

DRINKING WATER QUALITY MANAGEMENT PLAN (DWQMP) ANNUAL REPORT 2018 – 2019

Current as of September 2019

Presented By: Water & Wastewater Department

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DEFINITIONS

ADWG 2004	Australian Drinking Water Guidelines (2004). Published by the National Health and Medical Research Council of Australia
ADWG 2001	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	<i>Escherichia coli</i> , 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

The approved DWQMP applies to eight drinking water supply 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.

2.1 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;
- Calcium hypochlorite dosing for iron and manganese oxidation and sufficient residual for final disinfection; (Sodium hypochlorite could also be used)
- Polymer dosing as a flocculation aid;
- Flocculation;
- Clarification; and
- Media filtration.

Carmila WTP operates at normal capacity of 1.5 L/s but can run at up to 3 L/s if required, starts and stops based on pre-set levels in the Treated Water Reservoir.

2.2 CLERMONT

Raw water is extracted from the Theresa Creek Dam and pumped to a balance reservoir, then gravity feeds to a 2 ML raw water reservoir and then gravity feed to the WTP inlet where it is treated using the following treatment process:

- Potassium permanganate dosing used during high algal period (when required)
- Pre-pH correction with sodium hydroxide; (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;
- Media filtration;
- Disinfection with chlorine gas;
- pH correction with sodium hydroxide; and
- Trim chlorine gas dosing to maintain a residual in the reticulation.

Clermont WTP operates at normal capacity of 65 L/s but can run at up to 80 L/s if required. Operation of the WTP starts and stops based on pre-set levels in the Treated Water Reservoir.

2.3 DYSART

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

- Aluminium Chlorohydrate (ACH) dosing before entering DAF unit;
- Two stage flocculation;
- Dissolved Air Flootation (DAF) to remove Algae and other organics;
- 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;
- Media filtration;
- Granular Activated Carbon (GAC) filtration (for odour and taste removal); and
- Disinfection with chlorine gas.

Dysart WTP operates at normal capacity of 80 L/s but can run at up to 100 L/s if required 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.

2.4 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;
- Media filtration;
- Post-pH adjustment with sodium hydroxide; and
- Disinfection with sodium hypochlorite.

Glenden WTP operates at normal capacity of 60 L/s but can run at up to 80 L/s if required. The WTP typically operates depending on levels in the Treated Water Reservoir.

2.5 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 All Clear 345 (When required alternative dose are ACH and 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;
- Media filtration;
- Post-pH correction with sodium hydroxide (if required); and
- Disinfection with chlorine gas.

Middlemount WTP operates at normal capacity of 80 L/s but can run at up to 90 L/s if required and starts and stops based on pre-set levels in the Treated Water Reservoir.

2.6 MORANBAH

There are two separate process trains at Moranbah – Bobby WTP and the Main 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 Sodium Hydroxide (When required)
- Pre-chlorine gas for iron and manganese oxidation;
- PAC for taste and odour removal;
- Coagulation with ACH;
- Polymer dosing for flocculation aid (Main WTP only);
- Flocculation;
- Clarification;
- Media filtration;
- Sodium Hydroxide dosing for pH adjustment;
- Disinfection with chlorine gas; and
- Fluoridation with sodium fluoride.

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

2.7 NEBO

Raw water is currently pumped from 6 bores from 2 through 7. Nebo bore field has 3 DNRME water allocations. Bore 2 and 3 has 75 ML/annum, Bore 4 and 5 has 75 ML/annum and Bore 6 and 7 has 100 ML/annum, providing a total annual water allocation of Nebo bore field of 250 ML/Annum. The pumping of the bores intended to distribute as evenly as possible (Eg: Bores 3, 5 and 7 or 2,4 and 6).

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 except bore 5 which is 6 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. A new bore (Bore 7) was brought online from March 2018. Bore 6 was not used during this reporting period due to water quality and bore integrity issues and bore 1 has been disconnected and decommissioned from the supply system.

2.8 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 potassium permanganate (calcium hypochlorite also available but not typically used because of THM issues);
- Pre-pH correction with soda ash;
- Coagulation with aluminium sulphate;
- Flocculation;
- Clarification;
- Media filtration; and
- Calcium hypochlorite dosing for final disinfection;

St Lawrence WTP operates at normal capacity of 2.2 L/s but can run at up to 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, some improvement items are delayed due to priority and budgetary constrain. An additional 30 improvements have been completed in current reporting period (July 2018-June 2019) (Highlighted in Appendix A). A summary of completed and actions in progress are listed below:

3.1 COMPLETED (IN CURRENT REPORTING PERIOD)

- Standard operating procedure (SOPs) are prepared as Work Instructions for all WTP, circulated and made available at IRC website.
- Phase 2 upgradation at Dysart WTP completed in previous reporting period and all the final works completed including handing over of the final copy of the O&M manual in the reporting period.
- Many upgradations work completed for Moranbah WTP, some works are still remaining (like SCADA integration) which are ongoing and will be completed by the current financial year.
- Damaged water infrastructures have been repaired or replaced as part of 10 years CAPEX program.
- Training of operation staffs for all the above upgrades has been completed.

3.2 IN PROGRESS

- Capital upgrades for all Water treatment plant facilities are in progress for the coming financial year.
- Additional instrumentation for process monitoring and SCADA modifications for configuration of alarms are in progress.

- Investigative works to determine future upgrades or avenues for optimising operations of water quality and supply system.

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 delayed further progress.

Capital upgrades are ongoing for Moranbah, Nebo new WTP 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. Ongoing upgrades at Moranbah and construction of a new WTP at Nebo are main activity for reporting financial year which will be completed in the 2019-2020 financial year.

Increased documentation and better document management is assisting with issues arising from high staff turnover. Training matrix has been developed and approved to identify the, record and track needs of training and competencies for all the water and wastewater staffs.

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. The approved verification monitoring program implemented since July 2017 have been carried out for this reporting period for all the towns. Algal toxin analysis were carried out only when the total cell counts for toxin producing algae (Cyanobacteria) exceeds 500 cells/ml, as per IRC Blue Green Algae Management Plan (BGAMP).

Annual testing of inorganics has been undertaken for all systems. At least one sample has been recorded in the year's data as per the verification monitoring plan.

IRC periodically conducts 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 implemented from July 2017 followed for this reporting period from July 2018 to June 2019.

5 NOTIFICATIONS TO THE REGULATOR UNDER SECTIONS 102 AND 102A OF THE ACT

There is no health exceedance reported for this reporting period of July 2018-June 2019.

Carmila:

- No exceedance

Clermont:

- No exceedance

Dysart:

- No exceedance

Glenden:

- No exceedance

Middlemount:

- No exceedance

Moranbah:

- No exceedance

Nebo:

- No exceedance

St Lawrence:

- No exceedance

6 CUSTOMER COMPLAINTS RELATED TO WATER QUALITY

Table 1 outlines the water quality complaints reported by consumers in the 2018-19 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

	Health Concern	Discoloured Water	Taste	Odour	Other	Total
CARMILA	0	0	0	0	0	0
CLERMONT	0	79	0	4	8	91
DYSART	0	2	0	0	0	2
GLENDEN	0	0	0	0	0	0
MIDDLEMOUNT	0	1	0	0	0	1
MORANBAH	0	3	3	1	1	8
NEBO	0	0	0	0	1	1
ST LAWRENCE	0	0	0	0	0	0
TOTAL	0	85	3	5	10	103

6.1 HEALTH CONCERN

Customers who suspect their water may be of a health concern can contact Isaac Regional Council on 1300 ISAACS. This concern will be further investigated with respect to water quality, typically by testing closest reticulation sampling point.

During 2018-2019 there were no reports of health concern arising from the water supply system.

6.2 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).

6.3 FOR DISCOLOURED WATER

- a. Review of treatment processes and chemical dosing systems.
- b. Drain vessels in treatment plant if contamination is suspected.
- c. Perform action as per section 6.2

6.4 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, down rate the water treatment plant and introduce water restrictions.
- c. Perform action as per section 6.2

7 FINDINGS AND RECOMMENDATION OF THE DWQMP AUDITOR

The next internal review of IRC DWQMP is due before 11 November 2022.

8 OUTCOME OF THE REVIEW OF THE DWQMP AND HOW ISSUES RAISED HAVE BEEN ADDRESSED

The next internal review of IRC DWQMP is due before 11 November 2019.

APPENDIX A IMPLEMENTATION OF THE DWQMP RISK MANAGEMENT IMPROVEMENT PROGRAM BASED ON - 2017 RISK REGISTER

The tasks completed for the reporting period 2018-2019 is highlighted.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
GEN1	General Issues	Out of date Standard Operating Procedure	Update Standard Operating Procedure across all WTPs to ensure consistency across the region	Dec-13	Complete	SOPs are prepared as Work Instructions, circulated and available at IRC website.
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 annually 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	SOP for main flushing is completed and issued during Mar 2018. Preparation of SOP for reservoir 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	In Progress	Network modelling project proposed for 2019-2020 budget, however, postponed because of budget restriction and hence planned to include in 2020 – 2021 budget.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 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.
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	Complete	Chemical dosing upgradation along with installation of online monitoring instrumentation and Citect SCADA system completed and commissioned by Apr 2018

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
CL4	Clermont Dam / Catchment	Rapid Variation in raw water quality caused by stormwater flows	<p>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.</p> <p>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.</p>	Dec-13	Complete	<p>Pre dose of chlorine has been removed.</p> <p>Revised verification monitoring programme includes THM monitoring</p>
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	<p>The campground caretaker to be educated on the dam as a potable water source.</p> <p>Information sheets to be provided for the caretaker to assist him in passing on this message to campers.</p> <p>An information board is to be posted at the boat ramp.</p>	Dec-13	Complete	Information has previously been provided to the caretaker. Required training provided to the caretaker about the dam by Jun 2018

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
CL8	Clermont Dam / Catchment	Human Access	As for item CL7	Dec-13	Complete	Intake area is fenced off, Required training provided to the caretaker about the dam by Jun 2018
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	Complete	Chemical dosing upgradation along with installation of online monitoring instrumentation and Citect SCADA system completed and commissioned by Apr 2018
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	Complete	Raw water quality parameters are being monitored daily. Chemical dosing upgradation along with installation of online monitoring instrumentation and Citect SCADA system completed and commissioned by Apr 2018
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	Complete	Raw water quality parameters are being monitored daily. Chemical dosing upgradation along with installation of online monitoring instrumentation and Citect SCADA system completed and commissioned by Apr 2018 to monitor the raw water parameters against such situation.
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 2019	Comments 2019
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	Complete	Chemical dosing upgradation along with installation of online monitoring instrumentation and Citect SCADA system completed and commissioned by Mar 18
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	On going	Clermont Sustainable Water Study has been completed by Jan 2018. Gap analysis on the outcome of the study conducted by June 2019. Review of the gap analysis is being carried out and expected to finish by Dec 2019.
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	Complete	Chemical dosing upgradation along with installation of online monitoring instrumentation and Citect SCADA system completed and commissioned by Apr 2018

