Drinking Water Quality Management Plan (DWQMP) Annual Report 2016 -2017

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Glossary of terms

ADWG 2004	Australian Drinking Water Guidelines (2004). Published by the National Health and Medical Research Council of Australia
ADWG 2011	Australian Drinking Water Guidelines (2011). Published by the National Health and Medical Research Council of Australia
ADWG 2016	Australian Drinking Water Guidelines (2016). Published by the National Health and Medical Research Council of Australia
E. coli	*Escherichia coli*, a bacterium which is considered to indicate the presence of faecal contamination and therefore potential health risk
HACCP	Hazard Analysis and Critical Control Points certification for protecting drinking water quality
mg/L	Milligrams per litre
NTU	Nephelometric Turbidity Units
MPN/100mL	Most probable number per 100 millilitres
CFU/100mL	Colony forming units per 100 millilitres
<	Less than
>	Greater than
SCM	Streaming Current Meter

1. Introduction

This report documents the performance of Isaac Regional Council's drinking water service with respect to water quality and performance in implementing the actions detailed in the drinking water quality management plan (DWQMP) as required under the *Water Supply (Safety and Reliability) Act 2008* (the Act).

2. Overview of Operations

This approved DWQMP applies to eight drinking water schemes within the Isaac Regional Council - Carmila, Clermont, Dysart, Glenden, Middlemount, Moranbah, Nebo, and St Lawrence. An overview of the treatment processes and capacities of each water supply system is listed below.

Carmila

Raw water is extracted from 2 shallow bores adjacent to Carmila Creek and pumped to the WTP inlet where it is treated using the following treatment process:

- Coagulation with alum;
- Sodium hypochlorite dosing for additional iron and manganese oxidation and sufficient residual for final disinfection;
- Polymer dosing as a flocculation aid;
- Flocculation;
- Clarification; and
- Media filtration.

Carmila WTP has a capacity of 3 L/s and starts and stops based on pre-set levels in the Treated Water Reservoir.

Clermont

Raw water is extracted from the Theresa Creek Dam and pumped to the WTP inlet where it is treated using the following treatment process:

- Pre-pH correction with soda ash (when required);
- Pre-chlorine gas dosing for metals oxidation;
- Coagulation with alum;
- Polymer dosing for flocculation aid (when required);
- Flocculation;
- Clarification;
- PAC dosing for taste and odour removal;
- Sand filtration;
- Disinfection with chlorine gas;
- pH correction with soda ash; and
- Trim chlorine gas dosing to maintain a residual in the reticulation.

Clermont WTP has a design capacity of 65 L/s but can run at up to 70 L/s if required. Operation of the WTP starts and stops based on pre-set levels in the Treated Water Reservoir.

Dysart

Raw water is extracted from the Mackenzie River and pumped to BMA's Turkeys Nest Dam located to the south west of the WTP site. Water is pumped on demand from the Turkey's Nest Dam to the inlet where it is treated using the following treatment process:

- Sodium hydroxide dosing for pH adjustment prior to oxidation
- Hydrochloric acid dosing for pH adjustment prior to oxidation
- Potassium permanganate dosing for oxidation of metals (preferred method of oxidation);
- Chlorine gas dosing for oxidation of metals (alternative oxidant);
- Coagulation with Aluminium Chlorohydrate (ACH);
- PAC dosing for taste and odour removal;
- Polymer dosing for flocculation aid;
- Flocculation;
- Clarification;
- Dual media filtration; and
- Disinfection with chlorine gas.

Dysart WTP has a capacity of 90 L/s limited by flow through the clarifiers, but can be operated at 100 L/s for short periods. The WTP is operated to minimise the number of starts/stops by controlling raw water influent flows based on levels in the Treated Water Reservoirs.

Glenden

Raw water is extracted from the Bowen River Weir, stored in 100 ML Mine Dam and pumped to the WTP inlet where it is treated using the following treatment process:

- PAC dosing for removal of tastes and odours (when required);
- Coagulation with aluminium sulphate;
- Polymer dosing for flocculation aid (when required);
- Flocculation;
- Clarification;
- Sand filtration;
- Post-pH adjustment with sodium hydroxide; and
- Disinfection with sodium hypochlorite.

Glenden WTP has a design capacity of 76 L/s, limited by flow through the sand filters. The WTP typically processes 60 L/s and operates depending on levels in the Treated Water Reservoir.

Middlemount

Raw water is extracted from the Mackenzie Weir, pumped to Bingegang Dam and finally to a raw water storage dam on site and pumped to the WTP inlet where it is treated using the following treatment process:

- Coagulation with Nalco Ultrion 44560;
- PAC dosing prior to the flash mixer, clarifier and filter inlets (when necessary);
- Chlorine gas dosing for iron and manganese oxidation (optional);
- Flocculation;
- Clarification;
- Sand filtration;
- Post-pH correction with sodium hydroxide (if required); and

- Disinfection with chlorine gas.

Middlemount WTP has a capacity of 90 L/s and starts and stops based on pre-set levels in the Treated Water Reservoir.

Moranbah

There are two separate process trains at Moranbah – Boby WTP and the WTP
Raw water is extracted from the Burdekin Dam (occasionally Eungella Dam and potentially from the Braeside Bore field) and pumped to the WTP inlet where it is treated using the following treatment process:

- Pre-pH adjustment with lime;
- Pre-chlorine gas for iron and manganese oxidation;
- PAC for taste and odour removal;
- Coagulation with ACH;
- Polymer dosing for flocculation aid (WTP only);
- Flocculation;
- Clarification;
- Sand filtration;
- Lime dosing for pH adjustment;
- Disinfection with chlorine gas; and
- Fluoridation with sodium fluoride.

Moranbah has a combined capacity of 230 L/s, the Boby Plant processing up to 70 L/s and the WTP processing 160 L/s. These WTPs can operate individually or simultaneously, according to the level in the Treated Water Storage. The Boby Plant is rarely used but is available during high demand periods and when the main WTP train is offline for maintenance.

Nebo

Raw water is currently pumped from 4 bores. Bores 4 and 5 are preferred as the primary bores for raw water supply as they are better quality (lower alkalinity and hardness). Bores 2 and 3 are standby and are used during peak demand periods and to manage water allocation usage.

Water pumped from the bores is disinfected with sodium hypochlorite before it is pumped to the water tower for storage and distribution.

Each bore has a capacity of 8 L/s, with standard operation being to pump from bores 4 and 5 totalling 16 L/s. When additional capacity is required (determined by levels in the Water Tower) a third bore is brought online to provide up to 24 L/s. Bore 1 has been disconnected and decommissioned from the supply system, and Bore 6 is no longer used due to water quality and bore integrity issues.

St Lawrence

Raw water is extracted from St Lawrence Creek and pumped to the WTP inlet where it is treated using the following treatment process:

- Oxidation of iron and manganese with calcium hypochlorite (potassium permanganate also available but not typically used);
- Pre-pH correction with soda ash;
- Coagulation with aluminium sulphate;
- Polymer dosing to aid flocculation;
- Flocculation;

- Clarification;
- Media filtration; and
- Calcium hypochlorite dosing for final disinfection;

St Lawrence WTP has a design capacity of 5.4 L/s and starts and stops based on the level in the Treated Water Reservoir.

3. Actions Taken to Implement the DWQMP

The current Improvement Program with status updates is included in Appendix A. Progress has been made across all water supply systems to meet the requirements of the DWQMP, however some improvement items are now overdue. An additional 70 improvements have been completed in current reporting period. A summary of completed and overdue actions is listed below

Complete (in current reporting period)

- Further progress has been made with formalisation of testing procedures and other SOPs developed
- Operational and verification monitoring programs have been updated
- Maintenance schedules have been developed for major process equipment
- On site spares have been installed for standby operation
- Minor process reconfigurations (e.g. automated backwash reconfigured at Clermont)
- New and revised SOPs have been developed.
- Damaged plant equipment has been repaired or replaced.

Overdue

- Major capital upgrades – upgrades at Dysart, Middlemount and Clermont are in progress and others are scheduled in the coming financial year
- Additional instrumentation for process monitoring and SCADA modifications for configuration of alarms
- Investigative works to determine future upgrades or avenues for optimising operations.

Good progress has been made to address the improvement actions for all 8 water supply systems, staffing changes at all levels (operators through to middle and senior management staff) and limited availability of funds have hindered further progress.

Capital upgrades are underway or planned for Clermont, Moranbah, Middlemount, Dysart (phase 2) and project scopes have been developed to cover as many improvement actions and process areas as possible to minimise service disruptions and enable project management and procurement savings and efficiencies. Upgrades at Moranbah and potential construction of a WTP at Nebo have been identified for further scoping and scheduled for implementation in the following financial years.

Increased documentation and better document management is assisting with issues arising from high staff turnover. Development of an operator training and testing program is also under consideration to record and track operator training and competencies.

4. Compliance with Water Quality Criteria for Drinking Water

Summaries of each supply system's verification monitoring and *E. coli* compliance with water quality criteria are included in Appendix B. There are some discrepancies between the approved verification monitoring program and the monitoring being undertaken, where shortfalls in monitoring are occurring these have been outlined below.

Carmila

- Turbidity measured monthly- required weekly (being measured weekly since Jul 2017, daily operational monitoring for turbidity in place)
- Fluoride not monitored – required monthly (being measured monthly since Jul 2017)
- Pesticides and beryllium not measured- required annually (implemented since Jul 2017)

Clermont

- TDS and conductivity not measured - required weekly (being measured weekly since Jul 2017)
- Algal toxins measured once - required monthly (being measured monthly since Jul 2017)
- Fluoride not monitored – required monthly (being measured monthly since Jul 2017)
- Beryllium not measured- required annually (implemented since Jul 2017)

Dysart

- TDS and conductivity measured once - required weekly (being measured weekly since Jul 2017)
- Algal toxins measured once - required monthly (being measured monthly since Jul 2017)
- Residual alkalinity and fluoride not monitored – required monthly (being measured monthly since Jul 2017)
- Beryllium not measured- required annually (implemented since Jul 2017)

Glenden

- TDS and conductivity not measured - required weekly (being measured weekly since Jul 2017)
- Fluoride not monitored – required monthly (being measured monthly since Jul 2017)
- Residual alkalinity monitored bimonthly (approximately) - required monthly (being measured monthly since Jul 2017)
- Beryllium not measured- required annually (implemented since Jul 2017)

Middlemount

- TDS and conductivity not measured - required weekly (being measured weekly since Jul 2017)
- Residual alkalinity and fluoride not monitored – required monthly (being measured monthly since Jul 2017)
- Algal toxins measured once - required monthly (being measured monthly since Jul 2017)
- Beryllium not measured- required annually (implemented since Jul 2017)

Moranbah

- Aluminium, Conductivity and TDS not measured – required weekly (being measured weekly since Jul 2017)
- Residual alkalinity and algal toxins not monitored – required monthly (being measured monthly since Jul 2017)
- Beryllium and Iodide not measured- required annually (implemented since Jul 2017)

Nebo

- Fluoride not monitored – required monthly (being measured monthly since Jul 2017)
- Beryllium not measured- required annually (implemented since Jul 2017)

St Lawrence

- Turbidity measured monthly- required weekly (being measured weekly since Jul 2017)
- Fluoride not monitored – required monthly (being measured monthly since Jul 2017)
- Beryllium not measured- required annually (implemented since Jul 2017)

Annual testing of inorganics has been undertaken for all systems. At least one sample has been recorded in the year's data for all inorganics required annually as per the verification monitoring plan, with the exception of beryllium where no results were recorded for any system during the reporting period.

During this reporting period, IRC conducted a review of the verification monitoring program for testing conducted by Mackay Regional Council Laboratory to ensure it is appropriate for the raw water sources used and to minimise any unnecessary testing. The revised verification monitoring program was implemented in July 2017 to address discrepancies between ADWG recommendations and current practice. The revised plan has been included in the updated DWQMP.

5. Notifications to the Regulator under Sections 102 and 102A of the Act

Several exceedances of the ADWG aesthetic limits for several parameters have been identified during the course of analysis for this report. IRC investigated these exceedances at the time to ensure quality of supply was maintained and that there was no risk to public health. Only health exceedances are required to be reported to DEWS, and therefore notification is not required for any of the below exceedances.

Carmila

- 1 exceedances of ADWG aesthetic limit for Manganese
- 9 detections below the ADWG aesthetic threshold for DO

Clermont

- 6 detections below the ADWG aesthetic threshold for DO

Dysart

- 1 aesthetic exceedances for turbidity (92 NTU on 7/3/17)
    - **Note: One of these values appears to be recorded incorrectly.** On March 7th, 2017, a result of 92 NTU was recorded in the verification monitoring results. On that same day, a raw water turbidity of 31.2 NTU and treated water turbidity of 0.12 NTU was recorded in operational monitoring logs. Operational data for treated water on subsequent days was also inconsistent with the 92 NTU reading, not exceeding 0.18 NTU for the entire month of March.

Glenden

- No exceedances recorded during the 2016-17 reporting period

Middlemount

- 1 detection below the ADWG aesthetic threshold for DO

Moranbah

- 1 aesthetic exceedance of ADWG limit for turbidity (5.6 NTU – 01/11/16)

Nebo

- 25 exceedances of ADWG aesthetic limit for TDS
- 11 detections below the ADWG aesthetic threshold for DO
- 6 exceedances of ADWG aesthetic limit for total hardness

St Lawrence

- 1 exceedance of ADWG aesthetic limit for hydrogen sulphide (1 mg/L – 7/3/17)
    - Results is extremely high – appears to be recorded incorrectly as all previous results are reported as less than the limit of reporting (< 0.005 mg/L).
- 3 exceedances of ADWG aesthetic limit for aluminium
- 1 detection below the ADWG aesthetic threshold for DO

E. coli

E coli. was detected in one sample (January) for the St Lawrence supply system analysed during the 2016-2017 year. However it was most likely the case of contaminated sample and a repeat sample from the same location and test was carried out within 24 hours with no detection of E.coli.

6. Customer Complaints Related to Water Quality

Table 1 outlines the water quality complaints reported by consumers in the 2016-17 reporting year. Many complaints were reported for aesthetic issues (tastes, odours and discolouration) but no complaints were received regarding suspected or confirmed illnesses.

Table 1: Water Quality Complaints

	Suspected Illness	Discoloured Water	Taste	Odour	Other	Total
CARMILA	0	0	0	0	0	**0**
CLERMONT	0	29	1	1	0	**31**
DYSART	0	1	4	1	0	**6**
GLENDEN	0	0	0	0	0	**0**
MIDDLEMOUNT	0	9	16	3	0	**28**
MORANBAH	0	86	4	0	0	**90**
NEBO	0	0	0	0	0	**0**
ST LAWRENCE	0	0	0	0	0	**0**
TOTAL	**0**	**125**	**25**	**5**	**0**	**155**

Suspected Illness

Complaints are sometimes received from customers who suspect their water may be associated with an illness they are experiencing. Isaac Regional Council investigates each complaint relating to alleged illness from our water quality, typically by testing the customers tap and closest reticulation sampling point for the presence of *E. coli*.

During 2016-2017 there were no reports of confirmed or suspected cases of illness arising from the water supply system.

Aesthetic Complaints

When water quality complaints are received, the following standard responses are performed as appropriate. Between each action, the water is sampled to determine whether the situation has been rectified.

1. Localised flushing.
2. Mains flushing.
3. Samples collected for further investigation (if required, particularly if the cause of the complaint is unknown).

For Discoloured Water:

a) Review of treatment processes and chemical dosing systems.

b) Drain vessels in treatment plant if contamination is suspected.

For Tastes and Odours:

a) Review raw water quality and make necessary adjustments to the treatment process (e.g. PAC dose and/or Potassium Permanganate dose changes).

b) If the problem persists, downrate the water treatment plant and introduce water restrictions.

7. Findings and Recommendations of the DWQMP Auditor

An external audit was conducted in November 2017. Eight components of the plan were assessed for compliance with the following outcomes:

Provision and conditions in the approval notice	Compliant
Implementation of preventive measures	Compliant
Implementation of operational and maintenance procedures	Compliant
Implementation of process for managing incidents and emergencies	Minor Non-compliance
Implementation of operational and verification monitoring programs	Compliant
Implementation of the risk management improvement program	Compliant
Maintaining records	Compliant
Undertaking regular reviews	Compliant

There were 6 recommendations made to address minor non-compliances, as well as 17 opportunities for improvement where activities conformed but could be improved.

The complete audit report is attached as Appendix C.

8. Outcomes of the Review of the DWQMP and How Issues Raised Have Been Addressed

A preliminary review of the DWQMP was undertaken in preparation for the DWQMP external audit in November 2017. This included:

- Review and update of water supply system details;
- Review and update of supply system schematic diagrams (including treatment plant diagrams), if required;
- Update of water quality summaries for each system with new data;
- Combination of verification monitoring program for all systems;
- Combination of risk assessment and preventive measures tables to produce a consolidated risk register;
- Update and simplify Improvement Programme – status updates and comments to be provided by IRC;
- Review of entire DWQMP for consistency of layout and information between and within sections

The external audit found no major gaps or non-conformances with the DWQMP. The DWQMP will be finalised to address applicable outcomes from the audit and submitted to DEWS for approval of amendments.

Council will continue to improve and update the plan and systems as per the improvement program.

During this reporting period, no major changes have been made to any of the water supply systems covered by this DWQMP, and no hazards or hazardous events not addressed by the Plan have been experienced.

The revised DWQMP will be submitted to DEWS following finalisation in December 2017. The date of the next review will be advised by DEWS following approval of the revised DWQMP.

Appendix A – Implementation of the DWQMP Risk Management Improvement Program

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
GEN1	General Issues	Out of date Standard Operating Procedure	Update Standard Operating Procedure across all WTPs to ensure consistency across the region	Dec-13	Ongoing	Stage 1 roll out to each site completed between 2013 and 2015. Further updates are still in progress.
GEN2	General Issues	Emergency procedures not included in SOP	Update Standard Operating Procedure across all WTPs to ensure consistency across the region	Dec-13	Ongoing	Gap analysis is currently being done to identify the requirements of further SOPs.
GEN3	General Issues	Poor information recording system	Streamlining information / record keeping procedure to be implemented	Jun-14	Complete	Current Data is captured on network system for easy access and review
GEN4	General Issues	Poor water quality data record keeping	Provide central storage of test results report (Electronic, Graphical format) to allow instantaneous data retrieval as circumstances require	Jun-14	Complete	All test results are captured on Monitor Pro a system used by Mackay Regional Council
GEN6	General Issues	Inadequate or irregular water main flushing	A general flushing procedure for water mains and reservoir to be developed.	Jun-14	In progress	Process for mains flushing has been developed and a programmed maintenance task for mains flushing is in progress
GEN7	General Issues	Lack of pressure monitoring of water network	Council is progressing with water network modelling to identify low flow zones	Jun-17	Overdue	Network modelling to be commissioned separately and completed by Jun 2019
GEN8	General Issues	Lack of formalised communication protocol with BMA/Sunwater	Establish a communication protocol with BMA/Sunwater regarding quantity and quality of raw water as well as alerts for rapid change of raw water quality	Jun-14	Completed	Communications have been developed with water suppliers and IRC now receive available raw water quality data.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
GEN9	General Issues	Lack of formalised communication protocol with Xstrata/Bloomfield	Establish a communication protocol with Xstrata/Bloomfield regarding quantity and quality of raw water as well as alerts for rapid change of raw water quality	Jun-14	Complete	IRC Management are notified by Glencore / Bloomfield if RW quality issues arise.
GEN10	General Issues	Fragmented/Incomplete Record Water Complaints	Streamline recording of water quality complaints and reporting to Supervisors and Managers. Additional details of complaints and resolution should be included in the record.	Jun-14	Complete	TechOne has improved the capture of complaints. Actions taken and outcomes are recorded in the program and are communicated through monthly reports to management.
GEN11	General Issues	Poor water quality data record keeping	Establish procedure for compilation of external test results and graphical and statistical analysis. Include annual review of results to establish any required changes in testing frequencies.	Dec-16	Complete	All test results are captured on Monitor Pro a system used by Mackay Regional Council
CL1	Clermont Dam / Catchment	Algal Bloom	Algal toxin monitoring is to be included as part of verification/external testing regime	Dec-13	Complete	Revised operational and verification monitoring plan has been implemented.
CL3	Clermont Dam / Catchment	Rapid Variation in raw water quality	The current WTP process combined with operator input is considered capable of dealing with most turbidity events. However, if future data shows that this system becomes unreliable, a raw water turbidity meter and/or SCM with alarms should be considered in future to assist operators in chemical dosing adjustments.	Jun-15	In progress	Chemical dosing upgrades along with installation of online monitoring instrumentation and Citect SCADA system are in progress as of Oct 2017. Expected to be completed and commissioned by Dec 2017

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
CL4	Clermont Dam / Catchment	Rapid Variation in raw water quality caused by stormwater flows	Current barrier (WTP process and turbidity monitoring) is considered sufficient for treating colour. The operating procedure including the charts which operators use needs to be formalised. The colour testing procedure needs to be revised. Since the raw water is dosed with chlorine, True colour should be tested in samples sent to Queensland Health. Any sample that is above 15 HU should also be tested for THMs (this is a requirement in ADWG). These THM levels should be recorded and checked against ADWG limits. Further action may be required if THMs above 0.25mg/L are detected.	Dec-13	Complete	Pre dose of chlorine has been removed. Revised verification monitoring programme includes THM monitoring
CL5	Clermont Dam / Catchment	Chemical use in catchment areas (e.g. Weed spray)	Pesticide monitoring to be included as part of verification monitoring programme.	Dec-13	Complete	Revised verification monitoring programme includes pesticides monitoring
CL6	Clermont Dam / Catchment	Heavy metal	Heavy metals to be monitored as part of verification monitoring programme.	Dec-13	Complete	Revised verification monitoring programme includes heavy metals monitoring
CL7	Clermont Dam / Catchment	Accidental Spills	The campground caretaker to be educated on the dam as a potable water source. Information sheets to be provided for the caretaker to assist him in passing on this message to campers. An information board is to be posted at the boat ramp.	Dec-13	Ongoing	Information has previously been provided to the caretaker, but education and ongoing communication still to be undertaken
CL8	Clermont Dam / Catchment	Human Access	As for item CL7	Dec-13	Ongoing	Intake area is fenced off but ongoing education required

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
CL9	Clermont Dam / Catchment	Wildlife Access (native and feral) and unrestricted livestock	Online chlorine analyser with alarm would assist operators to ensure that chlorine residual is always maintained.	Jun-17	In progress	Residual chlorine being monitored daily Chemical dosing upgrades along with installation of online monitoring instrumentation and Citect SCADA system are in progress as of Oct 2017. Expected to be completed and commissioned by Dec 2017
CL12	Clermont Dam / Catchment	Heavy Rainfall / Flooding	Operator actions as described are considered to be appropriate to mitigate this risk. Consideration to be given to online raw water instruments with alarms (as per item CL2) to assist operators.	Jun-17	In progress	Raw water quality parameters are being monitored daily. Chemical dosing upgrades along with installation of online monitoring instrumentation and Citect SCADA system are in progress as of Oct 2017. Expected to be completed and commissioned by Dec 2017
CL13	Clermont Dam / Catchment	Drought / Bushfires	Operator actions as described are considered to be appropriate to mitigate this risk. Consideration to be given to online raw water instruments with alarms (as per item CL3) to assist operators.	Jun-15	In progress	Chemical dosing upgrades along with installation of online monitoring instrumentation and Citect SCADA system are in progress as of Oct 2017. Expected to be completed and commissioned by Dec 2017
CL15	Clermont Dam / Catchment	Demand Increase	Drought management plan to be implemented to provide triggers for water restrictions and raw water storage capacity to be reviewed.	Jun-18	Complete	Water restriction levels have been introduced as required to manage the supply of water.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
CL16	Clermont Dam / Catchment	Demand Increase	Operator actions as described are considered to be appropriate to mitigate this risk. Consideration to be given to online raw water instruments with alarms (as per item CL3) to assist operators.	Jun-15	Complete	Water restriction levels have been introduced as required to manage the supply of water. Installation of online monitoring instrumentation and Citect SCADA are in progress and expected to be completed by Dec 2017
CL19	Clermont Storage Reservoirs and Intakes	Human Access	Investigate whether further protection from human access could be implemented at the surge tank.	Jun-16	Complete	No further protection required around surge tank.
CL20	Clermont Storage Reservoirs and Intakes	Animal access including birds and vermin	An analyser as per CL9 would continuously monitor chlorine level at plant outlet and advise operators if disinfection is compromised.	Jun-15	In progress	Chemical dosing upgrades along with installation of online monitoring instrumentation and Citect SCADA system are in progress as of Oct 2017. Expected to be completed and commissioned by Dec 2017
CL22	Clermont Storage Reservoirs and Intakes	No alternative water sources	Formalise this risk as part of the Emergency Response Plan. Operational monitoring revised to include more parameters as well as more extensive verification monitoring programme.	Jun-14	In progress	Clermont Sustainable Water Study is currently being undertaken.
CL23	Clermont WTP General	Significant Flow variations	Implementation of flow paced chemical dosing during future control system upgrade if this becomes a high risk in future.	Jun-17	In progress	Chemical dosing upgrades along with installation of online monitoring instrumentation and Citect SCADA system are in progress as of Oct 2017. Expected to be completed and commissioned by Dec 2017
CL24	Clermont WTP Inlet/ Flocculation	Process control incapability	Verification monitoring of aluminium to be implemented.	Dec-13	Complete	Revised verification monitoring programme includes pesticides monitoring

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
CL25	Clermont WTP Inlet/ Flocculation	Process control incapability	No further action. It is considered that reasonable preventative measures are taken by the operators and the risk is minimised. Turbidity and pH analysers with alarms could be considered to assist operators.	Jun-17	In progress	Chemical dosing upgrades along with installation of online monitoring instrumentation and Citect SCADA system are in progress as of Oct 2017. Expected to be completed and commissioned by Dec 2017
CL29	Clermont WTP Inlet/ Flocculation	Equipment malfunction	Alarm on failure of inlet flowmeter.	Jun-15	In progress	Chemical dosing upgrades along with installation of online monitoring instrumentation and Citect SCADA system are in progress as of Oct 2017. Expected to be completed and commissioned by Dec 2017
CL31	Clermont WTP Inlet/ Flocculation	Inadequate mixing	Install baffles in flash mixer or alternative method of mixing at WTP inlet.	Jun-15	Complete	Current mixing method has been reviewed and deemed adequate. No further action required.
CL32	Clermont WTP Inlet/ Flocculation	Poor reliability of process	An online turbidity meter for treated water (as per item CL3) would assist operators.	Jun-15	In progress	Chemical dosing upgrades along with installation of online monitoring instrumentation and Citect SCADA system are in progress as of Oct 2017. Expected to be completed and commissioned by Dec 2017
CL33	Clermont WTP General	Formation of disinfection by-products	Verification monitoring of THMs to be implemented.	Dec-13	Complete	Revised verification monitoring programme includes pesticides monitoring
CL34	Clermont Clarification	Chemical dosing failure / Equipment Malfunction	Algal toxin monitoring is to be included as part of verification/external testing regime	Dec-13	Complete	Revised verification monitoring programme includes pesticides monitoring

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
CL35	Clermont Filtration	Process control incapability	Online filtered water turbidity analyser for filtered water with alarm would assist operators.	Jun-15	In progress	Chemical dosing upgrades along with installation of online monitoring instrumentation and Citect SCADA system are in progress as of Oct 2017. Expected to be completed and commissioned by Dec 2017
CL36	Clermont Filtration	Inadequate filter operation	Online filtered water turbidity analyser for filtered water with alarm would assist operators (as per CL35)	Jun-15	In progress	Chemical dosing upgrades along with installation of online monitoring instrumentation and Citect SCADA system are in progress as of Oct 2017. Expected to be completed and commissioned by Dec 2017
CL39	Clermont Filtration	Equipment malfunction	Some valves will be replaced in 2013 with new (more reliable) valves which can be manually closed by the operator.	Jun-14	Complete	Review of current valves indicates replacements of valves not required.
CL40	Clermont Filtered Water	Ineffective disinfection	Install online treated water pH, turbidity and chlorine analyser with alarming (as per CL35 and CL9)	Jun-15	In progress	Chemical dosing upgrades along with installation of online monitoring instrumentation and Citect SCADA system are in progress as of Oct 2017. Expected to be completed and commissioned by Dec 2017
CL41	Clermont Filtered Water	Chemical dosing failure	Install online treated water pH, turbidity and chlorine analyser with alarming (as per CL35 and CL9)	Jun-15	In progress	Chemical dosing upgrades along with installation of online monitoring instrumentation and Citect SCADA system are in progress as of Oct 2017. Expected to be completed and commissioned by Dec 2017

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
CL46	Clermont Reticulation	Aged pipes (AC)	Council to continue the current reactive maintenance replacement programme. It is considered that adequate procedures are in place to ensure repairs are undertaken in a timely manner.	Ongoing	Ongoing	10 year CAPEX program is in place to address ageing infrastructure including replacement and renewals.
CL49	Clermont Reticulation	Biofilms, sloughing and re-suspension, regrowth	Critical sample locations are to be established from network modelling. Once established, samples for testing are to be taken from these locations. Operational monitoring of chlorine in the reticulation to be increased to daily to ensure operators have the data necessary to set the correct chlorine dose rate on a daily basis.	Jun-15	Complete	Operational monitoring has been revised to include Chlorine testing in reticulation.
CL51	Clermont Reticulation	Flow variability, inadequate pressures	Increase operational monitoring of chlorine residual in reticulation to ensure better compliance.	Dec-13	Complete	Operational monitoring has been revised to include Chlorine testing in reticulation.
CL53	Clermont Reticulation	Inadequate maintenance of chlorine residual	As per CL51	Dec-13	Complete	Operational monitoring has been revised to include Chlorine testing in reticulation.
CL56	Clermont Whole System	Chemical dosing failure	Treated water is currently tested for dissolved iron and manganese. The ADWG requires testing for Total Iron and Total Manganese. Operators to test these at least weekly as per ADWG. Raw water from the dam (prior to the first chlorine dose point) should be tested for iron and manganese. The number of chlorine dose points should be re-evaluated to ensure they are all required.	Dec-13	Complete	Total Iron and Manganese are now being tested as part of both Operational and Verification monitoring. Pre-chlorine dosing has been removed.
CL59	Clermont Whole System	Capacity	Population to be monitored on at least a 5 yearly basis.	Jun-17	Ongoing	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
CL60	Clermont Dam / Catchment	Rapid Variation in raw water quality	Monitor iron and manganese in raw water more frequently (prior to chlorine dosing) as part of operational monitoring.	Dec-16	Complete	Chlorine is no longer dosed in raw water prior to WTP.
CL61	Clermont WTP Inlet/ Flocculation	Chemical dosing failure	Upgrade all chemical dosing systems to include duty/standby dosing pumps (with auto changeover on pump fault) and calibration tubes (Priority 1 Change). Configure flow paced dosing (Priority 3 Change).	Dec-16	In progress	Chemical dosing upgrades along with installation of online monitoring instrumentation and Citect SCADA system are in progress as of Oct 2017. Expected to be completed and commissioned by Dec 2017
CL62	Clermont WTP Inlet/ Flocculation	Equipment malfunction	Minimise number of starts of WTP by running as continuously as possible and ramp up flows on start up.	Jun-17	In progress	Chemical dosing upgrades along with installation of online monitoring instrumentation and Citect SCADA system are in progress as of Oct 2017. Expected to be completed and commissioned by Dec 2017
CL63	Clermont Clarification	Chemical dosing failure	Install new polymer batching and dosing system to aid in coagulation/ flocculation during extreme dirty water events.	Jun-18	In progress	Chemical dosing upgrades along with installation of online monitoring instrumentation and Citect SCADA system are in progress as of Oct 2017. Expected to be completed and commissioned by Dec 2017
CL64	Clermont Filtration	Inadequate filter operation	Inspect filters and refurbish/replace if required (including internal epoxy coatings, media, underdrains, nozzles, launders and valves).	Dec-16	In progress	New media and filter upgrades are in progress and will be completed by Dec 2017

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
CL65	Clermont Filtration	Inadequate filter operation	Develop SOP for filter backwash to ensure manual backwash is completed more regularly (Priority 1). Reconfigure and automate backwash sequence based on headloss, turbidity and/or filter run time (Priority 2).	Dec-16	In Progress	Manual backwash is still performed, but SOP is now in place. However this SOP is yet to be formalised. Installation of SCADA system is in progress and will be completed by Dec 2017.
CL66	Clermont Filtered Water	Disinfection failure	Install carrier water on the chlorine gas dosing system to ensure adequate disinfection. Include interim chlorine testing in operational monitoring (i.e. chlorinated water from the dam and after additional chlorine dosing at WTP inlet).	Dec-16	In progress	Chemical dosing upgrades along with installation of online monitoring instrumentation and Citect SCADA system are in progress as of Oct 2017. Expected to be completed and commissioned by Dec 2017
CL67	Clermont Filtered Water	Disinfection failure	Install auto changeover capability from 920 kg chlorine gas drum to 70 kg chlorine gas cylinders.	Dec-16	In progress	Chemical dosing upgrades along with installation of online monitoring instrumentation and Citect SCADA system are in progress as of Oct 2017. Expected to be completed and commissioned by Dec 2017. Duplicate 920kg drum system being installed for duty/standby with auto changeover between drums.
CL68	Clermont Filtered Water	Disinfection failure	Install regulator on each 70 kg chlorine gas cylinder to allow each cylinder to drain down separately.	Jun-17	Complete	No longer required as duplicate 920kg system is being installed as duty/standby.
CL69	Clermont Filtered Water	Disinfection failure	Procure and install scales for each 70 kg chlorine gas cylinder.	Dec-16	Complete	No longer required as duplicate 920kg system is being installed as duty/standby.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
CL70	Clermont Filtered Water	Disinfection failure	Include alarms for chlorine dosing failure.	Jun-17	In progress	Chemical dosing upgrades along with installation of online monitoring instrumentation and Citect SCADA system are in progress as of Oct 2017. Expected to be completed and commissioned by Dec 2017
CL71	Clermont Filtered Water	Chemical dosing failure	Install carrier water on the chlorine gas dosing system to ensure adequate disinfection. Include interim chlorine testing in operational monitoring (i.e. chlorinated water from the dam and after additional chlorine dosing at WTP inlet).	Dec-16	In progress	Chemical dosing upgrades along with installation of online monitoring instrumentation and Citect SCADA system are in progress as of Oct 2017. Expected to be completed and commissioned by Dec 2017 Pre-chlorine dose is no longer performed prior to WTP so interim dosing not required
CL72	Clermont Reticulation	Inadequate disinfection	Undertake an assessment to confirm which users (if any) are receiving inadequately chlorinated water.	Jun-17	In progress	Chlorine system upgrades are in progress and should rectify this issue. Part of chemical upgrades with expected completion of Dec 2017
CL73	Clermont Chlorine System	Chlorine dosing failure Chlorine leak Exposure of operators to Chlorine gas	Audit chlorine system against Australian Standard (AS/NZS 2927) and upgrade as required	Dec-16	In progress	Chlorine system upgrades are in progress and should rectify this issue. Part of chemical upgrades with expected completion of Dec 2017
MO1	Moranbah Raw Water	Algal Bloom	Event-based algae and algal toxin monitoring is to be included as part of verification/external testing regime.	Dec-13	Complete	Blue Green Algae Management Plan for all IRC systems (based on Qld Water Directorate) has been developed which will includes sampling and response requirements. Monthly testing is conducted with weekly testing if algae is present.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
MO2	Moranbah Raw Water	Rapid Variation in raw water quality	The current WTP process combined with operator input is considered capable of dealing with most turbidity events and increases in iron and manganese. However, if future data shows that this system becomes unreliable, a raw water turbidity meter and/or SCM with alarms should be considered in future to assist operators in chemical dosing adjustments.	Jun-17	In progress	New water line to divert incoming raw water to 400ML dam will assist with blending and water quality to prevent fluctuating raw water quality. IRC is currently advertising for tenders to construct pipeline.
MO3	Moranbah Raw Water	Rapid Variation in raw water quality caused by stormwater flows	Current barrier (WTP process and turbidity monitoring) is considered sufficient for treating colour. Consider instruments as per MO2. The colour testing procedure needs to be revised. Since the raw water is dosed with chlorine, True colour should be tested in samples sent to Queensland Health. Any sample that is above 15 HU should also be tested for THMs (this is a requirement in ADWG). These THM levels should be recorded and checked against ADWG limits. Further action may be required if THMs above 0.25mg/L are detected.	Dec-13	Complete	True Colour and THM testing is being done. SOPs have been updated to reflect monitoring changes.
MO4	Moranbah Raw Water	Chemical use in catchment areas (e.g. Weed spray)	Undertake monthly test for 2 years before reviewing the frequency.	Dec-13	Complete	Testing frequency to be reviewed
MO5	Moranbah Raw Water	Heavy metal in raw water	Heavy metals added to verification monitoring testing programme.	Dec-13	Complete	Included in current verification monitoring program
MO6	Moranbah Raw Water	Wildlife Access (native and feral) and unrestricted livestock	Increase operational testing of chlorine residual in reticulation.	Jun-17	Complete	Raw water storage reservoirs are protected with fencing and locked gates. Free Cl is being tested for network samples daily.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
MO7	Moranbah Raw Water	Wildlife Access (native and feral) and unrestricted livestock	Consider online raw water instruments with alarms (as per item MO2) to assist operators.	Jul-17	In Progress	Raw water reservoirs are protected with fencing and locked gates to prevent wildlife access. Chemical dosing upgrades along with installation of online monitoring instruments and SCADA system is planned for 2018
MO8	Moranbah Raw Water	Heavy Rainfall / Flooding	Consider online raw water instruments with alarms (as per item MO2) to assist operators.	Jun-17	In Progress	Chemical dosing upgrades along with installation of online monitoring instruments and SCADA system is planned for 2018
MO9	Moranbah Raw Water	Drought / Bushfires	Consider online raw water instruments with alarms (as per item MO2) to assist operators.	Jun-17	In Progress	Chemical dosing upgrades along with installation of online monitoring instruments and SCADA system is planned for 2018
MO12	Moranbah Raw Water	Animal access including birds and vermin	Increased operational monitoring of chlorine residual in the reticulation. Some chlorine results have been outside the limits. More frequent monitoring should assist operators with increasing dosing when necessary to maintain residual.	Dec-13	Complete	Reticulation samples are tested daily for chlorine residual.
MO14	Moranbah WTP General	Significant Flow variations	Consider implementation of chemical dose flow pacing during future control system upgrade if this becomes a high risk in future.	Jun-17	In Progress	Chemical dosing upgrades along with installation of online monitoring instruments and SCADA system is planned for 2018
MO15	Moranbah WTP Inlet/ Flocculation	Process control incapability	Verification monitoring of aluminium to be implemented.	Dec-13	Complete	
MO16	Moranbah WTP Inlet/ Flocculation	Process control incapability	Raw water turbidity and pH analysers or streaming current monitor with alarms could be considered to assist operators (refer MO2).	Jun-17	In Progress	Chemical dosing upgrades along with installation of online monitoring instruments and SCADA system is planned for 2018

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
MO21	Moranbah WTP Inlet/ Flocculation	Inadequate mixing	Mud balls have recently been removed from filters and additional media installed. Treated water turbidity results in future to be monitored to ensure compliance.	Dec-13	Complete	All 9 filters at main WTP have been refurbished including replacement of filter media and underdrains during second half of 2017.
MO22	Moranbah WTP Inlet/ Flocculation	Poor reliability of process	As per MO21	Dec-13	Complete	All 9 filters at main WTP have been refurbished including replacement of filter media and underdrains during second half of 2017.
MO23	Moranbah WTP General	Formation of disinfection by-products	As per item MO3. Verification monitoring programme has been revised to include regular THM monitoring.	Dec-13	Complete	
MO24	Moranbah Clarification	Chemical dosing failure / Equipment Malfunction	Algal toxin monitoring is to be included as part of verification/external testing regime.	Dec-13	Complete	
MO25	Moranbah Filtration	Process control incapability	As per MO21	Dec-13	Complete	All 9 filters at main WTP have been refurbished including replacement of filter media and underdrains during second half of 2017.
MO26	Moranbah Filtration	Inadequate filter operation	As per MO21	Dec-13	Complete	All 9 filters at main WTP have been refurbished including replacement of filter media and underdrains during second half of 2017.
MO27	Moranbah Filtration	Inadequate filter operation	As per MO21	Dec-13	Complete	All 9 filters at main WTP have been refurbished including replacement of filter media and underdrains during second half of 2017.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
MO29	Moranbah Filtered Water	Ineffective disinfection	As per MO12	Dec-13	Complete	
MO32	Moranbah Reservoirs / Water Towers	Build up of sediment and slime	Regular inspection and maintenance of 8ML reservoir.	Jun-15	Complete	Cleaning of reservoir was completed in 2016-17. Programme to be put in place for maintenance and inspection on a regular basis
MO33	Moranbah Reservoirs / Water Towers	Aged infrastructure / corrosion. Inadequate repair and maintenance	Regular inspection and maintenance of 8ML reservoir.	Jun-15	Complete	Cleaning of reservoir was completed in 2016-17. Programme to be put in place for maintenance and inspection on a regular basis
MO34	Moranbah Reticulation	Build up of sediment and slime	Council to develop flushing and maintenance programme.	Jun-14	Ongoing	Flushing procedure will be standardised as part of SOP update. 10 year CAPEX programme in place now for upgrades, replacements and renewals of IRC's W&WW assets
MO36	Moranbah Reticulation	Corrosion	Council to ensure a maintenance / replacement programme is compiled for galv service connections.	Jun-14	Ongoing	10 year CAPEX programme in place now for upgrades, replacements and renewals of IRC's W&WW assets
MO39	Moranbah Reticulation	Biofilms, sloughing and re-suspension, regrowth	Chlorine testing at reticulation as per MO12	Dec-13	Complete	
MO41	Moranbah Reticulation	Flow variability, inadequate pressures	Chlorine testing at reticulation as per MO12	Dec-13	Complete	
MO42	Moranbah Reticulation	Firefighting increasing demand on the network	Chlorine testing at reticulation as per MO12	Dec-13	Complete	
MO43	Moranbah Reticulation	Inadequate maintenance of chlorine residual	Chlorine testing at reticulation as per MO12	Dec-13	Complete	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
MO44	Moranbah Whole System	Chemical dosing failure	Chlorine analyser with alarms would continuously monitor chlorine level and inform operators if disinfection is compromised.	Jun-14	In Progress	Chlorine analyser has been installed on the WTP filtered water line however it's currently out of order awaiting replacement and calibration of probes.
MO46	Moranbah Whole System	Capacity	Continue monitoring growth and development (Ongoing)	Dec-13	Ongoing	
MO48	Moranbah General	Operator involvement and intervention in plant function too great	Upgrade Moranbah WTP to SCADA system and PLC control for ease of operation and improved treatment and monitoring	Jun-18	Pending	Planned for 2018 as part of 10 year CAPEX program
MO49	Moranbah General	Process upset on plant startup	Minimise number of starts of WTP by running as continuously as possible and ramp up flows on start up.	Jun-19	Pending	May not be feasible without remote monitoring as it will require additional operators to monitor plant operation. Can be implemented once MO48 is complete.
MO50	Moranbah General	Process control incapability	Connect and make operational inline pH, turbidity and chlorine analysers on WTP filtered water line and equip with alarms (Priority 1). Install inline analysers for pH, turbidity and chlorine on Boby Plant filtered water line (Priority 2)	Dec-16	In Progress	To be completed as part of Chemical and SCADA upgrades planned for 2018.
MO51	Moranbah General	Chemical dosing failures	Consider installing a service water system to supply dilution water for all chemical dosing at a ratio of 10:1 to assist in even dispersion and mixing.	Jun-19	Pending	Planned for 2018 as part of 10 year CAPEX program
MO52	Moranbah Raw Water	Variable raw water quality	Develop and implement communication protocol with Sunwater/ BMA for notification of raw water source and quality changes	Jun-17	In progress	New water line to divert incoming raw water to 400ML dam will assist with blending and water quality to prevent fluctuating raw water quality

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
MO53	Moranbah Raw Water	Unknown flow entering WTP	Install new flowmeter on raw water main at existing instrument tapping point (Priority 1). Flow pace raw water chemical dosing based on this instrument (Priority 3).	Dec-16	In progress	Flowmeter has been installed. Flow pacing has not been completed, but is not required until June 2018 (Priority 3). Chemical dosing upgrades along with installation of online monitoring instruments and SCADA system is planned for 2018
MO54	Moranbah WTP Inlet/ Flocculation	Capacity	Capacity of flash mixer should be increased to enable max flow (potentially up to 200 L/s)	Jun-18	Ongoing	Continue monitoring growth and development in area
MO55	Moranbah WTP Clarification (Boby and WTP)	Sludge blanket poorly defined	Trial polymer dosing to improve sludge blanket definition	Dec-16	Complete	Polymer is being dosed into the WTP Flash Mixer. Boby Plant currently not in use.
MO56	Moranbah WTP Clarification (Boby and WTP)	Sludge blanket poorly defined	Install level sensors to monitor sludge blanket level and optimise sludge bleed operation	Jun-19	Complete	SOPs have been developed for operators to use and monitor levels in the meantime. If revised monitoring is deemed sufficient, level sensors may not be required.
MO57	Moranbah Boby WTP Filtration	Process control incapability	PLC and control panel should be installed for automatic control of the backwash sequence	Jun-17	Complete	
MO58	Moranbah Boby WTP Filtration	Inadequate filter operation	Upgrade air scour system (including additional air lines) for operation without operator intervention	Jun-18	Complete	
MO59	Moranbah Boby WTP Filtration	Process control incapability	DP cells need to be installed to backwash based on headloss instead of time	Dec-16	In Progress	To be considered during chemical and SCADA upgrades planned for 2018
MO60	Moranbah WTP Filtration	Inadequate filter operation	Existing DP cells need to be connected to PLC for headloss trigger function	Dec-16	In Progress	To be considered during chemical and SCADA upgrades planned for 2018

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
MO61	Moranbah WTP Filtration	Inadequate filter operation	Upgrade air scour system, including new duty/common standby blowers and new air lines	Jun-18	Pending	WTP wastewater filter valves have been replaced. Separate duty air scour systems are available for the WTP and Boby Plant. No common (or separate) standby system available (Dec 2016).
MO62	Moranbah WTP Filtration (both Boby and WTP)	Inadequate filter operation	Backwash valves (including wastewater isolation valves for the WTP) should be replaced to prevent further leaking and damage of air lines	Dec-16	Complete	
MO63	Moranbah WTP Filtration (both Boby and WTP)	Backwash discharging to Finger Dam	Finger Dam discharges should be reviewed in line with best practice processes and EPA requirements	Jun-17	Overdue	Requirements for flow and quality monitoring for backwash and waste water being sent to Finger Dam should be reviewed – review and necessary actions to be completed by Mar 2018
MO64	Moranbah WTP Filtration (both Boby and WTP)	Process control incapability	Install online turbidity analysers with alarms on common filter outlet of both Boby and WTP (Priority 1). Install online turbidity analysers on outlet of each filter (Priority 3).	Dec-16	In Progress	Upgrades in progress for main WTP. Boby Plant is not a priority at this stage as it is not in use.
MO65	Moranbah Filtered Water (Boby and WTP)	Process control incapability	Install treated water flowmeters on both treatment streams (Boby and WTP) (Priority 1). Flow pace treated water chemical dosing based on this instrument (Priority 2).	Jun-17	In Progress	To be considered during chemical and SCADA upgrades planned for 2018

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
MO66	Moranbah Filtered Water	Chemical dosing failure	Post chemical dosing order should be changed to chlorine gas, fluoride followed by lime as per best practice configuration	Jun-19	Pending	Current process is lime, chlorine gas followed by fluoride. Replacement of lime with sodium hydroxide is in progress. Chemical order and spacing of dosing points will be trialled at a later date prior to deadline. Will be completed as part of Chemical upgrades in 2018.
MO67	Moranbah Filtered Water (Boby WTP)	Process control incapability	Online analysers with alarms should be installed on the Boby WTP treated water to monitor chlorine residual, pH and turbidity	Jun-17	In Progress	Chemical dosing upgrades along with installation of online monitoring instruments and SCADA system is planned for 2018.
MO68	Moranbah Chlorine Dosing	Disinfection failure	Install a second regulator on the standby drum and provisions for auto-changeover	Dec-16	In Progress	A second set of scales will be required when auto-changeover is enabled Chemical dosing upgrades along with installation of online monitoring instruments and SCADA system is planned for 2018
MO69	Moranbah Chlorine Dosing	Disinfection failure	Install standby pump with auto-changeover capabilities on failure	Jun-17	In Progress	Chemical dosing upgrades along with installation of online monitoring instruments and SCADA system is planned for 2018
MO70	Moranbah Chlorine Dosing	Disinfection failure	Install common standby ejectors and chlorinators in case of failure or required maintenance	Jun-18	Pending	Will be completed as part of duty/standby upgrade
MO71	Moranbah Chlorine Dosing	Disinfection failure	Upgrade chlorine system to enable automatic shutdown of WTP and dial out alarms in the case of dosing failure. SCADA connection and remote control should also be considered for online, remote operation and monitoring	Jun-18	Pending	Will be completed as part of Chemical and SCADA upgrades planned for 2018.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
MO72	Moranbah Reservoirs / Water Towers	Aged Infrastructure-corrosion	Rust affected areas on weir boxes at inlet to treated water reservoirs should be replaced or repaired	Jun-17	Completed	
MO73	Moranbah Reservoirs / Water Towers	Animal access including birds and vermin	Weir boxes on treated water reservoirs should be enclosed to prevent contamination from vermin and birds	Dec-16	Completed	
G1	Glenden Raw Water	Algal Bloom	Implement Event-based algae and algal toxins monitoring based on observation of turkey nest and Xstrata/Sunwater WQ information	Dec-13	Completed	THMs are monitored monthly as an indicator for increased organics. IRC BGAMP has been developed. Liaison with Newland Coal will be required prior to finalisation of Glenden specific requirements.
G2	Glenden Raw Water	Rapid Variation in raw water quality	The current WTP process combined with operator input is considered capable of dealing with turbidity events. However, if future data shows that this system becomes unreliable, a raw water turbidity meter and/or SCM with alarms should be considered in future to assist operators in chemical dosing adjustments.	Jun-17	Complete	To be considered in future if monitoring shows future instrumentation to be necessary. Currently unlikely as raw water quality is monitored manually and online filtered water turbidity monitoring is in place and has been deemed sufficient.
G3	Glenden Raw Water	Rapid Variation in raw water quality caused by stormwater flows	Installation of Raw water Turbidity analyser would assist operators with indication of when coagulant adjustment is required.	Jun-15	Complete	RW turbidity is being monitored daily. To be considered in future if monitoring shows online instrumentation to be necessary.
G4	Glenden Raw Water	Chemical use in catchment areas (e.g. Weed spray)	Undertake monthly test for 1 year before reviewing the frequency.	Dec-13	Complete	
G5	Glenden Raw Water	Heavy metal in catchment (e.g. mining)	Undertake testing quarterly or annually (dependant on the heavy metal) as per revised verification monitoring programme.	Dec-13	Complete	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
G6	Glenden Raw Water	Wildlife Access (native and feral) and unrestricted livestock	Operational monitoring record of chlorine to be included for reticulation.	Dec-13	Complete	
G8	Glenden Raw Water	Heavy Rainfall / Flooding	Current barriers (Intake screening, WTP process, disinfection and turbidity monitoring) are considered sufficient. During Dec 2010 (high rainfall month) the treated water turbidity was compliant. Instruments as per G2 could be considered to provide additional assistance to operators.	Jun-17	Complete	To be considered in future if monitoring shows online instrumentation to be necessary.
G9	Glenden Raw Water	Drought / Bushfires	Current barrier (WTP process and turbidity monitoring) is considered sufficient. Instrumentation as per G2 could be considered as required in future to assist operators with monitoring.	Jun-17	Complete	To be considered in future if monitoring shows online instrumentation to be necessary.
G10	Glenden Raw Water	Equipment Failure	A maintenance schedule for the main items of process equipment to be implemented.	Jun-14	Complete	Operator to follow O&M manual and SBMP
G11	Glenden Raw Water	Demand Increase	Drought management plan to be implemented to provide triggers for water restrictions.	Dec-13	Complete	W&S Manager to review the drought management practice
G12	Glenden Raw Water	Uncovered storage	As per G6	Dec-13	Complete	
G15	Glenden WTP Inlet/ Flocculation	Process control incapability	Aluminium testing to be included in verification monitoring programme.	Dec-13	Complete	
G21	Glenden WTP General	Use of unapproved or contaminated water treatment chemicals	Current coagulant (alum) creates white solids in the base of the tanks creating maintenance problems. Consider alternative chemical supplier. This is an operational issue and will not be included in risk improvement programme.	#N/A	N/A	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
G25	Glenden WTP General	Formation of disinfection by-products	No chlorine pre-dosing at present but is being considered. THM monitoring added to verification monitoring programme on at least a monthly basis.	Dec-13	Complete	
G26	Glenden Clarification	Chemical dosing failure / Equipment Malfunction	Algal monitoring added to the verification monitoring programme.	Dec-13	Complete	
G27	Glenden Filtration	Process control incapability	Installation of treated water monitoring (turbidity, pH and chlorine) instrumentation with alarms would assist in assessing contamination.	Jun-15	Complete	Use filtered water turbidity to detect breakthrough
G28	Glenden Filtration	Inadequate filter operation	Installation of treated water monitoring (turbidity) instrumentation with alarms would assist in assessing filter performance. As per G23.	Jun-15	Complete	Use filtered water turbidity to detect breakthrough
G29	Glenden Filtration	Inadequate filter operation	Consider recording filter run time and backwashing after a set runtime rather than weekly.	Jun-14	Complete	Head loss is being used as an indicator for backwash requirements
G30	Glenden Filtration	Backwash recovery tank sludge return to Turkey Nest via sludge pond	Online turbidity & chlorine analyser and guidance will provide detection of turbidity spikes or low residual chlorine, as per G27	Jun-15	Complete	Use filtered water turbidity to detect breakthrough
G31	Glenden Filtration	Backwash recovery tank sludge return to Turkey Nest via sludge pond	Online turbidity & chlorine analyser and guidance will provide detection of turbidity spikes or low residual chlorine, as per G27	Jun-15	Complete	
G33	Glenden Filtered Water	Ineffective disinfection	Chlorine residual test results for the reticulation not currently available. Testing to be added to the operational monitoring programme.	Dec-13	Complete	
G34	Glenden Filtered Water	Chemical dosing failure	Process upsets will be detected by online turbidity and chlorine analysers and the respective alarms, as per G27	Jun-15	Complete	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
G36	Glenden Clear Water Tank / Water Tower	Build up of sediment and slime	Storage tank and water main flushing maintenance procedures to be formalised.	Jun-14	In Progress	Flushing procedure will be standardised as part of SOP update - in progress. No problem has been reported. Storage tank was last cleaned in Aug 2016.
G37	Glenden Clear Water Tank / Water Tower	Aged infrastructure / corrosion. Inadequate repair and maintenance	Develop a more robust testing programme. As per G33	Dec-13	Complete	
G38	Glenden Reticulation	Build up of sediment and slime	Council to implement flushing and maintenance programme	Jun-14	In Progress	Programme to be put in place for maintenance and inspection on a regular basis for all water schemes in the Isaac Regional Council area. Cost is dependent on frequency required
G40	Glenden Reticulation	Corrosion	Addressed by maintenance programme, as per G38	Jun-14	In Progress	Programme to be put in place for maintenance and inspection on a regular basis for all water schemes in the Isaac Regional Council area. Cost is dependent on frequency required
G42	Glenden Reticulation	Biofilms, sloughing and re-suspension, regrowth	Addressed by more comprehensive residual chlorine and E Coli testing, as per G33	Dec-13	Complete	
G44	Glenden Reticulation	Flow variability, inadequate pressures	Addressed by more comprehensive residual chlorine and E Coli testing, as per G33	Dec-13	Complete	
G45	Glenden Reticulation	Firefighting increasing demand on the network	Addressed by more comprehensive residual chlorine and E Coli testing, as per G33	Dec-13	Complete	
G46	Glenden Reticulation	Inadequate maintenance of chlorine residual	Addressed by more comprehensive residual chlorine and E Coli testing, as per G33	Dec-13	Complete	
G49	Glenden Whole System	Capacity	Monitored as the population increases and reviewed every year	Jun-17	Ongoing	Ongoing monitoring as growth is sensitive to new mine development/ expansion

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
G50	Glenden Raw Water	Inadequate signage	Install signage indicating raw water filling station (not for consumption).	Dec-16	In Progress	Temporary signage is in place. Permanent signage has been ordered and will be installed by Jan 2018.
G51	Glenden WTP General	Stop/ start plant operation	Adjust plant start and stop Clearwater Tank levels to increase run times. Additionally, variable speed drives (VSDs) can be installed on the raw water pumps to downrate plant for ideally 20 hrs/day operation.	Dec-16	Complete	Plant is only being run during day in the presence of operators.
G52	Glenden WTP General	Equipment failure or incorrect calibration	Redevelop operator check sheet to include more frequent plant checks including: chemical dosing pump drop tests, sodium hypochlorite concentration testing and instrument calibration.	Dec-16	In Progress	SOPs and operators check sheets are currently being reviewed and revised. To be completed by Mar 2018.
G53	Glenden WTP General	Poor reliability of process	Addition of SCADA and telemetry, plus online analysers with alarms (as per G27) to provide immediate notification of process failure.	Jun-18	Pending	
G54	Glenden WTP Inlet/ Flocculation	Chemical dosing failures	Install calibration tubes on all chemical dosing pumps. Complete drop tests regularly (as per G52).	Jun-17	Complete	Calibration tubes have been installed for Liquid Alum, Polymer and Sodium Hypochlorite and drop tests are being done regularly
G55	Glenden WTP Inlet/ Flocculation	Chemical dosing failures	Consider installing a service water system to supply dilution water for all chemical dosing at a ratio of 10:1 to assist in even dispersion and mixing.	Jun-19	Complete	NaOH, PAC and Polymer dosing has service water system
G56	Glenden WTP Inlet/ Flocculation	Chemical dosing failure	Configure flow paced dosing for all chemicals.	Jun-18	Pending	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
G57	Glenden WTP Inlet/ Flocculation	Equipment malfunction	Minimise number of starts of WTP by running as continuously as possible and ramp up flows on start up.	Jun-18	Pending	
G58	Glenden WTP Clarification	Aged infrastructure / corrosion. Inadequate repair and maintenance	Corrosion observed in flocculation zone of clarifier. Clarifier interior should be resealed.	Jun-17	Overdue	10 year CAPEX program is in place to address ageing infrastructure including replacement and renewals. Clarifier interior to be resealed by end of 2018
G59	Glenden Filtration	Inadequate filter operation	Inspect filters and refurbish/replace if required (including internal epoxy coatings, media, underdrains, nozzles, launders and valves).	Jun-17	Overdue	Filter refurbishment is planned for 2018-19. Filter backwash is triggered manually however the sequence is set on auto
G60	Glenden Filtration	Inadequate filter operation	Develop SOP for filter backwash to ensure manual backwash is completed more regularly (Priority 2). Reconfigure and automate backwash sequence based on headloss, turbidity and/or filter run time (Priority 3).	Jun-17	Complete	Filter backwash is triggered manually however the sequence is set on auto. Draft SOP is in place.
G61	Glenden Filtration	Process control incapability	Individual, online filtered water turbidity analysers with alarms would assist operators. Existing treated water turbidimeter should have alarms associated and be regularly calibrated (as per G52).	Dec-16	Overdue	Part of 10 year regional CAPEX program. To be considered during chemical and SCADA upgrades.
G62	Glenden Filtration	Inadequate filter operation	Investigate the need to install oxidation with chlorine prior to the filters if dissolved metals are consistently a problem in the raw water or increased concentration is seen in treated water	Jun-18	Ongoing	Raw water quality, filter operation and treated water quality are being monitored daily. Requirement for oxidation prior to filters to be considered in future is required.
G63	Glenden WTP Filtered Water	Ineffective disinfection	Install standby sodium hypochlorite dosing pump (Priority 1 Change) with auto changeover on fault (Priority 3 Change).	Dec-16	Overdue	To be done as part of Chemical upgrades. Not currently schedule but part of 10 year CAPEX program.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
G64	Glenden WTP Filtered Water	High turbidity levels in filtered water	Include turbidity monitoring at the filter outlet (individual filters) as part of operational monitoring	Dec-16	In Progress	Operational monitoring to be revised to include Manual sampling of individual filter for turbidity. Combined filtered water turbidity is monitored continuously (online). Daily operational monitoring sheet to be revised by Feb 2018
G65	Glenden WTP Filtered Water	Process control incapability	Install treated water flowmeter (Priority 1). Flow pace treated water chemical dosing based on this instrument (Priority 2).	Jun-17	Overdue	To be done as part of Chemical upgrades. Not currently schedule but part of 10 year CAPEX program.
N1	Nebo Bores	Unconfirmed/shallow aquifers	Revised operational and verification monitoring programme to be implemented to provide more regular chlorine residual monitoring.	Dec-13	Complete	
N2	Nebo Bores	Groundwater under direct influence of surface water	As per N1	Dec-13	Complete	
N3	Nebo Bores	Inadequate well head protection and unhygienic practices	As per N1	Dec-13	In Progress	Inspection deemed Bore 4 casing needs to be lifted
N4	Nebo Bores	Uncased or inadequately cased bores	As per N1	Dec-13	In Progress	Inspection deemed Bore 4 casing needs to be lifted
N5	Nebo Bores	Contaminated aquifers from onsite septic tanks discharge	Revised operational and verification monitoring programme to be implemented to provide additional turbidity data. Further assessment of turbidity data may result in further treatment being required.	Dec-13	Complete	Majority of town is connected to STP
N6	Nebo Bores	Contaminated aquifers from onsite septic tanks discharge	As per N1. Additional testing will provide the operators with more information on which basis to adjust chlorine dosing to appropriate levels.	Dec-13	Complete	Majority of town is connected to STP

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
N7	Nebo Bores	Pesticides use in the area	Pesticide monitoring included in new verification testing programme.	Dec-13	Complete	
N8	Nebo Bores	Heavy Rainfall	As per N1	N/A	Complete	
N9	Nebo Bores	Drought	Investigate the feasibility of hiring a water softening plant during drought conditions to reduce hardness.	Jun-14	Complete	Being addressed through using multiple bores
N11	Nebo Bores	No alternative water sources	IRC is working with DEWS on water supply to Nebo and Moranbah (already in progress).	Jun-14	Ongoing	Ongoing liaison with DEWS
N13	Nebo Bores	Equipment Failure	Install a chlorine analyser on the inlet to the water tower with alarm on high/low chlorine.	Jun-15	N/A	Funding for new WTP has been approved. No further actions are required for existing disinfection only system.
N15	Nebo Reservoirs	Build up of sediment and slime	Council to compile maintenance / flushing programme.	Jun-14	In Progress	Programme to be put in place for maintenance and inspection on a regular basis for all water schemes in the Isaac Regional Council area. Cost is dependent on frequency required.
N16	Nebo Reservoirs	Aged infrastructure / corrosion. Inadequate repair and maintenance	As per N15	Jun-14	In Progress	Programme to be put in place for maintenance and inspection on a regular basis for all water schemes in the Isaac Regional Council area. Cost is dependent on frequency required.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
N17	Nebo Reticulation	Inadequate disinfection	Undertake an assessment to confirm which users are receiving inadequately chlorinated water. Any users that require increased contact time could have a pipework coil installed in their connection to the reticulation. Alternatively, storage which allows contact time can be provided in a location that allows all consumers to be supplied appropriately disinfected water.	Jun-14	Complete	Additional monitoring to confirm adequate chlorine residual for connections upstream of the Water Tower – some consumers (4-5 connections) receive water direct from the bore (after chlorination but before entering the Water Tower). Ct modelling should be performed throughout the network to confirm adequate disinfection is achieved. Current data indicates Cl disinfection levels are being achieved
N18	Nebo Reticulation	Build up of sediment and slime	As per N15	Jun-14	In Progress	Flushing procedure will be standardised as part of SOP update
N19	Nebo Reticulation	Aged pipes (AC)	Council to monitor asset condition and complete maintenance programme as per N15	Jun-14	In Progress	Programme to be put in place for maintenance and inspection on a regular basis for all water schemes in the Isaac Regional Council area. Cost is dependent on frequency required.
N20	Nebo Reticulation	Corrosion	Council to monitor asset condition and complete maintenance programme as per N15	Jun-14	In Progress	Programme to be put in place for maintenance and inspection on a regular basis for all water schemes in the Isaac Regional Council area. Cost is dependent on frequency required.
N23	Nebo Reticulation	Biofilms, sloughing and re-suspension, regrowth	As per N15	Jun-14	In Progress	Programme to be put in place for maintenance and inspection on a regular basis for all water schemes in the Isaac Regional Council area. Cost is dependent on frequency required.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
N25	Nebo Reticulation	Flow variability, inadequate pressures	Some chlorine residual results not within limits and some E.coli samples also not within limits. Increase operational monitoring of chlorine in reticulation to give operators more data and ensure that chlorine dose rates are increased when required to maintain the necessary reticulation residual.	Dec-13	Complete	
N26	Nebo Reticulation	Firefighting increasing demand on the network	As per N25	Dec-13	Complete	
N27	Nebo Reticulation	Inadequate maintenance of chlorine residual	As per N25	Dec-13	Complete	
N30	Nebo Whole System	Capacity	Monitored as the population increases and reviewed every year	Dec-13	Ongoing	Ongoing monitoring as growth is sensitive to new mine development/ expansion
N31	Nebo General	Variation of raw water quality	Include weekly monitoring of iron and manganese in raw and treated water as part of operational monitoring. Include weekly iron and manganese testing in treated water as part of verification monitoring.	Dec-16	In Progress	Have advised plant operators on 22nd Aug 2017 to implement weekly Fe and Mn tests as part of operational monitoring
N32	Nebo Bores	Turbulent water as a result of using Bores 3,4 & 5 together	Extend pipework on either side of the flow meter (generally 10 diameters on either side is required, but is dependent on manufacturer) or move the flowmeter to reduce turbulence and improve accuracy of flow paced chlorine dosing	Jun-17	Complete	Only occurs when Bores 3, 4 and 5 are in operation together. Bores 3,4 & 5 are not used together
N33	Nebo Whole System	Failure/ incorrect chlorine dosing	Install an online chlorine analyser with alarms on the inlet to the water tower	Jun-17	N/A	Funding for new WTP has been approved. No further actions are required for existing disinfection only system.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
N34	Nebo Reticulation	Insufficient contact time for effective disinfection	Change configuration of the inlet and outlet to water tower to prevent short circuiting and allow sufficient contact time for effective disinfection	Dec-16	In Progress	ADWG 2011 includes a guideline C.t value of 15 min.mg/L, which is based on the World Health Organisation's recommendation that effective disinfection for bacteria and viruses can generally be achieved by applying a 30 minute contact time to a free chlorine concentration of 0.5 mg/L. Consider time spent in pipeline. New WTP and reservoir is expected to be completed by Jun 2019.
N35	Nebo Reticulation	Capacity	Install treated water reservoir with minimum three days storage in the reticulation	Jun-18	In Progress	Funding for new WTP has been approved. New WTP and reservoir is expected to be completed by Jun 2019.
CA1	Carmila Bores	Unconfirmed/shallow aquifers	Operational monitoring is to be revised to include more regular monitoring of some parameters.	Dec-13	Complete	
CA2	Carmila Bores	Groundwater under direct influence of surface water	As per CA1	Dec-13	Complete	
CA3	Carmila Bores	Inadequate well head protection and unhygienic practices	No further action. Data shows that reasonable steps have been taken by operators to minimise this risk and it is as low as practicable.	N/A	Complete	Concrete casing has been installed
CA5	Carmila Bores	Contaminated aquifers from onsite septic tanks discharge	Complete testing and sampling as per revised operational and verification testing programme to ensure all necessary parameters have been tested, documented and can be further actioned as required.	Dec-13	Complete	Operational and verification monitoring has been updated as per best practice recommendations
CA7	Carmila Bores	Contaminated aquifers from Carmila Creek and upstream tributaries	As per CA5	Dec-13	Complete	Operational and verification monitoring has been updated as per best practice recommendations

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
CA9	Carmila Bores	Heavy Rainfall	As per CA5	Dec-13	Complete	Operational and verification monitoring has been updated as per best practice recommendations
CA11	Carmila Bores	No alternative water sources	Emergency plan of water supply (Potable Water Tanker) to be developed.	Jun-16	In Progress	Water tankers from Sarina and/or Mackay to be utilised. Further liaison with MRC to develop emergency plan detail.
CA13	Carmila WTP General	Emergency Bypass valve accidentally opened	Bypass valve handle can be taken off and/or locked to further minimise this risk.	Dec-13	Complete	
CA14	Carmila WTP Inlet/ Flocculation	Process control incapability	Aluminium testing to be included in verification monitoring programme.	Dec-13	Complete	
CA18	Carmila WTP Inlet/ Flocculation	Chemical dosing failures	Install final water turbidity analyser with alarms to continuously monitor treated water turbidity and detect spikes	Jun-17	Complete	To be considered in future if monitoring shows online instrumentation to be necessary.
CA21	Carmila WTP Inlet/ Flocculation	Inadequate mixing due to mixer failure	Online turbidity monitoring and alarms, as per CA18	Jun-17	Complete	To be considered in future if monitoring shows online instrumentation to be necessary.
CA22	Carmila WTP Inlet/ Flocculation	Poor reliability of process	Online turbidity monitoring and alarms, as per CA18	Jun-17	Complete	To be considered in future if monitoring shows online instrumentation to be necessary.
CA23	Carmila WTP General	Formation of disinfection by-products	Verification monitoring to be undertaken for 6 months for THMs to ensure no problem.	Dec-13	Complete	
CA26	Carmila Filtration	Inadequate filter operation	As per CA18	Jun-17	Complete	To be considered in future if monitoring shows online instrumentation to be necessary.
CA27	Carmila Filtration	Equipment malfunction	Check spare pump availability from suppliers and keeping spare at Council depot.	Jun-15	Complete	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
CA29	Carmila Filtered Water	Ineffective disinfection	Operational monitoring of treated water chlorine level from weekly to daily testing (Priority 1 Change). Install online treated water pH and chlorine analyser with alarms (Priority 5 Change)	Jun-17	Complete	Priority 1 change complete. Online treated water pH / chlorine analyser with alarms pending ($15k) – to be considered in future if required
CA31	Carmila Reservoirs	Build up of sediment and slime	Council to continue/improve maintenance / flushing programme.	Jun-14	Complete	Programme to be put in place for maintenance and inspection on a regular basis for all water schemes in the Isaac Regional Council area.
CA33	Carmila Reticulation	Build up of sediment and slime	As per CA31	Jun-14	In Progress	Programme to be put in place for maintenance and inspection on a regular basis for all water schemes in the Isaac Regional Council area.
CA34	Carmila Reticulation	Aged pipes (AC)	As per CA29	Jun-14	Complete	Priority 1 change complete. Online treated water pH / chlorine analyser with alarms pending ($15k) – to be considered in future if required
CA35	Carmila Reticulation	Corrosion	As per CA31	N/A	Complete	Programme to be put in place for maintenance and inspection on a regular basis for all water schemes in the Isaac Regional Council area.
CA38	Carmila Reticulation	Biofilms, sloughing and re-suspension, regrowth	E.coli and chlorine residual within reticulation have been within limits. Chlorine residual and E.coli to be tested more frequently as part of new operational monitoring programme.	Dec-13	Complete	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
CA39	Carmila Reticulation	Pipe bursts or leaks. Inadequate repair and maintenance, inadequate system flushing and reservoir cleaning. Commissioning new mains.	As per CA38	Dec-13	Complete	
CA40	Carmila Reticulation	Flow variability, inadequate pressures	As per CA38	Dec-13	Complete	Pressure measurement should also be carried out - pending
CA41	Carmila Reticulation	Firefighting increasing demand on the network	As per CA38	Dec-13	Complete	Pressure measurement should also be carried out - pending
CA42	Carmila Reticulation	Inadequate maintenance of chlorine residual	As per CA38	Dec-13	Complete	
CA45	Carmila General	Process control incapability	Raw water turbidity and pH, clarified turbidity and filtered turbidity should be tested daily as part of operational monitoring (Priority 1 Change). Additionally, online monitoring with alarms should be installed to measure raw water turbidity and pH (Priority 3 Change), filtered water turbidity and final water pH, turbidity and chlorine residual (Priority 2 Change).	Dec-16	Complete	Refer to 2017-18 daily data logs for daily/operational monitoring program Online monitoring to be considered in future if required
CA46	Carmila General	Process control incapability	SCADA should be installed with remote access to reduce operator reliance	Jun-19	Complete	Plant is on VT SCADA to monitor treated water reservoirs level and raw water pump faults. Online monitoring for water quality to be considered in future if required.
CA47	Carmila General	Stop/ start plant operation	Adjust plant start and stop Clearwater Tank levels to increase run times. Additionally, variable speed drives (VSDs) can be installed on the raw water pumps to downrate plant for ideally 20 hrs/day operation.	Jun-17	Complete	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
CA48	Carmila General	Aging infrastructure	Reassess condition of package plant following sand blasting (to be completed FY 2015/16)	Dec-16	Complete	Treatment plant has been completely refurbished in 2016
CA49	Carmila Raw Water	Rapid variation in raw water quality	Raw water to be tested for iron and manganese as part of operational sampling. Pre-chlorine dose rate should be adjusted accordingly to oxidise any soluble metals	Dec-16	Complete	Raw water is tested for Iron and Manganese daily
CA50	Carmila WTP Inlet/ Flocculation	Over dosing of polymer	Install separate dosing pump and pipework for each dose point for better management of dosing	Jun-17	Complete	
CA51	Carmila WTP Inlet/ Flocculation	Chemical dosing failure	Configure flow paced dosing for all chemicals.	Jun-18	Completed	To be considered in future if required
CA52	Carmila WTP Inlet/ Flocculation	One dosing point for chlorine at head of WTP	Install second chlorine dosing point at inlet to Clear Water Tank for disinfection and residual	Dec-16	Complete	Chlorine is currently only dosed at the inlet to the WTP for oxidation and disinfection. Analysis of network samples indicate secondary chlorine dosing is not required. To be considered in future if required.
CA53	Carmila WTP General	Equipment failure	Incorporate cleaning of batching tanks as an operator task to be performed at least quarterly	Jun-17	In Progress	Plant (including chemical dosing systems) has been replaced.
CA54	Carmila WTP General	Lack of bunding around chemicals	Install bunds on chemical tanks in site building and chlorine storage shed	Dec-16	Overdue	Planned for installation in 2018
CA55	Carmila WTP Inlet/ Flocculation	Aging infrastructure	Replace aerator and consider installing new injection point for chlorine into raw water line prior to aeration	Dec-16	Complete	Sodium Hypo is being used for oxidation and is dosed in a raw water line upstream of Flash Mixer. There is no aerator in place. Additional injection point for chlorine is not required.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
CA56	Carmila WTP Inlet/ Flocculation	Poor reliability of process	Trial alternative chlorine dosing point (as per CA54) and install flocculator in floc zone of package plant	Jun-18	Complete	Flocculator in place in floc zone
CA57	Carmila Filtration	Inadequate filter operation	Backwash sequence should be adjusted to allow filter to drain down to 100 mm above the media before water wash begins	Jun-17	Complete	
CA58	Carmila Filtration	Inadequate filter operation	Install air scour system and integrate into backwash sequence to improve backwash effectiveness	Jun-18	Complete	Air scour is not possible for small size packaged unit
CA59	Carmila Filtration	Inadequate filter operation	Consider replacement of media after sand blasting of package plant has occurred. Review underdrains and nozzles in filter and consider upgrades if required	Jun-17	Complete	Plant was completely refurbished in 2016 including filter media and underdrain upgrades. Glass filter media in use.
CA60	Carmila WTP General	Backwash water draining to unknown location	Investigate EPA requirements for discharging waste streams and consider alternatives for discharging backwash water	Jun-17	Complete	Sludge drain and backwash water go to sludge drying beds, offsite discharge is no longer performed
CA61	Carmila WTP General	Equipment malfunction	Install new level sensor in filter interlocked with automatic filtered water outlet valve	Jun-17	Complete	Not being considered for installation with current operation.
CA62	Carmila Filtered Water	Human/animal access	Investigate options to replace hatch and lid so that it can be safely opened and closed by the operator to check water level (Priority 1 Change). Install level sensor in Clearwater Tank (Priority 3 Change)	Dec-16	In Progress	Clearwater roof will be refurbished including installation of hatch which can be safely opened and closed by operator in 2018
CA63	Carmila Filtered Water	Corrosion of treated water pumps	Investigate replacement options	Dec-16	Complete	Plant have been refurbished in 2016

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
CA64	Carmila Reservoirs	Ineffective disinfection	Increase operational monitoring in reticulation at additional sampling points during the summer months	Dec-16	Complete	Operational monitoring points and frequency have been increased. No issues have been experienced.
CA65	Carmila Reservoirs	Human/animal access	Ensure Elevated Reservoir is fully sealed and vermin proofed. Conduct regular inspections and cleaning of reservoirs.	Dec-16	Complete	New roof is in place.
SL1	St Lawrence Catchment	Rapid Variation in raw water quality	The current WTP process combined with operator input is considered capable of dealing with most turbidity events. Install raw water turbidity analyser with alarms to alert operator of water quality changes.	Jun-17	Complete	To be considered in future if monitoring shows future instrumentation to be necessary.
SL2	St Lawrence Catchment	Rapid Variation in raw water quality caused by stormwater flows	The colour testing procedure needs to be revised. Since the raw water is dosed with chlorine, True colour should be tested in samples sent to Queensland Health. Any sample that is above 15 HU should also be tested for THMs. These THM levels should be recorded and checked against ADWG limits. Further action may be required if THMs above 0.25mg/L are detected.	Dec-13	Complete	
SL3	St Lawrence Catchment	Algal bloom	Implement Event-based algae and algal toxins monitoring as part of external testing programme	Dec-13	Complete	IRC BGAMP has been developed.
SL4	St Lawrence Catchment	Chemical use in catchment areas (e.g. Weed spray)	Testing for pesticides on a regular basis is not required under the ADWG unless potential exists for contamination of the water supply. Annual test added to verification programme.	Dec-13	Complete	
SL7	St Lawrence Catchment	Changes in surrounding land use	Council to regularly review plans for industrial developments in the area.	Jun-17	Ongoing	Land use in catchment is largely grazing (rural).
SL11	St Lawrence Catchment	Demand Increase	Drought management to be implemented to provide triggers for water restrictions.	Jun-14	Complete	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
SL12	St Lawrence Catchment	Demand Increase	New operational and verification monitoring programmes to be put in place for more regular data collection.	Dec-13	Complete	Operational and verification testing programmes have been updated to include parameters as per recommendations in the DWQMP
SL15	St Lawrence Catchment	No alternative water sources	New operational and verification monitoring programmes to be put in place for more regular data collection. This will also provide more information for operators to use when adjusting treatment process.	Dec-13	Complete	Operational and verification testing programmes have been updated to include parameters as per recommendations in the DWQMP
SL16	St Lawrence WTP General	Significant Flow variations	Operating manual to be compiled.	Dec-13	In Progress	O&M manual is being prepared and compiled and expected to be completed by Jun 2018
SL17	St Lawrence WTP Inlet/ Flocculation	Process control incapability	Aluminium testing to be included in verification monitoring programme.	Dec-13	Complete	
SL22	St Lawrence WTP Inlet/ Flocculation	Inadequate mixing	Clarified (settled) water turbidity testing to be added to operational monitoring programme as this provides indication of adequate flocculation.	Dec-13	Ongoing	WTP has been upgraded. Requirement for settled water turbidity analysis to be reviewed
SL23	St Lawrence WTP Inlet/ Flocculation	Poor reliability of process	As perSL22	Dec-13	Ongoing	WTP has been upgraded. Requirement for settled water turbidity analysis to be reviewed
SL24	St Lawrence WTP General	Formation of disinfection by-products	Verification testing programme amended to include THMs.	Dec-13	Complete	
SL25	St Lawrence WTP General	Uncontrolled recycle of backwash water	Additional operational and verification monitoring will show if there are any additional chemical contaminants that are building up.	Dec-13	Complete	Backwash water is not being recycled

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
SL26	St Lawrence WTP General	Uncontrolled recycle of backwash water	Operating procedure to be prepared to minimise operational error. More extensive operational testing to be completed (e.g. Daily turbidity monitoring).	Jun-14	Complete	
SL28	St Lawrence Filtration	Inadequate filter operation	Turbidity analyser for treated water would assist operator to identify turbidity spikes.	Jun-17	Complete	To be considered in future if monitoring shows online instrumentation to be necessary
SL29	St Lawrence Filtration	Inadequate filter operation	As per SL28	N/A	Complete	Use filtered turbidity to detect breakthrough. Online turbidimeter to be considered in future if monitoring deems it necessary
SL30	St Lawrence Filtration	Equipment malfunction	Install spare backwash pump.	Jun-15	Complete	WTP has been upgraded/ refurbished
SL31	St Lawrence Filtered Water	Ineffective disinfection	Operational monitoring of treated water chlorine level from weekly to daily testing (Priority 1 Change). Install online pH and chlorine analyser with alarms (Priority 5 Change)	Jun-17	Complete	Treated water chlorine level is now monitored daily. To be considered in future if monitoring shows online instrumentation to be necessary.
SL32	St Lawrence Filtered Water	Chemical dosing failure	Future online pH and chlorine analyser, As per SL31	Jun-17	Complete	To be considered in future if monitoring shows online instrumentation to be necessary.
SL33	St Lawrence Filtered Water	Aging Carbon Filter	Install bypass pipework to allow flow bypass the carbon filter tank.	Jun-14	Complete	WTP has been upgraded / no carbon filter in place
SL34	St Lawrence Reservoirs	Human/animal access	Install access gate	Jun-15	Complete	
SL35	St Lawrence Reservoirs	Build up of sediment and slime	Council to compile maintenance / flushing programme.	Jun-14	Complete	Programme in place for maintenance and inspection on a regular basis for all water schemes in the Isaac Regional Council area.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
SL36	St Lawrence Reservoirs	Aged infrastructure / corrosion. Inadequate repair and maintenance	As per SL35	Jun-14	Complete	Programme in place for maintenance and inspection on a regular basis for all water schemes in the Isaac Regional Council area.
SL37	St Lawrence Reticulation	Aged pipes (AC)	As per SL35	Jun-14	Complete	Programme in place for maintenance and inspection on a regular basis for all water schemes in the Isaac Regional Council area. Cost is dependent on frequency required.
SL38	St Lawrence Reticulation	Corrosion	As per SL35	Jun-14	Complete	Programme in place for maintenance and inspection on a regular basis for all water schemes in the Isaac Regional Council area.
SL40	St Lawrence Reticulation	Biofilms, sloughing and re-suspension, regrowth	E.coli and chlorine residual within reticulation have been within limits. Chlorine residual to be tested more frequently as part of new operational monitoring programme.	Dec-13	Complete	
SL41	St Lawrence Reticulation	Pipe bursts or leaks. Inadequate repair and maintenance, inadequate system flushing and reservoir cleaning. Commissioning new mains.	As per SL40	Dec-13	Complete	
SL42	St Lawrence Reticulation	Flow variability, inadequate pressures	As per SL40	Dec-13	Complete	Pressure monitoring to be undertaken.
SL43	St Lawrence Reticulation	Firefighting increasing demand on the network	As per SL40	Dec-13	Complete	Pressure monitoring to be undertaken.
SL44	St Lawrence Reticulation	Inadequate maintenance of chlorine residual	As per SL40	Dec-13	Complete	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
SL45	St Lawrence Whole System	Chemical dosing failure	As per SL40	Dec-13	Complete	
SL46	St Lawrence Whole System	Power Failure	Backup generator should be considered.	Jun-15	Complete	
SL47	St Lawrence Whole System	Sabotage	WTP fencing/entrance gate to be put in place, as per SL34.	Jun-15	Complete	
SL48	St Lawrence WTP General	Aging infrastructure	Package plant should be recoated or replaced	Dec-16	Complete	
SL49	St Lawrence General	Variable water quality	Raw water turbidity and pH, clarified turbidity and filtered turbidity should be tested daily as part of operational monitoring (Priority 1 Change). Additionally, online monitoring with alarms should be installed to measure raw water turbidity and pH (Priority 3 Change), filtered water turbidity (Priority 1 Change) and final water pH, turbidity and chlorine residual (Priority 2 Change).	Dec-16	Complete	pH and turbidity of raw and treated water are being measured daily. Online monitoring to be considered in future is necessary.
SL50	St Lawrence General	Process control incapability	SCADA should be installed with remote access to reduce reliance on operator	Jun-18	Pending	
SL51	St Lawrence General	Power Failure	Install lightning rod to protect electrical systems and operators	Dec-16	Complete	
SL52	St Lawrence Whole System	Equipment failure	Procure and install a standby chlorine dosing pump with auto-changeover capabilities	Dec-16	Complete	Stand by pump is available at plant for manual changeover if and when required. Auto changeover to be consider during future plant upgrades.
SL53	St Lawrence Whole System	Process control incapability	Installation of appropriately sized calibration tubes on all dosing pumps. Include regular drop tests as part of operator checks	Jun-19	Pending	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
SL54	St Lawrence Whole System	Chemical dosing failures	Consider installing a service water system to supply dilution water for all chemical dosing at a ratio of 10:1 to assist in even dispersion and mixing.	Jun-19	Pending	
SL55	St Lawrence Whole System	Chemical dosing failure	Install raw water flowmeter and configure flow paced dosing for all pre- dosed chemicals.	Jun-18	Pending	
SL56	St Lawrence WTP Inlet/ Flocculation	Inadequate mixing	Install new mixer that can achieve a velocity gradient of 30 to 150/s	Jun-18	Pending	Mixer has been removed
SL57	St Lawrence WTP Inlet/ Flocculation	Inadequate mixing	Install new soda ash dosing point on the filter outlet after final chlorine dosing point	Jun-18	Pending	
SL58	St Lawrence Filtration	Backwash with primary filtered water	Configure system to use treated water as backwash water	Dec-16	Complete	
SL59	St Lawrence Filtration	Contamination of filtered water	Configure filter outlet valve operation to open and close (based on plant start/stop) to reduce potential for dry bedding to occur	Dec-16	Complete	
SL60	St Lawrence Filtration	Inadequate filter operation	As per SL49, filtered water turbidity should be monitored at least daily as part of the operational monitoring programme. Online turbidity meter should be installed to filter outlet and final treated water.	Dec-16	Complete	pH and turbidity of raw and treated water are being measured daily. Online monitoring to be considered in future is necessary.
SL61	St Lawrence Filtration	Inadequate filter operation (secondary filter)	Consider disconnecting secondary filter (limited knowledge of setup, including underdrain system and media configuration) until the filter can be inspected with view for full refurbishment or replacement	Jun-17	Complete	Plant has been refurbished, no secondary filter in place. Glass filter media in use.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
SL62	St Lawrence Filtered Water	Process control incapability	Treated water online monitoring of chlorine residual, turbidity and pH with alarms should be added	Jun-17	Complete	pH and turbidity of raw and treated water are being measured daily. Online monitoring to be considered in future is necessary.
SL63	St Lawrence Reservoirs	Aged infrastructure / corrosion. Inadequate repair and maintenance	Replace hatch and roof of Final Water Reservoir	Dec-16	In Progress	Refurbishment of roof including replacement of hatch is planned for 2018.
SL64	St Lawrence Reticulation	Dead ends in reticulation	Council to compile maintenance/flushing program as per GEN6	Jun-14	Complete	
MI1	Middlemount Raw Water	Algal Bloom	Implement Event-based Algae and Algal Toxin monitoring as part of external testing regime based on observations of Turkey Nest and Sunwater WQ information	Dec-13	Complete	IRC Blue Green Algae Management Plan has been developed.
MI2	Middlemount Raw Water	Rapid Variation in raw water quality	The current WTP process combined with operator input is considered capable of dealing with turbidity events. However, if future data shows that this system becomes unreliable, a raw water turbidity meter and/or SCM with alarms should be considered to assist operators in chemical dosing adjustments.	Jun-15	In Progress	Chemical and online monitoring upgrades at the WTP are currently in progress (in final stages of design Oct 2017)

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
MI3	Middlemount Raw Water	Rapid Variation in raw water quality caused by stormwater flows	The colour testing procedure is adequate for coagulant adjustment, but needs to be revised to ensure THMs are dealt with since the raw water is dosed with chlorine. True colour should be tested in samples sent to Queensland Health. Any sample that is above 15 HU should also be tested for THMs. These THM levels should be recorded and checked against ADWG limits. Further action may be required if THMs above 0.25mg/L are detected. Verification monitoring programme has been adjusted and will be followed in future.	Dec-13	Complete	Verification monitoring regime has been updated to include monthly THM testing
MI4	Middlemount Raw Water	Chemical use in catchment areas (e.g. Weed spray)	Pesticide testing added to verification monitoring programme.	Dec-13	Complete	
MI5	Middlemount Raw Water	Heavy metals (mining)	More comprehensive testing of metals added to verification testing programme.	Dec-13	Complete	
MI8	Middlemount Raw Water	Changes in surrounding land use	Monitor land use changes (ongoing)	Dec-13	Ongoing	
MI13	Middlemount WTP General	Significant Flow variations	Link treated water turbidity analyser outputs to alarms	Dec-13	In Progress	Inline treated water turbidity analyser in place however alarms are not working.
MI14	Middlemount WTP Inlet/ Flocculation	Chemical dosing failures	Turbidity spikes detected by online analysers, as per MI13	Dec-13	In Progress	Inline treated water turbidity analyser in place however alarms are not working.
MI15	Middlemount WTP Inlet/ Flocculation	Equipment malfunction	An operating procedure for manual operation of the plant should be included in the operating manual. (As per GEN2)	Dec-13	In Progress	Draft SOP have been completed. To be formalised by Feb 2018
MI17	Middlemount WTP Inlet/ Flocculation	Inadequate mixing	As per MI13	Dec-13	In Progress	Inline treated water turbidity analyser in place however alarms are not working.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
MI18	Middlemount WTP Inlet/ Flocculation	Poor reliability of process	As per MI13	Dec-13	In Progress	Inline treated water turbidity analyser in place however alarms are not working.
MI19	Middlemount WTP General	Formation of disinfection by-products	Incorporate THMs testing as part of regular external testing regime	Dec-13	Complete	
MI21	Middlemount Filtration	Process control incapability	Connect filtered water turbidity monitor to PLC with alarms as per item MI13	Dec-13	In Progress	Connected to PLC however alarm is not working
MI25	Middlemount Filtration	Equipment malfunction	Dry bedding will cause turbidity to spike. Turbidity alarm as per MI13 will assist the operator to identify there is a problem.	Dec-13	In Progress	Using filtered turbidity to detect breakthrough. Dry bedding does not occur at Middlemount. Turbidimeter is connected to SCADA but alarms are not currently working
MI26	Middlemount Filtered Water	Ineffective disinfection	Online final water chlorine analyser to be connected to the PLC for alarms	Dec-13	In Progress	SCADA and telemetry modifications. Chlorine analyser is online and connected to SCADA, but no alarms as yet
MI27	Middlemount WTP General	Sludge drying beds supernatant return to Turkey Nest	As per MI13 (link treated water turbidity to alarms), and MI25 (link chlorine meter to alarm).	Dec-13	Complete	
MI30	Middlemount Reservoirs	Aged infrastructure / corrosion. Inadequate repair and maintenance	Corrosion observed in the roof. Repair works to commence in 2012/13 and progressively completed in coming years.	Jun-17	Complete	
MI31	Middlemount Reticulation	Build up of sediment and slime	Council to compile maintenance / replacement programme.	Jun-14	In Progress	
MI32	Middlemount Reticulation	Aged pipes (AC)	as per MI31	Jun-14	In Progress	
MI33	Middlemount Reticulation	Corrosion	as per MI31	Jun-14	In Progress	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
MI34	Middlemount Reticulation	Infiltration and ingress of contamination from cross connections, backflow (soil and groundwater)	Complete system pressure monitoring to ensure low pressure zones properly identified.	Jun-17	Overdue	Review of infiltration, cross connection and backflow devices are currently being undertaken. Network modelling to be completed by 2019.
MI35	Middlemount Reticulation	Pipe bursts or leaks. Inadequate repair and maintenance, inadequate system flushing and reservoir cleaning. Commissioning new mains.	Chlorine testing in reticulation either not done or not recorded. To be added to operational monitoring programme to assist operators with maintaining an adequate residual.	Dec-13	Complete	
MI36	Middlemount Reticulation	Flow variability, inadequate pressures	As per MI34	Jun-17	Overdue	Review of infiltration, cross connection and backflow devices are currently being undertaken. Network modelling to be completed by 2019.
MI37	Middlemount Reticulation	Firefighting increasing demand on the network	As per MI34	Dec-13	Overdue	Network modelling to be commissioned separately and completed by 2019
MI38	Middlemount Reticulation	Inadequate maintenance of chlorine residual	As per MI35	Dec-13	Complete	
MI39	Middlemount Whole System	Chemical dosing failure	As per MI13 and MI25	Dec-13	In Progress	Analyser online but alarms not working
MI42	Middlemount WTP General	Rapid Variation in raw water quality	Increase frequency of iron and manganese operational monitoring in raw and treated water in order to accurately assess chlorine doses for oxidation	Dec-16	Complete	Iron and Manganese are currently being monitored weekly, external (verification) testing on Tuesdays and internal (operational) testing on Thursdays. Internal testing frequency should be increased to daily.
MI43	Middlemount Raw Water	Rapid Variation in raw water quality	Install potassium permanganate dosing system for improved oxidation of soluble metals	Dec-16	In Progress	Tender has been awarded for MMT chemical dosing upgrades.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
MI44	Middlemount WTP Inlet/ Flocculation	Chemical dosing failure	Configure flow paced dosing for all chemicals.	Jun-18	In Progress	Chemical systems upgrades are currently being upgraded.
MI45	Middlemount WTP Inlet/ Flocculation	Chemical dosing failure	Install standby dosing pumps for coagulant. Add auto changeover on pump fault (Priority 1 Change). Install caustic soda dosing system (to replace soda ash system), including duty/ standby dosing pumps (Priority 2 Change).	Dec-16	In Progress	Chemical systems upgrades are currently being upgraded.
MI46	Middlemount WTP Inlet/ Flocculation	Poor reliability of process	Consider changing order of raw water dosing to achieve optimal results (recommend soda ash dosed first, followed by chlorine then coagulant). PAC dosing (when required) should also be dosed prior to the flash mixer.	Jun-19	In Progress	Chemical systems upgrades are currently being upgraded. Optimum dosing arrangement will be incorporated into this project.
MI47	Middlemount Whole System	Equipment Failure	PE hosing should be changed to a suitable material for contact with chlorine	Dec-16	In Progress	Chemical systems upgrades are currently being upgraded.
MI48	Middlemount WTP Clarification	Poor clarification	Install polymer dosing system to aid in coagulation/ flocculation	Jun-17	In Progress	Chemical systems upgrades are currently being upgraded.
MI49	Middlemount WTP Inlet/ Flocculation	Equipment malfunction	Downrate the plant upon startup to minimise floc carryover to filters	Jun-18	Complete	
MI50	Middlemount Filtration	Inadequate filter operation	Reconfigure backwash sequence to improve filter performance and minimise media loss	Jun-17	Complete	
MI51	Middlemount Filtration	Process control incapability	Install online turbidity analysers on outlet of each filter.	Jun-18	In Progress	Chemical system and SCADA upgrades are currently being upgraded.
MI52	Middlemount Filtration	Process control incapability	Install level sensors in filters and reconfigure the backwash drain down sequence to be based on level	Dec-16	Complete	Backwash is being done manually. SOP is in place.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
MI53	Middlemount Filtration	Inadequate filter operation	Install standby air blower for air scour	Dec-16	In Progress	Chemical systems upgrades are currently being completed. A standby blower will be incorporated into this project.
MI54	Middlemount Filtration	Process control incapability	Change limits on filtered water turbidity analyser to be in line with ADWG recommendations	Dec-16	Complete	ADWG 2011 targets less than 0.2 NTU at filter outlet, with a critical limit of 0.5 NTU. Turbidimeter triggers alarm at 0.2 NTU.
MI55	Middlemount Whole system	Disinfection failure	Procure and install scales for each 70 kg chlorine gas cylinder	Dec-16	In Progress	Chemical systems are currently being upgraded. Cylinders will be replaced with a second 920kg drum
MI56	Middlemount Whole system	Disinfection failure	Install auto changeover capability on 70 kg chlorine gas cylinders	Dec-16	In Progress	Chemical systems are currently being upgraded. Cylinders will be replaced with a second 920kg drum
MI57	Middlemount Whole system	Process control incapability	Clean and calibrate chlorine analyser regularly as part of operator checks (Priority 1 Change). Install call out alarms on low and high chlorine residual (Priority 2 Change).	Dec-16	Complete	
MI58	Middlemount Whole system	Animal access to Clearwater Tanks including birds and vermin	Repair or replace mesh where vermin and birds can access Clearwater Tank #1	Dec-16	In Progress	Currently advertising for tenders to repair roof
MI59	Middlemount Whole system	Aged infrastructure/ corrosion	Hatch on Clearwater Tank #1 should be replaced.	Dec-16	In Progress	Currently advertising for tenders to repair roof
MI60	Middlemount Town Reservoir	Aged infrastructure/ corrosion	Areas of corrosion visible in roof. Repair or replace roof.	Jun-17	In Progress	Currently advertising for tenders to repair roof
MI61	Middlemount Town Reservoir	Ageing infrastructure and sludge buildup	Desludge Town Reservoir	Dec-16	Complete	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
MI62	Middlemount Town Reservoir	Inadequate maintenance of chlorine residual	Install new booster chlorine dosing system at Town Reservoir with online monitoring and alarms	Jun-17	Complete	Reservoirs have since been cleaned and booster chlorine system is no longer required. Reservoir maintenance program has been developed and should prevent any future build-up requiring additional chlorine dosing.
MI63	Middlemount Whole system	Tankered sewage discharges at Middlemount WTP	Discharge tankered sewage at Middlemount Sewage Treatment Plant only	Jun-17	Complete	
D1	Dysart Raw Water	Algal Bloom	Implement Event-based Algae and Algal Toxin monitoring as part of verification monitoring based on observations of Turkey Nest and Sunwater WQ information	Dec-13	Complete	
D2	Dysart Raw Water	Rapid Variation in raw water quality	The current WTP process combined with operator input is considered capable of dealing with turbidity events. However, if future data shows that this system becomes unreliable, a raw water turbidity meter and/or SCM with alarms should be considered to assist operators in chemical dosing adjustments.	Jun-17	Complete	
D3	Dysart Raw Water	Rapid Variation in raw water quality caused by stormwater flows	The colour testing procedure needs to be revised. Since the raw water is dosed with chlorine, True colour should be tested in samples sent to Queensland Health. Any sample that is above 15 HU should also be tested for THMs. These THM levels should be recorded and checked against ADWG limits. Further action may be required if THMs above 0.25mg/L are detected. This requirement has been added to the verification monitoring programme.	Dec-13	Complete	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
D4	Dysart Raw Water	Chemical use in catchment areas (e.g. Weed spray)	Pesticide testing added to verification monitoring programme.	Dec-13	Complete	
D5	Dysart Raw Water	Chemical use in catchment areas (mining)	Testing for metals added to the revised verification monitoring programme.	Dec-13	Complete	
D13	Dysart WTP Inlet/ Flocculation	Process control incapability	Verification monitoring to include more regular testing of aluminium.	Dec-13	Complete	
D16	Dysart WTP Inlet/ Flocculation	Equipment malfunction	Alarm on failure of inlet flowmeter and/or alarm on treated water turbidity measurement will alert the operator that there is a problem. Operating manual to be put in place to assist operators with manual operation (priority 2)	Dec-13	In Progress	SCADA and telemetry upgrades and modifications including alarms have been completed. New O&M manual will be developed following the Phase 2 Upgrades (mid 2018) to cover all aspects of plant operation.
D20	Dysart WTP General	Formation of disinfection by-products	Verification monitoring programme to include defined timeframe for THM testing.	Dec-13	Complete	
D21	Dysart Filtration	Process control incapability	Alarm on treated water turbidity to be implemented as per D16.	Dec-13	Complete	
D22	Dysart Filtration	Inadequate filter operation	Alarm on treated water turbidity to be implemented as per D16.	Dec-13	Complete	
D23	Dysart Filtration	Inadequate filter operation	Alarm on treated water turbidity to be implemented as per D16.	Dec-13	Complete	
D26	Dysart Filtered Water	Ineffective disinfection	Online chlorine analyser probe is to be replaced/upgraded and included in the PLC for alarms.	Dec-13	Complete	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
D27	Dysart WTP General	Sludge pond supernatant return	As per D16 and D26 to detect abnormal process conditions	N/A	In Progress	SCADA and telemetry upgrades and modifications including alarms have been completed. New O&M manual will be developed following the Phase 2 Upgrades (mid 2018) to cover all aspects of plant operation.
D29	Dysart Reservoirs	Build up of sediment and slime	Council to compile flushing/ maintenance programme.	Jun-14	In Progress	Reservoirs are cleaned regularly and networks are flushed regularly. Formal schedule for cleaning and flushing is being prepared. Draft SOP for main flushing is completed. To be formalised by Mar 2018.
D31	Dysart Reticulation	Build up of sediment and slime	As per D29	Jun-14	In Progress	Reservoirs are cleaned regularly and networks are flushed regularly. Formal schedule for cleaning and flushing is being prepared. Draft SOP for main flushing is completed. To be formalised by Mar 2018.
D32	Dysart Reticulation	Aged pipes (AC)	As per D29	Jun-14	In Progress	10 year CAPEX program is in place to address ageing infrastructure including replacement and renewals.
D33	Dysart Reticulation	Corrosion	As per D29	Jun-14	In Progress	10 year CAPEX program is in place to address ageing infrastructure including replacement and renewals.
D35	Dysart Reticulation	Biofilms, sloughing and re-suspension, regrowth	Chlorine testing in reticulation either not done or not recorded. To be added to operational monitoring programme to assist operators with maintaining an adequate residual. New flushing procedure is necessary	Dec-13	Complete	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
D36	Dysart Reticulation	Pipe bursts or leaks. Inadequate repair and maintenance, inadequate system flushing and reservoir cleaning. Commissioning new mains.	As per D35	Dec-13	Complete	
D37	Dysart Reticulation	Flow variability, inadequate pressures	Council to ensure that test results of pressure readings are recorded or a model produced for the reticulation network to identify any issues.	Jun-17	Overdue	Network modelling to be commissioned separately and completed by June 2019.
D38	Dysart Reticulation	Firefighting increasing demand on the network	As per D35	Dec-13	Complete	
D39	Dysart Reticulation	Inadequate maintenance of chlorine residual	As per D35	Dec-13	Complete	
D42	Dysart Whole System	Capacity	Monitor population on a yearly basis and assess against plant capacity.	Dec-13	Ongoing	
D43	Dysart General	Process control incapability	Complete matrix calibration to finalise commissioning of LiquID analyser	Dec-16	In Progress	LiquID matrix calibration and final commissioning is currently being arranged.
D44	Dysart General	Process control incapability	Ensure analysers are regularly calibrated as part of operator checks	Dec-16	Ongoing	All analysers are being calibrated regularly.
D45	Dysart General	Chemical dosing failure / Equipment Malfunction	Develop more robust chemical ordering process to ensure constant supply of required reagents for online analysers	Dec-16	Complete	Chemical supply contracts are in place.
D46	Dysart General	Process control incapability	Determine alarm limits and assign priorities, including shutdown and call out alarms, in SCADA	Dec-16	In Progress	Overall alarm hierarchy to be prepared for Phase 2 upgrades commissioning
D47	Dysart WTP Clarification	Process control incapability	Include operator changeable clarifier sludge blowdown setpoint on SCADA to increase control of frequency	Jun-17	In Progress	Further upgrades and automation to be included in Phase 2 works

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2017	Comments 2017
D48	Dysart General	Out of date Standard Operating Procedure	Develop/ Revise SOPs for new treatment processes at Dysart (as per GEN1) and all chemical systems	Dec-16	In Progress	Require updated SOPs for operation and maintenance of all chemical systems (e.g. filling poly and potassium permanganate hoppers, flushing poly dosing lines) Additional SOPs for new processes under Phase 2 Upgrades will be developed as part of commissioning finalisation and practical completion
D49	Dysart General	Equipment malfunction	Develop spare parts list for whole of plant	Dec-16	In Progress	Various new processes at WTP that require on the shelf spares
D50	Dysart Filtration	Inadequate filter operation	Confirm SCADA settings and capability for auto backwash trigger on high turbidity alarm	Dec-16	Complete	Refurbished filters automatically backwash based on run time, head loss or high filtered water turbidity set points
D51	Dysart General	Process control incapability	Ensure SCADA is showing all instrument and equipment values correctly	Dec-16	Complete	

Appendix B – Summary of Compliance with Water Quality Criteria

All testing results were obtained via the MRC lab, with the exception of daily free chlorine residuals which were obtained from operational plant monitoring data. Health and aesthetic exceedances are highlighted. Parameters that are not currently being measured but that are required by the approved monitoring program are highlighted red.

Carmila Treated Water

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min		Average		Max	LOR
E. coli	MPN/100mL	Weekly	54	0	0	<1	<1	<1	<1	<1	1.000
Residual Chlorine (Jul – Oct)	mg/L		22	22	0	0.8	0.9	1.5	2	2	none
Residual Chlorine (Nov -Jun)	mg/L		37	37	0	0.64	0.99	1.5	2.5	2.5	none
Turbidity	NTU		14	13	0	<0.1	<0.1	<0.1	<0.1	1.18	0.100
pH (Jul – Oct)	-		22	22	0	7.3	7.3	7.5	7.7	7.7	none
pH (Nov -Jun)	-		37	37	0	7.2	7.4	7.6	7.9	7.9	none
Aluminium	mg/L		52	1	0	<0.07	<0.07	<0.07	<0.07	0.07	0.070
Iron	mg/L		52	7	0	<0.007	<0.007	<0.007	<0.007	0.2279	0.007
Manganese	mg/L		52	12	0	<0.004	<0.004	<0.004	<0.004	0.065	0.004
Conductivity	µS/cm		54	54	N/A	161	267	330	407	721	none
Total Dissolved Solids (TDS)	mg/L		54	54	0	97	160	198	244	433	none
True Colour	TCU	Monthly	14	8	0	<1	<1	1.2	<1	5	1.000
Total Hardness	mg/L		14	14	0	79.65	82.83	94.83	108.37	109.03	none
Temporary Hardness	mg/L		14	14	N/A	75.3	77.7	90.5	101.4	105.0	none
Ammonia	mg/L		14	0	0	<0.01	<0.01	<0.01	<0.01	<0.01	0.010
Calcium	mg/L		14	14	N/A	18.07	18.67	22.20	27.37	27.94	none
Magnesium	mg/L		14	14	N/A	8.382	8.394	9.682	10.992	11.118	none

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min		Average		Max	LOR
Alkalinity	mg/L		14	14	N/A	75.3	77.7	90.5	101.3	105.0	none
Residual Alkalinity	meq/L		7	0	N/A	<0.1	<0.1	<0.1	<0.1	<0.1	0.100
THMs	µg/L		28	28	0	13	16.15	55.8571	101.55	104	none
Dissolved Oxygen	% Sat.		14	14	9 (Aesthetic)	68.7	73.9	83.4929	99.805	100	none
Fluoride	mg/L										
Arsenic	µg/L	Quarterly	5	2	0	<1	<1	0.3372	<1	0.936	1.000
Selenium	µg/L		5	0	0	<1	<1	<1	<1	<1	1.000
Lead	µg/L		5	0	0	<1	<1	<1	<1	<1	1.000
Mercury	µg/L		5	0	0	<0.05	<0.05	<0.05	<0.05	<0.05	0.050
Cadmium	mg/L		5	0	0	<0.002	<0.002	<0.002	<0.002	<0.002	0.002
Chromium	mg/L		5	0	0	<0.01	<0.01	<0.01	<0.01	<0.01	0.010
Nickel	mg/L		5	0	0	<0.03	<0.03	<0.03	<0.03	<0.03	0.030
Zinc	mg/L		5	1	0	<0.005	<0.005	0.00106	<0.005	0.0053	0.005
Copper	mg/L		5	0	0	<0.015	<0.015	<0.015	<0.015	<0.015	0.015
Hydrogen Sulphide	mg/L		5	0	0	<0.005	<0.005	<0.005	<0.005	<0.005	0.005
Radionuclides - Gross alpha	Bq/L		4	0	0	<0.05	<0.05	<0.05	<0.05	<0.05	0.050
Radionuclides - Gross beta	Bq/L		4	0	0	<0.10	<0.10	<0.10	<0.10	<0.10	0.100
Pesticides	µg/L	Annually									
Tin	µg/L		1	0	N/A	<1	<1	<1	<1	<1	1.000
Silver	µg/L		1	0	0	<1	<1	<1	<1	<1	1.000
Beryllium	µg/L										
Uranium	µg/L		1	0	0	<1	<1	<1	<1	<1	1.000
Iodide	µg/L		1	0	0	<20	<20	<20	<20	<20	20.000

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min		Average		Max	LOR
Molybdenum	µg/L		1	0	0	<1	<1	<1	<1	<1	1.000
Boron	µg/L		1	0	N/A	<1	<1	<1	<1	<1	1.000
Barium	µg/L		1	1	0	17.76	17.76	17.757	17.757	17.757	none

Carmila Reticulation

Parameter	Units	No Samples	Detections	Exceedances	Min	5 %ile	Average	95 %ile	Max	LOD
Sample Location: 6 Music St										
pH		52	52	0	7.30	7.40	7.58	7.77	7.90	-
Free Chlorine	mg/L	52	52	0	0.20	0.30	0.46	0.80	1.20	-
E. coli	MPN/100mL	53	0	0	<1	<1	<1	<1	<1	1.000

Carmila *E. coli*

Drinking water scheme: CARMILA

Year	***2016 - 2017***											
Month	***July***	***Aug***	***Sept***	***Oct***	***Nov***	***Dec***	***Jan***	***Feb***	***Mar***	***Apr***	***May***	***June***
No. of samples collected	8	9	8	10	10	8	10	8	6	8	10	8
No. of samples collected in which E. coli is detected (i.e. a failure)	0	0	0	0	0	0	0	0	0	0	0	0
No. of samples collected in previous 12 month period	52	57	61	67	73	77	83	87	89	93	99	103
No. of failures for previous 12 month period	0	0	0	0	0	0	0	0	0	0	0	0
% of samples that comply	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Compliance with 98% annual value	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Clermont Treated Water

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th Percentile	Average	95th Percentile	Max	LOR
E. coli	MPN/100mL	Weekly	56	0	0	<1	<1	<1	<1	<1	1.000
pH (Jul – Oct)	-		24	26	0	0.02	0.72	1.74	3.29	3.5	none
pH (Nov -Jun)	-		53	51	0	0.68	0.8	1.5	2.7	3.1	none
Residual Chlorine (Jul – Oct)	mg/L		24	26	0	6.98	7.04	7.28	7.65	7.67	none
Residual Chlorine (Nov -Jun)	mg/L		53	51	0	6.89	6.9	7.17	7.41	7.47	none
Aluminium	mg/L		54	1	0	<0.07	<0.07	<0.07	<0.07	0.0715	0.070
Iron	mg/L		54	0	0	<0.007	<0.007	<0.007	<0.007	<0.007	0.007
Manganese	mg/L		54	13	1 (Aesthetic)	<0.004	<0.004	<0.004	<0.004	0.1061	0.004
Total Dissolved Solids (TDS)	mg/L										
Conductivity	µS/cm										
Turbidity	NTU	Monthly	13	13	0	0.17	0.18	0.67	1.83	2.18	none
True Colour	TCU		13	7	0	<1	<1	<1	<1	4	1.000
Total Hardness	mg/L		13	13	0	44.26	54.00	82.02	120.29	121.47	none
Temporary Hardness	mg/L		13	13	N/A	65.7	75.4	92.0	120.4	123.7	none
Sodium	mg/L		2	2	0	57.56	57.59	57.80	58.01	58.03	none
Potassium	mg/L		3	3	N/A	2.491	2.565	3.121	3.598	3.638	none
Calcium	mg/L		13	13	N/A	11.367	14.287	20.167	29.100	30.261	none
Magnesium	mg/L		13	13	N/A	3.856	5.007	7.782	11.427	11.843	none
Alkalinity	mg/L		13	13	N/A	65.68	75.388	91.969231	120.428	123.74	none
Residual Alkalinity	meq/L										

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th Percentile	Average	95th Percentile	Max	LOR
THMs	µg/L		26	26	0	48	55	91	122	125	none
Dissolved Oxygen	% Sat.		13	13	6 (Aesthetic)	80	81	87	95	99	none
Algal Toxins	cells/mL		1	1	N/A	60	60	60	60	60	none
Fluoride	mg/L										
Ammonia	mg/L		13	0	0	<0.01	<0.01	<0.01	<0.01	<0.01	0.010
Arsenic	µg/L	Quarterly	5	2	0	<1	<1	<1	<1	0.536	1.000
Selenium	µg/L		5	0	0	<1	<1	<1	<1	<1	1.000
Lead	µg/L		5	0	0	<1	<1	<1	<1	<1	1.000
Mercury	µg/L		5	0	0	<0.05	<0.05	<0.05	<0.05	<0.05	0.050
Cadmium	mg/L		5	0	0	<0.002	<0.002	<0.002	<0.002	<0.002	0.002
Chromium	mg/L		5	0	0	<0.01	<0.01	<0.01	<0.01	<0.01	0.010
Nickel	mg/L		5	0	0	<0.03	<0.03	<0.03	<0.03	<0.03	0.030
Zinc	mg/L		5	0	0	<0.005	<0.005	<0.005	<0.005	<0.005	0.005
Copper	mg/L		5	0	0	<0.015	<0.015	<0.015	<0.015	<0.015	0.015
Hydrogen Sulphide	mg/L		5	0	0	<0.005	<0.005	<0.005	<0.005	<0.005	0.005
Radionuclides - Gross alpha	Bq/L		3	0	0	<0.05	<0.05	<0.05	<0.05	<0.05	0.050
Radionuclides - Gross beta	Bq/L		3	0	0	<0.10	<0.10	<0.10	<0.10	<0.10	0.100
Pesticides*	µg/L		4	0	N/A	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.000
Tin	µg/L	Annually	1	0	N/A	<1	<1	<1	<1	<1	1.000
Silver	µg/L		1	0	0	<1	<1	<1	<1	<1	1.000
Beryllium	µg/L										
Uranium	µg/L		1	0	0	<1	<1	<1	<1	<1	1.000

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th Percentile	Average	95th Percentile	Max	LOR
Iodide	µg/L		1	0	0	<20	<20	<20	<20	<20	20.000
Molybdenum	µg/L		1	0	0	<1	<1	<1	<1	<1	1.000
Boron	µg/L		1	1	N/A	24.373	24.373	24.373	24.373	24.373	none
Barium	µg/L		1	1	0	33.882	33.882	33.882	33.882	33.882	none

* 13 types of pesticides sampled – No Detections

Clermont Reticulation

Parameter	Units	No Samples	Detections	Exceedances	Min	5 %ile	Average	95 %ile	Max	LOD
Sample Location: Clermont Network Centenary Park										
pH	-	28	28	0	6.95	7.02	7.30	7.57	7.61	none
Free Chlorine	mg/L	28	28	0	0.2	0.2	1.1	2.2	2.3	none
E. coli	MPN/100mL	28	0	0	<1	<1	<1	<1	<1	1.000
Sample Location: Clermont Network Fitness Centre										
pH	-	19	19	0	6.95	7.02	7.30	7.57	7.61	none
Free Chlorine	mg/L	19	19	0	0.2	0.2	1.1	2.2	2.3	none
E. coli	MPN/100mL	17	0	0	<1	<1	<1	<1	<1	1.000
Sample Location: Clermont Network Spring Park										
pH	-	16	16	0	7.06	7.17	7.36	7.50	7.52	none
Free Chlorine	mg/L	16	16	0	0.73	0.81	1.14	1.43	1.5	none
E. coli	MPN/100mL	17	0	0	<1	<1	<1	<1	<1	1
Combined Retic Results for All Sample Points										
pH	-	63	63	0	6.95	7.06	7.34	7.61	7.85	none
Free Chlorine	mg/L	63	63	0	0.08	0.201	1.00	2.19	2.6	none
E. coli	MPN/100mL	64	0	0	<1	<1	<1	<1	<1	1.000

Clermont *E. coli*

Drinking water scheme: CLERMONT

Year	*2016 - 2017*											
Month	***July***	***Aug***	***Sept***	***Oct***	***Nov***	***Dec***	***Jan***	***Feb***	***Mar***	***Apr***	***May***	***June***
No. of samples collected	10	10	8	8	10	8	10	8	6	8	10	8
No. of samples collected in which E. coli is detected (i.e. a failure)	0	0	0	0	0	0	0	0	0	0	0	0
No. of samples collected in previous 12 month period	100	102	100	100	108	106	108	108	104	104	104	104
No. of failures for previous 12 month period	0	0	0	0	0	0	0	0	0	0	0	0
% of samples that comply	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Compliance with 98% annual value	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Dysart Treated Water

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th Percentile	Average	95th Percentile	Max	LOR
E. coli	MPN/100mL	Weekly	52	0	0	<1	<1	<1	<1	<1	1.000
Residual Chlorine (Jul – Oct)	mg/L		20	20	0	0.46	1.65	2.81	4.98	4.98	none
Residual Chlorine (Nov - Jun)	mg/L		44	44	0	1.34	1.58	2.54	3.4	4.4	none
Turbidity	NTU		13	13	1 (Aesthetic)	0.16	0.17	7.54	37.84	92	none
pH (Jul – Oct)	-		21	21	0	6.62	7.05	7.43	7.7	7.7	none
pH (Nov -Jun)	-		44	44	0	7.05	7.05	7.36	7.69	7.7	none
Iron	mg/L		50	0	0	<0.007	<0.007	<0.007	<0.007	<0.007	0.007
Manganese	mg/L		50	2	0	<0.004	<0.004	<0.004	<0.004	0.0107	0.004
Total Dissolved Solids (TDS)	mg/L		1	1	0	265	265	265	265	265	none
Conductivity	µS/cm		1	1	N/A	442	442	442.00	442	442	none
True Colour	TCU	Monthly	12	8	0	<1	<1	2.17	<1	5	1.000
Total Hardness	mg/L		12	12	0	60.43	64.16	83.67	107.39	120.85	none
Temporary Hardness	mg/L		11	11	N/A	51.5	55.25	68.07	84.8	91.7	none
Sodium	mg/L		1	1	0	27.047	27.047	27.047	27.047	27.047	none
Potassium	mg/L		1	1	N/A	4.716	4.716	4.716	4.716	4.716	none

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th Percentile	Average	95th Percentile	Max	LOR
Calcium	mg/L		13	13	N/A	14.12	16.53	20.03	23.66	25.48	none
Magnesium	mg/L		13	13	N/A	6.03	6.08	8.29	12.11	13.90	none
Alkalinity	mg/L		12	12	N/A	51.5	55.603	68.91	84.266	91.68	none
Residual Alkalinity	meq/L										
THMs	µg/L		25	25	0	18	21.4	89.00	230.4	247	none
Algal Toxins	cells/mL		1	1	N/A	380	380	380.00	380	380	none
Fluoride	mg/L										
Ammonia	mg/L		12	0	0	<0.01	<0.01	<0.01	<0.01	<0.01	0.010
Arsenic	µg/L	Alternate Months	5	2	0	<1	<1	0.28	<1	0.876	1.000
Selenium	µg/L	Quarterly	5	0	0	<1	<1	<1	<1	<1	1.000
Lead	µg/L		5	0	0	<1	<1	<1	<1	<1	1.000
Mercury	µg/L		5	0	0	<0.05	<0.05	<0.05	<0.05	<0.05	0.050
Cadmium	mg/L		4	0	0	<0.002	<0.002	<0.002	<0.002	<0.002	0.002
Chromium	mg/L		4	0	0	<0.01	<0.01	<0.01	<0.01	<0.01	0.010
Nickel	mg/L		4	0	0	<0.03	<0.03	<0.03	<0.03	<0.03	0.030
Zinc	mg/L		4	3	0	<0.005	<0.005	0.01	<0.005	0.0128	0.005
Copper	mg/L		4	4	0	0.016	0.016	0.018	0.021	0.022	none
Hydrogen Sulphide	mg/L		5	0	0	<0.005	<0.005	<0.005	<0.005	<0.005	0.005
Radionuclides - Gross alpha	Bq/L	Quarterly	3	0	0	<0.05	<0.05	<0.05	<0.05	<0.05	0.050

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th Percentile	Average	95th Percentile	Max	LOR
Radionuclides - Gross beta	Bq/L	Quarterly	3	1	N/A	<0.10	<0.10	0.03	<0.10	0.1	0.100
Pesticides	µg/L		4	4	N/A	0.055	0.085	0.452	1.092	1.239	none
Tin	µg/L	Annually	2	0	0	<1	<1	<1	<1	<1	1.000
Silver	µg/L	Annually	2	0	N/A	<1	<1	<1	<1	<1	1.000
Beryllium	µg/L										
Uranium	µg/L		2	0	0	<1	<1	<1	<1	<1	1.000
Iodide	µg/L		1	0	0	<20	<20	<20	<20	<20	20.000
Molybdenum	µg/L		2	0	N/A	<1	<1	<1	<1	<1	1.000
Boron	µg/L		2	2	0	35.37	35.51	36.79	38.08	38.22	none
Barium	µg/L		2	2	0	37.33	37.85	42.56	47.26	47.79	none

Dysart Reticulation

Parameter	Units	No Samples	Detections	Exceedances	Min	5 %ile	Average	95 %ile	Max	LOD
Sample Location: Dysart Network 1 Fisher St (May 2016 - Dec 2016)										
pH	-	9	9	0	7.05	7.21	7.51	7.70	7.7	none
Free Chlorine	mg/L	9	9	0	0.02	0.04	0.30	0.93	1.3	none
E. coli	MPN/100mL	9	0	0	<1	<1	<1	<1	<1	1.000
Sample Location: Dysart Network Office Shannon Crescent (Jun 2016 - Oct 2016)										
pH	-	8	8	0	7.2	7.25	7.57	7.85	7.85	none
Free Chlorine	mg/L	8	8	0	0.02	0.07	1.55	3.17	3.75	none
E. coli	MPN/100mL	8	0	0	<1	<1	<1	<1	<1	1.000
Sample Location: Dysart Network 3 Eales St (Jun 2016 - Aug 2016)										
pH	-	2	2	0	7.4	7.41	7.48	7.54	7.55	none
Free Chlorine	mg/L	2	2	0	1.37	1.40	1.63	1.86	1.89	none
E. coli	MPN/100mL	2	0	0	<1	<1	<1	<1	<1	1.000
Sample Location: Dysart Network Centenary Park (Nov 2016 - Jun 2017)										
pH	-	7	7	0	7.25	7.27	7.38	7.52	7.55	none
Free Chlorine	mg/L	7	7	0	0.38	0.43	0.83	1.27	1.28	none
E. coli	MPN/100mL	7	0	0	<1	<1	<1	<1	<1	1.000
Sample Location: Dysart Network Fisher St Sports Complex (Feb 2017 - Jun 2017)										
pH	-	4	4	0	7.3	7.32	7.43	7.49	7.5	none
Free Chlorine	mg/L	4	4	0	0.16	0.18	0.63	1.24	1.32	none
E. coli	MPN/100mL	4	0	0	<1	<1	<1	<1	<1	1.000
Sample Location: Dysart Network Fox Park (Jan 2017 - Jun 2017)										
pH	-	6	6	0	7.05	7.10	7.43	7.74	7.75	none
Free Chlorine	mg/L	6	6	0	0.22	0.33	0.89	1.44	1.5	none
E. coli	MPN/100mL	6	0	0	<1	<1	<1	<1	<1	1.000

Parameter	Units	No Samples	Detections	Exceedances	Min	5 %ile	Average	95 %ile	Max	LOD
Sample Location: Dysart Network Lions Park (Dec 2016 - May 2017)										
pH	-	9	9	0	7.35	7.35	7.51	7.63	7.65	none
Free Chlorine	mg/L	9	9	0	0.05	0.06	0.69	1.48	1.5	none
E. coli	MPN/100mL	9	0	0	<1	<1	<1	<1	<1	1.000
Sample Location: Dysart Network Powell St SPS (Dec 2016 - May 2017)										
pH	-	4	4	0	7.35	7.37	7.49	7.55	7.55	none
Free Chlorine	mg/L	4	4	0	0.24	0.30	0.76	1.08	1.08	none
E. coli	MPN/100mL	4	0	0	<1	<1	<1	<1	<1	1.000
Sample Location: Dysart Network 50 Brock Cres (Dec 2016 - May 2017)										
pH	-	4	4	0	7.4	7.45	7.66	7.79	7.8	none
Free Chlorine	mg/L	4	4	0	0.08	0.26	1.10	1.52	1.52	none
E. coli	MPN/100mL	4	0	0	<1	<1	<1	<1	<1	1.000
Combined Retic Results for All Sample Points										
pH	-	53	53	0	7.05	7.23	7.49	7.77	7.85	none
Free Chlorine	mg/L	53	53	0	0.02	0.06	0.86	1.96	3.75	none
E. coli	MPN/100mL	53	0	0	<1	<1	<1	<1	<1	1.000

Dysart *E. coli*

Drinking water scheme: DYSART

Year	***2016 - 2017***											
Month	***July***	***Aug***	***Sept***	***Oct***	***Nov***	***Dec***	***Jan***	***Feb***	***Mar***	***Apr***	***May***	***June***
No. of samples collected	9	10	8	8	10	8	10	8	6	8	10	8
No. of samples collected in which E. coli is detected (i.e. a failure)	0	0	0	0	0	0	0	0	0	0	0	0
No. of samples collected in previous 12 month period	83	89	92	96	102	105	107	107	103	103	103	103
No. of failures for previous 12 month period	0	0	0	0	0	0	0	0	0	0	0	0
% of samples that comply	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Compliance with 98% annual value	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Glenden Treated Water

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th Percentile	Average	95th Percentile	Max	LOR
E. coli	MPN/100mL	Weekly	50	0	0	<1	<1	<1	<1	<1	1.000
Free Chlorine Residual	mg/L		18	18	0	0.91	0.92	1.40	1.88	2.10	none
Free Chlorine Residual	mg/L		58	58	0	0.89	1.04	1.41	2.10	2.10	none
Turbidity	NTU		14	14	0	0.16	0.19	0.37	0.62	0.63	none
pH	-		21	21	0	6.95	6.95	7.15	7.38	7.55	none
pH	-		58	58	0	7.15	7.15	7.26	7.36	7.40	none
Aluminium	mg/L		48	2	0	<0.07	<0.07	0.00	<0.07	0.08	0.070
Iron	mg/L		48	0	0	<0.007	<0.007	<0.007	<0.007	<0.007	0.007
Manganese	mg/L		48	0	0	<0.004	<0.004	<0.004	<0.004	<0.004	0.004
Total Dissolved Solids (TDS)	mg/L										
Conductivity	µS/cm										
True Colour	TCU	Monthly	13	8	0	<1	<1	2.23	<1	7.00	1.000
Total Hardness	mg/L		13	13	0	57.99	58.50	69.65	83.89	85.98	none
Temporary Hardness	mg/L		13	13	N/A	40.00	40.48	56.02	70.82	76.40	none
Calcium	mg/L		13	13	N/A	16.78	16.82	19.66	22.76	23.07	none
Magnesium	mg/L		13	13	N/A	4.02	4.07	5.06	6.57	6.89	none
Alkalinity	mg/L		13	13	N/A	39.96	40.45	56.01	70.79	76.38	none
Residual Alkalinity	meq/L		7	0	N/A	<0.1	<0.1	<0.1	<0.1	<0.1	0.100
THMs	µg/L		25	24	0	<5	<5	52.88	<5	178.00	5.000
Algal Toxins	cells/mL										
Dissolved Oxygen	% Sat.		13	13	0	88.50	89.10	94.78	100.34	101.90	none

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th Percentile	Average	95th Percentile	Max	LOR
Ammonia	mg/L		12	1	0	<0.01	<0.01	0.00	<0.01	0.04	0.010
Fluoride	mg/L										
Pesticides*	µg/L		5	0	N/A	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.000
Arsenic	µg/L	Quarterly	5	0	0	<1	<1	<1	<1	<1	1.000
Selenium	µg/L		5	0	0	<1	<1	<1	<1	<1	1.000
Lead	µg/L		5	0	0	<1	<1	<1	<1	<1	1.000
Mercury	µg/L		5	0	0	<0.05	<0.05	<0.05	<0.05	<0.05	0.050
Cadmium	mg/L		4	0	0	<0.002	<0.002	<0.002	<0.002	<0.002	0.002
Chromium	mg/L		4	0	0	<0.01	<0.01	<0.01	<0.01	<0.01	0.010
Nickel	mg/L		4	0	0	<0.03	<0.03	<0.03	<0.03	<0.03	0.030
Zinc	mg/L		4	0	0	<0.005	<0.005	<0.005	<0.005	<0.005	0.005
Copper	mg/L		4	0	0	<0.015	<0.015	<0.015	<0.015	<0.015	0.015
Hydrogen Sulphide	mg/L		6	0	0	<0.005	<0.005	<0.005	<0.005	<0.005	0.005
Radionuclides - Gross alpha	Bq/L		5	1	0	<0.05	<0.05	0.02	<0.05	0.08	0.050
Radionuclides - Gross beta	Bq/L		5	0	0	<0.10	<0.10	<0.10	<0.10	<0.10	0.100
Tin	µg/L	Annually	1	0	N/A	<1	<1	<1	<1	<1	1.000
Silver	µg/L		1	0	0	<1	<1	<1	<1	<1	1.000
Beryllium	µg/L										
Uranium	µg/L		1	0	0	<1	<1	<1	<1	<1	1.000
Iodide	µg/L		1	0	0	<20	<20	<20	<20	<20	20.000
Molybdenum	µg/L		1	0	0	<1	<1	<1	<1	<1	1.000
Boron	µg/L		1	1	N/A	13.76	13.76	13.76	13.76	13.76	none
Barium	µg/L		1	1	0	16.49	16.49	16.49	16.49	16.49	none

*13 types of pesticides sampled

Glenden Reticulation

Parameter	Units	No Samples	Detections	Exceedances	Min	5 %ile	Average	95 %ile	Max	LOD
Sample Location: Glenden Network 7B Usher Terrace (Jan 2017 - Jun 2017)										
pH	-	13	13	0	6.95	6.98	7.04	7.12	7.15	none
Free Chlorine	mg/L	13	13	0	0.7	0.76	0.95	1.10	1.1	none
E. coli	MPN/100mL	13	0	0	<1	<1	<1	<1	<1	1.000
Sample Location: Glenden Network Depot (Jan 2017 - Jun 2017)										
pH	-	12	12	0	7	7.00	7.16	7.43	7.53	none
Free Chlorine	mg/L	12	12	0	0.25	0.44	0.93	1.27	1.28	none
E. coli	MPN/100mL	12	0	0	<1	<1	<1	<1	<1	1.000
Sample Location: Glenden Network Golf Club (Jul 2016 - Jun 2017)										
pH	-	13	13	0	7	7.03	7.23	7.50	7.5	none
Free Chlorine	mg/L	13	13	0	0.24	0.52	0.92	1.26	1.52	none
E. coli	MPN/100mL	13	0	0	<1	<1	<1	<1	<1	1.000
Sample Location: Glenden Network Library (Jul 2016 - Jun 2017)										
pH	-	12	12	0	7	7.06	7.22	7.45	7.5	none
Free Chlorine	mg/L	12	12	0	0.54	0.57	0.84	1.14	1.18	none
E. coli	MPN/100mL	12	0	0	<1	<1	<1	<1	<1	1.000
Combined Retic Results for All Sample Points										
pH	-	50	50	0	6.95	7.00	7.16	7.50	7.53	none
Free Chlorine	mg/L	50	50	0	0.24	0.56	0.91	1.26	1.52	none
E. coli	MPN/100mL	50	0	0	<1	<1	<1	<1	<1	1.000

Glenden *E. coli*

Drinking water scheme: GLENDEN

Year	*2016 - 2017*											
Month	***July***	***Aug***	***Sept***	***Oct***	***Nov***	***Dec***	***Jan***	***Feb***	***Mar***	***Apr***	***May***	***June***
No. of samples collected	8	10	8	8	10	8	6	8	7	9	10	8
No. of samples collected in which E. coli is detected (i.e. a failure)	0	0	0	0	0	0	0	0	0	0	0	0
No. of samples collected in previous 12 month period	104	106	104	104	106	104	102	102	99	100	102	100
No. of failures for previous 12 month period	0	0	0	0	0	0	0	0	0	0	0	0
% of samples that comply	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Compliance with 98% annual value	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Middlemount Treated Water

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min		Average		Max	LOR
E. coli	MPN/100mL	Weekly	51	0	0	<1	<1	<1	<1	<1	1.000
Residual Chlorine (Jul – Oct)	mg/L		20	20	0	0.09	0.28	2.29	2.98	2.98	none
Residual Chlorine (Nov -Jun)	mg/L		53	53	0	1.61	1.89	2.77	3.48	3.75	none
Turbidity	NTU		13	12	0	<0.1	<0.1	0.58	<0.1	2.83	0.100
pH (Jul – Oct)	-		19	19	0	6.98	7.00	7.24	7.43	7.49	none
pH (Nov -Jun)	-		53	53	N/A	7.00	7.00	7.35	7.87	8.41	none
Iron	mg/L		50	0	0	<0.007	<0.007	<0.007	<0.007	<0.007	0.007
Manganese	mg/L		50	7	0	<0.004	<0.004	0.00	<0.004	0.04	0.004
Total Dissolved Solids (TDS)	mg/L										
Conductivity	µS/cm										
True Colour	TCU	Monthly	13	9	0	<1	<1	3.00	<1	13.00	1.000
Total Hardness	mg/L		12	12	0	59.80	60.75	80.15	107.55	119.00	none
Temporary Hardness	mg/L		11	11	N/A	55.80	58.85	73.25	90.65	95.10	none
Calcium	mg/L		12	12	N/A	13.07	14.34	17.89	23.54	25.85	none
Magnesium	mg/L		12	12	N/A	5.97	6.31	8.64	11.98	13.22	none
Alkalinity	mg/L		12	12	N/A	55.76	59.15	73.12	90.21	95.10	none
Residual Alkalinity	meq/L										
THMs	µg/L		26	25	0	<5	<5	101.08	<5	174.00	5.000
Algal Toxins	cells/mL		1	1	N/A	220.00	220.00	220.00	220.00	220.00	none
Dissolved Oxygen	% Sat.		12	12	1	83.90	86.76	91.93	97.30	99.00	none

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min		Average		Max	LOR
					(Aesthetic)						
Fluoride	mg/L										
Ammonia	mg/L		12	1	0	<0.01	<0.01	0.00	<0.01	0.02	0.010
Arsenic	µg/L	Quarterly	4	3	0	<1	<1	0.76	<1	1.12	1.000
Selenium	µg/L		4	0	0	<1	<1	<1	<1	<1	1.000
Lead	µg/L		4	0	0	<1	<1	<1	<1	<1	1.000
Mercury	µg/L		4	0	0	<0.05	<0.05	<0.05	<0.05	<0.05	0.050
Cadmium	mg/L		4	0	0	<0.002	<0.002	<0.002	<0.002	<0.002	0.002
Chromium	mg/L		4	0	0	<0.01	<0.01	<0.01	<0.01	<0.01	0.010
Nickel	mg/L		4	0	0	<0.03	<0.03	<0.03	<0.03	<0.03	0.030
Zinc	mg/L		4	3	0	<0.005	<0.005	0.01	<0.005	0.01	0.005
Copper	mg/L		4	0	0	<0.015	<0.015	<0.015	<0.015	<0.015	0.015
Hydrogen Sulphide	mg/L		4	0	0	<0.005	<0.005	<0.005	<0.005	<0.005	0.005
Radionuclides - Gross alpha	Bq/L		5	0	0	<0.05	<0.05	<0.05	<0.05	<0.05	0.050
Radionuclides - Gross beta	Bq/L		5	1	0	<0.10	<0.10	0.02	<0.10	0.10	0.100
Pesticides - Diuron	µg/L		5	0	N/A	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.000
Pesticides - Tebuthiuron	µg/L		5	3	N/A	<0.0001	<0.0001	0.17	<0.0001	0.38	0.000
Pesticides - Simazine	µg/L		5	2	N/A	<0.0001	<0.0001	0.11	<0.0001	0.30	0.000
Pesticides* - Metolachlor	µg/L		5	1	N/A	<0.0001	<0.0001	0.02	<0.0001	0.12	0.000
Tin	µg/L	Annually	1	0	N/A	<1	<1	<1	<1	<1	1.000
Silver	µg/L		1	0	0	<1	<1	<1	<1	<1	1.000
Beryllium	µg/L										

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min		Average		Max	LOR
Uranium	µg/L		1	0	0	<1	<1	<1	<1	<1	1.000
Iodide	µg/L		2	0	0	<20	<20	<20	<20	<20	20.000
Molybdenum	µg/L		1	0	0	<1	<1	<1	<1	<1	1.000
Boron	µg/L		1	1	N/A	33.98	33.98	33.98	33.98	33.98	none
Barium	µg/L		1	1	0	27.03	27.03	27.03	27.03	27.03	none

*13 types of pesticides sampled – types not shown had no detections

Middlemount Reticulation

Parameter	Units	No Samples	Detections	Exceedances	Min	5 %ile	Average	95 %ile	Max	LOD
Sample Location: Middlemount Network 12 Clarence Baker Drive (Aug 2016 - Mar 2017)										
pH	-	4	4	0	7.27	7.28	7.39	7.49	7.5	none
Free Chlorine	mg/L	4	4	0	0.02	0.08	0.68	1.39	1.5	none
E. coli	MPN/100mL	4	0	0	<1	<1	<1	<1	<1	1.000
Sample Location: Middlemount Network Council Office (Jul 2016 - Feb 2017)										
pH	-	9	9	0	7.17	7.21	7.55	8.22	8.42	none
Free Chlorine	mg/L	9	9	0	0.04	0.05	0.27	0.46	0.48	none
E. coli	MPN/100mL	9	0	0	<1	<1	<1	<1	<1	1.000
Sample Location: Middlemount Network Emu Park (Jul 2016 - Jun 2017)										
pH	-	10	10	0	7.13	7.13	7.39	7.68	7.71	none
Free Chlorine	mg/L	10	10	0	0.07	0.07	0.33	1.11	1.55	none
E. coli	MPN/100mL	10	0	0	<1	<1	<1	<1	<1	1.000
Sample Location: Middlemount Network Footy Fields (Feb 2017 - Jun 2017)										
pH	-	4	4	0	7.13	7.16	7.34	7.50	7.52	none
Free Chlorine	mg/L	4	4	0	0.31	0.33	0.84	1.74	1.92	none
E. coli	MPN/100mL	4	0	0	<1	<1	<1	<1	<1	1.000
Sample Location: Middlemount Network Kookaburra Park (Apr 2017 - Jun 2017)										
pH	-	3	3	0	7.04	7.07	7.25	7.40	7.41	none
Free Chlorine	mg/L	3	3	0	0.45	0.51	0.87	1.11	1.11	none
E. coli	MPN/100mL	3	0	0	<1	<1	<1	<1	<1	1.000
Sample Location: Middlemount Network MMT Golf Course (Mar 2017 - May 2017)										
pH	-	4	4	0	7.1	7.12	7.28	7.41	7.41	none
Free Chlorine	mg/L	4	4	0	0.39	0.40	0.61	0.86	0.9	none
E. coli	MPN/100mL	4	0	0	<1	<1	<1	<1	<1	1.000

Parameter	Units	No Samples	Detections	Exceedances	Min	5 %ile	Average	95 %ile	Max	LOD
Sample Location: Middlemount Network Rural Traders (Jul 2016 - Aug 2016)										
pH	-	2	2	0	7.09	7.10	7.20	7.30	7.31	none
Free Chlorine	mg/L	2	2	0	0.38	0.39	0.45	0.50	0.51	none
E. coli	MPN/100mL	2	0	0	<1	<1	<1	<1	<1	1.000
Sample Location: Middlemount Network Shopping Centre OLD (Jul 2016 - Jun 2017)										
pH	-	13	13	0	7.07	7.08	7.33	7.63	7.74	none
Free Chlorine	mg/L	13	13	0	0.02	0.06	0.61	1.68	2.74	none
E. coli	MPN/100mL	13	0	0	<1	<1	<1	<1	<1	1.000
Combined Retic Results for All Sample Points										
pH	-	49	49	0	7.04	7.09	7.37	7.75	8.42	none
Free Chlorine	mg/L	49	49	0	0.02	0.05	0.52	1.53	2.74	none
E. coli	MPN/100mL	49	0	0	<1	<1	<1	<1	<1	1.000

Middlemount *E. coli*

Drinking water scheme: MIDDLEMOUNT

Year	*2016 - 2017*											
Month	***July***	***Aug***	***Sept***	***Oct***	***Nov***	***Dec***	***Jan***	***Feb***	***Mar***	***Apr***	***May***	***June***
No. of samples collected	8	10	8	8	10	8	10	8	8	7	10	8
No. of samples collected in which E. coli is detected (i.e. a failure)	0	0	0	0	0	0	0	0	0	0	0	0
No. of samples collected in previous 12 month period	98	100	100	102	104	102	104	106	104	103	103	103
No. of failures for previous 12 month period	0	0	0	0	0	0	0	0	0	0	0	0
% of samples that comply	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Compliance with 98% annual value	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Moranbah WTP

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th Percentile	Average	95th Percentile	Max	LOR
E. coli	MPN/100mL	Weekly	52	0	0	<1	<1	<1	<1	<1	1.000
Residual Chlorine (Jul – Oct)	mg/L		20	20	0	0.31	1.17	1.73	2.35	3.11	none
Residual Chlorine (Nov -Jun)	mg/L		58	58	0	1.04	1.24	1.60	1.93	2.35	none
Turbidity	NTU		12	12	1 (Aesthetic)	0.15	0.19	0.99	3.67	5.60	none
pH (Jul – Oct)	-		20	20	0	6.50	6.79	7.15	7.52	7.80	none
pH (Nov -Jun)	-		58	58	0	7.00	7.13	7.52	8.06	8.07	none
Aluminium	mg/L										
Iron	mg/L		50	1	0	<0.007	<0.007	0.00	<0.007	0.01	0.007
Manganese	mg/L		50	0	0	<0.004	<0.004	<0.004	<0.004	<0.004	0.004
Total Dissolved Solids (TDS)	mg/L										
Conductivity	µS/cm										
True Colour	TCU	Monthly	12	8	0	<1	<1	1.17	<1	3.00	1.000
Total Hardness	mg/L		12	12	0	48.49	52.88	62.83	71.12	74.76	none
Temporary Hardness	mg/L		12	12	N/A	43.80	51.28	64.83	73.32	78.10	none
Calcium	mg/L		12	12	N/A	11.41	12.27	14.73	17.24	18.51	none
Magnesium	mg/L		12	12	N/A	4.86	5.40	6.44	7.17	7.47	none
Alkalinity	mg/L		12	12	N/A	43.80	51.27	64.83	73.28	78.06	none
Residual Alkalinity	meq/L										
THMs	µg/L		18	18	0	15.00	15.00	33.50	43.95	55.00	none

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th Percentile	Average	95th Percentile	Max	LOR
Algal Toxins	cells/mL										
Dissolved Oxygen	% Sat.		12	12	0	86.60	87.10	93.53	103.33	103.60	none
Fluoride	mg/L		52	51	0	0.05	0.06	0.54	0.74	0.85	none
Ammonia	mg/L		12	0	0	<0.01	<0.01	<0.01	<0.01	<0.01	0.010
Arsenic	µg/L	Quarterly	5	0	0	<1	<1	<1	<1	<1	1.000
Selenium	µg/L		5	1	0	<1	<1	0.20	<1	1.02	1.000
Lead	µg/L		5	0	0	<1	<1	<1	<1	<1	1.000
Mercury	µg/L		5	0	0	<0.05	<0.05	<0.05	<0.05	<0.05	0.050
Cadmium	mg/L		4	0	0	<0.002	<0.002	<0.002	<0.002	<0.002	0.002
Chromium	mg/L		4	0	0	<0.01	<0.01	<0.01	<0.01	<0.01	0.010
Nickel	mg/L		4	0	0	<0.03	<0.03	<0.03	<0.03	<0.03	0.030
Zinc	mg/L		5	4	0	<0.005	<0.005	0.01	<0.005	0.01	0.005
Copper	mg/L		5	0	0	<0.015	<0.015	<0.015	<0.015	<0.015	0.015
Hydrogen Sulphide	mg/L		5	0	0	<0.005	<0.005	<0.005	<0.005	<0.005	0.005
Radionuclides - Gross alpha	Bq/L		2	0	0	<0.05	<0.05	<0.05	<0.05	<0.05	0.050
Radionuclides - Gross beta	Bq/L		2	1	0	<0.10	<0.10	0.08	<0.10	0.15	0.100
Pesticides*	µg/L		4	0	N/A	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.000
Tin	mg/L	Annually	1	0	N/A	<1	<1	<1	<1	<1	1.000
Silver	µg/L		1	0	0	<1	<1	<1	<1	<1	1.000
Beryllium	µg/L										
Uranium	µg/L		1	0	0	<1	<1	<1	<1	<1	1.000
Iodide	µg/L										

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th Percentile	Average	95th Percentile	Max	LOR
Molybdenum	mg/L		1	0	0	<1	<1	<1	<1	<1	1.000
Boron	µg/L		1	1	N/A	31.33	31.33	31.33	31.33	31.33	none
Barium	µg/L		1	1	0	42.00	42.00	42.00	42.00	42.00	none

*13 types of pesticides sampled – no detections

Moranbah Reticulation

Parameter	Units	No Samples	Detections	Exceedances	Min	5 %ile	Average	95 %ile	Max	LOD
Sample Location: Moranbah Network #1 Belyando Ave (Jul 2016 - Jun 2017)										
pH	-	19	19	0	7.01	7.04	7.41	7.95	8.03	none
Free Chlorine	mg/L	19	19	0	0.89	1.10	1.45	1.86	1.86	none
E. coli	MPN/100mL	19	0	0	<1	<1	<1	<1	<1	1.000
Sample Location: Moranbah Network #2 cnr Jackson & Cuthbert (Jul 2016 - Jun 2017)										
pH	-	20	20	0	6.99	7.00	7.39	7.80	8.02	none
Free Chlorine	mg/L	20	20	0	0.6	0.68	0.98	1.26	1.74	none
E. coli	MPN/100mL	20	0	0	<1	<1	<1	<1	<1	1.000
Sample Location: Moranbah Network #3 1A Archer Drive (Jul 2016 - Jun 2017)										
pH	-	23	23	0	7.03	7.05	7.48	7.84	7.86	none
Free Chlorine	mg/L	21	21	0	0.48	0.98	1.31	1.93	1.96	none
E. coli	MPN/100mL	21	0	0	<1	<1	<1	<1	<1	1.000
Sample Location: Moranbah Network #4 Binda Park (Jul 2016 - Jun 2017)										
pH	-	19	19	0	7	7.01	7.47	7.85	8.29	none
Free Chlorine	mg/L	19	19	0	0.57	0.64	1.18	2.06	2.2	none
E. coli	MPN/100mL	19	0	0	<1	<1	<1	<1	<1	1.000
Sample Location: Moranbah Network #5 O'Neil St (Jul 2016 - Jun 2017)										
pH	-	20	20	0	6.75	6.99	7.36	7.68	7.89	none
Free Chlorine	mg/L	20	20	0	0.34	0.35	0.71	1.29	1.38	none
E. coli	MPN/100mL	20	0	0	<1	<1	<1	<1	<1	1.000
Sample Location: Moranbah Network 114 Mcool St (13 Jul 2017)										
pH	-	1	1	0	6.5	6.50	6.50	6.50	6.5	none
Free Chlorine	mg/L	1	1	0	1.09	1.09	1.09	1.09	1.09	none

Sample Location: Moranbah Network 29 Connor Dr (14 Mar 2017)										
pH	-	2	2	0	7.18	7.18	7.18	7.18	7.18	none
Free Chlorine	mg/L	2	2	0	1.66	1.66	1.66	1.66	1.66	none
E. coli	MPN/100mL	1	0	0	<1	<1	<1	<1	<1	1.000
Sample Location: Moranbah Network 3 Finch St (14 Mar 2017)										
pH	-	2	2	0	7.6	7.60	7.60	7.60	7.6	none
Free Chlorine	mg/L	2	2	0	1.46	1.46	1.46	1.46	1.46	none
E. coli	MPN/100mL	1	0	0	<1	<1	<1	<1	<1	1.000
Sample Location: Moranbah Network 50m swimming pool (13 Jul 2017)										
pH	-	1	1	1	6.28	6.28	6.28	6.28	6.28	none
Combined Retic Results for All Sample Points										
pH	-	106	106	1	6.28	7.00	7.41	7.86	8.29	none
Free Chlorine	mg/L	103	103	0	0.34	0.47	1.14	1.86	2.2	none
E. coli	MPN/100mL	101	0	0	<1	<1	<1	<1	<1	1.000

Moranbah *E. coli*

Drinking water scheme: MORANBAH

Year	***2016 - 2017***											
Month	***July***	***Aug***	***Sept***	***Oct***	***Nov***	***Dec***	***Jan***	***Feb***	***Mar***	***Apr***	***May***	***June***
No. of samples collected	14	14	12	12	14	12	14	12	11	12	14	12
No. of samples collected in which E. coli is detected (i.e. a failure)	0	0	0	0	0	0	0	0	0	0	0	0
No. of samples collected in previous 12 month period	146	146	146	146	148	148	150	150	151	151	153	153
No. of failures for previous 12 month period	0	0	0	0	0	0	0	0	0	0	0	0
% of samples that comply	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Compliance with 98% annual value	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Nebo Treated Water

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th Percentile	Average	95th Percentile	Max	LOR
E. coli	MPN/100mL	Weekly	51	0	0	<1	<1	<1	<1	<1	1.000
Residual Chlorine (Jul – Oct)	mg/L		18	18	0	0.53	0.57	0.78	0.93	0.96	none
Residual Chlorine (Nov -Jun)	mg/L		38	37	0	<0.02	<0.02	0.66	<0.02	1.40	0.020
Turbidity	NTU		12	12	0	0.11	0.11	0.21	0.27	0.28	none
pH (Jul – Oct)	-		18	18	0	6.75	6.75	6.89	7.06	7.10	none
pH (Nov -Jun)	-		38	38	0	6.70	6.80	6.88	7.01	7.05	none
Total Dissolved Solids (TDS)	mg/L		48	48	25 (Aesthetic)	268	287	561	845	880	none
Conductivity	µS/cm		51	51	N/A	446	479	943	1416	1466	none
True Colour	TCU	Monthly	12	7	0	<1	<1	2	<1	7.00	1.000
Total Hardness	mg/L		12	12	6 (Aesthetic)	71.59	109.36	258.08	444.53	487.57	none
Temporary Hardness	mg/L		12	12	N/A	108.9	112.9	163.7	243.0	244.2	none
Sodium	mg/L		1	1	0	38.42	38.42	38.42	38.42	38.42	none
Potassium	mg/L		1	0	N/A	<1	<1	<1	<1	<1	1.000
Calcium	mg/L		12	12	N/A	20.34	27.31	54.00	87.96	95.52	none
Magnesium	mg/L		12	12	N/A	5.05	10.61	30.43	54.99	60.48	none
Alkalinity	mg/L		12	12	N/A	108.92	112.87	163.66	242.99	244.20	none
Residual Alkalinity	meq/L		5	0	N/A	<0.1	<0.1	<0.1	<0.1	<0.1	0.100
THMs	µg/L		21	9	0	<5	<5	19	<5	165	5.000
Dissolved Oxygen	% Sat.		12	12	11 (Aesthetic)	56.2	60.3	70.7	83.8	85.9	none
Fluoride	mg/L		1	1	0	0.1156	0.1156	0.1156	0.1156	0.1156	none

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th Percentile	Average	95th Percentile	Max	LOR
Arsenic	µg/L	Quarterly	5	0	0	<1	<1	<1	<1	<1	1.000
Selenium	µg/L		5	0	0	<1	<1	<1	<1	<1	1.000
Lead	µg/L		5	3	0	<1	<1	<1	<1	1.10	1.000
Mercury	µg/L		5	0	0	<0.05	<0.05	<0.05	<0.05	<0.05	0.050
Ammonia	mg/L		12	0	0	<0.01	<0.01	<0.01	<0.01	<0.01	0.010
Cadmium	mg/L		4	0	0	<0.002	<0.002	<0.002	<0.002	<0.002	0.002
Chromium	mg/L		4	0	0	<0.01	<0.01	<0.01	<0.01	<0.01	0.010
Nickel	mg/L		4	0	0	<0.03	<0.03	<0.03	<0.03	<0.03	0.030
Zinc	mg/L		4	4	0	0.0059	0.0062	0.0083	0.01	0.01	none
Copper	mg/L		4	0	0	<0.015	<0.015	<0.015	<0.015	<0.015	0.015
Hydrogen Sulphide	mg/L		5	0	0	<0.005	<0.005	<0.005	<0.005	<0.005	0.005
Radionuclides - Gross alpha	Bq/L		4	1	0	<0.05	<0.05	<0.05	<0.05	0.05	0.050
Radionuclides - Gross beta	Bq/L		4	0	0	<0.10	<0.10	<0.10	<0.10	<0.10	0.100
Iron	mg/L	Annually	1	0	0	<0.007	<0.007	<0.007	<0.007	<0.007	0.007
Manganese	mg/L		1	0	0	<0.004	<0.004	<0.004	<0.004	<0.004	0.004
Tin	µg/L		2	0	N/A	<1	<1	<1	<1	<1	1.000
Silver	µg/L		2	0	0	<1	<1	<1	<1	<1	1.000
Beryllium	µg/L										
Uranium	µg/L		2	0	0	<1	<1	<1	<1	<1	1.000
Iodide	µg/L		1	0	0	<20	<20	<20	<20	<20	20.000
Molybdenum	µg/L		2	0	0	<1	<1	<1	<1	<1	1.000
Boron	µg/L		2	2	N/A	18.38	18.47	19.28	20.09	20.18	none
Barium	µg/L		2	2	0	11.49	11.51	11.78	12.04	12.07	none

Nebo Reticulation

Parameter	Units	No Samples	Detections	Exceedances	Min	5 %ile	Average	95 %ile	Max	LOD
Sample Location: Nebo Network Depot (Jul 2016 - Jun 2017)										
pH	-	15	15	0	6.7	6.77	6.89	7.05	7.05	none
Free Chlorine	mg/L	15	15	0	0.14	0.16	0.50	1.02	1.2	none
E. coli	MPN/100mL	23	0	0	<1	<1	<1	<1	<1	1.000
Sample Location: Nebo Network Office (Jul 2016 - Jun 2017)										
pH	-	28	28	0	6.75	6.82	6.95	7.10	7.2	none
Free Chlorine	mg/L	28	28	0	0.02	0.16	0.63	1.00	1.06	none
E. coli	MPN/100mL	28	0	0	<1	<1	<1	<1	<1	1.000
Combined Retic Results for All Sample Points										
pH	-	51	51	0	6.7	6.80	6.93	7.10	7.2	none
Free Chlorine	mg/L	51	51	0	0.02	0.16	0.61	1.03	1.2	none
E. coli	MPN/100mL	51	0	0	<1	<1	<1	<1	<1	1.000

Nebo *E. coli*

Drinking water scheme: NEBO

Year	***2016 - 2017***											
Month	***July***	***Aug***	***Sept***	***Oct***	***Nov***	***Dec***	***Jan***	***Feb***	***Mar***	***Apr***	***May***	***June***
No. of samples collected	8	10	8	8	10	8	8	8	8	8	10	8
No. of samples collected in which E. coli is detected (i.e. a failure)	0	0	0	0	0	0	0	0	0	0	0	0
No. of samples collected in previous 12 month period	120	117	109	104	99	104	104	104	102	102	104	102
No. of failures for previous 12 month period	1	0	0	0	0	0	0	0	0	0	0	0
% of samples that comply	99.2%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Compliance with 98% annual value	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

St Lawrence Treated Water

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th Percentile	Average	95th Percentile	Max	LOR
E. coli	MPN/100mL	Weekly	51	0	0	<1	<1	<1	<1	<1	1.000
Residual Chlorine (Jul – Oct)	mg/L		19	19	0	1.00	1.18	1.75	2.00	2.00	none
Residual Chlorine (Nov -Jun)	mg/L		59	59	0	1.06	1.20	1.82	2.50	2.50	none
Turbidity	NTU		13	12	0	<0.1	<0.1	0.51	<0.1	1.39	0.100
pH (Jul – Oct)	-		19	19	0	7.10	7.10	7.31	7.60	7.60	none
pH (Nov -Jun)	-		59	59	0	7.10	7.10	7.36	7.60	7.70	none
Aluminium	mg/L		49	22	3 (Aesthetic)	<0.07	<0.07	<0.07	<0.07	0.59	0.070
Iron	mg/L		49	11	0	<0.007	<0.007	0.01	<0.007	0.12	0.007
Manganese	mg/L		49	15	0	<0.004	<0.004	0.01	<0.004	0.08	0.004
Total Dissolved Solids (TDS)	mg/L		51	51	0	58.00	114.50	156.18	216.00	263.00	none
Conductivity	µS/cm		51	51	N/A	97.00	190.50	260.37	360.00	438.10	none
True Colour	TCU	Monthly	13	6	0	<1	<1	1.38	<1	7.00	1.000
Total Hardness	mg/L		13	13	0	26.92	28.89	37.16	55.19	73.48	none
Temporary Hardness	mg/L		12	12	N/A	30.20	33.12	52.59	71.00	75.40	none
Calcium	mg/L		13	13	N/A	6.09	6.11	8.37	12.54	16.42	none
Magnesium	mg/L		13	13	N/A	2.69	2.75	3.99	5.86	7.89	none
Alkalinity	mg/L		13	13	N/A	30.22	33.36	53.42	70.58	75.42	none
Residual Alkalinity	meq/L		7	0	N/A	<0.1	<0.1	<0.1	<0.1	<0.1	0.100

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th Percentile	Average	95th Percentile	Max	LOR
THMs	µg/L		27	26	0	<5	<5	104	<5	189	5.000
Fluoride	mg/L										
Dissolved Oxygen	% Sat.	Quarterly	13	13	1 (Aesthetic)	80.40	83.76	90.06	99.16	102.40	none
Arsenic	µg/L		4	0	0	<1	<1	<1	<1	<1	1.000
Selenium	µg/L		4	0	0	<1	<1	<1	<1	<1	1.000
Lead	µg/L		4	0	0	<1	<1	<1	<1	<1	1.000
Mercury	µg/L		4	0	0	<0.05	<0.05	<0.05	<0.05	<0.05	0.050
Ammonia	mg/L		13	1	0	<0.01	<0.01	<0.01	<0.01	0.03	0.010
Cadmium	mg/L		4	0	0	<0.002	<0.002	<0.002	<0.002	<0.002	0.002
Chromium	mg/L		4	0	0	<0.01	<0.01	<0.01	<0.01	<0.01	0.010
Nickel	mg/L		4	0	0	<0.03	<0.03	<0.03	<0.03	<0.03	0.030
Zinc	mg/L		4	1	0	<0.005	<0.005	<0.005	<0.005	0.01	0.005
Copper	mg/L		4	1	0	<0.015	<0.015	0.02	<0.015	0.08	0.015
Hydrogen Sulphide	mg/L		4	1	1 (Aesthetic)	<0.005	<0.005	0.25	<0.005	1.00	0.005
Radionuclides - Gross alpha	Bq/L		3	0	0	<0.05	<0.05	<0.05	<0.05	<0.05	0.050
Radionuclides - Gross beta	Bq/L		3	0	0	<0.10	<0.10	<0.10	<0.10	<0.10	0.100
Pesticides*	µg/L	Annually	1	0	N/A	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.000
Tin	µg/L		1	0	N/A	<1	<1	<1	<1	<1	1.000
Silver	µg/L		1	0	0	<1	<1	<1	<1	<1	1.000
Beryllium	µg/L										
Uranium	µg/L		1	0	0	<1	<1	<1	<1	<1	1.000

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th Percentile	Average	95th Percentile	Max	LOR
Iodide	µg/L		1	0	0	<20	<20	<20	<20	<20	20.000
Molybdenum	µg/L		1	0	0	<1	<1	<1	<1	<1	1.000
Boron	µg/L		1	1	N/A	20.07	20.07	20.07	20.07	20.07	none
Barium	µg/L		1	1	0	14.92	14.92	14.92	14.92	14.92	none

*13 types of pesticides sampled – no detections

St Lawrence Reticulation

Parameter	Units	No Samples	Detections	Exceedances	Min	5 %ile	Average	95 %ile	Max	LOD
Sample Location: St Lawrence Network 36 Macartney St (Jul 2016 - Jun 2017)										
pH	-	51	51	0	7.1	7.10	7.34	7.60	7.7	none
Free Chlorine	mg/L	51	51	0	0.2	0.20	0.43	0.70	1.5	none
E. coli	MPN/100mL	51	1	0	<1	<1	<1	<1	1	1.000
Sample Location: St Lawrence Network QR Railyard (Jul 2017										
pH	-	3	3	0	6.9	6.92	7.17	7.50	7.55	none
Free Chlorine	mg/L	3	3	0	0.2	0.23	0.50	0.77	0.8	none
E. coli	MPN/100mL	3	0	0	<1	<1	<1	<1	<1	1.000
Combined Retic Results for All Sample Points										
pH	-	54	54	0	6.9	7.10	7.33	7.60	7.7	none
Free Chlorine	mg/L	54	54	0	0.2	0.20	0.43	0.70	1.5	none
E. coli	MPN/100mL	54	1	0	<1	<1	<1	<1	1	1.000

St Lawrence *E. coli*

Drinking water scheme: ST LAWRENCE

Year	*2016 - 2017*											
Month	***July***	***Aug***	***Sept***	***Oct***	***Nov***	***Dec***	***Jan***	***Feb***	***Mar***	***Apr***	***May***	***June***
No. of samples collected	8	10	8	9	10	8	11	8	6	8	10	8
No. of samples collected in which E. coli is detected (i.e. a failure)	0	0	0	0	0	0	1	0	0	0	0	0
No. of samples collected in previous 12 month period	76	82	86	91	97	101	105	105	102	103	104	104
No. of failures for previous 12 month period	0	0	0	0	0	0	1	1	1	1	1	1
% of samples that comply	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%
Compliance with 98% annual value	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Appendix C – External Audit Report

DWQMP Regular Audit Report

Isaac Regional Council

November 2017

VIRIDIS CONSULTANTS

DWQMP Regular Audit Report

Isaac Regional Council

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Document History and Status

Revision	Date	Reviewed by	Signature	Details
0.1	8 Nov 2017	James Howey	JH	Internal review.
1.0	24 Nov 2017	Tasleem Hasan		Final, following client review and acceptance.

Author:	Tasleem Hasan
Project manager:	Tasleem Hasan
Name of client:	Isaac Regional Council
Name of project:	DWQMP Regular Audit Report
Name of document:	Isaac Regional Council
Document number	REC-17-214
Document version:	1.0
Project number	17QU28

Executive Summary

The auditor believes that Isaac Regional Council overall demonstrated good compliance with the regular audit criteria imposed by the *Water Supply (Safety and Reliability) Act 2008*.

The auditor noted that there have been best efforts to provide safe drinking water. In particular, it was pleasing to note the following:

- staff endeavor to do a good job and now there is less turn-over of staff (mid-upper level) and a new structure to strengthen water quality management
- external testing is undertaken at a NATA accredited laboratory with automated processes for quick short-term assessment of results
- critical control points (CCPs) have been established and are being implemented
- operators are required to hold at least a certificate III in water operations, and new operators are actively supported to obtain this qualification
- a 10-year capital plan has been approved by Council and work on upgrading the water treatment plants is underway
- there is realisation that the DWQMP needs to be streamlined to make it more user-friendly.

The audit concluded that Council:

- would benefit from strengthening the data validity and review process associated with the DWQMP annual reports provided to the regulator
- implemented its DWQMP fully for most of the elements
- would benefit highly from reviewing the relevance of the plan.

The summary of compliance is shown in Table 1, eleven (11) requirements were audited. Recommendations and opportunities for improvement have been identified, where relevant.

Table 1 Compliance Summary

Compliance Codes		Number of Findings
Compliant	C	8
Minor Non-Compliant	N	3
Major Non-Compliant	M	0

There were three (3) minor non-compliances identified across the audit areas, which related to data accuracy in the DWQMP annual reports, the incident management process and plan relevance.

Council should undertake a comprehensive review of the DWQMP to ensure it is accurate, current and remains relevant. While most of the processes used are appropriate, there is a need to document these, considering best industry practices.

The recommendations from the audit are as follows:

- **REC 1:** Ensure that data reported in the annual DWQMP report is accurate.
- **REC 2:** Review and update the incident and emergency response (IER) process in the DWQMP or develop a specific drinking water quality IER plan to reflect current practice, including sections on incident de-briefs, periodic scenario testing, community notification (e.g. boil water notices and templates) and record keeping. Ensure that the process is implemented in accordance with the approved DWQMP.
- **REC 3:** Review and update the schematics and infrastructure details in the DWQMP to ensure that they accurately reflect the current components.
- **REC 4:** Review and update the risk assessment/register as there have been improvements and changes implemented.

- **REC 5:** Review and update the CCP procedures to ensure that the corrective actions include the reporting requirements and appropriate timeframes. This should include both internal and external reporting as required.
- **REC 6:** Calculate the effectiveness of disinfection (C.*t*[1]) for the Clermont and Middlemount schemes (and other schemes) and use this information to confirm the lower critical limit for the chlorination CCP.

[1] The C.*t* concept describes the relative effectiveness of a disinfectant. It is determined by multiplying the concentration of residual disinfectant (in mg/L) after the contact vessel by the contact time (in minutes).

1 Introduction

Viridis Consultants Pty Ltd (Viridis) was engaged by Isaac Regional Council, service provider identification number 486, to undertake the first regular (external) audit of the Drinking Water Quality Management Plan (DWQMP).

As required by the *Water Supply (Safety and Reliability) Act 2008* (the Act), Council is operating its drinking water service under an approved DWQMP. As a condition of the approval notice, Council is required to complete the first regular audit of its approved DWQMP by 11 November 2017.

This report includes the findings and conclusions from the first regular audit of the DWQMP.

1.1 Objectives

The objectives included:

- undertake an audit of Council's DWQMP to fulfil the requirements of the Act and approval notice
- conduct the audit in line with the *Drinking Water Quality Management Plan Review and Audit Guidelines 2013*.

1.2 Regulatory Regime

The statutory requirements for DWQMP regular audits are detailed in the Act. The relevant provisions in the Act for providing audit reports are:

- section 99(2)(c) - if the regulator approves the plan, the notice of the decision or information notice for the decision, will state that if the regulator requires audits of the approved plan – the intervals at which the audits must be conducted
- section 99(4) - the interval for regular audits will not be less than two years
- section 108(1) - the provider must arrange for regular audit reports to be prepared about the provider's plans and compliance with the plans
- section 108(2) - regular audit reports must be prepared in accordance with the notice given by the regulator under section 99
- section 108(3) states that the purpose of the regular audit report for this plan is:
  - to verify the accuracy of the monitoring and performance data provided to the regulator under the plan
  - to assess the service provider's compliance with the plan
  - to assess the relevance of the plan in relation to the provider's drinking water service.
- section 108(6) outlines that the regular audit report for this plan must be prepared by a person, other than an employee of the service provider or someone employed in operating the service provider's infrastructure, who is certified under the Drinking Water Quality Management System Auditor Certification Scheme to conduct an audit of the type to which the report relates, or has a qualification the regulator is satisfied is at least equivalent to this qualification
- section 108(6) also states that the regular audit report must be:
  - prepared in accordance with the guidelines made by the regulator about preparing regular audit reports
  - given to the regulator within 30 business days after its completion
  - made available for inspection and purchase.
- section 575 states that the provider must keep a copy of the audit report available for inspection by the public during office hours on business days at the office of the service provider.

1.3 Audit Scope

The scope of the audit was to:

- verify the accuracy of monitoring and performance data
- assess compliance with the DWQMP
- assess the relevance of the DWQMP in relation to the drinking water service.

1.4 Audit Criteria

The approved amended DWQMP version B (16 November 2015) and approval notices (29 May 14 and 7 March 16).

1.5 Audit Standard

AS/NZS ISO 19011:2014 *Guidelines for Auditing Management Systems* was relied upon to ensure good auditing practices.

2 Audit Method

2.1 Auditor

Tasleem Hasan conducted the audit. Tasleem is an Exemplar Global Certified Lead Auditor for Drinking Water Quality Management Systems. He is experienced in undertaking audits of drinking water systems and has extensive knowledge of the operation and regulation of drinking water schemes.

The auditor confirms that:

- sufficient evidence has been sighted on which to base audit conclusions
- the audit conclusions and findings accurately reflect the professional opinion of the auditor
- the audit conclusions and findings have not been unduly influenced by the auditee and/or any of its associates.

2.2 Reference Documentation

The key reference documents and evidence relied on for the audit are identified in the detailed audit findings table in Appendix A.

2.3 Audit Agenda

The audit comprised of the following steps:

1. information requests to Council, identifying necessary information and documentation required to undertake the audit
2. preparation for audit, development of audit checklist
3. on-site audit and verification, including staff interviews – 31 October 17 to 2 November 17
4. audit report preparation.

Table 2 includes the detailed onsite audit agenda and attendees.

Table 2 Onsite Audit Agenda and Attendees

Time	Details	Attendees
Day 1 - Audit Start		
9:30 – 10:00	Opening meeting • Audit Scope / Audit Process • Audit Report (Draft / Final) • Any Other Business	Tasleem Hasan, Lead Auditor Dushyant Patel, Senior Water & Wastewater Engineer
Day 1 - Audit Interviews		
10:15 – 10:45	Data for the DWQMP Annual Reports	Tasleem Hasan, Lead Auditor Dushyant Patel, Senior Water & Wastewater Engineer
10:30 – 11:00	Implementation of process for managing incidents and emergencies	Tasleem Hasan, Lead Auditor Dushyant Patel, Senior Water & Wastewater Engineer
11:00 – 11:30	Implementation of the risk management improvement program	Tasleem Hasan, Lead Auditor Dushyant Patel, Senior Water & Wastewater Engineer
11:30 – 12:00	Implementation of operational and verification monitoring programs	Tasleem Hasan, Lead Auditor Dushyant Patel, Senior Water & Wastewater Engineer Site Operators
12:00 – 1:00	Break	

Time	Details	Attendees
Day 1 - Site Visit		
1:00 – 4:30	Location: Moranbah WTP • Compliance with plan • Relevance of plan	Tasleem Hasan, Lead Auditor Dushyant Patel, Senior Water & Wastewater Engineer Julie Smith, Senior WTP Operator
Day 2 – Site Visits		
8:00 – 1:30	Location: Clermont WTP • Compliance with plan • Relevance of plan	Tasleem Hasan, Lead Auditor Dushyant Patel, Senior Water & Wastewater Engineer Glen Goodwin, WTP Operator Peter K Patrick, Senior WTP/STP Operator
1:30 – 2:00	Break	
2:00 – 5:00	Location: Middlemount WTP • Compliance with plan • Relevance of plan	Tasleem Hasan, Lead Auditor Dushyant Patel, Senior Water & Wastewater Engineer Steve Coleman, WTP and WWTP Operator
Day 3 - Audit Interviews and Close		
9:00 – 9:30	Maintain records using information management systems	Tasleem Hasan, Lead Auditor Dushyant Patel, Senior Water & Wastewater Engineer Karen Moller, Water and Wastewater Admin
9:30 – 10:00	Undertaking regular review at the frequency specified in the approval notice.	Tasleem Hasan, Lead Auditor Dushyant Patel, Senior Water & Wastewater Engineer
10:00 – 10:30	Break	
10:30 – 11:30	Implementation of operational and maintenance procedures	Tasleem Hasan, Lead Auditor Dushyant Patel, Senior Water & Wastewater Engineer Peter Fentiman, Network Coordinator Site Operators
11:30 – 12:30	• Compile findings for closing meeting • Request any remaining information	n/a
12:30 – 1:30	Break	
2:00 – 2:30	Closing meeting • Brief audit findings • Next steps	Tasleem Hasan, Lead Auditor Dushyant Patel, Senior Water & Wastewater Engineer

2.4 Audit Grades

Table 3 identifies the grades used for this audit.

Table 3 Audit Grades

Compliance Codes		Definition
Compliant	C	Indicates conformance of audit findings with reference documentation.
Minor Non-Compliance	N	Does not comply, however, deficiency does not compromise the delivery of products or outcomes and does not compromise the ability to achieve defined objectives.
Major Non-Compliance	M	Does not comply. Deficiency that compromises the delivery of products or outcomes, and the ability to achieve defined objectives.

A recommendation is provided for requirements which do not comply, that is, minor or major non-conformance.

An opportunity for improvement (OFI) is identified for activities which conform but may also be improved. This may be an opportunity for process improvement or comments that may be relevant to the next audit.

2.5 Quality Assurance Process

This audit was carried out in accordance with the Viridis Quality Manual, consistent with ISO 9001:2008. Tasleem Hasan was the Lead Auditor for the audit and responsible for ensuring the quality of the deliverables. Quality assurance activities undertaken during the audit comprised of:

- compliance with the Viridis Quality Manual
- internal peer review of report
- document control and approval processes.

3 Audit Findings

The audit was carried out as described in Section 2. The completed audit checklist is in Appendix A, which provides the detailed findings for the audit. These findings have been outlined in the sections below.

3.1 Accuracy of Monitoring and Performance Data

3.1.1 Compliance

Council had a minor non-compliance with this audit area, data used in the annual report was not validated appropriately.

3.1.2 Recommendation

REC 1: Ensure that data reported in the annual DWQMP report is accurate.

3.1.3 Opportunities for Improvement

- **OFI 1:** Discuss with the external laboratory about quality control measures to eliminate data entry errors in MonitorPro.
- **OFI 2:** Establish an internal review process for the DWQMP annual report prior to release to stakeholders (e.g. DEWS).
- **OFI 3:** Investigate value in the operators maintaining a separate *E. coli* rolling spreadsheet. This seems like a duplication of data stored and accessible through MonitorPro.

3.2 Compliance with the Plan

3.2.1 Compliance

Council demonstrated a high level of compliance with this audit area. Operations and actions are generally implemented as described in the approved plan, although some processes have been improved since the plan was prepared.

The auditor assessed the following specific components for compliance with this audit area:

- *Provision and conditions in the approval notice* — Compliant
- *Implementation of preventive measures* — Compliant
- *Implementation of operational and maintenance procedures* — Compliant
- *Implementation of process for managing incidents and emergencies* — Minor Non-compliance
- *Implementation of operational and verification monitoring programs* — Compliant
- *Implementation of the risk management improvement program* — Compliant
- *Maintaining records* — Compliant
- *Undertaking regular reviews* — Compliant

3.2.2 Recommendation

REC 2: Review and update the incident and emergency response (IER) process in the DWQMP or develop a specific drinking water quality IER plan to reflect current practice, including sections on incident de-briefs, periodic scenario testing, community notification (e.g. boil water notices and templates) and record keeping. Ensure that the process is implemented in accordance with the approved DWQMP.

3.2.3 Opportunities for Improvement

The following opportunities for improvement have been made in relation to this audit area:

- **OFI 4:** Identify and note the standard operating procedure (SOP) associated with a particular preventive measure (in the risk register), as practical.
- **OFI 5:** Establish a process to document the corrective actions undertaken when CCP limits are breached, especially breach of a critical limit.
- **OFI 6:** Investigate options to improve document access and control, for example, use of the intranet site as currently done for the WHS procedures or a dedicated folder in the water shared drive.
- **OFI 7:** Develop SOPs for significant preventive measures. Those identified as part of the audit include:
  - filter backwash
  - reservoir cleaning and inspection, including frequency
  - calibration schedule, including frequency
  - mains/pipe repairs
  - chemical procurement, delivery and receipt process to ensure relevant risks are managed (e.g. incorrect chemical, incorrect chemical strength, sufficient chemical quantity at hand, stock rotation)
  - sample collection process, including chain of custody, sample collection and transportation.

  The SOPs should include the records to be filled and record location to demonstrate that a preventive measure was implemented.
- **OFI 8:** Investigate the opportunity for operator certification with Water Industry Operators Association of Australia (WIOA). The advantage with this would be that renewal will be required every 5 years, hence operators will undertake continuous professional development (CPD).
- **OFI 9:** Consolidate the various incident levels relating to *E. coli*, as the response protocols would be similar, including external reporting requirements.
- **OFI 10:** Undertake conditional formatting of the operational spreadsheet to highlight out of specification results through colour change of cells, especially for CCP limit breaches.
- **OFI 11:** Undertake testing for total chlorine, at least when the CCP upper critical limit for chlorine is breached to ensure that the total chlorine concentration is not >5 mg/L, which is a reportable incident.
- **OFI 12:** Include priority levels for the actions in the improvement plan to target and progress improvements incrementally.
- **OFI 13:** Include new improvement actions, when relevant, e.g. those identified through other mechanisms like incidents, reviews and audits to demonstrate continual improvement and track implementation.
- **OFI 14:** Update the details for information management and record keeping in the DWQMP to reflect the current practices.
- **OFI 15:** Establish a process, including triggers, for undertaking a DWQMP review and maintain appropriate records of reviews undertaken, including elements reviewed, review date/s and the review team.

3.3 Relevance of the Plan

3.3.1 Compliance

The audit was required to assess the relevance of the DWQMP. The auditor assessed the following components for compliance and found that details of the scheme need to be updated in the DWQMP.

- *Service description and details of infrastructure* — Minor Non-compliance
- *Catchment characteristics and water quality information* — Compliant

3.3.2 Recommendations

The following recommendations have been made in relation to this audit area:

- **REC 3:** Review and update the schematics and infrastructure details in the DWQMP to ensure that they accurately reflect the current components.
- **REC 4:** Review and update the risk assessment/register as there have been improvements and changes implemented.
- **REC 5:** Review and update the CCP procedures to ensure that the corrective actions include the reporting requirements and appropriate timeframes. This should include both internal and external reporting as required.
- **REC 6:** Calculate the effectiveness of disinfection (C.*t*) for the Clermont and Middlemount schemes (and other schemes) and use this information to confirm the lower critical limit for the chlorination CCP.

3.3.3 Opportunities for Improvement

- **OFI 16:** Ensure that the raw water by-pass valve is clearly marked and appropriately locked for the Moranbah scheme.
- **OFI 17:** Evaluate water quality data through trend charts also to monitor water quality performance and to help identify any potential issue.

4 Audit Conclusions

Council overall demonstrated good compliance with the regular audit imposed by the *Water Supply (Safety and Reliability) Act 2008* for the audit period. The summary of compliance is shown in Table 4, eleven (11) requirements were audited.

The audit concluded that Council:

- would benefit from strengthening the data validity and review process associated with the DWQMP annual report provided to the regulator
- implemented its DWQMP fully for most of the elements with one minor non-compliance noted for plan compliance
- would benefit highly from reviewing the relevance of the plan.

The auditor noted that there have been best efforts to provide safe drinking water. In particular, it was pleasing to note the following:

- staff endeavor to do a good job and now there is less turn-over of staff (mid-upper level) and a new structure to strengthen water quality management
- external testing is undertaken at a NATA accredited laboratory with automated processes for quick short-term assessment of results
- CCPs have been established and are being implemented
- operators are required to hold at least a certificate III in water operations, and new operators are actively supported to obtain this qualification
- a 10-year capital plan has been approved by Council and work on upgrading the water treatment plants is underway
- there is realisation that the DWQMP needs to be streamlined to make it more user-friendly.

There were three (3) minor non-compliances identified across the audit areas, which related to data accuracy in the DWQMP annual reports, incident management process and plan relevance.

Council will benefit highly from a comprehensive review of the DWQMP to ensure it is accurate, current and remains relevant. While most of the processes used are appropriate, there is a need to document these, considering best industry practices.

Recommendations and opportunities for improvement have been identified, where relevant.

Table 4 Audit Compliance Summary

Compliance Codes		Number of Findings
Compliant	C	8
Minor Non-Compliant	N	3
Major Non-Compliant	M	0

Glossary

Word	Description
CCP	Critical Control Point
CPD	Continuous Professional Development
DEWS	Department of Energy and Water Supply
DWQMP	Drinking Water Quality Management Plan
IER	Incident and Emergency Response
NATA	National Association of Testing Authorities
OFI	Opportunity for Improvement
SOP	Standard Operating Procedure
THMs	Trihalomethanes
WIOA	Water Industry Operators Association of Australia

Appendix A

Audit Checklist

Detailed Audit Findings

Table 5 Detailed Audit Findings

Checklist	Evidence	Findings and Discussions	Compliance Grade	Recommendation (REC) / OFI
Accuracy of Monitoring and Performance Data – Verify accuracy of monitoring and performance data supplied to the regulator				
Accurate data	MonitorPro software DWQMP annual reports for 2014-15 and 2015-16 Staff interview	The process used for compiling data for the annual reports was explained. Verification monitoring samples are tested by the Mackay Regional Council's NATA accredited laboratory. Data is stored in MonitorPro software, which Council can access through a username and password. Data cannot be edited by Council (quality control measure). Council generally engages an external contractor to prepare the annual report. The contractor is able to download all verification data from MonitorPro (can be exported to Excel) and collate/analyse for the annual report. The results for Moranbah THMs reported in the 2015-16 annual report was checked for accuracy. Data from MonitorPro was extracted. It was noticed that the result for 02/02/16 THMs was entered as "16-0475". This was a sample reference identification number, the actual result was traced back from the laboratory as 53 mg/L THMs. 12 samples were tested as required, with the minimum and maximum being accurate. However, the average value was incorrect (most probably due to the incorrectly entered THMs result, which was not identified appropriately as a data entry error). Due to staff shortages previously, there was no internal review undertaken for the annual report in general, but Council is working towards an appropriate review process. The *E. coli* rolling spreadsheet was checked for 2014-15 for Dec 14 results. The annual report stated 9 samples were tested with no *E. coli* detected. Data extracted from MonitorPro confirmed that no *E. coli* was detected, however, the sample number was 10 (minor discrepancy). The *E. coli* rolling spreadsheet is maintained by operators.	N	**REC 1:** Ensure that data reported in the annual DWQMP Report is accurate. **OFI 1:** Discuss with the external laboratory about quality control measures to eliminate data entry errors in MonitorPro. **OFI 2:** Establish an internal review process for the DWQMP annual report prior to release to stakeholders (e.g. DEWS). **OFI 3:** Investigate value in the operators maintaining a separate E. coli rolling spreadsheet. This seems like a duplication of data stored and accessible through MonitorPro.

Checklist	Evidence	Findings and Discussions	Compliance Grade	Recommendation (REC) / OFI
Compliance with the plan – Provisions and conditions in the Approval Notice				
DWQMP Report submission	DWQMP Annual Reports 14-15 and 15-16 Email of receipt of submission for 2015-16 report by DEWS Email of receipt of submission for 2014-15 report by DEWS Phone call to DEWS (Pushpa) on 30/10/17.	The DWQMP Annual Report 14-15 was prepared and submitted to DEWS on 16 Dec 15, which is within the timeframe (17 Dec 15 or 120 business days). The DWQMP Annual Report 15-16 was prepared and submitted to DEWS on 19 Dec 16, which is within the due date (19 Dec 16 or 120 business days). The Annual Reports are available on the Council website, as required in the Act (although out of audit scope). Period reporting of water quality was required for the time period of 11 November 2013 to 30 June 2014. This was confirmed to be submitted (verified over phone with DEWS).	C	NA

Checklist	Evidence	Findings and Discussions	Compliance Grade	Recommendation (REC) / OFI
Compliance with the plan – Implementation of preventive measures described in the plan				
Preventive measures clearly identified **Preventive measures implemented**	DWQMP Site inspections – Moranbah, Clermont and Middlemount schemes Staff interview	The preventive measures are identified in Appendix 3 (also duplicated in Appendix 4). Many of the preventive measures are general in nature. To ensure risks are managed effectively it would be beneficial, where appropriate, to check that the preventive measures have associated documented procedures. This would ensure that the appropriate action is undertaken and provide auditable evidence / records. A sample of the preventive measures listed in the DWQMP was checked. <u>Moranbah</u> • PAC is used. • Drop tests undertaken on pumps (plan is underway to establish a more regular frequency for drop tests). • Backwash is being undertaken (automated process, a documented SOP/steps will be useful, OFI mentioned under operational procedures element). <u>Clermont</u> • Chlorine pre-dosing undertaken for control of iron and manganese. • Operators flush PAC lines daily to ensure likelihood of blockages is reduced. • Reservoir – inspection and cleaning undertaken in Nov 2016 (no formalised reservoir cleaning and inspection program currently though, OFI mentioned under operational procedures element). <u>Middlemount</u> • PAC is used. • Backwashs are undertaken.	C	**OFI 4:** Identify and note the SOP associated with a particular preventive measure (in the risk register), as practical.

Checklist	Evidence	Findings and Discussions	Compliance Grade	Recommendation (REC) / OFI
Compliance with the plan – Implementation of operational and maintenance procedures				
Procedures implemented **Currency** **Calibration** **Maintenance** **Reservoirs** **Training and Awareness** **Chemical procurement and deliveries**	Site inspections – Moranbah, Clermont and Middlemount schemes WTP O&M manuals Daily tick list WHS intranet site Calibration stickers on equipment Reservoir inspection and cleaning reports 2016 Staff interview	There are some SOPs available, which operators use, e.g. the daily tick list (sighted on site). CCP procedures are displayed at the WTPs. Corrective actions were undertaken for CCP breaches (operator interviews), however, this was not documented. Document control (including for SOPs) is managed by staff, but will benefit from improvement to the system. The WHS procedures for example are maintained as PDFs on the intranet (for most current version). This could be applied to DWQMP related documents also. Calibration of equipment is done through external contractors annually. Calibration stickers were seen on site. The request is raised by the senior operators for the calibration job to be completed. The process should be documented. Maintenance tasks are managed mainly by the operators. However, an asset management program is in the pipeline to improve the process. Mains/pipes repairs are undertaken by council plumbers or local qualified contractors. Repairs are undertaken according to best practice. However, there is no documented process for this, including any testing of the water quality following the repairs (e.g. simple free chlorine test). There is no formal reservoir cleaning and inspection program in place. However, all reservoirs were cleaned in 2016. The next step will be to formalise a program and implement it. Operators play a very crucial role in DWQMP implementation. Council has ensured that all operators hold at least a certificate III, some also have certificate IV. It is important also to ensure that operators continue their professional development. Chemical orders are raised by senior operators. Operators are present onsite when delivery is done to ensure correct chemical is delivered and stored appropriately. However, there is no documented process for chemical quality control.	C	**OFI 5:** Establish a process to document the corrective actions undertaken when CCP limits are breached, especially breach of a critical limit. **OFI 6:** Investigate options to improve document access and control, for example, use of the intranet site as currently done for the WHS procedures or a dedicated folder in the water shared drive. **OFI 7:** Develop SOPs for significant preventive measures. Those identified as part of the audit include: • filter backwash • reservoir cleaning and inspection with frequency • calibration schedule, including frequency • mains/pipe repairs • chemical procurement, delivery and receipt process to ensure relevant risks are managed (e.g. incorrect chemical, incorrect chemical strength, sufficient chemical quantity at hand, stock rotation) • sample collection process, including chain of custody, sample collection and transportation. The SOPs should include the records keeping process to demonstrate that a preventive measure was implemented. **OFI 8:** Investigate the opportunity for operator certification with WIOA. The advantage with this would be that renewal will be required every 5 years, hence operators will undertake CPD.

Checklist	Evidence	Findings and Discussions	Compliance Grade	Recommendation (REC) / OFI
Compliance with the plan – Implementation of process for managing incidents and emergencies				
Process documented **Incident management** **Staff training**	DWQMP DWQMP annual report 14-15 MonitorPro alerts *E. coli* testing results example sent by laboratory (sample collected 25/10/17, result received 26/10/17) Staff interview	The process in the DWQMP does not reflect the current practice, and external reporting requirements to DEWS is not captured. However, appropriate incident management protocols are understood and followed by the relevant staff. Alerts are sent from MonitorPro to a Council water email group, and corrective actions, including reporting initiated. This is a good process to ensure that incidents are acted upon as soon as known from the laboratory. Example of this was seen. There have been no incidents of *E. coli* of late that required reporting. There were some exceedences of the water quality criteria reported in the 2014-15 DWQMP annual report for manganese, however, these were not reported to DEWS within the required timeframe due to changes in upper management and the process not being clear in the DWQMP. It will be beneficial to undertake periodic scenario testing on incident management for staff awareness, as incidents have been fortunately rare. Consumer notifications, if required, are managed by the Brand Media and Communications Department. During the suggested scenario exercises they should be included to check/confirm the customer notifications process.	N	**REC 2:** Review and update the incident and emergency response (IER) process in the DWQMP or develop a specific drinking water quality IER plan to reflect current practice, including sections on incident de-briefs, periodic scenario testing, community notification (e.g. boil water notices and templates) and record keeping. Ensure that the process is implemented in accordance with the approved DWQMP. **OFI 9:** Consolidate the various incident levels relating to *E. coli*, as the response protocols would be similar, including external reporting requirements.

Checklist	Evidence	Findings and Discussions	Compliance Grade	Recommendation (REC) / OFI
Compliance with the plan – Implementation of operational and verification monitoring plan				
Operational monitoring plan implementation **Verification monitoring plan implementation** **Targets and limits**	DWQMP CCP procedures Operational data spreadsheet MonitorPro DWQMP annual report 15-16 Chain of custody form Site inspections – Moranbah, Clermont and Middlemount schemes Staff interview	Operational monitoring is undertaken as stated in the DWQMP. CCPs are also tested. There have been improvements to the data recording spreadsheet to make it more consistent and easier to implement the operational monitoring requirements. The spreadsheet is also controlled so operators can only enter data and not change anything else. Operators manually enter data into the spreadsheet, this has the risk of data entry errors. However, Council is already investigating options to make this process electronic. The spreadsheet will benefit further from conditional formatting to enable better short-term analysis of data, and prompts for recording of actions undertaken (e.g. for CCP limit breaches). It was noted that only free chlorine is tested. Total chlorine should be tested also to ensure that the sum of combined and free chlorine do not exceed 5 mg/L. Verification monitoring is now undertaken as stated in the DWQMP. There were some discrepancies as reported by Council in the 2015-16 DWQMP annual report, which were identified and rectified. Since these have been appropriately resolved now a non-compliance is not given against it. Samples are collected and tested at the Mackay Regional Council's NATA accredited laboratory. The chain of custody form is printed by samplers weekly (for most current version), samples collected and sent off within the required timeframe. The process should be documented (OFI under operational procedures element). Data storage has been discussed under accuracy of data element. The targets and limits for the operational monitoring are in the operational spreadsheet, and for the verification monitoring are set within MonitorPro.	C	**OFI 10:** Undertake conditional formatting of the operational spreadsheet to highlight out of specification results through colour change of cells, especially for CCP limit breaches. **OFI 11:** Undertake testing for total chlorine, at least when the CCP upper critical limit for chlorine is breached to ensure that the total chlorine concentration is not >5 mg/L, which is a reportable incident.

Checklist	Evidence	Findings and Discussions	Compliance Grade	Recommendation (REC) / OFI
Compliance with the plan – Implementation of risk management improvement program				
Improvement program implementation **Monitoring progress** **Continual improvement**	DWQMP DWQMP annual reports for 14-15 and 15-16 10-year capital plan BGA management manual 2017 Staff interview	The improvement actions are being undertaken, for example, BGA management manual prepared, WTP upgrades happening. Delays are explained in the DWQMP annual reports. Council is progressing and has planned implementation of many key improvements through the recent 10-year capital plan (approved by council in 2017). This is very positive to see. Progress on implementation is checked mainly before the annual DWQMP report is prepared, more frequent checks will be useful. Continual improvement is visible and Council is working towards improving their systems. However, no new improvement actions from other means, e.g. incidents have been noted in the improvement plan.	C	**OFI 12:** Include priority levels for the actions in the improvement plan to target and progress improvements incrementally. **OFI 13:** Include new improvement actions, when relevant, e.g. those identified through other mechanisms like incidents, reviews and audits to demonstrate continual improvement and track implementation.
Compliance with the plan – Maintaining records as described in the plan				
Records management	DWQMP Site inspections – Moranbah, Clermont and Middlemount schemes Staff interview	Operational data is recorded in spreadsheets. ECM is now used for records/document management (recently). InfoXpert is no longer used. MonitorPro is used to record verification monitoring data. Operational monitoring is recorded in excel spreadsheets. TechOne is used for complaints records.	C	**OFI 14:** Update the details for information management and record keeping in the DWQMP to reflect the current practices.
Compliance with the plan – Undertaking reviews at the frequency specified in the Approval Notice				
Review undertaken **Review process**	Amended plan approval notice dated 7 March 2016 DWQMP Version B – 16 November 2015	Information notices approving the amended DWQMP indicates that the review was submitted on 18 November 2015, the version information of the DWQMP also indicates that the review was undertaken in this period. However, there was no report or like on the review process, what was reviewed and the review team.	C	**OFI 15:** Establish a process, including triggers, for undertaking a review and maintain appropriate records of reviews undertaken, including elements reviewed, review date/s and the review team.

Checklist	Evidence	Findings and Discussions	Compliance Grade	Recommendation (REC) / OFI
Relevance of the plan – Service description and details of infrastructure reflect current circumstances				
Infrastructure **Risk management** **Monitoring**	DWQMP Site inspections – Moranbah, Clermont and Middlemount schemes CCP procedures Staff interview	A walk-through the schemes visited was undertaken from plant head to final treated water. The flow charts were verified for accuracy: • Moranbah – update required, for example, PAC is dosed prior to flash mixer not filters, poly is used, there is a raw water bypass, separate reticulation zones in normal operation mode (separated through valves). It was pleasing to note the 7 out of the 9 filters had been recently fully refurnished and the remaining 2 will be undertaken very soon. Plant upgrade for chemical dosing and online monitoring is also about to progress. Raw water quality can fluctuate depending on which source is used to supply water by the raw water supplier BMA (Angelo only uses Eungella Dam). To counter this issue, council is investing in directing all raw water to the 400 ML turkeys nest, which will buffer the water from large variations. • Clermont – update required, for example, there is no pre-chlorination at the raw water balance reservoir, PAC is dosed prior to clarifiers not filters, there are a few customers before the Jeffery Street reservoir. The chlorination C.*t* should be calculated to ensure effectiveness of primary kill. Plant upgrade for chemical dosing and online monitoring is also about to progress. 2 of the 3 filters have been fully refurbished and the third one was almost done (paint was drying during site visit). • Middlemount – update required, for example, there is no pre-soda ash dosing, pre chlorine is dosed in the flash mixer not prior, PAC is not dosed prior to the filters, treated water from the clear water tank can be fed straight into the reticulation during periods of high demand before being pumped into the water reservoir. The chlorination C.*t* should be calculated to ensure effectiveness of primary kill. The 4 filters had been fully refurbished 2 years ago. Plant upgrade for chemical dosing and online monitoring is also about to progress. The risk assessment was undertaken in 2012 and with the	N	**REC 3:** Review and update the schematics and infrastructure details in the DWQMP to ensure that they accurately reflect the current components. **REC 4:** Review and update the risk assessment/register as there have been improvements and changes undertaken. **REC 5:** Review and update the CCP procedures to ensure that the corrective actions include the reporting requirements and appropriate timeframes. This should include both internal and external reporting as required. **REC 6:** Calculate the effectiveness of disinfection (C.*t*) for the Clermont and Middlemount schemes (and other schemes) and use this information to confirm the lower critical limit for the chlorination CCP. **OFI 16:** Ensure that the raw water by-pass valve is clearly marked and appropriately locked for the Moranbah scheme.

Checklist	Evidence	Findings and Discussions	Compliance Grade	Recommendation (REC) / OFI
		recent improvements/changes, needs to be reviewed and updated. The CCP limits are appropriate (e.g. for filtration, chlorination should be confirmed following C.*t* calculation). However, the corrective actions can be strengthened by including timeframes, for example, consider when the supervisor needs to be informed internally on a critical limit breach and when DEWS should be notified. A critical limit is a prescribed tolerance that distinguishes acceptable from unacceptable performance at a CCP. Corrective actions should immediately be instituted to resume control of the process. The operational monitoring looks appropriate (e.g. daily testing of filtered water turbidity immediately post filters, while plant upgrade is being progressed to online testing). There are also targets/limits to refer to for process control.		
Relevance of the plan – Confirm catchment characteristics and water quality information reflect current circumstances				
Catchment **Water quality information**	DWQMP DWQMP annual reports 14-15 and 15-16 Site inspections – Moranbah, Clermont and Middlemount schemes MonitorPro Staff interview	There have been no changes to the catchment characteristics. It was noted that while the short-term evaluation of the water quality data is practiced, there are no trend charts generated to monitor water quality performance or help identify any potential issue, although the feature is present in MonitorPro. Data is generally analysed only statistically in the DWQMP annual reports.	C	**OFI 17:** Evaluate water quality data also through trend charts to monitor water quality performance and help to identify any potential issue.

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