Cook Shire COUNCIL

Laura

Drinking Water Quality Management Plan

+ DOCUMENT CONTROL SHEET

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Term	Definition
ADWG	Australian Drinking Water Guidelines 2011
CSC	Cook Shire Council
DNRME	Department Natural Resources Mines and Energy
DRDMW	Department of Regional Development, Manufacturing and Water
PHR	Public Health Regulation 2005
RMIP	Risk Management Improvement Program
QH	Department of Health Queensland
WSR	Water Supply Regulation
WS(SR)A	Water Supply (Safety and Reliability) Act 2010

1 LAURA

1.1 Overview

Laura is a small community of ~151 people located approximately 80 km west from Cooktown; however, it is 140 km by road. The scheme is a bore scheme with 2 operational bores with aeration, microfiltration and chlorination for treatment.

1.2 Climate Summary

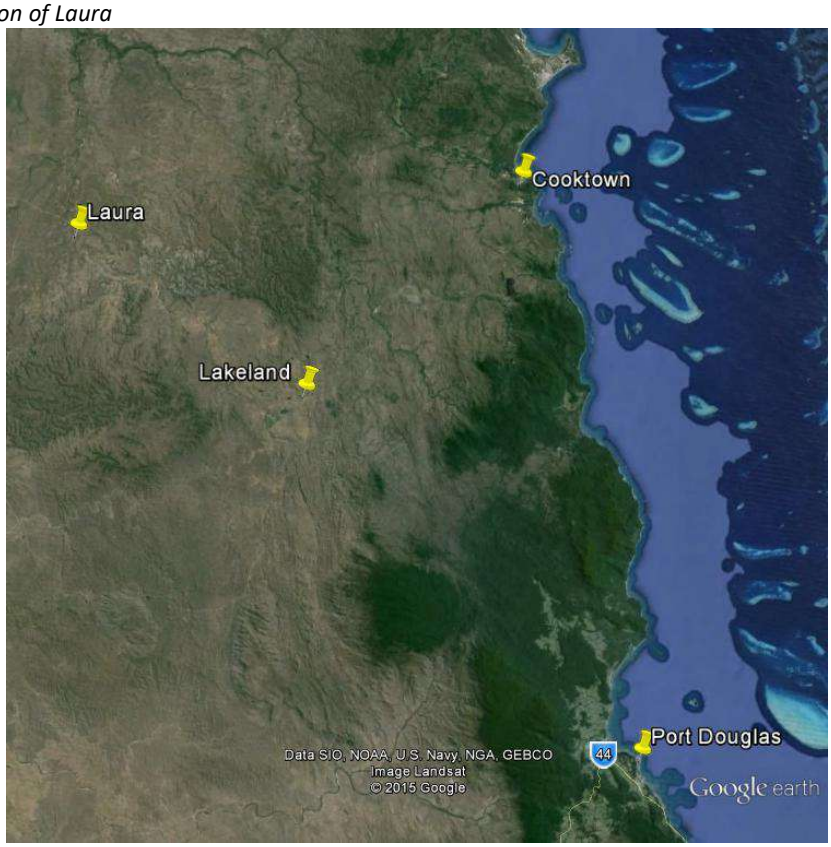
Laura is drier than Cooktown, but also has distinct wet and dry seasons. In general, there is little to no rain from around March/ April until the following wet season in December/ January.

Table 1 Laura Post Office Rainfall 1897-2022

Statistics for this station calculated over all years of data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	235.9	248.0	176.0	34.9	9.3	8.9	3.4	2.4	2.9	17.1	57.0	147.9
Median	218.4	251.3	148.2	19.8	2.0	1.5	0.0	0.0	0.0	3.3	32.0	114.1
Highest daily	*172.8*	175.3	223.5	*125.1*	74.6	91.4	30.5	76.2	53.3	101.2	123.6	159.5
Date of highest daily	23rd 2013	11th 1949	7th 1940	11th 2013	6th 1996	17th 1939	4th 1938	6th 1947	27th 1947	10th 1996	20th 1989	11th 1906

Figure 1 Location of Laura



2 INFRASTRUCTURE – LAURA

The Laura scheme uses bore water that is high quality with the exception of elevated levels of iron. The water treatment processes are primarily required to remove iron.

2.1 Laura Bores

Laura scheme utilises 2 bores located at the WTP site. Bore 2 was sunk first and is a 200 m deep bore with a diameter of 150mm. Council engaged a bore driller to ream out the bore to 200mm diameter in 1995, but the drill bit became stuck at ~35m, and the driller abandoned his drill bit. Subsequent attempts to remove the drill bit were also unsuccessful, however, a camera was passed down the borehole and showed that water can pass by the drill bit. Nonetheless, the stuck bit does limit the maximum depth of the bore pump, and lowers the yield of the bore. Hence Bore 2 is now predominantly used as a backup supply.

Bore 1 was drilled in 1996 to a depth of 150 m, through the Gilbert River and Dalrymple Sandstone. Bore 1 has a plastic casing, is grouted to a depth of 28 m, and taps aquifers at 70-76 and 118 to 148m depth. Water quality of the bore is very good with the exception of high levels of dissolved iron that require treatment.

Figure 2 Location of Infrastructure

2.1.1 Aeration and chemical oxidation (chlorination)

Due to the high iron in the raw water, raw water is dosed with chlorine prior to the water entering the top of the aeration tower which is mounted above a 22kL settling tank. A minimum of 0.8mg/L of chlorine residual in the settling tank is required to complete the oxidation process. The chlorine system is a recirculation system that operates continually to maintain 0.9 mg/L in the aeration tank.

2.1.2 Filtration

Filtration is through 2 x US Filter / Memcor 6M10V CMF Micro-Filtration units. Each unit has a bank of 6 membranes with a combined flow rate of 4.8 L/s. Each unit is backwashed (automatically) every 30 minutes of run time, and has a CIP (Clean in Place) every 168 Hrs of operation with citric acid. The units have an annual "Full Service" by an external company, with Cook Shire staff performing intermediate maintenance. An electrician is

also available as required. Both units are individually PLC controlled, both units receive a common Start / Stop signal, but either unit can be stopped independent of the other for maintenance or other reasons. Two reciprocating air compressors supply the compressed air requirements of the 2 plants.

Both units are linked to the SCADA and can be monitored / controlled by water staff in Cooktown.
The filtrate from both units is pumped directly to the 300kL reservoir.

2.1.3 Disinfection

A second recirculation chlorination system operates on the Main Reservoir; however, as the residual after treatment is normally already greater than the set point, the second chlorinator essentially works as a fully redundant backup for the oxidation chlorination step.

2.1.4 High Level Tanks

There is a 48 kL poly tank on a 10m high tank stand. The overhead tanks are filled with chlorinated water by the night pump as and when required. Water flows to the mains from the high level tanks at any time whilst the pressure pumps are not operating which includes night time. A sampling point is available on the outlet of the tank for the monitoring of free chlorine residual and is recorded in Councils SWIM database.

2.1.5 Pressure pumps

A bank of 4 Grundfos CR8 – 40 vertical multistage pumps supply the pressure for the reticulation mains, these are all controlled through the PLC with input from the pressure sensor. One of the pumps becomes the daily duty pump, which runs continuously all day with the others cutting in and out as required, the duty pump is rotated daily to distribute wear & tear. This arrangement generally maintains mains pressure around 350 KPA and with all 4 pumps operating can supply approximately 18L/s. The pumps pump directly into the reticulation mains with a flow meter recording the instantaneous flow as well as the accumulated total volume. The pressure pumps are switched off from 11pm to 4am and the town is fed from the high level tanks.

2.1.6 SCADA

The SCADA was setup to monitor and operate the Laura Water Treatment Plant as it's an unmanned facility. The SCADA shows equipment status, e.g. running, off or faulted, levels of most tanks, process air pressure, mains pressure flow rates and accumulated values, plant voltage and amps draw as well as all the details available from the filtration units.
Trending of numerous parameters is also available and via password protection operating parameters can be altered.

2.1.7 Reticulation Mains

The reticulation mains (installed by Cook Shire Council) were installed in 1996 and are all UPVC or poly, with a maximum of 400KPA available this is well within the pressure rating of the pipes (1200KPA) and consequently we have no leaks or bursts since their commissioning, the mains have regular scouring to promote healthy mains.

The reticulation mains in the Ang-Gnarra sub division which were installed by Ang-Gnarra contractors, (both sides of the Peninsula Development Road) were completed, inspected, pressure tested and signed off as being fully compliant by Cook Shire in August 2013

Table 2 Infrastructure details

Laura Bores	
Name	Laura
Type	Bore 1
% of supply	100
Reliability	Has run constantly since 1996 with no supply issues
Water quality issues	Elevated levels of iron in the raw water
Name	Laura
Type	Bore 2
% of supply	0
Reliability	Back up bore for bore 1
Water quality issues	Elevated levels of iron in the raw water
Bore Head Details	
Year Bore/s Sunk	1994
Bore Casing size	150mm
Bore Casing Material	Cl 12 PVC with steel protection at the top
Sealed to prevent surface water ingress	Yes, All the Bore Casings are typically 600mm above surface level & encased in concrete preventing surface water ingress
Sealed to prevent vermin (frogs / snakes etc.) from entering bore	Yes, All bores sealed to prevent vermin (frogs / snakes etc.) from entering the bore
Aquifer Name	Gilbert River Formation – Sub Artesian
Type (pumped/gravity/equipped bore/etc.)	Electric submersible pumps fitted to each Bore
Description	Both bores are at a depth of 200 metres, bore 2 has a drill bit stuck at approximately 36 metres and the bore pump is set above this level. The driller had no success removing the stuck bit.
Laura Treatment Plant	
Process	Process comprises of Aeration, micro filtration and chlorination
Design Capacity (20 hr operation)	0.36 ML/d
Daily flow range	0.92 to 0.377 ML/d
Chemicals added	Sodium Hypochlorite
Standby chemical dosing facilities (Y/N)	No Duty /Standby, but there are 2 dosing pumps that inject Hypo into 2 separate locations. Both are PLC Controlled
Water sourced from and %	Water is sourced 100% from the bores
% of average day demand provided	100%
% of scheme supply Distribution area supplied	100%
Bypasses / Variations	No
Disinfection(Primary)	
Location	Laura Treatment Plant – Aeration Tank
Type	Sodium Hypochlorite Dosing
Dose rate	Unknown (Dosing to maintain target residual level) PLC Controlled
Target residual levels	0.9mg/L
Duty/standby	No
Dosing arrangements	PLC controlled with feedback from free chlorine residual analyser
Alarms	Yes (high and low chlorine)
Auto shut-off arrangements	Primary dosing shuts down when chlorine residual target set point is reached , recommences dosing if target residual falls below target set point
Disinfection (Secondary)	
Location	Laura Treatment Plant – Main Reservoir
Type	Sodium Hypochlorite Dosing

Dose rate	Unknown (Dosing to maintain target residual level)
Target residual levels	0.8mg/L
Duty/standby	No
Dosing arrangements	PLC controlled with feedback from free chlorine residual analyser
Alarms	Yes (high and low chlorine)
Auto shut-off arrangements	Secondary dosing shuts down when chlorine residual target set point is reached , recommences dosing if target residual falls below target set point
Storage Reservoir	
Capacity (ML)	0.3 ML
Roofed (Y/N)	Yes
Vermin-proof (Y/N)	Yes
Runoff directed off roof (Y/N)	Yes

2.1.8 Detailed Process Steps

Assuming the Clean Water Reservoir is full to start with.

The pressure pumps run continuously supplying the mains pressure to the township, the duty pump runs for 24 hrs, (duty pump is rotated daily) whilst the other 3 pumps cut in / out as required these are PLC controlled based on mains pressure i.e. If the demand suddenly increases and the pump/s currently running cannot maintain the pressure, then the mains pressure drops, this then starts the next pump in the queue, if that is still not sufficient to maintain the pressure then another will start, up till all 4 are running. Alternatively, when the demand decreases the additional pumps will stop one by one until there is only the one left. There are 3 pressure accumulators to smooth out the stop / starts of the pumps. This 4 pump pumping unit whilst it does work, it is not as efficient and smooth as the 3 phase units with their variable speed drives and the ability to ramp the motors down with low flows.

Laura is serviced with a SWER (Single Wire Earth Return) Power line from Lakeland, this limits all electric infrastructures to single phase, so VSD pumps are not an option.

The Reservoir is drawn down by the pressure pumps. When the Reservoir level gets to 1.84m, this starts the 2 Memcor microfiltration plants. These draw chlorinated water from the aeration tank, filter the water through the micro filtration plants, and pumps the filtrate back to the clean water reservoir. When the water is lowered in the settling tank from the full level of 2.45m down to 2.25m, the large bore pump starts (Bore1). This water passes through an aerator to the settling tank. The settling tank is chlorinated to the chlorine residual set point. As raw water enters the aeration tank, the chlorine residual decreases. There is a small pump constantly recirculating water with a chlorine residual analyser reading the chlorine level from the recirculated water. As the chlorine residual falls then the chlorinator will start pumping sodium hypochlorite to raise the chlorine residual. This process continues until the clean water reservoir reaches the full level (2.44m). The first to stop is the 2 Memcor micro filtration plants, the bore continues to run until the aeration tank reaches its full level (2.45m) then stops. The sodium hypochlorite dosing pump will run until the target level is reached then stop.

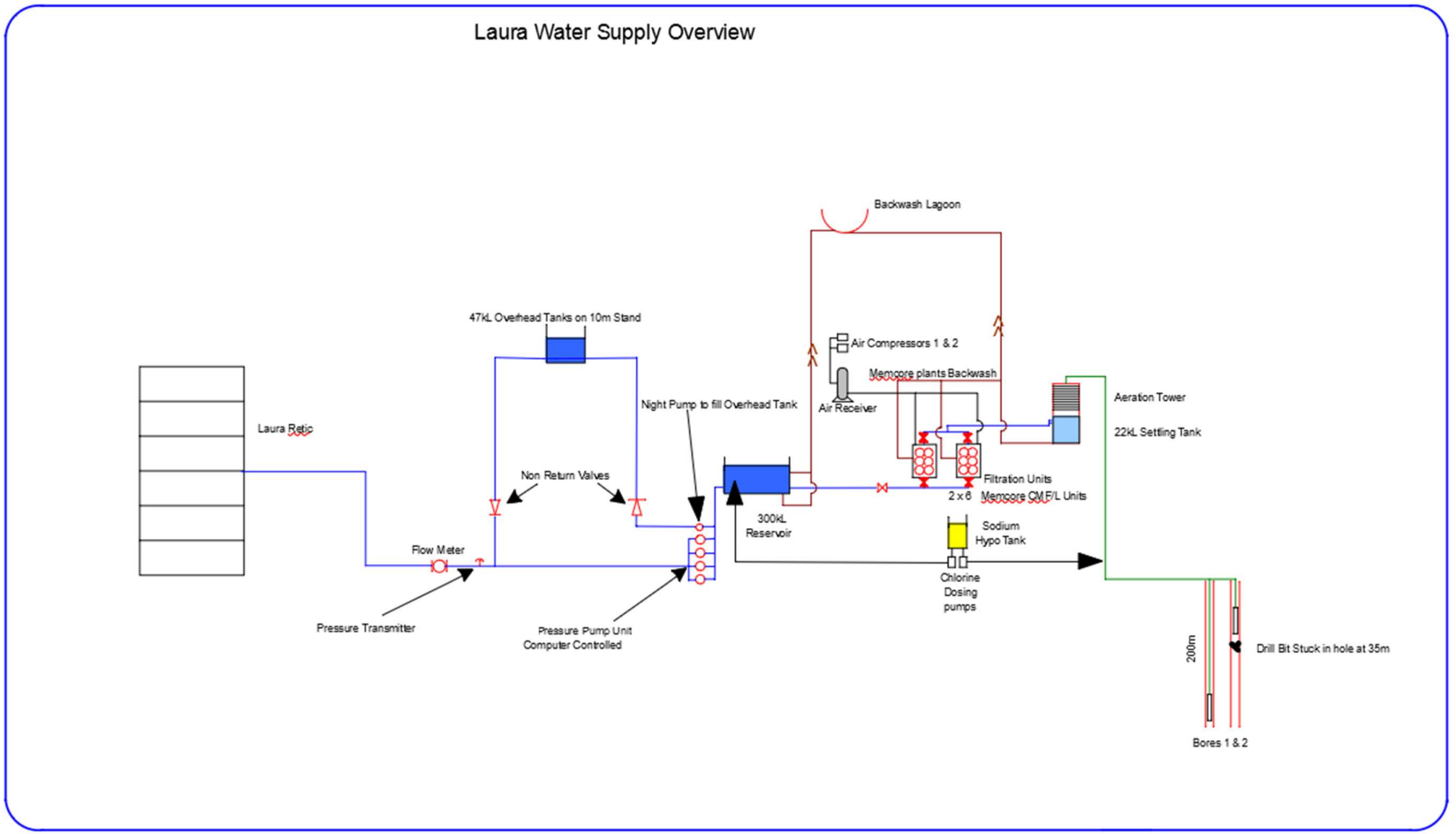
There are another 2 pumps (Duty / Standby) constantly recirculating water from the clean water reservoir with a second chlorine residual analyser reading the chlorine level from the recirculated reservoir water. As the chlorine residual falls then the second chlorinator will start pumping in Sodium hypochlorite to raise the chlorine residual.

The 2 Micro filtration Memcor plants together can produce water at the rate of 4.8 L/s whilst the bore pump produces more than 5L/s so consequently has been throttled back to match the plant output. Once started the plant runs for anywhere between 6 – 18 hrs / day depending on demand and the season.

The night time flow rate has been reduced to below 0.5 L/s and the daytime flow rates are now generally less the 2.0 L/s.

The only chemicals used for water treatment at Laura are sodium hypochlorite and citric acid for CIPs.

Figure 3 Catchment to tap schematic – Laura



3 RISK ASSESSMENT

3.1 Laura Risk Assessment for Risk Management Improvement Plan

Following the hazard identification and unmitigated risk assessment detailed in the overarching plan, the Laura Scheme risk assessment was undertaken, following the same methodology. Individual process failures were considered, and the mitigated risks calculated. The risk assessment is presented below.

Table 3 Laura Risk Assessment for Risk Management Improvement Plan

Laura Water													
Process Step	**Hazardous Event**	**Hazards managed by same barriers**	**Unmitigated Risk**	**Primary preventive measure**	**Other Preventive Measures**	**Mitigated**			**Uncertainty**	**Comments**	**Risk Management Improvements**		
						Consequence	**Likelihood**	**Risk**			**2022/2023**	**2023/2024**	**2024/2025**
Bores	Ingress into bore	bacteria and virus	High 16	Microfiltration disinfection	Borehead sealed and inspection program 6 monthly; Raw bore E.coli sampling weekly	Major	Rare	Medium 5	Reliable				
Bores	Ingress into bore	protozoa	High 16	microfiltration	Borehead sealed and inspection program 6 monthly	Major	Rare	Medium 5	Confident				
Bores	Septic contamination of aquifer	bacteria and virus	High 12	Disinfection	Microfiltration; Raw bore E.coli sampling weekly	Major	Rare	Medium 5	Certain				
Bores	Septic contamination of aquifer	protozoa	Extreme 16	microfiltration	CED sewerage system operational in Laura	Major	Rare	Medium 5	Confident	Laura Wastewater CED scheme is operational. Septic tanks now overflow into CED system			

Laura Water

Process Step	Hazardous Event	Hazards managed by same barriers	Unmitigated Risk	Primary preventive measure	Other Preventive Measures	Mitigated			Uncertainty	Comments	Risk Management Improvements		
						Consequence	Likelihood	Risk			2022/2023	2023/2024	2024/2025
Bores	Bore pump failure	Failure of supply	Medium 6	Back up bore	Water restrictions can be implemented	Minor	Rare	Low 2	Confident	Laura rarely has water restrictions.			
Aeration	Under dose chlorine	Iron	High 10	Chlorine addition	Aerator will remove some iron in absence of chlorine, MF will remove a large percentage of iron	Minor	Possible	Medium 6	Confident	Water has good turbidity but has some colour in event of aeration failure			
Microfiltration	Filter breakthrough	Protozoa	Extreme 20	TMP monitored.	Membranes replaced in 2016	Major	Rare	Medium 5	Reliable	Annual servicing of membranes			
Microfiltration	Filter breakthrough	turbidity	Medium 6	Daily turbidity monitoring via online analyser	TMP monitored	Minor	Unlikely	Low 4	Reliable				
Microfiltration	Membrane fouling	restrict supply	Medium 8	Daily production monitored	CIPs done weekly	Minor	Unlikely	Low 4					
Disinfection	Overdose	Chlorine	High 15	Target 0.6-1.8 mg/L critical at 2 mg/L. on-line analyser	SCADA, Alarms and auto dialler	Minor	Possible	Medium 6	Confident	SCADA monitoring, and EDAC call outs.			
Disinfection	Insufficient dose	bacteria/virus	High 10	Target 0.6-1.8 mg/L critical at 2 mg/L. on-line analyser	SCADA, Alarms and auto dialler	Moderate	Unlikely	Medium 6	Confident	Laura has 2 locations for chlorination plus bore water source (not surface water)			

Laura Water

Process Step	Hazardous Event	Hazards managed by same barriers	Unmitigated Risk	Primary preventive measure	Other Preventive Measures	Mitigated			Uncertainty	Comments	Risk Management Improvements		
						Consequence	Likelihood	Risk			2022/2023	2023/2024	2024/2025
Disinfection	Chemical breakdown	chlorate	High 12		Dual chlorine tanks in place to allow cleaning of tank before addition of new sodium hypochlorite	Moderate	Possible	Medium 6	Reliable	THM monitoring of Reticulation system	Work with QH and WSR to find solutions		
Disinfection	Ineffective disinfection due to turbidity	bacteria	High 10	Microfiltration	Disinfection plus low turbidity in raw water (bore water)	Moderate	Rare	Low 3	Estimate	Raw water E. coli testing shows not E.coli in raw bore water			
Treated water storage/ Reservoirs	Ingress into reservoirs	bacteria virus	Extreme 20	Integrity and sealing	Disinfection Reservoir inspection program	Catastrophic	Rare	Medium 6	Confident	Reservoirs have been sealed			
Treated water storage/ Reservoirs	Ingress into reservoirs	Protozoa	Extreme 20	Integrity and sealing	Reservoir inspection program	Catastrophic	Rare	Medium 6	Estimate	Reservoirs have been sealed			
Treated water storage/ Reservoirs	Ingress of amoeba	amoeba	High 12	disinfection as above items	Integrity	Major	Rare	Medium 5	Reliable	disinfection maintained in reticulation			
Reticulation	Ingress of contaminated water	Bacteria virus	Extreme 20	network pressure, residual disinfection	mains break procedure WS 0002; Low chlorine flushing procedure WS006	Major	Unlikely	Medium 8	Reliable	weekly reticulation monitoring			
Reticulation	Ingress of contaminated water	protozoa	Extreme 20	network pressure	mains break procedure	Major	Unlikely	Medium 8	Reliable				

Laura Water

Process Step	Hazardous Event	Hazards managed by same barriers	Unmitigated Risk	Primary preventive measure	Other Preventive Measures	Mitigated			Uncertainty	Comments	Risk Management Improvements		
						Consequence	Likelihood	Risk			2022/2023	2023/2024	2024/2025
Reticulation	Stagnant water in Laura High level reservoir	bacteria	Extreme 20	turnover through nightly shutdown of reticulation pumps	Only one high level reservoir 48KL; Sampling point on high level reservoir. Cl sampled weekly	Major	Rare	Medium 5	Estimate	Currently do not meet minimum pressure overnight.			
Reticulation	Biofilm growth	opportunistic pathogens	High 15	flushing program		Moderate	Rare	Low 3	Estimate	Disinfection maintained.			
Reticulation	Power failure	Failure of supply	High 12	Generators can run pressure pumps to get water to town	Water to town will come from elevated tanks is generator is not on	Moderate	Possible	Medium 9	Confident	SWER line Hard to find generators to run off single phase			
Reticulation	change in flow rate, reservoir run low, disturbing sediment in pipe	turbidity	Medium 6	Disinfection residual, mains flushing	Reservoir low level alarm Multiple days storage in reservoir	Insignificant	Possible	Low 3	Confident				
Reticulation	backflow	protozoa	Extreme 20	system integrity, backflow prevention on new installations		Major	Rare	Medium 5	Estimate	Taggle meters investigated and not currently viable for Cook Shire due to total number of connections			
System Wide	WTP Fire	Failure of supply	High 10	DMP		Catastrophic	Rare	Medium 6	Reliable				
System Wide	Cyclone	Failure of supply	High 10	Cyclone preparation procedure WS0032	Bitumen road and good access	Catastrophic	Rare	Medium 6	Reliable				

Laura Water													
Process Step	**Hazardous Event**	**Hazards managed by same barriers**	**Unmitigated Risk**	**Primary preventive measure**	**Other Preventive Measures**	**Mitigated**			**Uncertainty**	**Comments**	**Risk Management Improvements**		
						Consequence	**Likelihood**	**Risk**			**2022/2023**	**2023/2024**	**2024/2025**
System Wide	operator error	any	Extreme 25	training, experience, mentoring	All current operators have Cert III in water operations and new staff are currently doing a Cert III	Moderate	Rare	Low 3	Estimate	Checklists in place for operations at plant. Procedures have been developed.			
System Wide	Cybersecurity	Cyber attack	High 12	Gateway software	Anti-virus and threat detection software	Major	Rare	Medium 5	Estimate				

3.2 Laura Risk Management Improvement Plan

Table 4 Laura Risk Management Improvement Plan

Process Step	Hazard	Risk Management Improvements	Priority	Responsible Person	Year
Disinfection	Chlorate	• Dual tanks have been installed. Procedure to clean out tanks before addition of new chlorine. (difficult as site is remotely operated)	High - Complete	Manager Water and Wastewater	Complete
Disinfection	Chlorate	• Use alcohol wipes to wipe down taps before sampling instead of chlorine in spray bottle.	High - Complete	Manager Water and Wastewater	Complete
Disinfection	Chlorate	• Continue monitoring chlorates in reticulation system	Low (on-going)	Manager Water and Wastewater	On-going
Disinfection	Chlorate	• Investigate additional solutions in conjunction with Queensland Health.	Low (on-going)	Manager Water and Wastewater	On-going

3.3 Cybersecurity

The Cook Shire Council's network is set up to detect cybersecurity breaches. The breach is identified through the internal network security monitoring tools which includes gateways and anti-virus threat detection.

In the instance of a cybersecurity attack that gets through, the Council IT department would try to detect its origin, look at removing the computer from the network, restore information from backups.

To date, there have been no detectable cyber-attacks on our SCADA systems in Council

Changes made to the Water Section in the cyber security space include, separate log in for individual employees when logging onto the SCADA system and the end of support for Windows 7 which has forced Council to migrate SCADA control software to the Windows 10 operating system.

All cyber security incidents/breaches are reported to the QGCIO. The details for the QGCIO are:
Queensland Government Information Security Virtual Response Team (QGISVRT).
Phone: 07 3215 3951
Email: qgisvrt@qld.gov.au
Website: www.qgcio.qld.gov.au

3.4 Outcome of recent incidents

Recent incidents for the Laura Water Scheme from 01 January 2020 to 31 March 2022.

Table 5 Recent water quality incidents

Date	Place	Parameter	Concentration	Action Plan
14 February 2022	Laura Roadhouse	Chlorate	0.984 mg/L	The new chlorine shed is now built and dual chlorine tanks have been installed. The new procedure will ensure that each tank is cleaned out before being filled with new chlorine.
9 August 2021	Laura Library	Chlorate	0.968 mg/L	

3.5 Chlorate Management Plan

The chlorate management plan below is based on the qldwater Chlorate Fact Sheet – Managing Chlorate Residuals.

Table 6 Chlorate Management Plan

Potential mitigation action	Action	Future Action
Reduce age of chlorine		
Bulk chlorine is delivered to the Annan WTP	Annan operators perform a chlorine strength and a pH test on the delivered chlorine.	Continue
Work with supplier to reduce chlorate in source material	Cooktown does not have high chlorate levels, therefore, it is assumed that the bulk supply does not have high levels of chlorate.	No action

Work with supplier to minimise the time from manufacture to delivery and use	Laura is a remote community in Cape York. This would be difficult to achieve.	No action
Increase turn-over/delivery of hypochlorite	Laura is a remote community in Cape York. This would be difficult to achieve. Population is 125.	No action
Replace oversized tanks	Smaller tanks would not be suitable due to the remoteness of the site. Staff visit site once a week. Tanks are 250L.	No action
Reduce rate of chlorate formation prior to use		
Dilute stock concentrations	Chlorine is diluted 50:50 with water.	Action complete
Store solution in cool area and out of direct sunlight	Laura chlorination shed has been rebuilt. It is a besser block shed with insulation in the roof. The shed has two big vents that take up most of the wall space on two opposing sides of the shed.	Action complete
Control the pH of stored hypochlorite solutions at pH 11-13, even after dilution	Action: This option will be investigated.	Investigate
Rinse sodium hypochlorite storage tanks between refills	Sodium Hypochlorite is transferred from the bulk solution to the Laura WTP. Laura has two tanks which are both filled. Both tanks are online. Before the tanks are filled, the remaining chlorine is transferred into tank 1. Tank 2 is flushed. The remaining chlorine is transferred into Tank 2 and Tank 1 is flushed. In the dry season, the tanks are filled on average, fortnightly. In the wet season, the tanks are filled, on average, monthly.	Continue
Ensure processes and maintenance are optimized		
Optimise the chlorination process to avoid high doses of chlorine	Set point for Chlorine disinfection level in Laura are 0.9 mg/L. This cannot be lower and still maintain disinfection to the end of the mains.	No action
Optimize the coagulation, flocculation, sedimentation, filtration processes to reduce chlorine demand	Laura is a groundwater source with iron and manganese above the ADWG aesthetic guideline value. Pre chlorination is used to oxidize the iron and manganese, followed by membrane filtration. Investigation into the formation of chlorates at the Laura WTP may show whether the chlorates are formed during pre-chlorination of whether they are forming in the reticulation. Council will undergo testing throughout the plant to see if this can be established.	Investigate
Reduce chlorine demand of reservoirs and networks caused by biofilm and sediment	Laura reservoir is cleaned every two years. Water mains are flushed once a year. The water team does not have the capacity to increase the frequency of these options.	No action
Explore alternative disinfection options		
Converting to disinfection using chlorine gas	This option is considered too dangerous. Laura WTP is operated remotely by SCADA and visited once a week. The WTP is situated in the middle of town. Qldwater Disinfection	No action

	Options for Water Service Providers Guidance Paper lists chlorine gas as high risk for very small remote places.	
Convert to onsite generation of chlorine	Council will investigate the use of on-site chlorine generation	Investigate
Additional Council Actions		
Chlorate samples taken every three months	Sampling includes E. coli and therefore the tap is sterilized before samples are taken. Staff have two options. Option 1 is the use of alcohol wipes to sterilize the tap. Samples can then be taken (including chlorate) or Option 2 is to take the chlorate sample, then sterilize the tap with liquid chlorine and then take the E. coli sample last.	Continue
Chlorate detected	If chlorate is detected, the regulator and QH will be notified	Continue
Chlorate detected in two consecutive samples	If chlorate is detected in two consecutive samples then a “do not consume” notice will be discussed with QH. This is considered a long-term exceedance.	Continue

4 OPERATIONAL PROCEDURES

In general CSC has few specific documented procedures for each process step as required under the ADWG. However, the operational limits are well defined, and actions are understood by the WTP operators. The following table forms the basis of more comprehensive operational procedures that will be developed over time.

Table 7 Operational Limits for Laura WTP and Reticulation system

Process Step / Location in System	Parameter	Operational Monitoring	Target Range	Monitoring Frequency	Operator Intervention Range	Report to Supervisor Range	Corrective Actions/ Comments
Raw Water	Free Chlorine residual	Y	 <0.4 and >3 mg/L 0.4 – 0.6 and >2 mg/L 0.6 – 1.8 mg/L	Daily online analyser. Weekly hand held free chlorine meter	<0.6 mg/L and <1.8 mg/L	<0.4 mg/L and > 3 mg/L	• If chlorine is above 2 mg/L - Check operation of Chlorine dosing equipment. Check chlorine analyser is reading accurately using hand held analyser. Decrease chlorine dose as chlorine may have been added without dilution. • If chlorine is below 0.4mg/L - Check operation of chlorine dosing equipment, ensure no air bubbles in chlorine line. Check chlorine tank levels. Check chlorine analyser using hand held unit. Increase chlorine dose.
Final Treated Water	Iron	Y	 > 0.3 mg/L 0.2– 0.3 mg/L <0.2mg/L	Quarterly	0.15 – 0.2 mg/L	<0.2 mg/L	• Raw chlorine Dosing not correct / Raw dosing fault / Raw Chlorine Analyser Fault • Low Chlorine tank levels • Filtration membrane failure
	Free Chlorine Residual	Y	 <0.4 and >3mg/L 0.4 – 0.6 and >2 mg/L 0.6 -1.8 mg/L	Daily online analyser. Weekly hand held free chlorine meter	<0.6 and >2 mg/L	<0.4 and >3 mg/L	• If chlorine is above 2.0mg/L - Check operation of Chlorine dosing equipment. Check chlorine analyser is reading accurately using hand held analyser. Decrease chlorine dose as chlorine may have been added without dilution. • If chlorine is below 0.4mg/L - Check operation of chlorine dosing equipment, ensure no air bubbles in chlorine line. Check chlorine tank levels. Check chlorine analyser using hand held unit. Increase chlorine dose.
	Turbidity	Y	 <2 NTU 1 – 2 NTU <1 NTU	Daily online analyser. Monthly samples. Verified quarterly.	>1 NTU	>2 NTU	• Clean turbidity analyser. • Check SCADA for operational issues • Ensure raw water chlorine dosing is working correctly to remove iron and manganese. • Clean aeration tank • Check reservoir (Reservoir cleaned every 2 years)

Documented procedures for Water and Wastewater are listed below:

Table 8 Cook Shire Council Water and Wastewater procedures

Number	Documented Procedure Name	Date of last revision	Area
WS 0001	Safe Handling of Sodium Hypochlorite	2021	All
WS 0002	Water Main Repairs	2021	Reticulation
WS 0003	DWQMP Annual Report Creation	2021	Admin
WS 0004	SWIM Annual Report Creation	2021	Admin
WS 0005	E. Coli Detection Reporting	2021	Admin
WS 0006	Water Mains Flushing and flushing for Low reticulation free chlorine residual	2021	Reticulation
WS 0007	Water Reservoir Cleaning	2021	Reticulation
WS 0008	Water Sampling	2021	Reticulation
WS 0009	Water Testing Coliforms & E.coli Analysis	2021	Annan Lab
WS 0010	Water Service - New Installation	2021	Reticulation
WS 0011	Water Mains - New Installation	2021	Reticulation
WS 0012	CIP Procedure Laura	2021	Treatment
WS 0013	Water Service Repairs	2021	Reticulation
WS 0014	Operation Procedure for Lakeland WTP	2021	Reticulation
WS 0015	Chlorine Analysers Maintenance Procedure	2021	Treatment
WS 0016	Jar Testing Procedure	2021	Treatment
WS 0017	Incident Notification	2021	Admin
WS 0018	Coagulation & Flocculation	2021	Treatment
WS 0019	Flow meter Calibration	2021	Admin
WS 0020	Working around sewage	2021	Sewage
WS 0021	High Pressure Sewer Cleaning	2021	Sewage
WS 0022	Troubleshooting DAF Plant Coen	2021	Treatment
WS 0023	Running the Coen Bore field	2021	Treatment

WS 0024	Recharging the Coen Bores	2021	Treatment
WS 0025	Using Hydrochloric Acid (Splash Park)	2021	Reticulation
WS 0026	Wastewater Sampling at the Coen STP (NATA lab)	2021	Sewage
WS 0027	Cleaning Baskets	2021	Sewage
WS 0028	Dealing with high flow at the Cooktown STP	2021	Sewage
WS 0029	Lakeland WTP Generator	2021	Treatment
WS 0030	Cooktown STP Generator	2021	Sewage
WS 0031	Detection of a chemical parameter above ADWG	2021	Admin
WS 0032	Splash Park Procedure	2021	Reticulation
WS 0033	Cyclone Preparation procedure - Lakeland, Laura and Cooktown (Using bore fields)	2021	Reticulation/Treatment
WS 0034	Cyclone Preparation procedure - Lakeland, Laura and Cooktown (not using the bore fields)	2021	Reticulation/Treatment
WS 0035	Cyclone Preparation procedure - Coen	2021	Reticulation/Treatment
WS 0036	Procedure in the event of environmental Incident	2021	Sewage
WS 0037	Boiled water alert (Media coordinator)	2021	Media liaison
WS 0038	Fire Service configuration and metering procedure	2021	Admin and Reticulation
WS 0039	E. coli analysis using Idexx	2021	Annan and Coen WTPs
WS 0040	High Level new chlorine analyser maintenance at the High Level Reservoir	2021	Reticulation
WS 0041	Power Outage at the Cooktown STP	2021	Cooktown Sewage
WS 0042	Pressure Decay Test Coen WTP	2021	Coen WTP
WS 0043	Pressure Decay Test Laura WTP	2021	Laura WTP
WS 0044	Lock out, tag out procedure	2021	All
WS 0045	Chemical Batching – Soda Ash – Annan WTP	2021	Annan WTP
WS 0046	Chemical Batching – Lime – Annan WTP	2021	Annan WTP
WS 0047	Chemical Batching – Alum – Annan WTP	2021	Annan WTP
WS 048	Running the Annan Generator	2021	Annan WTP

WS 0049	Activating bypass of two filters during	2021	Annan WTP
WS 0050	Sludge removal from the Annan sedimentation basin	2021	Annan WTP
WS 0051	Chemical Batching – Poly – Annan WTP	2021	Annan WTP
WS 0052	Run Annan WTP on 2 filters	2021	Annan WTP
WS 0053	Change or modify ABB drawers at Cooktown STP	2021	Cooktown STP
WS 0054	Water meter reading	2021	Reticulation/Rates
WS 0055	Sodium Hypochlorite concentration test	2021	Annan WTP
WS 0056	Annan Water Treatment Plant – Water testing procedure	2021	Annan WTP
WS 0057	Water sampling process for One Drive	2021	Reticulation and Treatment Plants
WS 0058	Clean Y strainer	2021	Annan WTP
WS 0059	Bore Flushing	2021	Bores
WS 0060	Septic waste disposal at the Cooktown STP	2021	Cooktown STP
WS0061	DAF Maintenance Procedure	2021	Coen WTP
WS 0062	Calibrate 4670 Turbidity meter	2021	Water Treatment Plants

5 OPERATIONAL AND VERIFICATION MONITORING

Operational monitoring is undertaken by CSC to ensure that the water treatment barriers are operating effectively. This monitoring provides confidence that we are producing safe water. Operational monitoring is conducted by the WTP operators and NATA registered laboratory where CSC do not have the facilities to analyse parameters. Where any value exceeds the ADWG health guideline in treated or reticulated water, the Manager Water and Wastewater is immediately informed and the regulator is informed. A procedure is available for reporting E. coli detection to the regulator. The operational monitoring undertaken by CSC includes total coliforms and E. coli, colour, dissolved oxygen, electrical conductivity, pH, total dissolved solids, total hardness, turbidity and water temperature.

Verification monitoring is also undertaken by a NATA registered laboratory. This includes physical/chemical parameters and metals in the reticulation system, raw bore water and final water leaving from the Laura reservoir. Certificates of analysis are reviewed immediately upon receipt, and if a value exceeds the ADWG Health Guideline value, the Manager Water and Wastewater is informed, and it is reported to the regulator.

Verification monitoring is undertaken to ensure that the analysis done by CSC is correct. *E coli* samples are taken weekly and analysed by CSC. Every three months the E. coli sample is split and sent to a NATA registered laboratory for analysis. Results are compared via the SWIM database Verification monitoring data is reported in our annual report.

5.1 Sampling Locations

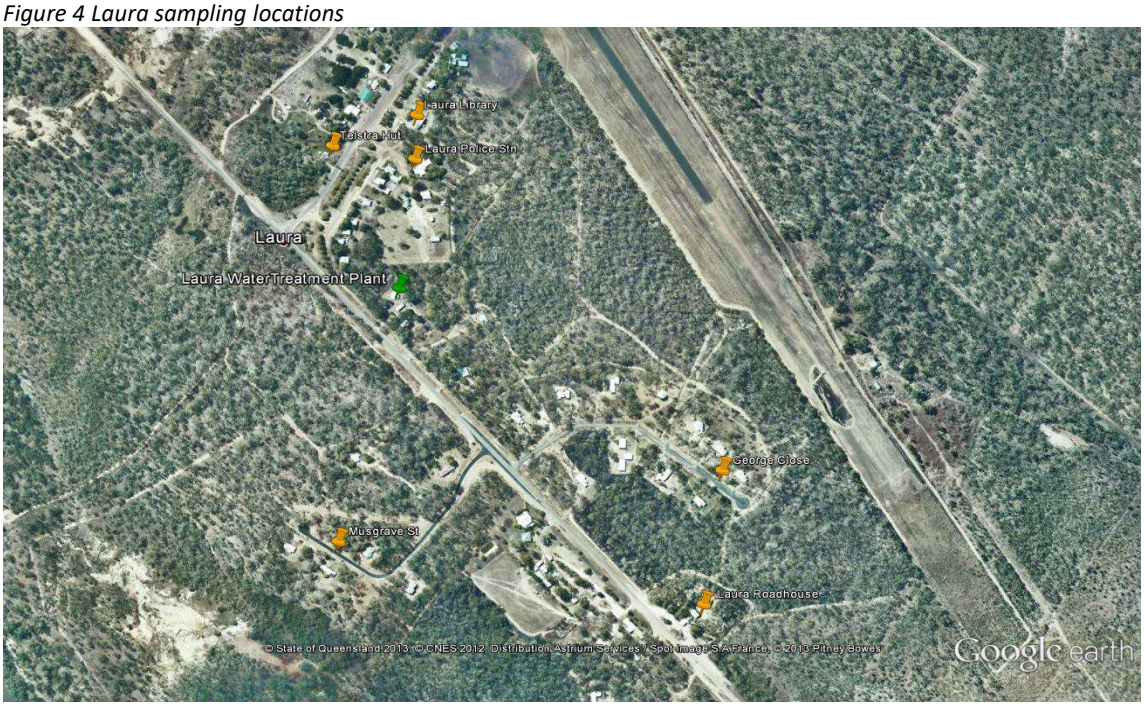
Operational monitoring occurs at a number of steps through the WTP process, and these are identified in the tables that follow.

Additionally, there are sample locations for both operational and verification monitoring that are located throughout the reticulation network. These are detailed below.

Table 9 Reticulation sample locations

Sample Location Name	Street Name	Site Chosen Because	GPS Coordinates *
Laura Roadhouse	Peninsula Development Rd	End of the line.	15°33'59.10"S - 144°27'3.32"E
Telstra Hut	Terminus St	Towards the end of the line.	15°33'32.89"S - 144°26'42.73"E
Laura Library	Terminus St	Ease of access	15°33'31.15"S - 144°26'47.43"E
Laura Police Station	Gladwell Court	Centrally located	15°33'33.67"S - 144°26'47.32"E
End of George Close	George Close	Towards the end of the line.	15°33'51.48"S - 144°27'4.35"E
End of Musgrave St	Musgrave St	Towards the end of the line.	15°33'55.55"S - 144°26'43.10"E

Figure 4 Laura sampling locations



The above sample locations give a good cross section of the town including the dead end areas as shown in the figure below.

Table 10 Verification and Operational monitoring

Process Step / Location in System	Parameter	Sampling			Is this sample Verified by a NATA registered Lab	Operational Monitoring Comments
		Location	Frequency	Type		
Raw Water Composite Bore Sample	**Physical / Chemical Analysis** pH, Electrical Conductivity, Total Hardness, Turbidity, Colour apparent, Salinity & Silica	Bores	Quarterly	Grab Sample	Y	NATA registered laboratory.
	Metals: Fe, Mn	Bores	Quarterly	Grab Sample	Y	NATA registered laboratory.
	Coliforms/E.coli	Bores	Weekly	Grab Sample	N	E.coli analysed by CSC Annan WTP staff
Treatment Plant Final	**Physical / Chemical Analysis** pH, Electrical Conductivity, Total Hardness, Turbidity, Colour apparent, Salinity & Silica	WTP Final water to town	Quarterly	Grab Sample	Y	NATA registered laboratory.
	Metals: Fe, Mn	WTP Final water to town	Quarterly	Grab Sample	Y	NATA registered laboratory.
	Coliforms / E.coli	WTP Final water to town	Weekly	Grab Sample	Y	IDEXX Colisure method. Analysed at the Annan Water Treatment Plant by Cook Shire Council staff. Verified quarterly at NATA registered lab.
	Free chlorine	WTP Final water to town	Continuous	Analyser	N	
	Free chlorine	Elevated tank	Weekly	Grab Sample	N	On-site analyses with handheld chlorine analyser
Reticulation	**Physical / Chemical Analysis** pH, Electrical Conductivity, Total Hardness, Turbidity, Colour apparent, Salinity & Silica	Various Samples sites in the reticulation system. See Table 6.	Quarterly	Grab Sample	Y	NATA registered laboratory.
	Metals: Fe, Mn				Y	
	pH	Various Samples sites in the reticulation system. See Table 6.	Monthly	Grab Sample	Y	Samples analysed at the Annan Water Treatment Plant by Cook Shire Council staff. Verified quarterly at a NATA registered lab.
	Temperature				N	
	Dissolved Oxygen				N	
	Turbidity				Y	
	Colour				Y	
	Electrical Conductivity				Y	
	Total Dissolved Solids				Y	

	Total Hardness				Y	
	Free Chlorine - Residual				Y	
	Coliforms / E.coli		1 sample per Week	Grab Sample	Y	IDEXX Colisure method. Analysed at the Annan Water Treatment Plant by Cook Shire Council staff. Verified quarterly at NATA registered lab.
	Trihalomethanes including Chloroform, Bromodichlormethane, Dibromochloromethane, Bromoform and Total Trihalomethanes. Oxyhalides including chlorate.		Quarterly	Grab Sample	Y	NATA registered laboratory.

- Verification samples for *E. coli* are split in half. Half is analysed by CSC Annan Staff using IDEXX and the other half is sent to a NATA certified laboratory.
- Physical/Chemical samples are verified quarterly. Samples are split in half. Half is analysed by CSC Annan Staff and the other half is sent to a NATA certified laboratory.
- All water samples are collected by either the Reticulation staff, or the Water Treatment Plant operators all of which have had the appropriate training to collect water samples. Samples collected for verification are transported to Cairns by Air, and analysed by NATA accredited Laboratories (Cairns Regional Council Water Quality Laboratory at present).
- In the event that a parameter being analysed exceeds the ADWG health guidelines, it is reported to regulation as per procedure WS0015.
- Gross α (Bq/L) and Gross β (Bq/L) will be tested twice in February and August 2023 on Laura raw water as a screen for radiological water quality.
- Pharmaceutical and Personal Care Product (PPCP) testing will be done in February and August 2023 on Laura raw water as a screen for bore water contamination.

6 WATER QUALITY CHARACTERISATION

Table 11 Laura WTP Raw water quality - Laura Bores (NATA lab)

Parameter	Sampling Location	Time Period	No of samples taken in time period	Summary of results		
				Min Value	Max Value	Average Value
Alkalinity mg/L CaCO3	Laura Raw Bore Sampled from the Bores	1 January 2017 to 31 March 2022	19	64.0	79.0	70.7
Calcium mg/L			19	3.1	5.8	4.1
Chloride mg/L			19	14.0	34.0	20.8
Colour Apparent Pt-Co			19	1.0	52.0	21.2
Electrical Conductance µS/cm^2			19	190.0	260.0	215.3
Fluoride mg/L			19	0.09	0.16	0.12
Total Hardness mg/L			19	11.0	19.0	13.6
Magnesium mg/L			19	0.69	1.00	0.81
pH			19	6.7	7.9	7.2
Potassium mg/L			19	2.8	3.3	3.0
Salinity			19	90.0	130.0	100.0
Sodium mg/L			19	30.0	47.0	37.2
Total Dissolved Solids mg/L			19	110.0	160.0	129.8
Sulphate mg/L			19	3.5	4.5	4.0
Turbidity NTU			19	0.1	30.0	6.6
Arsenic mg/L			19	0.0002	0.001	0.0004
Barium mg/L			19	0.224	0.329	0.259
Beryllium mg/L			19	0.0001	0.001	0.0003
Cadmium mg/L			19	0.0001	0.0001	0.0001
Chromium mg/L			19	0.0002	0.0010	0.0005
Cobalt mg/L			19	0.0005	0.0010	0.0006
Copper mg/L			19	0.001	0.130	0.011
Iron mg/L			19	0.008	2.62	1.309
Lead mg/L			19	0.0005	0.0011	0.0006
Manganese mg/L			19	0.0002	0.0798	0.0519
Mercury mg/L			19	0.00001	0.00006	0.00006
Nickel mg/L			19	0.0005	0.0021	0.0008
Selenium mg/L			19	0.002	0.005	0.003
Vanadium mg/L			19	0.0001	0.001	0.0003

Parameter	Sampling Location	Time Period	No of samples taken in time period	Summary of results		
				Min Value	Max Value	Average Value
Zinc mg/L			19	0.008	0.601	0.045

Table 12 Laura WTP Final Treated Water Quality (NATA lab)

Parameter	Sampling Location	Time Period	No of samples taken in time period	Summary of results			Australian Drinking Water Guidelines guideline value (2011)	No of samples exceeding Australian Drinking Water Guidelines guideline value
				Min. Value	Max Value	Average Value		
Alkalinity mg/L $CaCO_3$	Laura Final Treated Water Sampling Tap	1 January 2018 to 31 March 2022	13	68	79	72		
Calcium mg/L			13	3.7	5.8	4.6		
Chloride mg/L			13	20.0	34.0	26.0	250 - mg/L	0
Colour Apparent Pt-Co			13	0.0	19.0	2.1	15 – Pt/Co	1
Electrical Conductance µS/cm²			13	210.0	270.0	232.7		
Fluoride mg/L			13	0.09	0.18	0.13	1.5 - mg/L	0
Total Hardness mg/L $CaCO_3$			13	12.0	19.0	14.9	200 - mg/L	0
Magnesium mg/L			13	0.71	1.20	0.88		
pH			13	7.2	8.0	7.8	6.5 – 8.5	0
Potassium mg/L			13	2.9	3.5	3.0		
Salinity mg/L			13	100	130	110		
Sodium mg/L			13	35.0	48.0	40.9	180 - mg/L	0
Total Dissolved Solids mg/L			13	130	160	142	600 - mg/L	0
Sulphate mg/L			13	3.8	4.5	4.1	250 - mg/L	0
Turbidity NTU			13	0.1	7.1	0.5	5 - NTU	1
Arsenic mg/L		1 January 2017 to 31 March 2022	17	0.0002	0.0010	0.0004	0.01 - mg/L	0
Barium mg/L			17	0.223	0.360	0.264	2.0 - mg/L	0
Beryllium mg/L			17	0.0001	0.0010	0.0003	0.06 - mg/L	0
Cadmium mg/L			17	0.0001	0.0001	0.0001	0.002 - mg/L	0
Chromium mg/L			17	0.0002	0.0010	0.0005	0.05 - mg/L	0
Cobalt mg/L			17	0.0005	0.0010	0.0006	0.01 - mg/L	0
Copper mg/L			17	0.001	0.042	0.010	2.0 - mg/L	0
Iron mg/L			17	0.008	1.880	0.087	0.3 - mg/L	1
Lead mg/L			17	0.0005	0.0037	0.0008	0.01 - mg/L	0
Manganese mg/L			17	0.0002	0.0803	0.0045	0.1 - mg/L	0
Mercury mg/L			17	0.00006	0.00006	0.00006	0.01 mg/L	0
Nickel mg/L			17	0.0005	0.0010	0.0006	0.02 - mg/L	0
Selenium mg/L			17	0.002	0.005	0.003	0.01 - mg/L	0
Vanadium mg/L			17	0.0001	0.0010	0.0003		
Zinc mg/L			17	0.007	0.043	0.014	3.0 - mg/L	0

Table 13 Laura Reticulation Water Quality data (NATA Lab)

Parameter	Sampling Location	Time Period	No of samples taken in time period	Summary of results			Australian Drinking Water Guidelines guideline value (2011)	No of samples exceeding Australian Drinking Water Guidelines guideline value
				Min Value	Max Value	Average Value		
Alkalinity mg/L CaCO3	Various Locations within the Laura Reticulation as per Table 6	01 January 2018 – 31 March 2022	15	68.0	79.0	72.2		
Calcium mg/L			15	3.7	5.7	4.81		
Chloride mg/L			15	20.0	33.0	26.2	250 - *mg/L*	0
Colour Apparent Pt- Co			15	1.0	5.2	1.3	15 *Pt/Co*	0
Electrical Conductance µS/cm²			15	210.0	260.0	233.9		
Fluoride mg/L			15	0.09	0.16	0.13	1.5 - *mg/L*	0
Total Hardness mg/L CaCO3			15	12.0	19.0	15.7	200 *mg/L*	0
Magnesium mg/L			15	0.71	1.10	0.89		
pH			15	7.70	8.00	7.86	6.5 – 8.5	0
Potassium mg/L			15	2.8	3.4	3.03		
Salinity			14	100.0	130.0	110.0		
Silicon mg/L			13	15.0	23.0	18.8	80mg/L Silica	0
Sodium mg/L			15	35.0	47.0	41.1		
Sulphate mg/L			15	3.9	4.6	4.3	180 *mg/L*	0
Total Dissolved Solids mg/L			15	130.0	160.0	142.3	600 *mg/L*	0
Turbidity NTU			15	0.10	0.50	0.16	<5 NTU	0
Arsenic mg/L		01 January 2017 – 31 March 2022	20	0.0002	0.001	0.0004	0.01 *mg/L*	0
Barium mg/L			20	0.228	0.321	0.266	2 *mg/L*	0
Beryllium mg/L			20	0.0001	0.001	0.0003	0.06 *mg/L*	0
Cadmium mg/L			20	0.0001	0.0001	0.0001	0.002 *mg/L*	0
Chromium mg/L			20	0.0002	0.001	0.0005	0.05 *mg/L*	0
Cobalt mg/L			20	0.0005	0.001	0.0006		
Copper mg/L			20	0.001	0.142	0.029	2.0 *mg/L*	0
Iron mg/L			20	0.0080	0.2000	0.0204		
Lead mg/L			20	0.0005	0.0058	0.0010	0.01 *mg/L*	0
Manganese mg/L			20	0.0002	0.0580	0.0030		
Mercury mg/L			20	0.00006	0.00010	0.00006	0.001 mg/L	0
Nickel mg/L			20	0.0005	0.0050	0.0009	0.02 *mg/L*	0
Selenium mg/L			20	0.0020	0.0050	0.0027	0.01 *mg/L*	0
Vanadium mg/L			20	0.0001	0.001	0.0004		
Zinc mg/L			20	0.0080	0.4710	0.0494	3.0 *mg/L*	0

Table 14 Treated Water quality details - Laura Reticulation (Annan Lab)

These are sampled from the Laura Reticulation, at various locations and analysed at the Annan Lab by CSC

Parameter	Sampling Location	Time Period	No of samples taken in time period	Summary of results			Australian Drinking Water Guidelines guideline value (2011)	No of samples exceeding Australian Drinking Water Guidelines guideline value
				Min Value	Max Value	Avg Value		
Chlorine residual (Free) *mg/L*	Various Locations within the Laura Reticulation	01 January 2017 – 31 March 2022	56	0.35	1.37	0.78	<5	0
Colour Apparent - *Pt- Co*			56	0	21.0	1.6	15 – *Pt/Co*	0
Dissolved Oxygen *mg/L*			56	5.0	8.5	7.1		
Electrical Conductance			57	187.6	521.0	244.8		
Total Hardness - *mg/L CaCO3*			54	7	171	21.4	200 - *mg/L*	0
pH			57	6.6	7.9	7.2	6.5 – 8.5	0
Total Dissolved Solids - *mg/L*			45	105.9	314.3	137.1	600 - *mg/L*	0
Turbidity *NTU*			55	0.04	2.72	0.28	<5 NTU	0

Table 15 E.coli Results – Laura Reticulation (Annan Lab)

Parameter	Sampling Location	Time Period	No of samples analysed in time period	Results	Australian Drinking Water Guidelines guideline value (2011)	No of samples exceeding Australian Drinking Water Guidelines guideline value
				No of Samples where *E.coli* was Detected		
Escherichia coli	Various Locations within the Laura Reticulation	01 January 2017 – 31 March 2022	200	0	Escherichia coli should not be detected in any 100 mL sample of drinking water.	0

Table 16 Laura WTP daily chlorine residuals (on-line analyser)

	SCADA on line Chlorine readings (mg/L) 01/07/2017 – 31/03/2022
Count	1,725
Min	0.33
Max	4.90
Avg	0.87
No of samples recorded as below 0.3	0

Table 17 Laura Reticulation Trihalomethanes and Chlorate results (NATA lab)

Date Sampled – 01/10/2017 – 31/12/2019								
Parameter	Unit	No of Samples collected	Summary of Results			ADWQ Guidelines Value (2011)	No of Samples exceeding ADWG or WHO	
			Min. Value	Max. Value	Avg. Value		Health	Aesthetic
Chloroform	µg/L	14	5	101	21	<250 µg/L	0	-
Bromodichloromethane	µg/L	14	5	36	16	<250 µg/L	0	-
Dibromochloromethane	µg/L	14	5	16	8	< 250 mg/L	0	-
Bromoform	µg/L	14	5	18	6	<250 µg/L	0	-
Total Trihalomethanes	µg/L	14	5	144	43	<250 µg/L	0	-
Chlorate	mg/L	14	0.59	1.57	0.95	<0.8 mg/L	6	-

Table 18 Laura Raw Water E. Coli (Annan Lab)

Parameter	Sampling Location	Time Period	No of samples analysed in time period	Summary of Results		
				Min. Value	Max. Value	Avg. Value
Escherichia coli	**Raw Bore Water**	1 July 2017 to 31 July 2022	183	0	40	1