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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
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	Complete	Chemical dosing upgradation along with installation of online monitoring instrumentation and Citect SCADA system completed and commissioned by Apr 2018
CL29	Clermont WTP Inlet/ Flocculation	Equipment malfunction	Alarm on failure of inlet flowmeter.	Jun-15	Complete	Chemical dosing upgradation along with installation of online monitoring instrumentation and Citect SCADA system completed and commissioned by Apr 2018
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	Complete	Chemical dosing upgradation along with installation of online monitoring instrumentation and Citect SCADA system completed and commissioned by Apr 2018
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 2019	Comments 2019
CL35	Clermont Filtration	Process control incapability	Online filtered water turbidity analyser for filtered water with alarm would assist operators.	Jun-15	Complete	Chemical dosing upgradation along with installation of online monitoring instrumentation and Citect SCADA system completed and commissioned by Apr 2018
CL36	Clermont Filtration	Inadequate filter operation	Online filtered water turbidity analyser for filtered water with alarm would assist operators (as per CL35)	Jun-15	Complete	Chemical dosing upgradation along with installation of online monitoring instrumentation and Citect SCADA system completed and commissioned by Apr 2018
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	Complete	Chemical dosing upgradation along with installation of online monitoring instrumentation and Citect SCADA system completed and commissioned by Apr 2018
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	Complete	Chemical dosing upgradation along with installation of online monitoring instrumentation and Citect SCADA system completed and commissioned by Apr 2018
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.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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	The current and future population will be monitored for further development.
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.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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	Complete	Chemical dosing upgradation along with installation of online monitoring instrumentation and Citect SCADA system completed and commissioned by Apr 2018
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	Complete	Chemical dosing upgradation along with installation of online monitoring instrumentation and Citect SCADA system completed and commissioned by Apr 2018
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	Complete	Chemical dosing upgradation along with installation of online monitoring instrumentation and Citect SCADA system completed and commissioned by Apr 2018
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	Complete	New media and filter upgradation completed by Dec 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 head loss, turbidity and/or filter run time (Priority 2).	Dec-16	Complete	SOP is now in place and formalised. Installation of Citect SCADA system completed and commissioned by Apr 2018.
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	Complete	Chemical dosing upgradation along with installation of online monitoring instrumentation and Citect SCADA system completed and commissioned by Apr 2018

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
CL67	Clermont Filtered Water	Disinfection failure	Install auto changeover capability from 920 kg chlorine gas drum to 70 kg chlorine gas cylinders.	Dec-16	Complete	Chemical dosing upgradation along with installation of online monitoring instrumentation and Citect SCADA system completed and commissioned by Apr 2018 Duplicate 920kg drum system installed for duty/standby with auto changeover between drums by Apr 2018
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.
CL70	Clermont Filtered Water	Disinfection failure	Include alarms for chlorine dosing failure.	Jun-17	Complete	Chemical dosing upgradation along with installation of online monitoring instrumentation and Citect SCADA system completed and commissioned by Apr 2018
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	Complete	Chemical dosing upgradation along with installation of online monitoring instrumentation and Citect SCADA system completed and commissioned by Apr 2018 Pre-chlorine dose is no longer performed prior to WTP so interim dosing not required

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
CL72	Clermont Reticulation	Inadequate disinfection	Undertake an assessment to confirm which users (if any) are receiving inadequately chlorinated water.	Jun-17	Complete	Water treatment plant chlorination system upgraded by Aug 2018 and no further action is anticipate.
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	Apr-18	Complete	Chlorine system upgradation completed as part of chemical dosing system upgrades by Apr 2018
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.
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	Complete	New raw water pipeline to divert the incoming raw water to 400ML dam for proper blending to prevent fluctuation on raw water quality, constructed by Jun 2018

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
MO3	Moranbah Raw Water	Rapid Variation in raw water quality caused by stormwater flows	<p>Current barrier (WTP process and turbidity monitoring) is considered sufficient for treating colour. Consider instruments as per MO2.</p> <p>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.</p>	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	<p>Raw water storage reservoirs are protected with fencing and locked gates.</p> <p>Free Cl is being tested for network samples daily.</p>
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	Complete	<p>Raw water reservoirs are protected with fencing and locked gates to prevent wildlife access.</p> <p>Online raw water monitoring, instruments with alarm system is installed by March 2019.</p>

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
MO8	Moranbah Raw Water	Heavy Rainfall / Flooding	Consider online raw water instruments with alarms (as per item MO2) to assist operators.	Jul-17	Complete	Online raw water monitoring, instruments with alarm system is installed by March 2019.
MO9	Moranbah Raw Water	Drought / Bushfires	Consider online raw water instruments with alarms (as per item MO2) to assist operators.	Jul-17	Complete	Online raw water monitoring, instruments with alarm system is installed by March 2019.
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	On going	Flow paced dosing system is installed by June 2019. Commissioning and integration with SCADA are going on which will be completed by December 2019.
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	Complete	Online raw water monitoring, instruments with alarm system is installed by March 2019.
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.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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.
MO29	Moranbah Filtered Water	Ineffective disinfection	As per MO12	Dec-13	Complete	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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. Program 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. Program 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	SOP for water main flushing procedure has been developed and in place. 10 year CAPEX program in place now for upgrades, replacements and renewals of IRC's water assets
MO36	Moranbah Reticulation	Corrosion	Council to ensure a maintenance / replacement programme is compiled for galv service connections.	Jun-14	Ongoing	10-year CAPEX program in place for upgrades to address the corroded infrastructure. Replacements and renewals of IRC's corroded assets are in progress.
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 2019	Comments 2019
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	Completed	Chlorine analyser has been installed on the WTP filtered water line, replacement and calibration of probes are carried out by Jun 2018.
MO46	Moranbah Whole System	Capacity	Continue monitoring growth and development (Ongoing)	Dec-13	Ongoing	IRC Monitoring the population growth and developments for improvements
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	Ongoing	Implementation is ongoing which is expected to be completed by June 2020.
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	Ongoing	Ultrasonic level sensors are installed in 6.8 ML reservoir to optimize the stop/starts. 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	Completed	Online pH, turbidity and chlorine analysers on WTP filtered water line with alarms installation completed by Jun 2018. Online analysers for pH, turbidity and chlorine on Boby Plant filtered water line installed as part of Chemical and SCADA upgrades by June 2019.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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	Ongoing	Installation is completed, commissioning work on going which will be completed by December 2019.
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	Completed	New water pipeline to divert the incoming raw water to 400ML dam for proper blending to prevent fluctuation on raw water quality, constructed by Jun 2018
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 paced chemical doing also installed, however not commissioned which is expected to be completed by Dec 2019. (Priority3).
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	In progress	To optimise operation of Main WTP flow changes to commence in 2019 2020 financial year to the maximum capacity of 180 l/s. To identify the need for a possible increase of Main WTP flash mixer capacity.
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.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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 implemented during chemical and SCADA upgrades planned for December 2019
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 implemented during chemical and SCADA upgrades planned for December 2019
MO61	Moranbah WTP Filtration	Inadequate filter operation	Upgrade air scour system, including new duty/common standby blowers and new air lines	Jun-18	Completed	WTP wash water filter valves have been replaced. Separate duty air scour systems are available for the WTP and Boby Plant. New Duty /standby blowers are installed by June 2019
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	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
MO63	Moranbah WTP Filtration (both Bobby and WTP)	Backwash discharging to Finger Dam	Finger Dam discharges should be reviewed in line with best practice processes and EPA requirements	Jul-17	Complete	Gabions are installed to stop the discharge into creek, so there is no overflow to the creek. The review carried out and the current process meets the EPA requirement.
MO64	Moranbah WTP Filtration (both Bobby and WTP)	Process control incapability	Install online turbidity analysers with alarms on common filter outlet of both Bobby and WTP (Priority 1). Install online turbidity analysers on outlet of each filter (Priority 3).	Dec-16	Completed	Installation of turbidity analysers with alarms on common filter outlet of both Bobby and WTP Works on main WTP is completed by March 2019. Turbidity analyser on each filter considered as not required.
MO65	Moranbah Filtered Water (Bobby and WTP)	Process control incapability	Install treated water flowmeters on both treatment streams (Bobby and WTP) (Priority 1). Flow pace treated water chemical dosing based on this instrument (Priority 2).	Jun-17	Completed	Installation of flowmeter and flow pace treated water chemical dosing based on this flowmeter is completed by June 2019
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	Completed	Current process is lime, chlorine gas followed by fluoride. Replacement of lime with sodium hydroxide is completed. Chemical order and spacing of dosing points prioritised and installed by June 2019.
MO67	Moranbah Filtered Water (Bobby WTP)	Process control incapability	Online analysers with alarms should be installed on the Bobby WTP treated water to monitor chlorine residual, pH and turbidity	Jun-17	Completed	Chemical dosing upgrades along with installation of online monitoring instruments and SCADA system is completed by March 2019.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
MO68	Moranbah Chlorine Dosing	Disinfection failure	Install a second regulator on the standby drum and provisions for auto-changeover	Dec-16	Completed	Set of scales installed for auto-changeover. Chlorine dosing upgrades and installation completed by Dec-17. Online monitoring and SCADA system installed by March 2019
MO69	Moranbah Chlorine Dosing	Disinfection failure	Install standby pump with auto-changeover capabilities on failure	Jun-17	Completed	Set of scales installed for auto-changeover. Chlorine dosing upgrades and installation completed by Dec-17. Chemical dosing upgrades along with installation of online monitoring instruments and SCADA system completed by March 2019
MO70	Moranbah Chlorine Dosing	Disinfection failure	Install common standby ejectors and chlorinators in case of failure or required maintenance	Jun-18	Completed	Completed as part of duty/standby upgrade by March 2019
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	Completed	Completed as part of Chemical and SCADA upgrades by March 2019.
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	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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	
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	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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 2019	Comments 2019
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	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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	
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	On going	Flushing procedure will be standardised as part of SOP update (in progress). No problem has been reported yet. 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	SOP for water main flushing procedure has been developed and in place. 10 year CAPEX program in place now for upgrades, replacements and renewals of IRC's water assets
G40	Glenden Reticulation	Corrosion	Addressed by maintenance programme, as per G38	Jun-14	In Progress	10-year CAPEX program in place for upgrades to address the corroded infrastructure. Replacements and renewals of IRC's corroded assets are in progress.
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	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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
G50	Glenden Raw Water	Inadequate signage	Install signage indicating raw water filling station (not for consumption).	Dec-16	Complete	Permanent signage has been installed at site August 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	Complete	SOPs are prepared as Work Instructions, circulated and available at IRC website September 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	In Progress	SCADA design in progress as part of IRC regional upgrade
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

