



Drinking Water Quality Management Plan (DWQMP) Annual Report 2015-2016



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Glossary of terms

ADWG 2004	Australian Drinking Water Guidelines (2004). Published by the National Health and Medical Research Council of Australia
ADWG 2011	Australian Drinking Water Guidelines (2011). Published by the National Health and Medical Research Council of Australia
ADWG 2016	Australian Drinking Water Guidelines (2016). Published by the National Health and Medical Research Council of Australia
<i>E. coli</i>	<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

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

Carmila

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

- Coagulation with alum;
- Aeration for oxidation of iron and manganese;
- Calcium hypochlorite dosing for additional iron and manganese oxidation and final disinfection;
- Polymer dosing as a flocculation aid;
- Flocculation;
- Clarification;
- Polymer dosing as filtration aid; and
- Sand filtration.

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

Clermont

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

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

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

Dysart

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

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

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

Glenden

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

- Pre-pH correction with soda ash (when required);
- Coagulation with aluminium sulphate;
- Polymer dosing for flocculation aid (when required);
- Flocculation;
- Clarification;
- Sand filtration; and
- Disinfection with sodium hypochlorite.

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

Middlemount

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

- Pre-pH adjustment with soda ash;
- Coagulation with Nalco Ultrion 44560;
- Chlorine gas dosing for iron and manganese oxidation (optional);
- Flocculation;
- PAC dosing into the clarifier (when necessary);
- Clarification;
- Sand filtration; and
- Disinfection with chlorine gas.

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

Moranbah

Raw water is extracted from the Burdekin Dam (occasionally Eungella Dam and possibly from the Braeside Borefield) and pumped to the WTP inlet where it is treated using the following treatment process:

- Pre-pH adjustment with lime;
- Pre-chlorine gas for iron and manganese oxidation;
- Coagulation with Nalco Ultrion 44560;
- Flocculation;
- Clarification;
- PAC for taste and odour removal;
- Sand filtration;
- Lime dosing for pH adjustment;
- Disinfection with chlorine gas; and
- Fluoridation with sodium fluoride.

Moranbah has a combined capacity of 130 L/s, the Bobby Plant processing up to 70 L/s and the WTP processing 160 L/s. These WTPs can operate individually or simultaneously, according to the level in the Treated Water Storage.

Nebo

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

Each bore has a capacity of 8 L/s, with standard operation being to pump from bores 4 and 5 totalling 16 L/s. When additional capacity is required (determined by levels in the Water Tower) a third bore is brought online to provide up to 24 L/s.

St Lawrence

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

- Oxidation of iron and manganese with calcium hypochlorite (potassium permanganate also available but not preferred);
- Coagulation with aluminium sulphate;
- Flocculation;
- Clarification;
- pH correction with soda ash;
- Sand filtration;
- Calcium hypochlorite dosing for final disinfection; and
- Granular Activated Carbon (GAC) filtration.

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

3. Actions Taken to Implement the DWQMP

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

Complete

- Operational and verification monitoring programs have been updated.
- New and revised SOPs have been developed.
- Additional documentation for managing the water supply system has been produced, including maintenance and emergency response plans.
- Damaged plant equipment has been repaired or replaced.
- Filter optimisation (operational adjustments only, capital upgrades are largely overdue).

Overdue

- Some capital upgrades.
- Additional instrumentation and SCADA modifications for configuration of alarms.
- Investigative works to determine future upgrades or avenues for optimising operations.
- Update and/or development of O&M manuals (some WTPs are currently being upgraded, or are scheduled to be upgraded, and will have up to date O&M manuals prepared following the upgrades).

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

Capital and instrumentation upgrades are being scheduled as funds become available and project scopes are 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.

Increased documentation and better document management is assisting with issues arising from high staff turnover. Procedures and management plans are now largely documented allowing for easier information sharing. IRC is also moving towards more reliably automated operation of its treatment plants, easing reliance on operator attendance and manual tasks. Development of an operator training and testing program is also under consideration to record and track operator training and competencies.

4. Compliance with Water Quality Criteria for Drinking Water

Summaries of each supply system's verification monitoring and *E. coli* compliance with water quality criteria are in Appendix B. Revised verification monitoring program / external testing regime was proposed as part of DWQMP review and submitted on 18th November 2015. Proposed amendments were subsequently approved by Department of Energy and Water Supply on 07th Mar 2016. There are some discrepancies between the approved verification monitoring program and the monitoring being undertaken, where shortfalls in monitoring are occurring these have been outlined below. It should also be noted here that the limit of reporting (LOR) for Nickel monitoring (0.03 mg/L) from NATA accredited laboratory is higher than the ADWG health value of 0.02 mg/L therefore it is unknown whether there have been any exceedances for this parameter.

Nebo

- Iron and manganese are currently not being monitored – Now being undertaken as required.

St Lawrence

- DO was only monitored in Jan, Feb and Jun 2016 – Now being undertaken as required
- THMs were not monitored in March, April and May– Now being undertaken as required

There has been no annual inorganics testing recorded for any site, nor monitoring of radionuclides or pesticides at any frequency. These parameters were included in the revised verification monitoring program approved following the review of the DWQMP by CWT in November 2015. Quarterly testing of radionuclides and pesticides (if included in the verification monitoring program for each site) should have been tested twice during this sample period, however no results have been recorded. Annual testing may be scheduled for later in 2016 and therefore may not be included until the 2016-17 reporting period.

Following submission of this Annual Report, IRC plan to review and amend the monitoring contracts that are currently in place with the Mackay Regional Council NATA Laboratory to ensure compliance with the DWQMP. A review of the existing data and all parameters currently being monitored will be conducted in the 2016-17 Reporting year to ensure the monitoring program is appropriate for the water sources and to minimise unnecessary monitoring.

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

Several exceedances of the ADWG aesthetic and health values have been identified during the course of analysis for this report. Due to changes in management and operating staff, these were not captured at the time of the incident and therefore were not reported. IRC will investigate these exceedances and prepare notifications to DEWS as appropriate following submission of this report.

Carmila

No exceedances have been recorded.

Clermont

- 3 aesthetic manganese exceedances
- 1 health turbidity exceedance
- 3 detections below the ADWG aesthetic threshold for DO

Dysart

- 3 health exceedances for free chlorine
 - Note that these samples are taken at the WTP outlet. Treated water is then pumped to a reservoir before being distributed to consumers, by which time it is likely that chlorine residuals are below the recommended limit.
- 1 aesthetic pH exceedance

Glenden

- 1 detection below the ADWG aesthetic threshold for DO

Middlemount

- 3 health turbidity exceedances
- 1 aesthetic pH exceedance
- 2 detections below the ADWG aesthetic threshold for DO

Moranbah

- 3 health turbidity exceedances

Nebo

- 13 aesthetic TDS exceedances
- 5 detections below the ADWG aesthetic threshold for DO

St Lawrence

- 3 aesthetic manganese exceedances

E coli. was not detected in any of the samples analysed during the 2015-16 year.

6. Customer Complaints Related to Water Quality

Table 1 outlines the water quality complaints reported by consumers in the 2015-16 reporting year. A large number of complaints were reported for aesthetic issues (tastes, odours and discolouration) but none were reported for or linked to suspected or confirmed illnesses.

Table 1: Water Quality Complaints

	Suspected Illness	Discoloured Water	Taste	Odour	Other	Total
CARMILA	0	0	0	0	0	0
CLERMONT	0	19	1	1	1 ^a	22
DYSART	0	6	0	6	0	12
GLENDEN	0	2	0	0	0	2
MIDDLEMOUNT	0	1	0	0	0	1
MORANBAH	0	3	10	1	1 ^b	15
NEBO	0	0	0	0	0	0
ST LAWRENCE	0	0	0	0	0	0
TOTAL	0	31	11	8	2	52

(a) Water Leak

(b) Mains flushing

Suspected Illness

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

During 2015-2016 there were no reports or confirmed cases of illness arising from the water supply system.

Aesthetic Complaints

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

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

For Discoloured Water:

- a) Review of treatment processes and chemical dosing systems.
- b) Drain vessels in treatment plant if contamination is suspected.

For Tastes and Odours:

- a) Review raw water quality and make necessary adjustments to the treatment process (e.g. PAC dose and/or Potassium Permanganate dose changes).
- b) If the problem persists, downrate the water treatment plant and introduce water restrictions.



7. Findings and Recommendations of the DWQMP Auditor

The next audit of the IRC DWQMP is due by 11th November 2017. Findings and recommendations from this audit will be included in the 2016-17 Annual Report.

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

The most recent version of the DWQMP was approved in November 2015 and therefore has been in place for just over 12 months.

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

Appendix A – Implementation of the DWQMP Risk Management Improvement Program

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
GEN1	General Issues	Out of date Standard Operating Procedure	Update Standard Operating Procedure across all WTPs to ensure consistency across the region	Dec-17	Ongoing	Stage 1 roll out to each site completed between 2013 and 2015. Further updates are still in progress. Expected to be completed by Dec 2017
GEN2	General Issues	Emergency procedures not included in SOP	Update Standard Operating Procedure across all WTPs to ensure consistency across the region	Dec-17	Ongoing	See GEN1
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
GEN5	General Issues	Poor distribution channel of new operational procedure / new regulation requirements	No further action. It is considered that reasonable steps have been taken to minimise this risk.	N/A	N/A	
GEN6	General Issues	Inadequate or irregular water main flushing	A general flushing procedure for water mains and reservoir to be developed.	Jun-14	Complete	Process for mains flushing has been developed and a programmed maintenance task for mains flushing is in progress
GEN7	General Issues	Lack of pressure monitoring of water network	Council is progressing with water network modelling to identify low flow zones	Jun-17		
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	N/A	Ongoing	Communications have been developed with water suppliers and IRC now receive available raw water quality data.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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	N/A	Ongoing	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	
CL2	Clermont Dam / Catchment	Rapid Variation in raw water quality	The current WTP process combined with operator input is considered capable of dealing with iron and manganese.	N/A	N/A	
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.	N/A	Ongoing	To be considered in future if monitoring shows online instrumentation to be necessary.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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	Pre dose of chlorine has been removed
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	Testing procedure to add to the new SOP
CL6	Clermont Dam / Catchment	Heavy metal	Heavy metals to be monitored as part of verification monitoring programme.	Dec-13	Complete	Testing procedure to add to the new SOP
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	Cost allowance for communication between Water and Sewerage team and the campground caretaker
CL8	Clermont Dam / Catchment	Human Access	As for item CL7	Dec-13	Complete	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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.	N/A	Ongoing	Residual chlorine being monitored daily. Online chlorine analyser to be considered if monitoring shows online instrumentation to be necessary
CL10	Clermont Dam / Catchment	Wildlife Access (native and feral) and unrestricted livestock	The current operational measures are considered to be appropriate for dealing with this risk and it is considered to be as low as practicable.	N/A	N/A	
CL11	Clermont Dam / Catchment	Changes in surrounding land use	No further action. It is considered that reasonable steps have been taken to minimise this risk.	N/A	N/A	
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		Raw water quality parameters are being monitored daily. Online instrumentation to be considered if monitoring shows online instrumentation to be necessary
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.	N/A	Ongoing	To be considered in future if monitoring shows online instrumentation to be necessary.
CL14	Clermont Dam / Catchment	Equipment Failure	Operator actions as described are considered to be appropriate to mitigate this risk and the risk is considered to be as low as practicable.	N/A	N/A	
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 to manage the supply of water.
CL16	Clermont Dam / Catchment	Demand Increase	Operator actions as described are considered to be appropriate to mitigate this risk.	Jun-15	Complete	Water restriction levels have been introduced to manage the supply of water.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
			Consideration to be given to online raw water instruments with alarms (as per item CL3) to assist operators.			
CL17	Clermont Dam / Catchment	Failure of the dam	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
CL18	Clermont Storage Reservoirs and Intakes	Open reservoirs and aqueducts / uncovered storage	No further action. It is considered that reasonable preventative measures are taken by the operators and the risk is minimised. An analyser as per CL9 would assist operators.	N/A	N/A	
CL19	Clermont Storage Reservoirs and Intakes	Human Access	Investigate whether further protection from human access could be implemented at the surge tank.	Jun-16	Pending	
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.	N/A	Ongoing	Refer to CL9
CL21	Clermont Storage Reservoirs and Intakes	Depletion of reservoir storage	No further action. It is considered that reasonable steps are being implemented by the operators to minimise this risk.	N/A	N/A	
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	Complete	
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	Pending	Cannot be completed until the control system is replaced. Cost estimate to be completed at the time of control system upgrade.
CL24	Clermont WTP Inlet/ Flocculation	Process control incapability	Verification monitoring of aluminium to be implemented.	Dec-13	Complete	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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	Pending	It is expected that this can be completed during process control system upgrades – this project is currently out to Tender and should commence in early 2017.
CL26	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 to as low as practicable.	N/A	N/A	
CL27	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 to as low as practicable.	N/A	N/A	
CL28	Clermont WTP Inlet/ Flocculation	Chemical dosing failures	No further action. It is considered that reasonable preventative measures are taken by the operators and the risk is minimised to as low as practicable.	N/A	N/A	
CL29	Clermont WTP Inlet/ Flocculation	Equipment malfunction	Alarm on failure of inlet flowmeter.	Jun-15	In Progress	Site control system upgrade is planned (project to commence early 2017). Should ensure these additional alarms are included
CL30	Clermont WTP General	Use of unapproved or contaminated water treatment chemicals	No further action. It is considered that reasonable steps have been taken to minimise this risk and the risk is as low as practicable.	N/A	N/A	
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.	N/A	Ongoing	To be considered in future if monitoring shows online instrumentation to be necessary.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
CL33	Clermont WTP General	Formation of disinfection by-products	Verification monitoring of THMs to be implemented.	Dec-13	Complete	
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	
CL35	Clermont Filtration	Process control incapability	Online filtered water turbidity analyser for filtered water with alarm would assist operators.	Jun-15	Complete	Current testing method has been reviewed and deemed adequate. Further consideration may be required in future to be in line with stricter monitoring requirements.
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	Current testing method has been reviewed and deemed adequate. Further consideration may be required in future to be in line with stricter monitoring requirements.
CL37	Clermont Filtration	Inadequate filter operation	No further action. It is considered that reasonable steps have been taken to minimise this risk and the risk is as low as practicable.	N/A	N/A	
CL38	Clermont Filtration	Equipment malfunction	No further action. It is considered that reasonable steps have been taken to minimise this risk and the risk is as low as practicable.	N/A	N/A	
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)	N/A	Ongoing	To be considered in future if monitoring shows online instrumentation to be necessary.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
CL41	Clermont Filtered Water	Chemical dosing failure	Install online treated water pH, turbidity and chlorine analyser with alarming (as per CL35 and CL9)	N/A	Ongoing	To be considered in future if monitoring shows online instrumentation to be necessary.
CL42	Clermont Reservoirs	Human/animal access	No further action. It is considered that reasonable preventative measures have been taken to protect the system and the risk is minimised to as low as practicable.	N/A	N/A	
CL43	Clermont Reservoirs	Build-up of sediment and slime	No further action. It is considered that reasonable steps have been taken to minimise this risk.	N/A	N/A	Flushing procedure will be standardised as part of SOP update
CL44	Clermont Reservoirs	Aged infrastructure / corrosion. Inadequate repair and maintenance	No further action. It is considered that reasonable steps have been taken to minimise this risk.	N/A	N/A	
CL45	Clermont Reticulation	Build-up of sediment and slime	No further action. It is considered that reasonable steps have been taken to minimise this risk.	N/A	N/A	Flushing procedure will be standardised as part of SOP update
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.	N/A	Ongoing	
CL47	Clermont Reticulation	Corrosion	No further action. It is considered that reasonable preventative measures have been taken to protect the system and the risk is minimised to as low as practicable.	N/A	N/A	
CL48	Clermont Reticulation	Infiltration and ingress of contamination from cross connections, backflow (soil and groundwater)	No further action. It is considered that reasonable steps have been taken to minimise this risk and the risk is as low as practicable.	N/A	N/A	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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.	N/A	Ongoing	Air scouring program and looping of water mains have been introduced to prevent these issues.
CL50	Clermont Reticulation	Pipe bursts or leaks. Inadequate repair and maintenance, inadequate system flushing and reservoir cleaning. Commissioning new mains.	No further action. It is considered that reasonable steps have been taken to minimise this risk.	N/A	N/A	
CL51	Clermont Reticulation	Flow variability, inadequate pressures	Increase operational monitoring of chlorine residual in reticulation to ensure better compliance.	Dec-13	Complete	Network modelling being commissioned separately
CL53	Clermont Reticulation	Inadequate maintenance of chlorine residual	As per CL51	Dec-13	Complete	
CL54	Clermont Reticulation	Natural Disaster	No further action. It is considered that reasonable steps have been taken to ensure procedures are in place for natural disasters.	N/A	N/A	
CL55	Clermont Consumers	Inappropriate plumbing or construction materials. Leaching of metals.	No further action. It is considered that reasonable steps have been taken to minimise this risk.	N/A	N/A	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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.
CL57	Clermont Whole System	Power Failure	Shutdown is considered to be the best option on power failure as this ensures that the water treatment process does not reduce in effectiveness. It is considered that this minimises the risk to consumers during power failure.	N/A	N/A	
CL58	Clermont Whole System	Sabotage	No further action. It is considered that reasonable steps have been taken to protect the system and minimise this risk to a level as low as practicable.	N/A	N/A	
CL59	Clermont Whole System	Capacity	Population to be monitored on at least a 5-yearly basis.	N/A	Ongoing	
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	Levels of Iron and Manganese are monitored through the operational and verification programs and dosing is adjusted accordingly based on results.
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	Pending	It is expected that this can be completed during process control system upgrades (project to commence early 2017)

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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	Pending	It is expected that this can be completed during process control system upgrades (project to commence early 2017)
CL63	Clermont Clarification	Chemical dosing failure	Install new polymer batching and dosing system to aid in coagulation/ flocculation during extreme dirty water events.	Jun-18	Pending	It is expected that this can be completed during process control system upgrades (project to commence early 2017)
CL64	Clermont Filtration	Inadequate filter operation	Inspect filters and refurbish/replace if required (including internal epoxy coatings, media, underdrains, nozzles, launders and valves).	Dec-16	Pending	New media and filter upgrades are to be completed by 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	Automated backwash has been reconfigured. Manual backwash is still performed, but SOP is now in place.
CL66	Clermont Filtered Water	Disinfection failure	Install carrier water on the chlorine gas dosing system to ensure adequate disinfection. Include interim chlorine testing in operational monitoring (i.e. chlorinated water from the dam and after additional chlorine dosing at WTP inlet).	Dec-16	In Progress	Upgrades are in progress; interim Chlorine monitoring is being conducted.
CL67	Clermont Filtered Water	Disinfection failure	Install auto changeover capability from 920 kg chlorine gas drum to 70 kg chlorine gas cylinders.	Dec-16	In Progress	Upgrades are in progress.
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	Pending	It is expected that this can be completed during process control system upgrades (project to commence early 2017)

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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	Pending	It is expected that this can be completed during process control system upgrades (project to commence early 2017)
CL71	Clermont Filtered Water	Chemical dosing failure	Install carrier water on the chlorine gas dosing system to ensure adequate disinfection. Include interim chlorine testing in operational monitoring (i.e. chlorinated water from the dam and after additional chlorine dosing at WTP inlet).	Dec-16	Pending	Upgrades are in progress; interim Chlorine monitoring is being conducted.
CL72	Clermont Reticulation	Inadequate disinfection	Undertake an assessment to confirm which users (if any) are receiving inadequately chlorinated water.	Jun-17	In Progress	Chlorine system upgrades are in progress and should rectify this issue.
CL73	Clermont Chlorine System	Chlorine dosing failure Chlorine leak Exposure of operators to Chlorine gas	Audit chlorine system against Australian Standard (AS/NZS 2927) and upgrade as required	Dec-16	Pending	Chlorine system upgrades are in progress.
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	In Progress	Develop a Blue Green Algae Management Plan for all IRC systems (should be based on Qld Water Directorate) which will include sampling and response requirements. Update: Monthly testing is conducted in summer with weekly testing if algae is present. A BGAMP is currently being developed (Dec 2016).

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

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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.	N/A	N/A	
MO8	Moranbah Raw Water	Heavy Rainfall / Flooding	Consider online raw water instruments with alarms (as per item MO2) to assist operators.	Jun-17	Pending	Turbidity and pH meters should be installed to monitor the raw water quality entering the WTP. An SCM may also assist with determining optimum coagulant doses.
MO9	Moranbah Raw Water	Drought / Bushfires	Consider online raw water instruments with alarms (as per item MO2) to assist operators.	Jun-17	Pending	Turbidity and pH meters should be installed to monitor the raw water quality entering the WTP. An SCM may also assist with determining optimum coagulant doses.
MO10	Moranbah Raw Water	Equipment Failure	No further action. It is considered that reasonable equipment redundancy measures are in place to minimise this risk and it is as low as practicable.	N/A	N/A	
MO11	Moranbah Raw Water	Demand Increase	No further action. There have been no problems with water allocation to date.	N/A	N/A	
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	
MO13	Moranbah Raw Water	No alternative water sources	No further action. It is considered that reasonable steps have been taken to minimise this risk with an alternative water supply in place.	N/A	N/A	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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	Pending	It is expected that this can be completed during process control system upgrades (project to commence early 2017)
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).	N/A	Ongoing	To be considered in future if monitoring shows future online instrumentation to be necessary.
MO17	Moranbah WTP Inlet/ Flocculation	Process control incapability	No further action. It is considered that operator takes reasonable steps to minimise this risk and it is as low as practicable.	N/A	N/A	
MO18	Moranbah WTP Inlet/ Flocculation	Process control incapability	No further action. It is considered that operator takes reasonable steps to minimise this risk and it is as low as practicable.	N/A	N/A	
MO19	Moranbah WTP Inlet/ Flocculation	Chemical dosing failures	No Action. Chemical dosing system has recently been fixed. It is considered that reasonable steps have been taken to minimise this risk.	N/A	N/A	
MO20	Moranbah WTP General	Use of unapproved or contaminated water treatment chemicals	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
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.	N/A	Ongoing	SOPs have been developed to address lack of filter media maintenance. Will also be addressed by periodic media upgrades.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
MO22	Moranbah WTP Inlet/ Flocculation	Poor reliability of process	As per MO21	N/A	Ongoing	SOPs have been developed to address lack of filter media maintenance. Will also be addressed by periodic media upgrades.
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	N/A	Ongoing	SOPs have been developed to address lack of filter media maintenance. Will also be addressed by periodic media upgrades.
MO26	Moranbah Filtration	Inadequate filter operation	As per MO21	N/A	Ongoing	SOPs have been developed to address lack of filter media maintenance. Will also be addressed by periodic media upgrades. Filter inspections are currently being undertaken (Dec 2016)
MO27	Moranbah Filtration	Inadequate filter operation	As per MO21	N/A	Ongoing	SOPs have been developed to address lack of filter media maintenance. Will also be addressed by periodic media upgrades. Filter inspections are currently being undertaken (Dec 2016)
MO28	Moranbah Filtration	Equipment malfunction	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
MO29	Moranbah Filtered Water	Ineffective disinfection	As per MO12	N/A	N/A	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
MO30	Moranbah Filtered Water	Chemical dosing failure	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
MO31	Moranbah Reservoirs / Water Towers	Human/animal access	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
MO32	Moranbah Reservoirs / Water Towers	Build-up of sediment and slime	Regular inspection and maintenance of 8ML reservoir.	N/A	Ongoing	Programme to be put in place for maintenance and inspection on a regular basis for all water schemes in the Isaac Regional Council area. Cost is dependent on frequency required.
MO33	Moranbah Reservoirs / Water Towers	Aged infrastructure / corrosion. Inadequate repair and maintenance	Regular inspection and maintenance of 8ML reservoir.	N/A	Ongoing	Programme to be put in place for maintenance and inspection on a regular basis for all water schemes in the Isaac Regional Council area. Cost is dependent on frequency required.
MO34	Moranbah Reticulation	Build-up of sediment and slime	Council to develop flushing and maintenance programme.	N/A	Ongoing	Flushing procedure will be standardised as part of SOP update
MO35	Moranbah Reticulation	Aged pipes (AC)	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
MO36	Moranbah Reticulation	Corrosion	Council to ensure a maintenance / replacement programme is compiled for galvanised service connections.	N/A	Ongoing	
MO37	Moranbah Reticulation	Mixing of different source waters	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
MO38	Moranbah Reticulation	Infiltration and ingress of contamination from cross connections, backflow (soil and groundwater)	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
MO39	Moranbah Reticulation	Biofilms, sloughing and re-suspension, regrowth	Chlorine testing at reticulation as per MO12	Dec-13	Complete	
MO40	Moranbah Reticulation	Pipe bursts or leaks. Inadequate repair and maintenance, inadequate system flushing and reservoir cleaning. Commissioning new mains.	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
MO41	Moranbah Reticulation	Flow variability, inadequate pressures	Chlorine testing at reticulation as per MO12	Dec-13	Complete	
MO42	Moranbah Reticulation	Fire fighting 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	
MO44	Moranbah Whole System	Chemical dosing failure	Chlorine analyser with alarms would continuously monitor chlorine level and inform operators if disinfection is compromised.	Jun-14	In Progress	Chlorine analyser has been installed on the WTP filtered water line but final commissioning is still in progress. Analyser is inline only, with no alarms as yet (Aug 2015)
MO45	Moranbah Whole System	Power Failure	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
MO46	Moranbah Whole System	Capacity	Continue monitoring growth and development (Ongoing)	N/A	Ongoing	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
MO47	Moranbah Whole System	Sabotage	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
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	In Progress	
MO49	Moranbah General	Process upset on plant start-up	Minimise number of starts of WTP by running as continuously as possible and ramp up flows on start up.	Jun-19	Pending	May not be feasible without remote monitoring as it will require additional operators to monitor plant operation. Can be implemented once MO48 is complete.
MO50	Moranbah General	Process control incapability	Connect and make operational inline pH, turbidity and chlorine analysers on WTP filtered water line and equip with alarms (Priority 1). Install inline analysers for pH, turbidity and chlorine on Bobby Plant filtered water line (Priority 2)	Dec-16	In Progress	Upgrades are in progress – configuration of alarms is outstanding
MO51	Moranbah General	Chemical dosing failures	Consider installing a service water system to supply dilution water for all chemical dosing at a ratio of 10:1 to assist in even dispersion and mixing.	Jun-19	Pending	Review the cost/benefit of installing service water for all (or some) chemical dosing systems.
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	Pending	New water line to divert incoming raw water to 400ML dam will assist with blending and water quality to prevent fluctuating raw water quality
MO53	Moranbah Raw Water	Unknown flow entering WTP	Install new flowmeter on raw water main at existing instrument tapping point (Priority 1). Flow pace raw water chemical dosing based on this instrument (Priority 3).	Dec-16	In Progress	Flowmeter has been installed. Flow pacing has not been completed, but is not required until June 2018 (Priority 3)

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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	Pending	Continue monitoring growth and development in area (as per MO47)
MO55	Moranbah WTP Clarification (Boby and WTP)	Sludge blanket poorly defined	Trial polymer dosing to improve sludge blanket definition	Dec-16	In Progress	Upgrades are in progress.
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	Pending	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 head loss instead of time	Dec-16	In Progress	
MO60	Moranbah WTP Filtration	Inadequate filter operation	Existing DP cells need to be connected to PLC for head loss trigger function	Dec-16	In Progress	
MO61	Moranbah WTP Filtration	Inadequate filter operation	Upgrade air scour system, including new duty/common standby blowers and new air lines	Jun-18	Pending	Air scour not currently available at WTP due to malfunction and damage to blower and air lines. Wastewater isolation valves must be replaced prior to replacement of the airlines to prevent more damage (as per MO62) Update: Separate duty air scour systems are available for the WTP and Boby Plant. No common (or separate) standby system available (Dec 2016).

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
MO62	Moranbah WTP Filtration (both Bobby and WTP)	Inadequate filter operation	Backwash valves (including wastewater isolation valves for the WTP) should be replaced to prevent further leaking and damage of air lines	Dec-16	Complete	
MO63	Moranbah WTP Filtration (both Bobby and WTP)	Backwash discharging to Finger Dam	Finger Dam discharges should be reviewed in line with best practice processes and EPA requirements	Jun-17	Pending	Requirements for flow and quality monitoring for backwash and waste water being sent to Finger Dam should be reviewed – liaison with DEHP will be required to ensure no environmental or other licence breaches.
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	In Progress	Upgrades in progress for main WTP. Bobby Plant is not a priority at this stage.
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	Pending	Optimises plant operations and chemical consumption
MO66	Moranbah Filtered Water	Chemical dosing failure	Post chemical dosing order should be changed to chlorine gas, fluoride followed by lime as per best practice configuration	Jun-19	Pending	Current process is lime, chlorine gas followed by fluoride. Replacement of lime with sodium hydroxide is in progress. Chemical order and spacing of dosing points will be trialled at a later date prior to deadline
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	Pending	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
MO68	Moranbah Chlorine Dosing	Disinfection failure	Install a second regulator on the standby drum and provisions for auto-changeover	Dec-16	In Progress	A second set of scales will be required when auto-changeover is enabled
MO69	Moranbah Chlorine Dosing	Disinfection failure	Install standby pump with auto-changeover capabilities on failure	Jun-17	In Progress	
MO70	Moranbah Chlorine Dosing	Disinfection failure	Install common standby ejectors and chlorinators in case of failure or required maintenance	Jun-18	Pending	Will be completed as part of duty/standby upgrade
MO71	Moranbah Chlorine Dosing	Disinfection failure	Upgrade chlorine system to enable automatic shutdown of WTP and dial out alarms in the case of dosing failure. SCADA connection and remote control should also be considered for online, remote operation and monitoring	Jun-18	Pending	
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	In Progress	Repairs include sandblasting or repainting
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	In Progress	
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	In Progress	THMs are monitored monthly as an indicator for increased organics. BGAMP for Glenden needs to be developed in conjunction with Newland Coal. IRC BGAMP is currently being developed. Liaison with Newland Coal will be required prior to finalisation.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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	Pending	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.	N/A	Ongoing	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	
G7	Glenden Raw Water	Wildlife Access (native and feral) and unrestricted livestock	No further action. It is considered that reasonable operational actions have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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.	N/A	Ongoing	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.	N/A	Ongoing	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	N/A	N/A	
G13	Glenden Raw Water	Depletion of turkey's nest storage	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
G14	Glenden WTP General	Significant Flow variations	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
G15	Glenden 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	Comments
G16	Glenden WTP Inlet/ Flocculation	Process control incapability	No further action. It is considered that the operator completes reasonable steps to minimise this risk and it is as low as practicable.	N/A	N/A	
G17	Glenden WTP Inlet/ Flocculation	Process control incapability	No further action. It is considered that the operator completes reasonable steps to minimise this risk and it is as low as practicable.	N/A	N/A	
G18	Glenden WTP Inlet/ Flocculation	Process control incapability	No further action. It is considered that the operator completes reasonable steps to minimise this risk and it is as low as practicable.	N/A	N/A	
G19	Glenden WTP Inlet/ Flocculation	Chemical dosing failures	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	#N/A	N/A	
G20	Glenden WTP Inlet/ Flocculation	Equipment malfunction	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	#N/A	N/A	
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	
G22	Glenden WTP General	Clarifier sludge return to Turkey Nest	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	#N/A	N/A	
G23	Glenden WTP Inlet/ Flocculation	Inadequate mixing	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	#N/A	N/A	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
G24	Glenden WTP Inlet/ Flocculation	Poor reliability of process	No further action. It is considered that reasonable steps have been taken to minimise this risk.	#N/A	N/A	
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	
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. Add procedure to the new SOP.
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 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	Use filtered turbidity to detect breakthrough
G32	Glenden Filtration	Equipment malfunction	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
G33	Glenden Filtered Water	Ineffective disinfection	Chlorine residual test results for the reticulation not currently available. Testing to be added to the operational monitoring programme.	Dec-13	Complete	
G34	Glenden Filtered Water	Chemical dosing failure	Process upsets will be detected by online turbidity and chlorine analysers and the respective alarms, as per G27	Jun-15	Complete	
G35	Glenden Clear Water Tank / Water Tower	Human/animal access	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
G36	Glenden Clear Water Tank / Water Tower	Build-up of sediment and slime	Storage tank and water main flushing maintenance procedures to be formalised.	Jun-14	In Progress	Flushing procedure will be standardised as part of SOP update. No problem has been reported
G37	Glenden Clear Water Tank / Water Tower	Aged infrastructure / corrosion. Inadequate repair and maintenance	Develop a more robust testing programme. As per G33	Dec-13	Complete	
G38	Glenden Reticulation	Build-up of sediment and slime	Council to implement flushing and maintenance programme	Jun-14	In Progress	Programme to be put in place for maintenance and inspection on a regular basis for all water schemes in the Isaac Regional Council area. Cost is dependent on frequency required.
G39	Glenden Reticulation	Aged pipes (AC)	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
G40	Glenden Reticulation	Corrosion	Addressed by maintenance programme, as per G38	Jun-14	In Progress	
G41	Glenden Reticulation	Infiltration and ingress of contamination from cross connections, backflow (soil and groundwater)	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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	Flushing procedure will be standardised as part of SOP update
G43	Glenden Reticulation	Pipe bursts or leaks. Inadequate repair and maintenance, inadequate system flushing and reservoir cleaning. Commissioning new mains.	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
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	Fire fighting increasing demand on the network	Addressed by more comprehensive residual chlorine and E Coli testing, as per G33	Dec-13	Complete	Also commence network modelling study
G46	Glenden Reticulation	Inadequate maintenance of chlorine residual	Addressed by more comprehensive residual chlorine and E Coli testing, as per G33	Dec-13	Complete	
G47	Glenden Whole System	Power Failure	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
G48	Glenden Whole System	Sabotage	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
G49	Glenden Whole System	Capacity	Monitored as the population increases and reviewed every year	N/A	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	In Progress	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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 down rate plant for ideally 20 hrs/day operation.	Dec-16	Pending	
G52	Glenden WTP General	Equipment failure or incorrect calibration	Redevelop operator check sheet to include more frequent plant checks including: chemical dosing pump drop tests, sodium hypochlorite concentration testing and instrument calibration.	Dec-16	In Progress	
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	
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 and operator check sheets and SOPs have been updated accordingly.
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	Pending	
G56	Glenden WTP Inlet/ Flocculation	Chemical dosing failure	Configure flow paced dosing for all chemicals.	Jun-18	Pending	
G57	Glenden WTP Inlet/ Flocculation	Equipment malfunction	Minimise number of starts of WTP by running as continuously as possible and ramp up flows on start up.	Jun-18	Pending	
G58	Glenden WTP Clarification	Aged infrastructure / corrosion. Inadequate repair and maintenance	Corrosion observed in flocculation zone of clarifier. Clarifier interior should be resealed.	Jun-17	Pending	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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	Pending	All filters appeared to be in poor condition during a site visit in August 2015.
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 head loss, turbidity and/or filter run time (Priority 3).	Jun-17	Complete	
G61	Glenden Filtration	Process control incapability	Individual, online filtered water turbidity analysers with alarms would assist operators. Existing treated water turbid meter should have alarms associated and be regularly calibrated (as per G52).	Dec-16	Pending	
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	Pending	Cease the practice of 'super' chlorination as it is likely doing more damage than good
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	Pending	
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	Complete	Manual sampling of individual filter turbidity is performed. Combined filtered water turbidity is monitored continuously (online).
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	Pending	Optimises plant operations and chemical consumption
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	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
N2	Nebo Bores	Groundwater under direct influence of surface water	As per N1	Dec-13	Complete	
N3	Nebo Bores	Inadequate well head protection and unhygienic practices	As per N1	Dec-13	Complete	
N4	Nebo Bores	Uncased or inadequately cased bores	As per N1	Dec-13	Complete	
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	
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	
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	N/A	
N9	Nebo Bores	Drought	Investigate the feasibility of hiring a water softening plant during drought conditions to reduce hardness.	Jun-14	Complete	
N10	Nebo Bores	Sabotage	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
N11	Nebo Bores	No alternative water sources	IRC is working with DEWS on water supply to Nebo and Moranbah (already in progress).	Jun-14	In progress	Ongoing liaison with DEWS
N12	Nebo Bores	Equipment Failure	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
N13	Nebo Bores	Equipment Failure	Install a chlorine analyser on the inlet to the water tower with alarm on high/low chlorine.	N/A	N/A	Awaiting funding for new WTP
N14	Nebo Reservoirs	Human/animal access	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
N15	Nebo Reservoirs	Build-up of sediment and slime	Council to compile maintenance / flushing programme.	Jun-14	In Progress	Programme to be put in place for maintenance and inspection on a regular basis for all water schemes in the Isaac Regional Council area. Cost is dependent on frequency required.
N16	Nebo Reservoirs	Aged infrastructure / corrosion. Inadequate repair and maintenance	As per N15	Jun-14	In Progress	
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 indicated Cl disinfection levels are being achieved.
N18	Nebo Reticulation	Build-up of sediment and slime	As per N15	Jun-14	In Progress	Flushing procedure will be standardised as part of SOP update

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
N19	Nebo Reticulation	Aged pipes (AC)	Council to monitor asset condition and complete maintenance programme as per N15	Jun-14	In Progress	
N20	Nebo Reticulation	Corrosion	Council to monitor asset condition and complete maintenance programme as per N15	Jun-14	In Progress	
N21	Nebo Reticulation	Mixing of different source waters	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
N22	Nebo Reticulation	Infiltration and ingress of contamination from cross connections, backflow (soil and groundwater)	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
N23	Nebo Reticulation	Biofilms, sloughing and re-suspension, regrowth	As per N15	Jun-14	In Progress	
N24	Nebo Reticulation	Pipe bursts or leaks. Inadequate repair and maintenance, inadequate system flushing and reservoir cleaning. Commissioning new mains.	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
N25	Nebo Reticulation	Flow variability, inadequate pressures	Some chlorine residual results not within limits and some <i>E. coli</i> 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	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
N27	Nebo Reticulation	Inadequate maintenance of chlorine residual	As per N25	Dec-13	Complete	
N28	Nebo Whole System	Power Failure	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
N29	Nebo Whole System	Sabotage	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
N30	Nebo Whole System	Capacity	Monitored as the population increases and reviewed every year	N/A	Ongoing	Ongoing monitoring as growth is sensitive to new mine development/ expansion
N31	Nebo General	Variation of raw water quality	Include weekly monitoring of iron and manganese in raw and treated water as part of operational monitoring. Include weekly iron and manganese testing in treated water as part of verification monitoring.	Dec-16	Pending	During site visits, there was no indication that these metals were tested
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	Pending	Only occurs when Bores 3,4 and 5 are in operation 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	Pending	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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	Pending	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.
N35	Nebo Reticulation	Capacity	Install treated water reservoir with minimum three days' storage in the reticulation	Jun-18	Pending	
CA1	Carmila Bores	Unconfirmed/shallow aquifers	Operational monitoring is to be revised to include more regular monitoring of some parameters.	Dec-13	Complete	WTP has been upgraded and verification monitoring regime has been revised
CA2	Carmila Bores	Groundwater under direct influence of surface water	As per CA1	Dec-13	Complete	As per CA1
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	N/A	Concrete casing has been installed
CA4	Carmila Bores	Uncased or inadequately cased bores	No further action. Data shows that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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	In progress	Verification testing programme has been updated to include parameters as per recommendations in the DWQMP Operational testing programme needs to be expanded further and is detailed in Section 23: Future Monitoring of the DWQMP
CA6	Carmila Bores	Contaminated aquifers from onsite septic tanks discharge	No further action. Data shows that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
CA7	Carmila Bores	Contaminated aquifers from Carmila Creek and upstream tributaries	As per CA5	Dec-13	In progress	Verification testing programme has been updated to include parameters as per recommendations in the DWQMP Operational testing programme needs to be expanded further and is detailed in Section 23: Future Monitoring of the DWQMP
CA8	Carmila Bores	Contaminated aquifers from Carmila Creek and upstream tributaries (grazing, recreation use)	No further action. Data shows that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
CA9	Carmila Bores	Heavy Rainfall	As per CA5	Dec-13	In progress	Verification testing programme has been updated to include parameters as per recommendations in the DWQMP Operational testing programme needs to be expanded further and is detailed in Section 23: Future Monitoring of the DWQMP
CA10	Carmila Bores	Drought	No further action. Data shows that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
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.
CA12	Carmila WTP General	Significant Flow variations	No further action. Operators complete reasonable steps to minimise this risk and it is as low as practicable.	N/A	N/A	
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	Testing to be added to the new SOP
CA15	Carmila WTP Inlet/ Flocculation	Process control incapability	No further action. It is considered that the operator taking reasonable steps to minimise this risk and it is as low as practicable.	N/A	N/A	
CA16	Carmila WTP Inlet/ Flocculation	Process control incapability	No further action. It is considered that the operator taking reasonable steps to minimise this risk and it is as low as practicable.	N/A	N/A	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
CA17	Carmila WTP Inlet/ Flocculation	Process control incapability	No further action. It is considered that the operator taking reasonable steps to minimise this risk and it is as low as practicable.	N/A	N/A	
CA18	Carmila WTP Inlet/ Flocculation	Chemical dosing failures	Install final water turbidity analyser with alarms to continuously monitor treated water turbidity and detect spikes	N/A	Ongoing	To be considered in future if monitoring shows online instrumentation to be necessary.
CA19	Carmila WTP Inlet/ Flocculation	Equipment malfunction	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
CA20	Carmila WTP General	Use of unapproved or contaminated water treatment chemicals	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
CA21	Carmila WTP Inlet/ Flocculation	Inadequate mixing due to mixer failure	Online turbidity monitoring and alarms, as per CA18	N/A	Ongoing	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	N/A	Ongoing	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	
CA24	Carmila Filtration	Process control incapability	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
CA25	Carmila Filtration	Inadequate filter operation	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
CA26	Carmila Filtration	Inadequate filter operation	As per CA18	Jun-17	Complete	
CA27	Carmila Filtration	Equipment malfunction	Check spare pump availability from suppliers and keeping spare at Council depot.	Jun-15	Complete	
CA28	Carmila Filtration	Equipment malfunction	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
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	Pending	Priority 1 change complete. pH / chlorine analyser (\$15k)
CA30	Carmila Reservoirs	Human/animal access	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
CA31	Carmila Reservoirs	Build-up of sediment and slime	Council to continue/improve maintenance / flushing programme.	Jun-14	Complete	Flushing procedure will be standardised as part of SOP update
CA32	Carmila Reservoirs	Aged infrastructure / corrosion. Inadequate repair and maintenance	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
CA33	Carmila Reticulation	Build-up of sediment and slime	As per CA31	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. Cost is dependent on frequency required.
CA34	Carmila Reticulation	Aged pipes (AC)	As per CA29	Jun-14	In progress	As per CA29

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
CA35	Carmila Reticulation	Corrosion	As per CA31	N/A	N/A	
CA36	Carmila Reticulation	Mixing of different source waters	No further action.	N/A	N/A	
CA37	Carmila Reticulation	Infiltration and ingress of contamination from cross connections, backflow (soil and groundwater)	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
CA38	Carmila Reticulation	Biofilms, sloughing and re-suspension, regrowth	Ecoli and chlorine residual within reticulation have been within limits. Chlorine residual and Ecoli to be tested more frequently as part of new operational monitoring programme.	Dec-13	Complete	Testing to be added to the new SOP
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.
CA41	Carmila Reticulation	Firefighting increasing demand on the network	As per CA38	Dec-13	Complete	Pressure measurement should also be carried out.
CA42	Carmila Reticulation	Inadequate maintenance of chlorine residual	As per CA38	Dec-13	Complete	
CA43	Carmila Whole System	Power Failure	No further action. It is considered that the safest option during power failure is plant shutdown as this ensures that there is no breach of ADWG.	N/A	N/A	
CA44	Carmila Whole System	Sabotage	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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	Pending	Note different priorities in Improvement Action
CA46	Carmila General	Process control incapability	SCADA should be installed with remote access to reduce operator reliance	Jun-19	Pending	
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 down rate 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 replaced.
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 weekly.
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	Pending	
CA51	Carmila WTP Inlet/ Flocculation	Chemical dosing failure	Configure flow paced dosing for all chemicals.	Jun-18	Pending	
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	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
CA53	Carmila WTP General	Equipment failure	Incorporate cleaning of batching tanks as an operator task to be performed at least quarterly	Jun-17	Pending	Frogs, grasses and debris were visible in the batching tanks during site visit (August 2015) Update: Plant (including chemical dosing systems) has been replaced. Confirm that cleaning is part of quarterly maintenance.
CA54	Carmila WTP General	Lack of bunding around chemicals	Install bunds on chemical tanks in site building and chlorine storage shed	Dec-16	Complete	
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	
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	
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 during backwashing is best practice when polymer is dosed to improve media cleanliness and reduce likelihood of mudballs
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	
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
CA61	Carmila WTP General	Equipment malfunction	Install new level sensor in filter interlocked with automatic filtered water outlet valve	Jun-17	Pending	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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	Complete	
CA63	Carmila Filtered Water	Corrosion of treated water pumps	Investigate replacement options	Dec-16	Complete	
CA64	Carmila Reservoirs	Ineffective disinfection	Increase operational monitoring in reticulation at additional sampling points during the summer months	Dec-16	Complete	Recently replaced roof that hasn't been tested during summer months yet; consider implementing increased operational sampling sooner than Priority 1 (suggested Summer 2015) Update: Operational monitoring points and frequency have been increased. No issues have been experienced.
CA65	Carmila Reservoirs	Human/animal access	Ensure Elevated Reservoir is fully sealed and vermin proofed. Conduct regular inspections and cleaning of reservoirs.	Dec-16	Complete	New roof is in place.
SL1	St Lawrence Catchment	Rapid Variation in raw water quality	The current WTP process combined with operator input is considered capable of dealing with most turbidity events. Install raw water turbidity analyser with alarms to alert operator of water quality changes.	Jun-17	Pending	To be considered in future if monitoring shows future instrumentation to be necessary.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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	In progress	THM monitoring is in place. Update of SOP is in progress.
SL3	St Lawrence Catchment	Algal bloom	Implement Event-based algae and algal toxins monitoring as part of external testing programme	Dec-13	In Progress	Testing to be added to the new SOP. Develop a Blue Green Algae Management Plan for all IRC systems (should be based on Qld Water Directorate) which will include sampling and response requirements
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	Testing to be added to the new SOP
SL5	St Lawrence Catchment	Wildlife Access (native and feral) and unrestricted livestock	No further action. It is considered that reasonable operational steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
SL6	St Lawrence Catchment	Wildlife Access (native and feral) and unrestricted livestock	No further action. It is considered that reasonable operational steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
SL7	St Lawrence Catchment	Changes in surrounding land use	Council to regularly review plans for industrial developments in the area.	N/A	Ongoing	Land use in catchment is largely grazing (rural).

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
SL8	St Lawrence Catchment	Heavy Rainfall / Flooding	No further action. It is considered that reasonable steps are being taken by the operator to minimise this risk and it is as low as practicable.	N/A	N/A	
SL9	St Lawrence Catchment	Drought / Bushfires	No further action. It is considered that reasonable steps are being taken by the operator to minimise this risk and it is as low as practicable.	N/A	N/A	
SL10	St Lawrence Catchment	Equipment Failure	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
SL11	St Lawrence Catchment	Demand Increase	Drought management to be implemented to provide triggers for water restrictions.	Jun-14	Complete	Review the current drought management practice
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.
SL13	St. Lawrence Catchment	Septic Tank Discharge	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
SL14	St. Lawrence Catchment	Septic Tank Discharge	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
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.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
SL16	St Lawrence WTP General	Significant Flow variations	Operating manual to be compiled.	Dec-13	In progress	
SL17	St Lawrence WTP Inlet/ Flocculation	Process control incapability	Aluminium testing to be included in verification monitoring programme.	Dec-13	Complete	
SL18	St Lawrence WTP Inlet/ Flocculation	Process control incapability	No further action. It is considered that reasonable steps have been taken by the operator to minimise this risk and it is as low as practicable.	N/A	N/A	
SL19	St Lawrence WTP Inlet/ Flocculation	Chemical dosing failures	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
SL20	St Lawrence WTP Inlet/ Flocculation	Equipment malfunction	No further action.	N/A	N/A	
SL21	St Lawrence WTP General	Use of unapproved or contaminated water treatment chemicals	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
SL22	St Lawrence WTP Inlet/ Flocculation	Inadequate mixing	Clarified (settled) water turbidity testing to be added to operational monitoring programme as this provides indication of adequate flocculation.	Dec-13	Ongoing	WTP has been upgraded. Requirement for settled water turbidity analysis to be reviewed.
SL23	St Lawrence WTP Inlet/ Flocculation	Poor reliability of process	As per SL22	Dec-13	Complete	WTP has been upgraded.
SL24	St Lawrence WTP General	Formation of disinfection by-products	Verification testing programme amended to include THMs.	Dec-13	Complete	
SL25	St Lawrence WTP General	Uncontrolled recycle of backwash water	Additional operational and verification monitoring will show if there are any additional chemical contaminants that are building up.	Dec-13	Complete	Backwash water is currently irrigated on-site and not being recycled.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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	Backwash water is currently irrigated on-site and not being recycled.
SL27	St Lawrence Filtration	Process control incapability	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
SL28	St Lawrence Filtration	Inadequate filter operation	Turbidity analyser for treated water would assist operator to identify turbidity spikes.	N/A	Ongoing	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	N/A	Use filtered turbidity to detect breakthrough
SL30	St Lawrence Filtration	Equipment malfunction	Install spare backwash pump.	Jun-15	Complete	WTP has been upgraded
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)	N/A	Ongoing	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	N/A	Ongoing	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
SL34	St Lawrence Reservoirs	Human/animal access	Install access gate	Jun-15	Complete	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
SL35	St Lawrence Reservoirs	Build-up of sediment and slime	Council to compile maintenance / flushing programme.	Jun-14	Complete	Flushing procedure will be standardised as part of SOP update Desludging of reservoir to be completed during reservoir roof replacement.
SL36	St Lawrence Reservoirs	Aged infrastructure / corrosion. Inadequate repair and maintenance	As per SL35	Jun-14	Complete	
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	
SL39	St Lawrence Reticulation	Infiltration and ingress of contamination from cross connections, backflow (soil and groundwater)	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
SL40	St Lawrence Reticulation	Biofilms, sloughing and re-suspension, regrowth	Ecoli 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	Comments
SL42	St Lawrence Reticulation	Flow variability, inadequate pressures	As per SL40	Dec-13	Complete	Pressure monitoring to be undertaken.
SL43	St Lawrence Reticulation	Fire fighting 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	Part of full plant reconditioning works.
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	Pending	
SL50	St Lawrence General	Process control incapability	SCADA should be installed with remote access to reduce reliance on operator	Jun-18	In progress	
SL51	St Lawrence General	Power Failure	Install lightning rod to protect electrical systems and operators	Dec-16	In progress	Anecdotal evidence of frequent lightning strikes at WTP and raw water pumps, shorting control systems and run start/stop signals. In scope of current upgrades.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
SL52	St Lawrence Whole System	Equipment failure	Procure and install a standby chlorine dosing pump with auto-changeover capabilities	Dec-16	In progress	In scope of current 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	In scope of current upgrades
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	In progress	In scope of current upgrades
SL55	St Lawrence Whole System	Chemical dosing failure	Install raw water flowmeter and configure flow paced dosing for all pre-dosed chemicals.	Jun-18	In progress	In scope of current upgrades
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	Severe corrosion observed on flocculator during site visit (August 2015)
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	In progress	
SL58	St Lawrence Filtration	Backwash with primary filtered water	Configure system to use treated water as backwash water	Dec-16	Pending	
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	Pending	Dry bedding or filter overflow will occur due to current setup
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	Pending	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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	
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	Pending	
SL63	St Lawrence Reservoirs	Aged infrastructure / corrosion. Inadequate repair and maintenance	Replace hatch and roof of Final Water Reservoir	Dec-16	In progress	
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	
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.	N/A	Ongoing	Instrumentation considered but determined not to be required at this stage. Fluctuations of raw water quality are mainly due to rainfall and daily operational monitoring is considered to be adequate for sufficient treatment. Instrumentation may be further considered in future if appropriate.

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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	
MI6	Middlemount Raw Water	Wildlife Access (native and feral) and unrestricted livestock	No further action. It is considered that reasonable operational steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
MI7	Middlemount Raw Water	Wildlife Access (native and feral) and unrestricted livestock	No further action. It is considered that reasonable operational steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
MI8	Middlemount Raw Water	Changes in surrounding land use	Monitor land use changes (ongoing)	N/A	Ongoing	
MI9	Middlemount Raw Water	Heavy Rainfall / Flooding	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
MI10	Middlemount Raw Water	Drought / Bushfires	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
MI11	Middlemount Raw Water	Equipment Failure	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
MI12	Middlemount Raw Water	No alternative water sources	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
MI13	Middlemount WTP General	Significant Flow variations	Link treated water turbidity analyser outputs to alarms	Dec-13	Complete	SCADA and telemetry modifications have been completed and alarms are in line with CCP limits.
MI14	Middlemount WTP Inlet/ Flocculation	Chemical dosing failures	Turbidity spikes detected by online analysers, as per MI13	Dec-13	Complete	SCADA and telemetry modifications have been completed and alarms are in line with CCP limits.
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)	N/A	N/A	Plant is being operated manually
MI16	Middlemount WTP General	Use of unapproved or contaminated water treatment chemicals	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
MI17	Middlemount WTP Inlet/ Flocculation	Inadequate mixing	As per MI13	Dec-13	Complete	
MI18	Middlemount WTP Inlet/ Flocculation	Poor reliability of process	As per MI13	Dec-13	Complete	
MI19	Middlemount WTP General	Formation of disinfection by-products	Incorporate THMs testing as part of regular external testing regime	Dec-13	Complete	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
MI20	Middlemount Filtration	Chemical dosing failure / Equipment Malfunction	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
MI21	Middlemount Filtration	Process control incapability	Connect filtered water turbidity monitor to PLC with alarms as per item MI13	Dec-13	Complete	Use filtered turbidity to detect breakthrough
MI22	Middlemount Filtration	Inadequate filter operation	No further action. It is considered that reasonable steps are being taken by operators to minimise this risk and it is as low as practicable.	N/A	N/A	
MI23	Middlemount Filtration	Inadequate filter operation	No further action. It is considered that reasonable steps are being taken by operators to minimise this risk and it is as low as practicable.	N/A	N/A	
MI24	Middlemount Filtration	Equipment malfunction	No further action. It is considered that reasonable steps have been taken to provide standby equipment and thus minimise this risk and it is as low as practicable.	N/A	N/A	
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
MI26	Middlemount Filtered Water	Ineffective disinfection	Online final water chlorine analyser to be connected to the PLC for alarms	Dec-13	In Progress	SCADA and telemetry modifications. Chlorine analyser is online and connected to SCADA, but no alarms as yet (Aug 2015) Update: Still no alarms as of Dec 2016.
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	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
MI28	Middlemount Reservoirs	Human/animal access	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
MI29	Middlemount Reservoirs	Build-up of sediment and slime	No further action. It is considered that reasonable steps have been taken to inspect the system and thus minimise this risk and it is as low as practicable.	N/A	N/A	Flushing procedure will be standardised as part of SOP update
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	Flushing procedure has been standardised and SOPs have been updated.
MI32	Middlemount Reticulation	Aged pipes (AC)	as per MI31	Jun-14	Complete	
MI33	Middlemount Reticulation	Corrosion	as per MI31	Jun-14	In Progress	Programme to be put in place for maintenance and inspection on a regular basis for all water schemes in the Isaac Regional Council area. Cost is dependent on frequency required.
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	
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	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
MI36	Middlemount Reticulation	Flow variability, inadequate pressures	As per MI34	Jun-17	In progress	
MI37	Middlemount Reticulation	Firefighting increasing demand on the network	As per MI34	Dec-13	In progress	Network modelling to be commissioned separately
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	Complete	
MI40	Middlemount Whole System	Power Failure	No further action. It is considered that shutdown is the best option to protect the plant in the case of power failure and thus minimise this risk of inappropriate treatment.	N/A	N/A	
MI41	Middlemount Whole System	Sabotage	No further action. It is considered that reasonable steps have been taken to secure the system and thus minimise this risk and it is as low as practicable.	N/A	N/A	
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	Pending	Operational monitoring should be increased to determine potassium permanganate dosing ratios for sufficient manganese removal. Iron and Manganese are currently being monitored weekly, external (verification) testing on Tuesdays and internal (operational) testing on Thursdays. Internal testing frequency should be increased to daily.
MI43	Middlemount Raw Water	Rapid Variation in raw water quality	Install potassium permanganate dosing system for improved oxidation of soluble metals	Dec-16	In progress	Utilise existing tapping at raw water pumps for injection point

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
MI44	Middlemount WTP Inlet/ Flocculation	Chemical dosing failure	Configure flow paced dosing for all chemicals.	Jun-18	Pending	
MI45	Middlemount WTP Inlet/ Flocculation	Chemical dosing failure	Install standby dosing pumps for coagulant. Add auto changeover on pump fault (Priority 1 Change). Install caustic soda dosing system (to replace soda ash system), including duty/ standby dosing pumps (Priority 2 Change).	Dec-16	In progress	Chemical systems upgrades are currently being specified to be put out to tender.
MI46	Middlemount WTP Inlet/ Flocculation	Poor reliability of process	Consider changing order of raw water dosing to achieve optimal results (recommend soda ash dosed first, followed by chlorine then coagulant). PAC dosing (when required) should also be dosed prior to the flash mixer.	Jun-19	In progress	There are available dosing points so changes can be trialled easily. When PAC and chlorine/ potassium permanganate are both required, PAC can be dosed into flocculation zone (as per the current setup). Chemical systems upgrades are currently being specified to be put out to tender. Optimum dosing arrangement will be incorporated into this project.
MI47	Middlemount Whole System	Equipment Failure	PE hosing should be changed to a suitable material for contact with chlorine	Dec-16	In progress	Recommend replacing with CPVC
MI48	Middlemount WTP Clarification	Poor clarification	Install polymer dosing system to aid in coagulation/ flocculation	Jun-17	In progress	
MI49	Middlemount WTP Inlet/ Flocculation	Equipment malfunction	Downrate the plant upon startup to minimise floc carryover to filters	Jun-18	Complete	
MI50	Middlemount Filtration	Inadequate filter operation	Reconfigure backwash sequence to improve filter performance and minimise media loss	Jun-17	Complete	Recommend more operator involvement in filter backwash process (i.e. checking filter media level biannually)
MI51	Middlemount Filtration	Process control incapability	Install online turbidity analysers on outlet of each filter.	Jun-18	Pending	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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	This will achieve sufficient drain down to enable appropriate bed expansion during backwashing
MI53	Middlemount Filtration	Inadequate filter operation	Install standby air blower for air scour	Dec-16	Pending	Chemical systems upgrades are currently being specified to be put out to tender. 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	N/A	70kg cylinders are no longer in use.
MI56	Middlemount Whole system	Disinfection failure	Install auto changeover capability on 70 kg chlorine gas cylinders	Dec-16	N/A	70kg cylinders are no longer in use.
MI57	Middlemount Whole system	Process control incapability	Clean and calibrate chlorine analyser regularly as part of operator checks (Priority 1 Change). Install call out alarms on low and high chlorine residual (Priority 2 Change).	Dec-16	Complete	
MI58	Middlemount Whole system	Animal access to Clearwater Tanks including birds and vermin	Repair or replace mesh where vermin and birds can access Clearwater Tank #1	Dec-16	Complete	
MI59	Middlemount Whole system	Aged infrastructure/corrosion	Hatch on Clearwater Tank #1 should be replaced.	Dec-16	Pending	Consider replacing entire roof
MI60	Middlemount Town Reservoir	Aged infrastructure/corrosion	Areas of corrosion visible in roof. Repair or replace roof.	Jun-17	Complete	
MI61	Middlemount Town Reservoir	Ageing infrastructure and sludge build-up	Desludge Town Reservoir	Dec-16	Complete	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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	N/A	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	Sewage discharge point has been relocated to SPS 1.
D1	Dysart Raw Water	Algal Bloom	Implement Event-based Algae and Algal Toxin monitoring as part of verification monitoring based on observations of Turkey Nest and Sunwater WQ information	Dec-13	Complete	
D2	Dysart Raw Water	Rapid Variation in raw water quality	The current WTP process combined with operator input is considered capable of dealing with turbidity events. However, if future data shows that this system becomes unreliable, a raw water turbidity meter and/or SCM with alarms should be considered to assist operators in chemical dosing adjustments.	Jun-17	Complete	Online raw water turbidity monitoring is in place. Alarms may be configured later if deemed necessary, but current processes are sufficient for now.
D3	Dysart Raw Water	Rapid Variation in raw water quality caused by stormwater flows	The colour testing procedure needs to be revised. Since the raw water is dosed with chlorine, True colour should be tested in samples sent to Queensland Health. Any sample that is above 15 HU should also be tested for THMs. These THM levels should be recorded and checked against ADWG limits. Further action may be required if THMs above 0.25mg/L are detected. This requirement has been added to the verification monitoring programme.	Dec-13	Complete	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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	
D6	Dysart Raw Water	Wildlife Access (native and feral) and unrestricted livestock	No further action. It is considered that all reasonable operational steps are being taken by the operator minimise this risk and it is as low as practicable.	N/A	N/A	
D7	Dysart Raw Water	Wildlife Access (native and feral) and unrestricted livestock	No further action. It is considered that all reasonable operational steps are being taken by the operator minimise this risk and it is as low as practicable.	N/A	N/A	
D8	Dysart Raw Water	Heavy Rainfall / Flooding	No further action. It is considered that reasonable step are being taken by the operator treat the changes in raw water and this risk is as low as practicable.	N/A	N/A	
D9	Dysart Raw Water	Drought / Bushfires	No further action. It is considered that reasonable step are being taken by the operator treat the changes in raw water and this risk is as low as practicable.	N/A	N/A	
D10	Dysart Raw Water	Equipment Failure	No further action. It is considered that reasonable steps have been taken by including redundancy and this risk is as low as practicable.	N/A	N/A	
D11	Dysart Raw Water	Chemical dosing failure / Equipment Malfunction	No further action. It is considered that reasonable steps have been taken by including redundancy and operator action and thus this risk is as low as practicable.	N/A	N/A	
D12	Dysart WTP General	Significant Flow variations	No further action. It is considered those reasonable steps are being taken by the operator to ensure the flocculation process is effective and this risk is as low as practicable.	N/A	N/A	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
D13	Dysart WTP Inlet/ Flocculation	Process control incapability	Verification monitoring to include more regular testing of aluminium.	Dec-13	Complete	
D14	Dysart WTP Inlet/ Flocculation	Process control incapability	No further action. It is considered those reasonable steps are being taken by the operator to ensure the coagulant dose is appropriate. This risk is as low as practicable.	N/A	N/A	
D15	Dysart WTP Inlet/ Flocculation	Chemical dosing failures	No further action. It is considered those reasonable steps are being taken by the operator to ensure the coagulant dose is appropriate. This risk is as low as practicable.	N/A	N/A	
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)	Jun-18	Ongoing	SCADA and telemetry upgrades and modifications including alarms have been completed. New O&M manual will be developed following the Phase 2 Upgrades (mid 2018) to cover all aspects of plant operation.
D17	Dysart WTP General	Use of unapproved or contaminated water treatment chemicals	No further action. It is considered that reasonable steps have been taken to minimise this risk and it is as low as practicable.	N/A	N/A	
D18	Dysart WTP Inlet/ Flocculation	Inadequate mixing	No further action. It is considered those reasonable steps are being taken by the operator to ensure the coagulant dose is appropriate. This risk is as low as practicable.	N/A	N/A	
D19	Dysart WTP Inlet/ Flocculation	Poor reliability of process	No further action. It is considered those reasonable steps are being taken by the operator to ensure the coagulant dose is appropriate. This risk is as low as practicable.	N/A	N/A	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
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	Using filtered turbidity to detect breakthrough
D22	Dysart Filtration	Inadequate filter operation	Alarm on treated water turbidity to be implemented as per D16.	Dec-13	Complete	Using filtered turbidity to detect breakthrough
D23	Dysart Filtration	Inadequate filter operation	Alarm on treated water turbidity to be implemented as per D16.	Dec-13	Complete	Using filtered turbidity to detect breakthrough
D24	Dysart Filtration	Equipment malfunction	No further action. It is considered that duty/standby equipment ensures that this risk is as low as practicable.	N/A	N/A	
D25	Dysart Filtration	Equipment malfunction	It is considered that adequate steps have been taken to minimise this risk. No further action.	N/A	N/A	
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	N/A	
D28	Dysart Reservoirs	Human/animal access	It is considered that adequate steps have been taken to protect the system and this risk is as low as practicable.	N/A	N/A	
D29	Dysart Reservoirs	Build-up of sediment and slime	Council to compile flushing/ maintenance programme.	Jun-14	Complete	Flushing procedure has been standardised as part of SOP update
D30	Dysart Reservoirs	Aged infrastructure / corrosion. Inadequate repair and maintenance	No further action. It is considered that reasonable steps have been taken to minimise this risk.	N/A	N/A	

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
D31	Dysart Reticulation	Build-up of sediment and slime	As per D29	Jun-14	Complete	Programme in place for maintenance and inspection on a regular basis for all water schemes in the Isaac Regional Council area.
D32	Dysart Reticulation	Aged pipes (AC)	As per D29	Jun-14	Complete	Programme in place for maintenance and inspection on a regular basis for all water schemes in the Isaac Regional Council area.
D33	Dysart Reticulation	Corrosion	As per D29	Jun-14	Complete	Programme in place for maintenance and inspection on a regular basis for all water schemes in the Isaac Regional Council area.
D34	Dysart Reticulation	Infiltration and ingress of contamination from cross connections, backflow (soil and groundwater)	No further action. It is considered that reasonable steps have been taken to minimise this risk.	N/A	N/A	
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	Pending	Network modelling to be commissioned separately

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
D38	Dysart Reticulation	Firefighting increasing demand on the network	As per D35	Dec-13	Complete	
D39	Dysart Reticulation	Inadequate maintenance of chlorine residual	As per D35	Dec-13	Complete	
D40	Dysart Whole System	Power Failure	No further action. It is considered that shutdown is the best option to protect the plant in the case of power failure and thus minimise this risk of inappropriate treatment.	N/A	N/A	
D41	Dysart Whole System	Sabotage	No further action. It is considered that reasonable steps have been undertaken.	N/A	N/A	
D42	Dysart Whole System	Capacity	Monitor population on a yearly basis and assess against plant capacity.	N/A	Ongoing	
D43	Dysart General	Process control incapability	Complete matrix calibration to finalise commissioning of Liquid analyser	Dec-16	Complete	Liquid calibration and commissioning has been finalised.
D44	Dysart General	Process control incapability	Ensure analysers are regularly calibrated as part of operator checks	Dec-16	Complete	SOP in place.
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	Limits and call out priorities should be consistent with CCPs
D47	Dysart WTP Clarification	Process control incapability	Include operator changeable clarifier sludge blowdown setpoint on SCADA to increase control of frequency	Jun-17	Complete	Further upgrades and automation to be included in Phase 2 works
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	Require updated SOPs for operation and maintenance of all chemical systems (e.g. filling poly and potassium permanganate hoppers, flushing poly dosing lines)

#	Process Step	Hazardous Event	Improvement Action	Timeframe	Status	Comments
D49	Dysart General	Equipment malfunction	Develop spare parts list for whole of plant	Dec-16	Pending	Various new processes at WTP that require on the shelf spares
D50	Dysart Filtration	Inadequate filter operation	Confirm SCADA settings and capability for auto backwash trigger on high turbidity alarm	Dec-16	Complete	Refurbished filters are to have functionality to automatically backwash based on run time, head loss or high filtered water turbidity
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

Carmila WTP

Component	Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	Average	Max	LOR	Laboratory
Treated Water	E. coli	MPN/100m L	Weekly	50	0	0	<1	<1	<1	1	MRC
Treated Water	Free Chlorine Residual	mg/L	Daily Weekly	293 49	293 49	0 0	1 0.17	1.61 1.19	2.5 2.2		Inhouse MRC
Treated Water	Turbidity	NTU	Weekly	34	-	0	<0.1	0.289	0.98	0.1	MRC
Treated Water	pH	-		49	-	0	7.25	7.77	8.17	-	
Treated Water	Aluminium	mg/L		48	14	0	<0.07	<0.07	0.112	0.07	
Treated Water	Iron	mg/L		48	1	0	<0.007	<0.007	0.016		
Treated Water	Manganese	mg/L		48	1	0	<0.004	<0.004	0.01	0.004	
Treated Water	Conductivity	µS/cm		49	49	-	203	357	431		
Treated Water	Total Dissolved Solids (TDS)	mg/L		49	-	-	122	214	259		
Treated Water	True Colour	TCU		13	3	0	<1	<1	5	1	
Treated Water	Total Hardness	mg/L		13	13	-	29.2	105	137		
Treated Water	Temporary Hardness	mg/L	12	12	-	54.2	94.8	115			
Treated Water	Sodium	mg/L	Monthly	6	6	0	25.2	28.1	29.2		
Treated Water	Ammonia	mg/L		11	1	0	<0.01	<0.01	0.035	0.01	
Treated Water	Potassium	mg/L		6	6	-	0.63	1.01	1.91		
Treated Water	Calcium	mg/L		13	13	-	6.72	24.4	31.7		

Component	Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	Average	Max	LOR	Laboratory
Water											
Treated Water	Magnesium	mg/L		13	13	-	2.38	10.7	14.0		
Treated Water	Hydrogen	mg/L		6	0	-	0	0	0		
Treated Water	Alkalinity	mg/L		10	10	-	54.2	100	115		
Treated Water	Residual Alkalinity	meq/L		9	0	-	<0.1	<0.1	<0.1	0.1	
Treated Water	Silica	mg/L		6	6	0	11.4	16.5	23.7		
Treated Water	THMs	µg/L		13	13	0	66	110	191		
Treated Water	Dissolved Oxygen	% Sat.		10	10	0	86.1	91.7	100		
Treated Water	Fluoride	mg/L		7	7	0	0.09	0.107	0.141		
Treated Water	Arsenic	µg/L		Quarterly	2	0	0	<1	<1	<1	1
Treated Water	Selenium	µg/L	2		0	0	<1	<1	<1	1	
Treated Water	Lead	µg/L	Quarterly	2	0	0	<1	<1	<1	1	
Treated Water	Mercury	µg/L		2	1	0	<0.05	0.15	0.299	0.05	
Treated Water	Cadmium	mg/L		2	0	0	<0.002	<0.002	<0.002	0.002	
Treated Water	Chromium	mg/L		2	0	0	<0.01	<0.01	<0.01	0.01	
Treated Water	Nickel	mg/L		2	0	0	<0.03	<0.03	<0.03	0.03	
Treated Water	Zinc	mg/L		2	0	0	<0.005	<0.005	<0.005	0.005	
Treated Water	Copper	mg/L		2	0	0	<0.015	<0.015	<0.015	0.015	

Component	Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	Average	Max	LOR	Laboratory
Treated Water	Hydrogen Sulphide	mg/L		2	0	0	<0.005	<0.005	<0.005	0.005	
Treated Water	Radionuclides										
Treated Water	Pesticides		Annually								
Treated Water	Tin										
Treated Water	Silver										
Treated Water	Beryllium										
Treated Water	Uranium										
Treated Water	Iodide										
Treated Water	Molybdenum										
Treated Water	Boron										
Treated Water	Barium										

Drinking water scheme: CARMILA

<i>Year</i>	<i>2015 - 2016</i>											
<i>Month</i>	<i>July</i>	<i>Aug</i>	<i>Sept</i>	<i>Oct</i>	<i>Nov</i>	<i>Dec</i>	<i>Jan</i>	<i>Feb</i>	<i>Mar</i>	<i>Apr</i>	<i>May</i>	<i>June</i>
No. of samples collected	4	4	4	4	4	4	4	4	4	4	4	4
No. of samples collected in which E. coli is detected (i.e. a failure)	0	0	0	0	0	0	0	0	0	0	0	0
No. of samples collected in previous 12 month period	48	48	48	48	48	48	48	48	48	48	48	48
No. of failures for previous 12 month period	0	0	0	0	0	0	0	0	0	0	0	0
% of samples that comply	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Compliance with 98% annual value	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Clermont WTP

Component	Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	Average	Max	LOR	Laboratory
Treated Water	E. coli	MPN/100mL	Weekly								MRC
Treated Water	Free Chlorine Residual	mg/L	Daily Weekly	361 52	361 52	0 0	0.21 0.21	2.14 1.808	4.3 3.5		Inhouse MRC
Treated Water	pH	-	Weekly	52	52	0	6.5	7.13	7.96		MRC
Treated Water	Aluminium	mg/L		51	2	0	<0.07	<0.07	0.07	0.07	
Treated Water	Iron	mg/L		51	0	0	<0.007	<0.007	<0.007	0.007	
Treated Water	Manganese	mg/L		51	12	3 (Aesthetic)	<0.004	0.012	0.2	0.004	
Treated Water	Total Dissolved Solids (TDS)	mg/L		26	26	0	218	353	520		
Treated Water	Conductivity	µS/cm		26	26	-	363	588	867		
Treated Water	Turbidity	NTU		32	32	1 (Health)	0.13	0.623	2.18		
Treated Water	True Colour	TCU		11	8	0	<1	2.455	9.00	1	
Treated Water	Total Hardness	mg/L	Monthly	11	11	-	76.5	132	172		MRC
Treated Water	Temporary Hardness	mg/L		10	10	-	77.80	121.650	159.90		
Treated Water	Sodium	mg/L		6	6	0	60.55	68.239	74.41		
Treated Water	Potassium	mg/L		6	5	-	3.16	3.405	5.08		
Treated Water	Calcium	mg/L		11	11	-	60.55	68.239	41.81		
Treated Water	Magnesium	mg/L		11	11	-	7.15	12.79	16.4		
Treated Water	Hydrogen	mg/L		5	0	-	0	0	0		

Component	Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	Average	Max	LOR	Laboratory
Water											
Treated Water	Alkalinity	mg/L		8	8	-	77.82	124.370	159.86		
Treated Water	Residual Alkalinity	meq/L		7	0	-	<0.1	<0.1	<0.1	0.1	
Treated Water	Silica	mg/L		5	5	0	10.40	11.320	12.60		
Treated Water	THMs	µg/L		11	10	0	88	111.455	201.00		
Treated Water	Dissolved Oxygen	% Sat.		6	6	3 (Aesthetic)	70.70	83.317	92		
Treated Water	Algal Toxins										
Treated Water	Fluoride	mg/L		5	5	0	0.10	0.165	0.23		
Treated Water	Ammonia	mg/L		6	2	0	<0.01	<0.01	0.02	0.01	
Treated Water	Arsenic	µg/L	Quarterly	2	0	0	<1	<1	<1	1	
Treated Water	Selenium	µg/L		2	0	0	<1	<1	<1	1	
Treated Water	Lead	µg/L		2	0	0	<1	<1	<1	1	
Treated Water	Mercury	µg/L		2	0	0	<0.05	<0.05	<0.05	0.05	
Treated Water	Cadmium	mg/L		2	0	0	<0.002	<0.002	<0.002	0.002	
Treated Water	Chromium	mg/L	Quarterly	2	0	0	<0.01	<0.01	<0.01	0.01	
Treated Water	Nickel	mg/L		2	0	0	<0.03	<0.03	<0.03	0.03	
Treated Water	Zinc	mg/L		2	0	0	<0.005	<0.005	<0.005	0.005	
Treated Water	Copper	mg/L		2	0	0	<0.015	<0.015	<0.015	0.015	

Component	Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	Average	Max	LOR	Laboratory	
Treated Water	Hydrogen Sulphide	mg/L	Annually	2	0	0	<0.005	<0.005	<0.005	0.005		
Treated Water	Radionuclides											
Treated Water	Pesticides											
Treated Water	Tin											
Treated Water	Silver											
Treated Water	Beryllium											
Treated Water	Uranium											
Treated Water	Iodide											
Treated Water	Molybdenum											
Treated Water	Boron											
Treated Water	Barium											

Drinking water scheme: CLERMONT

<i>Year</i>	<i>2015 - 2016</i>											
<i>Month</i>	<i>July</i>	<i>Aug</i>	<i>Sept</i>	<i>Oct</i>	<i>Nov</i>	<i>Dec</i>	<i>Jan</i>	<i>Feb</i>	<i>Mar</i>	<i>Apr</i>	<i>May</i>	<i>June</i>
No. of samples collected	8	8	10	8	2	10	8	8	10	8	10	8
No. of samples collected in which E. coli is detected (i.e. a failure)	0	0	0	0	0	0	0	0	0	0	0	0
No. of samples collected in previous 12 month period	144	136	135	126	114	115	111	110	102	101	102	98
No. of failures for previous 12 month period	0	0	0	0	0	0	0	0	0	0	0	0
% of samples that comply	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Compliance with 98% annual value	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Dysart WTP

Component	Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	Average	Max	LOR	Laboratory
Treated Water	E. coli	MPN/100mL	Weekly	53	1	0	<1	<1	1	1	MRC
Treated Water	Free Chlorine Residual	mg/L	Daily Weekly	338 54	338 54	3 (Health) 0	0 0.06	3.12 2.68	7.81 4.90		Inhouse MRC
Treated Water	Turbidity	NTU	Weekly	33	30	0	<0.1	0.377	0.90	0.1	MRC
Treated Water	pH	-		54	54	1 (Aesthetic)	6.87	7.51	8.67		
Treated Water	Iron	mg/L		52	0	0	<0.007	<0.007	<0.007	0.007	
Treated Water	Manganese	mg/L		52	0	0	<0.004	<0.004	<0.004	0.004	
Treated Water	Total Dissolved Solids (TDS)	mg/L		27	26	0	<1	245	360	1	
Treated Water	Conductivity	µS/cm		27	27	-	378	424	600		
Treated Water	True Colour	TCU		10	6	0	<1	1.90	7.00	1	
Treated Water	Total Hardness	mg/L		11	11	-	58.1	89.1	108		
Treated Water	Temporary Hardness	mg/L	11	11	-	56.1	81.4	104			
Treated Water	Sodium	mg/L	Monthly	5	5	0	35.4	39.8	44.9		
Treated Water	Potassium	mg/L		5	4	-	4.41	5.00	5.52		
Treated Water	Calcium	mg/L		11	11	-	13.9	20.5	24.09		
Treated Water	Magnesium	mg/L		11	11	-	5.69	9.19	12.9		
Treated Water	Hydrogen	mg/L		5	0	-	0	0	0		
Treated	Alkalinity	mg/L		9	9	-	56.1	83.7	104		

Component	Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	Average	Max	LOR	Laboratory
Water											
Treated Water	Residual Alkalinity	meq/L		8	0	-	<0.1	<0.1	<0.1	0.1	
Treated Water	Silica	mg/L		5	5	0	3	9.86	14.10		
Treated Water	THMs	µg/L		11	10	0	28	52.9	129		
Treated Water	Algal Toxins										
Treated Water	Fluoride	mg/L		5	5	0	0.10	0.135	0.16		
Treated Water	Ammonia	mg/L		6	6	0	<0.01	<0.01	<0.01	0.01	
Treated Water	Arsenic	µg/L		2	0	0	<1	<1	<1	1	
Treated Water	Selenium	µg/L	Alternate Months	2	0	0	<1	<1	<1	1	
Treated Water	Lead	µg/L		2	0	0	<1	<1	<1	1	
Treated Water	Mercury	µg/L		2	1	0	<0.05	0.148	0.30	0.05	
Treated Water	Cadmium	mg/L		2	0	0	<0.002	<0.002	<0.002	0.002	
Treated Water	Chromium	mg/L		2	0	0	<0.01	<0.01	<0.01	0.01	
Treated Water	Nickel	mg/L		2	0	0	<0.03	<0.03	<0.03	0.03	
Treated Water	Zinc	mg/L	Alternate Months	2	0	0	<0.005	<0.005	<0.005	0.005	
Treated Water	Copper	mg/L		2	0	0	0.03	0.03	0.03		
Treated Water	Hydrogen Sulphide	mg/L		2	0	0	<0.005	<0.005	<0.005	0.005	
Treated Water	Radionuclides		Quarterly								

Component	Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	Average	Max	LOR	Laboratory
Treated Water	Pesticides										
Treated Water	Tin		Annually								
Treated Water	Silver										
Treated Water	Beryllium										
Treated Water	Uranium										
Treated Water	Iodide										
Treated Water	Molybdenum										
Treated Water	Boron										
Treated Water	Barium										

Drinking water scheme: DYSART

<i>Year</i>	<i>2015 - 2016</i>											
<i>Month</i>	<i>July</i>	<i>Aug</i>	<i>Sept</i>	<i>Oct</i>	<i>Nov</i>	<i>Dec</i>	<i>Jan</i>	<i>Feb</i>	<i>Mar</i>	<i>Apr</i>	<i>May</i>	<i>June</i>
No. of samples collected	4	4	5	4	4	5	8	8	10	8	10	8
No. of samples collected in which E. coli is detected (i.e. a failure)	0	0	0	0	0	0	0	0	0	0	0	0
No. of samples collected in previous 12 month period	70	66	63	59	55	52	56	60	65	69	75	78
No. of failures for previous 12 month period	0	0	0	0	0	0	0	0	0	0	0	0
% of samples that comply	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Compliance with 98% annual value	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Glenden WTP

Component	Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	Average	Max	LOR	Laboratory
Treated Water	E. coli	MPN/100mL	Weekly	55	0	0	<1	<1	<1	1	MRC
Treated Water	Free Chlorine Residual	mg/L	Daily Weekly	364 55	364 55	0 0	0 0.71	0.371 1.407	5 3		Inhouse MRC
Treated Water	Turbidity	NTU	Weekly	36	36	0	0.12	.344	0.70		MRC
Treated Water	pH	-		55	55	0	6.8	7.294	7.89		
Treated Water	Aluminium	mg/L		41	3	0	<0.07	<0.07	0.11	0.07	
Treated Water	Iron	mg/L		55	1	0	<0.007	<0.007	0.02	0.007	
Treated Water	Manganese	mg/L		55	0	0	<0.004	<0.004	<0.004	0.004	
Treated Water	Total Dissolved Solids (TDS)	mg/L		30	30	0	108	147.633	198		
Treated Water	Conductivity	µS/cm		30	30	-	180.20	246.147	330		
Treated Water	True Colour	TCU		10	2	0	<1	<1	1	1	
Treated Water	Total Hardness	mg/L		10	10	-	58.08	83.403	117.82		
Treated Water	Temporary Hardness	mg/L	10	10	-	43.60	71.310	97.50			
Treated Water	Sodium	mg/L	Monthly	6	6	0	13.57	19.083	24.26		
Treated Water	Potassium	mg/L		6	5	-	0.90	1.167	1.69		
Treated Water	Calcium	mg/L		10	10	-	16.12	22.285	30.42		
Treated Water	Magnesium	mg/L		10	10	-	4.33	6.741	10.16		
Treated	Hydrogen	mg/L		6	0	-	0	0	0		

Component	Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	Average	Max	LOR	Laboratory
Water											
Treated Water	Alkalinity	mg/L		8	8	-	52.18	76.328	97.54		
Treated Water	Residual Alkalinity	meq/L		8	0	-	<0.1	<0.1	<0.1	0.1	
Treated Water	Silica	mg/L		6	6	0	9.10	10.683	13.20		
Treated Water	THMs	µg/L		10	10	0	23	51.2	82		
Treated Water	Algal Toxins										
Treated Water	Dissolved Oxygen	% Sat.		4	4	1 (Aesthetic)	9.56	73.118	97.60		
Treated Water	Ammonia	mg/L		4	0	0	<0.01	<0.01	<0.01	0.01	
Treated Water	Fluoride	mg/L		7	7	0	0.06	0.07	0.09		
Treated Water	Pesticides										
Treated Water	Arsenic	µg/L		Quarterly	1	0	0	<1	<1	<1	1
Treated Water	Selenium	µg/L	1		0	0	<1	<1	<1	1	
Treated Water	Lead	µg/L	Quarterly	1	0	0	<1	<1	<1	1	
Treated Water	Mercury	µg/L		1	0	0	<0.05	<0.05	<0.05	0.05	
Treated Water	Cadmium	mg/L		1	0	0	<0.002	<0.002	<0.002	0.002	
Treated Water	Chromium	mg/L		1	0	0	<0.01	<0.01	<0.01	0.01	
Treated Water	Nickel	mg/L		1	0	0	<0.03	<0.03	<0.03	0.03	
Treated Water	Zinc	mg/L		1	0	0	<0.005	<0.005	<0.005	0.005	

Component	Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	Average	Max	LOR	Laboratory
Treated Water	Copper	mg/L		1	0	0	<0.015	<0.015	<0.015	0.015	
Treated Water	Hydrogen Sulphide	mg/L		1	0	0	<0.005	<0.005	<0.005	0.005	
Treated Water	Radionuclides		Annually								
Treated Water	Tin										
Treated Water	Silver										
Treated Water	Beryllium										
Treated Water	Uranium										
Treated Water	Iodide										
Treated Water	Molybdenum										
Treated Water	Boron										
Treated Water	Barium										

Middlemount WTP

Component	Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	Average	Max	LOR	Laboratory
Treated Water	E. coli	MPN/100mL	Weekly	53	0	0	<1	<1	<1	1	MRC
Treated Water	Free Chlorine Residual	mg/L	Daily Weekly	311 53	311 52	0 0	0.79 1.15	2.248 2.171	4.74 3.06		Inhouse MRC
Treated Water	Turbidity	NTU	Weekly	34	34	3 (Health)	0.16	0.509	1.79		MRC
Treated Water	pH	-		53	53	1 (Aesthetic)	6.97	7.60	8.53		
Treated Water	Iron	mg/L		52	0	0	<0.007	<0.007	<0.007	0.007	
Treated Water	Manganese	mg/L		52	4	0	<0.004	0.001	0.01	0.004	
Treated Water	Total Dissolved Solids (TDS)	mg/L		27	27	0	227	262.222	368		
Treated Water	Conductivity	µS/cm		27	27	-	379	437.185	614		
Treated Water	True Colour	TCU		11	8	0	<1	1.818	6	1	
Treated Water	Total Hardness	mg/L		12	12	-	59.77	99.583	142.31		
Treated Water	Temporary Hardness	mg/L	12	12	-	57.10	96.483	131.40			
Treated Water	Sodium	mg/L	Monthly	6	6	0	38.73	45.563	55.37		
Treated Water	Potassium	mg/L		6	4	-	1.69	2.792	6.28		
Treated Water	Calcium	mg/L		12	12	-	13.53	21.954	34.61		
Treated Water	Magnesium	mg/L		12	12	-	6.31	10.870	15.76		
Treated Water	Hydrogen	mg/L		6	0	-	0	0	0		
Treated	Alkalinity	mg/L		10	10	-	57.08	100.426	131.42		

Component	Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	Average	Max	LOR	Laboratory
Water											
Treated Water	Residual Alkalinity	meq/L		9	0	-	<0.1	<0.1	<0.1	0.1	
Treated Water	Silica	mg/L		6	6	0	14.90	15.633	16.90		
Treated Water	THMs	µg/L		12	11	0	23	110.667	182		
Treated Water	Algal Toxins										
Treated Water	Dissolved Oxygen	% Sat.		6	6	2 (Aesthetic)	82.30	88.967	96		
Treated Water	Fluoride	mg/L		6	6	0	0.10	0.138	0.17		
Treated Water	Ammonia	mg/L		6	0	0	<0.01	<0.01	<0.01	0.01	

Component	Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	Average	Max	LOR	Laboratory
Treated Water	Arsenic	µg/L	Quarterly	3	1	0	<1	<1	1.05	1	
Treated Water	Selenium	µg/L		3	0	0	<1	<1	<1	1	
Treated Water	Lead	µg/L		3	0	0	<1	<1	<1	1	
Treated Water	Mercury	µg/L		3	1	0	<1	0.183	0.55	1	
Treated Water	Cadmium	mg/L		3	0	0	<0.002	<0.002	<0.002	0.002	
Treated Water	Chromium	mg/L		3	0	0	<0.01	<0.01	<0.01	0.01	
Treated Water	Nickel	mg/L		3	0	0	<0.03	<0.03	<0.03	0.03	
Treated Water	Zinc	mg/L		3	0	0	<0.005	<0.005	<0.005	0.005	
Treated Water	Copper	mg/L		3	0	0	<0.007	<0.007	<0.007	0.007	
Treated Water	Hydrogen Sulphide	mg/L		2	0	0	<0.005	<0.005	<0.005	0.005	
Treated Water	Radionuclides										
Treated Water	Pesticides										
Treated Water	Tin		Annually								
Treated Water	Silver										
Treated Water	Beryllium										
Treated Water	Uranium										
Treated Water	Iodide										
Treated Water	Molybdenum										

Component	Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	Average	Max	LOR	Laboratory
Water											
Treated Water	Boron										
Treated Water	Barium										

Drinking water scheme: MIDDLEMOUNT

<i>Year</i>	<i>2015 - 2016</i>											
<i>Month</i>	<i>July</i>	<i>Aug</i>	<i>Sept</i>	<i>Oct</i>	<i>Nov</i>	<i>Dec</i>	<i>Jan</i>	<i>Feb</i>	<i>Mar</i>	<i>Apr</i>	<i>May</i>	<i>June</i>
No. of samples collected	8	8	8	6	8	10	8	6	10	8	10	8
No. of samples collected in which E. coli is detected (i.e. a failure)	0	0	0	0	0	0	0	0	0	0	0	0
No. of samples collected in previous 12 month period	99	101	103	102	104	86	86	88	92	92	96	98
No. of failures for previous 12 month period	0	0	0	0	0	0	0	0	0	0	0	0
% of samples that comply	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Compliance with 98% annual value	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Moranbah WTP

Component	Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	Average	Max	LOR	Laboratory
Treated Water	E. coli	MPN/100mL	Weekly	52	0	0	<1	<1	<1	1	MRC
Treated Water	Free Chlorine Residual	mg/L	Daily Weekly	366 51	366 51	0 0	0.76 0.55	1.771 1.7	2.82 2.63		Inhouse MRC
Treated Water	Turbidity	NTU	Weekly	32	32	3 (Health)	0.26	0.764	4.10		MRC
Treated Water	pH	-		51	51	0	6.86	7.522	8.01		
Treated Water	Aluminium	mg/L									
Treated Water	Iron	mg/L		52	3	0	<0.007	<0.007	0.01	0.007	
Treated Water	Manganese	mg/L		52	1	0	<0.004	<0.004	0.01	0.004	
Treated Water	Total Dissolved Solids (TDS)	mg/L		27	27	0	136	154.37	181		
Treated Water	Conductivity	µS/cm		28	28	-	226	257.107	301		
Treated Water	True Colour	TCU		12	8	0	<1	1.667	7	1	
Treated Water	Total Hardness	mg/L		12	12	-	58.88	76.142	92.69		
Treated Water	Temporary Hardness	mg/L	12	12	-	49.70	80.717	100.80			
Treated Water	Sodium	mg/L	Monthly	7	7	0	20.50	23.271	26.43		
Treated Water	Potassium	mg/L		7	6	-	2.87	3.316	4.72		
Treated Water	Calcium	mg/L		12	12	-	13.52	16.522	21		
Treated Water	Magnesium	mg/L		12	12	-	6.10	8.472	11.14		
Treated	Hydrogen	mg/L		7	0	-	0	0	0		

Component	Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	Average	Max	LOR	Laboratory
Water											
Treated Water	Alkalinity	mg/L		10	10	-	49.70	82.256	100.8		
Treated Water	Residual Alkalinity	meq/L		9	0	-	<0.1	<0.1	<0.1	0.1	
Treated Water	Silica	mg/L		7	7	0	11.60	13.057	14.50		
Treated Water	THMs	µg/L		12	11	0	14	54.417	106		
Treated Water	Algal Toxins										
Treated Water	Dissolved Oxygen	% Sat.		6	6	0	88.60	94.783	104.30		
Treated Water	Fluoride	mg/L		32	32	0	0.33	0.596	0.90		
Treated Water	Ammonia	mg/L		6	0	0	<0.01	<0.01	<0.01	0.01	
Treated Water	Arsenic	µg/L		Quarterly	3	1	0	<1	<1	1.24	1
Treated Water	Selenium	µg/L	3		0	0	<1	<1	<1	1	
Treated Water	Lead	µg/L	3		0	0	<1	<1	<1	1	
Treated Water	Mercury	µg/L	Quarterly	3	0	0	<1	<1	0.19	1	
Treated Water	Cadmium	mg/L		3	0	0	<0.002	<0.002	<0.002	0.002	
Treated Water	Chromium	mg/L		3	0	0	<0.01	<0.01	<0.01	0.01	
Treated Water	Nickel	mg/L		3	0	0	<0.03	<0.03	<0.03	0.03	
Treated Water	Zinc	mg/L		3	2	0	<0.005	0.006	0.01	0.005	
Treated Water	Copper	mg/L		3	0	0	<0.015	<0.015	<0.015	0.015	

Component	Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	Average	Max	LOR	Laboratory	
Treated Water	Hydrogen Sulphide	mg/L	Annually	3	1	0	<0.005	0.002	0.01	0.005		
Treated Water	Radionuclides											
Treated Water	Pesticides											
Treated Water	Tin											
Treated Water	Silver											
Treated Water	Beryllium											
Treated Water	Uranium											
Treated Water	Iodide											
Treated Water	Molybdenum											
Treated Water	Boron											
Treated Water	Barium											

Drinking water scheme: MORANBAH

<i>Year</i>	<i>2015 - 2016</i>											
<i>Month</i>	<i>July</i>	<i>Aug</i>	<i>Sept</i>	<i>Oct</i>	<i>Nov</i>	<i>Dec</i>	<i>Jan</i>	<i>Feb</i>	<i>Mar</i>	<i>Apr</i>	<i>May</i>	<i>June</i>
No. of samples collected	12	14	12	12	12	12	12	12	10	12	12	12
No. of samples collected in which E. coli is detected (i.e. a failure)	0	0	0	0	0	0	0	0	0	0	0	0
No. of samples collected in previous 12 month period	144	146	148	148	148	148	148	148	144	144	146	144
No. of failures for previous 12 month period	0	0	0	0	0	0	0	0	0	0	0	0
% of samples that comply	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Compliance with 98% annual value	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Nebo System

Component	Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	Average	Max	LOR	Laboratory
Treated Water	E. coli	MPN/100mL	Weekly	53	0	0	<1	<1	<1	1	MRC
Treated Water	Free Chlorine Residual	mg/L	Daily Weekly	366 54	366 53	0 0	0.01 0.02	0.688 0.675	1.64 1.66		Inhouse MRC
Treated Water	Turbidity	NTU	Weekly	32	28	0	<0.1	0.269	0.59	0.1	MRC
Treated Water	pH	-		53	53	0	6.80	6.98	7.25		
Treated Water	Total Dissolved Solids (TDS)	mg/L		52	52	13 (Aesthetic)	123	506	754		
Treated Water	Conductivity	µS/cm		53	53	-	205	843	1256		
Treated Water	True Colour	TCU	Monthly	11	1	0	<1	<1	1	1	MRC
Treated Water	Total Hardness	mg/L		11	11	-	134	271	411		
Treated Water	Temporary Hardness	mg/L		11	11	-	11.8	165	210		
Treated Water	Sodium	mg/L		6	6	0	37.3	73.5	98.6		
Treated Water	Potassium	mg/L		6	3	-	<1	0.459	1.19	1	
Treated Water	Calcium	mg/L		11	11	-	28.9	56.1	83.3		
Treated Water	Magnesium	mg/L		11	11	-	14.9	31.9	49.4		
Treated Water	Hydrogen	mg/L		6	0	-	0	0	0		
Treated Water	Alkalinity	mg/L		9	9	-	112	166	210		
Treated Water	Residual Alkalinity	meq/L		7	0	-	<0.1	<0.1	<0.1	0.1	
Treated	Silica	mg/L		6	6	0	33.10	36.967	40.40		

Component	Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	Average	Max	LOR	Laboratory
Water											
Treated Water	THMs	µg/L		11	5	0	<5	21.091	207	5	
Treated Water	Dissolved Oxygen	% Sat.		5	5	5 (Aesthetic)	55.60	65.482	80.50		
Treated Water	Fluoride	mg/L		6	6	0	0.11	0.138	0.16		
Treated Water	Arsenic	µg/L	Quarterly	3	0	0	<1	<1	<1	1	
Treated Water	Selenium	µg/L		3	0	0	<1	<1	<1	1	
Treated Water	Lead	µg/L		3	0	0	<1	<1	<1	1	
Treated Water	Mercury	µg/L		2	0	0	<0.05	<0.05	<0.05	0.05	
Treated Water	Ammonia	mg/L		5	0	0	<0.01	<0.01	<0.01	0.01	
Treated Water	Cadmium	mg/L		3	0	0	<0.002	<0.002	<0.002	0.002	
Treated Water	Chromium	mg/L		3	0	0	<0.01	<0.01	<0.01	0.01	
Treated Water	Nickel	mg/L		3	0	0	<0.03	<0.03	<0.03	0.03	
Treated Water	Zinc	mg/L		3	1	0	<0.005	<0.005	0.01	0.005	
Treated Water	Copper	mg/L	Quarterly	3	1	0	<0.015	<0.015	0.02	0.015	
Treated Water	Hydrogen Sulphide	mg/L		3	0	0	<0.005	<0.005	<0.005	0.005	
Treated Water	Radionuclides										
Treated Water	Iron	mg/L	Annually	1	0	0	<0.007	<0.007	<0.007		
Treated Water	Manganese	mg/L		1	0	0	<0.004	<0.004	<0.004		

Component	Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	Average	Max	LOR	Laboratory
Treated Water	Tin										
Treated Water	Silver										
Treated Water	Beryllium										
Treated Water	Uranium										
Treated Water	Iodide										
Treated Water	Molybdenum										
Treated Water	Boron										
Treated Water	Barium										

Drinking water scheme: NEBO

<i>Year</i>	<i>2015 - 2016</i>											
<i>Month</i>	<i>July</i>	<i>Aug</i>	<i>Sept</i>	<i>Oct</i>	<i>Nov</i>	<i>Dec</i>	<i>Jan</i>	<i>Feb</i>	<i>Mar</i>	<i>Apr</i>	<i>May</i>	<i>June</i>
No. of samples collected	13	13	16	13	15	3	1	0	1	1	1	1
No. of samples collected in which E. coli is detected (i.e. a failure)	0	1	0	0	0	0	0	0	0	0	0	0
No. of samples collected in previous 12 month period	83	92	107	120	134	136	135	132	115	100	87	78
No. of failures for previous 12 month period	0	1	1	1	1	1	1	1	1	1	1	1
% of samples that comply	100.0%	98.9%	99.1%	99.2%	99.3%	99.3%	99.3%	99.2%	99.1%	99.0%	98.9%	98.7%
Compliance with 98% annual value	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

St Lawrence WTP

Component	Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	Average	Max	LOR	Laboratory
Treated Water	E. coli	MPN/100mL	Weekly	51	0	0	<1	<1	<1	1	MRC
Treated Water	Free Chlorine Residual	mg/L	Daily Weekly	292 50	292 50	0 0	1 0.50	2.298 1.468	3 2.10		Inhouse MRC
Treated Water	Turbidity	NTU	Weekly	30	30	0	0.11	0.318	0.75		MRC
Treated Water	pH	-		50	50	0	7	7.425	7.75		
Treated Water	Aluminium	mg/L		51	9	0	<0.07	0.018	0.20	0.07	
Treated Water	Iron	mg/L		51	5	0	<0.007	<0.007	0.08	0.007	
Treated Water	Manganese	mg/L		51	7	3 (Aesthetic)	<0.004	0.02	0.5	0.004	
Treated Water	Total Dissolved Solids (TDS)	mg/L		51	51	0	100	160.216	252		
Treated Water	Conductivity	µS/cm		51	51	-	167	267.141	420		
Treated Water	True Colour	TCU		9	4	0	<1	1.556	10	1	
Treated Water	Total Hardness	mg/L		9	9	-	33.19	41.144	56.86		
Treated Water	Temporary Hardness	mg/L	9	9	-	45.90	65.433	141.70			
Treated Water	Sodium	mg/L	Monthly	6	6	0	27.94	38.880	70.94		MRC
Treated Water	Potassium	mg/L		6	5	-	1.02	1.150	2.01		
Treated Water	Calcium	mg/L		9	9	-	8.08	10.553	15.12		
Treated Water	Magnesium	mg/L		9	9	-	2.26	3.593	4.73		
Treated Water	Hydrogen	mg/L		6	0	-	0	0	0		

Component	Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	Average	Max	LOR	Laboratory
Water											
Treated Water	Alkalinity	mg/L		8	8	-	46.88	67.888	141.68		
Treated Water	Residual Alkalinity	meq/L		7	0	-	<0.1	<0.1	<0.1	0.1	
Treated Water	Silica	mg/L		6	6	0	11	13.917	16.80		
Treated Water	THMs	µg/L		9	9	0	89	162.778	248		
Treated Water	Fluoride	mg/L		6	6	0	0.03	0.048	0.07		
Treated Water	Dissolved Oxygen	% Sat.		Quarterly	3	3	0	86.6	89.333	91.20	
Treated Water	Arsenic	µg/L	2		0	0	<1	<1	<1	1	
Treated Water	Selenium	µg/L	2		1	1 (Health)	<1	<1	1.32	1	
Treated Water	Lead	µg/L	2		0	0	<1	<1	<1	1	
Treated Water	Mercury	µg/L	2		1	0	<0.05	0.104	0.21	0.05	
Treated Water	Ammonia	mg/L	Quarterly		3	0	0	<0.01	<0.01	<0.01	0.01
Treated Water	Cadmium	mg/L		2	0	0	<0.002	<0.002	<0.002	0.002	
Treated Water	Chromium	mg/L		2	0	0	<0.01	<0.01	<0.01	0.01	
Treated Water	Nickel	mg/L		2	0	0	<0.03	<0.03	<0.03	0.03	
Treated Water	Zinc	mg/L		2	0	0	<0.005	<0.005	<0.005	0.005	
Treated Water	Copper	mg/L		2	0	0	<0.015	<0.015	<0.015	0.015	
Treated Water	Hydrogen Sulphide	mg/L		2	0	0	<0.005	<0.005	<0.005	0.005	

Component	Parameter	Units	Frequency	No. Samples	Detections	Exceedances	Min	Average	Max	LOR	Laboratory
Treated Water	Radionuclides										
Treated Water	Pesticides		Annually								
Treated Water	Tin										
Treated Water	Silver										
Treated Water	Beryllium										
Treated Water	Uranium										
Treated Water	Iodide										
Treated Water	Molybdenum										
Treated Water	Boron										
Treated Water	Barium										

Drinking water scheme: ST LAWRENCE

<i>Year</i>	<i>2015 - 2016</i>											
<i>Month</i>	<i>July</i>	<i>Aug</i>	<i>Sept</i>	<i>Oct</i>	<i>Nov</i>	<i>Dec</i>	<i>Jan</i>	<i>Feb</i>	<i>Mar</i>	<i>Apr</i>	<i>May</i>	<i>June</i>
No. of samples collected	4	4	4	4	4	4	4	4	4	4	4	4
No. of samples collected in which E. coli is detected (i.e. a failure)	0	0	0	0	0	0	0	0	0	0	0	0
No. of samples collected in previous 12 month period	48	48	48	48	48	48	48	48	48	48	48	48
No. of failures for previous 12 month period	0	0	0	0	0	0	0	0	0	0	0	0
% of samples that comply	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Compliance with 98% annual value	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES