

Drinking Water Quality Management Plan

ANNUAL REPORT

2018/2019 (FINANCIAL YEAR)

SPID	506
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Report contains	Activities undertaken over the 2018/2019 financial year in operating Townsville City Council's (TCC) drinking water service. Summary of drinking water quality for Townsville's three drinking water schemes. Summary of TCC's performance in implementing their approved Drinking Water Quality Management Plan (DWQMP).



Ross River Dam 2019

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Abbreviations and Acronyms

Acronym	Definition
ADWG	Australian Drinking Water Guidelines
BWA	Boil Water Advisory
C.t.	Contact time
DBP	Disinfection By-Product
DWS	Drinking Water Scheme
DNRME	Department of Natural Resources, Mines and Energy
DWQMP	Drinking Water Quality Management Plan
FM	Flow Meter
GAC	Granular Activated Carbon
HACCP	Hazard Analysis Critical Control Point
LIMS	Laboratory Information Management System
MIB	2-Methylisoborneol
NWTP	Northern Water Treatment Plant
OS	Owner's Side
PAC	Powdered Activated Carbon
PFAS	Per- and Poly-Fluoroalkyl Substances
PFHxS	Perfluorohexane Sulfonate
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulfonic Acid
SCADA	Supervisory Control and Data Acquisition
SES	State Emergency Services
TCC	Townsville City Council
THM	Trihalomethanes
TLS	Townsville Laboratory Services
T&O	Taste and Odour
WTP	Water Treatment Plant
WQP	Water Quality Program

APPROVALS

In signing this approval:

I agree that the report meets the standards required and approve the report to be submitted to Water Supply Regulation, Department of Natural Resources, Mines and Energy.



Stephen Martin

Team Manager – Water and Wastewater

1. Executive Summary

Townsville City Council's Drinking Water Quality Management Plan (DWQMP) was approved in August 2012. Included in the approval notice was the requirement to submit an annual water quality report to outline the performance of Townsville Water against the DWQMP as required under the *Water Supply (Safety and Reliability) Act 2008*.

Townsville Water has met all requirements under the DWQMP, the Australian Drinking Water Guidelines 2011 (ADWG) and the *Public Health Regulation 2005* for the 2018/2019 financial year.

Overall annual compliance for *Escherichia coli* (*E.coli*) for Townsville, Giru/Cungulla and Paluma drinking water schemes met the *Public Health Regulation 2005*, with 99.84% compliance for all three schemes.

January and February 2019 saw a record-breaking volume of rain fall on Townsville over a fourteen-day period, with over 1.4m of rain falling in parts of Townsville. Some areas saw over 300mm of rain in 24-hour periods. Throughout this unprecedented monsoon event water quality in Townsville, Paluma and Cungulla was not compromised. Chlorine residuals were maintained, Supervisory Control and Data Acquisition (SCADA) was available throughout the period, the Water Treatment Plants (WTP) were optimised and water quality and supply was maintained despite several large water main breaks.

A precautionary boil water advisory (BWA) was in place for Cungulla from 3 February 2019 to 4 February 2019. This was due to mains power failure at Cungulla during the February 2019 unprecedented monsoon event. The onsite generator had low fuel supply left due to the extended period of road closure and power outage. The BWA was put in place as a safeguard in the event Cungulla Reservoir refilled with unchlorinated water. Once power was restored the BWA was lifted. It must be noted that the reservoir did not fill and an adequate chlorine residual was maintained at all times.

Six notifications of non-compliance were submitted to the Office of the Water Supply Regulator (The Regulator):

- 2 disinfection-by-product exceedances,
- 2 *E.coli* detections,
- 1 lead exceedance, and
- 1 precautionary BWA.

There were 111 customer complaints regarding drinking water quality:

- 44 dirty water,
- 9 milky water,
- 29 taste & odour (T&O) (23 2-Methylisoborneol (MIB)),
- 8 suspected illness,
- 20 owner's side (OS) issues, and
- 1 vexatious complaint.

A review of the plan was undertaken in March and April 2019 and submitted to The Regulator on 18 April 2019. The main changes were the inclusion of cybersecurity risks and the setting of a chlorate limit to 0.82mg/L under the advice of Queensland Health.

An audit of Paluma WTP was undertaken in March 2019 as part of this review.

This report is made available to customers at townsville.qld.gov.au, upon request via email to enquiries@townsville.qld.gov.au or inspection upon request at the Customer Service Centre, 103 Walker Street, Townsville City.



Delivery of Cungulla Reservoir, March 2019

2. Overview

Townsville Water is a business unit of Council and is a registered service provider under the *Water Supply (Safety and Reliability) Act 2008*. Townsville Water is responsible for the management of the city's potable water supply network and provision of safe and reliable water to the residents of Townsville, Paluma Township and Cungulla Township. This is achieved through proactive identification and minimisation of public health related risks associated with drinking water.

Council's DWQMP was submitted to The Regulator on 21 June 2011. It was approved with conditions on 29 August 2012. Townsville's first DWQMP Audit was undertaken in July 2016. The plan was reviewed, with significant amendments made in January 2018. The amendments were approved with conditions on 23 April 2018. The plan is reviewed every two years, with an external audit being undertaken every four years.

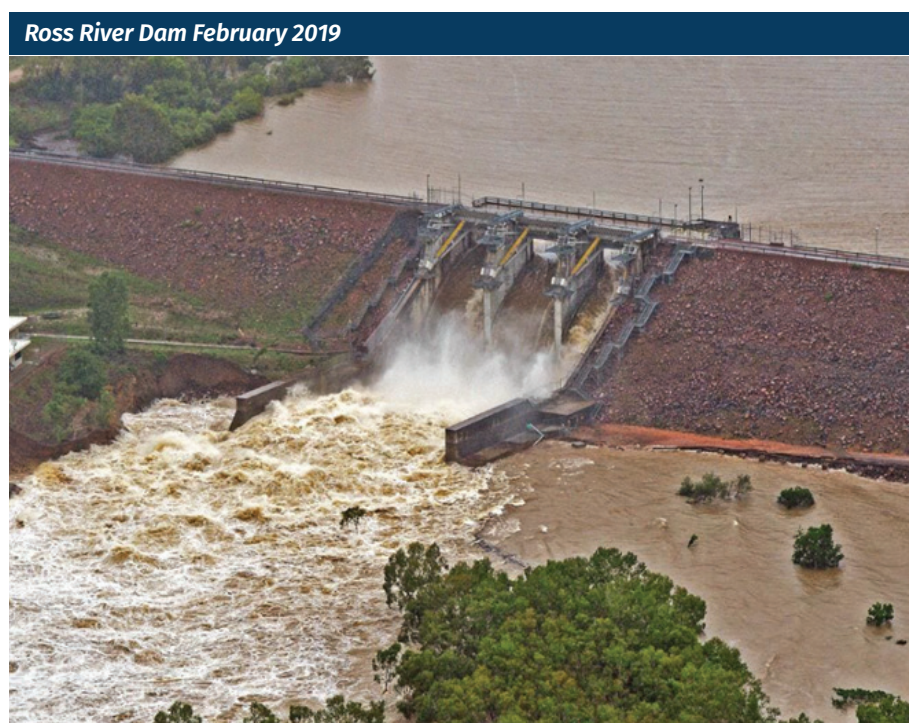
Townsville Water services a population of approximately 194,072 people, with 85,952 connected properties in three drinking water schemes: Townsville Drinking Water Scheme, Paluma Drinking Water Scheme and Giru/Cungulla Drinking Water Scheme.

Table 1. Summary of Townsville's Drinking Water Schemes

Scheme Name	Water Treatment Plant	Water Source	Treatment Processes	Treatment Capacity	Towns Supplied
Townsville Drinking Water Scheme	Douglas Water Treatment Plant (Angus Smith Drive)	Ross River Dam (with water supplemented from the Burdekin Dam through the Haughton Pipeline when required)	Conventional treatment with chlorine disinfection	232 ML/D	Townsville
Townsville Drinking Water Scheme	Northern Water Treatment Plant (Kinduro)	Paluma Dam Crystal Creek	Microfiltration with chlorine disinfection	40 ML/D	Townsville
Giru/Cungulla Drinking Water Scheme	Giru Water Treatment Plant	Haughton River	Conventional treatment with chlorine disinfection	2 ML/D	Cungulla township
Paluma Drinking Water Scheme	Paluma Water Treatment Plant	Paluma Weir	Ultrafiltration with UV and chlorine disinfection	90 KL/D	Paluma township

Giru Water Treatment Plant also supplies water to Giru Township through agreement with Burdekin Shire Council. Management of Giru's drinking water quality is covered under Burdekin Shire Council's DWQMP.

46,810ML of potable water was produced in the 2018/2019 financial year. Townsville Water maintains two dams (Ross River Dam and Paluma Dam), two weirs (Paluma Weir and Blacks Weir), 23 water pumping stations, 18 chlorinators, 41 reservoirs (treated water storage facilities) and 2,654 km of water distribution mains.





3. Actions taken to implement the DWQMP

The DWQMP is managed and maintained by the Drinking Water Quality Officer. Both the Water Treatment Engineer and Water Quality Officer's role is to monitor, regulate and improve water quality for Townsville. They deal with all water quality non-compliances, water quality complaints and queries from customers, monitor all Critical Control Points, the water sampling plan and the subsequent data it generates. They are part of a broader Water Quality Team which also includes the Water Operations Engineer, Commercial Compliance Officer, Bulk Water Maintenance Officer and the Water Operators.

Trility are engaged to operate Douglas Water Treatment Plant and Northern Water Treatment Plant under a managed contract with Council. The contract is managed through informal weekly operations meetings, formal monthly operational management team meetings and formal quarterly contract management committee meetings. Any issues arising between these times are dealt with through phone calls, emails, face to face and ad hoc meetings.

The Water Quality Team hold a weekly water quality meeting, with water quality also discussed at weekly planning meetings and at toolbox meetings with staff as required. A water quality governance meeting is held with management every two months and is chaired by the General Manager Townsville Water and Waste.

Water quality presentations were delivered to Council's outdoor workforce in "Toolbox Talks".

Ten staff members have started the Water Industry Worker Program. The Water Industry Worker Program was developed in partnership with QldWater, government, industry and training providers to help retain skilled staff and improve future opportunities for workers through industry specific training. The program is focussed on the formal recognition of skills and training employees within the construction and maintenance field in the water industry. A large component of this training is drinking water quality and the role of the worker in maintaining safe supply as a public health requirement of their role. It is envisaged that this program will be rolled out to all water maintenance employees.

The risk management improvement program implementation plan is included in Table 2 overpage.

Table 2. Risk management improvement program implementation status

Scheme Name	Component	Improvement Actions	Target Date	Status and revised target date	Responsible Officer	Complete
TOWNSVILLE DRINKING WATER SCHEME (DWS)	Douglas WTP Turbidity (Common and Modules 1 &2)	Pre-Treatment Clarifier – Confirm the design envelope for the clarifiers and ensure that this is utilised.	Design in 2017/18 financial year with construct in 2019/20 financial year.	End 2020/21 financial year for design	Manager Water and Waste	December 2022
		Sludge Handling – Confirm the amount of time available to ‘stop’ recycle to ensure that criticality is appropriate for the supernatant recycle system.	July 2019	December 2019	Trility Operations Manager	Scenario sheet developed and several case studies available. Summary to be submitted to Council
		Reservoirs – The reservoir cleaning program has stalled, for a number of reasons, but should be re-instated and prioritised.		January 2019	Water Treatment Engineer and Drinking Water Quality Officer	
		Data is required to be assembled and reviewed to validate that the reactivator has been optimised.	December 2018	June 2020 Summary of performance data and activities to be submitted June 2020.	Trility Operations Manager	WQP under review
	Douglas WTP Turbidity Modules 3&4 Direct Filtration	Pre-Treatment and Filtration – Performance trials are planned to confirm the raw water range under which the system can operate to produce safe water.	Aim to complete further trials in 2020, subject to suitable raw water conditions.	Aim to complete further trials in 2020, subject to suitable raw water conditions. Data from February monsoon event to be reviewed by June 2020	Water Treatment Engineer, Contract Compliance Officer Trility Operations Manager	Existing data from February monsoon event period to be reviewed by June 2020
	Douglas WTP Pathogens - Crypto	Modelling is being undertaken to help clarify the likelihood of the presence of Crypto. and Giardia in 2017. This is to be used to increase certainty.		February 2018	Drinking Water Quality Officer	Completed
		Filtration - Compare performance against ADWG value of 0.20 and Health Based Targets guideline of 0.15NTU as 95 percentiles. Contract uses higher turbidity targets.		February 2018	Drinking Water Quality Officer	Completed
		Sludge Handling - Confirm the control around returning supernatant, including turbidity target.		Complete 20 November 2018	Trility – Operations Support Engineer	Completed
	Douglas WTP Pathogens – <i>E.coli</i> and Virus	Disinfection point Chlorination - Complete tracer testing to confirm modelling of Contact time (C.t.)		December 2018	Trility Operations Manager	Completed
		Review Disinfection Control Plan to make sure that control philosophy is locked in and that there is no opportunity to control in a way that would jeopardise the C.t.		Online C.t. calculation planned early 2019.	Trility Operations Manager	Completed

Scheme Name	Component	Improvement Actions	Target Date	Status and revised target date	Responsible Officer	Complete
TOWNSVILLE DWS	Pathogens – <i>Naegleria fowleri</i> (<i>N.fowleri</i>)	Investigate and confirm the response of <i>N.fowleri</i> to settling. Pipes/reservoirs - Need to investigate the prevalence of <i>N.fowleri</i> . Pipes/reservoirs - High and low turnover - Investigate options to increase the chlorine residual above 0.5 mg/L (reservoirs, lines, dead ends) to ensure effective barrier to <i>N.fowleri</i> .		June 2019	Drinking Water Quality Officer	Complete (Further sampling occurring summer of 19/20)
	Organics and colour	Pipes/reservoirs – Documentation of system 'age' optimisation is required to ensure continuity. Currently this is primarily undertaken by one person.		June 2019	Water Treatment Engineer	
	High Chlorine	Investigate Julago system cut-off to ensure that it minimises the risk of over-dosing chlorine.		June 2019	Water Treatment Engineer	
	Water Emergency Response Plan	Updated copy to be included in DWQMP.	January 2019	January 2019	Manager Water Operations	Completed
	Hazard Analysis Critical Control Point (HACCP)	Requires updating (last updated 2009). This will be included in Trility's Water quality plans due to be finalised 2018.	December 2019	June 2020	Trility - Operations Manager	
	Chlorates in Network	Investigate replacing Sodium Hypochlorite dosing system with a chlorine gas dosing system.	2020	Designs are currently being completed. Construction due end 2020		
	Network Schematic	Requires updating to include recent infrastructure.	January 2019	January 2019	Drinking Water Quality Officer	
	Crypto Model	Clarification and UV required at Douglas Water Treatment Plant to reduce Cryptosporidium risk.	2020	Designs are currently being completed. Construction due end 2020		
	NWTP Turbidity	Filtration Node – False positives have been identified in the past and an investigation into sample preparation to eliminate false positives is underway.				Ongoing
	Pathogens - Crypto	Modelling is being undertaken to help clarify the likelihood of the presence of Cryptosporidium and Giardia in 2017.			Drinking Water Quality Officer	Completed

Scheme Name	Component	Improvement Actions	Target Date	Status and revised target date	Responsible Officer	Complete
TOWNSVILLE DWS	Pathogens – <i>E.coli</i> and Virus	Confirm virus removal capability of the membrane and whether coagulant is or is not required to claim virus removal with the membranes.		29/11/2018		Completed
		Confirm the C.t (max flow, min level, chlorine minimum (1)) available at the WTP and compare this to the typical target C.t of 15 mg.min/L.	1/2/2019	1/3/2020	Operations Support Engineer	C.t performance of tank analysed. Review including pipework to be conducted
	Geosmin (Taste and Odour)	Consider measuring the level of geosmin in the open channel between Paluma and Crystal Creek intake to confirm the source of geosmin as well as continuing to investigate the source water.		This area is in a steep gorge and inaccessible -parked	Drinking Water Quality Officer	Parked
		Treatment strategies to remove geosmin are to be investigated, including Powdered Activated Carbon (PAC) dosing even though this was noted as having a negative impact on membrane performance/life.	End 2020	End 2021 Project underway investigating PAC dosing and UV for NWTP	Team Manager Water and Wastewater	
	Iron	Confirm iron results in raw and treated water. There is a discrepancy between the numbers in the raw (soluble) and the performance of the membranes. Essentially all of the soluble should pass through the membranes but the monitoring suggests that the membranes are pulling out 'soluble' iron. This could mean that the iron is colloidal and not 'true' soluble. Include event-based monitoring to investigate iron spikes in the raw water.	June 2020			
	HACCP	Requires updating (last updated 2009). This will be included in Trility's Water Quality Plans due to be finalised 2018.		June 2020		WQP under review
	Crypto Model	UV may be required for NWTP. This requires investigating and funding if required.	June 2020	Designs have been completed. Will present for approval to include in the 2020/21 Capital Program	Manager Water and Wastewater	

Scheme Name	Component	Improvement Actions	Target Date	Status and revised target date	Responsible Officer	Complete
GIRU/CUNGULLA DWS	Turbidity	Incorporate routine supernatant monitoring to add certainty to the performance of residuals handling.	June 2019	Online Turbidity Analyser installed. Available on SCADA.	Water Treatment Engineer	Completed
		Coagulation Control needs to be documented to ensure that everyone is targeting the same thing.	January 2019	Diary notes kept. Jar test to target the best flocculation. With dose changed accordingly	Water Treatment Engineer	Completed
		Confirm the correct location for the filtered water outlet turbidity meter (individual filter turbidity (IFT) is the benchmark).	December 2018	Installed. 1. Below filter media. 2. Return to service water line.	Drinking Water Quality Officer	Completed
		Align filter turbidity target, alert and critical limits with ADWG and best practice.	June 2019	Complete. SCADA. Alarms at 0.3NTU, Max 1	Water Treatment Engineer	Completed
		Supernatant flows monitored, not yet alarmed or online. Opportunity to include allowing for early detection of failure, disturbance, particularly when the wash-water system is stressed.		Susceptible to air and sand during backwash. Do not want alarm every time backwash occurs as this will result in nuisance alarms		Completed
	Pathogens - Cryptosporidium	Operational Control Point (OCP) required to be documented and put into practice to assist in management of supernatant return.	March 2019		Water Treatment Engineer	
		High level tank is a risk, budget allocated for tank replacement and action should be pursued. Pressure pumps to be utilised in the interim.	June 2019	June 2019	Bulk Water Engineer	
	Pathogens – E. coli and Virus	Free chlorine analyser to be installed and alarming incorporated into the system control.	June 2018	April 2019	Water Treatment Engineer	Completed
	Pathogens – <i>N.fowleri</i>	As per <i>E.coli</i> , move towards an online continuous free chlorine analyser to confirm that chlorine has been dosed and a C.t has been achieved and a minimum of 0.5 mg/L free chlorine is maintained leaving the WTP.			Water Treatment Engineer	Completed
		Need to investigate the prevalence of <i>N.fowleri</i> .	Testing for <i>N.fowleri</i> began summer 2018/19 with further sampling to occur summer 2019/20. Risk managed as if it is present		Drinking Water Quality Officer	Ongoing
		Investigate options to increase the chlorine residual above 0.5 mg/L (reservoirs, Cungulla Balance Tank, lines and dead ends).			Drinking Water Quality Officer	

Scheme Name	Component	Improvement Actions	Target Date	Status and revised target date	Responsible Officer	Complete
GIRU/CUNGULLA DWS	Organics and Colour	Suggest that measuring true colour of filtered water on jar testing will assist in managing coagulation (helps to identify the 'best' dosing regimen).	Parked	June 2019	Water Treatment Engineer	
	Verification of Drinking Water Quality	Undertake project to acquire handheld devices and store all water quality results in Laboratory Information System (LIMS).	September 2019	Project with Laboratory being undertaken for all data to be stored in LIMS September 2020	Bulk Water Engineer Drinking Water Quality Officer/ Water Treatment Engineer	
	Water Emergency Response Plan	Updated copy to be included in DWQMP.	January 2019			
	Development of algae/algal toxin Trigger Scenarios	Procedure for detection of algae/algal toxins requires to be developed. This is not of high risk as algal blooms have not been detected in the Haughton River supply but a procedure should still be in place.	December 2019	Procedure has been drafted with Trility which will be used to draft procedure for Giru WTP June 2020	Drinking Water Quality Officer	
PALUMA DWS	Pathogens – <i>N.fowleri</i>	Need to investigate the prevalence of <i>N.fowleri</i> to better understand the risk.		June 2019	Drinking Water Quality Officer	Ongoing to ensure adequate data is obtained in order to determine risk adequately
	Organics and Colour	Continue to monitor after WTP operational to confirm reduction in organics and Trihalomethanes (THMs).	September 2018	Ongoing. Data collected weekly so trends can be analysed specially after rain.	Drinking Water Quality Officer	Ongoing

Drinking Water Quality Audit Opportunities for Improvement

Scheme Name	Component	Opportunity for Improvement	Target Date	Actions taken to date	Status and revised target date	Responsible Officer	Complete
All	Spare Parts	Council staff had ensured that majority of parts, and particularly the more sensitive parts, were retained indoor and undercover. However, some large pipes and fittings remained exposed outdoors. Council should consider looking to store all potentially vulnerable parts that may form part of the drinking supply network undercover.	October 2019	Project required to move spare parts to Douglas WTP and secure capital expenditure to cover all large pipes and fittings. Work being undertaken currently to cap all large pipes.	December 2020	Bulk Water Engineer	Completed

4. Research Activities

Per- and poly-fluoroalkyl Sampling

Perfluorooctane sulfonic acid (PFOS), perfluorooctanoic acid (PFOA) and perfluorohexane sulfonate (PFHxS) are part of a family of manufactured compounds called per- and poly-fluoroalkyl substances (PFAS). These compounds have been used in a range of common household products and specialty applications, including the manufacture of non-stick cookware, carpet and furniture stain protection, food packaging and some types of fire-fighting foams. Due to their stability they do not break down in the environment and can persist for a long time.

Sampling for PFAS was undertaken at 15 sample sites across the network during the months of February, March and April 2019, covering raw water, water treatment plants, transmission and reticulation. Of the 30 samples collected, PFAS and PFOA were not detected at any site. All results were made available to Queensland Health and a copy is attached in Appendix A. PFAS/PFOA testing will occur on Townsville's raw water sources twice a year in April and October.

Analysis of *Naegleria fowleri* in a Tropical Distribution Network

Naegleria fowleri is a free-living thermophilic amoeba which, when inhaled through the nasal passages, may cause an infection resulting in the inflammation and destruction of brain tissue. Any freshwater body that seasonally exceeds 30°C or continually exceeds 25°C can support the growth of *N. fowleri*. Over twenty years of water monitoring data in Townsville shows that water temperatures >25°C can occur for long periods of time and temperatures can exceed 30°C in the summer months.

A monitoring program has been put in place to determine if *N. fowleri* is present in Townsville's drinking water supply. Sections of the supply network where *N. fowleri* is most likely to be present are monitored for thermophilic amoeba.

Results from 49 samples taken throughout the water distribution network in the summer of 2018/19 did not detect *N. fowleri*.

Even though *N. fowleri* was not detected the risk will continue to be managed and further sampling will be undertaken in the summer months of 2019/20 to help further quantify the risk.



5. Information supplied to the regulator regarding non-compliances and prescribed incidents

There were six non-compliances with water quality criteria reported for the 2018/19 financial year, with a precautionary boil water advisory issued to Cungulla Township during the February 2019 unprecedented monsoon event.

Table 3. Incidents reported to the Regulator

Incident Date and Number	Water Scheme and Location	Parameter and Issue	Corrective and Preventative Actions
9/01/2019 DWI-7-506-00059	Townsville Drinking Water Scheme	<i>E.coli</i> , 2 orgs/100ml	The laboratory was unsure if this was a valid <i>E.coli</i> detection. It was decided to err on the side of caution, report to The Regulator and investigate it as if it were. Chlorine residual was 1.46mg/L. Resample detected no <i>E.coli</i> . The chlorinator was working correctly with no airlocks. All chlorine residuals for the week previous were >1.4mg/L. It was determined that the <i>E.coli</i> was not a positive detect.
17/01/2019 DWI-7-506-00060	Paluma Drinking Water Scheme	<i>E.coli</i> , 3 org/ 100ml	Free chlorine was 0.7mg/L, turbidity was 0.4NTU and pH was 7. Reservoir integrity was good. WTP was working adequately with steady chlorine residual of ~1mg/L. No <i>E.coli</i> were detected in two other samples from the same day. Sample point was a house sample point, which may have caused sampling error. Sample point has been changed to a Ned Kelly. No further detections at this point or in Paluma has occurred to date.
18/01/2019 DWI-7-506-00061	Townsville Drinking Water Scheme Balgall Beach, Toolakea.	Lead, 0.013 and 0.012 mg/L	No lead detections elsewhere in the system or at the WTP on this date or in previous weeks. It was determined that this was a localised issue at the two sample taps. Resample did not detect lead and previous samples at these points had not detected lead. Sample points were replaced with dedicated Ned Kelly sample points and lead has not been detected since.
17/1/2019 DWI-7-506-00062	Paluma Drinking Water Scheme	THMs, 293, 290, 371 µg/L	Low water usage resulted in the reservoir level being too high and due to increased water age there was more time for THM formation to occur. There was low water use due to high rainfall. Reservoir level was reduced and fresh water added. This reduced THM concentration in the water. Work has since been carried out on the GAC with more frequent backwashing occurring. THM formation potential pre and post GAC is monitored closely.
04/02/2019 DWI-7-506-00063	Cungulla Drinking Water Scheme	Precautionary BWA	Mains power failure at Cungulla due to February 2019 unprecedented monsoon event. Generator had low fuel supply left due to extended period of road closure and power outage. The BWA was put in place in case the reservoir filled quickly due to water mains breaks, with unchlorinated water entering the reservoir. However, this did not occur, and chlorine residual did not drop below 1.1mg/L. Once power was restored the BWA was lifted. Extra fuel will be stored in the SES shed if power is lost for extended periods again.
15/05/2019 DWI-7-506-00064	Townsville Drinking Water Scheme Roseneath	Chlorates, 940 µg/L	Localised incident as chlorates at all other sites were low. Hypochlorite stock was replaced at Roseneath Reservoir and resamples returned chlorate concentration of at 0.559 µg/L and 0.320µg/L. Readvised staff of the requirement to monitor stock appropriately and replace before stock becomes old and decays, even if it means replacing it before it has been used up.
14/06/2019 DWI-7-506-00065	Paluma Drinking Water Scheme	Lead, 0.01mg/L	This was a new sample point and, upon discussion with Townsville Public Health, it was decided to monitor the sample point further rather than installing a new sample point. Twelve further samples have not detected lead and the original result is believed to be erroneous.

6. Compliance with water quality criteria for drinking water

Townsville Water has a comprehensive sampling regime “from catchment to tap” which covers raw water supply, water treatment and water distribution. Over 100,000 tests are taken over the year for various parameters including but not limited to chlorine, pH, turbidity, alkalinity, metals, chemical, pesticides and microbiological. Two new sample parameters were included in the sampling regime this year; PFAS (PFOS/PFOA) which will be sampled for twice a year and *N.fowleri* which will be sampled for in the summer months.

Treated water samples are taken from dedicated sample points in Council owned parks and open spaces. These sample points are housed in secure vandal-proof casings.

All samples are taken and analysed by Townsville Laboratory Services (TLS) which is National Association of Testing Authorities accredited. Results are emailed to the Water Quality Team once they are verified and finalised by TLS. The Water Quality Team also have access to LIMS to obtain results as required. All results above ADWG limits are called through immediately to the Water Quality Officer (Water Treatment Engineer if Water Quality Officer is not available). Exceedance reports can be generated as required. All water quality data is monitored, and trends are analysed throughout the year by the Water Quality Officer.

Townsville Water has been largely compliant with the water quality criteria for the financial year, having six water quality incidents and a precautionary BWA at Cungulla Township, as outlined in Table 3.

Two reportable incidents were due to disinfection by-products (DBP) above the ADWG limit. Water restrictions mean greater management of the system is required with regards to maintaining chlorine residuals to the network endpoints. The system must be managed so that disinfection is not compromised, whilst reducing DBP. The long, hot and dry summer also compounds the issue. With the unprecedented monsoon event in February 2019 and the Ross River Dam filling to 100%, water restrictions were eased back to level 1. The resultant slight increase in water usage improved water quality by increasing turnover and reducing water age. It also enabled Council to reduce chlorine set-points both at the WTPs and at the re-chlorination points. This led to a reduction in number of DBP incidents and how long reportable incidents remained open.

There were two *E.coli* incidents as outlined in Table 3. One was for the Townsville Drinking Water Scheme with a 99.98% compliance rate and one was for the Paluma Drinking Water Scheme with a 99.54% compliance rate. The difference in compliance

rate for one *E.coli* detection is due to the number of samples taken at both locations, with Paluma being a smaller scheme requiring fewer samples, which affects the compliance calculation.

January and February 2019 saw a record-breaking volume of rain fall on Townsville over a fourteen-day period, with over 2m of rain falling in parts of Townsville. Some areas saw over 300mm of rain in 24-hour periods. The high rainfall in combination with releases from Ross River Dam (with three and a half times the volume of the dam released) culminated in an unprecedented monsoon event for the city. Throughout this period water quality in Townsville, Paluma and Cungulla was not compromised. Chlorine residuals were maintained, SCADA was available throughout the period, the WTPs were optimised and water quality and supply was maintained despite several large water main breaks.

Cyanobacteria have been detected in the Ross River Dam and in the raw water feed into Douglas WTP. Whilst this has not resulted in any non-compliance issues as the water treatment process is removing the cells (and the toxins), it has resulted in a greater management of the process, the optimisation of filters and filter chemical dose and ensuring adequate contact time in the clear water storage. Townsville Water has increased sampling both in the dam and at the WTP for algal cell count, algal species and toxins.

There have been no failures to meet sampling frequencies and all locations have been sampled.

Overall annual compliance for *E.coli* for each scheme was in compliance under the *Public Health Regulation 2005* which requires “nil cfu/100ml found in 98% of the samples taken for a 12 month period”.

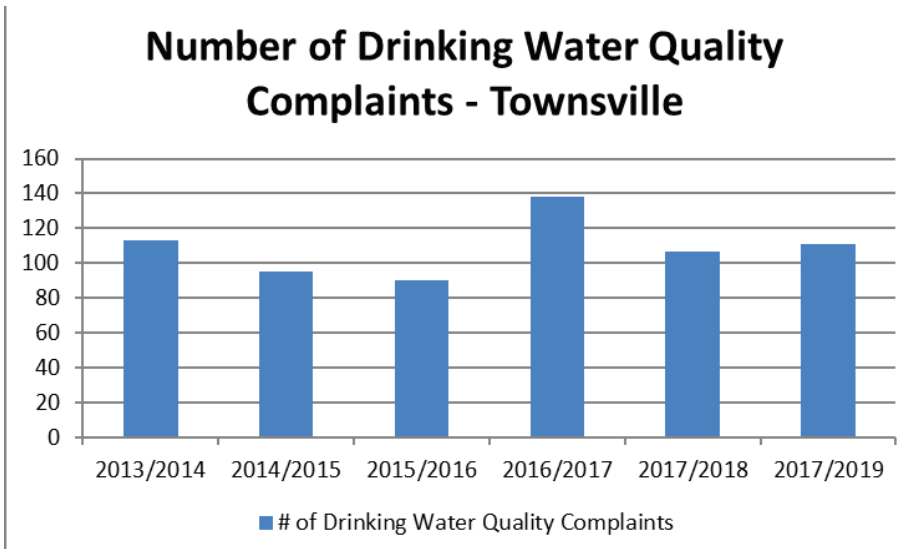
Table 4: E.coli compliance for Townsville Water's drinking water schemes.

Drinking Water Scheme	No. of samples taken	% Annual Compliance
Townsville	3,192	99.98%
Paluma	97	99.54%
Giru/Cungulla	152	100%

Drinking water quality performance (verification monitoring) is included in Appendix A.

7. Details of complaints made to the provider about the drinking water service supplied to customers

All water quality complaints are lodged through Council’s 24-hour Customer Service Centre, with data entered into Property and Rating (TechnologyOne). Each complaint has a unique number which enables the complaint to be followed from start to finish with notes added at each step. There were 111 drinking water quality complaints, similar to the amount received in 2017/18 financial year (107 complaints).



Graph 1: Number of drinking water quality complaints per financial year.

Most water quality complaints by type were relatively static with preceding years. However, this year saw the detection of MIB in suburbs supplied with Douglas WTP water, which has not occurred previously. MIB imparts a distinctive earthy, musty taste to the water. Whilst the water is safe to drink it is unpalatable to many people even in low concentrations (parts per trillions). The event lasted from September 2018 through to November 2018 with some suburbs being affected and others not. Most complaints were from Annandale, Rasmussen and Douglas. Water was flushed to see if it improved the taste and in most cases this was sufficient. Douglas WTP does not have the ability to remove taste and odour and PAC is being investigated as a means to remove MIB if the issue occurs again.

Suspected illness complaints also increased this year from three complaints to eight complaints. This was in large part due to the unprecedented monsoon event, with people concerned that the water may be making them sick as the dam was more turbulent. A phone call to the resident and an explanation of how we treat and test the water served to allay their concerns. Water quality testing was also conducted at the properties, with all samples meeting ADWG and being safe to drink.

Table 5: Number of dirty water complaints by type

Type of Water Quality Complaint	Dirty Water	Milky Water	Taste/ Odour	MIB	Suspected illness/ Customer Concern	FM/OS	Vexatious Customer Complaints
# of complaints	44	9	6	23	8	7 FM 13 OS	1



There are four main types of water quality complaints in Townsville as outlined below:

Dirty Water and Milky Water

Dirty water results when sediments from the bottom of pipes are stirred up due to works occurring in the area such as pipe repairs, water trucks filling from hydrants and construction works with heavy machinery. It can also be caused by changing velocities in pipes stirring up the sediment. When a dirty water complaint is lodged, a water reticulation crew is dispatched to flush the area until the dirty water is removed and the chlorine residuals are back within specification. Customers are advised to flush their side by running sprinklers. Customers receive a call the following day to ensure water remains clear.

Milky water is caused when air becomes trapped in the water under pressure, forming tiny bubbles. As these air bubbles escape, they cause the water to look milky. Milky water occurs following large main repairs or when new mains are commissioned. The issue usually resolves itself once all the air has escaped but if it doesn't the mains are flushed. If this still does not rectify the issue, more air valves are cut into the mains.

Taste and Odour

T&O complaints in Townsville are generally are caused by

- Dirty water events
- MIB/Geosmin
- High chlorine (or sudden changes in chlorine concentration)
- Old or new pipework on customer's side of the meter.

Townsville Water liaises with customers for all T&O complaints, flush where required and take samples for further investigation if warranted.

Owner's Side

There were 20 OS issues this financial year with seven caused by flick mix taps. Near the end of the life of flick mix taps (after seven to ten years) the inside braided hose degrades and leaves a black oily residue in the water. This issue is rectified through a phone call to customers to explain the issue and the requirement for a private plumber to install new taps.

The remaining 13 were for a mix of old pipework on the OS and hot water systems nearing the end of their life and the breakdown of the anode inside. Townsville Water analyse samples through TLS where required and communicate with customers to resolve these issues.

Suspected Illness

There were eight suspected illness complaints this year. This was largely due to the unprecedented monsoon event in February, with some residents concerned post-event that the water may be contaminated or that Ross River Dam may be too turbulent for the WTPs. In all instances residents were contacted and water from their property was analysed through TLS. In all instances the water met the ADWG limits and was safe to drink.

There was one vexatious complaint this year from the same customer as previous years.

8. Outcome of review and recommendations of audit

Review

A review of the plan was undertaken in March and April 2019 and submitted to The Regulator on 18 April 2019. There were a number of minor changes to all three DWQMPs. There were also some larger changes:

- Inclusion of cybersecurity risks and how Council will work towards the mitigation of these risks
- Inclusion of Algae and Cyanobacteria Organic Containment Response plan
- Inclusion of new chlorate limit which changed from 0.7mg/L to 0.82mg/L under advice from Queensland Health
- Improved hazard identification and analysis
- Updates to water quality data
- Update to emergency response plans.

Audit

There was no requirement for an audit in the 2018/19 financial year. Hunter H2O were engaged to audit the Paluma WTP, one-year post commissioning of Paluma WTP to look into any issues that had arisen in the time period. The next regulatory audit is required in August 2020 for all three schemes.



9. Appendix A. Drinking water quality performance – verification monitoring



GIRU/CUNGULLA DRINKING WATER SCHEME

Drinking Water Service Provider: Townsville City Council

SPID: 506

Drinking Water Scheme: Giru/Cungulla Drinking Water Scheme

Names of towns, communities or regions serviced by this scheme: Cungulla

Population serviced by this scheme: 288

Reporting year: July 2018 - June 2019

Laboratory name: Townsville Laboratory Services

Scheme Component		Parameter Category	Parameter	Unit of Measure	Limit of Reporting (LOR)	Count	# of samples detected	# DW Guidelines Value	Min Value	Max Value	Avg Value	95th %tile	Comments
GIRU	Source Water Giru Raw Water (Haughton River)	Thermotolerant Coliforms	Total Coliform	org/100ml	1	47	46	0	0	24200	1019	2420	
		Thermotolerant Coliforms	E.coli	MPN/100ml	1	47	9	0	0	39	2	10	
		Turbidity	Turbidity	NTU	0.1	47	47	0	1	64	8.11	24.27	
		pH	pH	pH Units	1	47	47	0	7.05	8.23	7.71	8.07	
		Metals	Iron, Total	mg/L	0.005	47	47	0	0.04	3.5	0.44	1.54	
		Metals	Manganese, Total	mg/L	0.001	47	47	0	0.005	0.06	0.02	0.05	
	Water Treatment Plant Giru Clear Water Storage	Thermotolerant Coliforms	Total Coliform	org/100ml	1	48	2	0	0	2	0	0	
		Thermotolerant Coliforms	E.coli	MPN/100ml	1	48	0	0	0	0	0	0	
		Turbidity	Turbidity	NTU	0.1	48	48	0	0	1.4	0.31	0.83	
		pH	pH	pH Units	1	48	48	0	6.27	7.51	7	7	
		Metals	Iron, Total	mg/L	0.005	48	17	0	0	0.01	0	0	
		Metals	Manganese, Total	mg/L	0.001	48	39	0	0	0.02	0.003	0.007	
CUNGULLA	Transmission Cungulla Reservoir	Thermotolerant Coliforms	Total Coliform	org/100ml	1	50	0	0	0	0	0	0	
		Thermotolerant Coliforms	E.coli	MPN/100ml	1	50	0	0	0	0	0	0	
		Turbidity	Turbidity	NTU	0.1	50	49	0	0	0.7	0.36	0.55	
		pH	pH	pH Units	1	50	50	0	6.57	8.01	7.60	7.89	
		Metals	Iron, Total	mg/L	0.005	50	39	0	0	0.38	0.02	0.05	
		Metals	Manganese, Total	mg/L	0.001	50	48	0	0	0.03	0.002	0.015	
		Disinfection Residual	Chlorine (free)	mg/L	0.05	50	50	0	0.57	1.86	1.27	1.77	
		Disinfection Residual	Chlorine (Total)	mg/L	0.05	50	50	0	0.89	2.23	1.59	2.1	
		Disinfection By products	Chlorates	µg/L	15	12	12	0	151	658	342	581	
		Disinfection By products	Trihalomethanes	µg/L	2	12	12	0	21	119	62	101	
	Reticulation Cungulla Houses	Thermotolerant Coliforms	Total Coliform	org/100ml	1	102	1	0	0	1	0	0	
		Thermotolerant Coliforms	E.coli	MPN/100ml	1	102	0	0	0	0	0	0	
		Turbidity	Turbidity	NTU	0.1	64	62	0	0.00	0.60	0.27	0.40	
		pH	pH	pH Units	1	102	102	0	6.63	7.97	7.55	7.88	
		Metals	Iron, Total	mg/L	0.005	50	35	0	0	0.02	0.004	0.01	
		Metals	Manganese, Total	mg/L	0.001	52	34	0	0	0.007	0.0008	0.002	
		Metals	Lead	mg/L	0.0006	58	9	0	0	0.003	0.0002	0.001	
		Disinfection Residual	Chlorine (free)	mg/L	0.05	102	102	0	0.52	1.81	1.14	1.62	
		Disinfection Residual	Chlorine (Total)	mg/L	0.05	102	102	0	0.88	2.12	1.43	1.9	

PALUMA DRINKING WATER SCHEME

Please note Paluma Township was on a boil water advisory from 28 October 2016 through to April 2018. Water quality data is provided from when the water treatment plant came online.

Drinking Water Service Provider: Townsville City Council

SPID: 506

Drinking Water Scheme: Paluma Drinking Water Scheme

Names of towns, communities or regions serviced by this scheme: Paluma

Population serviced by this scheme: 25-140

Reporting year: July 2018 - June 2019

Laboratory name: Townsville Laboratory Services

Scheme Component	Parameter Category	Parameter	Unit of Measure	Limit of Reporting (LOR)	Count	# of samples detected	# DW Guidelines Value	Min Value	Max Value	Avg Value	95th %tile	Comments
Source Water Paluma Weir	Thermotolerant Coliforms	Total Coliforms	MPN/100ml	0	12	12	0	10	11000	1048	5335	
	Thermotolerant Coliforms	E.coli	MPN/100ml	0	12	12	0	10	3667	429	2035	
	pH	pH	pH Units	0	12	12	0	5.78	7.83	6.47	7.45	
	Metals	Iron	mg/L	0.002	12	12	0	0.33	1.4	0.68	1.29	
	Metals	Manganese	mg/L	0.0003	12	12	0	0.008	0.04	0.02	0.04	
	Turbidity	Turbidity	NTU	0.1	12	12	0	2.6	171	5.26	12.04	
	Cryptosporidium	Cryptosporidium	cells/10 Li	1	3	0	0	0	0	0	0	
	Giardia	Giardia	cells/10 Li	1	3	0	0	0	0	0	0	
Water Treatment Plant (treated water pre-reservoir)	Thermotolerant Coliforms	E.coli	MPN/100ml	1	45	0	0	0	0	0	0	
	Disinfection Residual	Chlorine (free)	mg/L	0.05	44	44	0	0.45	2.1	1.27	1.75	
	Disinfection Residual	Chlorine (total)	mg/L	0.05	44	44	0	0.5	2.41	1.48	2.13	
	pH	pH	pH Units		45	45	0	6	6.99	6.72	6.97	
	Turbidity	Turbidity	NTU	0.1	45	45	0	0.1	1.3	0.39	0.7	
	Colour	Color, true	Pt-Co Units	1	45	45	0	0	10	0.84	4	
	Metals	Iron	mg/L	0.002	45	45	0	0.02	0.27	0.07	0.22	
	Metals	Aluminium	mg/L	0.0003	45	45	0	0	0.33	0.03	0.11	
Transmission Paluma Reservoir	Thermotolerant Coliforms	Total Coliform	org/100ml	1	12	0	0	0	0	0	0	
	Thermotolerant Coliforms	E.coli	MPN/100ml	1	12	0	0	0	0	0	0	
	Disinfection Residual	Chlorine (free)	mg/L	0.05	12	12	0	0.58	1.76	1.14	1.60	
	Disinfection Residual	Chlorine (total)	mg/L	0.05	12	12	0	0.64	2.19	1.32	1.96	
	pH	pH	pH Units		12	12	0	6.22	7.72	6.95	7.57	
	Turbidity	Turbidity	NTU	0.1	12	11	0	0	0.6	0.29	0.49	
	Metals	Iron	mg/L	0.002	12	12	0	0.03	0.19	0.08	0.19	
	Metals	Manganese	mg/L	0.0003	12	12	0	0.001	0.02	0.01	0.02	
	Metals	Aluminium	mg/L	0.0003	12	10	0	0	0.074	0.03	0.07	
	Metals	Lead	mg/L	0.0006	6	0	0	0	0	0	0	
	Disinfection By-product	Chlorates	µg/L	50	12	12	0	97	707	385	691	
	Disinfection By-product	Trihalomethanes	µg/L	5	14	11	1	0	293	109	260	
Reticulation Paluma Houses	Thermotolerant Coliforms	Total Coliform	org/100ml	1	36	3	0	0	201	6	2	
	Thermotolerant Coliforms	E.coli	MPN/100ml	1	82	1	1	0	3	0	0	
	Disinfection Residual	Chlorine (free)	mg/L	1	36	36	0	0.19	1.74	0.88	1.66	
	Disinfection Residual	Chlorine (total)	mg/L	1	36	36	0	0.22	1.97	1.00	1.89	
	pH	pH	pH Units		36	36	0	6.47	8.75	7.72	8.56	
	Turbidity	Turbidity	NTU	0.1	36	36	0	0.1	2.6	0.57	1.83	
	Metals	Iron	mg/L	0.002	82	81	0	0	0.54	0.14	0.28	
	Metals	Manganese	mg/L	0.0003	36	36	0	0.001	0.12	0.01	0.03	
	Metals	Aluminium	mg/L	0.0003	82	81	0	0	0.26	0.03	0.08	
	Metals	Lead	mg/L	0.0006	14	13	1	0	0.01	0.00	0.01	DWI-7-506-00062
	Fluoride	Fluoride (naturally occurring)	mg/L	0.02	36	36	0	0.06	0.16	0.11	0.16	
	Disinfection By-product	Chlorates	µg/L	50	24	24	0	100	738	379	728	
	Disinfection By-product	Trihalomethanes	µg/L	5	37	0	4	5	371	107	308	DWI-7-506-00065

TOWNSVILLE DRINKING WATER SCHEME

Drinking Water Service Provider: Townsville City Council

Drinking Water Scheme: Townsville Drinking Water Scheme

Population serviced by this scheme:

Laboratory name: Townsville Laboratory Services

SPID: 506

Names of towns, communities or regions serviced by this scheme: Townsville

Reporting year: July 2018 - June 2019

Scheme Component	Parameter Category	Parameter	Unit of Measure	Limit of Reporting (LOR)	Count	# of samples detected	# DW Guidelines Value	Min Value	Max Value	Avg Value	95th %tile	Comments
Source Water Ross River Dam	Thermotolerant Coliforms	Total Coliforms	org/100ml	1	250	250	0	3	173300	10837	72700	
	Thermotolerant Coliforms	E.coli	MPN/100ml	1	201	51	0	0	44	1	2	
	Turbidity	Turbidity	NTU	0.1	522	522	0	1.2	46.5	5.16	10.30	
	pH	pH	pH Units	1	559	559	0	5.4	8.41	7.41	8.03	
	Metals	Iron, Total	mg/L	0.005	523	523	0	0.04	2.1	0.23	0.51	
	Metals	Manganese, Total	mg/L	0.001	523	523	0	0.006	0.81	0.05	0.2	
	Anions	Nitrate	mg/L	0.01	522	69	0	0	0.19	0.01	0.03	
Source Water Paluma Dam	Thermotolerant Coliforms	Thermotolerant Coliforms	org/100ml	1	56	56	0	196	2420	833	1550	
	Thermotolerant Coliforms	E.coli	MPN/100ml	1	129	79	0	0.0	18	2	6	
	Turbidity	Turbidity	NTU	0.1	111	111	0	0.80	27.8	2.44	5	
	pH	pH	pH Units	1	129	129	0	4.98	7.85	6	7.17	
	Metals	Iron, Soluble	mg/L	0.005	111	111	0	0.2	3.9	0.79	2.05	
	Metals	Manganese, Soluble	mg/L	0.001	111	111	0	0.007	0.11	0.02	0.06	
	Anions	Nitrate	mg/L	0.01	111	35	0	0	0.19	0.02	0.08	
Water Treatment Plant Douglas WTP Raw Water	Thermotolerant Coliforms	Total Coliforms	org/100ml	1	57	55	0	0	155300	4897	17836	
	Thermotolerant Coliforms	E.coli	MPN/100ml	1	57	16	0	0	488	9	4	
	Turbidity	Turbidity	NTU	0.1	396	396	0	1.53		8.22	17.88	
	pH	pH	pH Units	1	396	396	0	6.80	7.96	7.53	7.76	
	Anions	Sulphate	mg/L	0.5	13	13	0	1.20	3.80	2.35	3.74	
	Metals	Iron, Total	mg/L	0.005	57	57	0	0.01	0.36	0.06	0.26	
	Metals	Manganese, Total	mg/L	0.001	57	41	0	0.00	0.02	0	0	
	Geosmin/ MIB	Geosmin	ng/L	1	75	35	0.00	0	21	2	5	
	Geosmin/ MIB	MIB	ng/L	1	75	71	0.00	0	28	9	21	
	Fluoride	Fluoride (Naturally occurring)	mg/L	0.02	57	54	0.00	0	0	0	0	
	Metals	Arsenic	mg/L	0.001	4	3	0.00	0	0.001	0.0007	0.001	
	Metals	Selenium	mg/L	0.001	4	0	0	0	0	0	0	
	Metals	Mercury	mg/L	0.0006	4	0	0	0	0	0	0	
	Metals	Cadmium	mg/L	0.0001	4	0	0	0	0	0	0	
	Metals	Nickel	mg/L	0.001	4	0	0	0	0.001	0.0003	0	
	Metals	Chromium	mg/L	0.001	4	0	0	0	0.001	0.0003	0	
	Giardia	Giardia	cysts/100ml	1	4	0	0	0	0	0	0	
	Cryptosporidium	Cryptosporidium	oocysts/10L	1	4	0	0	0	0	0	0	

Water Treatment Plant Douglas WTP Treated Water	Thermotolerant Coliforms	Total Coliforms	org/100ml	1	76	2	0	0	3	0	0	
	Thermotolerant Coliforms	E.coli	MPN/100ml	1	72	0	0	0	0	0	0	
	Disinfection Residual	Chlorine, free	mg/L	0.05	727	727	0	0.30	4.47	2.71	3.43	
	Turbidity	Turbidity	NTU	0.1	729	729	0	0.01	0.56	0.12	0.29	
	pH	pH	pH Units	1	729	729	0	7.25	7.78	7.54	7.63	
	Anions	Sulphate	mg/L	0.5	23	23	0	1.40	3.80	2.41	3.75	
	Anions	Nitrate	mg/L	0.01	23	23	0	0.03	0.12	0.07	0.11	
	Metals	Iron, Total	mg/L	0.005	206	36	0	0	0.02	0.001	0.007	
	Metals	Manganese, Total	mg/L	0.001	100	48	0	0	0.05	0.001	0.003	
	Metals	Aluminium	mg/L	0.005	727	690	0	0	0.12	0.02	0.05	
	Fluoride	Fluoride	mg/L	0.02	729	729	0	0.58	0.79	0.67	0.72	
	Metals	Copper	mg/L	0.002	23	0	0	0	0	0	0	
	Metals	Zinc	mg/L	0.001	23	6	0	0	0.005	0.001	0.004	
	Metals	Arsenic	mg/L	0.001	8	2	0	0	0.001	0	0.001	
	Metals	Selenium	mg/L	0.001	8	0	0	0	0	0	0	
	Metals	Mercury	mg/L	0.0006	8	0	0	0	0	0	0	
	Metals	Cadmium	mg/L	0.0001	8	0	0	0	0	0	0	
	Metals	Nickel	mg/L	0.001	8	0	0	0	0	0	0	
	Metals	Chromium	mg/L	0.001	8	0	0	0	0	0	0	
	Disinfection By-product	Trihalomethanes	ug/L	5	98	98	0	10	65	35.3	60.15	
Water Treatment Plant Northern WTP Raw Water	Thermotolerant Coliforms	Total Coliforms	org/100ml	1	47	46	0	0	6488	253	867	
	Thermotolerant Coliforms	E.coli	MPN/100ml	1	47	26	0	0	378	21	119	
	Turbidity	Turbidity	NTU	0.1	340	340	0	0.45	22.3	1.51	3.50	
	pH	pH	pH Units	1	340	340	0	1.36	10.85	10.51	10.73	
	Anions	Sulphate	mg/L	0.5	12	12	0	0.73	4	1.92	3.56	
	Metals	Iron, Total	mg/L	0.005	48	48	0	0.03	0.40	0.14	0.34	
	Metals	Manganese, Total	mg/L	0.001	48	48	0	0.00	0.02	0.01	0.01	
	Geosmin/ MIB	Geosmin	ng/L	1	12	5	0	0	18	4	18	
	Geosmin/ MIB	MIB	ng/L	1	12	3	0	0	6	0.89	4.19	
	Fluoride	Fluoride	mg/L	0.02	48	28	0	0	0.09	0.03	0.07	
	Metals	Arsenic	mg/L	0.001	4	0	0	0	0	0	0	
	Metals	Selenium	mg/L	0.001	4	0	0	0	0	0	0	
	Metals	Mercury	mg/L	0.0006	4	0	0	0	0	0	0	
	Metals	Cadmium	mg/L	0.0001	4	0	0	0	0	0	0	
	Metals	Nickel	mg/L	0.001	4	0	0	0	0	0	0	
	Metals	Chromium	mg/L	0.001	4	0	0	0	0	0	0	
	Giardia	Giardia	cysts/100ml	1	4	0	0	0	0	0	0	
	Cryptosporidium	Cryptosporidium	oocysts/10L	1	4	0	0	0	0	0	0	

Water Treatment Plant Northern WTP Treated Water	Thermotolerant Coliforms	Total Coliforms	org/100ml	1	47	0	0	0	0	0	0	
	Thermotolerant Coliforms	E.coli	MPN/100ml	1	47	0	0	0	0	0	0	
	Disinfection Residual	Chlorine, free	mg/L	0.05	339	339	0	1.50	2.43	1.87	2.19	
	Turbidity	Turbidity	NTU	0.1	339	339	0	0.01	0.08	0.04	0.05	
	pH	pH	pH Units	1	339	339	0	7.28	7.64	7.5	7.56	
	Anions	Sulphate	mg/L	0.5	12	12	0	0.91	3.9	2.23	3.74	
	Anions	Nitrate	mg/L	0.01	12	12	0	0.01	0.17	0.05	0.15	
	Metals	Manganese, Total	mg/L	0.001	47	46	0	0	0.01	0	0	
	Metals	Iron, Total	mg/L	0.005	96	17	0	0	0.02	0	0.01	
	Metals	Aluminium	mg/L	0.005	337	259	0	0	0.06	0.01	0.03	
	Fluoride	Fluoride	mg/L	0.02	339	339	0	0.63	0.75	0.68	0.72	
	Metals	Copper	mg/L	0.002	12	5	0	0	0	0	0	
	Metals	Zinc	mg/L	0.001	12	7	0	0	0.01	0	0.01	
	Metals	Arsenic	mg/L	0.001	4	0	0	0	0	0	0	
	Metals	Selenium	mg/L	0.001	4	0	0	0	0	0	0	
	Metals	Mercury	mg/L	0.0006	4	0	0	0	0	0	0	
	Metals	Cadmium	mg/L	0.0001	4	0	0	0	0	0	0	
	Metals	Nickel	mg/L	0.001	4	0	0	0	0	0	0	
	Metals	Chromium	mg/L	0.001	4	0	0	0	0	0	0	
	Disinfection By-product	Trihalomethanes	ug/L	5	47	46	0	0	83	19.26	44.2	
Transmission Reservoirs	Thermotolerant Coliforms	Total Coliforms	org/100ml	1	951	14	0	0	109	0	0	
	Thermotolerant Coliforms	E.coli	MPN/100ml	1	951	1	1	0	2	0	0	DWI-07-506-00059
	Disinfection residual	Chlorine, free	mg/L	0.05	960	958	0	0	2.92	1.18	1.83	
	Disinfection residual	Chlorine, total	mg/L	0.05	960	958	0	0	3.34	1.51	2.27	
	Turbidity	Turbidity	NTU	0.1	959	830	0	0	0.8	0.18	0.4	
	pH	pH	pH Units	1	960	960	0	6.27	8.67	7.54	8.07	
	Metals	Iron, Total	mg/L	0.005	959	539	0	0	0.16	0.00	0.01	
	Metals	Manganese, Total	mg/L	0.001	959	668	0	0	0.30	0	0.01	
	Metals	Lead, Total	mg/L	0.0006	959	24	0	0	0	0	0	
	Disinfection By-product	Trihalomethanes	µg/L	5	958	955	0	0	229	75	153	
Reticulation Houses	Disinfection By-product	Chlorates	µg/L	50	128	101	1	0	940	213	558	DWI-07-506-00064
	Thermotolerant Coliforms	Total Coliforms	org/100ml	1	2039	45	0	0	145	0	0	
	Thermotolerant Coliforms	E.coli	MPN/100ml	1	2042	0	0	0	0	0	0	
	Disinfection residual	Chlorine, free	mg/L	0.05	2055	2039	0	0	3.32	1.02	1.79	
	Disinfection residual	Chlorine, total	mg/L	0.05	2055	2050	0	0	3.39	1.34	2.2	
	Turbidity	Turbidity	NTU	0.1	993	808	0	0	2.7	0.19	0.4	
	pH	pH	pH Units	1	2055	2055	0	6.28	8.51	7.51	8.08	
	Metals	Iron, Total	mg/L	0.005	497	299	0	0	0.85	0.01	0.03	
	Metals	Manganese, Total	mg/L	0.001	463	356	0	0	4.20	2.30	3.8	
	Metals	Lead, Total	mg/L	0.001	583	287	6	0	0.03	0	0.002	DWI-7-506-00061
	Fluoride	Fluoride	mg/L	0.02	511	508	0	0	0.8	0.68	0.74	
	Disinfection By-product	Trihalomethanes	µg/L	5	555	555	0	7	249	80	153	
	Disinfection By-product	Chlorates	µg/L	50	65	65	0	61	548	255	472	