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
G56	Glenden WTP Inlet/ Flocculation	Chemical dosing failure	Configure flow paced dosing for all chemicals.	Jun-18	In Progress	Investigating the possibility during the SCADA optimization
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	In Progress	The plant is operating in one block for the 24-hour period to avoid continuous starting and stopping
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	In Progress	10 year CAPEX program is in place to address ageing infrastructure including replacement and renewals. Clarifier interior to be resealed by 2018-2019
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	Complete	Filter refurbishment work is completed by November 2018. 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	In Progress	To be considered during chemical and SCADA upgrades.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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. At present there is no necessary to add chlorine for manganese oxidation. Requirement for oxidation prior to filters to be considered in future.
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	In Progress	To be done as part of Chemical upgrades. Not currently schedule but part of 10 year CAPEX program.
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 Aug 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	In Progress	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	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
N3	Nebo Bores	Inadequate well head protection and unhygienic practices	As per N1	Dec-13	Complete	Pipe work condition investigation completed and required pipe length are replaced by December 2018
N4	Nebo Bores	Uncased or inadequately cased bores	As per N1	Dec-13	In Progress	Drilling program is ongoing to replace the bore casing at bores 2,3 and 4.
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
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 DNRME on water supply to Nebo and Moranbah (already in progress).	Jun-14	Ongoing	Ongoing liaison with DNRME for higher bore water allocation. No alternate water source Moranbah required at this time.
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.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
N15	Nebo Reservoirs	Buildup of sediment and slime	Council to compile maintenance / flushing programme.	Jun-14	In Progress	Flushing procedure will be standardised as part of SOP update (in progress).
N16	Nebo Reservoirs	Aged infrastructure / corrosion. Inadequate repair and maintenance	As per N15	Jun-14	In Progress	10 year CAPEX program in place now for upgrades, replacements and renewals of IRC's water assets.
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	SOP for water main flushing procedure has been developed and in place. 10 year CAPEX program in place now for upgrades, replacements and renewals of IRC's water assets

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
N19	Nebo Reticulation	Aged pipes (AC)	Council to monitor asset condition and complete maintenance programme as per N15	Jun-14	In Progress	10 year CAPEX program in place now for upgrades, replacements and renewals of IRC's water assets.
N20	Nebo Reticulation	Corrosion	Council to monitor asset condition and complete maintenance programme as per N15	Jun-14	In Progress	10-year CAPEX program in place for upgrades to address the corroded infrastructure. Replacements and renewals of IRC's corroded assets are in progress.
N23	Nebo Reticulation	Biofilms, sloughing and re-suspension, regrowth	As per N15	Jun-14	Complete	SOP for water main flushing procedure has been developed and in place 2018.
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

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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	Complete	Iron and manganese monitoring in raw and treated water has been implemented from Aug 2017 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	In Progress	New water treatment plant work in ongoing and expected to be completed by October 2019. No further action required in bores.
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 October 2019
N35	Nebo Reticulation	Capacity	Install treated water reservoir with minimum three days storage in the reticulation	Jun-18	In Progress	New WTP and reservoir is expected to be completed by October 2019.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 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
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	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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	
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.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
CA33	Carmila Reticulation	Build up of sediment and slime	As per CA31	Jun-14	Ongoing	SOP for water main flushing procedure has been developed and in place. 10-year CAPEX program in place now for upgrades, replacements and renewals of IRC's water assets
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	
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

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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	
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

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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	Complete	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	In Progress	Planned for installation during 2019-2020 financial year.
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 2019	Comments 2019
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 reservoir hatch planned to install in 2019-2020 financial year.
CA63	Carmila Filtered Water	Corrosion of treated water pumps	Investigate replacement options	Dec-16	Complete	Plant have been refurbished in 2016
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.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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 2019	Comments 2019
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	Complete	SOPs are prepared as Work Instructions, circulated and available at IRC website September 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	Complete	WTP has been upgraded, turbidity analysis is carried out at NATA laboratory as per monitoring program and in addition operator is performing the test on site as an operating parameter
SL23	St Lawrence WTP Inlet/ Flocculation	Poor reliability of process	As per SL22	Dec-13	Complete	WTP has been upgraded, turbidity analysis is carried out at NATA laboratory as per monitoring program and in addition operator is performing the test on site as an operating parameter
SL24	St Lawrence WTP General	Formation of disinfection by-products	Verification testing programme amended to include THMs.	Dec-13	Complete	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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
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	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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.
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	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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	
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	Complete	Installed as part of the WTP upgradation
SL51	St Lawrence General	Power Failure	Install lightning rod to protect electrical systems and operators	Dec-16	Complete	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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	In Progress	Action to include in work flow procedure a weekly dropdown test will be completed by December 2019
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	Complete	Investigation carried out, found that the water is already metered hose connected to all the tank considered sufficient. December 2018
SL55	St Lawrence Whole System	Chemical dosing failure	Install raw water flowmeter and configure flow paced dosing for all pre- dosed chemicals.	Jun-18	Complete	As part of WTP upgradation raw water flowmeter is installed and flow paced chemical dosing is in place from Mar 2018
SL56	St Lawrence WTP Inlet/ Flocculation	Inadequate mixing	Install new mixer that can achieve a velocity gradient of 30 to 150/s	Jun-18	Complete	New mixer has been installed from Mar 2018
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	Complete	Installed by Mar 2018
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	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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.
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	Complete	Refurbishment of roof including replacement of hatch were completed May 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.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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	Complete	Completed as part of Chemical and online monitoring upgradation project by Mar 2018
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	IRC Monitoring the land use pattern for further improvements

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
MI13	Middlemount WTP General	Significant Flow variations	Link treated water turbidity analyser outputs to alarms	Dec-13	Complete	Inline treated water turbidity analyser alarms issues were addressed and working fine from Mar 2018.
MI14	Middlemount WTP Inlet/ Flocculation	Chemical dosing failures	Turbidity spikes detected by online analysers, as per MI13	Dec-13	Complete	Inline treated water turbidity analyser alarms issues were addressed and working fine from Mar 2018.
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	Complete	SOPs are prepared as Work Instructions, circulated and available at IRC website September 2018.
MI17	Middlemount WTP Inlet/ Flocculation	Inadequate mixing	As per MI13	Dec-13	Complete	Inline treated water turbidity analyser alarms issues were addressed and working fine from Mar 2018.
MI18	Middlemount WTP Inlet/ Flocculation	Poor reliability of process	As per MI13	Dec-13	Complete	Inline treated water turbidity analyser alarms issues were addressed and working fine from Mar 2018.
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	Complete	Connected to PLC and the alarms issues were addressed and working fine from Mar 2018.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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	Complete	Using filtered turbidity to detect breakthrough. Dry bedding does not occur at Middlemount. Turbidity meter is connected to SCADA, alarms issues were addressed and working fine from Mar 2018.
MI26	Middlemount Filtered Water	Ineffective disinfection	Online final water chlorine analyser to be connected to the PLC for alarms	Dec-13	Complete	Chlorine analyser is online and connected to SCADA, alarms issues were addressed and working fine from Mar 2018.
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	Complete	SOP for main flushing is completed and issued Mar 2018.
MI32	Middlemount Reticulation	Aged pipes (AC)	as per MI31	Jun-14	In Progress	10 year CAPEX program in place now for upgrades, replacements and renewals of IRC's water assets.
MI33	Middlemount Reticulation	Corrosion	as per MI31	Jun-14	In Progress	10-year CAPEX program in place for upgrades to address the corroded infrastructure. Replacements and renewals of IRC's corroded assets are in progress.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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	In Progress	Network modelling to be completed by Jun 2021.
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	In Progress	Network modelling to be completed by Jun 2021.
MI37	Middlemount Reticulation	Firefighting increasing demand on the network	As per MI34	Dec-13	In Progress	Network modelling to be commissioned separately and completed by Jun 2021
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	Completed	Online analyser, alarms issues were addressed and working fine from Mar 2018.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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	Complete	Chemical dosing upgradation completed by Mar 2018
MI44	Middlemount WTP Inlet/ Flocculation	Chemical dosing failure	Configure flow paced dosing for all chemicals.	Jun-18	Complete	Chemical dosing upgradation completed by Mar 2018
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	Complete	Chemical dosing upgradation completed by Mar 2018
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	Complete	Chemical dosing upgradation completed and the optimum dosing arrangements incorporated by Mar 2018
MI47	Middlemount Whole System	Equipment Failure	PE hosing should be changed to a suitable material for contact with chlorine	Dec-16	Complete	Chemical dosing upgradation completed by Mar 2018
MI48	Middlemount WTP Clarification	Poor clarification	Install polymer dosing system to aid in coagulation/ flocculation	Jun-17	Complete	Chemical dosing upgradation completed by Mar 2018
MI49	Middlemount WTP Inlet/ Flocculation	Equipment malfunction	Downrate the plant upon startup to minimise floc carryover to filters	Jun-18	Complete	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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	Complete	Chemical dosing and SCADA upgradation completed by Mar 2018
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.
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	Completed	Chemical dosing system upgradation completed. 70 kg cylinders were replaced with a second 920kg drums by Mar 2018
MI56	Middlemount Whole system	Disinfection failure	Install auto changeover capability on 70 kg chlorine gas cylinders	Dec-16	Completed	Chemical dosing system upgradation completed. 70 kg cylinders were replaced with 920kg drums including auto changeover by Mar 2018
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	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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	The clear water reservoir roof will be replaced by June 2020
MI59	Middlemount Whole system	Aged infrastructure/corrosion	Hatch on Clearwater Tank #1 should be replaced.	Dec-16	In Progress	The clear water reservoir roof will be replaced by June 2020
MI60	Middlemount Town Reservoir	Aged infrastructure/corrosion	Areas of corrosion visible in roof. Repair or replace roof.	Jun-17	In Progress	The clear water reservoir roof will be replaced by June 2020
MI61	Middlemount Town Reservoir	Ageing infrastructure and sludge buildup	Desludge Town Reservoir	Dec-16	Complete	
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	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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	
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	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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	Complete	Comments from the principal have been incorporated at the review and final information is being collected, incorporated and final O&M manual have been issued at plant by September 2018.
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	
D27	Dysart WTP General	Sludge pond supernatant return	As per D16 and D26 to detect abnormal process conditions	N/A	Complete	Comments from the principal have been incorporated at the review and final information is being collected, incorporated and final O&M manual have been issued at plant by September 2018.
D29	Dysart Reservoirs	Build up of sediment and slime	Council to compile flushing/ maintenance programme.	Jun-14	Ongoing	Reservoirs are cleaned regularly. Flushing procedure will be standardised as part of SOP update (in progress).
D31	Dysart Reticulation	Build up of sediment and slime	As per D29	Jun-14	Complete	SOP for main flushing is completed and issued Mar 2018.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
D32	Dysart Reticulation	Aged pipes (AC)	As per D29	Jun-14	In Progress	10-year CAPEX program in place now for upgrades, replacements and renewals of IRC's water assets.
D33	Dysart Reticulation	Corrosion	As per D29	Jun-14	In Progress	10-year CAPEX program in place for upgrades to address the corroded infrastructure. Replacements and renewals of IRC's corroded assets are in progress.
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	
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	In Progress	Network modelling project proposed for 2019-2020 budget, however, postponed because of budget restriction and hence planned to include in 2020 – 2021 budget.
D38	Dysart Reticulation	Firefighting increasing demand on the network	As per D35	Dec-13	Complete	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
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	The current and future population will be monitored for further development.
D43	Dysart General	Process control incapability	Complete matrix calibration to finalise commissioning of LiquiD analyser	Dec-16	Complete	LiquiD matrix calibration and final commissioning completed.
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	Complete	Final alarm hierarchy with functional description has been issued with final copy of O&M manual by September 2018
D47	Dysart WTP Clarification	Process control incapability	Include operator changeable clarifier sludge blowdown setpoint on SCADA to increase control of frequency	Jun-17	Complete	Completed as part of upgradation in Phase 2 works by Jan 2018
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	Complete	O&M manual with operating procedure for the upgraded process and units of the plant are issued. Operators are trained as part of commissioning and handing over process. SOPs for the WTP is prepared and issued by September 2018

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status 2019	Comments 2019
D49	Dysart General	Equipment malfunction	Develop spare parts list for whole of plant	Dec-16	Complete	Spare parts list has been submitted as part of final O&M manual September 2018.
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.

Legend	
-	- Number of Aesthetic exceedances
-	- Number of Health exceedances

A) CARMILA SUPPLY SYSTEM

i. Carmila Treated Water

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th percentile	Average	95th percentile	Max	LOR
Aluminium	µg/L	Weekly	54	53	0	<5	23.90	39.64	58.51	103.95	5.00
Conductivity	µS/cm		54	54	0	162.30	230.10	315.91	410.00	449.00	none
E. coli	MPN/100mL		54	0	0	<1	<1	<1	<1	<1	1.00
Iron	µg/L		54	29	0	<2	<2	2.77	5.86	7.58	2.00
Manganese	µg/L		54	17	0	<1	<1	1.04	2.60	3.51	1.00
pH			79	79	0	7.60	7.70	7.79	7.83	7.90	none
Residual Chlorine	mg/L		79	79	0	1.00	1.00	1.49	2.13	2.80	none
Total Dissolved Solids (TDS)	mg/L		54	54	0	97.00	133.00	187.87	238.50	269.00	none
Turbidity	NTU		72	65	0	<0.1	<0.1	0.13	0.16	0.85	0.10
Alkalinity	mg/L	Monthly	13	13	0	60.32	68.06	87.47	102.11	102.20	none
Bromate	µg/L		25	0	0	<5	7.07	6.93	7.07	7.07	5.00
Calcium	mg/L		13	13	0	16.93	18.69	23.33	26.94	27.08	none
Chlorate	µg/L		25	25	0	99.00	112.40	181.98	260.09	340.00	none
Chlorite	µg/L		25	0	0	<5	<10	<10	<10	<10	10.00
Dissolved Oxygen	% Sat		13	13	2 (Aesthetic)	78.40	81.26	94.31	104.39	104.50	none
Fluoride	mg/L		13	13	0	0.02	0.04	0.09	0.14	0.14	0.01
Magnesium	mg/L		13	13	0	6.10	6.86	9.39	11.12	11.35	none
Nitrate	mg/L		13	10	0	<0.015	<0.015	0.27	0.44	0.74	0.02
Nitrite	mg/L		13	1	0	<0.004	<0.004	0.02	0.09	0.20	0.00

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th percentile	Average	95th percentile	Max	LOR
Residual Alkalinity	mg/L		13	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Temporary Hardness	mg/L		13	13	0	60.30	68.06	87.47	102.09	102.20	none
THMs	µg/L		24	24	0	15.00	23.60	56.93	99.25	108.00	none
Total Hardness	mg/L		13	13	0	67.40	74.94	96.92	111.09	111.20	none
True Colour	TCU		13	3	0	<1	<1	<1	1.45	2.00	1.00
Ammonia	mg/L	Quarterly	4	0	0	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Arsenic	µg/L		4	1	0	<0.5	<0.5	<0.5	0.65	0.70	0.50
Cadmium	µg/L		4	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Chromium	µg/L		4	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Copper	µg/L		4	2	0	<1	<1	3.04	6.08	6.38	1.00
Formaldehyde	mg/L		3	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Hydrogen Sulphide	mg/L		4	1	0	<0.005	<0.005	0.01	0.01	0.01	0.01
Lead	µg/L		4	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Mercury	µg/L		4	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Nickel	µg/L		4	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Pesticides*	µg/L		7	0	0	<0.0001	0.00	<<0.0001	0.00	<0.0001	<0.0001
Selenium	µg/L		4	0	0	<5	<5	<5	<5	<5	5.00
Zinc	µg/L		4	3	0	<1	0.77	3.47	6.09	6.12	1.00
Barium	µg/L	Annually	1	1	0	20.74	20.74	20.74	20.74	20.74	none
Beryllium	µg/L		1	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Boron	µg/L		1	1	0	16.68	16.68	16.68	16.68	16.68	none
Iodide	µg/L		1	0	0	<20	<20	<20	<20	<20	20.00
Molybdenum	µg/L		1	0	0	<1	<1	<1	<1	<1	1.00
Radionuclides - Gross alpha	Bq/L		1	0	0	<0.05	<0.05	<0.05	<0.05	<0.05	0.05
Radionuclides - Gross beta	Bq/L		1	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Silver	µg/L		1	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Tin	µg/L		1	1	0	1.03	1.03	1.03	1.03	1.03	none
Uranium	µg/L		1	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50

ii. Carmila Reticulation

Parameter	Units	No. Samples	Detections	Exceedances	Min	5th percentile	Average	95th percentile	Max	LOR
Sample Location: Carmila Network 6 Music St (Jul 2018 - Jun 2019)										
pH	-	51	51	0	7.5	7.75	7.80	7.85	7.90	none
Free Chlorine	mg/L	51	51	0	0.11	0.15	0.30	0.50	2.80	none
E. coli	MPN/100mL	47	0	0	<1	<1	<1	<1	<1	1.00

iii. Carmila E. Coli Compliance

Year	2018 - 2019											
Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
No. of samples collected	8	10	8	10	8	8	10	8	6	8	10	8
No. of samples collected in which <i>E. coli</i> 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	105	105	102	102	102	102	102	104	104	100	99
No. of failures for previous 12-month period	0	0	0	0	0	0	0	0	0	0	0	0
% of samples that comply	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Compliance with 98% annual value	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

B) CLERMONT SUPPLY SYSTEM

i. Clermont Treated Water

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th percentile	Average	95th percentile	Max	LOR	
Aluminium	µg/L	Weekly	52	51	1 (Aesthetic)	<5	6.83	42.40	144.75	446.21	5.00	
Conductivity	µS/cm		52	52	0	113.20	251.33	298.15	347.90	461.50	none	
E. coli	MPN/10 0mL		52	0	0	<1	<1	<1	<1	<1	1.00	
Iron	µg/L		52	9	0	<2	<2	2.87	6.58	51.37	2.00	
Manganese	µg/L		52	20	1 (Aesthetic)	<1	<1	8.78	14.18	254.31	1.00	
pH			79	79	0	6.95	7.02	7.22	7.42	7.78	none	
Residual Chlorine	mg/L		79	79	0	1.20	1.56	1.97	2.51	3.20	none	
Total Dissolved Solids (TDS)	mg/L		52	52	0	68.00	150.85	178.88	208.45	277.00	none	
Turbidity	NTU		75	55	0	<0.1	<0.1	0.28	1.60	1.90	0.10	
Alkalinity	mg/L	Monthly	12	12	0	28.48	33.17	61.79	89.55	93.88	none	
Bromate	µg/L		13	0	0	<5	5.30	6.75	7.07	7.07	5.00	
Calcium	mg/L		12	12	0	10.53	12.24	18.97	25.44	26.13	none	
Chlorate	µg/L		13	0	0	7.07	21.21	32.78	35.36	35.36	none	
Chlorite	µg/L		13	0	0	<5	<10	<10	<10	<10	10.00	
Dissolved Oxygen	% Sat		12	12	1 (Aesthetic)	82.40	84.11	91.03	98.25	100.50	none	
Fluoride	mg/L		12	11	0	<0.01	0.01	0.07	0.11	0.12	0.01	
Magnesium	mg/L		12	12	0	3.25	3.68	6.15	8.64	8.78	none	
Nitrate	mg/L		12	11	0	<0.015	0.09	0.85	1.81	2.04	0.02	
Nitrite	mg/L		12	0	0	<0.004	<0.004	<0.004	<0.004	<0.004	0.00	
Residual Alkalinity	mg/L		12	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10	
Temporary Hardness	mg/L		12	12	0	28.50	33.18	61.79	89.56	93.90	none	
THMs	µg/L		13	11	0	75.00	77.50	119.45	189.50	217.00	none	
Total Algae	cells/mL		25	0	0	0	0	0	0	0	None	
Algal Toxins	cells/mL		0	As per IRC BGAMP, not required to test Algal toxins, if Cyanobacteria is less than 500 cells/ml.								
Total Hardness	mg/L		12	12	0	39.70	45.70	72.70	97.75	98.30	none	
True Colour	TCU	12	5	0	<1	<1	1.50	4.00	4.00	1.00		

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th percentile	Average	95th percentile	Max	LOR
Ammonia	mg/L	Quarterly	4	0	0	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Arsenic	µg/L		4	2	0	<0.5	<0.5	<0.5	0.59	0.60	0.50
Cadmium	µg/L		4	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Chromium	µg/L		4	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Copper	µg/L		4	3	0	<1	0.85	2.24	3.90	4.17	1.00
Formaldehyde	mg/L		3	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Hydrogen Sulphide	mg/L		4	0	0	<0.005	<0.005	<0.005	<0.005	<0.005	0.01
Lead	µg/L		4	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Mercury	µg/L		4	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Nickel	µg/L		4	1	0	<0.5	<0.5	<0.5	0.53	0.56	0.50
Pesticides*	µg/L		5	1	0	<0.0001	<0.0001	0	<0.0001	0.14	0.00
Selenium	µg/L		4	0	0	<5	<5	<5	<5	<5	5.00
Zinc	µg/L		4	3	0	<1	0.80	2.84	6.65	7.50	1.00
Barium	µg/L	Annually	1	1	0	47.71	47.71	47.71	47.71	47.71	none
Beryllium	µg/L		1	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Boron	µg/L		1	1	0	55.98	55.98	55.98	55.98	55.98	none
Iodide	µg/L		1	0	0	<20	<20	<20	<20	<20	20.00
Molybdenum	µg/L		1	0	0	<1	<1	<1	<1	<1	1.00
Radionuclides - Gross alpha	Bq/L		1	0	0	<0.05	<0.05	<0.05	<0.05	<0.05	0.05
Radionuclides - Gross beta	Bq/L		1	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Silver	µg/L		1	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Tin	µg/L		1	0	0	0.71	0.71	0.71	0.71	0.71	none
Uranium	µg/L		1	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50

ii. Clermont Reticulation

Parameter	Units	No. Samples	Detections	Exceedances	Min	5th percentile	Average	95th percentile	Max	LOR
Sample Location: Clermont Network Centenary Park (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	0	0	0	<1	<1	<1	<1	<1	1.00
pH	-	14	14	0	7.04	7.05	7.28	7.52	7.73	none
Free Chlorine	mg/L	14	14	0	0.64	0.69	1.48	2.15	2.40	none
Sample Location: Clermont Network Hospital (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	2	0	0	<1	<1	<1	<1	<1	1.00
pH	-	2	2	0	7.31	7.31	7.33	7.34	7.34	none
Free Chlorine	mg/L	2	2	0	0.54	0.61	1.19	1.78	1.84	none
Sample Location: Clermont Network Jeffery Street (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	8	0	0	<1	<1	<1	<1	<1	1.00
pH	-	8	8	0	7.10	7.16	7.42	7.69	7.70	none
Free Chlorine	mg/L	8	8	0	0.95	1.18	1.80	2.10	2.10	none
Sample Location: Clermont Network Library (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	14	0	0	<1	<1	<1	<1	<1	1.00
pH	-	14	14	0	7.09	7.12	7.26	7.37	7.37	none
Free Chlorine	mg/L	14	14	0	0.76	0.80	1.52	2.10	2.10	none
Sample Location: Clermont Network Rose Harris Park (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	14	0	0	<1	<1	<1	<1	<1	1.00
pH	-	14	14	0	7.00	7.04	7.27	7.51	7.56	none
Free Chlorine	mg/L	14	14	0	0.54	0.60	1.59	2.31	2.50	none
Sample Location: Clermont Network Spring Park (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	15	0	0	<1	<1	<1	<1	<1	1.00
pH	-	15	15	0	7.02	7.07	7.35	7.68	7.97	none
Free Chlorine	mg/L	15	15	0	0.91	1.03	1.64	2.22	2.50	none
Combined Results for All Sample Points										
E. coli	MPN/100mL	67	0	0	<1	<1	<1	<1	<1	1.00
pH	-	67	67	0	7.00	7.05	7.31	7.66	7.97	none
Free Chlorine	mg/L	67	67	0	0.54	0.66	1.58	2.20	2.50	none

iii. Clermont E. Coli Compliance

Year		2018 - 2019											
Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	
No. of samples collected	8	10	10	9	10	19	11	8	8	9	9	9	
No. of samples collected in which <i>E. coli</i> 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	101	102	102	103	103	103	101	99	101	102	102	102	
No. of failures for previous 12-month period	0	0	0	0	0	0	0	0	0	0	0	0	
% of samples that comply	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	
Compliance with 98% annual value	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	

C) DYSART SUPPLY SYSTEM

i. Dysart Treated Water

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th percentile	Average	95th percentile	Max	LOR
Aluminium	µg/L	Weekly	52	52	0	5.64	6.45	15.59	31.67	60.61	5.00
Conductivity	µS/cm		52	52	0	119.00	220.55	303.68	409.52	460.00	none
E. coli	MPN/100mL		52	0	0	<1	<1	<1	<1	<1	1.00
Iron	µg/L		52	19	0	<2	<2	4.81	16.71	64.27	2.00
Manganese	µg/L		52	5	0	<1	<1	<1	1.84	3.11	1.00
pH			71	71	0	6.78	6.87	7.25	7.50	7.60	none
Residual Chlorine	mg/L		69	69	0	0.52	1.44	2.15	2.70	3.10	none
Total Dissolved Solids (TDS)	mg/L		52	52	0	71.00	132.55	182.19	245.90	276.00	none
Turbidity	NTU		65	56	0	<0.1	<0.1	0.15	0.32	0.53	0.10
Alkalinity	mg/L	Monthly	12	12	0	68.00	68.91	81.69	111.21	117.08	none
Bromate	µg/L		11	0	0	<5	5.30	6.75	7.07	7.07	5.00
Calcium	mg/L		12	12	0	17.75	17.78	20.32	25.93	26.27	none
Chlorate	µg/L		11	0	0	7.07	21.21	32.78	35.36	35.36	none
Chlorite	µg/L		11	0	0	<5	<10	<10	<10	<10	10.00
Dissolved Oxygen	% Sat		12	12	2 (Aesthetic)	81.30	83.17	92.60	100.65	101.20	none
Fluoride	mg/L		12	12	0	0.01	0.05	0.13	0.20	0.21	0.01
Magnesium	mg/L		12	12	0	6.52	6.67	8.44	11.49	11.83	none
Nitrate	mg/L		12	11	0	<0.015	0.10	0.42	0.76	0.97	0.02
Nitrite	mg/L		12	0	0	<0.004	<0.004	<0.004	<0.004	<0.004	0.00
Residual Alkalinity	mg/L		12	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Temporary Hardness	mg/L		12	12	0	68.00	68.94	81.70	111.22	117.10	none
THMs	µg/L		11	11	0	25.00	33.90	76.89	119.00	137.00	none
Total Hardness	mg/L		12	12	0	0.00	39.44	78.11	112.25	112.80	none
True Colour	TCU		12	7	0	<1	<1	1.38	3.45	4.00	1.00
Total Algae	cells/mL		2	3		0	0	0	0	150	none
Algal Toxins	cells/mL	0	As per IRC BGAMP, not required to test Algal toxins, if Cyanobacteria is less than 500 cells/ml.								
Ammonia	mg/L	Quarterly	4	0	0	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Arsenic	µg/L		4	1	0	<0.5	<0.5	<0.5	0.50	0.52	0.50

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th percentile	Average	95th percentile	Max	LOR
Cadmium	µg/L		4	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Chromium	µg/L		4	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Copper	µg/L		4	4	0	12.14	12.47	25.18	40.07	41.34	1.00
Formaldehyde	mg/L		3	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Hydrogen Sulphide	mg/L		4	0	0	<0.005	<0.005	<0.005	<0.005	<0.005	0.01
Lead	µg/L		4	2	0	<0.5	<0.5	1.38	3.53	4.02	0.50
Mercury	µg/L		4	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Nickel	µg/L		4	4	0	0.67	0.67	0.75	0.88	0.90	0.50
Pesticides*	µg/L		5	1	0	<0.0001	<0.0001	0.00	<0.0001	0.15	0.00
Selenium	µg/L		4	0	0	<5	<5	<5	<5	<5	5.00
Zinc	µg/L		4	4	0	6.87	7.40	13.56	22.56	24.31	1.00
Barium	µg/L	Annually	1	1	0	35.92	35.92	35.92	35.92	35.92	none
Beryllium	µg/L		1	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Boron	µg/L		1	1	0	60.37	60.37	60.37	60.37	60.37	none
Iodide	µg/L		1	0	0	<20	<20	<20	<20	<20	20.00
Molybdenum	µg/L		1	0	0	<1	<1	<1	<1	<1	1.00
Radionuclides - Gross alpha	Bq/L		1	0	0	<0.05	<0.05	<0.05	<0.05	<0.05	0.05
Radionuclides - Gross beta	Bq/L		1	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Silver	µg/L		1	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Tin	µg/L		1	0	0	0.71	0.71	0.71	0.71	0.71	none
Uranium	µg/L		1	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50

ii. Dysart Reticulation

Parameter	Units	No. Samples	Detections	Exceedances	Min	5th percentile	Average	95th percentile	Max	LOR
Sample Location: Dysart Network 1 Fisher St (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	11	0	0	<1	<1	<1	<1	<1	1.00
Free Chlorine	mg/L	11	11	0	0.37	0.51	1.16	1.95	2.20	none
pH	-	11	11	0	7.15	7.28	7.44	7.55	7.55	none
Sample Location: Dysart Network Centenary Park (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	9	0	0	<1	<1	<1	<1	<1	1.00
Free Chlorine	mg/L	9	9	0	0.75	0.78	1.28	1.94	1.98	none
pH	-	9	9	0	7.15	7.19	7.50	7.71	7.75	none
Sample Location: Dysart Network Fisher St Sports Complex (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	2	0	0	<1	<1	<1	<1	<1	1.00
Free Chlorine	mg/L	2	2	0	1.24	1.24	1.25	1.26	1.26	none
pH	-	2	2	0	7.15	7.17	7.33	7.48	7.50	none
Sample Location: Dysart Network Fox Park (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	10	0	0	<1	<1	<1	<1	<1	1.00
Free Chlorine	mg/L	10	10	0	0.35	0.39	1.13	1.70	1.76	none
pH	-	10	10	0	7.14	7.23	7.50	7.73	7.75	none
Sample Location: Dysart Network Lions Park (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	9	0	0	<1	<1	<1	<1	<1	1.00
Free Chlorine	mg/L	9	9	0	0.31	0.38	1.26	2.52	2.90	none
pH	-	9	9	0	6.98	7.06	7.49	7.82	7.85	none
Sample Location: Dysart Network Powell St SPS (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	10	0	0	<1	<1	<1	<1	<1	1.00
Free Chlorine	mg/L	10	10	0	0.24	0.32	0.84	1.53	1.72	none
pH	-	10	10	0	7.3	7.33	7.49	7.75	7.75	none
Sample Location: Dysart Network Gale Street (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	3	0	0	<1	<1	<1	<1	<1	1.00
Free Chlorine	mg/L	3	3	0	0.42	0.49	1.18	1.91	2	none
pH	-	3	3	0	6.95	6.99	7.21	7.37	7.38	none
Sample Location: Dysart Network Office Shannon Crescent (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	1	0	0	<1	<1	<1	<1	<1	1.00
Free Chlorine	mg/L	1	1	0	0.65	0.65	0.65	0.65	0.65	none

Parameter	Units	No. Samples	Detections	Exceedances	Min	5th percentile	Average	95th percentile	Max	LOR
pH	-	1	1	0	7.65	7.65	7.65	7.65	7.65	none
Combined Results for All Sample Points										
E. coli	MPN/100mL	55	0	0	<1	<1	<1	<1	<1	1.00
Free Chlorine	mg/L	55	55	0	0.24	0.38	1.13	2.00	2.90	none
pH	-	55	55	0	6.95	7.14	7.46	7.75	7.85	none

iii. Dysart E. Coli Compliance

Year		2018 - 2019											
Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	
No. of samples collected	9	9	10	9	11	7	9	9	8	9	9	8	
No. of samples collected in which <i>E. coli</i> 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	93	93	96	99	100	101	101	101	104	105	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	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	
Compliance with 98% annual value	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	

D) GLENDEN SUPPLY SYSTEM

i. Glenden Treated Water

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th percentile	Average	95th percentile	Max	LOR
Aluminium	µg/L	Weekly	52	52	0	12.91	14.61	23.06	41.70	47.79	5.00
Conductivity	µS/cm		52	52	0	109.00	162.03	251.10	321.09	337.00	none
E. coli	MPN/100mL		52	0	0	<1	<1	<1	<1	<1	1.00
Iron	µg/L		52	9	0	<2	<2	3.30	4.17	82.93	2.00
Manganese	µg/L		52	10	0	<1	<1	<1	2.33	5.07	1.00
pH			98	98	0	6.95	6.99	7.11	7.30	7.30	none
Residual Chlorine	mg/L		92	92	0	0.60	0.72	1.25	1.94	2.60	none
Total Dissolved Solids (TDS)	mg/L		52	52	0	65.00	97.60	150.71	193.00	202.00	none
Turbidity	NTU		67	49	0	<0.1	<0.1	0.15	0.29	0.35	0.10
Alkalinity	mg/L	Monthly	12	12	0	52.56	52.69	63.11	83.82	85.02	none
Bromate	µg/L		27	0	0	<5	<10	<10	<10	<10	10.00
Calcium	mg/L		12	12	0	18.22	18.66	22.41	26.96	28.26	none
Chlorate	µg/L		27	20	0	35.36	35.36	205.31	606.01	660.00	none
Chlorite	µg/L		27	0	0	<5	<10	<10	<10	<10	10.00
Dissolved Oxygen	% Sat		12	12	0	91.10	92.26	98.40	104.55	104.60	none
Fluoride	mg/L		12	11	0	<0.01	0.01	0.05	0.11	0.17	0.01
Magnesium	mg/L		12	12	0	4.27	4.38	5.91	8.76	9.06	none
Nitrate	mg/L		12	11	0	<0.015	0.08	0.38	0.80	0.96	0.02
Nitrite	mg/L		12	0	0	<0.004	<0.004	<0.004	<0.004	<0.004	0.00
Residual Alkalinity	mg/L		12	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Temporary Hardness	mg/L		12	12	0	52.60	52.71	63.11	83.79	85.00	none
THMs	µg/L		26	18	0	14.00	14.14	28.22	60.10	65.00	none
Total Hardness	mg/L		12	12	0	0.00	35.15	71.33	95.86	96.90	none
True Colour	TCU		12	2	0	<1	<1	<1	1.00	1.00	1.00
Total Algae	cells/mL		45	3	0	0	0	0	0	40	none
Algal Toxins	cells/mL		0	As per IRC BGAMP, not required to test Algal toxins, if Cyanobacteria is less than 500 cells/ml.							
Ammonia	mg/L	Quarterly	4	0	0	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Arsenic	µg/L		4	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th percentile	Average	95th percentile	Max	LOR
Cadmium	µg/L		4	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Chromium	µg/L		4	1	0	<0.1	<0.1	<0.1	0.11	0.12	0.10
Copper	µg/L		4	4	0	2.30	2.45	4.06	5.98	6.26	1.00
Formaldehyde	mg/L		3	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Hydrogen Sulphide	mg/L		4	0	0	<0.005	<0.005	<0.005	<0.005	<0.005	0.01
Lead	µg/L		4	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Mercury	µg/L		4	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Nickel	µg/L		4	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Pesticides*	µg/L		4	1	0	<0.0001	<0.0001	0	<0.0001	2.12	0.00
Selenium	µg/L		4	0	0	<5	<5	<5	<5	<5	5.00
Zinc	µg/L		4	4	0	1.80	1.90	2.89	4.09	4.27	1.00
Barium	µg/L	Annually	1	1	0	17.96	17.96	17.96	17.96	17.96	none
Beryllium	µg/L		1	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Boron	µg/L		1	1	0	14.81	14.81	14.81	14.81	14.81	none
Iodide	µg/L		1	0	0	<20	<20	<20	<20	<20	20.00
Molybdenum	µg/L		1	0	0	<1	<1	<1	<1	<1	1.00
Radionuclides - Gross alpha	Bq/L		1	0	0	<0.05	<0.05	<0.05	<0.05	<0.05	0.05
Radionuclides - Gross beta	Bq/L		1	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Silver	µg/L		1	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Tin	µg/L		1	0	0	0.71	0.71	0.71	0.71	0.71	none
Uranium	µg/L		1	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50

ii. Glenden Reticulation

Parameter	Units	No. Samples	Detections	Exceedances	Min	5th percentile	Average	95th percentile	Max	LOR
Sample Location: Glenden Network 7B Usher Terrace (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	14	0	0	<1	<1	<1	<1	<1	1.00
pH	-	14	14	0	6.95	7.02	7.18	7.35	7.35	none
Free Chlorine	mg/L	14	14	0	0.57	0.58	1.30	2.11	2.50	none
Sample Location: Glenden Network Depot (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	12	0	0	<1	<1	<1	<1	<1	1.00
pH	-	12	12	0	6.90	6.93	7.20	7.37	7.40	none
Free Chlorine	mg/L	12	12	0	0.68	0.69	1.16	1.78	1.80	none
Sample Location: Glenden Network Golf Club (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	12	0	0	<1	<1	<1	<1	<1	1.00
pH	-	12	12	0	6.95	6.98	7.23	7.50	7.55	none
Free Chlorine	mg/L	12	12	0	0.60	0.61	0.99	1.65	1.88	none
Sample Location: Glenden Network Library (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	14	0	0	<1	<1	<1	<1	<1	1.00
pH	-	14	14	0	7.00	7.07	7.25	7.45	7.45	none
Free Chlorine	mg/L	14	14	0	0.40	0.40	0.96	1.65	1.68	none
Combined Results for All Sample Points										
E. coli	MPN/100mL	52	0	0	<1	<1	<1	<1	<1	1.00
pH	-	52	52	0	6.90	6.95	7.22	7.45	7.55	none
Free Chlorine	mg/L	52	52	0	0.40	0.56	1.11	1.84	2.50	none

iii. Glenden E. Coli Compliance

Year		2018 - 2019											
Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	
No. of samples collected	8	10	9	9	8	8	11	7	8	8	11	8	
No. of samples collected in which <i>E. coli</i> 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	99	100	100	99	101	101	103	104	105	107	106	106	
No. of failures for previous 12-month period	0	0	0	0	0	0	0	0	0	0	0	0	
% of samples that comply	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	
Compliance with 98% annual value	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	

E) MIDDLEMOUNT SUPPLY SYSTEM

i. Middlemount Treated Water

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th percentile	Average	95th percentile	Max	LOR
Aluminium	µg/L	Weekly	54	18	0	<5	<5	5.09	10.03	15.69	5.00
Conductivity	µS/cm		55	55	0	113.70	219.10	303.13	463.85	505.00	none
E. coli	MPN/100mL		55	0	0	<1	<1	<1	<1	<1	1.00
Iron	µg/L		55	11	0	<2	<2	3.07	3.68	76.16	2.00
Manganese	µg/L		55	3	0	<1	<1	<1	<1	2.48	1.00
pH			73	73	0	7.22	7.32	7.50	7.67	7.68	none
Residual Chlorine	mg/L		73	73	0	1.96	2.10	2.52	2.96	3.24	none
Total Dissolved Solids (TDS)	mg/L		55	55	0	68.00	131.40	181.93	278.40	303.00	none
Turbidity	NTU		55	36	0	<0.1	<0.1	0.13	0.23	0.62	0.10
Alkalinity	mg/L	Monthly	13	13	0	47.48	53.91	78.80	109.12	112.60	none
Bromate	µg/L		15	0	0	<5	5.48	<10	<10	<10	10.00
Calcium	mg/L		13	13	0	10.50	14.06	19.16	26.35	26.99	none
Chlorate	µg/L		15	0	0	7.07	22.63	33.00	35.36	35.36	none
Chlorite	µg/L		15	0	0	<5	<10	<10	<10	<10	10.00
Dissolved Oxygen	% Sat		13	13	0	91.00	93.40	98.25	103.56	107.10	none
Fluoride	mg/L		13	12	0	<0.01	0.01	0.12	0.20	0.22	0.01
Magnesium	mg/L		13	13	0	4.97	5.80	8.37	12.99	13.04	none
Nitrate	mg/L		13	13	0	0.22	0.35	1.02	1.88	2.22	0.02
Nitrite	mg/L		13	0	0	<0.004	<0.004	<0.004	<0.004	<0.004	0.00
Residual Alkalinity	mg/L		13	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Temporary Hardness	mg/L		13	13	0	47.50	53.92	78.80	109.12	112.60	none
THMs	µg/L		14	11	0	14.14	53.17	141.10	215.35	217.00	none
Total Hardness	mg/L		13	13	0	46.70	59.42	82.29	119.30	121.10	none
True Colour	TCU		13	7	0	<1	<1	1.17	2.00	2.00	1.00
Total Algae	cells/mL		19	0	0	0	0	0	0	0	none
Algal Toxins	cells/mL	0	As per IRC BGAMP, not required to test Algal toxins, if Cyanobacteria is less than 500 cells/ml.								
Ammonia	mg/L	Quarterly	4	0	0	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Arsenic	µg/L		4	4	0	0.53	0.56	0.84	1.18	1.24	0.50

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th percentile	Average	95th percentile	Max	LOR
Cadmium	µg/L		4	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Chromium	µg/L		4	1	0	<0.1	<0.1	<0.1	0.10	0.11	0.10
Copper	µg/L		4	4	0	11.17	11.51	17.92	25.41	26.20	1.00
Formaldehyde	mg/L		3	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Hydrogen Sulphide	mg/L		5	1	0	<0.005	<0.005	<0.005	0.01	0.01	0.01
Lead	µg/L		4	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Mercury	µg/L		4	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Nickel	µg/L		4	4	0	1.36	1.38	1.48	1.55	1.56	0.50
Pesticides*	µg/L		4	2	0	<0.0001	<0.0001	<0.0001	<0.0001	0.51	0.00
Selenium	µg/L		4	0	0	<5	<5	<5	<5	<5	5.00
Zinc	µg/L		4	4	0	7.13	0.00	9.29	0.00	11.84	1.00
Barium	µg/L		Annually	1	1	0	38.77	38.77	38.77	38.77	38.77
Beryllium	µg/L	1		0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Boron	µg/L	1		1	0	42.83	42.83	42.83	42.83	42.83	none
Iodide	µg/L	1		0	0	<20	<20	<20	<20	<20	20.00
Molybdenum	µg/L	1		0	0	<1	<1	<1	<1	<1	1.00
Radionuclides - Gross alpha	Bq/L	1		0	0	<0.05	<0.05	<0.05	<0.05	<0.05	0.05
Radionuclides - Gross beta	Bq/L	1		0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Silver	µg/L	1		0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Tin	µg/L	1		0	0	0.71	0.71	0.71	0.71	0.71	none
Uranium	µg/L	1		0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50

ii. Middlemount Reticulation

Parameter	Units	No. Samples	Detections	Exceedances	Min	5th percentile	Average	95th percentile	Max	LOR
Sample Location: Middlemount Network Emu Park (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	12	0	0	<1	<1	<1	<1	<1	1.00
pH	-	12	12	0	7.31	7.37	7.65	7.81	7.85	none
Free Chlorine	mg/L	12	12	0	0.36	0.37	0.87	1.41	1.53	none
Sample Location: Middlemount Network Footy Fields (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	2	0	0	<1	<1	<1	<1	<1	1.00
pH	-	2	2	0	7.70	7.70	7.73	7.75	7.75	none
Free Chlorine	mg/L	2	2	0	2.38	2.39	2.52	2.65	2.66	none
Sample Location: Middlemount Network Kookaburra Park (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	13	0	0	<1	<1	<1	<1	<1	1.00
pH	-	13	13	0	7.30	7.34	7.61	7.83	7.84	none
Free Chlorine	mg/L	13	13	0	0.33	0.43	0.71	1.02	1.02	none
Sample Location: Middlemount Network MMT Golf Course (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	12	0	0	<1	<1	<1	<1	<1	1.00
pH	-	12	12	0	7.31	7.39	7.65	7.78	7.80	none
Free Chlorine	mg/L	12	12	0	0.31	0.33	0.68	1.22	1.38	none
Sample Location: Middlemount Network Shopping Centre (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	12	0	0	<1	<1	<1	<1	<1	1.00
pH	-	12	12	0	7.36	7.37	7.62	7.81	7.84	none
Free Chlorine	mg/L	12	12	0	0.38	0.46	0.67	0.95	1.00	none
Combined Results for All Sample Points										
E. coli	MPN/100mL	67	0	0	<1	<1	<1	<1	<1	1.00
pH	-	67	67	0	7.00	7.05	7.31	7.66	7.97	none
Free Chlorine	mg/L	67	67	0	0.54	0.66	1.58	2.20	2.50	none

iii. Middlemount E. Coli Compliance

Year		2018 - 2019											
Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	
No. of samples collected	8	10	9	9	8	8	9	8	9	8	9	7	
No. of samples collected in which <i>E. coli</i> 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	100	102	99	100	102	100	101	101	101	102	102	
No. of failures for previous 12-month period	0	0	0	0	0	0	0	0	0	0	0	0	
% of samples that comply	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	
Compliance with 98% annual value	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	

F) MORANBAH SUPPLY SYSTEM

i. Moranbah Treated Water

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th percentile	Average	95th percentile	Max	LOR
Aluminium	µg/L	Weekly	52	48	0	<5	<5	10.14	18.53	22.71	5.00
Conductivity	µS/cm		52	52	0	111.80	182.38	212.32	222.35	870.00	none
E. coli	MPN/100mL		52	0	0	<1	<1	<1	<1	<1	1.00
Iron	µg/L		52	16	0	<2	<2	3.20	4.17	68.27	2.00
Manganese	µg/L		52	4	0	<1	<1	<1	<1	2.52	1.00
pH			69	69	0	7.22	7.29	7.45	7.76	7.89	none
Residual Chlorine	mg/L		69	69	0	1.19	1.40	1.71	2.10	2.17	none
Total Dissolved Solids (TDS)	mg/L		52	52	0	67.00	109.55	127.42	133.45	522.00	none
Turbidity	NTU		52	29	0	<0.1	<0.1	0.13	0.14	1.81	0.10
Alkalinity	mg/L	Monthly	12	12	0	44.84	47.46	54.29	62.48	65.50	none
Bromate	µg/L		13	0	0	<5	5.30	<10	<10	<10	10.00
Calcium	mg/L		12	12	0	12.83	12.86	13.69	14.56	14.82	none
Chlorate	µg/L		13	0	0	7.07	21.21	32.78	35.36	35.36	none
Chlorite	µg/L		13	0	0	<5	<10	<10	<10	<10	10.00
Dissolved Oxygen	% Sat		12	12	0	93.80	95.45	99.52	103.86	106.00	none
Fluoride	mg/L		52	52	0	0.38	0.58	0.71	0.83	0.90	0.01
Magnesium	mg/L		12	12	0	5.29	5.40	5.91	6.41	6.46	none
Nitrate	mg/L		12	11	0	<0.015	0.07	0.19	0.28	0.29	0.02
Nitrite	mg/L		12	0	0	<0.004	<0.004	<0.004	<0.004	<0.004	0.00
Residual Alkalinity	mg/L		12	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Temporary Hardness	mg/L		12	12	0	44.80	47.44	54.28	62.48	65.50	none
THMs	µg/L		13	10	0	14.14	16.57	37.15	56.50	57.00	none
Total Hardness	mg/L		12	12	0	53.80	55.01	58.53	62.78	63.60	none
True Colour	TCU		12	3	0	<1	<1	1.28	3.00	3.00	1.00
Total Algae	cells/mL		2	0	0	0	0	0	0	0	none
Algal Toxins	cells/mL	0	As per IRC BGAMP, not required to test Algal toxins, if Cyanobacteria is less than 500 cells/ml.								
Ammonia	mg/L	Quarterly	4	0	0	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Arsenic	µg/L		4	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th percentile	Average	95th percentile	Max	LOR
Cadmium	µg/L		4	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Chromium	µg/L		4	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Copper	µg/L		4	0	0	<1	<1	<1	<1	<1	1.00
Formaldehyde	mg/L		3	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Hydrogen Sulphide	mg/L		4	1	0	<0.005	<0.005	0.01	0.01	0.01	0.01
Lead	µg/L		4	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Mercury	µg/L		4	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Nickel	µg/L		4	1	0	<0.5	<0.5	<0.5	0.60	0.64	0.50
Pesticides*	µg/L		4	0	0	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00
Selenium	µg/L		4	0	0	<5	<5	<5	<5	<5	5.00
Zinc	µg/L		4	4	0	5.92	5.98	9.46	15.77	17.04	1.00
Barium	µg/L		Annually	1	1	0	33.67	33.67	33.67	33.67	33.67
Beryllium	µg/L	1		0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Boron	µg/L	1		1	0	38.55	38.55	38.55	38.55	38.55	none
Iodide	µg/L	1		0	0	<20	<20	<20	<20	<20	20.00
Molybdenum	µg/L	1		0	0	<1	<1	<1	<1	<1	1.00
Radionuclides - Gross alpha	Bq/L	1		0	0	<0.05	<0.05	<0.05	<0.05	<0.05	0.05
Radionuclides - Gross beta	Bq/L	1		0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Silver	µg/L	1		0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Tin	µg/L	1		0	0	0.71	0.71	0.71	0.71	0.71	none
Uranium	µg/L	1		0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50

ii. Moranbah Reticulation

Parameter	Units	No. Samples	Detections	Exceedances	Min	5th percentile	Average	95th percentile	Max	LOR
Sample Location: Moranbah Network #1 Belyando Ave (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	19	0	0	<1	<1	<1	<1	<1	1.00
pH	-	19	19	0	7.12	7.19	7.52	7.72	7.74	none
Free Chlorine	mg/L	19	19	0	1.02	1.02	1.34	1.81	1.87	none
Sample Location: Moranbah Network #2 cnr Jackson & Cuthbert (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	21	0	0	<1	<1	<1	<1	<1	1.00
pH	-	21	21	0	7.10	7.10	7.43	7.61	7.85	none
Free Chlorine	mg/L	21	21	0	0.71	0.95	1.36	1.71	1.79	none
Sample Location: Moranbah Network #3 1A Archer Drive (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	20	0	0	<1	<1	<1	<1	<1	1.00
pH	-	20	20	0	7.05	7.15	7.52	7.93	8.00	none
Free Chlorine	mg/L	20	20	0	0.90	1.00	1.54	1.87	1.94	none
Sample Location: Moranbah Network #4 Binda Park (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	20	0	0	<1	<1	<1	<1	<1	1.00
pH	-	20	20	0	7.16	7.19	7.38	7.55	7.63	none
Free Chlorine	mg/L	20	20	0	0.50	0.56	1.34	1.80	2.20	none
Sample Location: Moranbah Network #5 O'Neil St (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	20	0	0	<1	<1	<1	<1	<1	1.00
pH	-	20	20	0	7.05	7.13	7.46	7.76	7.83	none
Free Chlorine	mg/L	20	20	0	0.30	0.51	0.96	1.34	1.40	none
Combined Results for All Sample Points										
E. coli	MPN/100mL	100	0	0	<1	<1	<1	<1	<1	1.00
pH	-	100	100	0	7.05	7.13	7.46	7.74	8.00	none
Free Chlorine	mg/L	100	100	0	0.30	0.69	1.31	1.79	2.20	none

iii. Moranbah E. Coli Compliance

Year		2018 - 2019											
Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	
No. of samples collected	12	14	12	14	12	12	14	12	14	10	16	10	
No. of samples collected in which <i>E. coli</i> 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	151	151	151	152	152	151	151	149	151	150	150	149	
No. of failures for previous 12-month period	0	0	0	0	0	0	0	0	0	0	0	0	
% of samples that comply	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	
Compliance with 98% annual value	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	

G) NEBO SUPPLY SYSTEM

i. Nebo Treated Water

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th percentile	Average	95th percentile	Max	LOR
Aluminium	µg/L	Weekly	52	5	0	<5	<5	<5	6.76	37.54	5.00
Conductivity	µS/cm		52	52	0	446.00	480.55	740.18	972.90	1008.20	none
E. coli	MPN/ 100mL		52	0	0	<1	<1	<1	<1	<1	1.00
Iron	µg/L		52	7	0	<2	<2	3.33	4.03	90.07	2.00
Manganese	µg/L		52	11	0	<1	<1	1.01	<1	3.64	1.00
pH			76	76	0	6.60	6.80	6.90	7.05	7.25	none
Residual Chlorine	mg/L		76	76	0	0.33	0.50	1.18	1.86	2.68	none
Total Dissolved Solids (TDS)	mg/L		52	52	1 (Aesthetic)	268.00	288.15	444.13	583.70	605.00	none
Turbidity	NTU		66	65	0	<0.1	0.11	0.19	0.31	0.85	0.10
Alkalinity	mg/L	Monthly	12	12	0	131.60	139.77	176.28	221.44	257.52	none
Bromate	µg/L		27	0	0	<5	<10	<10	<10	<10	10.00
Calcium	mg/L		12	12	0	35.78	36.79	52.12	60.15	62.93	none
Chlorate	µg/L		27	18	0	35.36	35.36	105.40	304.60	696.00	none
Chlorite	µg/L		27	0	0	<5	<10	<10	<10	<10	10.00
Dissolved Oxygen	% Sat		12	12	10 (Aesthetic)	61.40	62.78	74.09	87.51	89.10	none
Fluoride	mg/L		12	12	0	0.03	0.05	0.11	0.16	0.18	0.01
Magnesium	mg/L		12	12	0	16.18	17.79	27.35	32.17	34.03	none
Nitrate	mg/L		12	12	0	0.50	0.52	2.19	3.04	3.08	0.02
Nitrite	mg/L		12	0	0	<0.004	<0.004	<0.004	<0.004	<0.004	0.00
Residual Alkalinity	mg/L		12	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Temporary Hardness	mg/L		12	12	0	131.60	139.80	176.28	221.42	257.50	none
THMs	µg/L		27	1	0	1.20	3.54	11.93	14.14	14.14	none
Total Hardness	mg/L		12	12	0	156.00	165.13	242.76	281.85	297.30	none
True Colour	TCU	12	7	0	<1	<1	1.04	2.00	2.00	1.00	
Ammonia	mg/L	Quarterly	4	0	0	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Arsenic	µg/L		4	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Cadmium	µg/L		4	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th percentile	Average	95th percentile	Max	LOR
Chromium	µg/L		4	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Copper	µg/L		4	4	0	7.72	7.96	11.11	15.22	15.87	1.00
Formaldehyde	mg/L		3	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Hydrogen Sulphide	mg/L		4	0	0	<0.005	<0.005	<0.005	<0.005	<0.005	0.01
Lead	µg/L		4	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Mercury	µg/L		4	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Nickel	µg/L		4	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Pesticides*	µg/L		4	0	0	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00
Selenium	µg/L		4	0	0	<5	<5	<5	<5	<5	5.00
Zinc	µg/L		4	4	0	6.29	6.36	7.49	9.37	9.76	1.00
Barium	µg/L		Annually	1	1	0	17.46	17.46	17.46	17.46	17.46
Beryllium	µg/L	1		0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Boron	µg/L	1		1	0	21.51	21.51	21.51	21.51	21.51	none
Iodide	µg/L	1		0	0	<20	<20	<20	<20	<20	20.00
Molybdenum	µg/L	1		0	0	<1	<1	<1	<1	<1	1.00
Radionuclides - Gross alpha	Bq/L	1		0	0	<0.05	<0.05	<0.05	<0.05	<0.05	0.05
Radionuclides - Gross beta	Bq/L	1		0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Silver	µg/L	1		0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Tin	µg/L	1		0	0	0.71	0.71	0.71	0.71	0.71	none
Uranium	µg/L	1		0	0	<0.5	<0.5	<0.5	<0.5	<0.5	0.50

ii. Nebo Reticulation

Parameter	Units	No. Samples	Detections	Exceedances	Min	5th percentile	Average	95th percentile	Max	LOR
Sample Location: Nebo Network Depot (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	24	0	0	<1	<1	<1	<1	<1	1.00
pH	-	24	24	0	6.75	6.80	6.96	7.27	7.35	none
Free Chlorine	mg/L	24	24	0	0.54	0.71	1.22	1.58	1.74	none
Sample Location: Nebo Network Office (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	27	0	0	<1	<1	<1	<1	<1	1.00
pH	-	27	27	0	6.80	6.85	6.99	7.10	7.20	none
Free Chlorine	mg/L	27	27	0	0.47	0.60	1.35	2.28	2.50	none
Combined Results for All Sample Points										
E. coli	MPN/100mL	51	0	0	<1	<1	<1	<1	<1	1.00
pH	-	51	51	0	6.75	6.80	6.98	7.15	7.35	none
Free Chlorine	mg/L	51	51	0	0.47	0.62	1.29	2.20	2.50	none

iii. Nebo E. Coli Compliance

Year	2018 - 2019											
Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
No. of samples collected	8	10	8	10	9	11	15	12	12	12	10	8
No. of samples collected in which <i>E. coli</i> 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	102	102	102	102	102	102	104	104	103	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	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Compliance with 98% annual value	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

F) ST LAWRENCE SUPPLY SYSTEM

i. St Lawrence Treated Water

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th percentile	Average	95th percentile	Max	LOR
Aluminium	µg/L	Weekly	50	48	0	<5	6.69	45.17	118.34	142.64	5.00
Conductivity	µS/cm		51	51	0	118.00	172.50	228.65	329.95	358.90	none
E. coli	MPN/ 100mL		51	0	0	<1	<1	<1	<1	<1	1.00
Iron	µg/L		51	34	0	<2	<2	8.56	31.49	133.92	2.00
Manganese	µg/L		51	36	0	<1	<1	6.89	<1	89.35	1.00
pH			86	86	0	7.00	7.10	7.41	7.80	7.90	none
Residual Chlorine	mg/L		86	86	0	1.20	1.40	1.77	2.20	2.80	none
Total Dissolved Solids (TDS)	mg/L		51	51	0	71.00	103.50	137.16	198.00	215.00	none
Turbidity	NTU	64	59	0	<0.1	0.10	0.13	0.20	1.00	0.10	
Alkalinity	mg/L	Monthly	11	11	0	35.60	35.97	57.11	89.27	100.96	none
Bromate	µg/L		25	0	0	<5	<10	<10	<10	<10	10.00
Calcium	mg/L		11	11	0	8.84	8.92	10.75	16.76	21.31	none
Chlorate	µg/L		25	23	0	132.00	141.40	353.17	633.90	2352.00	none
Chlorite	µg/L		25	0	0	<5	<10	<10	<10	<10	10.00
Dissolved Oxygen	% Sat		11	11	0	86.40	90.70	101.34	111.55	116.00	none
Fluoride	mg/L		11	10	0	<0.01	0.01	0.05	0.09	0.11	0.01
Magnesium	mg/L		11	11	0	2.34	2.65	3.61	4.54	4.59	none
Nitrate	mg/L		11	10	0	<0.015	0.13	0.42	0.86	0.96	0.02
Nitrite	mg/L		11	0	0	<0.004	<0.004	<0.004	<0.004	<0.004	0.00
Residual Alkalinity	mg/L		11	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Temporary Hardness	mg/L		11	11	0	35.60	35.95	57.11	89.30	101.00	none
THMs	µg/L		25	23	0	23.4	75.64	181.35	192	20	23.4
Total Hardness	mg/L		11	11	0	33.00	34.10	41.71	55.65	66.20	none
True Colour	TCU		11	6	0	<1	<1	1.32	3.00	4.00	1.00
Total Algae	cells/mL		21	0	0	0	0	0	0	0	none
Algal Toxins	cells/mL	0	As per IRC BGAMP, not required to test Algal toxins, if Cyanobacteria is less than 500 cells/ml.								
Ammonia	mg/L	Quarterly	3	0	0	<0.01	<0.01	<0.01	<0.01	<0.01	0.01

Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	5th percentile	Average	95th percentile	Max	LOR	
Arsenic	µg/L		3	1	0	<0.5	<0.5	<0.5	0.49	0.50	0.50	
Cadmium	µg/L		3	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Chromium	µg/L		3	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Copper	µg/L		3	3	0	1.82	1.85	2.19	2.56	2.61	2.61	1.00
Formaldehyde	mg/L		3	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Hydrogen Sulphide	mg/L		3	1	0	<0.005	<0.005	0.01	0.01	0.01	0.01	0.01
Lead	µg/L		3	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Mercury	µg/L		3	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Nickel	µg/L		3	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Pesticides*	µg/L		4	1	0	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.29	0.00
Selenium	µg/L		3	0	0	<5	<5	<5	<5	<5	<5	5.00
Zinc	µg/L		3	3	0	2.74	3.03	4.71	5.76	5.77	5.77	1.00
Barium	µg/L	Annually	1	1	0	12.90	12.90	12.90	12.90	12.90	12.90	none
Beryllium	µg/L		1	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.50
Boron	µg/L		1	1	0	25.06	25.06	25.06	25.06	25.06	25.06	none
Iodide	µg/L		1	0	0	<20	<20	<20	<20	<20	<20	20.00
Molybdenum	µg/L		1	0	0	<1	<1	<1	<1	<1	<1	1.00
Radionuclides - Gross alpha	Bq/L		1	0	0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05
Radionuclides - Gross beta	Bq/L		1	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Silver	µg/L		1	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.10
Tin	µg/L		1	0	0	0.71	0.71	0.71	0.71	0.71	0.71	none
Uranium	µg/L		1	0	0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.50

ii. St Lawrence Reticulation

Parameter	Units	No. Samples	Detections	Exceedances	Min	5th percentile	Average	95th percentile	Max	LOR
Sample Location: St Lawrence Network 36 Macartney St (Jul 2018 - Jun 2019)										
E. coli	MPN/100mL	49	0	0	<1	<1	<1	<1	<1	1.00
pH	-	49	49	0	7.00	7.10	7.41	7.72	7.90	none
Free Chlorine	mg/L	49	49	0	0.10	0.10	0.21	0.37	1.00	none

iii. St Lawrence E. Coli Compliance

Year	2018 - 2019											
Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
No. of samples collected	7	10	7	10	8	7	10	8	8	8	10	8
No. of samples collected in which <i>E. coli</i> 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	108	105	105	104	104	103	102	102	104	105	106	106
No. of failures for previous 12-month period	0	0	0	0	0	0	0	0	0	0	0	0
% of samples that comply	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Compliance with 98% annual value	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES