of additional water storage on the Connors, Dawson and Fitzroy Rivers. Currently there is minimal impact from urban development, industrial activities or recreational activities on the located adjacent to Rockhampton on the water quality in the Fitzroy River Barrage storage. Urban development includes low level residential development, industrial activities include sand dredging and livestock grazing, and recreational activities are mainly limited to rowing and water skiing. These development activities have the potential to cause slight increases in turbidity (e.g. dredging) or microbial pathogen loads (e.g. from livestock) although there is no evidence to date that these activities are significantly impacting water quality in the Barrage storage.

### 3.1.2 Dee River, No 7 Dam and Fletchers Creek

The township of Mount Morgan and surrounding areas receive approximately 800 mm rainfall per year on average. The Dee River passes through the township of Mount Morgan. Although more famous for its highly coloured waters due to impacts caused by acid and metal pollution from the Mount Morgan mine site, the No. 7 Dam constructed on the Dee River just upstream of the town by the Mount Morgan Gold Mining Company is by contrast a relatively clean and undisturbed catchment. It is still however, an unprotected surface water with cattle grazing activities conducted upstream of the No. 7 Dam site in what is largely open eucalypt woodland on rocky soils through hilly terrain. The upper catchment of the Dee River contains minimal other urban, rural or industrial development or land use activities. It is possible that agricultural or grazing activities could impact the water quality in No. 7 Dam through the release of nutrients or microbial pathogens to the catchment. There is currently no evidence that these activities are having a negative impact on the quality of raw water in No. 7 Dam.

Fletchers Creek is located approximately 15 km to the south of Mount Morgan and is comprised of a small catchment that winds its way through a series of low hills that consist of open dry eucalypt woodlands and grasslands. The area is used predominantly for cattle grazing purposes with minimal other urban, rural or industrial development in the catchment area. The southern edge of the copper and gold-bearing sulphide ore body that extends through to just north of Mount Morgan is located within a few kilometres of the Fletchers Creek weir. The sulphide ore body has no direct impact on the Fletchers Creek system, however, the slightly acidic soils create highly corrosive conditions for acid-sensitive metallic pipe materials.

The Mount Morgan area has not experienced significant levels of growth and development in recent years. The potential exists for the Mount Morgan mine to again become active. Although this has the potential to lead to increased development and population growth in the township, this type of development does not appear likely to impact the upper Dee River or Fletchers Creek catchment areas.

## 3.2 Raw Water and Drinking Water Quality

Prior to the amalgamation of Councils to form RRC in 2008, the analysis of raw water and drinking water quality was performed to varying degrees using a range of different approaches. In early 2009 a standardised approach to water quality monitoring was commenced across the existing drinking water schemes to ensure monitoring of raw water and drinking water quality was conducted appropriately. Since then, the operational and verification monitoring programs have been refined towards ensuring safe and reliable water supplies. These monitoring programs are defined in more detail in a later section. The raw water sources and the treatment processes used to produce drinking water vary significantly among the schemes included in this DWQMP. Only the raw water sources, and their associated water quality, that are owned and operated by Fitzroy River Water are described in detail below.

### 3.2.1 Rockhampton Water Supply Scheme

As described above, the Fitzroy Basin is a very large and complex catchment system. The Fitzroy River raw water quality data presented in Table 3.1 reflects the size and complexity of the catchment. Of particular note is the massive range over which raw turbidity measurements have been recorded. High raw water turbidity occurs due to flow events in the river. The Dawson River catchment has historically been the greatest source of high turbidity raw water with values in excess of 2000 NTU recorded during flood events that occurred late last century.

The raw water also contains low background concentrations of fluoride. The specific source of the fluoride is unknown. Relatively high concentrations of iron and manganese have also been observed in the raw water. During a flood event in early 2010 raw water total iron concentrations of up to 14 mg/L were recorded. Similarly, a flood event in February 2013 and the water quality event following Tropical Cyclone Marcia in February 2015 recorded total manganese concentrations above 0.5 mg/L.

Low levels of the cyanobacterial toxin cylindrospermopsin were detected during a bloom of *Cylindrospermopsis raciborskii* which occurred in 2009 and 2015. This toxin-producing species of cyanobacteria is usually detected during prolonged periods of low raw water turbidity in late winter and spring. Low levels of the potentially toxic *Anabaena circinalis* are also detected usually from early spring.

Testing for more than 20 different pesticides (see Appendix B) revealed the presence of many pesticides at less than the limits of detection in the raw water. None of the pesticides were detected at concentrations above ADWG values.

Drinking water produced by the GWTP is of a very high quality and consistently meets ADWG. The value for final water turbidity ($95^{th}$ Percentile = 0.445 NTU) is slightly higher than expected compared to the individual filter outlet turbidity measurements which rarely exceed 0.3 NTU. The slightly higher turbidity readings are due to the addition of lime post-filtration. Disinfection by-product formation (e.g. trihalomethanes (THM)) in the Rockhampton Water Supply Scheme occurs with a THM concentration of between50µg/L and 200µg/L (at the extremities of the scheme).

| Source Water (RAW) Glenmore Water Treatment Plant ROCKHAMPTON QLD | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *(a = L/2 used for < results)* | | Data obtained from sampling July 2022 - June 2023 | | | | | | Data obtained from sampling July 2018-June 2023 | | | | | | |
| | | | | Summary of results | | | | | | Summary of results | | | | |
| Parameter | | Unit | Time Period | No. of Samples | Average Value | Min value | Max value | 95th percentile | Time Period | No. of Samples | Average Value | Min value | Max value | 95th percentile |
| pH | | Unit | 1 year | 12 | 7.44 | 6.70 | 7.86 | 7.76 | 5 years | 60 | 7.58 | 6.70 | 8.1 | 8.0 |
| Colour (True) | | HU | 1 year | 12 | 59.58 | 30.00 | 140.00 | 126.25 | 5 years | 59 | 40.14 | 10 | 140 | 126.3 |
| Turbidity | | NTU | 1 year | 12 | 184.08 | 51.30 | 530.00 | 499.2 | 5 years | 60 | 178.14 | 5.40 | 1330 | 499.2 |
| Electrical Conductivity | | µS/cm | 1 year | 12 | 213.08 | 133.00 | 303.00 | 290.35 | 5 years | 60 | 221.20 | 118 | 310 | 290.4 |
| Total Dissolved Solids | | mg/L | 1 year | 12 | 245.17 | 161.00 | 396.00 | 362.45 | 5 years | 60 | 234.22 | 100 | 396 | 362.5 |
| Chloride | | mg/L | 1 year | 12 | 23.00 | 16.00 | 36.00 | 32.7 | 5 years | 60 | 30.77 | 10 | 81 | 32.7 |
| Fluoride | a | mg/L | 1 year | 12 | 0.55 | 0.005 | 0.10 | 0.1 | 5 years | 60 | 0.091 | 0.005 | 0.200 | 0.1 |
| Nitrate (as N) | | mg/L | 1 year | 12 | 0.21 | 0.10 | 0.59 | 0.43 | 5 years | 60 | 0.187 | 0.002 | 0.590 | 0.4 |
| Nitrite (as N) | a | mg/L | 1 year | 12 | 0.005 | 0.005 | 0.005 | 0.005 | 5 years | 60 | 0.01 | 0.00 | 0.088 | 0.0 |
| Sulphate | | mg/L | 1 year | 12 | 5.00 | 3.00 | 8.00 | 6.9 | 5 years | 60 | 5.62 | 2 | 12 | 9.1 |
| Aluminium (Acid Soluble) | | mg/L | 1 year | 12 | 0.64 | 0.117 | 1.98 | 1.50 | 5 years | 60 | 0.44 | 0.01 | 1.98 | 1.1 |
| Iron (Total) | | mg/L | 1 year | 9 | 8.22 | 3.38 | 17.70 | 15.54 | 5 years | 57 | 4.90 | 0.00 | 17.7 | 12.6 |
| Manganese (Total) | | mg/L | 1 year | 9 | 0.10 | 0.047 | 0.215 | 0.19 | 5 years | 57 | 0.10 | 0.00 | 0.723 | 0.3 |
| Copper (Total) | | mg/L | 1 year | 9 | 0.009 | 0.01 | 0.017 | 0.02 | 5 years | 57 | 0.01 | 0.00 | 0.021 | 0.0162 |
| Lead (Total) | a | mg/L | 1 year | 9 | 0.002 | 0.001 | 0.004 | 0.004 | 5 years | 57 | 0.00 | 0.00 | 0.0082 | 0.0056 |
| Zinc (Total) | | mg/L | 1 year | 9 | 0.017 | 0.006 | 0.03 | 0.03 | 5 years | 57 | 0.01 | 0.00 | 0.091 | 0.0356 |
| Calcium (Total) | | mg/L | 1 year | 12 | 12.00 | 7.00 | 18.00 | 16.9 | 5 years | 60 | 12.02 | 6.70 | 18 | 16.0 |
| Sodium (Total) | | mg/L | 1 year | 12 | 20.50 | 14.00 | 28.00 | 27.45 | 5 years | 60 | 20.13 | 11 | 28 | 26.1 |
| Potassium (Total) | | mg/L | 1 year | 12 | 5.08 | 4.00 | 8.00 | 7.45 | 5 years | 60 | 4.29 | 2 | 8 | 7.0 |
| Magnesium (Total) | | mg/L | 1 year | 12 | 7.75 | 5.00 | 11.00 | 9.9 | 5 years | 60 | 7.39 | 4.10 | 13 | 9.1 |
| Hardness (Total) | | mg/L | 1 year | 12 | 51.50 | 31.00 | 72.00 | 70.9 | 5 years | 59 | 52.81 | 25 | 75 | 70.2 |
| Alkalinity (Total) as $CaCO_3$ | | mg/L | 1 year | 12 | 57.33 | 31.00 | 80.00 | 77.8 | 5 years | 60 | 56.67 | 30 | 93 | 77.2 |
| Total Organic Carbon | | mg/L | 1 year | 1 | 5.00 | 5.00 | 5.00 | 5 | 5 years | 15 | 7.25 | 5.10 | 11 | 10.0 |
| Arsenic | | mg/L | 1 year | 6 | 0.0022 | 0.0020 | 0.0030 | 0.00275 | 5 years | 11 | 0.0019 | 0.0005 | 0.0030 | 0.0028 |
| Barium | | mg/L | 1 year | 6 | 0.066 | 0.04 | 0.12 | 0.11 | 5 years | 11 | 0.077 | 0.041 | 0.193 | 0.1575 |
| Beryllium | a | mg/L | 1 year | 6 | 0.001 | 0.001 | 0.001 | 0.0005 | 5 years | 11 | 0.00 | 0.00 | 0.001 | 0.0008 |
| Cadmium | a | mg/L | 1 year | 6 | 0.00005 | 0.00005 | 0.00005 | 0.00005 | 5 years | 11 | 0.00005 | 0.00005 | 0.00005 | 0.0001 |
| Chromium | | mg/L | 1 year | 0 | NR | NR | NR | NR | 5 years | 2 | 0.007 | 0.004 | 0.011 | 0.0106 |
| Mercury | a | mg/L | 1 year | 5 | 0.00005 | 0.00005 | 0.00005 | 0.00005 | 5 years | 10 | 0.0001 | 0.0001 | 0.00072 | 0.0004 |
| Nickel | | mg/L | 1 year | 6 | 0.0165 | 0.0050 | 0.0520 | 0.0448 | 5 years | 11 | 0.01361 | 0.00050 | 0.052 | 0.0375 |
| Selenium | a | µg/L | 1 year | 6 | 0.005 | 0.005 | 0.005 | 0.005 | 5 years | 11 | 0.00 | 0.00 | 0.005 | 0.0050 |
| Perfluorooctanoic Acid | | µg/L | 1 year | 2 | 0.45 | 0.01 | 0.89 | 0.85 | 5 years | 5 | 0.19 | 0.01 | 0.89 | 0.7170 |
| Perfluorooctane Sulphate | | µg/L | 1 year | 0 | NR | NR | NR | NR | 5 years | 3 | 0.01 | 0.01 | 0.025 | 0.0235 |
| Pesticides | | µg/L | 1 year | 1 | 0.10 | 0.10 | 0.10 | 0.1 | 5 years | 4 | 0.10 | 0.10 | 0.1 | 0.1000 |
| BOD | | mg/L | 1 year | 11 | 2.50 | 1.00 | 4.00 | 4 | 5 years | 16 | 2.81 | 1 | 5 | 4.2500 |
| *Cryptosporidium* | | oocyst/10L | 1 year | 1 | 0.00 | 0.00 | 0.00 | 0.00 | 5 years | 6 | 0.00 | 0.00 | 0 | 0.0000 |
| *Giardia* | | oocyst/10L | 1 year | 1 | 0.00 | 0.00 | 0.00 | 0.00 | 5 years | 6 | 0.00 | 0.00 | 0 | 0.0000 |
| Cyanide | | mg/L | 1 year | 0 | NR | NR | NR | NR | 5 years | 2 | 0.00 | 0.00 | 0.002 | 0.0020 |

| Potable Water (TREATED) Glenmore Water Treatment Plant ROCKHAMPTON QLD | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (a = L/2 used for < results) | Data obtained from sampling July 2022 - June 2023 | | | | | | | | | Data obtained from sampling July 2018-June 2023 | | | | | | |
| Parameter | ADWG | | | Time Period | No. of Samples | Summary of results | | | | Time Period | No. of Samples | Summary of results | | | | No. of exceed ADWG value |
| | Health | Aesthetic | Unit | | | Average Value | Min value | Max value | 95th percentile | | | Average Value | Min value | Max value | 95th percentile | |
| pH | No Value | 6.5-8.5 | unit | 1 year | 12 | 7.61 | 7.37 | 7.78 | 7.769 | 5 years | 60 | 7.63967 | 7.08 | 8.16 | 7.9005 | Nil |
| Colour (True) | No Value | 15 HU | TCU | 1 year | 12 | 2.83 | 1 | 10.00 | 7.25 | 5 years | 60 | 1.78333 | 1 | 10 | 2.05 | Nil |
| Turbidity | <1 NTU | 5 NTU | NTU | 1 year | 12 | 0.22 | 0.05 | 0.50 | 0.445 | 5 years | 60 | 0.2 | 0.05 | 0.7 | 0.505 | Nil |
| Electrical Conductivity | No Value | No Value | µS/cm | 1 year | 12 | 236.75 | 170 | 288.00 | 286.9 | 5 years | 60 | 242.7 | 142 | 288 | 300.5 | Nil |
| Total Dissolved Solids | No Value | 600 mg/L | mg/L | 1 year | 12 | 136.17 | 100 | 176.00 | 170.5 | 5 years | 60 | 141.533 | 83 | 210 | 180.5 | Nil |
| Chloride | No Value | 250 mg/L | mg/L | 1 year | 12 | 32.75 | 21 | 81.00 | 59 | 5 years | 60 | 38.05 | 15 | 81 | 76.1 | Nil |
| Fluoride a | 1.5 mg/L | No Value | mg/L | 1 year | 12 | 0.07 | 0.05 | 0.10 | 0.1 | 5 years | 60 | 0.08083 | 0.05 | 0.2 | 0.11 | Nil |
| Nitrate (as N) a | 50 mg/L | No Value | mg/L | 1 year | 12 | 0.02 | 0.005 | 0.12 | 0.1145 | 5 years | 60 | 0.17088 | 0.005 | 0.6 | 0.372 | Nil |
| Nitrite (as N) a | 3 mg/L | No Value | mg/L | 1 year | 12 | 0.22 | 0.005 | 0.60 | 0.446 | 5 years | 60 | 0.04636 | 0.0025 | 0.6 | 0.2905 | Nil |
| Sulphate | 500 mg/L | 250 mg/L | mg/L | 1 year | 12 | 4.17 | 2 | 5.00 | 5 | 5 years | 60 | 4.5 | 2 | 12 | 8.05 | Nil |
| Aluminium (Acid Soluble) a | No Value | 0.20 mg/L | mg/L | 1 year | 12 | 0.01 | 0.0025 | 0.03 | 0.0215 | 5 years | 60 | 0.00828 | 0.0025 | 0.027 | 0.01605 | Nil |
| Iron (Total) a | No Value | 0.30 mg/L | mg/L | 1 year | 9 | 0.09 | 0.0025 | 0.68 | 0.418 | 5 years | 57 | 0.01642 | 0.0025 | 0.68 | 0.025 | Nil |
| Manganese (Total) a | 0.50 mg/L | 0.10 mg/L | mg/L | 1 year | 9 | 0.03 | 0.0005 | 0.29 | 0.176 | 5 years | 57 | 0.00622 | 0.00025 | 0.292 | 0.00246 | Nil |
| Copper (Total) a | 2 mg/L | 1 mg/L | mg/L | 1 year | 9 | 0.004 | 0.001 | 0.007 | 0.0058 | 5 years | 57 | 0.00432 | 0.001 | 0.012 | 0.0074 | Nil |
| Lead (Total) a | 0.01 mg/L | No Value | mg/L | 1 year | 9 | 0.0005 | 0.0005 | 0.0005 | 0.0005 | 5 years | 57 | 0.00054 | 0.00022 | 0.0011 | 0.000896 | Nil |
| Zinc (Total) a | No Value | 3 mg/L | mg/L | 1 year | 9 | 0.003 | 0.0025 | 0.006 | 0.0046 | 5 years | 57 | 0.0026 | 0.0018 | 0.006 | 0.0025 | Nil |
| Calcium (Total) | No Value | No Value | mg/L | 1 year | 12 | 14.50 | 8 | 20.00 | 18.35 | 5 years | 60 | 13.66 | 8 | 20 | 17.05 | Nil |
| Sodium (Total) | No Value | 180 mg/L | mg/L | 1 year | 12 | 21.17 | 14 | 28.00 | 27.45 | 5 years | 60 | 20.3 | 11 | 28 | 27 | Nil |
| Potassium (Total) | No Value | No Value | mg/L | 1 year | 12 | 4.33 | 3 | 6.00 | 6 | 5 years | 60 | 3.81333 | 2 | 6 | 6 | Nil |
| Magnesium (Total) | No Value | No Value | mg/L | 1 year | 12 | 6.83 | 4 | 10.00 | 9.45 | 5 years | 59 | 6.65593 | 3.8 | 14 | 9 | Nil |
| Hardness (Total) | No Value | 200 mg/L | mg/L | 1 year | 12 | 61.58 | 40 | 77.00 | 77 | 5 years | 60 | 59.95 | 36 | 95 | 77.05 | Nil |
| Alkalinity (Total) as CaCO3 | No Value | No Value | mg/L | 1 year | 12 | 59.67 | 32 | 79.00 | 79 | 5 years | 60 | 57.25 | 32 | 107 | 75.2 | Nil |
| Total Organic Carbon a | No Value | No Value | mg/L | 1 year | 4 | 1.88 | 0.5 | 3.00 | 2.85 | 5 years | 19 | 2.96316 | 0.5 | 7 | 5.83 | Nil |
| Trihalomethanes | 250 µg/L | No Value | mg/L | 1 year | 4 | 34.75 | 19 | 50.00 | 48.2 | 5 years | 19 | 32.4526 | 19 | 51 | 50.1 | Nil |
| Trihalomethanes - Retic | 250 µg/L | No Value | mg/L | 1 year | 4 | 146 | 73 | 212 | 204.05 | 5 years | 18 | 118.106 | 71.1 | 212 | 170.35 | Nil |
| Arsenic a | 0.01 mg/L | No Value | mg/L | 1 year | 6 | 0.0005 | 0.0005 | 0.0005 | 0.0005 | 5 years | 11 | 0.00044 | 0.00005 | 0.0005 | 0.0005 | Nil |
| Barium a | 2 mg/L | No Value | mg/L | 1 year | 6 | 0.0365 | 0.032 | 0.0410 | 0.0405 | 5 years | 11 | 0.03186 | 0.0205 | 0.045 | 0.043 | Nil |
| Beryllium a | 0.06 mg/L | No Value | mg/L | 1 year | 6 | 0.0005 | 0.0005 | 0.0005 | 0.0005 | 5 years | 11 | 0.00042 | 0.00005 | 0.0005 | 0.0005 | Nil |
| Cadmium a | 0.002 mg/L | No Value | mg/L | 1 year | 6 | 0.00005 | 0.00005 | 0.00005 | 0.00005 | 5 years | 11 | 0.00005 | 0.00005 | 0.00005 | 0.00005 | Nil |
| Chromium a | 0.05 mg/L | No Value | mg/L | 1 year | NR | NR | NR | NR | NR | 5 years | 2 | 0.00025 | 0.00025 | 0.0003 | 0.00025 | Nil |
| Mercury a | 0.001 mg/L | No Value | mg/L | 1 year | 5 | 0.00005 | 0.00005 | 0.00005 | 0.00005 | 5 years | 10 | 0.00005 | 0.00005 | 0.00005 | 0.00005 | Nil |
| Nickel a | 0.02 mg/L | No Value | µg/L | 1 year | 6 | 0.0007 | 0.0005 | 0.001 | 0.001 | 5 years | 11 | 0.00062 | 0.0005 | 0.001 | 0.001 | Nil |
| Selenium a | 0.01 mg/L | No Value | µg/L | 1 year | 6 | 0.005 | 0.005 | 0.01 | 0.005 | 5 years | 11 | 0.00414 | 0.00025 | 0.005 | 0.005 | Nil |
| Perfluorooctanoic Acid a | 0.01 µg/L | No Value | µg/L | 1 year | 1 | 0.005 | 0.005 | 0.005 | 0.005 | 5 years | 3.000 | 0.007 | 0.005 | 0.010 | 0.010 | Nil |
| Sum of PFOS + PFHxS a | 0.05 µg/L | No Value | µg/L | 1 year | 1 | 0.01 | 0.005 | 0.005 | 0.005 | 5 years | 3.000 | 0.020 | 0.010 | 0.025 | 0.025 | Nil |
| Chlorate a | No Value | No Value | mg/L | 1 year | 7 | 0.02 | 0.001 | 0.102 | 0.0729 | 5 years | 19 | 0.03375 | 0.001 | 0.132 | 0.1303 | Nil |
| Chlorite a | 0.8 mg/L | No Value | mg/L | 1 year | 7 | 0.002 | 0.001 | 0.005 | 0.00425 | 5 years | 20 | 0.00532 | 0.001 | 0.027 | 0.0243 | Nil |
| Cryptosporidium | <1 organism/L | No Value | oocyst/10L | 1 year | 1 | Nil Detected | Nil Detected | Nil Detected | 0 | 5 years | 5 | Nil Detected | Nil Detected | Nil Detected | 0 | Nil |
| Giardia | <1 organism/L | No Value | oocyst/10L | 1 year | 1 | Nil Detected | Nil Detected | Nil Detected | 0 | 5 years | 5 | Nil Detected | Nil Detected | Nil Detected | 0 | Nil |
| Cyanide | 0.8 mg/L | No Value | mg/L | 1 year | 0 | NR | NR | NR | NR | 5 years | 2 | 0.002 | 0.002 | 0.002 | 0.002 | Nil |

Raw water quality in the Fitzroy River typically varies seasonally. This variation is usually flow dependent and is perhaps best illustrated by the changes in turbidity as flow events occur and then gradually decline over subsequent months. Figure 3.1 shows data for raw water turbidity during a wet weather event at the Glenmore WTP between May 2022 and April 2023. During this period, the Fitzroy River changed from having low flow and low turbidity to an extended period of flow events and associated high turbidity from late May 2022 until early 2023 before flows gradually reduced. The high and rapidly changing turbidity seen during this period is typical of these flow events which usually occur at least once a year. The Glenmore WTP effectively treats raw water with high turbidity due to its design and the use of the polyaluminium chlorhydrate coagulant. When raw water turbidity decreases to levels less than 20 NTU or an extended period of time, the river can experience algal blooms which have the potential to affect water quality. The coagulant and polymer dosing rates are adjusted during algal bloom events to treat the water and filter operation is managed closely in order to optimise filter run time and performance during these events.

**Figure 3.1: Changes in Fitzroy River raw water turbidity based on flow conditions from May 2022 to April 2023 during wet weather events.**

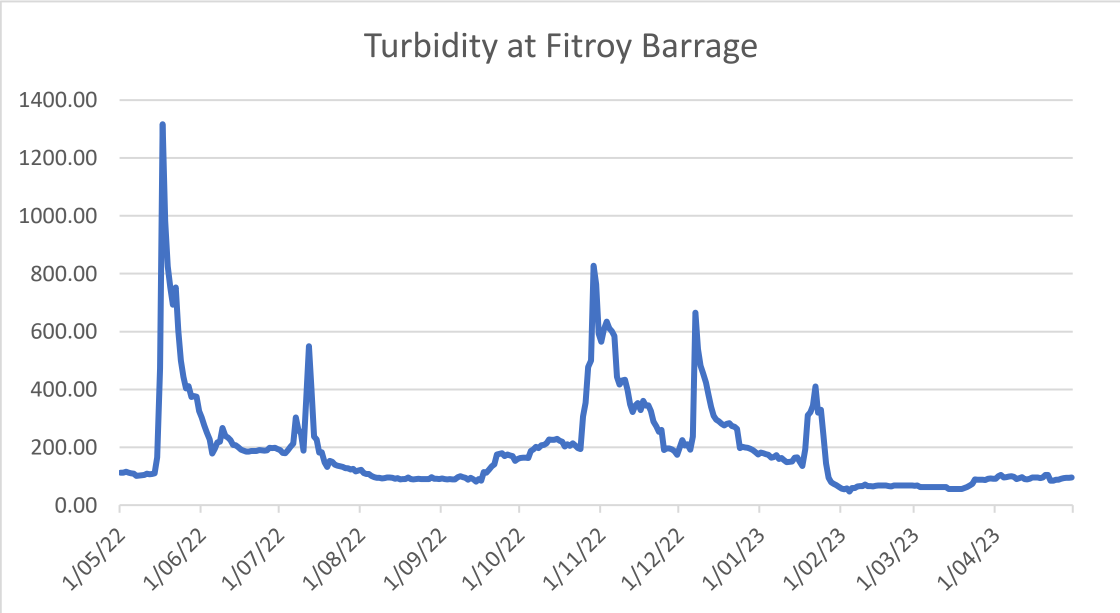
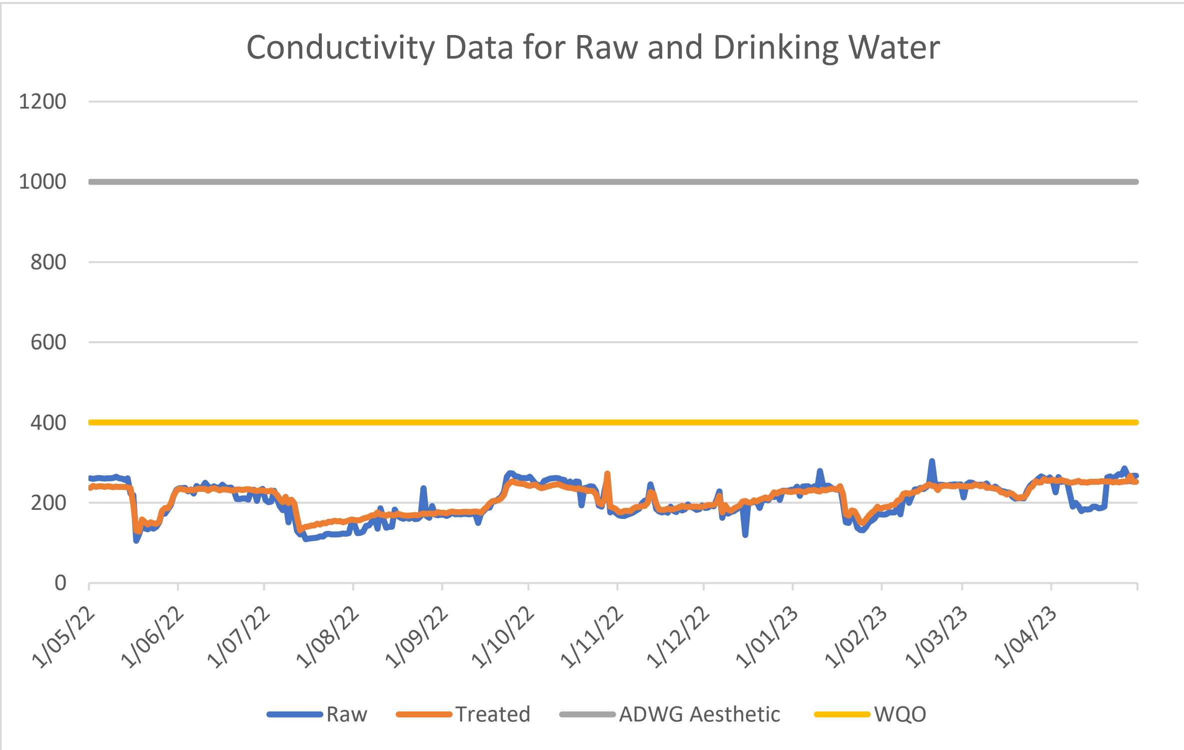



**Figure 3.2: Electrical Conductivity comparison data for Raw water and Drinking water at the Glenmore WTP between May 2022 to April 2023.**




**WQO = Water Quality Objective**

The Fitzroy Barrage raw water Electrical Conductivity (E.C.) also changes significantly due to events that occur upstream in the catchment. Figure 3.2 shows the changes in E.C. that occurred during the 12 month period from May 2022 to April 2023. High rainfall in parts of the catchment saw the input of high levels of E.C. into the Fitzroy Basin from rising groundwater with high electrical conductivity. After the peak of the wet weather event, high E.C. waters continued to flow downstream leading to a gradual increase in E.C. in the Fitzroy Barrage Storage.

### 3.2.2 Mount Morgan Water Supply Scheme

Raw water quality in the available water source No. 7 Dam varies considerably. Source Water monthly sampling is continuing to monitor the water quality. The water quality data is presented below. Elevated concentrations of iron, manganese as well as BGA have challenged the performance of the Mount Morgan WTP. Because of the generally lower quality of No. 7 Dam this source is currently not available to supply raw water for the treatment and supply of drinking water to the Mount Morgan Water Supply Scheme. Treated water from Glenmore Supply Scheme is currently transported in bulk water carriers from Gracemere to Mount Morgan WTP for re chlorination and distribution to the Mount Morgan Supply Scheme.

| No 7 Dam Source Water (RAW) Mount Morgan Water Treatment Plant MOUNT MORGAN QLD | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (a = L/2 used for < results) | | Data obtained from sampling July 2022 - June 2023 | | | | | | Data obtained from sampling July 2018-June 2023 | | | | | |
| Parameter | Unit | Time Period | No. of Samples | Summary of results | | | | Time Period | No. of Samples | Summary of results | | | |
| | | | | Average Value | Min value | Max value | 95th percentile | | | Average Value | Min value | Max value | 95th percentile |
| pH | Unit | 1 year | 12 | 7.74 | 7.38 | 7.97 | 7.9315 | 5 years | 60 | 8.01 | 7.38 | 9.05 | 8.733 |
| Colour (True) | HU | 1 year | 12 | 32.50 | 15.00 | 45.00 | 45 | 5 years | 60 | 19.03 | 1 | 70 | 50 |
| Turbidity | NTU | 1 year | 12 | 8.03 | 0.20 | 48.80 | 25.755 | 5 years | 60 | 11.16 | 0.20 | 72.4 | 31.355 |
| Electrical Conductivity | µS/cm | 1 year | 12 | 330.50 | 271.00 | 386.00 | 384.9 | 5 years | 60 | 337 | 180 | 550 | 480.4 |
| Total Dissolved Solids | mg/L | 1 year | 12 | 191.83 | 112.00 | 230.00 | 228.35 | 5 years | 60 | 194 | 66 | 307.00 | 276.85 |
| Chloride | mg/L | 1 year | 12 | 38.00 | 29.00 | 48.00 | 46.9 | 5 years | 60 | 43 | 22 | 85.00 | 70.4 |
| Fluoride | mg/L | 1 year | 12 | 0.06 | 0.01 | 0.1 | 0.1 | 5 years | 60 | 0.11 | 0.01 | 0.20 | 0.2 |
| Nitrate (as N) | mg/L | 1 year | 12 | 0.01 | 0.01 | 0.07 | 0.048 | 5 years | 60 | 0.0251 | 0.00 | 0.26 | 0.1505 |
| Nitrite (as N) | mg/L | 1 year | 11 | 0.0050 | 0.0050 | 0.0050 | 0.005 | 5 years | 59 | 0.0052 | 0.0025 | 0.0300 | 0.01115 |
| Sulphate | mg/L | 1 year | 12 | 6.42 | 2.00 | 12.00 | 12 | 5 years | 60 | 12 | 2 | 42 | 29 |
| Aluminium (Acid Soluble) a | mg/L | 1 year | 12 | 0.02 | 0.00 | 0.129 | 0.0773 | 5 years | 60 | 0.1102 | 0.0025 | 2.39 | 0.1847 |
| Iron (Total) | mg/L | 1 year | 10 | 0.19 | 0.00 | 0.61 | 0.5785 | 5 years | 59 | 0.5169 | 0.0025 | 4.60 | 1.663 |
| Manganese (Total) a | mg/L | 1 year | 9 | 0.11 | 0.00 | 0.208 | 0.184 | 5 years | 58 | 0.1711 | 0.0005 | 1.67 | 0.4254 |
| Copper (Total) a | mg/L | 1 year | 9 | 0.0018 | 0.0005 | 0.005 | 0.0038 | 5 years | 58 | 0.0018 | 0.0005 | 0.009 | 0.004405 |
| Lead (Total) a | mg/L | 1 year | 9 | 0.0005 | 0.0005 | 0.0005 | 0.0005 | 5 years | 58 | 0.00035 | 0.00005 | 0.001 | 0.0005 |
| Zinc (Total) a | mg/L | 1 year | 9 | 0.02 | 0.00 | 0.128 | 0.0778 | 5 years | 58 | 0.0062 | 0.0025 | 0.128 | 0.0132 |
| Calcium (Total) | mg/L | 1 year | 11 | 23.00 | 16.00 | 29.00 | 28.5 | 5 years | 59 | 20.16 | 9 | 31 | 29.1 |
| Sodium (Total) | mg/L | 1 year | 11 | 27.18 | 20.00 | 32.00 | 31.5 | 5 years | 59 | 28 | 12 | 51 | 46 |
| Potassium (Total) | mg/L | 1 year | 11 | 4.09 | 4.00 | 5.00 | 4.5 | 5 years | 59 | 2.94 | 1 | 5 | 5 |
| Magnesium (Total) | mg/L | 1 year | 11 | 11.73 | 8.00 | 14.00 | 13.5 | 5 years | 59 | 11.66 | 6 | 18 | 16 |
| Hardness (Total) | mg/L | 1 year | 10 | 104.00 | 90.00 | 118.00 | 118 | 5 years | 58 | 72 | 13 | 127 | 120.75 |
| Alkalinity (Total) as CaCO3 | mg/L | 1 year | 12 | 94.58 | 72.00 | 115.00 | 114.45 | 5 years | 60 | 89 | 55 | 141 | 120.1 |
| Total Organic Carbon | mg/L | 1 year | 4 | 13.25 | 11.00 | 15.00 | 15 | 5 years | 16 | 11.78 | 8 | 15 | 15 |
| Arsenic a | mg/L | 1 year | 6 | 0.00 | 0.00 | 0.00 | 0.0005 | 5 years | 12 | 0.0005 | 0.0005 | 0.0007 | 0.000584 |
| Barium | mg/L | 1 year | 6 | 0.01 | 0.01 | 0.04 | 0.02925 | 5 years | 12 | 0.0132 | 0.0045 | 0.035 | 0.0306 |
| Beryllium a | mg/L | 1 year | 6 | 0.00 | 0.00 | 0.0005 | 0.0005 | 5 years | 12 | 0.0004 | 0.0001 | 0.0005 | 0.0005 |
| Cadmium a | mg/L | 1 year | 7 | 0.00 | 0.00 | 0.00005 | 0.00005 | 5 years | 13 | 0.0001 | 0.00005 | 5E-05 | 0.00005 |
| Cyanide | mg/L | 1 year | 0 | NR | NR | NR | NR | 5 years | 1 | 0.0020 | 0.0020 | 0.002 | 0.002 |
| Chromium | mg/L | 1 year | 0 | NR | NR | NR | NR | 5 years | 2 | 0.00025 | 0.00025 | 0.0003 | 0.00025 |
| Mercury a | mg/L | 1 year | 5 | 0.00005 | 0.00005 | 0.00005 | 0.00005 | 5 years | 11 | 0.00005 | 0.00005 | 5E-05 | 0.00005 |
| Nickel a | µg/L | 1 year | 6 | 0.00075 | 0.00050 | 0.002 | 0.001625 | 5 years | 12 | 0.00058 | 0.0003 | 0.0020 | 0.001175 |
| Selenium a | µg/L | 1 year | 6 | 0.0050 | 0.0050 | 0.0050 | 0.005 | 5 years | 12 | 0.00421 | 0.0003 | 0.0050 | 0.005 |
| Cryptosporidium | oocyst/10L | 1 year | 1 | Nil Detected | Nil Detected | Nil Detected | 0 | 5 years | 6 | Nil Detected | Nil Detected | Nil Detected | 0.00 |
| Giardia | oocyst/10L | 1 year | 1 | Nil Detected | Nil Detected | Nil Detected | 0 | 5 years | 6 | Nil Detected | Nil Detected | Nil Detected | 0.00 |
| Pesticides | mg/L | 1 year | 1 | 0.0000 | 0.0000 | 0.0000 | 0 | 5 years | 3 | 0.1 | 0.1 | 0.1 | 0.1 |

| Potable Water (Treated) Mount Morgan Water Treatment Plant MOUNT MORGAN QLD | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a = L/2 used for < results | | | Data obtained from sampling July 2022 - June 2023 | | | | | | | Data obtained from sampling July 2022 - June 2023 | | | | | |
| Parameter | ADWG | | Units | Time Period | No. of Samples | Summary of results | | | | Time Period | No. of Samples | Summary of results | | | |
| | Health | Aesthetic | | | | Average Value | Minimum value | Maximum value | 95th percentile | | | Average Value | Minimum value | Maximum value | 95th percentile |
| pH | No Value | 6.5-8.5 | Unit | 1 year | 12 | 7.71 | 7.22 | 8.00 | 7.934 | 5 years | 60 | 7.66 | 7.14 | 8.00 | 7.97 |
| Colour (True) | No Value | 15 HU | HU | 1 year | 12 | 2.25 | 2 | 4 | 3.45 | 5 years | 60 | 2 | 1 | 5.00 | 3 |
| Turbidity | <1 NTU | 5 NTU | NTU | 1 year | 12 | 0.85 | 0.1 | 7 | 3.48 | 5 years | 60 | 0.44 | 0 | 7.00 | 0.705 |
| Electrical Conductivity | No Value | No Value | µS/cm | 1 year | 12 | 245.58 | 189 | 294 | 291.8 | 5 years | 60 | 338 | 189 | 605.00 | 549.3 |
| Total Dissolved Solids | No Value | 600 mg/L | mg/L | 1 year | 12 | 143.50 | 107 | 185 | 184.45 | 5 years | 60 | 194 | 107 | 345.00 | 321.5 |
| Chloride | No Value | 250 mg/L | mg/L | 1 year | 12 | 36.33 | 20 | 87 | 63.35 | 5 years | 60 | 39 | 20 | 87.00 | 63.45 |
| Fluoride a | 1.5 mg/L | No Value | mg/L | 1 year | 12 | 0.014 | 0.005 | 0.10 | 0.0505 | 5 years | 60 | 0.0468 | 0.0050 | 0.2000 | 0.1 |
| Nitrate (as N) | 50 mg/L | No Value | mg/L | 1 year | 12 | 0.24 | 0.12 | 0.50 | 0.445 | 5 years | 60 | 0.18 | 0.05 | 0.50 | 0.4005 |
| Nitrite (as N) a | 3 mg/L | No Value | mg/L | 1 year | 12 | 0.005 | 0.005 | 0.01 | 0.005 | 5 years | 60 | 0.0039 | 0.0025 | 0.0050 | 0.005 |
| Sulphate | 500 mg/L | 250 mg/L | mg/L | 1 year | 12 | 4.25 | 3 | 7 | 6.45 | 5 years | 60 | 33 | 3 | 84.00 | 78.1 |
| Aluminium (Acid Soluble) a | No Value | 0.20 mg/L | mg/L | 1 year | 12 | 0.0217 | 0.015 | 0.041 | 0.0355 | 5 years | 60 | 0.08 | 0.01 | 0.23 | 0.17 |
| Iron (Total) a | No Value | 0.30 mg/L | mg/L | 1 year | 9 | 0.0250 | 0.025 | 0.025 | 0.025 | 5 years | 57 | 0.0155 | 0.0025 | 0.0250 | 0.025 |
| Manganese (Total) a | 0.50 mg/L | 0.10 mg/L | mg/L | 1 year | 9 | 0.0012 | 0.0005 | 0.003 | 0.0026 | 5 years | 57 | 0.0124 | 0.0005 | 0.1000 | 0.0338 |
| Copper (Total) | 2 mg/L | 1 mg/L | mg/L | 1 year | 9 | 0.0023 | 0.001 | 0.004 | 0.0036 | 5 years | 57 | 0.0017 | 0.0005 | 0.0070 | 0.0032 |
| Lead (Total) a | 0.01 mg/L | No Value | mg/L | 1 year | 9 | 0.0005 | 0.0005 | 0.001 | 0.0005 | 5 years | 57 | 0.0003 | 0.0001 | 0.0005 | 0.0005 |
| Zinc (Total) a | No Value | 3 mg/L | mg/L | 1 year | 9 | 0.0042 | 0.0025 | 0.009 | 0.0086 | 5 years | 57 | 0.0082 | 0.0025 | 0.0180 | 0.017 |
| Calcium (Total) | No Value | No Value | mg/L | 1 year | 12 | 14.50 | 11 | 17 | 16.45 | 5 years | 60 | 15.37 | 9.20 | 26.00 | 22.1 |
| Sodium (Total) | No Value | 180 mg/L | mg/L | 1 year | 12 | 22.75 | 17 | 30 | 29.45 | 5 years | 60 | 37 | 15 | 81.00 | 74.2 |
| Potassium (Total) | No Value | No Value | mg/L | 1 year | 12 | 4.58 | 3 | 7 | 6.45 | 5 years | 60 | 3.24 | 1 | 7.00 | 6 |
| Magnesium (Total) | No Value | No Value | mg/L | 1 year | 12 | 6.58 | 5 | 9 | 8.45 | 5 years | 60 | 8 | 5 | 15.00 | 14 |
| Hardness (Total) | No Value | 200 mg/L | mg/L | 1 year | 10 | 61.20 | 46 | 74 | 73.55 | 5 years | 58 | 71 | 43 | 121.00 | 110 |
| Alkalinity (Total) as CaCO3 | No Value | No Value | mg/L | 1 year | 12 | 58.58 | 38 | 80 | 77.8 | 5 years | 60 | 71 | 33 | 145.00 | 111.05 |
| Total Organic Carbon | No Value | No Value | mg/L | 1 year | 4 | 3.25 | 2 | 4 | 4 | 5 years | 20 | 6 | 1 | 12.00 | 12 |
| Trihalomethanes | 250 µg/L | No Value | mg/L | 1 year | 4 | 120 | 77 | 158 | 154.4 | 5 years | 22 | 100.77 | 48 | 166.00 | 157 |
| Trihalomethanes - retic | 250 µg/L | No Value | mg/L | 1 year | 4 | 139.25 | 109 | 193 | 184.6 | 5 years | 22 | 125.56 | 67 | 235.00 | 193 |
| Arsenic a | 0.01 mg/L | No Value | mg/L | 1 year | 6 | 0.0005 | 0.0005 | 0.0005 | 0.0005 | 5 years | 11 | 0.0005 | 0.0003 | 0.0005 | 0.0005 |
| Barium | 2 mg/L | No Value | mg/L | 1 year | 6 | 0.0363 | 0.032 | 0.0390 | 0.03875 | 5 years | 11 | 0.0290 | 0.0029 | 0.0400 | 0.0395 |
| Beryllium a | 0.06 mg/L | No Value | mg/L | 1 year | 6 | 0.0005 | 0.0005 | 0.0005 | 0.0005 | 5 years | 11 | 0.0004 | 0.0001 | 0.0005 | 0.0005 |
| Cadmium a | 0.002 mg/L | No Value | mg/L | 1 year | 6 | 0.0001 | 5E-05 | 0.0001 | 0.00005 | 5 years | 11 | 0.0001 | 0.0001 | 0.0001 | 0.00005 |
| Chromium | 0.05 mg/L | No Value | mg/L | 1 year | 0 | NR | NR | NR | NR | 5 years | 2 | 0.00025 | 0.00025 | 0.00025 | 0.00025 |
| Mercury a | 0.001 mg/L | No Value | mg/L | 1 year | 5 | 0.00005 | 5E-05 | 0.00005 | 0.00005 | 5 years | 10 | 0.00005 | 0.00005 | 0.00005 | 0.00005 |
| Nickel a | 0.02 mg/L | No Value | mg/L | 1 year | 6 | 0.00058 | 0.0005 | 0.0010 | 0.00088 | 5 years | 10 | 0.0005 | 0.0003 | 0.0010 | 0.00083 |
| Selenium a | 0.01 mg/L | No Value | µg/L | 1 year | 5 | 0.0050 | 0.0050 | 0.0050 | 0.005 | 5 years | 9 | 0.0039 | 0.0003 | 0.0050 | 0.005 |
| *Cryptosporidium* | *<1 organism/L* | *No Value* | oocyst/10 L | 1 year | 1 | Nil Detected | Nil Detected | Nil Detected | 0.00 | 5 years | 6 | Nil Detected | Nil Detected | Nil Detected | 0.00 |
| *Giardia* | *<1 organism/L* | *No Value* | oocyst/10 L | 1 year | 1 | Nil Detected | Nil Detected | Nil Detected | 0.00 | 5 years | 6 | Nil Detected | Nil Detected | Nil Detected | 0.00 |
| Chlorate | 0.8 mg/L | No Value | mg/L | 1 year | 4 | 0.15 | 0.113 | 0.21 | 0.2024 | 5 years | 7 | 0.20 | 0.11 | 0.39 | 0.3716 |
| Chlorite | No Value | No Value | mg/L | 1 year | 4 | 0.00 | 0.00 | 0.00 | 0.0025 | 5 years | 7 | 0.0016 | 0.0010 | 0.0025 | 0.0025 |

Historically, there was very little data obtained for type and number of cyanobacteria in either of the raw water sources. The commencement of regular sampling in the No. 7 Dam in early 2011 detected low levels of the potentially toxic species *Microcystis aeruginosa* and *Cylindrospermopsis raciborskii*. With higher Cyanobacteria levels detected since April 2021 due to low storage level at No 7 Dam, treated water has been tankered to Mount Morgan Treatment Plant Black St Reservoir for distribution to the Water Supply Scheme.

The No. 7 Dam raw water quality is influenced by the flow patterns of the Dee River. Flows in the Dee River lead to increases in raw water turbidity and TDS. Installation of on-line turbidity, pH and electrical conductivity meters provided a better indication of how raw water changes over time. This enabled a better understanding of seasonal or other trends in raw water quality.

Drinking water produced by the MMWTP consistently meets ADWG, with recent upgrades and improvements made to the operation of the WTP. The installation of on-line analysis of key water quality parameters at different stages throughout the plant has enabled improvements to be made in the operation and performance of the WTP. The increased concentration of aluminium and sulphate in the final water compared to the raw water is due to the use of aluminium sulphate as the coagulant.

The formation of disinfection by-products such as THM throughout the Mount Morgan Water Supply Scheme has been profiled. The average concentration of THM in the distribution system is about 120 µg/L. The highest concentration of THM recorded in the distribution system was slightly above the ADWG health guideline value at 259 µg/L. This short-lived exceedance was detected in March 2021 as part of the additional operational monitoring in line with the increasing water quality issues in No. 7 Dam.

## 3.3 Drinking Water Quality Notifications

A number instances occurred resulting in the Regulator being notified in accordance with the *Water Supply (Safety and Reliability) Act* for non-compliances with a water quality criteria. There were also notifications made to the Regulator on drinking water quality events or detections of a parameter with no water quality criteria. Table 3.5 details the notifications made to the Regulator in the 2012-2013, 2014-2015, 2015-2016 and 2020-2021 reporting periods. There were no notifications made to the Regulator in the 2013-2014, 2016-17,2017-18, 2018-2019,2019-2020 and 2021-2022 annual reporting periods.

The *E. coli* detection recorded in the 2012-13 reporting period was attributed to the green tree frogs gaining access to the inside of the service reservoir. A range of preventative actions were implemented to reduce the risk of recurrence in all reservoirs by review of rechlorination, vermin-proofing of reservoirs and regular preventative maintenance checks.

The elevated manganese and THM levels in the 2014-15 reporting period were associated with the Tropical Cyclone Marcia event. In January 2018, a chlorine dioxide generator and dosing system was installed to provide the ability to oxidise manganese and/or iron and enhance the existing disinfection process without leading to significant increases in disinfection by-products.

The short-lived exceedance of THM level in 2020-2021 reporting period was associated with the deteriorating water quality as a result of the decreasing water levels in No. 7 Dam. A range of operational and network optimisation actions were implemented to reduce THM formation and alleviate taste and odour issues but without significant rainfall, these actions will not eliminate the recurrence of disinfection by-products. Since April 2021, Mount Morgan Water Supply Scheme has been 100% supplied with tankered water from Rockhampton Water Supply Scheme.

There was no specific treatment process or other failure specifically identified for the *Giardia* detected in 2015-16 reporting period. To enhance the performance of the treatment process, filters were refurbished and filter media was replaced at the Mount Morgan WTP in mid-2016. A UV disinfection system was also installed in 2017 to provide dual disinfection and to provide an effective treatment barrier for the destruction of protozoan pathogens including *Giardia* and *Cryptosporidium*.

During 2022-23 increased Chlorate testing was commenced as requested by the regulator. This will continue for a 12 month period. Test results are being monitored and testing results will be reported to the regulator after October 2023 results.

The regulator was notified in accordance with the *Water Supply (Safety and Reliability) Act* for possible non-compliance with a water quality criteria occurring October 31 2022. High Chlorine residual reading from online monitoring was recorded. After flushing of all hydrants downstream subsequent onsite testing returned results in the water supply system of 1.10mg/L. No water quality complaints were received.

**Table 3.5: Notifications made to the Regulator for Drinking Water Supply Schemes**

| Reporting Period | Scheme | Nature of Notification | System Location | Key Actions Taken |
|---|---|---|---|---|
| 2012-2013 | Mount Morgan | High turbidity | WTP | Flow rate reduced; Adjusted coagulation dose rates |
| | Rockhampton | Elevated manganese | WTP | Reviewed monitoring and treatment options during major flood events |
| | Rockhampton | *E. coli* detected | Reticulation | Frog-proofed reservoir; Reviewed rechlorination |
| 2014-2015 | Rockhampton | High chlorine | Reservoir | Chlorination ceased, dilution of reservoir; Repair and service of chlorine dosing system |
| | Rockhampton | Elevated manganese | WTP | Controlled raw water release; Pre-chlorination |
| | Rockhampton | Elevated THM | Reticulation | Adjusted pre-chlorination; Mains flushing and reservoir scouring; Chlorine dioxide system was installed in January 2018 |
| | Mount Morgan | *E. coli* detected | Reticulation | Inspection and monitoring of reservoir and chlorine dosing facility |
| | Rockhampton | Cyanobacteria bloom and cylindrospermopsin detected | Source water | WTP chemical dose rates adjusted |
| 2015-16 | Mount Morgan | 1 *Giardia* cyst detected | Reservoir | Processes and monitoring systems checked for any issues, follow-up testing performed. Filter media replaced and UV disinfection system was installed in 2017 |
| 2020-21 | Mount Morgan | Elevated THM | Reticulation | Addition of granulated activated carbon on the filter media; Strategic mains flushing; Tankering of potable water from the Rockhampton Water Supply Scheme |
| 2022-2023 | Rockhampton and Mount Morgan | Chlorate | Reticulation | Due to queries from Regulator collection of 3 samples quarterly from various water sampling sites tested for Chlorate level commenced. All results have been below Queensland Health interim guidelines value of 0.8mg/L. Recorded values 0.121mg/L to 0.386mg/L |
| 2022-2023 | Rockhampton | Free Chlorine Residual | Reticulation | >8.80mg/L Chlorine online residual reading at Yaamba Road Reservoir 23:00 31st October 2022. Retested at 00.00 with result being 1.10mg/L. Water was flushed from all hydrants downstream. No information to suggest that Public Health was impacted. FRW received no water quality complaints or incidents during this period. |

## 3.4 Drinking Water Quality Complaints

Drinking water quality complaints have been received from customers in the drinking water schemes. In most cases these complaints have been due to discoloured water or water containing entrained air bubbles. Table 3.6 shows the number of drinking water quality complaints received for each drinking water scheme.

**Table 3.6: Number of Water Quality Complaints for each Drinking Water Scheme**

| Reporting Period | Rockhampton (per 1000 connections) | Mount Morgan (per 1000 connections) |
|---|---|---|
| 2012-2013 | 160 (5.22) | 23 (15.6) |
| 2013-2014 | 54 (1.83) | 12 (8.16) |
| 2014-2015 | 277 (9.8) | 9 (6.12) |
| 2015-2016 | 61 (2.0) | 20 (13.6) |
| 2016-2017 | 42 (1.37) | 8 (5.4) |
| 2017-2018 | 38 (1.0) | 11 (7.28) |
| 2018-2019 | 30 (0.78) | 14 (9.27) |
| 2019-2020 | 28 (0.73) | 23 (15.2) |
| 2020-2021 | 38 (0.99) | 106 (70) |
| 2021-2022 | 32(1.04) | 7 (4.68) |
| 2022-2023 | 28 (0.91) | 3 (0.67) |

The water quality complaints for the Mount Morgan Water Supply Scheme are typically due to discoloured water complaints associated with iron and manganese in the distributed water. In the 2021-2022 and 2022-2023 reporting periods, the significant drop in complaints is due to treated water being tankered to the Water Treatment Plant.

In the Rockhampton Water Supply Scheme the water quality complaints are more evenly spread between discoloured water and other general quality complaints such as taste, odour or aesthetics. Majority of complaints were found to be internal issues such as galvanised pipes and faulty joined or damaged pipework. Major flood or cyclonic events as seen in 2012-2013 and 2014-2015 reporting periods, led to increased numbers of complaints due to variations in water quality leading to aesthetic changes to the drinking water supplied.

# 4 HAZARD IDENTIFICATION

The identification of hazards and hazardous events that have the potential to impact water quality is an ongoing process that continues to be conducted by technical, operational and managerial staff within FRW and RRC. See Section 5 below for a more detailed description of the roles of each of the participants in this process.

Table 4.1 contains a list of the specific hazards and hazardous events that have occurred or have the potential to impact water quality across drinking water schemes and provides an indication of the frequency of each event. A more detailed assessment of these hazards for each scheme including an assessment of the level of risk with and without existing or proposed controls is provided below in the section on Assessment of Risks.

**Table 4.1: Hazards and Hazardous Events That Have or May Impact Drinking Water Quality**

| Hazards | Hazardous Events | Has Occurred? (Frequency) | Critical Controls |
|---|---|---|---|
| **Catchment/Raw Water Storages** | | | |
| Bacterial Pathogens | Unrestricted livestock | Yes (ongoing) | Monitoring, Multiple barriers |
| Protozoan Pathogens | Unrestricted livestock | Yes (ongoing) | Monitoring. Multiple barriers |
| Toxic cyanobacteria | Stratification, eutrophication | Yes (>1/year) | Monitoring, Multiple barriers |
| Viral Pathogens | Unrestricted livestock | Unknown | Multiple barriers |
| Toxic/Radioactive metals | Industrial Spill/Release | No | Monitoring, Multiple barriers |
| Toxic Pesticides/organics | Agriculture | Yes (ongoing) | Monitoring |
| Perfluorocarbons | Leaching from contaminated lands | Unlikely | Monitoring |
| High Iron and Manganese | Flow event iron and manganese rich water | Yes (ongoing) | Monitoring, Pre-treatment oxidation |
| High E.C. or TDS | Industrial Spill/Release; Rising Groundwater; Flood Event | Yes (>1/year) | Monitoring |
| Excessive Turbidity | Flood Events/Bushfire | No (>1/year) | Monitoring, Multiple barriers |
| **Treatment** | | | |
| Bacterial Pathogens | Failure of treatment barrier | Yes (<1/year) | Operator training, Operational monitoring and alarms |
| Protozoan Pathogens | Failure of treatment barrier | No | Operator training, Operational monitoring and alarms |
| Toxic cyanobacteria | Failure of treatment barrier | Yes (<1/year) | Operator training, Operational monitoring and alarms |
| Viral Pathogens | Failure of treatment barrier | Unknown | Operator training, Operational monitoring and alarms |
| Toxic Pesticide/organics | No effective treatment | Yes (ongoing) | Monitoring |
| High E.C. or TDS | No effective treatment | Yes (>1/year) | Monitoring |
| Excessive Turbidity | Failure of treatment barrier | Yes (<1/year) | Operator training, Operational monitoring and alarms |
| Coagulant Underdose | Equipment/process control failure | Yes (<1/year) | Maintenance, Operational monitoring and alarms |
| Chlorine Underdose | Equipment/process control failure | Yes (<1/year) | Maintenance, Operational monitoring and alarms |
| Chemical Contamination | Unapproved chemicals | No | Supply contracts, specified QA |
| Coagulant Overdose | Equipment/process control failure | No | Operator training, Operational monitoring, Daily chemical usage |

| Hazards | Hazardous Events | Has Occurred? (Frequency) | Critical Controls |
|---|---|---|---|
| | | | reporting |
| Chlorite or Chlorine Dioxide Overdose | Equipment/process control | No | Operator training, Maintenance, Operational monitoring and alarms. Ongoing sampling. |
| Chlorine Overdose | Equipment/process control failure | Yes (<1/year) | Maintenance, Operational monitoring and alarms |
| **Distribution** | | | |
| Bacterial Pathogens | Animal access to reservoirs | Yes (>1/year) | Inspections/ Operational monitoring and alarms for chlorine residual |
| Protozoan Pathogens | Animal access to reservoirs | Yes (>1/year) | Inspections/ Operational monitoring and alarms for chlorine residual |
| Viral Pathogens | Animal access to reservoirs | Yes (>1/year) | Inspections/ Operational monitoring and alarms for chlorine residual |
| Microbial pathogens | Water mains break | Yes (<1/year) | Mains break repair procedure |
| Discoloured water | Pipewall biofilm and sediment mobilisation | Yes (>1/year) | Chlorine residual penetration, reticulation air scouring program |
| No chlorine residual | Long detention time | Yes (ongoing) | Increase chlorination, operate scheme to reduce water age. |
| Disinfection by-products | High TOC, rechlorination, long detention time | Yes (ongoing) | Effective Treatment/Monitoring, operate scheme to reduce water age. |
| Chemical contamination | Sabotage, terrorism | No | Physical Security/Site Inspection |
| Excessive chlorination | Equipment/process control failure at rechlorination site | Yes (>5/year) | Remote monitoring with alarms, Calibration/Site Inspection |
| **Customers Tap** | | | |
| Contamination | Inappropriate plumbing | No | Compliance inspections |
| Contamination | Inappropriate use | No | Education Programs |

# 5 ASSESSMENT OF RISKS

Since the preparation of the original risk assessment in the original approved DWQMP (described below) a review has been undertaken to update the risk assessment accordingly based on recent changes in risk profile due to completion of projects identified in the Risk Management Improvement Program or other events. The original risk assessment was prepared in accordance with the AS/NZS:4360 Risk Management Standard through a series of five workshops and meetings involving key FRW management, technical and operational staff working in association with the RRC Risk Management Coordinator. The following personnel are involved in the assessment and management of risks to drinking water supplies:

- Dan Toon ( Manager Water & Wastewater)
- Gavin Challinor (Coordinator Mechanical, Electrical and General Maintenance)
- Paul Dean (Senior Environmental Scientist)
- Evan Davison (Coordinator Network Operations)
- Peter Kofod (General Manager Regional Services)

The Manager Water & Wastewater, in conjunction with experienced treatment plant operators) is responsible for the day-to-day operation of WTPs and other distribution infrastructure. The Senior Environmental Scientist has more than 10 years experience working with drinking water quality monitoring and has relevant tertiary qualifications. The Coordinator Network Operations has more than 10 years experience in the construction and maintenance of water and wastewater networks. The Manager Water & Wastewater has extensive experience in Risk Management in the water industry.

Appendix A contains the Likelihood and Consequence Ratings tables, the Risk Rating Matrix and an Uncertainty Ratings table that were used in to prepare this Risk Assessment.

This more public health-specific risk assessment is presented in Tables 5.1 to 5.3. These risk assessments provide a description of the key risks that have the potential to impact each drinking water scheme at the catchment, treatment plant and distribution system stages of each scheme, including, some whole of service risks that are more broadly applicable across all schemes. All risks with a Residual Risk Rating above Low are considered unacceptable. In each case Proposed Actions are listed to further mitigate these unacceptable risks. These Proposed Actions are captured in the Risk Management Improvement Program (see Section 12).

**Table 5.1: Assessment of Risks with the Potential to Impact Drinking Water Quality in the Rockhampton Water Supply Scheme**

| Scheme Component | Hazardous Event | Hazard | CR | LH | IRR | Existing Preventative Measure/Barrier | CR | LH | RRR | Uncertainty | Comment/Proposed Further Risk Mitigation | Risk No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Source, Raw Water Intake** | No, low or high flow conditions in Fitzroy Barrage Storage, contamination via discharge release or access e.g. grazing livestock, industry water discharge (unprotected surface water catchment) | Bacterial pathogens | 5 | 5 | E25 | • Catchment monitoring and regular inspection of river intake structure for obvious contaminating material<br>• Stakeholder engagement towards preventing any high risk activities that might pose a threat. | 3 | 1 | L3 | Confident | • Alarms in place for monitoring of raw water turbidity to alert operator of any significant changes.<br>• No apparent change in risk during no, low or high flow events. | R01 |
| | | Protozoan pathogens | 5 | 3 | H15 | • Catchment monitoring and regular inspection of river intake structure for obvious contaminating material<br>• Stakeholder engagement towards preventing any high risk activities that might pose a threat. | 3 | 1 | L3 | Reliable | • Alarms in place for monitoring of raw water turbidity to alert operator of any significant changes.<br>• No *Cryptosporidium* or *Giardia* detected in GWTP raw or final water in the last 8 years.<br>• No apparent change in risk during no, low or high flow events. | R02 |
| | | Toxic cyanobacteria | 5 | 3 | H15 | • Catchment monitoring to detect toxic blooms.<br>• Variable depth intake to avoid surface scum during bloom events.<br>• Pre-treatment chlorination available to destroy toxic cyanobacteria.<br>• Powdered activated carbon dosing if required to remove toxins. | 3 | 1 | L3 | Reliable | • Cyanobacteria season highly dependent on river flow season and origin of flows in the upper catchments.<br>• Good engagement with local university to keep up to date with latest local research on cyanobacteria in the catchment. | R03 |
| | | Viral pathogens | 5 | 4 | E20 | • Catchment monitoring and regular inspection of river intake structure for obvious contaminating material<br>• Stakeholder engagement towards preventing any high risk activities that might pose a threat. | 3 | 1 | L3 | Reliable (based on chlorination performance) | • Alarms in place for monitoring of raw water turbidity to alert operator of any significant changes.<br>• No apparent change in risk during no, low or high flow events. | R04 |
| | | Toxic or Radioactive Metals | 5 | 1 | M6 | • Catchment monitoring and regular inspection of river intake structure for obvious contaminating material<br>• Stakeholder engagement towards preventing any high risk activities that might pose a | 3 | 1 | L3 | Reliable | • Constant engagement with other Fitzroy Basin stakeholders about water quality.<br>• No metals or radioisotopes detected at concentrations close to ADWG in last 3 years. | R05 |

| Scheme Component | Hazardous Event | Hazard | CR | LH | IRR | Existing Preventative Measure/Barrier | CR | LH | RRR | Uncertainty | Comment/Proposed Further Risk Mitigation | Risk No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | threat.<br>• Pre-treatment oxidation available if required | | | | | | |
| | | High Iron and Manganese | 3 | 2 | M6 | • Catchment and raw water monitoring<br>• Pre-treatment oxidation with chlorine gas or chlorine dioxide is available if required | 3 | 1 | L3 | Reliable | • Fitzroy River raw water does not usually contain high iron and manganese.<br>• This event only occurs during major flooding events | R06 |
| | | Toxic Pesticides or Organics | 5 | 1 | M6 | • Pre-treatment chlorination using chlorine gas or chlorine dioxide is available to oxidise organics and pesticides if required.<br>• Powdered activated carbon dosing if required to remove soluble compounds | 3 | 1 | L3 | Reliable | • Constant discussion with other Fitzroy Basin stakeholders about water quality.<br>• No pesticides detected at concentrations close to ADWG in last 8 years | R07 |
| | | Excessive E.C. or TDS | 3 | 4 | H12 | • Stakeholder engagement and catchment monitoring.<br>• No additional controls and no effective treatment process | 3 | 3 | M9 | Confident | • The combination of natural and artificial inputs of E.C. and sodium has led to the possibility that raw water will become unacceptable quality for treatment using conventional processes.<br>• **Proposed action: continue to lobby regulator for tighter water quality limits on mine water discharges.** | R08 |
| | | Excessive Turbidity | 3 | 2 | M6 | • On-line analysis of raw water turbidity with alarms in place to alert operator of significant changes in turbidity.<br>• Robust treatment plant and treatment process design.<br>• Stakeholder engagement and upstream monitoring of flow events. | 2 | 1 | L2 | Confident | • GWTP capable of 4-log removal of turbidity and can handle raw water >2000 NTU. | R09 |
| **Treatment, Multiple Barriers, Process Control** | Failure of Treatment Barrier, Lack of effective treatment, Process control failure | Bacterial pathogens | 5 | 5 | E25 | • Coagulation/sedimentation barrier with on-line monitoring of turbidity pre-filtration to assess effectiveness.<br>• Filtration performance closely monitored to backwash at >0.2 NTU.<br>• Filter to waste valves used for ripening of filters after backwash to ensure turbidity | 3 | 1 | L3 | Confident | • Alarms in place for monitoring of turbidity pre- and post-filtration to ensure process effectiveness.<br>• Alarms also in place to ensure effective chlorine residual achieved in clear water reservoirs.<br>• Individual filter turbidity rarely above 0.3 NTU.<br>• No *E. coli* detected in GWTP final water in the last 8 years. | R10 |

| Scheme Component | Hazardous Event | Hazard | CR | LH | IRR | Existing Preventative Measure/Barrier | CR | LH | RRR | Uncertainty | Comment/Proposed Further Risk Mitigation | Risk No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | <0.2 NTU.<br>• Gas chlorination closely monitored to ensure effective disinfection. | | | | | • No difference in performance during no, low or high flow events. | |
| | | Protozoan pathogens | 5 | 3 | H15 | • Coagulation/sedimentation barrier with on-line monitoring of turbidity pre-filtration to assess effectiveness.<br>• Filtration performance closely monitored to backwash at >0.2 NTU.<br>• Filter to waste valves used for ripening of filters after backwash to ensure turbidity <0.2 NTU. | 3 | 1 | L3 | Reliable | • Alarms in place for monitoring of turbidity pre and post filtration to ensure process effectiveness.<br>• Filter to waste valves prevent turbidity spikes following backwash.<br>• Individual filter turbidities rarely above 0.3 NTU.<br>• No *Cryptosporidium* or *Giardia* detected in GWTP raw or final water in the last 8 years.<br>• No difference in performance during no, low or high flow events. | R11 |
| | | Toxic cyanobacteria | 5 | 3 | H15 | • Coagulation/sedimentation barrier with on-line monitoring of turbidity pre-filtration to assess effectiveness.<br>• Pre-coagulation chlorination available to destroy toxic cyanobacteria.<br>• Powdered activated carbon dosing if required to remove toxins. | 3 | 1 | L3 | Reliable | • Effective removal of *Cylindrospermopsis raciborskii* using sedimentation and filtration validated at GWTP.<br>• Increased coagulant dose very effective under high bloom conditions.<br>• Very little if any penetration of cyanobacteria through to final water during blooms events over the last 5 years. | R12 |
| | | Viral pathogens | 5 | 4 | E20 | • Coagulation/sedimentation barrier with on-line monitoring of turbidity pre-filtration to assess effectiveness.<br>• Filtration performance closely monitored to backwash at >0.2 NTU.<br>• Filter to waste valves used for ripening of filters after backwash to ensure turbidity <0.2 NTU.<br>• Gas chlorination closely monitored to ensure effective disinfection. | 3 | 1 | L3 | Reliable (based on chlorination performance) | • Alarms in place for monitoring of turbidity pre- and post-filtration to ensure process effectiveness.<br>• Alarms also in place to ensure effective chlorine residual achieved in clear water reservoirs.<br>• Individual filter turbidities rarely above 0.3 NTU.<br>• No difference in performance during no, low or high flow events. | R13 |
| | | Toxic or Radioactive Metals | 5 | 1 | M6 | • Coagulation/sedimentation barrier with on-line monitoring of turbidity pre-filtration to assess effectiveness. | 3 | 1 | L3 | Reliable | • Constant discussion with other Fitzroy Basin stakeholders about water quality.<br>• No metals or radioisotopes detected at concentrations close to ADWG in last 3 | R14 |

| Scheme Component | Hazardous Event | Hazard | CR | LH | IRR | Existing Preventative Measure/Barrier | CR | LH | RRR | Uncertainty | Comment/Proposed Further Risk Mitigation | Risk No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | years.<br>• Very effective sedimentation process with 4-log turbidity removal. | |
| | | Toxic Pesticides or Organics | 5 | 1 | M6 | • Pre-coagulation chlorination available to oxidise organics and pesticides if required.<br>• Powdered activated carbon dosing if required to remove soluble compounds. | 3 | 1 | L3 | Reliable | • Constant discussion with other Fitzroy Basin stakeholders about water quality.<br>• No pesticides detected at concentrations close to ADWG in last 8 years. | R15 |
| | | Excessive E.C. or TDS | 3 | 4 | H12 | • Stakeholder engagement and catchment monitoring.<br>• No additional controls and no effective treatment process | 3 | 1 | L3 | Confident | • The combination of natural and artificial inputs of E.C. and sodium has led to the possibility that raw water will become unacceptable quality for treatment using conventional processes. | R16 |
| | | Excessive Turbidity | 3 | 2 | M6 | • Robust treatment plant and treatment process design.<br>• Coagulation/sedimentation barrier with on-line monitoring of turbidity pre-filtration to assess effectiveness.<br>• Filtration performance closely monitored to backwash at >0.2 NTU.<br>• Filter to waste valves used for ripening of filters after backwash to ensure turbidity <0.2 NTU. | 2 | 1 | L2 | Confident | • GWTP capable of 4-log removal of turbidity and can handle raw water >2000 NTU.<br>• In addition, the sedimentation and filtration processes and their controls are reliable and robust. | R17 |
| | Equipment or Process control failure, Chemical underdosing | Coagulant Underdose | 4 | 3 | H12 | • Coagulation/sedimentation barrier with on-line monitoring of turbidity pre-filtration to assess effectiveness.<br>• Filtration performance closely monitored to backwash at >0.2 NTU.<br>• Duty/Standby dosing pumps available | 2 | 2 | L4 | Reliable | • The on-line turbidity analysis has alarms set to alert operator to any problems with effectiveness of sedimentation process and possible coagulant underdosing.<br>• The PACL coagulant is a very effective product and not readily susceptible to underdosing issues | R18 |
| | | Chlorine Underdose | 5 | 3 | H15 | • Duplicate on-line chlorine analysers used to monitor effectiveness of chlorine dosing with low and low low alarms to alert of possible underdosing<br>• Duty/Standby chlorinators in place | 3 | 1 | L3 | Confident | • The robust design and good performance of the filtration and disinfection systems at the GWTP as well as the relevant SCADA alarms being in place provide good management of this risk | R19 |

| Scheme Component | Hazardous Event | Hazard | CR | LH | IRR | Existing Preventative Measure/Barrier | CR | LH | RRR | Uncertainty | Comment/Proposed Further Risk Mitigation | Risk No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Contaminated chemicals, Use of unapproved treatment chemical | Toxic Metals, Toxic Chemicals | 5 | 1 | M6 | • Chemical supply contracts in place with stringent quality assurance and chemical analysis specifications required. | 3 | 1 | L3 | Reliable | • Low chemical dose rates and the associated monitoring and daily checking of chemical usage generally prevents any inadvertent overdosing of chemicals that may lead to water quality problems. | R20 |
| | Equipment or Process control failure, Chemical overdosing | Coagulant Overdose | 3 | 3 | M9 | • Trained operators and on-line monitoring of process performance alerts operator of possible overdose<br>• Daily reporting of chemical consumption helps operator to identify potential overdosing<br>• Verification monitoring used to check for any overdosing of coagulant leading to high aluminium in potable water | 3 | 1 | L3 | Confident | • The PACL coagulant used at GWTP allows for effective treatment at lower aluminium concentrations than alum sulphate helping to avoid any possible impacts from overdosing.<br>• Verification monitoring data shows no evidence of any significant overdosing events leading to high aluminium in potable water. | R21 |
| | | Fluoride Overdose | 4 | 2 | M8 | • PLC interlocks to shutdown fluoride dosing prior to achieving harmful dose.<br>• High concentration alarms to warn operator of potential problem.<br>• Redundancy of flow metering and on-line analysis for fluoride. | 3 | 1 | L3 | Reliable | • Fluoride dosing system PLC separate to main WTP PLC and operates independently.<br>• High concentration alarms and daily manual testing and instrument calibration help to reduce the risk of any problems associated with high dosing or incorrect fluoride concentration measurements. | R22 |
| | | Chlorine Overdose | 4 | 2 | M8 | • PLC interlocks to shutdown chlorine dosing and highlift pump station prior to achieving harmful dose.<br>• High concentration alarms to warn operator of potential problem.<br>• Redundancy of on-line analysis for chlorine. | 3 | 1 | L3 | Confident | • GWTP high chlorine interlock shuts the WTP highlift pumps down before free chlorine residual exceeds 2.0 mg/L.<br>• High concentration alarms and daily manual testing and instrument calibration help to reduce the risk of any problems associated with high dosing or incorrect chlorine concentration measurements. | R23 |
| **Distribution system, trunk infrastructure, reservoirs, reticulation.** | Contamination due to animals accessing reservoirs. | Bacterial Pathogens | 5 | 3 | H15 | • Automated rechlorination or manual rechlorination at most reservoirs.<br>• Appropriate roof design to prevent animal access or contaminant entry via roof run-off (except Mt Charlton Reservoir).<br>• Regular inspection program to | 4 | 1 | M5 | Reliable | • Automated rechlorination maintains >0.5 mg/L free chlorine with a setpoint target of 1.0 mg/L.<br>• Remote monitoring and low level alarms used to identify and rectify any dosing faults.<br>• Standard roof design being specified for all new reservoirs to prevent animal ingress. | R24 |

| Scheme Component | Hazardous Event | Hazard | CR | LH | IRR | Existing Preventative Measure/Barrier | CR | LH | RRR | Uncertainty | Comment/Proposed Further Risk Mitigation | Risk No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | check reservoir integrity and measure free chlorine residual.<br>• Reliable rechlorination with alarms to indicate dosing faults. | | | | | • **Proposed action: repair and/or replace roof of identified high risk reservoirs to prevent animal access or contaminant entry via roof run-off**<br>**Proposed action: install remote monitoring on manually re-chlorinated reservoirs to allow continuous free chlorine residual monitoring and alarming to alert operator of underdosing** | |
| | | Protozoan Pathogens | 5 | 3 | H15 | • Appropriate roof design to prevent animal access or contaminant entry via roof run-off.<br>• Regular inspection program to check reservoir integrity | 3 | 1 | L3 | Reliable | • Standard roof design being specified for all new reservoirs to prevent animal ingress. | R25 |
| | | Viral Pathogen | 5 | 3 | H15 | • Automated rechlorination or manual rechlorination at all reservoirs.<br>• Appropriate roof design to prevent animal access or contaminant entry via roof run-off (except Mt Charlton Reservoir).<br>• Regular inspection program, Reliable rechlorination with alarms to indicate dosing faults. | 4 | 1 | M5 | Reliable (Based on chlorination performance) | • Automated rechlorination maintains >0.5 mg/L free chlorine with a setpoint target of 1.0 mg/L.<br>• Remote monitoring and low level alarms used to identify and rectify any dosing faults.<br>• Standard roof design being specified for all new reservoirs to prevent animal ingress.<br>• **Proposed action: repair and/or replace roof of identified high risk reservoirs to prevent animal access or contaminant entry via roof run-off**<br>**Proposed action: install remote monitoring on manually re-chlorinated reservoirs to allow continuous free chlorine residual monitoring and alarming to alert operator of underdosing** | R26 |
| | Contamination via water mains break or reservoir maintenance activity | Microbial Pathogens | 5 | 4 | E20 | • Procedures in place to minimise the entry of contaminating material into broken water mains or reservoirs during reactive or planned maintenance activities.<br>• Chlorination and flushing carried out as part of these procedures. | 3 | 1 | L3 | Reliable | • Procedures are based on AWWA methods for chlorination of water mains and reservoirs to ensure effective disinfection. | R27 |
| | Increased water age, | Excessive disinfection | 3 | 3 | M9 | • Effective treatment processes to remove organic carbon, | 3 | 1 | L3 | Reliable | • This hazard is somewhat subject to the prevailing scientific literature, or the | R28 |

| Scheme Component | Hazardous Event | Hazard | CR | LH | IRR | Existing Preventative Measure/Barrier | CR | LH | RRR | Uncertainty | Comment/Proposed Further Risk Mitigation | Risk No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | multiple rechlorination and high total organic carbon | by-products | | | | reticulation monitoring for disinfection by-product formation.<br>• Use of modelling to manage water age.<br>• Use of chlorine dioxide to oxidise organic carbon and reduce chlorine usage | | | | | perception of risk based on health guideline values which vary significantly around the world.<br>• Efforts are continuing to keep up to date with changes in strategies to prevent or manage disinfection by-product formation. | |
| | Increased water age due to long pipelines and lack of nearby rechlorination | No chlorine residual leads to unsafe water | 4 | 4 | H16 | • Increased chlorination where required to boost penetration of residual<br>• System operation optimised to reduce water age and aid in residual penetration | 3 | 1 | L3 | Reliable | • Most of the reticulation consistently receives water with free chlorine residual >0.2 mg/L, however, this level of protection is not likely to provide an effective barrier against significant quantities of contaminating material. | R29 |
| | Act of sabotage or terrorism | Toxic agent | 5 | 2 | M6 | • Adequate physical security and regular site inspection program.<br>• Internal tracking of security keys.<br>• Some CCTV at sites with higher risk of unauthorised access. | 4 | 1 | M5 | Reliable | • Signage, physical security and CCTV upgrades were made at various reservoirs to prevent unauthorised access, but are unlikely to be effective against a deliberate act of sabotage or terrorism. | R30 |
| | Equipment or Process control failure at reservoir rechlorination site | Chlorine Underdose | 4 | 3 | H12 | • Remote monitoring using on-line chlorine analysers with low and low low alarms to trigger rectification action<br>• Duty/Standby dosing pumps and critical spares kept<br>• Regular equipment servicing and regular monitoring and calibration of chlorine on-line analysers. | 3 | 1 | L3 | Reliable | • These measures listed here as well as the focus placed on regular inspection of reservoirs to prevent animal access and contamination provides good management of this risk. | R31 |
| | | Chlorine Overdose | 4 | 2 | M8 | • High alarms on chlorine residual concentrations to trigger rectification action,<br>• Regular equipment servicing and regular monitoring and calibration of chlorine on-line analysers. | 3 | 1 | L3 | Reliable | • Maintaining a regular inspection and calibration program is an essential part of ensuring that the on-line analysers read correctly and prevent any over-dosing of chlorine. | R32 |
| **Customers Tap** | Contamination via backflow or cross connection | Microbial pathogens | 5 | 2 | H10 | • Good penetration of free chlorine residual to most parts of the reticulation,<br>• Plumbing Inspection team to ensure plumbing and network | 3 | 1 | L3 | Reliable | • Most of the reticulation consistently receives water with free chlorine residual >0.2 mg/L, however, this level of protection is not likely to provide an effective barrier against significant | R33 |

| Scheme Component | Hazardous Event | Hazard | CR | LH | IRR | Existing Preventative Measure/Barrier | CR | LH | RRR | Uncertainty | Comment/Proposed Further Risk Mitigation | Risk No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | assets are constructed to meet legislative and standard requirements. | | | | | quantities of contaminating material.<br>• Prevention using backflow prevention devices or good regulation is the preferred approach. | |

**Table 5.2: Assessment of Risks with the Potential to Impact Drinking Water Quality in the Mount Morgan Water Supply Scheme**

| Scheme Component | Hazardous Event | Hazard | CR | LH | IRR | Existing Preventative Measure/Barrier | CR | LH | RRR | Uncertainty | Comment/Proposed Further Risk Mitigation | Risk No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Source, Raw Water Intake** | No, low or high flow conditions in No.7 Dam, contamination via discharge release or access e.g., grazing livestock, (unprotected surface water catchment) | Bacterial pathogens | 5 | 5 | E25 | • Catchment for No.7 Dam relatively undisturbed and well forested, however, still technically an unprotected surface water storage<br>• Catchment monitoring and on-line raw water turbidity monitoring alerts operator to changes in turbidity.<br>• Gas chlorination closely monitored manually to ensure effective disinfection. | 3 | 1 | L3 | Reliable | • Raw water turbidity rarely above 10 NTU throughout periods with no flow in the Dee River.<br>• No *E. coli* detected in WWTP final water in the last 8 years. | MM01 |
| | | Protozoan pathogens | 5 | 3 | H15 | • Catchment for No.7 Dam relatively undisturbed and well forested, however, still technically an unprotected surface water storage.<br>• Catchment monitoring and on-line raw water turbidity monitoring alerts operator to changes in turbidity. | 3 | 1 | L3 | Reliable | • Raw water turbidity rarely above 10 NTU throughout periods with no flow in the Dee River.<br>• No *Cryptosporidium* or *Giardia* detected in MMWTP raw or final water in the last 8 years. | MM02 |
| | | Toxic cyanobacteria | 5 | 3 | H15 | • Catchment monitoring to detect toxic blooms.<br>• Pre-treatment chlorination possible if required to destroy cyanobacteria<br>• Some ability to vary the intake depth at No.7 Dam to avoid surface scums. | 3 | 1 | L3 | Reliable | • Cyanobacteria have not posed a significant issue in No. 7 Dam during the last 3 years. | MM03 |
| | | Viral pathogens | 5 | 4 | E20 | • Catchment for No.7 Dam relatively undisturbed and well forested, however, still technically an unprotected surface water storage.<br>• Catchment monitoring and on-line raw water turbidity monitoring alerts operator to changes in turbidity.<br>• Sedimentation and filtration barriers are generally quite reliable although improved performance is being targeted. | 3 | 1 | L3 | Estimate | • Raw water turbidity rarely above 10 NTU throughout periods with no flow in the Dee River. | MM04 |

| Scheme Component | Hazardous Event | Hazard | CR | LH | IRR | Existing Preventative Measure/Barrier | CR | LH | RRR | Uncertainty | Comment/Proposed Further Risk Mitigation | Risk No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Toxic or Radioactive Metals | 5 | 1 | M6 | • Catchment for No.7 Dam relatively undisturbed and well forested, however, still technically an unprotected surface water storage.<br>• Catchment monitoring program provides indication of changes to raw water quality | 3 | 1 | L3 | Reliable | • No metals or radioisotopes detected at concentrations close to ADWG in last 3 years. | MM05 |
| | | High Iron and Manganese | 3 | 2 | M6 | • Catchment monitoring program provides indication of changes to raw water quality<br>• Pre-treatment oxidation available if required | 3 | 1 | L3 | Reliable | • Although No. 7 Dam raw water can have periodic increases in levels of iron and manganese, MMWTP potable water has consistently concentrations of iron and manganese beneath ADWG aesthetic guidelines. | MM06 |
| | | Toxic Pesticides or Organics | 5 | 1 | M6 | • Catchment for No.7 Dam relatively undisturbed and well forested, however, still technically an unprotected surface water storage.<br>• Catchment monitoring program provides indication of changes to raw water quality<br>• Pre-treatment chlorination available to oxidise organics and pesticides if required.<br>• Powdered activated carbon dosing if required to remove soluble compounds | 3 | 1 | L3 | Reliable | • No pesticides detected at concentrations close to ADWG in last 5 years. | MM07 |
| | | Excessive E.C. or TDS | 3 | 3 | M9 | • Catchment monitoring program provides indication of changes to raw water quality<br>• Naturally high background E.C. and TDS in raw water means that customers are used to this water quality. | 3 | 1 | L3 | Confident | • Raw water E.C. and TDS average 227 µS/cm and 271 mg/L respectively. | MM08 |
| | | Excessive Turbidity | 3 | 2 | M6 | • Catchment monitoring program provides indication of changes to raw water quality<br>• On-line monitoring of raw water turbidity with alarms to alert of any large increases in turbidity | 2 | 1 | L2 | Reliable | • Raw water turbidity rarely above 10 NTU throughout periods with no flow in the Dee River.<br>• | MM09 |

| Scheme Component | Hazardous Event | Hazard | CR | LH | IRR | Existing Preventative Measure/Barrier | CR | LH | RRR | Uncertainty | Comment/Proposed Further Risk Mitigation | Risk No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Fletchers Creek Emergency Source, Raw Water Intake (all hazards except for Iron and Manganese as per above for No.7 Dam)** | No, low or high flow conditions in No.7 Dam, contamination via discharge release or access e.g., grazing livestock, (unprotected surface water catchment) | High Iron and Manganese | 3 | 4 | H12 | • Catchment monitoring program provides indication of current raw water quality<br>• Source water only used in an emergency which is very unlikely<br>• Pre-treatment oxidation available to assist with iron and manganese removal | 3 | 1 | L3 | Estimate | • With the storage capacity in No.7 much greater than in previous years when Fletchers Creek was more commonly used, it is unlikely that this water source will be used again.<br>• Nevertheless monitoring and infrastructure maintenance continues should the need arise to use this water source. | MM10 |
| **Tankered Potable Water Emergency Source** | No, low or high flow conditions in No.7 Dam and Fletchers Creek | High Total Organic Carbon; Objectionable taste and/or odour | 3 | 1 | L3 | • Catchment monitoring program provides indication of changes to raw water quality<br>• Powdered activated carbon dosing to remove soluble compounds<br>• Tankered potable water delivered post filtration to blend with treated water or as a 100% emergency water source | 2 | 1 | L2 | Estimate (Contracts with bulk potable water carriers commenced in April 2021) | • Total organic carbon (TOC) and cyanobacteria data during the last 5 years are available to provide better understanding of raw water changes when No. 7 Dam's supply dwindles to very low levels.<br>• Newly installed tankered water inlet butterfly valve to enable approved potable tankers to deliver water post filtration | MM11 |
| **Treatment, Multiple Barriers, Process Control** | Failure of Treatment Barrier, Lack of effective treatment, Process control failure | Bacterial pathogens | 5 | 5 | E25 | • Coagulation/sedimentation and filtration barriers reasonably reliable and effective.<br>• Gas chlorination closely monitored manually to ensure effective disinfection.<br>• UV disinfection installed with an online monitoring to measure UV intensity and ensure system performance. | 3 | 1 | L3 | Reliable | • Alarms in place for monitoring of turbidity post-filtration to ensure process effectiveness. | MM12 |
| | | Protozoan pathogens | 5 | 3 | H15 | • Coagulation/sedimentation and filtration barriers reasonably reliable and effective.<br>• On-line analysis of filtered water turbidity with alarms in place to alert operator of poor performance.<br>• UV disinfection installed with an online monitoring to | 3 | 1 | L3 | Reliable | • Alarms and process interlocks in place for monitoring of turbidity post filtration to help optimise and control sedimentation and filtration performance. | MM13 |

| Scheme Component | Hazardous Event | Hazard | CR | LH | IRR | Existing Preventative Measure/Barrier | CR | LH | RRR | Uncertainty | Comment/Proposed Further Risk Mitigation | Risk No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | measure UV intensity and ensure system performance. | | | | | | |
| | | Toxic cyanobacteria | 5 | 3 | H15 | • Coagulation/sedimentation and filtration barriers reasonably reliable and effective.<br>• On-line analysis of filtered water turbidity with alarms in place to alert operator of poor performance.<br>• Pre-coagulation chlorination available if required to destroy toxic cyanobacteria.<br>• Powdered activated carbon dosing if required to remove toxins.<br>• UV disinfection system installed with an online monitoring UV intensity to ensure system performance. | 3 | 1 | L3 | Reliable | • **Alarms and interlocks** | MM14 |
| | | Viral pathogens | 5 | 4 | E20 | • Coagulation/sedimentation and filtration barriers reasonably reliable and effective.<br>• Installed on-line analysis of filtered water turbidity with alarms in place to alert operator of poor performance. Automated gas chlorination to ensure effective disinfection.<br>• | 4 | 2 | M8 | Reliable (Based on chlorination and filtration performance) | • Alarms in place to ensure effective free chlorine residual is achieved in the clear water reservoir.<br>• Alarms in place for monitoring of turbidity post-filtration to ensure process effectiveness.<br>• Process interlocks in place to stop WTP operation if treated or final water turbidity exceeds 1 NTU for 15 min or if free chlorine residual is <0.5 mg/L for 15 min.<br>• **Proposed action: perform testing for viruses for further confirmation of process effectiveness.** | MM15 |
| | | Toxic or Radioactive Metals | 5 | 1 | M6 | • Coagulation/sedimentation and filtration barriers reasonably reliable and effective.<br>• Catchment for No.7 Dam relatively undisturbed and well forested, however, still technically an unprotected | 3 | 1 | L3 | Reliable | • No metals or radioisotopes detected at concentrations close to ADWG in last 3 years. | MM16 |

| Scheme Component | Hazardous Event | Hazard | CR | LH | IRR | Existing Preventative Measure/Barrier | CR | LH | RRR | Uncertainty | Comment/Proposed Further Risk Mitigation | Risk No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | surface water storage. | | | | | | |
| | | Toxic Pesticides or Organics | 5 | 1 | M6 | • Pre-coagulation chlorination available to oxidise organics and pesticides if required.<br>• Powdered activated carbon dosing if required to remove soluble compounds.<br>• Catchment for No.7 Dam relatively undisturbed and well forested, however, still technically an unprotected surface water storage. | 3 | 1 | L3 | Reliable | • No pesticides detected at concentrations close to ADWG in last 5 years. | MM17 |
| | | Excessive E.C. or TDS | 3 | 2 | M6 | • On-line monitoring of raw water and final water E.C. used to alert operator of changes to water quality. | 3 | 1 | L3 | Reliable | • Customers are historically adapted to periods of potable water having elevated E.C. and TDS.<br>• There does not appear to be any need to further reduce this risk. | MM18 |
| | | Excessive Turbidity | 4 | 2 | M8 | • Coagulation/sedimentation and filtration barriers reasonably reliable and effective.<br>• On-line water quality analysis of raw and filtered water provides operational monitoring of barrier effectiveness<br>• Filter refurbishment and media replacement<br>• UV disinfection system installed with an online monitoring UV intensity to ensure system performance. | 3 | 1 | L3 | Reliable | • On-line monitoring of filtration performance and filtered water turbidity with alarms to alert operator or any reduced performance | MM19 |
| | Process failure leads to sludge return to inlet of WTP from sludge lagoons | Excessive Turbidity | 4 | 2 | M8 | • Return of supernatant from sludge lagoons is a fully manual process that is monitored visually to prevent sludge draw-off<br>• Automated process interlocked with WTP operation very low flow only | 3 | 1 | L3 | Reliable | • Manual process reliable but further risk mitigation possible. | MM20 |
| | Equipment or Process control failure, Chemical | Coagulant Underdose | 4 | 3 | H12 | • On-line water quality analysis of raw and filtered water provides operational monitoring of barrier | 3 | 1 | L3 | Reliable | • The on-line turbidity analysis has alarms set to alert operator to any problems with effectiveness of sedimentation process and | MM21 |

| Scheme Component | Hazardous Event | Hazard | CR | LH | IRR | Existing Preventative Measure/Barrier | CR | LH | RRR | Uncertainty | Comment/Proposed Further Risk Mitigation | Risk No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | underdosing | | | | | effectiveness<br>• Duty/Standby dosing pumps available<br>• PLC interlocks to shutdown the WTP process in the event of chemical dosing failure. | | | | | possible coagulant underdosing.<br>• Coagulant dosing using liquid alum for online flow metering and better measurement of chemical usage commenced in April 2018. | |
| | | Chlorine Underdose | 5 | 3 | H15 | • Automated gas chlorination installed with good on-line monitoring and control<br>• Alarms generated if chlorine dosing problem with remote monitoring of system to detect any issues. | 3 | 1 | L3 | Reliable | • System highly effective with chlorine residual typically between 1 and 1.5 mg/L with a long contact time in the clear water reservoir. | MM22 |
| | Contaminated chemicals, Use of unapproved treatment chemical | Toxic Metals, Toxic Chemicals | 5 | 1 | M6 | • Chemical supply contracts in place with stringent quality assurance and chemical analysis specifications required. | 3 | 1 | L3 | Reliable | • Verification monitoring data shows no evidence of any overdosing events leading to reduce quality potable water. | MM23 |
| | Equipment or Process control failure, Chemical overdosing | Coagulant Overdose | 3 | 3 | M9 | • Trained operators and on-line monitoring of process parameters such as pH alerts operator to possible overdose<br>• Daily reporting of chemical consumption helps operator to identify potential overdosing<br>• Verification monitoring used to check for any overdosing of coagulant leading to high aluminium in potable water | 3 | 1 | L3 | Confident | • Verification monitoring data shows no evidence of any significant overdosing events leading to high aluminium in potable water.<br>• Coagulant dosing using liquid alum for online flow metering and better measurement of chemical usage commenced in April 2018. | MM24 |
| | | Chlorine Overdose | 4 | 2 | M8 | • Automated gas chlorination installed with good on-line monitoring and control<br>• Alarms generated if chlorine dosing problem with remote monitoring of system to detect any issues. | 3 | 1 | L3 | Reliable | • System highly effective with chlorine residual typically between 1 and 1.5 mg/L with a long contact time in the clear water reservoir.<br>• | MM26 |
| | | Microbial Pathogen, | 5 | 1 | M6 | • Bulk potable water cartage contracts in place with | 2 | 1 | L2 | Estimate (Contracts with | • Dedicated filling point thru an inlet butterfly valve located post | MM27 |

| Scheme Component | Hazardous Event | Hazard | CR | LH | IRR | Existing Preventative Measure/Barrier | CR | LH | RRR | Uncertainty | Comment/Proposed Further Risk Mitigation | Risk No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Toxic Agent | | | | stringent quality assurance specifications.<br>• Contractor site induction and supervision<br>• Specified potable water filling areas in parts of the RWSS network. | | | | bulk potable water carriers commenced in April 2021) | filtration and pre-disinfection Carted potable water is disinfected with chlorine gas as it enters the clear water reservoir | |
| | Contamination due to delivery of tankered water | Bacterial Pathogens | 5 | 3 | H15 | • Automatic rechlorination with on-line monitoring.<br>• Appropriate roof design to prevent animal access or contaminant entry via roof run-off.<br>• Regular inspection program to check reservoir integrity and measure free chlorine residual. | 4 | 1 | M5 | Reliable | • Standard roof design specified for North Street Reservoir to prevent animal ingress. Automated rechlorination maintains >0.5 mg/L free chlorine with a setpoint target of 1.0 mg/L.<br>• Remote monitoring and low level alarms used to identify and rectify any dosing faults.<br>• **Proposed action: repair and/or replace Black Street Reservoir roof to prevent animal access or contaminant entry via roof run-off** | MM28 |
| **Distribution system, trunk infrastructure, reservoirs, reticulation.** | Contamination due to animals accessing reservoirs. | Protozoan Pathogens | 5 | 3 | H15 | • Appropriate roof design to prevent animal access or contaminant entry via roof run-off.<br>• Regular inspection program to check reservoir integrity | 3 | 1 | L3 | Estimate | • Standard roof design specified for North Street Reservoir to prevent animal ingress.<br>• Automated rechlorination maintains >0.5 mg/L free chlorine with a setpoint target of 1.0 mg/L.<br>• Remote monitoring and low level alarms used to identify and rectify any dosing faults. | MM29 |
| | | Viral Pathogen | 5 | 3 | H15 | • Automatic rechlorination with on-line monitoring.<br>• Appropriate roof design to prevent animal access or contaminant entry via roof run-off.<br>• Regular inspection program to check reservoir integrity and measure free chlorine residual. | 4 | 1 | M5 | Estimate | • Standard roof design specified for North Street Reservoir to prevent animal ingress.<br>• Automated rechlorination maintains >0.5 mg/L free chlorine with a setpoint target of 1.0 mg/L.<br>• Remote monitoring and low level alarms used to identify and rectify any dosing faults. **Proposed action: repair and/or replace Black Street Reservoir roof to prevent animal access or contaminant entry via roof run-off** | MM30 |

| Scheme Component | Hazardous Event | Hazard | CR | LH | IRR | Existing Preventative Measure/Barrier | CR | LH | RRR | Uncertainty | Comment/Proposed Further Risk Mitigation | Risk No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Microbial Pathogens | 5 | 4 | E20 | • Procedures in place to minimise the entry of contaminating material into broken water mains or reservoirs during reactive or planned maintenance activities.<br>• Chlorination and flushing carried out as part of these procedures.<br>• | 3 | 1 | L3 | Reliable | • Procedures are based on AWWA methods for chlorination of water mains and reservoirs to ensure effective disinfection. | MM31 |
| | Contamination via water mains break or reservoir maintenance activity | Excessive disinfection by-products | 3 | 3 | M9 | • Effective treatment processes to remove organic carbon, reticulation monitoring for disinfection by-product formation.<br>• Use of modelling to manage water age. | 3 | 1 | L3 | Reliable | • This hazard is somewhat subject to the prevailing scientific literature or the perception of risk based on health guideline values which vary significantly around the world.<br>• Efforts are continuing to keep up to date with changes in strategies to prevent or manage disinfection by-product formation. | MM32 |
| | Increased water age, multiple rechlorination and high total organic carbon | Objectionable taste and/or odour | 3 | 1 | L3 | • Effective treatment processes to remove organic carbon and reticulation monitoring<br>• Strategic flushing of mains<br>• Tankered potable water to blend with existing water supply or as a 100% water source | 2 | 1 | L2 | Reliable | • Newly installed tankered water inlet butterfly valve to enable approved potable tankers to deliver water to Mount Morgan WTP | MM33 |
| | | Objectionable taste and/or odour | 3 | 1 | L3 | • Effective treatment processes to remove organic carbon and reticulation monitoring<br>• Strategic flushing of mains<br>• Tankered potable water to blend with existing water supply or as a 100% water source | 2 | 1 | L2 | Reliable | • Newly installed tankered water inlet butterfly valve to enable approved potable tankers to deliver water to Mount Morgan WTP | MM33 |
| | | No chlorine residual leads to unsafe water | 4 | 4 | H16 | • Increased chlorination where required to boost penetration of residual<br>• System operation optimised to reduce water age and aid in residual penetration | 3 | 1 | L3 | Reliable | • The reticulation consistently receives water with free chlorine residual >0.2 mg/L, however, this level of protection is not likely to provide an effective barrier against significant quantities of contaminating material. | MM34 |

| Scheme Component | Hazardous Event | Hazard | CR | LH | IRR | Existing Preventative Measure/Barrier | CR | LH | RRR | Uncertainty | Comment/Proposed Further Risk Mitigation | Risk No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Increased water age due to long pipelines and lack of nearby rechlorination | Toxic agent | 5 | 2 | M6 | • Adequate physical security and regular site inspection program.<br>• Internal tracking of security keys. | 4 | 1 | M5 | Reliable | • Signage, physical security and CCTV help to prevent unauthorised access, but are unlikely to be effective against a deliberate act of sabotage or terrorism.<br>• Funding approved to install CCTV at high risk sites with completion December 2023.<br>• Access to all areas to be upgraded to Authorised Swipe Card with completion December 2023 | MM35 |
| | Act of sabotage or terrorism | Chlorine Underdose | 4 | 3 | H12 | • Remote monitoring using on-line chlorine analysers with low and low low alarms to trigger rectification action<br>• Duty/Standby dosing pumps and critical spares kept<br>• Regular equipment servicing and regular monitoring and calibration of chlorine on-line analysers. | 3 | 1 | L3 | Reliable | • These measures listed here as well as the focus placed on regular inspection of reservoirs to prevent animal access and contamination provides good management of this risk. | MM36 |
| | Equipment or Process control failure at reservoir rechlorination site | Chlorine Overdose | 4 | 2 | M8 | • High alarms on chlorine residual concentrations to trigger rectification action,<br>• Regular equipment servicing and regular monitoring and calibration of chlorine on-line analysers. | 3 | 1 | L3 | Reliable | Maintaining a regular inspection and calibration program is an essential part of ensuring that the on-line analysers read correctly and prevent any over-dosing of chlorine. | MM37 |
| | Mobilisation of Pipewall Biofilm or Sediments | Discoloured Water | 3 | 4 | H12 | • Increased free chlorine residual penetration through distribution system<br>• Air scouring program to clear reticulation 'hot spots' | 2 | 2 | L4 | Reliable | The air scouring program has been shown to be effective where applied to date. This work will continue as required. | MM38 |
| **Customers Tap** | Contamination via backflow or cross connection | Microbial pathogens | 5 | 2 | H10 | • Good penetration of free chlorine residual to most parts of the reticulation,<br>• Plumbing Inspection team to ensure plumbing and network assets are constructed to | 3 | 1 | L3 | Reliable | • Most of the reticulation consistently receives water with free chlorine residual >0.2 mg/L, however, this level of protection is not likely to provide an effective barrier against significant quantities of | MM39 |

| Scheme Component | Hazardous Event | Hazard | CR | LH | IRR | Existing Preventative Measure/Barrier | CR | LH | RRR | Uncertainty | Comment/Proposed Further Risk Mitigation | Risk No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | meet legislative and standard requirements. | | | | | contaminating material.<br>• Prevention using backflow prevention devices or good regulation is the preferred approach. | |

**Table 5.3: Assessment of Whole of Service Risks with the Potential to Impact Drinking Water Quality in Each Drinking Water Scheme**

| Scheme Component | Hazardous Event | Hazard | CR | LH | IRR | Existing Preventative Measure/Barrier | CR | LH | RRR | Uncertainty | Comment/Proposed Further Risk Mitigation | Risk No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Whole of Service | Extended Loss of Power to Infrastructure | No chlorine dosing at Reservoir Rechlorination Sites | 4 | 3 | H12 | • Hypochlorite in stock for manual dosing if required<br>• Portable pumping systems available to pump hypochlorite | 3 | 1 | L3 | Reliable | • In an extended power outage scenario, mobile gensets would be used if required to assist with operation of rechlorination sites | W01 |
| | | Inability to Treat Water to Potable Standard | 4 | 3 | H12 | • Emergency Genset at GWTP.<br>• 3-5 days storage in reservoirs for emergency supply | 3 | 1 | L3 | Reliable | • In a power outage all electrical systems would stop including pumps resulting in untreated water not entering distribution system | W02 |
| | Loss of Radio Telemetry | Unsafe exceedances not detected | 4 | 3 | H12 | • Rapid response to reinstate telemetry, communications links<br>• Most critical systems have localised control if comms are lost<br>• Critical spares kept for all communications systems | 3 | 1 | L3 | Reliable | • Highly trained competent staff available internally to attend to communications faults | W03 |
| | Lack of qualified and competent staff | Poor decision making, low competency leads to unsafe practices | 4 | 3 | H12 | • Training provided as appropriate to relevant staff<br>• Exposure of staff to industry events and technical developments | 3 | 1 | L3 | Reliable | • Attracting suitably qualified staff will always prove to be somewhat of a challenge | W04 |
| | Lack of availability of chemical supplies | Critical chemical processes cease leading to unsafe water | 4 | 3 | H12 | • Backup stocks and storages for critical treatment chemicals<br>• Alarms on storage vessels to indicate when they need restocking<br>• Good chemical supply contracts | 3 | 1 | L3 | Reliable | • Regular checking of chemical inventories done to ensure chemical availability. | W05 |
| | No information management system | Loss of important information | 4 | 3 | H12 | • Manual document system in place<br>• Electronic archiving in use | 3 | 1 | L3 | Reliable | • Continuous improvement is undertaken through revision of critical information | W06 |
| | Internal or External Cyberattack of SCADA | Loss of Process or Water Quality Control | 4 | 3 | H12 | • Secure SCADA Architecture post vulnerability assessment<br>• Regular system checks<br>• Mirror back-up off-site for reboot | 3 | 1 | L3 | Reliable | Physical security continually upgraded at key sites to control and monitor access. FRW under took a vulnerability assess again at the end of last year using a company call Cyber CX.<br>The outcome of this assessment was that we had to harden our software system and implement a cyber white listing (work completed by Honeywell) | W07 |

# 6 MANAGING RISKS

The assessment of risks for each drinking water scheme and the whole of service risks outlined above also provide a description of the existing risk treatments that minimise the risk posed by each hazard or hazardous event. The existing risk treatments include (but are not limited to), Operation and Maintenance (O&M) Manuals and procedures, water quality monitoring programs, preventative maintenance programs, redundancy in design, critical spares inventory, stringent quality assurance specifications in chemical supply and bulk water supply contracts, physical security, inspection programs, staff training and awareness, on-line monitoring and SCADA alarming, multiple treatment barriers, stakeholder engagement and asset management planning. These risk treatments are described in more detail in the following sections of the DWQMP. A number of risks continue to have an unacceptable albeit only moderate Residual Risk Rating. These risks and the proposed additional treatments are described in Table 6.1.

## 6.1 Unacceptable Risks to Drinking Water Quality

Of the 79 individual risks that were rated, 8 of the risks were considered to be unacceptable levels of risk as they have a moderate Residual Risk Rating (see Table 6.1). Proposed Actions have been identified to further mitigate each risk. The Proposed Actions being taken to mitigate these unacceptable risks form part of the Risk Management Improvement Program (see Section 12).

**Table 6.1: Unacceptable Risks Identified from Risk Assessments and Proposed Treatments**

| Risk No. | Component-Event-Hazard | RRR | Proposed Action |
|---|---|---|---|
| **Rockhampton Water Supply Scheme** | | | |
| R08 | Source – Contamination of raw water<br>Excessive E.C. or TDS | **M9** | Continue to lobby regulator for tighter water quality limits on mine water discharges. |
| R24 | Reservoir – Contamination due to animals accessing reservoirs<br>Bacterial Pathogen | **M5** | Repair and/or replace roof of identified high risk reservoirs to prevent animal access or contaminant entry via run-off;<br>Install remote monitoring on manually re-chlorinated reservoirs to allow for continuous free chlorine residual monitoring and alarming to alert operator of underdosing |
| R26 | Reservoir – Contamination due to animals accessing reservoirs<br>Viral Pathogen | **M5** | Repair and/or replace roof of identified high risk reservoirs to prevent animal access or contaminant entry via run-off;<br>Install remote monitoring on manually re-chlorinated reservoirs to allow for continuous free chlorine residual monitoring and alarming to alert operator of underdosing |
| R30 | Distribution – Sabotage or Terrorism<br>Toxic agent | **M5** | Identify high risk sites and install CCTV at these sites. |
| **Mount Morgan Water Supply Scheme** | | | |
| MM15 | Treatment – Lack of effective treatment<br>Viral Pathogen | **M8** | Perform testing for viruses for further confirmation of process effectiveness. |
| MM28 | Reservoir – Contamination due to animals accessing reservoirs<br>Bacterial Pathogen | **M5** | Repair and/or replace Black Street Reservoir roof to prevent animal access or contaminant entry via roof run-off |
| MM30 | Reservoir – Contamination due to animals accessing reservoirs | **M5** | Repair and/or replace Black Street Reservoir roof to prevent animal access or contaminant |

| Risk No. | Component-Event-Hazard | RRR | Proposed Action |
|---|---|---|---|
| | Viral Pathogen | | entry via roof run-off |
| MM32 | Distribution – Sabotage or Terrorism Toxic agent | **M5** | Identify high risk sites and install CCTV at these sites. |

# 7 OPERATION AND MAINTENANCE PROCEDURES

## 7.1 Manuals and Procedures for Drinking Water Schemes

Operation and Maintenance (O&M) Manuals exist for all WTP and many of their unit processes (e.g. chemical dosing systems) although most of these are not fully up to date due to changes since amalgamation in 2014. Table 7.1 contains a list of relevant manuals and procedures, the date they were prepared, the date for their next revision (if applicable) and the responsible officer. FRW is currently (July 2023) in the process of reviewing and renewing all WTP manuals and converting them into a standard O&M format (WTP template document released by the Queensland Water Directorate (QWD)) to allow for consistency of process description and to facilitate the ongoing updating of these manuals as changes are made to infrastructure or operating procedures. Once updated in electronic form manuals will be added to the Honeywell Experion SCADA system with active links to the manuals via the click of a button on the relevant SCADA screens.

**Table 7.1: Operation and Maintenance Manuals and Relevant Procedures for Managing Drinking Water Infrastructure**

| Document | Date Prepared | Last Reviewed | Date For Revision | Responsible Officer |
|---|---|---|---|---|
| Water Plan (Fitzroy Basin) Amendment Plan 2021 | 2021 | 2013 | 2031 | N/A |
| Glenmore WTP O&M Manual (QWD template) | In preparation. | N/A | Commenced internally May 2023. Waiting for commissioning to be completed after WTP Upgrade | Manager FRW |
| Mount Morgan WTP O&M Manual (Original) | 1993 | 1993 | Not planned | Manager FRW |
| Mount Morgan WTP O&M Manual (QWD template) | In preparation | N/A | Planned once current upgrade and commissioning completed | Manager FRW |
| Rockhampton to Yeppoon Pipeline O&M Manual | 2010 | 2010 | Not planned | Manager FRW |
| Lucas St Reservoir, Pump Station O&M Manual | 2003 | 2003 | Not planned | Coordinator MEG Maintenance |
| Mount Morgan WTP Chemical Dosing O&M Manual | 2018 | 2018 | Not planned | Manager FRW |
| Mount Morgan WTP UV Disinfection Manual | 2017 | 2018 | Not planned | Manager FRW |
| Rogar Avenue Re-Chlorination O&M Manual | 2017 | 2018 | Not planned | Manager FRW |

| | | | | |
|---|---|---|---|---|
| Activated Carbon Loading Procedure | 2010 | 2010 | Pending completion of current upgrading project | Manager FRW |
| Mains Break Repair Procedure | 2020 | 2020 | 2025 | Coordinator Network Operations |
| Mains Commissioning Procedure | In preparation | N/A | Ongoing | Coordinator Network Operations |
| Reservoir Disinfection and Inspection Procedure | 2020 | 2020 | 2025 | Manager FRW |
| Water Mains Air-Scouring Procedure | 2010 | In progress | 2024 | Coordinator Network Operations |
| Cyanobacteria Monitoring Protocol | 2009 | 2021 | 2026 | Manager FRW |

N/A = not applicable

Standard operating procedures are used for the operation of unit processes or associated equipment (e.g. powdered activated carbon bulk bag unloading system) to ensure they are operated according to manufacturer's specifications. Similarly, procedures for the operation and calibration of on-line and bench top analytical instrumentation are also in place. In most cases these procedures are as supplied by the manufacturer but in some instances the procedures are reproduced in a format that allows co-location next to the equipment being operated to help ensure correct operation occurs. Procedures are also in place for the disinfection of reservoirs, new water mains and broken water mains and for the regular reservoir inspection program and reticulation network air-scouring. Often these procedures are prepared in checklist format to document the completion of tasks for archiving purposes. FRW is currently reviewing and allocating numbers to all procedures to ensure that a register of current procedures is kept up to date.

The WTP O&M Manuals listed in Table 7.1 form the basis of the operating parameters coded into PLC codes or SCADA control setpoints used to control all key process treatment steps. The reviewing of these manuals is being done to ensure that there is consistency of information between the manuals and all the current operational settings used in PLC programs and SCADA settings. Since amalgamation, a large amount of capital upgrade work has been completed in all schemes and work is currently underway to ensure that all these infrastructure changes are captured in the relevant O&M manuals and procedures.

## 7.2 Preventative Maintenance Program

A preventative maintenance program is currently in place for drinking infrastructure within each supply scheme. The R1 software system is used to manage planned and reactive maintenance activities. More than 130 planned maintenance tasks are conducted by FRW staff and/or external contractors each year to ensure the continued reliable operation of a range of mechanical, electrical and process control system components. Table 7.2 provides an overview summary of the main types of preventative maintenance activities that are conducted and their frequency.

**Table 7.2: Overview of Preventative Maintenance Program for Drinking Water Infrastructure**

| Equipment Category | Specific Task | Frequency |
|---|---|---|
| Electrical | Backup generator servicing | yearly |
| | Switchboard thermography testing | yearly |
| | Chlorine gas sensor testing and servicing | 2 weekly |
| | Uninterruptible Power Supply servicing | 6 monthly |
| Mechanical | WPS pump servicing and greasing | 3 monthly |
| | WTP Air compressor and blower servicing | 3 monthly |
| | WTP coagulant dose pump servicing | 3 monthly |
| | Chlorinator and vacuum regulator servicing | 6 monthly |
| | Low lift pump intake screen cleaning | monthly |
| Process Control | pH, Electrical conductivity and turbidity meter calibrations | weekly |
| | Benchtop and online analytical equipment service | yearly |
| | Chlorine analysers servicing | 6 monthly |
| | Chlorine analysers calibration | monthly |
| | Chlorine gas facilities service | yearly |
| | Chlorine dioxide facility service | yearly |
| Reservoirs | Site, security and animal ingress inspection | monthly |

## 7.3 Reactive Maintenance Management

All reactive maintenance requirements are managed using a standard approach. Upon discovery of a process or component fault or an excursion from normal operational performance, an internal work order is raised using the R1 software system by the WTP Operator or staff member who discovers the issue. The nature and location of the issue is described in the work order together with an indication of the urgency of the maintenance request. The document is then electronically generated and allocated to the actioning staff or relevant supervisor involved in the operation and maintenance of drinking water infrastructure to provide the opportunity for comment on the fault or its urgency rating to optimise the prioritisation of reactive maintenance activities. At the same time a reactive maintenance worker is dispatched to attend and rectify the issue. Reporting of the progress made against the reactive maintenance targets is conducted to ensure tasks are completed in a timely manner.

# 8 MANAGEMENT OF EMERGENCIES, INCIDENTS, OR EXCURSIONS FROM NORMAL PERFORMANCE

## 8.1 Emergency Response Plan

FRW has in place an Emergency Response Plan (ERP) that details the approach for managing the response to, and recovery from, emergency situations e.g., natural disasters. The ERP has recently been reviewed and updated following the prolonged major flooding event that occurred during the 2010-2011 summer season. Mock emergency scenarios and desktop exercise alert workshops are held to provide training to key staff involved in the management of emergency situations.

## 8.2 Managing Drinking Water Incidents or Excursions from Normal Operational Performance

Drinking water incidents including reportable drinking water quality incidents or excursions from normal operational performance are rated and managed using the information provided Table 8.1 and Figure 8.1. An additional flow-charted procedure is in place for the management of microbiological water quality incidents following the detection of non-compliances within the drinking water schemes. Table 8.1 also provides information about the response and rectification time targets to return to normal safe operating status.

Members of the Treatment and Quality team within FRW together with other key stakeholders play different roles in the management of drinking water quality incidents or any excursion from normal operational performance. For example, an excursion from normal operating range is usually identified by a WTP Operator through a SCADA alarm whereas a non-compliance detected through verification monitoring (e.g. *E. coli* detection) is normally identified by the Senior Environmental Scientist or Manager FRW through the receipt of a non-compliant test result from an external laboratory. Depending on the nature of the excursion or non-compliance, each of these team members will attempt to take any action possible to immediately resolve the matter or alternatively, a work order will be submitted electronically for dispatch to maintenance staff according to the Priority Ratings given in Table 8.1.

The Maintenance and Dispatch Officers or WTP Operators are responsible for confirming the Priority Rating and dispatching the work order to the maintenance staff. This tasking is currently done using the R1 software system. In either case, the matter will be reported immediately to either the Senior Environmental Scientist or Manager FRW. These officers are responsible for assessing any action taken or for formulating a plan of further action (e.g., resampling) if required to address or investigate the non-compliance and for directing staff to complete these actions.

**Table 8.1: Priority Ratings of Possible Drinking Water Incidents or Events and the associated Response and Rectification Time Targets**

| **Consequences** (always rate using consequence with greatest potential impact) | | | |
|---|---|---|---|
| Generic Description | Negative public perception<br>Prevention of normal operations<br>Increased reactive maintenance<br>Disruption to normal staff duties<br>Loss of critical spares or supplies | Public complaint or environmental spill<br>Reduction in service level<br>Loss of normal design operating status<br>Loss of preventative maintenance<br>Unacceptable civil or site condition | Possible public health impact<br>Loss of service or non-compliance<br>Loss of SCADA control or monitoring<br>Loss of whole treatment barrier<br>Security or structural breach |
| *Examples* | *Site left untidy or poorly signed*<br>*Process shutdown required*<br>*Increased need for fault resetting*<br>*Normal planned tasks disrupted*<br>*No spare parts or store chemicals* | *Widespread drinking water complaint*<br>*Significant drop in reticulation pressure*<br>*Low or high alarm, loss of duty standby*<br>*On-line instrumentation not calibrated*<br>*Reservoir roof structure damaged* | *Reservoir contamination detected*<br>*Exceedance of ADWG health value*<br>*No radio telemetry or local comms*<br>*Chlorine dosing failure*<br>*Unauthorised access to WTP* |
| **Likelihood** | | | |
| Within 1 to 7 days | **P2 – Moderate Impact/Risk** | **P1 – High Impact/Risk** | **P1 – High Impact/Risk** |
| Within 7 to 28 days | **P3 – Low Impact/Risk** | **P2 – Moderate Impact/Risk** | **P1 – High Impact/Risk** |
| Not within 28 days | **P3 – Low Impact/Risk** | **P3 – Low Impact/Risk** | **P2 – Moderate Impact/Risk** |

| **Response and Rectification Time Targets** | | | |
|---|---|---|---|
| **Priority Rating** | **Response Time to Site** | **Rectification Time** | **Maximum Tolerable Outage** |
| **P1** | **1 hour** | **5 hours** | **5 hours** |
| **P2** | **2 hours** | **24 hours** | **24 hours** |
| **P3** | **24 hours** | **5 days** | **5 days** |

In the event of a notifiable water quality incident, the incident will be reported to the Department of Regional Development, Manufacturing and Water and simultaneously to Queensland Health and then investigated by either the Senior Environmental Scientist and/or the Manager FRW. Upon completion of the investigation the incidents are reported in writing to the Department of Regional Development, Manufacturing and Water (DRDMW) and to Queensland Health. Once fully resolved, the incident reporting is completed and any long term actions or preventative measures are incorporated into O&M Manuals or procedures or incorporated into future Capital Works Programs in order to prevent further incidents or excursions from normal operational performance targets.

Examples of specific actions that may be taken for events with different ratings are:

**P1 Rating**

- Resampling for further chemical or microbiological testing
- Manual dosing of sodium hypochlorite to boost disinfection
- Draining or isolation of reservoirs or issuing boil water alerts to avoid impact on public health
- Sourcing water from alternative supplies
- Install critical spare for chemical dosing pump

**P2 Rating**

- flushing of mains to clear a discoloured water event,
- scouring of reservoirs,
- changes made to treatment chemical dosing rates (e.g., coagulant dose),
- process control settings (e.g., changes to PID loops on chlorination systems)

**P3 Rating**

- air-scouring of water mains to remove sediment or biofilm

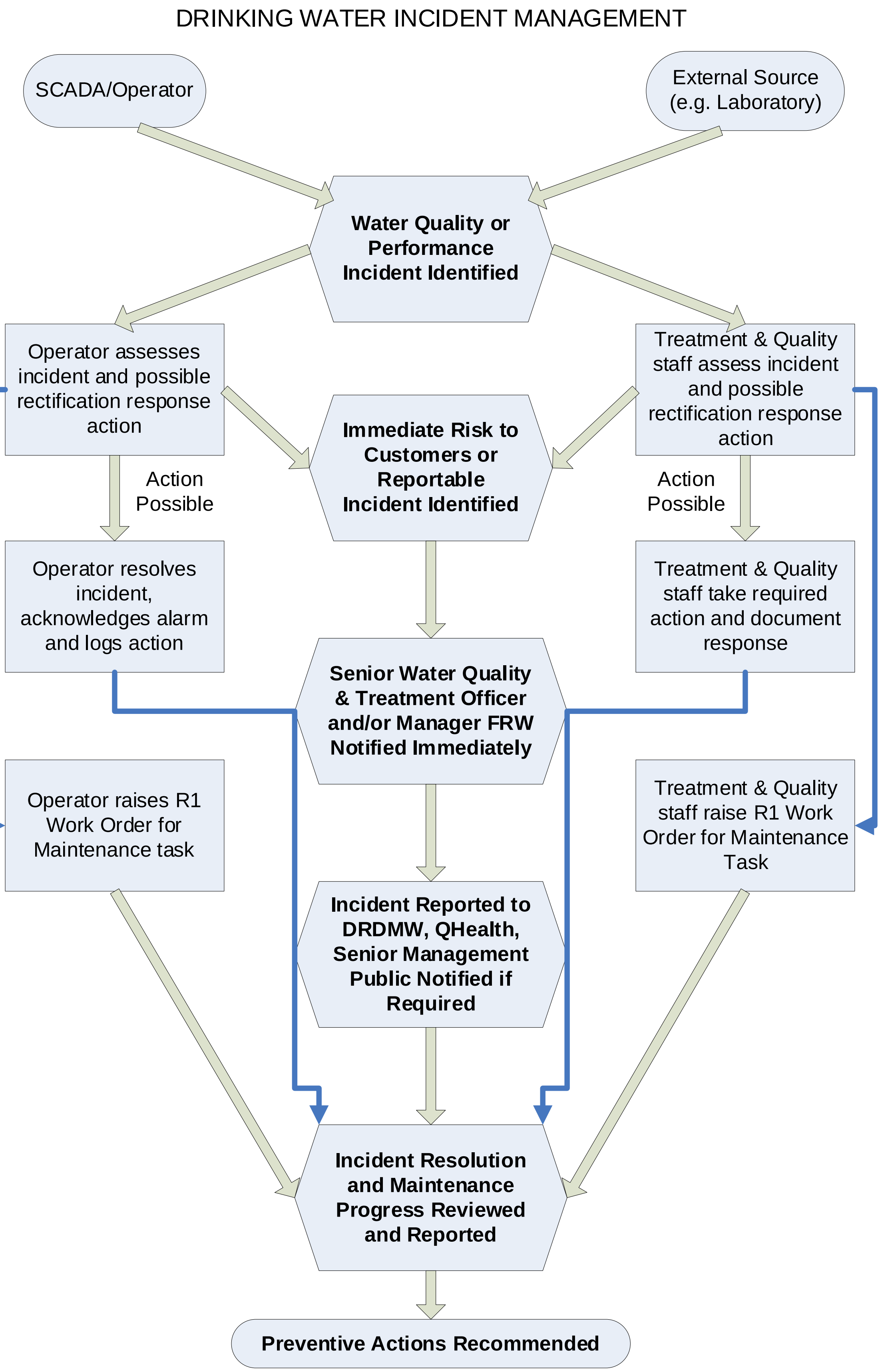
## 8.3 Emergency Contact Information

Table 8.2 identifies key personnel or stakeholders involved in managing drinking water incidents including FRW staff and officers within the Queensland Government. The positions in bold have in-depth knowledge of water treatment processes and/or water quality biology and chemistry and will engage with State Government officers if required to manage drinking water quality incidents.

**Table 8.2: FRW or other Personnel Involved in Managing Drinking Water Incidents**

| Name | Position | Role | Phone Number |
|---|---|---|---|
| Dan Toon | Manager FRW | Overall Responsibility | 1300 22 55 77 |
| Gavin Challinor | Coordinator Mech, Elec and Gen Maintenance | Managing Responses | 1300 22 55 77 |
| Paul Dean | Senior Environmental Scientist | Sampling, Reporting, Investigating | 1300 22 55 77 |
| Evan Davison | Coordinator Network Operations | Responding to and reporting on networks | 1300 22 55 77 |
| Vacant | Senior Asset and Maintenance Planner | Rectification Actions | 1300 22 55 77 |
| Department of Regional Development, Manufacturing and Water | Regulator for Drinking Water | Regulator, Management of Incident Response | 1300 59 67 09 |
| Queensland Health | Regulator for Public Health | Incident Response | 4920 6895 |

**Figure 8.1: Flow Chart Showing Approach to Drinking Water Incident Management**



# 9 SERVICE WIDE SUPPORT – INFORMATION MANAGEMENT

Record keeping, information management and reporting activities are currently performed in a number of different ways depending on the type and source of the information and its intended use. The overarching approach to record keeping and record retention requirements is prescribed in Council's Recordkeeping Policy (Policy No. POL.F4.7).

## 9.1 Information Management Systems

A number of different software systems are used to capture, manipulate and archive information relating to drinking water. These systems are accessible to all relevant staff through Council's online IT services. Table 9.1 provides a listing of the software systems that are currently in use and provides an indication of how current or up to date the information is in each system. O&M Manuals and procedure documents are also stored in hardcopy. The group responsible for maintaining and updating each software system is also indicated.

Information is made available or distributed to all staff via Toolbox Meetings held each month or through specially organised meetings or training workshops as required. In addition, information is presented on noticeboards and important safety information provided to team members in document wallets that accompany each of the work vehicles used by staff. If required email is used to distribute important information about drinking water operations and performance data.

**Table 9.1: Software Systems Used for Management of Drinking Water Associated Information**

| System | Function | Group Responsible | Currency |
|---|---|---|---|
| | | | |
| R1 Suite | Asset management including work orders, asset inventory and maintenance schedules; financials, supply chain and ECM. ECM is used for archiving of all business critical documents including internal and external correspondence | RRC, FRW Asset Management, FRW Admin | Current |
| Pathway | Management of all customer engagements including complaints and information requests | RRC and FRW Admin | Current |
| GeoCortex | Management of Council-wide GIS and asset location information | RRC and FRW Asset Management | Current |
| Experion SCADA | Archiving of all on-line monitored operational data for drinking water infrastructure | FRW Treatment and Quality Team | Current |
| Guardian | Management of Council-wide emergency events | RRC | Current |
| Microsoft Excel | Management of all water quality monitoring information | FRW Treatment and Quality Team | Current |
| SwimLocal | Management and reporting of all water quality monitoring information | FRW Treatment and Quality Team | In progress |

## 9.2 Reporting Activities

Currently all reporting activities are managed by a number of teams within FRW although predominantly members of the Treatment and Quality Team are responsible for all reporting related to drinking water quality. Information for reporting purposes is obtained from Microsoft Excel files (e.g. drinking water quality testing results), SCADA archives (e.g. WTP performance metrics, flow measurements and on-line drinking water quality results), Pathway archives (e.g. customer complaints), ECM (e.g. operation and maintenance manuals) and R1 archives (e.g. maintenance activities).

Reports are prepared by key members of the Treatment and Quality Team (e.g. Senior Water Quality and Treatment Officer) and are reviewed by other members of the team and the Manager FRW prior to submission. In this manner, the many different internal and external reporting requirements associated with drinking water (e.g. Council reports, internal team operational performance reports, FRW Website reports for customers, drinking water quality compliance reports and drinking water quality incident reports) are generated to meet business and legislative obligations.

# 10 OPERATIONAL AND VERIFICATION MONITORING PROGRAMS

A comprehensive water quality monitoring program is in place to ensure that operational performance is maintained to a sufficiently high level in order to consistently produce drinking water that meets ADWG. Table 10.1 provides an overview of the water quality monitoring program in its entirety. The same monitoring program is applied across all drinking water schemes. The ADWG values for health and aesthetics are used as the compliance targets for the water quality monitoring program. The sampling locations and frequency recommended in the ADWG serve as the basis for the locations and sampling frequency applied for each water quality parameter in the monitoring program. Raw water sources are monitored in accordance with a Cyanobacteria Monitoring Protocol based on best industry practice recommendations.

Unless specified, samples are grab samples and are delivered to external laboratories where required. Water quality staff use standard methods for sampling and sample handling with specialised containers and instructions supplied by analytical service providers incorporated in the sampling program. Additional detail on the operational monitoring conducted at each WTP and the detailed program for microbiological sampling across the drinking water schemes is provided below.

Excursions detected during operational or verification monitoring are managed according to the information outlined in the Section 8.

## 10.1 Operational Monitoring Within Drinking Water Scheme

Operational monitoring is performed at different stages in each drinking water scheme from catchment through to the distribution system. In particular, monitoring of the performance of key treatment barriers is a key focus of the operational monitoring conducted at each WTP. Table 10.2 provides a breakdown of the operational monitoring that is conducted within each drinking water scheme including information on how the sampling is performed, its frequency and where defined, the operational targets or ranges (if applicable) for each parameter tested. Where stated in Table 10.2, ranges reflect the values between the high and low alarms around the SCADA setpoint for a given on-line operating parameter or water quality parameter. Values outside of this range therefore trigger an alarm which is responded to as described in Section 8.

Manual sampling listed as daily is also conducted more frequently on an event-related basis as required.

## 10.2 Verification Monitoring within Drinking Water Schemes

In addition to the verification monitoring program described in Table 10.1, drinking water is sampled weekly throughout each drinking water scheme for *E. coli,* free chlorine residual testing and other physico-chemical testing described below. Each week 12 drinking water samples are tested for *E. coli*. A sample is collected from each WTP (Glenmore, Mount Morgan) and 10 samples (Rockhampton 8, Mount Morgan 2) are collected from 61 possible sampling sites located throughout the two distribution systems. Table 10.3 provides a list of all the sampling sites that the weekly sampling schedule is rotated through. Appendix C shows a typical *E. coli* verification monitoring schedule. For example, each week a sample is collected from each of eight different supply zones within the Rockhampton Water Supply. The following week another seven supply zones, with some overlap with the preceding week, are sampled in order to rotate through all the different individual sampling sites over an extended period of time. A breakdown of the sampling locations based on supply zones and scheme is provided in Table 10.3 and Appendix D. These supply zones are also identified in the water supply scheme schematics shown in Figures 2.1 and 2.3. Selection of the number and location of sampling sites was done in accordance with recommendations in the ADWG.

**Table 10.1: Overview of Water Quality Monitoring Program for Each Drinking Water Scheme**

| Water Quality Parameter | ADWG Health Guideline | ADWG Aesthetic Guideline | Location Sampled[*] | Sampling Frequency[#] (ADWG Guide) |
|---|---|---|---|---|
| *E. coli* | 0 cfu | No value | P, T, R | W, E (W) |
| *Cryptosporidium* | <1 organism/L | No value | S, P | Y, E, (E) |
| *Giardia* | <1 organism/L | No value | S, P | Y, E (E) |
| Cyanobacteria | No value | No value | S, P | M[+], E (M) |
| Cyanobacteria Toxin | Varies** | No value | S, P | E |
| pH | No value | 6.5-8.5 | S, P | C, D, (D, W) |
| Chlorine | 5 mg/L | 0.6 mg/L | P, T, R | C, D, (D, W) |
| Electrical Conductivity | No value | No value | S, P, R | C, D, M, (W, M) |
| Total Dissolved Solids | No value | 600 mg/L | S, P | M |
| Colour | No value | 15 HU | S, P | D, M, (W, M) |
| Turbidity | <1 NTU[&] | 5 NTU | S, P, R | C, D, M, (D, W) |
| Total Hardness | No value | 200 mg/L | S, P | M, (M) |
| Total Alkalinity | No value | No value | S, P | M, (W, M) |
| Sulphate | 500 mg/L | 250 mg/L | S, P | M, (Q) |
| Chlorate[×] | No value | No value | P, R | M, (Q) |
| Chlorite[×] | 0.8 mg/L | No value | P, R | M, (Q) |
| Chloride | No value | 250 mg/L | S, P | M, (Q) |
| Calcium | No value | No value | S, P | M, (Q) |
| Magnesium | No value | No value | S, P | M, (Q) |
| Sodium | No value | 180 mg/L | S, P | M, (Q) |
| Potassium | No value | No value | S, P | M, (Q) |
| Aluminium (acid-soluble) | No value | 0.2 mg/L | S, P | M, (D, W) |
| Copper | 2 mg/L | 1 mg/L | S, P | M, (M) |
| Lead | 0.01 mg/L | No value | S, P | M, (M) |
| Manganese | 0.5 mg/L | 0.1 mg/L | S, P | M, (F) |
| Zinc | No value | 3 mg/L | S, P | M, (M) |
| Iron | No value | 0.3 mg/L | S, P | M, (M) |
| Fluoride | 1.5 mg/L | No value | S, P | M (C, W) |
| Nitrite | 3 mg/L | No value | S, P | M, (M) |
| Nitrate | 50 mg/L | No value | S, P | M, (M) |
| Total Organic Carbon | No value | No value | S, P | Q, (M, Q) |
| Trihalomethanes | 0.25 mg/L | No value | P, R | Q, (M) |
| Taste/odour compounds | No value | No value | S, P | E, (W, M) |
| Heavy Metals[>] | Various | No values | S, P | E, Y |
| Pesticides[>] | Various | No values | S | E, Y (M, E) |
| PFOS + PFHxS [~] | 0.07 µg/L | No value | S, P | E, Y |
| PFOA [~] | 0.56 µg/L | No value | S, P | E, Y |
| Radionuclides | Various | No values | S | E, (5 years) |

cfu = colony forming unit, HU = Hazen units, NTU = nephelometric turbidity units, PFOS = perfluorooctane sulphonate, PFHxS = perfluorohexane sulphonate, PFOA = perfluorooctanoic acid
S = raw water source, P = treatment plant, T = transmission, R = reticulation
[#] C = continuous (online), D = daily, W = weekly, F = fortnightly, M = monthly, Q = quarterly, Y = yearly, E = event related, ** Microcystins - <1.3 µg/L, no guideline value for other toxins, [>]See Appendix B for details of the heavy metals and pesticide testing, [&] <1 NTU target is for effective disinfection only with <0.2 NTU the target for filtration of protozoan pathogens, [~] Rockhampton WSS only, [×] When Glenmore WTP chlorine dioxide facility is in use, [+] Dependent on catchment flow and water quality and in accordance with the Cyanobacteria Monitoring Protocol

**Table 10.2: Operational Monitoring Conducted within Each Drinking Water Scheme**

| Parameter | Location[a] | Frequency[b] | Target Values or Range |
|---|---|---|---|
| **Rockhampton Water Supply Scheme** | | | |
| Turbidity | RW, PS, PF, DW | D, On-line | PS (<1.5 NTU), PF (<0.3 NTU) |
| pH | RW, PF, PC, DW | D, On-line | PC & DW (pH 7.6-8.2) |
| Colour (true) | RW, DW | W, As required | DW (<5 HU) |
| Dissolved Oxygen | RW, DW | D | Not defined |
| Electrical Conductivity | RW, PF, DW | D, On-line | <400 µS/cm |
| Alkalinity | RW, DW | As required | RW (>30 mg/L) |
| Total Dissolved Solids | RW, DW | D | Not defined |
| Temperature | RW, DW | D, On-line | Not defined |
| Taste and Odour | RW, DW | D | Not objectionable |
| Streaming Current | CD | On-line | Deviation monitoring |
| Free Chlorine | CW, DW, SR | D, On-line | DW (1.0mg/L), SR (0.5 -1.5mg/L) |
| Chlorine Dioxide* | PF | D, On-line | <0.3 mg/L |
| **Mount Morgan Water Supply Scheme** | | | |
| Turbidity | RW, PF, DW | D, On-line | DW (<1.0 NTU) |
| pH | RW, PF, DW | D, On-line | CD (6.5-7.0), DW (pH 7.8) |
| Colour (true) | RW, DW | D | DW (<5 HU) |
| Dissolved Oxygen | RW, DW | D | Not defined |
| Alkalinity | RW, DW | As required | DW (30 mg/L) |
| Electrical Conductivity | RW, DW | D, On-line | <400 µS/cm |
| Temperature | RW, DW | D | Not defined |
| Taste and Odour | RW, DW | D | Not objectionable |
| Free Chlorine | DW, SR | D, On-line | DW (1.0 mg/L), SR (0.5-1.5mg/L) |
| UV Transmissivity | PF, DW | D, On-line | >85% |

[a]RW = raw water, PS = post-sedimentation, PF = post-filtration, DW = final drinking water from outlet of clear water reservoir, CD = pre-filtration coagulant-dosed water, FD = fluoride dosed filtered water, CW = clear water inlet, SR = service reservoir, PC = post-pH correction
[b]D = daily manual sampling, W = Weekly, *when the chlorine dioxide facility is in use

Care has been taken to select a range of different sampling points so that there is good coverage of areas with different attributes. For example, points towards the extremity of reticulation supply zones have been chosen in some instances due to long water age or known areas of limited free chlorine residual penetration. Examples of these sites include site NS1 in Baree on the Mount Morgan Water Supply Scheme, site BS2 on River Street in Mount Morgan, site ND1 on Norman Road in Norman Gardens, site MH4 on Somerset Rd in Gracemere or site MA1 at Sleipner St on Mt Archer in North Rockhampton. One site in Mount Morgan was chosen as the area occasionally experiences low pressure as well as being at the extremity of the reticulation system. This BS3 site on Smalls Rd provides a good indication of the penetration of free chlorine residuals in the Mount Morgan Water Supply Scheme. In contrast, areas of known good free chlorine residual have also been selected so that the maximum levels of free chlorine reaching the customer's tap are able to be monitored in some instance.

Each week 12 samples are collected randomly from the designated reticulation sampling sites in each scheme for *E. coli* and free chlorine residual testing. Four (4) samples are also collected randomly from reticulation sampling sites located in North and South Rockhampton, Gracemere and Mount Morgan for pH, colour, turbidity and electrical conductivity measurements. This is to determine any gross changes in water quality at different locations in the distribution system. In this way, areas where water quality changes significantly due to events that occur in the distribution system will be identified and an investigation of possible causes commenced. Appendix D shows the sampling sites for weekly verification monitoring relative to the reservoir supply zones.

FRW spends a significant amount of time and effort responding to customer water quality complaints or comments about changes in water quality. This is done in order to provide the best means of addressing the root cause of the water quality issue rather than only addressing the nature of the complaint. FRW receives a relatively low number of drinking water quality complaints from customers but understands the importance of using this information to help understand events or changes that occur in water quality and within the water distribution infrastructure.

The verification monitoring program in place is commensurate with the level of risk that exists within each of the water supply schemes based on the recent records of drinking water quality incidents or the frequency of drinking water quality complaints. Despite this, FRW intend to keep reviewing this monitoring program following some revision of the sections in the ADWG 2011 relevant to monitoring and also to further maximise the quality of drinking water supplied to customers. As with operational monitoring, if non-compliances or exceedances are detected during the verification monitoring program action is taken as described in Section 8.

**Table 10.3: Drinking Water Distribution System Sampling Sites for Weekly Verification Monitoring (Supply Zone codes are labelled on reticulation areas in Figures 2.1 and 2.3, Appendix D)**

| Site Code | Reservoir Supply Zone | Address |
|---|---|---|
| **Rockhampton Water Supply Scheme** | | |
| **AL1** | **Agnes St Low Pressure System** | **O'Connell St** |
| **AL2** | | **Cambridge St** |
| **AL3** | | **Exhibition Rd** |
| **AL4** | | **Ann St** |
| **AL5** | | **Gladstone Rd** |
| **AL6** | | **Hunter St** |
| **AL7** | | **Wandal Rd** |
| **AL8** | | **Port Curtis Rd** |
| **AL9** | | **Derby St** |
| **AL10** | | **Denham St** |
| **AL11** | | **Old Capricorn Hwy** |
| **AH1** | **Agnes St High Pressure System** | **Nathan St** |
| **AH2** | | **North St** |
| **AH3** | | **Herbert St** |
| **AH4** | | **Jessie St** |
| **YR1** | **Yaamba Road Reservoir System** | **Bruigom St** |
| **YR2** | | **Main St** |
| **YR3** | | **Macallister St** |
| **YR4** | | **Beaney St** |
| **YR5** | | **Norman Rd** |
| **YR6** | | **Maloney St** |
| **YR7** | | **Rachel Drv** |
| **YR8** | | **Robison St** |
| **TR1** | **Thozet Road** | **Earl St** |
| **TR2** | | **Lucas St** |

| Site Code | Reservoir Supply Zone | Address |
|---|---|---|
| TR3 | Reservoir System | Joiner St |
| TR4 | | Berserker St |
| TR5 | | O'Shanesy St |
| TR6 | | Lakes Creek Rd |
| MH1 | Mawdesley Hill Reservoir System | O'Shanesy St |
| MH2 | | Ranger St |
| MH3 | | James St |
| MH4 | | Somerset Rd |
| LS1 | Lucas St Reservoir System | Cherryfield Rd |
| LS2 | | Lillypilly Ave |
| LS3 | | Johnson Rd |
| LS4 | | Donovan Crs |
| LS5 | | Huff St |
| RA1 | Rogar Ave Reservoir System | Eichelberger St |
| RA2 | | Frenchville Rd |
| FR1 | Forbes Ave Reservoir System | Aldridge Ave |
| ND1 | Nagle Drv Reservoir System | Norman Rd |
| ND2 | | Selwyn Crs |
| ND3 | | Alyssa Court |
| PH1 | Parkhurst Trunk Main System | McMillan Ave |
| PH2 | | Yaamba Rd |
| LC1 | Lakes Ck Main | Emu Park Rd |
| MA1 | Mount Archer | Sleipner St |
| SC1 | Samuel Cres Reservoir System | Samuel Crs |
| SC2 | | Gremalis Dr |
| BD1 | Birkbeck Dr Reservoir System | Bush Crs |
| BD2 | | Springbrook Cl |
| RC1 | Ramsay Creek Pumped Main | Yaamba Rd |
| BH1 | Boundary Hill Reservoir System | Yeppoon Rd |
| Mount Morgan Water Supply Scheme | | |
| BS1 | Black Street Reservoir System | Dee St |
| BS2 | | River St |
| BS3 | | Smalls Rd |
| BS4 | | Limerick Ln |
| NS1 | North Street Reservoir System | Creek St |
| NS2 | | Gordon Ln |
| NS3 | | East St Ext |

# 11 BEST PRACTICE INITIATIVES

FRW is actively engaged in a number of activities and initiatives which demonstrate an approach consistent with industry best practice for drinking water quality management. These activities include an ongoing commitment to drinking water quality management through stakeholder engagement towards improved catchment management, initiation and sponsoring of research and development projects and staff awareness and training activities. A commitment to the implementation of an approach that includes ongoing review and continual improvement is outlined in the RMIP detailed above.

## 11.1 Commitment to Drinking Water Quality Management

FRW is involved in a number of key stakeholder initiatives designed to provide guidance to the overall management and monitoring of water quality and environmental health in the Fitzroy Basin. This Fitzroy River Basin is a very important part of Central Queensland with the vast majority of residents within RRC now dependent on the provision of safe drinking water sourced from the Fitzroy River. Management of the health of the catchment and the minimisation of the impact of catchment land use activities is therefore a key priority. FRW's ongoing involvement in the Fitzroy Water Quality Advisory Group established following the Ensham Mine discharge event in 2008, and its active participation in the Strategic Working Group of the Fitzroy Partnership for River Health underpins this commitment.

## 11.2 Research and Development Activities

Over the last eight years FRW has strengthened its collaborative ties with researchers at Central Queensland University. FRW has been involved in the initiation and funding of two research projects. The first project focused on developing an understanding of the diversity and abundance of micro-fungi within parts of the Rockhampton Water Supply Scheme. This PhD project generated very useful data related to the prevalence of micro-fungi and the role of frogs and aerosols in the contamination of service reservoirs.

The second project focused on the optimisation of treatment chemicals and associated processes for the optimisation of the removal of toxic species of cyanobacteria from the Fitzroy River raw water. Through this project FRW gained an insight into the effectiveness of different treatment options for the removal of the known toxin producer *Cylindrospermopsis raciborskii* – one of the more abundant population members during cyanobacterial blooms in the Fitzroy River.

Recently, Fitzroy River Water commenced working with colleagues in the Water Quality and Health Network (Water Services Association of Australia) to review the options and impacts of the implementation of health-based targets for pathogens in the schemes operated by Fitzroy River Water. This involves participating in surveys and completing a review of existing treatment process performance.

More recently the Department of Environment and Science (DES) established a mutual collaboration with FRW to manually collect water quality samples at the

GWTP inlet structure which represents the Fitzroy River end-of-system site of the Great Barrier Reef loads monitoring program. Data collected from the sampling program continues to provide an insight on suspended solids, nutrients and pesticides concentrations during baseflow and high flow event conditions. FRW is also working closely with Commonwealth Scientific and Industrial Research Organisation (CSIRO) to provide real time water quality data of the lower Fitzroy River catchment. FRW is the custodian of a water quality station installed on the inlet of Glenmore WTP to provide data on this part of the catchment. The real time data is accessible to FRW and is also used in the operational monitoring of river water quality.

## 11.3 Staff Awareness and Training

The importance of drinking water quality and the role of team members at FRW in the delivery of safe and reliable drinking water to the community is a topic that is emphasised regularly at staff Toolbox Meetings and during day to day activities. As continual improvements are made to operating procedures or infrastructure upgrades are completed, the significance of these changes with respect to improvements in water quality and levels of service are discussed and relevant training is provided. Equally, the importance of delivering a high quality drinking water service is emphasised to promote a culture of proactive behaviour, innovation and ownership of service delivery.

# 12 RISK MANAGEMENT IMPROVEMENT PROGRAM

FRW and RRC are committed to delivering safe and reliable drinking water services to the community. To ensure that this is achieved, and to minimise the risks posed to the current drinking water services, a Risk Management Improvement Program has been prepared that comprises five elements. These are:

- Element 1 - Infrastructure Upgrades and Improved Infrastructure Performance
- Element 2 - Optimisation of Information Management and Reporting Capabilities
- Element 3 - Enhanced Engagement with Stakeholders Associated with Drinking Water Infrastructure Management
- Element 4 - Improved Service Through Staff Awareness and Training
- Element 5 - Enhanced Water Quality Performance

Table 12.1 provides an overview of the outputs, priority level, timeframe for completion and availability of funding for each of the five Elements identified in the Risk Improvement Management Program. Table 12.2 provides a specific detail for each action identified as being required to mitigate the unacceptable residual risk ratings listed in Table 6.1 and also other areas where further actions have been identified as being required. The current status and timeframes and person responsible for the completion of these actions are also listed.

**Table 12.1: Risk Management Improvement Program for Drinking Water Services**

| Element | Outputs | Priority Level | Timeframe for Completion | Funding Availability |
|---|---|---|---|---|
| Element1<br><br>Infrastructure Upgrades and Improved Infrastructure Performance | Complete all capital upgrades to water supply infrastructure to mitigate unacceptable risks identified in Table 6.1 | High | Ongoing | Yes |
| Element 2<br><br>Information Management and Reporting Capability Enhancement | Consolidated and streamlined information management and reporting processes | High | Ongoing | Yes |
| Element 3<br><br>Enhanced Stakeholder Engagement | Influence on stakeholders delivers improved management of catchments and other water infrastructure | High | Ongoing | Yes |
| Element 4<br><br>Improved Service through Staff Awareness and Training | Deliver the DWQMP to staff and develop culture of awareness of drinking water quality management. Deliver appropriate training | High | Ongoing | Yes |
| Element 5<br><br>Enhanced Water Quality Performance | Deliver ongoing improvements to drinking water quality, safety and reliability. | High | Ongoing | Yes |

**Table 12.2: Specific Actions Identified to Mitigate Unacceptable Risks to Drinking Water Quality and Information Describing these Actions.**

| Risk No. | Component-Event-Hazard | RRR | Proposed Action | Responsible Officer | Status | Completion Date |
|---|---|---|---|---|---|---|
| **Rockhampton Water Supply Scheme** | | | | | | |
| R08 | Source – Contamination of raw water<br>Excessive E.C. or TDS | **M9** | Continue to lobby regulator for tighter water quality limits on mine water discharges. | Manager FRW | Ongoing | N/A |
| R24 | Reservoir – Contamination due to animals accessing reservoirs<br>Bacterial Pathogen | **M5** | Repair and/or replace roof of identified high risk reservoirs; Roof replacement capital upgrade is underway on one of the identified reservoirs | Manager FRW | Ongoing | |
| R26 | Reservoir – Contamination due to animals accessing reservoirs<br>Viral Pathogen | **M5** | Repair and/or replace roof of identified high risk reservoirs; Roof replacement capital upgrade is underway on one of the identified reservoirs | Manager FRW | Ongoing | |
| R30 | Distribution – Sabotage or Terrorism<br>Toxic agent | **M5** | Identify high risk sites and install CCTV at these sites. | Process Systems Technician | In progress. A number of sites completed. | 31/12/2023 |
| **Mount Morgan Water Supply Scheme** | | | | | | |
| MM15 | Treatment – Lack of effective treatment<br>Viral Pathogen | **M8** | Perform testing for viruses for further confirmation of process effectiveness. | Senior Water Quality and Treatment Officer | Ongoing | 31/12/2023 |
| MM28 | Reservoir – Contamination due to animals accessing reservoirs<br>Bacterial Pathogen | **M5** | Repair and/or replace Black Street Reservoir roof | Manager FRW | Ongoing | |
| MM30 | Reservoir – Contamination due to animals accessing reservoirs<br>Viral Pathogen | **M5** | Repair and/or replace Black Street Reservoir roof | Manager FRW | Ongoing | |
| MM32 | Distribution – Sabotage or Terrorism<br>Toxic agent | **M5** | Identify high risk sites and install CCTV at these sites. | Process Systems Technician | Ongoing | |

N/A = Not applicable

# APPENDIX A

## Likelihood Rating Table

| Likelihood | Description |
|---|---|
| 5. Almost Certain | Occurs more often than once per week (52/yr) |
| 4. Likely | Occurs more often than once per month (12/yr) and up to once per week (52/yr) |
| 3. Possible | Occurs more often than once per year and up to once per month (12/yr) |
| 2. Unlikely | Occurs more often than once every five years and up to once per year |
| 1. Rare | Occurs less than or equal to once every five years |

## Consequence Rating Table

| Consequence | Description |
|---|---|
| 5. Catastrophic | Potential acute health impact, declared outbreak expected |
| 4. Major | Potential acute health impact, no declared outbreak expected |
| 3. Moderate | Potential widespread aesthetic impact or repeated breach of chronic health parameter |
| 2. Minor | Potential local aesthetic, isolated exceedance of chronic health parameter |
| 1. Insignificant | Isolated exceedance of aesthetic parameter with little or no disruption to normal operation |

## Risk Rating Matrix

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

## Uncertainty Ratings

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

# APPENDIX B

## Example Sample Testing Results

CERTIFICATE OF ANALYSIS

**Environmental**

Accredited for compliance with ISO/IEC 17025 - Testing

***Analytical Results***

| **Sub-Matrix: WATER (Matrix: WATER)** | | | *Sample ID* | **Glenmore Raw** | **Mt Morgan Potable** | **No. 7 Dam Raw** | **Glenmore Potabe** | **Creek Street** |
|---|---|---|---|---|---|---|---|---|
| | | | *Sampling date / time* | **18-Jan-2023 00:00** | **18-Jan-2023 00:00** | **18-Jan-2023 00:00** | **18-Jan-2023 00:00** | **18-Jan-2023 00:00** |
| *Compound* | *CAS Number* | *LOR* | *Unit* | **ET2300329-001** | **ET2300329-002** | **ET2300329-003** | **ET2300329-004** | **ET2300329-005** |
| | | | | Result | Result | Result | Result | |
| **EA005P: pH by PC Titrator** | | | | | | | | |
| **pH Value** | — | 0.01 | pH Unit | | 7.80 | 7.38 | 7.69 | --- |
| **EA010P: Conductivity by PC Titrator** | | | | | | | | |
| **Electrical Conductivity @ 25°C** | — | 1 | gS/cm | | 257 | 271 | 241 | --- |
| **EA015: Total Dissolved Solids dried at 180 ± 5 °C** | | | | | | | | |
| **Total Dissolved Solids @180°C** | — | 10 | mg/L | | 148 | 112 | 143 | --- |
| **EA041: Colour (True)** | | | | | | | | |
| **Colour (True)** | ---- | 1 | PCU | 140 | 3 | 45 | 10 | ---- |
| **pH Colour** | ---- | 0.01 | pH Unit | 7.31 | 7.59 | 7.43 | 7.56 | ---- |
| | | | | | | | | |
| **Turbidity** | — | 0.1 | NTU | | 0.2 | 5.7 | 0.2 | _-- |
| | | | | | | | | |
| **Total Hardness as CaCO3** | — | 1 | mg/L | | 69 | 95 | 70 | _-- |
| | | | | | | | | |
| **Hydroxide Alkalinity as CaCO3** | DMO-210-001 | 1 | mg/L | <1 | <1 | <1 | <1 | — |
| **Carbonate Alkalinity as CaCO3** | 3812-32-6 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| **Bicarbonate Alkalinity as CaCO3** | 71-52-3 | 1 | mg/L | 50 | 60 | 82 | 59 | ---- |
| **Total Alkalinity as CaCO3** | — | 1 | mg/L | 50 | 60 | 82 | 59 | --- |
| **ED041G: Sulfate (Turbidimetric) as SO4 2-** | by DA | | | | | | | |
| **Sulfate as SO4 - Turbidimetric** | 14808-79-8 | 1 | mg/L | | 7 | 4 | 5 | --- |
| | | | | | | | | |
| **Chloride** | 16887-00-6 | 1 | mg/L | | 31 | 31 | 28 | ---- |
| | | | | | | | | |
| **Calcium** | 7440-70-2 | 1 | mg/L | 10 | 17 | 16 | 20 | — |
| **Magnesium** | 7439-95-4 | 1 | mg/L | 11 | 7 | 8 | 10 | ---- |
| **Sodium** | 7440-23-5 | 1 | mg/L | 18 | 23 | 20 | 23 | ---- |
| **Potassium** | 7440-09-7 | 1 | mg/L | 4 | 6 | 5 | 3 | --- |
| **EG020-MF: Acid-Soluble Metals following Microfiltration** | | | | | | | | |
| **Acid Soluble Aluminium** | ACID_SOL_AL | 0.005 | mg/L | | 0.041 | 0.026 | 0.027 | --- |
| **EG020T: Total Metals by ICP-MS** | | | | | | | | |
| **Arsenic** | 7440-38-2 | 0.001 | mg/L | 0.002 | <0.001 | <0.001 | <0.001 | — |
| **Beryllium** | 7440-41-7 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| **Barium** | 7440-39-3 | 0.001 | mg/L | 0.065 | 0.038 | 0.035 | 0.008 | ---- |
| **Cadmium** | 7440-43-9 | 0.0001 | mg/L | <0.0001 | <0.0001 | <0.0001 | <0.0001 | ---- |
| **EG020T: Total Metals by ICP-MS - Continued** | | | | | | | | |
| **Copper** | 7440-50-8 | 0.001 | mg/L | 0.009 | 0.002 | 0.005 | 0.001 | — |
| **Lead** | 7439-92-1 | 0.001 | mg/L | 0.002 | <0.001 | <0.001 | <0.001 | ---- |
| **Manganese** | 7439-96-5 | 0.001 | mg/L | 0.124 | 0.001 | <0.001 | 0.292 | ---- |
| **Nickel** | 7440-02-0 | 0.001 | mg/L | 0.052 | 0.001 | 0.002 | 0.002 | ---- |
| **Selenium** | 7782-49-2 | 0.01 | mg/L | <0.01 | <0.01 | <0.01 | <0.01 | ---- |
| **Zinc** | 7440-66-6 | 0.005 | mg/L | 0.018 | 0.009 | <0.005 | <0.005 | ---- |
| **Iron** | 7439-89-6 | 0.05 | mg/L | 8.67 | <0.05 | <0.05 | 0.68 | ---- |
| **EK040P: Fluoride by PC Titrator** | | | | | | | | |
| **Fluoride** | 16984-48-8 | | | | | | 0.1 | — |
| **EK057G: Nitrite as N by Discrete Analyser** | | | | | | | | |
| **Nitrite as N** | 14797-65-0 | | | | | | <0.01 | — |
| **EK058G: Nitrate as N by Discrete Analyser** | | | | | | | | |
| **Nitrate as N** | 14797-55-8 | | | | | | 0.29 | — |
| | | | | | | | | |
| **Nitrite + Nitrate as N** | — | | | | | | 0.29 | --- |
| | | | | | | | | |
| **Total Organic Carbon** | — | | | | | | 3 | --- |
| | | | | | | | | |
| **Biochemical Oxygen Demand** | — | | | | | | --- | --- |
| **EP068A: Organochlorine Pesticides (OC)** | | | | | | | | |
| **alpha-Endosulfan** | 959-98-8 | 0.5 | Mg/L | <0.5 | ---- | <0.5 | ---- | ---- |
| **beta-Endosulfan** | 33213-65-9 | 0.5 | Mg/L | <0.5 | ---- | <0.5 | ---- | ---- |
| **Endosulfan sulfate** | 1031-07-8 | 0.5 | MQ/L | <0.5 | --- | <0.5 | --- | --- |
| **EP074G: Trihalomethanes** | | | | | | | | |
| **Chloroform** | 67-66-3 | 5 | Mg/L | — | 117 | — | 34 | 157 |
| **Bromodichloromethane** | 75-27-4 | 5 | Mg/L | — | 33 | ---- | 16 | 30 |
| **Dibromochloromethane** | 124-48-1 | 5 | Mg/L | — | 8 | ---- | <5 | 6 |
| **Bromoform** | 75-25-2 | 5 | Mg/L | — | <5 | ---- | <5 | <5 |
| **[A] Total Trihalomethanes** | — | 5 | MQ/L | --- | 158 | --- | 50 | 193 |
| | | | | | | | | |
| **Azinphos-ethyl** | 2642-71-9 | 0.02 | Mg/L | <0.02 | — | <0.02 | — | — |
| **Azinphos-methyl** | 86-50-0 | 0.02 | Mg/L | <0.02 | ---- | <0.02 | ---- | ---- |
| **Bromophos-ethyl** | 4824-78-6 | 0.10 | Mg/L | <0.10 | ---- | <0.10 | ---- | ---- |
| **Carbofenothion** | 786-19-6 | 0.02 | Mg/L | <0.02 | ---- | <0.02 | ---- | ---- |

| Sub-Matrix: WATER (Matrix: WATER) | | | *Sample ID* | Glenmore Raw | Mt Morgan Potable | No. 7 Dam Raw | Glenmore Potabe | Creek Street |
|---|---|---|---|---|---|---|---|---|
| | | | *Sampling date / time* | 18-Jan-2023 00:00 | 18-Jan-2023 00:00 | 18-Jan-2023 00:00 | 18-Jan-2023 00:00 | 18-Jan-2023 00:00 |
| *Compound* | *CAS Number* | *LOR* | *Unit* | ET2300329-001 | ET2300329-002 | ET2300329-003 | ET2300329-004 | ET2300329-005 |
| **EP234A: OP Pesticides - Continued** | | | | | | | | |
| Chlorfenvinphos | 470-90-6 | 0.02 | ^g/L | <0.02 | ---- | <0.02 | ---- | ---- |
| Chlorpyrifos | 2921-88-2 | 0.02 | ^g/L | <0.02 | ---- | <0.02 | ---- | ---- |
| Chlorpyrifos-methyl | 5598-13-0 | 0.2 | ^g/L | <0.2 | ---- | <0.2 | ---- | ---- |
| Coumaphos | 56-72-4 | 0.01 | ^g/L | <0.01 | ---- | <0.01 | ---- | ---- |
| Demeton-O & Demeton-S | 298-03-3/126-75-( | 0.02 | ^g/L | <0.02 | ---- | <0.02 | ---- | ---- |
| Demeton-S-methyl | 919-86-8 | 0.02 | ^g/L | <0.02 | ---- | <0.02 | ---- | ---- |
| Diazinon | 333-41-5 | 0.01 | ^g/L | <0.01 | ---- | <0.01 | ---- | ---- |
| Dichlorvos | 62-73-7 | 0.20 | ^g/L | <0.20 | ---- | <0.20 | ---- | ---- |
| Dimethoate | 60-51-5 | 0.02 | ^g/L | <0.02 | ---- | <0.02 | ---- | ---- |
| Disulfoton | 298-04-4 | 0.05 | ^g/L | 0.10 | ---- | <0.05 | ---- | ---- |
| Ethion | 563-12-2 | 0.02 | ^g/L | <0.02 | ---- | <0.02 | ---- | ---- |
| EPN | 2104-64-5 | 0.05 | ^g/L | <0.05 | ---- | <0.05 | ---- | ---- |
| Ethoprophos | 13194-48-4 | 0.01 | ^g/L | <0.01 | ---- | <0.01 | ---- | ---- |
| Fenamiphos | 22224-92-6 | 0.01 | ^g/L | <0.01 | ---- | <0.01 | ---- | ---- |
| Fenchlorphos (Ronnel) | 299-84-3 | 10 | ^g/L | <10 | --- | <10 | | |
| Fenitrothion | 122-14-5 | 2 | ^g/L | <2 | ---- | <2 | ---- | ---- |
| Fensulfothion | 115-90-2 | 0.01 | ^g/L | <0.01 | ---- | <0.01 | ---- | ---- |
| Fenthion | 55-38-9 | 0.05 | ^g/L | <0.05 | ---- | <0.05 | ---- | ---- |
| Malathion | 121-75-5 | 0.02 | ^g/L | <0.02 | ---- | <0.02 | ---- | ---- |
| Mevinphos | 7786-34-7 | 0.02 | ^g/L | <0.02 | ---- | <0.02 | ---- | ---- |
| Monocrotophos | 6923-22-4 | 0.02 | ^g/L | <0.02 | ---- | <0.02 | ---- | ---- |
| Omethoate | 1113-02-6 | 0.01 | ^g/L | <0.01 | ---- | <0.01 | ---- | ---- |
| Parathion | 56-38-2 | 0.2 | ^g/L | <0.2 | ---- | <0.2 | ---- | ---- |
| Parathion-methyl | 298-00-0 | 2.0 | ^g/L | <2.0 | ---- | <2.0 | ---- | ---- |
| Phorate | 298-02-2 | 0.1 | ^g/L | <0.1 | ---- | <0.1 | ---- | ---- |
| Pirimiphos-ethyl | 23505-41-1 | 0.01 | ^g/L | <0.01 | ---- | <0.01 | ---- | ---- |
| Pirimiphos-methyl | 29232-93-7 | 0.01 | ^g/L | <0.01 | ---- | <0.01 | ---- | ---- |
| Profenofos | 41198-08-7 | 0.01 | ^g/L | <0.01 | ---- | <0.01 | ---- | ---- |
| Prothiofos | 34643-46-4 | 0.1 | ^g/L | <0.1 | ---- | <0.1 | ---- | ---- |
| Sulfotep | 3689-24-5 | 0.005 | ^g/L | <0.005 | ---- | <0.005 | ---- | ---- |
| Sulprofos | 35400-43-2 | 0.05 | ^g/L | <0.05 | ---- | <0.05 | ---- | ---- |
| Terbufos | 13071-79-9 | 0.01 | ^g/L | <0.01 | ---- | <0.01 | ---- | ---- |
| Temephos | 3383-96-8 | 0.02 | ^g/L | <0.02 | ---- | <0.02 | ---- | ---- |
| Tetrachlorvinphos | 22248-79-9 | 0.01 | ^g/L | <0.01 | ---- | <0.01 | ---- | ---- |
| Triazophos | 24017-47-8 | 0.005 | ^g/L | <0.005 | ---- | <0.005 | ---- | ---- |
| **EP234A: OP Pesticides - Continued** | | | | | | | | |
| Trichlorfon | 52-68-6 | 0.02 | ^g/L | <0.02 | ---- | <0.02 | ---- | ---- |
| Trichloronate | 327-98-0 | 0.5 | ^g/L | <0.5 | ---- | <0.5 | ---- | ---- |
| **EP234B: Thiocarbamates and Carbamates** | | | | | | | | |
| Aldicarb | 116-06-3 | 0.05 | ^g/L | <0.05 | ---- | <0.05 | ---- | ---- |
| Bendiocarb | 22781-23-3 | 0.10 | ^g/L | <0.10 | ---- | <0.10 | ---- | ---- |
| Benomyl | 17804-35-2 | 0.01 | ^g/L | <0.01 | ---- | <0.01 | ---- | ---- |
| Carbaryl | 63-25-2 | 0.01 | ^g/L | <0.01 | ---- | <0.01 | ---- | ---- |
| Carbofuran | 1563-66-2 | 0.01 | ^g/L | <0.01 | ---- | <0.01 | ---- | ---- |
| 3-Hydroxy Carbofuran | 16655-82-6 | 0.02 | ^g/L | <0.02 | ---- | <0.02 | ---- | ---- |
| Methiocarb | 2032-65-7 | 0.01 | ^g/L | <0.01 | ---- | <0.01 | ---- | ---- |
| Methomyl | 16752-77-5 | 0.01 | ^g/L | <0.01 | ---- | <0.01 | ---- | ---- |
| Molinate | 2212-67-1 | 0.1 | ^g/L | <0.1 | ---- | <0.1 | ---- | ---- |
| Oxamyl | 23135-22-0 | 0.01 | ^g/L | <0.01 | ---- | <0.01 | ---- | ---- |
| Thiobencarb | 28249-77-6 | 0.01 | ^g/L | <0.01 | ---- | <0.01 | ---- | ---- |
| Thiodicarb | 59669-26-0 | 0.01 | ^g/L | <0.01 | | <0.01 | | |
| **EP234C: Dinitroanilines** | | | | | | | | |
| Pendimethalin | 40487-42-1 | 0.05 | ^g/L | <0.05 | ---- | <0.05 | ---- | ---- |
| Trifluralin | 1582-09-8 | 10.0 | ^g/L | <10.0 | ---- | <10.0 | ---- | ---- |
| **EP234D: Triazinone Herbicides** | | | | | | | | |
| Hexazinone | 51235-04-2 | 0.02 | ^g/L | <0.02 | — | <0.02 | — | — |
| Metribuzin | 21087-64-9 | 0.02 | ^g/L | <0.02 | ---- | <0.02 | ---- | ---- |
| **EP234E: Conazole and Aminopyrimidine Fungicides** | | | | | | | | |
| Cyproconazole | 94361-06-5 | 0.02 | ^g/L | <0.02 | — | <0.02 | — | — |
| Difenoconazole | 119446-68-3 | 0.02 | ^g/L | <0.02 | ---- | <0.02 | ---- | ---- |
| Flusilazole | 85509-19-9 | 0.02 | ^g/L | <0.02 | ---- | <0.02 | ---- | ---- |
| Hexaconazole | 79983-71-4 | 0.02 | ^g/L | <0.02 | ---- | <0.02 | ---- | ---- |
| Paclobutrazole | 76738-62-0 | 0.05 | ^g/L | <0.05 | ---- | <0.05 | ---- | ---- |
| Penconazole | 66246-88-6 | 0.01 | ^g/L | <0.01 | ---- | <0.01 | ---- | ---- |
| Propiconazole | 60207-90-1 | 0.05 | ^g/L | <0.05 | ---- | <0.05 | ---- | ---- |
| Tebuconazole | 107534-96-3 | 0.01 | ^g/L | <0.01 | ---- | <0.01 | ---- | ---- |
| Cyprodinil | 121552-61-2 | 0.01 | ^g/L | <0.01 | ---- | <0.01 | ---- | ---- |
| Pyrimethanil | 53112-28-0 | 0.02 | ^g/L | <0.02 | ---- | <0.02 | ---- | ---- |
| **EP234F: Phenylurea, Thizdiazolurea, Uracil and Sulfonylurea Herbicides** | | | | | | | | |
| Diuron | 330-54-1 | 0.02 | ^g/L | 0.03 | | <0.02 | | |
| Fluometuron | 2164-17-2 | 0.01 | mq/l | <0.01 | — | <0.01 | — | — |
| Tebuthiuron | 34014-18-1 | 0.02 | mq/l | 3.01 | ---- | 0.02 | ---- | ---- |
| Bromacil | 314-40-9 | 0.02 | mq/l | <0.02 | ---- | <0.02 | ---- | ---- |
| Chlorsulfuron | 64902-72-3 | 0.2 | fjg/L | <0.2 | --- | <0.2 | --- | --- |
| | | | | | | | | |
| Metolachlor | 51218-45-2 | 0.01 | mq/l | 0.16 | --- | <0.01 | --- | --- |
| | | | | | | | | |
| Ametryn | 834-12-8 | 0.01 | mq/l | <0.01 | — | <0.01 | — | — |
| Atrazine | 1912-24-9 | 0.01 | mq/l | 0.05 | ---- | <0.01 | ---- | ---- |
| Cyanazine | 21725-46-2 | 0.02 | mq/l | <0.02 | ---- | <0.02 | ---- | ---- |
| Cyromazine | 66215-27-8 | 0.05 | mq/l | <0.05 | ---- | <0.05 | ---- | ---- |
| Prometryn | 7287-19-6 | 0.01 | mq/l | <0.01 | ---- | <0.01 | ---- | ---- |
| Propazine | 139-40-2 | 0.01 | mq/l | <0.01 | --- | <0.01 | --- | --- |
| Simazine | 122-34-9 | 0.02 | mq/l | <0.02 | ---- | <0.02 | ---- | ---- |
| Terbuthylazine | 5915-41-3 | 0.01 | mq/l | 0.08 | ---- | <0.01 | ---- | ---- |
| Terbutryn | 886-50-0 | 0.01 | mq/l | <0.01 | --- | <0.01 | --- | --- |
| | | | | | | | | |
| Diclofop-methyl | 51338-27-3 | 0.05 | mq/l | <0.05 | — | <0.05 | — | — |
| Fenarimol | 60168-88-9 | 0.02 | mq/l | <0.02 | ---- | <0.02 | ---- | ---- |
| Irgarol | 28159-98-0 | 0.002 | mq/l | <0.002 | ---- | <0.002 | ---- | ---- |
| Oxyfluorfen | 42874-03-3 | 1.0 | mq/l | <1.0 | ---- | <1.0 | ---- | ---- |
| Thiamethoxam | 153719-23-4 | 0.02 | mq/l | <0.02 | ---- | <0.02 | ---- | ---- |
| Imidacloprid | ---- | 0.01 | mq/l | <0.01 | ---- | <0.01 | ---- | ---- |
| | | | | | | | | |
| Dibromo-DDE | 21655-73-2 | 0.5 | % | 68.9 | | 78.5 | --- | --- |
| **EP068T: Organophosphorus Pesticide Surrogate** | | | | | | | | |
| DEF | 78-48-8 | 0.5 | % | 72.7 | | 82.9 | --- | --- |
| **EP074S: VOC Surrogates** | | | | | | | | |
| 1.2-Dichloroethane-D4 | 17060-07-0 | 5 | % | | 106 | — | 109 | 108 |
| Toluene-D8 | 2037-26-5 | 5 | % | | 97.1 | ---- | 98.6 | 95.4 |
| 4-Bromofluorobenzene | 460-00-4 | 5 | % | | 105 | ---- | 105 | 102 |
| **EP074G: Trihalomethanes** | | | | | | | | |
| Chloroform | 67-66-3 | 5 | mq/l | 159 | ---- | ---- | — | — |
| Bromodichloromethane | 75-27-4 | 5 | mq/l | 43 | _-- | -_- | — | — |
| Dibromochloromethane | 124-48-1 | 5 | mq/l | 10 | ---- | ---- | — | — |
| Bromoform | 75-25-2 | 5 | mq/l | <5 | ---- | ---- | — | — |
| [A] Total Trihalomethanes | ---- | 5 | mq/l | 212 | ---- | ---- | — | — |
| **EP074S: VOC Surrogates** | | | | | | | | |
| 1.2-Dichloroethane-D4 | 17060-07-0 | 5 | % | 107 | — | — | — | — |
| Toluene-D8 | 2037-26-5 | 5 | % | 96.3 | ---- | ---- | — | — |
| 4-Bromofluorobenzene | 460-00-4 | 5 | % | 101 | ---- | ---- | — | — |

# APPENDIX C

## Example of *E. coli* verification monitoring program schedule

| Week No. | Week Start | Glenmore WTP | Agnes Street Low Pressure System | | | | | | | | | | | Agnes Street High Pressure System | | | | Yaamba Road Reservoir System | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | AL1 | AL2 | AL3 | AL4 | AL5 | AL6 | AL7 | AL8 | AL9 | AL10 | AL11 | AH1 | AH2 | AH3 | AH4 | YR1 | YR2 | YR3 | YR4 | YR5 | YR6 | YR7 | YR8 |
| | | | O'Connell St | Cambridge St | Exhibition Rd | Ann St | Gladstone Rd | Hunter St | Wandal Rd | Port Curtis Rd | Derby St | Denham St | Old Capricorn Hwy | Nathan St | North St | Herbert St | Jessie St | Bruigom St | Main St | Macallister St | Beaney St | Norman Rd | Maloney St | Rachel Drv | Robison St |
| 1 | 02-Jan-17 | x | | | | | | | | x | | | | | | x | | | | | | x | | | |
| 2 | 09-Jan-17 | x | | | | | | | | | x | | | | | | x | | | | | | x | | |
| 3 | 16-Jan-17 | x | | | | | | | | | | x | | x | | | | | | | | | | x | |
| 4 | 23-Jan-17 | x | | | | | | | | | | | x | | x | | | | | | | | | | x |
| 5 | 30-Jan-17 | x | x | | | | | | | | | | | | | x | | x | | | | | | | |
| 6 | 06-Feb-17 | x | | x | | | | | | | | | | | | | x | | x | | | | | | |
| 7 | 13-Feb-17 | x | | | x | | | | | | | | | x | | | | | | x | | | | | |
| 8 | 20-Feb-17 | x | | | | x | | | | | | | | | x | | | | | | x | | | | |
| 9 | 27-Feb-17 | x | | | | | x | | | | | | | | | x | | | | | | x | | | |
| 10 | 06-Mar-17 | x | | | | | | x | | | | | | | | | x | | | | | | x | | |
| 11 | 13-Mar-17 | x | | | | | | | x | | | | | x | | | | | | | | | | x | |
| 12 | 20-Mar-17 | x | | | | | | | | x | | | | | x | | | | | | | | | | x |
| 13 | 27-Mar-17 | x | | | | | | | | | x | | | | | x | | x | | | | | | | |
| 14 | 03-Apr-17 | x | | | | | | | | | | x | | | | | x | | x | | | | | | |
| 15 | 10-Apr-17 | x | | | | | | | | | | | x | x | | | | | | x | | | | | |
| 16 | 17-Apr-17 | x | x | | | | | | | | | | | | x | | | | | | x | | | | |
| 17 | 24-Apr-17 | x | | x | | | | | | | | | | | | x | | | | | | x | | | |
| 18 | 01-May-17 | x | | | x | | | | | | | | | | | | x | | | | | | x | | |
| 19 | 08-May-17 | x | | | | x | | | | | | | | | | x | | | | | | | | x | |
| 20 | 15-May-17 | x | | | | | x | | | | | | | | | | x | | | | | | | | x |
| 21 | 22-May-17 | x | | | | | | x | | | | | | x | | | | x | | | | | | | |
| 22 | 29-May-17 | x | | | | | | | x | | | | | | x | | | | x | | | | | | |
| 23 | 05-Jun-17 | x | | | | | | | | x | | | | | | x | | | | x | | | | | |
| 24 | 12-Jun-17 | x | | | | | | | | | x | | | | | | x | | | | x | | | | |
| 25 | 19-Jun-17 | x | | | | | | | | | | x | | x | | | | | | | | x | | | |
| 26 | 26-Jun-17 | x | | | | | | | | | | | x | | x | | | | | | | | x | | |
| 27 | 03-Jul-17 | x | x | | | | | | | | | | | | | x | | | | | | | | x | |
| 28 | 10-Jul-17 | x | | x | | | | | | | | | | | | | x | | | | | | | | x |
| 29 | 17-Jul-17 | x | | | x | | | | | | | | | x | | | | x | | | | | | | |
| 30 | 24-Jul-17 | x | | | | x | | | | | | | | | x | | | | x | | | | | | |
| 31 | 31-Jul-17 | x | | | | | x | | | | | | | | | x | | | | x | | | | | |
| 32 | 07-Aug-17 | x | | | | | | x | | | | | | | | | x | | | | x | | | | |
| 33 | 14-Aug-17 | x | | | | | | | x | | | | | x | | | | | | | | x | | | |
| 34 | 21-Aug-17 | x | | | | | | | | x | | | | | x | | | | | | | | x | | |
| 35 | 28-Aug-17 | x | | | | | | | | | x | | | | | x | | | | | | | | x | |
| 36 | 04-Sep-17 | x | | | | | | | | | | x | | | | | x | | | | | | | | x |
| 37 | 11-Sep-17 | x | | | | | | | | | | | x | x | | | | x | | | | | | | |
| 38 | 18-Sep-17 | x | x | | | | | | | | | | | | x | | | | x | | | | | | |
| 39 | 25-Sep-17 | x | | x | | | | | | | | | | | | x | | | | x | | | | | |
| 40 | 02-Oct-17 | x | | | x | | | | | | | | | | | | x | | | | x | | | | |
| 41 | 09-Oct-17 | x | | | | x | | | | | | | | x | | | | | | | | x | | | |
| 42 | 16-Oct-17 | x | | | | | x | | | | | | | | x | | | | | | | | x | | |
| 43 | 23-Oct-17 | x | | | | | | x | | | | | | | | x | | | | | | | | x | |
| 44 | 30-Oct-17 | x | | | | | | | x | | | | | | | | x | | | | | | | | x |
| 45 | 06-Nov-17 | x | | | | | | | | x | | | | x | | | | x | | | | | | | |
| 46 | 13-Nov-17 | x | | | | | | | | | x | | | | x | | | | x | | | | | | |
| 47 | 20-Nov-17 | x | | | | | | | | | | x | | | | x | | | | x | | | | | |
| 48 | 27-Nov-17 | x | | | | | | | | | | | x | | | | x | | | | x | | | | |
| 49 | 04-Dec-17 | x | x | | | | | | | | | | | x | | | | | | | | x | | | |
| 50 | 11-Dec-17 | x | | x | | | | | | | | | | | x | | | | | | | | x | | |
| 51 | 18-Dec-17 | x | | | x | | | | | | | | | | | x | | | | | | | | x | |
| 52 | 25-Dec-17 | x | | | | x | | | | | | | | | | | x | | | | | | | | x |

Example of *E. coli* verification monitoring program schedule (continued)

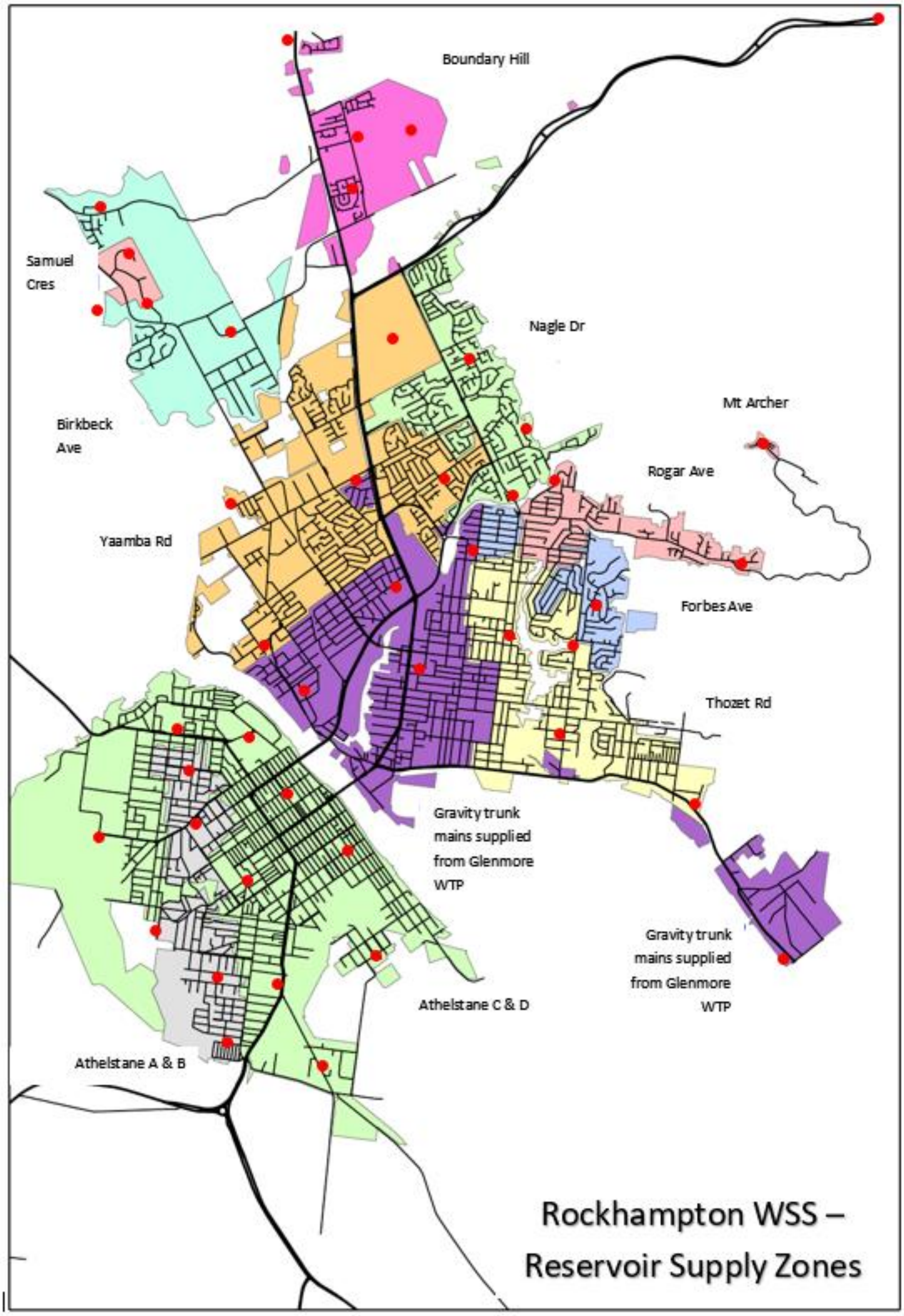
| Thozets Road Reservoir System | | | | | | Forbes Ave Reservoir System | Rogar Avenue Reservoir System | | Nagle Drive Reservoir System | | | Parkhurst Trunk Main System | | Lakes Creek Main | Mount Archer | Samuel Cres | | Birkbeck Reservoir System |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TR1 | TR2 | TR3 | TR4 | TR5 | TR6 | FR1 | RA1 | RA2 | ND1 | ND2 | ND3 | PH1 | PH2 | LC1 | MA1 | SC1 | SC2 | BD1 |
| Earl St | Lucas St | Joiner St | Berserker St | O'Shanesy St | Lakes Creek Rd | Aldridge Ave | Eichelberger St | Frenchville Rd | Norman Rd | Selwyn Crs | Alyssa Court | McMillan Ave | Yaamba Rd | Emu Park Rd | Sleipner St | Samuel Crs | Gremalis Dr | Bush Crs |
| | x | | | | | | x | | | x | | | | | | | | |
| | | x | | | | | | | | | | | x | x | | | | |
| | | | x | | | | | | | | | | | | x | | x | |
| | | | | x | | | | | | | | | | | | | | x |
| | | | | | x | | | x | | | x | | | | | | | |
| x | | | | | | | | | | | | x | | x | | | | |
| | x | | | | | | | | | | | | | | x | x | | |
| | | x | | | | | | | | | | | | | | | | x |
| | | | x | | | x | | | x | | | | | | | | | |
| | | | | x | | | | | | | | | x | x | | | | |
| | | | | | x | | | | | | | | | | x | | x | |
| x | | | | | | | | | | | | | | | | | | x |
| | x | | | | | | x | | | x | | | | | | | | |
| | | x | | | | | | | | | | x | | x | | | | |
| | | | x | | | | | | | | | | | | x | x | | |
| | | | | x | | | | | | | | | | | | | | x |
| | | | | | x | | | x | | | x | | | | | | | |
| x | | | | | | | | | | | | | x | x | | | | |
| | x | | | | | | | | | | | | | | x | | x | |
| | | x | | | | | | | | | | | | | | | | x |
| | | | x | | | x | | | x | | | | | | | | | |
| | | | | x | | | | | | | | x | | x | | | | |
| | | | | | x | | | | | | | | | | x | x | | |
| x | | | | | | | | | | | | | | | | | | x |
| | x | | | | | | x | | | x | | | | | | | | |
| | | x | | | | | | | | | | | x | x | | | | |
| | | | x | | | | | | | | | | | | x | | x | |
| | | | | x | | | | | | | | | | | | | | x |
| | | | | | x | | | x | | | x | | | | | | | |
| x | | | | | | | | | | | | x | | x | | | | |
| | x | | | | | | | | | | | | | | x | x | | |
| | | x | | | | | | | | | | | | | | | | x |
| | | | x | | | x | | | x | | | | | | | | | |
| | | | | x | | | | | | | | | x | x | | | | |
| | | | | | x | | | | | | | | | | x | | x | |
| x | | | | | | | | | | | | | | | | | | x |
| | x | | | | | | x | | | x | | | | | | | | |
| | | x | | | | | | | | | | x | | x | | | | |
| | | | x | | | | | | | | | | | | x | x | | |
| | | | | x | | | | | | | | | | | | | | x |
| | | | | | x | | | x | | | x | | | | | | | |
| x | | | | | | | | | | | | | x | x | | | | |
| | x | | | | | | | | | | | | | | x | | x | |
| | | x | | | | | | | | | | | | | | | | x |
| | | | x | | | x | | | x | | | | | | | | | |
| | | | | x | | | | | | | | x | | x | | | | |
| | | | | | x | | | | | | | | | | x | | x | |
| x | | | | | | | | | | | | | | | | | | x |
| | x | | | | | | x | | | x | | | | | | | | |
| | | x | | | | | | | | | | | x | x | | | | |
| | | | x | | | | | | | | | | | | x | x | | |
| | | | | x | | | | | | | | | | | | | | x |

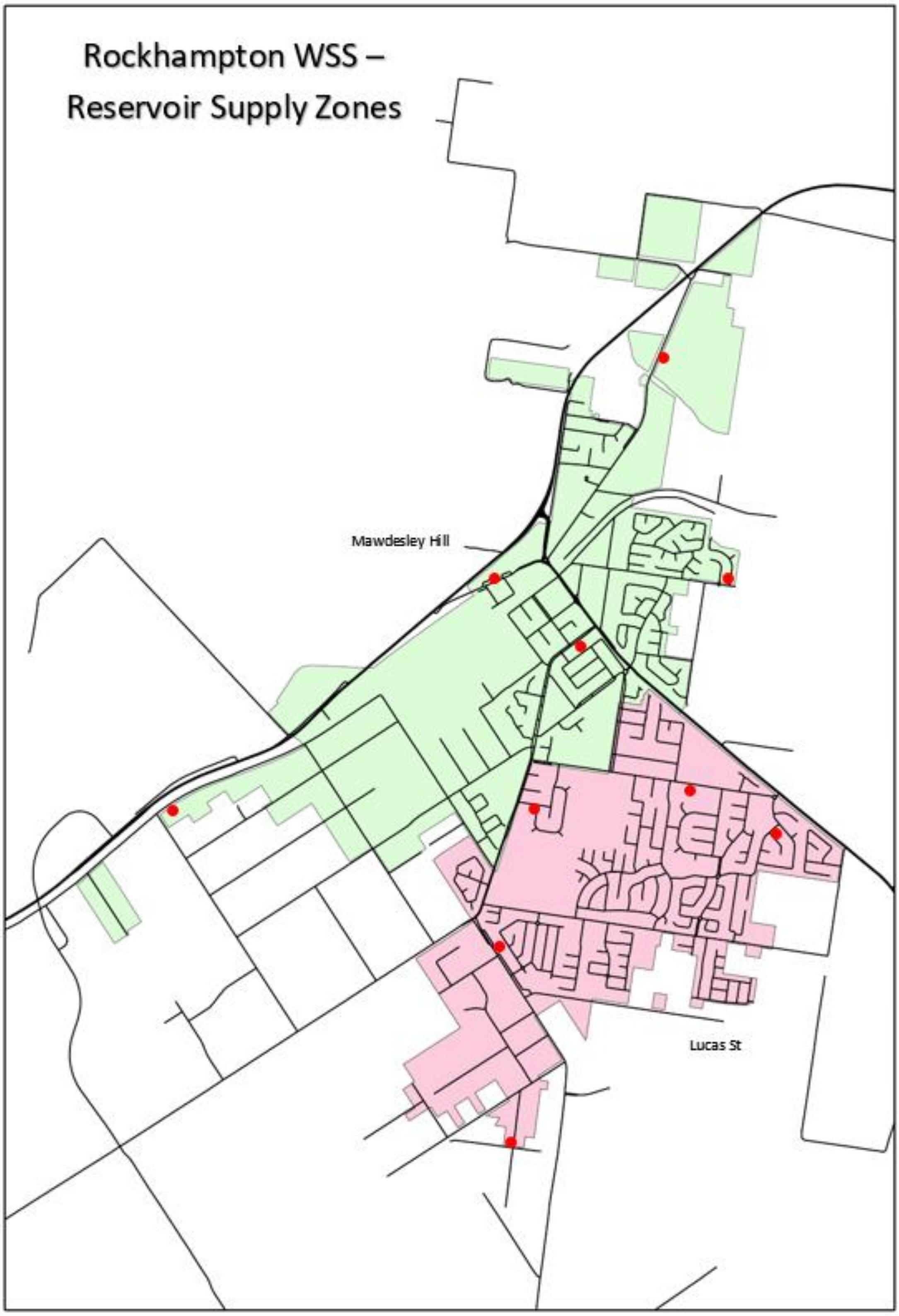
Example of *E. coli* verification monitoring program schedule (continued)

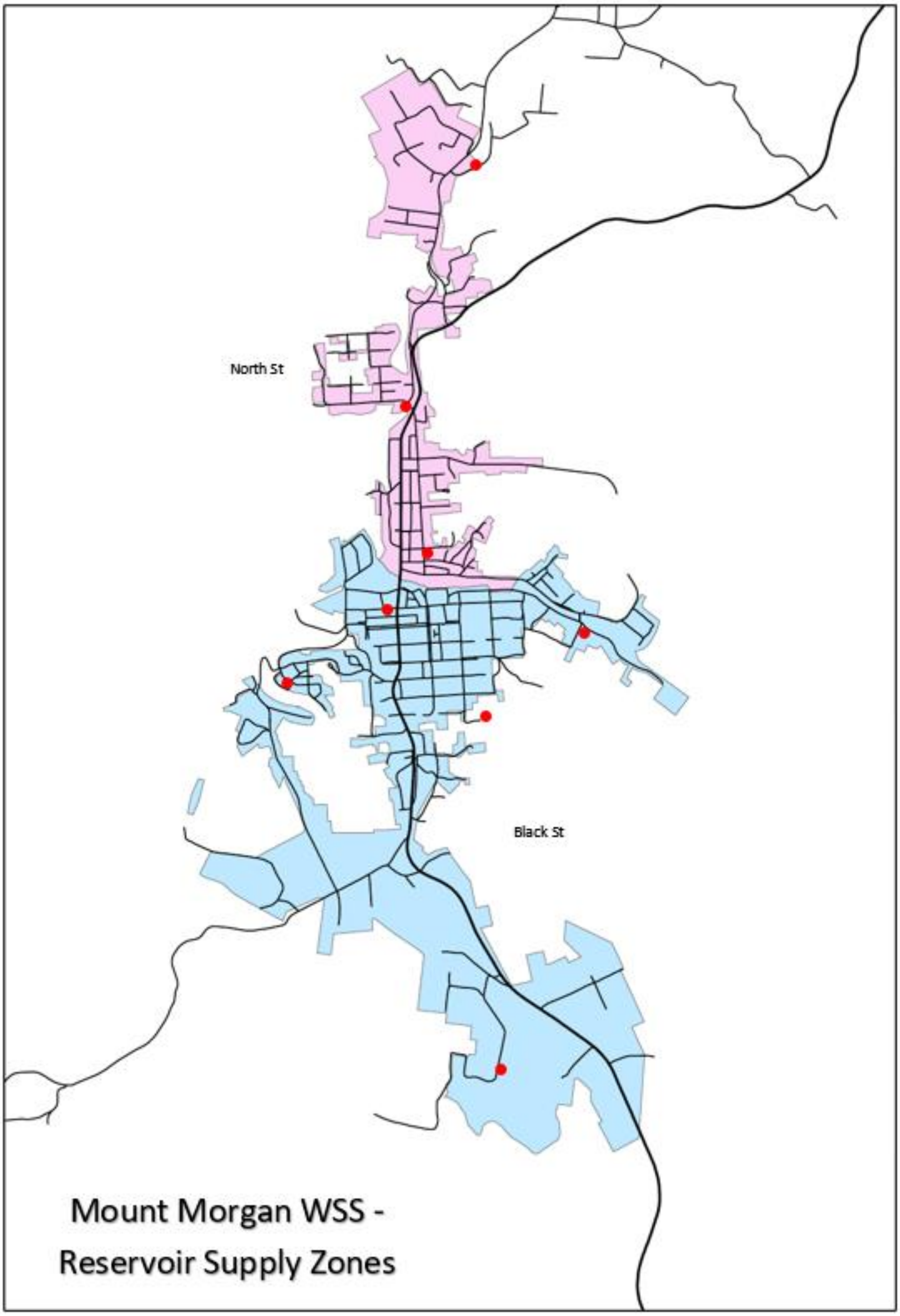
| Ramsay Creek Pumped | Mawdesley Hill Reservoir System | | | | Lucas Street Reservoir System | | | | Mt Morgan WTP | Black Street Reservoir System | | | | North Street Reservoir System | | | Total Number of Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RC1 | MH1 | MH2 | MH3 | MH4 | LS1 | LS2 | LS3 | LS4 | | BS1 | BS2 | BS3 | BS4 | NS1 | NS2 | NS3 | |
| Yaamba Rd | O'Shanesy St | Range St | James St | Somerset Rd | Cherryfiled Road | Lillypilly Ave | Johnson Rd | Donovan Crs | | Dee St | River St | Smalls Rd | Limerick Ln | Creek St | Gordon Lane | Byrnes Pde | |
| | | | | x | | x | | | x | x | | | | | x | | 12 |
| | x | | | | | | x | | x | | x | | | | | x | 12 |
| | | x | | | | | | x | x | | | x | | x | | | 12 |
| x | | | x | | x | | | | x | | | | x | | x | | 12 |
| | | | | x | | x | | | x | x | | | | | | x | 12 |
| | x | | | | | | x | | x | | x | | | x | | | 12 |
| | | x | | | | | | x | x | | | x | | | x | | 12 |
| x | | | x | | x | | | | x | | | | x | | | x | 12 |
| | | | | x | | x | | | x | x | | | | x | | | 12 |
| | x | | | | | | x | | x | | x | | | | x | | 12 |
| | | x | | | | | | x | x | | | x | | | | x | 12 |
| x | | | x | | x | | | | x | | | | x | x | | | 12 |
| | | | | x | | x | | | x | x | | | | | x | | 12 |
| | x | | | | | | x | | x | | x | | | | | x | 12 |
| | | x | | | | | | x | x | | | x | | x | | | 12 |
| x | | | x | | x | | | | x | | | | x | | x | | 12 |
| | | | | x | | x | | | x | x | | | | | | x | 12 |
| | x | | | | | | x | | x | | x | | | x | | | 12 |
| | | x | | | | | | x | x | | | x | | | x | | 12 |
| x | | | x | | x | | | | x | | | | x | | | x | 12 |
| | | | | x | | x | | | x | x | | | | x | | | 12 |
| | x | | | | | | x | | x | | x | | | | x | | 12 |
| | | x | | | | | | x | x | | | x | | | | x | 12 |
| x | | | x | | x | | | | x | | | | x | x | | | 12 |
| | | | | x | | x | | | x | x | | | | | x | | 12 |
| | x | | | | | | x | | x | | x | | | | | x | 12 |
| | | x | | | | | | x | x | | | x | | x | | | 12 |
| x | | | x | | x | | | | x | | | | x | | x | | 12 |
| | | | | x | | x | | | x | x | | | | | | x | 12 |
| | x | | | | | | x | | x | | x | | | x | | | 12 |
| | | x | | | | | | x | x | | | x | | | x | | 12 |
| x | | | x | | x | | | | x | | | | x | | | x | 12 |
| | | | | x | | x | | | x | x | | | | x | | | 12 |
| | x | | | | | | x | | x | | x | | | | x | | 12 |
| | | x | | | | | | x | x | | | x | | | | x | 12 |
| x | | | x | | x | | | | x | | | | x | x | | | 12 |
| | | | | x | | x | | | x | x | | | | | x | | 12 |
| | x | | | | | | x | | x | | x | | | | | x | 12 |
| | | x | | | | | | x | x | | | x | | x | | | 12 |
| x | | | x | | x | | | | x | | | | x | | x | | 12 |
| | | | | x | | x | | | x | x | | | | | | x | 12 |
| | x | | | | | | x | | x | | x | | | x | | | 12 |
| | | x | | | | | | x | x | | | x | | | x | | 12 |
| x | | | x | | x | | | | x | | | | x | | | x | 12 |
| | | | | x | | x | | | x | x | | | | x | | | 12 |
| | x | | | | | | x | | x | | x | | | | x | | 12 |
| | | x | | | | | | x | x | | | x | | | | x | 12 |
| x | | | x | | x | | | | x | | | | x | x | | | 12 |
| | | | | x | | x | | | x | x | | | | | x | | 12 |
| | x | | | | | | x | | x | | x | | | | | x | 12 |
| | | x | | | | | | x | x | | | x | | x | | | 12 |
| x | | | x | | x | | | | x | | | | x | | x | | 12 |

## APPENDIX D

## Reservoir water supply zones and sampling points




Rockhampton WSS –
Reservoir Supply Zones
Mawdesley Hill
Lucas St


North St
Black St
Mount Morgan WSS -
Reservoir Supply Zones