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Service Provider ID: 9

# **Drinking Water Quality Management Plan (DWQMP)**

## **ANNUAL REPORT 2019/2020**

## Glossary of terms

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

## 1. Introduction

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

The report assists the Regulator to determine whether the approved DWQMP and any approval conditions have been complied with and provides a mechanism for providers to report publicly on their performance in managing drinking water quality.

This template has been prepared in accordance with the *DWQMP report guidance note* published by the Department of Natural Resources, Mines and Energy, Queensland, accessible at [www.business.qld.gov.au/industries/mining-energy-water/water/industry-infrastructure/industry-regulation/drinking-water/annual-report](http://www.business.qld.gov.au/industries/mining-energy-water/water/industry-infrastructure/industry-regulation/drinking-water/annual-report).

## 2. Overview of Operations

Barcoo Shire incorporates the towns of Jundah, Stonehenge and Windorah, and covers an expanse of 61,974 sq km. The population of the shire is approximately 265. The administration centre of Barcoo Shire is 220 km south of Longreach in the township of Jundah.

Barcoo Shire Council is a small drinking water service provider as defined under the Act and provides drinking water to a population of approximately 190 people. Each town is serviced by dual water reticulation, a treated, potable water supply as well as an untreated non-potable supply.

Barcoo Shire Council is responsible for the following water supply schemes:

- **Jundah**

Raw water is sourced from a nearby waterhole on the Thomson River. This river water is coagulated and treated by conventional sedimentation and rapid sand filtration in a package module. After chlorination, it transfers to a ground level reservoir and from there it is pumped into a high-level reservoir which supplies the town.

Bore water is stored in a small ground level reservoir prior to treatment in the reverse osmosis plant and transfers to the same ground level reservoir as the treated river water. The reverse osmosis plant hasn't been in operation since November 2014.

- **Windorah**

Raw water is sourced from two nearby waterholes on the Cooper Creek. This river water is coagulated and treated by conventional sedimentation and dual media rapid gravity filtration in a package plant. After chlorination, it transfers to a ground level reservoir and from there it is pumped into a high-level reservoir which supplies the town.

- **Stonehenge**

Raw water is sourced from a nearby waterhole on the Thomson River and is pumped to an off-stream storage during river flows. Water from the off-stream storage is pumped, with addition of coagulant, to a small flocc-sed unit and then into a flow balance tank. The water then passes through a pressure filter and is chlorinated before being transferred to a ground level reservoir from which it is pumped into a high-level reservoir which supplies the town.

### 3. Actions taken to implement the DWQMP

#### **Progress in implementing the risk management improvement program**

Refer to the Appendices for a summary of progress in implementing each of the Improvement Program actions.

#### **Revisions made to the operational monitoring program to assist in maintaining the compliance with water quality criteria<sup>1</sup> in verification monitoring.**

No changes were made to the operational monitoring program in 2019/20.

#### **Amendments made to the DWQMP**

A full review was undertaken of the DWQMP following the first audit, with the amended DWQMP being approved on 3 September 2019. The main amendments were as a result of a new risk workshop being undertaken and the development of a new RMIP. There were also changes made to how incidents and emergencies are managed, as well as a general update of the infrastructure details.

### 4. Compliance with water quality criteria for drinking water

The water quality criteria mean health guideline values in the most current Australian Drinking Water Guidelines, as well as the standards in the Public Health Regulation 2005. Refer to Appendix A for the monitoring results.

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

This financial year there was one (1) instance where the Regulator was notified under sections 102 or 102A of the Act and one (1) ongoing incident.

#### **Non-compliances with the water quality criteria and corrective and preventive actions undertaken**

None

#### **Prescribed incidents or Events reported to the Regulator and corrective and preventive actions undertaken.**

On 9/1/2020 the notification of a drinking water event was made for Windorah. The issue was a faulty valve at the treatment plant that allowed raw water to pass through untreated, to the treated water storage. Corrective actions were taken and the fault remedied. The incident was closed out on 14/1/2020. As part of the DWQMP review due by 31 December 2020, Council will consider the inclusion of this type of event as a risk assessed hazardous event for inclusion in the DWQMP.

The detection of a parameter with no water quality criteria in all three towns occurred in December 2018. The event involved readings between 1.3 – 3.7 mg/L for chlorate. Follow up testing was undertaken with levels gradually declining by July 2019 but increasing again over the following

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<sup>1</sup> Refer to *Water Quality and Reporting Guideline for a Drinking Water Service* for the water quality criteria for drinking water.

summer period. A trend is developing with lower readings in winter and higher readings in summer. The preventative actions involved ensuring that treatment plant operators employ good practice when batching chlorine solution for the purpose of disinfection. Further action in changing to sodium hypochlorite for disinfection at both Jundah and Windorah has been taken along with the change in filter backwashing at Jundah.

Monitoring of this event/parameter is ongoing.

## 6. Customer complaints related to water quality

Barcoo Shire Council is required to report on the number of complaints, general details of complaints, and the responses undertaken.

Throughout the year, the following complaints about water quality were received:

**Table 1 - complaints about water quality, (including per 1000 customers)**

	Suspected Illness	Discoloured water	Taste and odour	Total
Jundah	0	0	1	1
Windorah	0	0	0	0
Stonehenge	0	0	1	1
Total	0	0	2	2

### Suspected Illness

Nil

### Discoloured water

Nil

### Taste and odour

Both complaints relate to the taste of chlorine. Investigation revealed that chlorine levels were in accordance with the DWQMP and ADWG.

## 7. Findings and recommendations of the DWQMP auditor

No audit of the DWQMP was undertaken in 2019/20. The next audit is due before 30 June 2022.

## 8. Outcome of the review of the DWQMP and how issues raised have been addressed

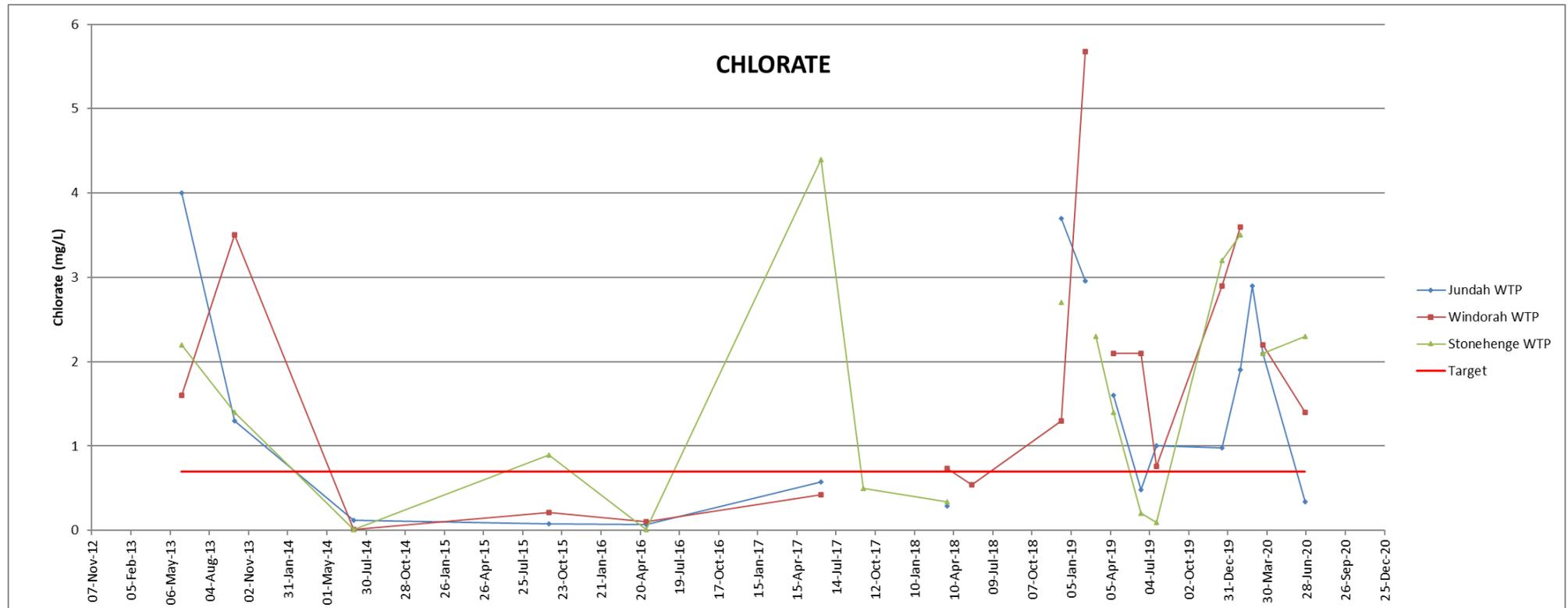
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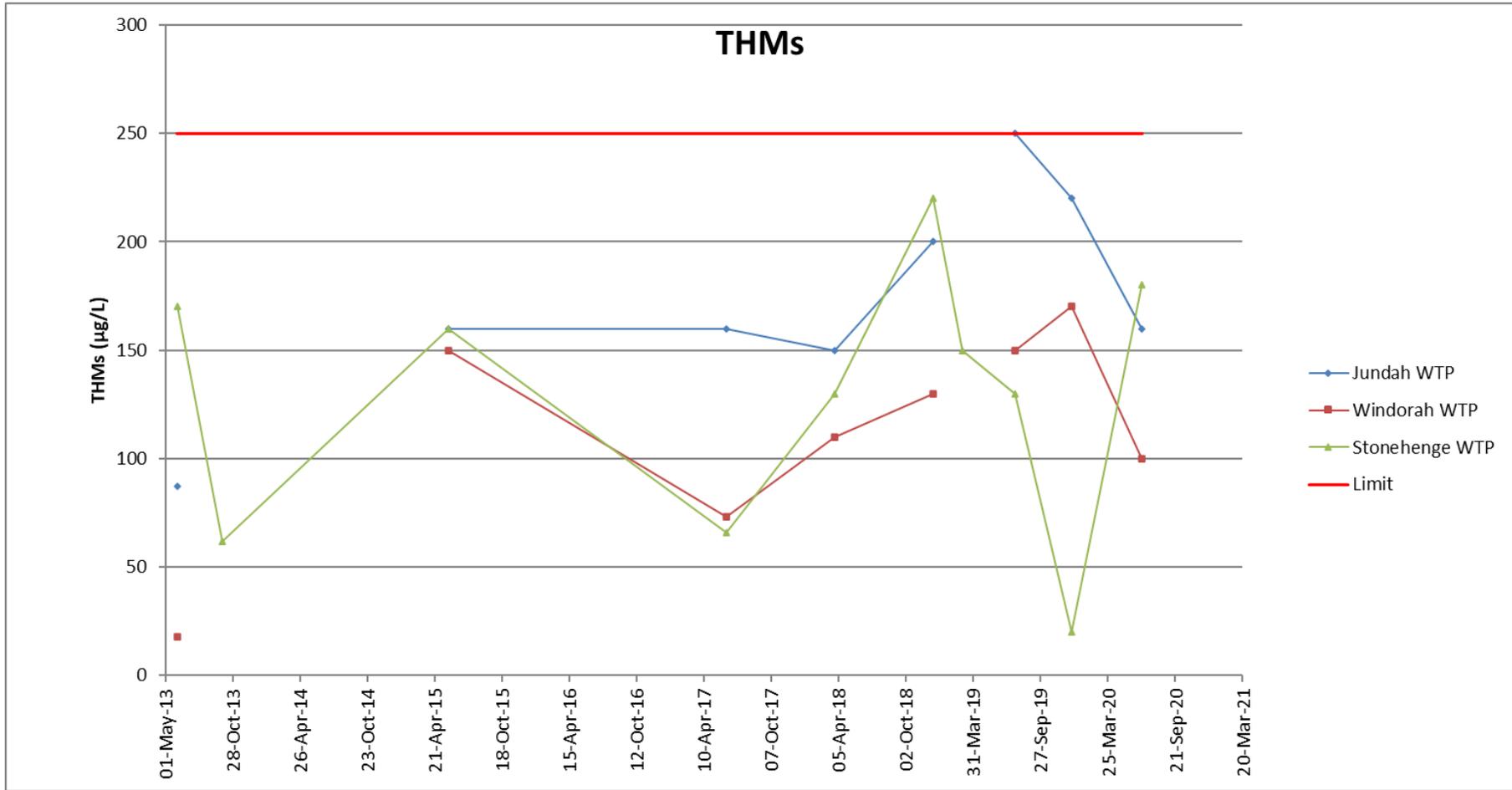
## Appendix A – Summary of compliance with water quality criteria

The results from the verification monitoring program have been compared against the levels of the water quality criteria specified by the Regulator in the *Water Quality and Reporting Guideline for a Drinking Water Service*.

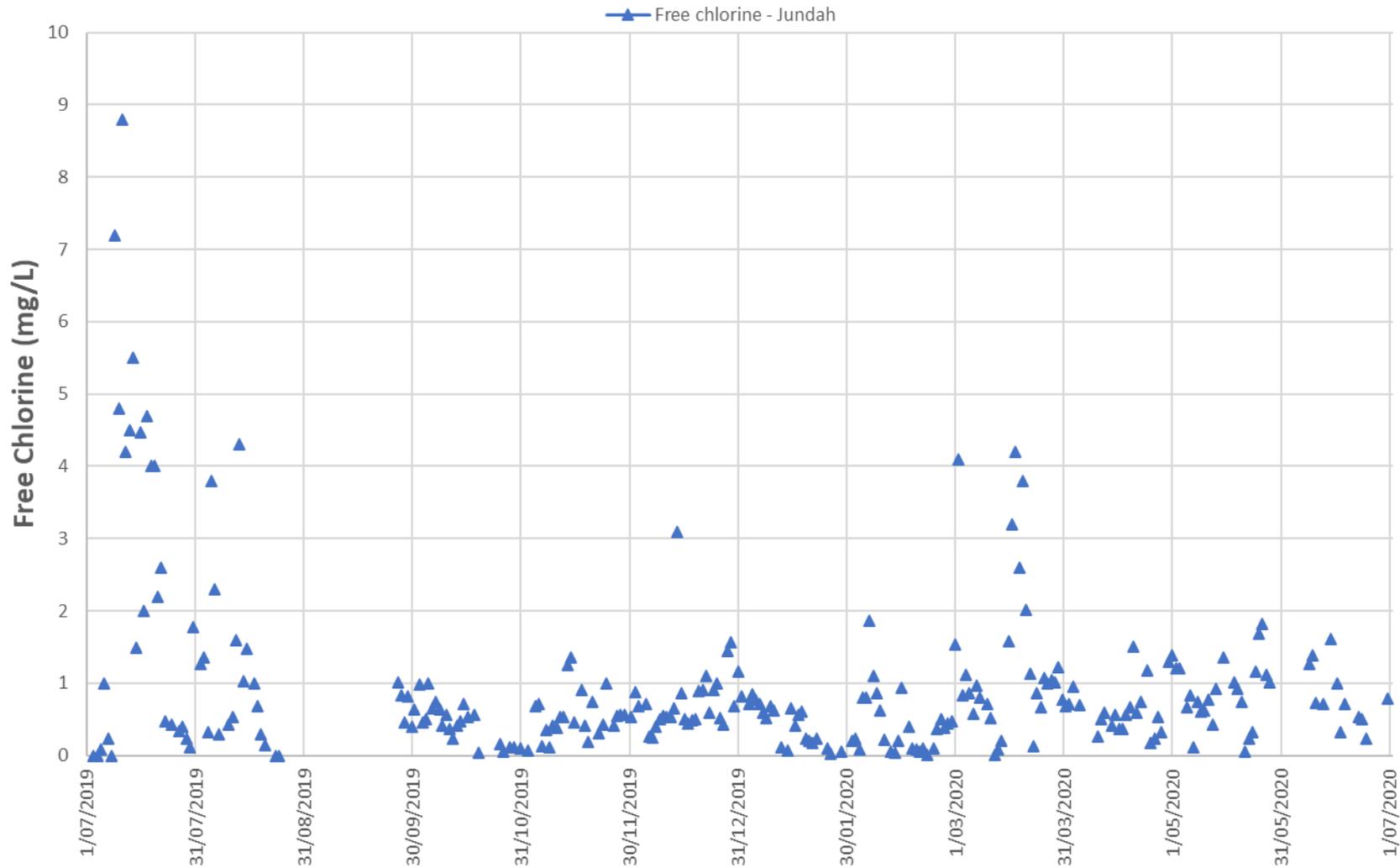
The reported statistics do not include results derived from repeat samples, or from emergency or investigative samples undertaken in response to an elevated result.

**Table 2 - Verification monitoring results**

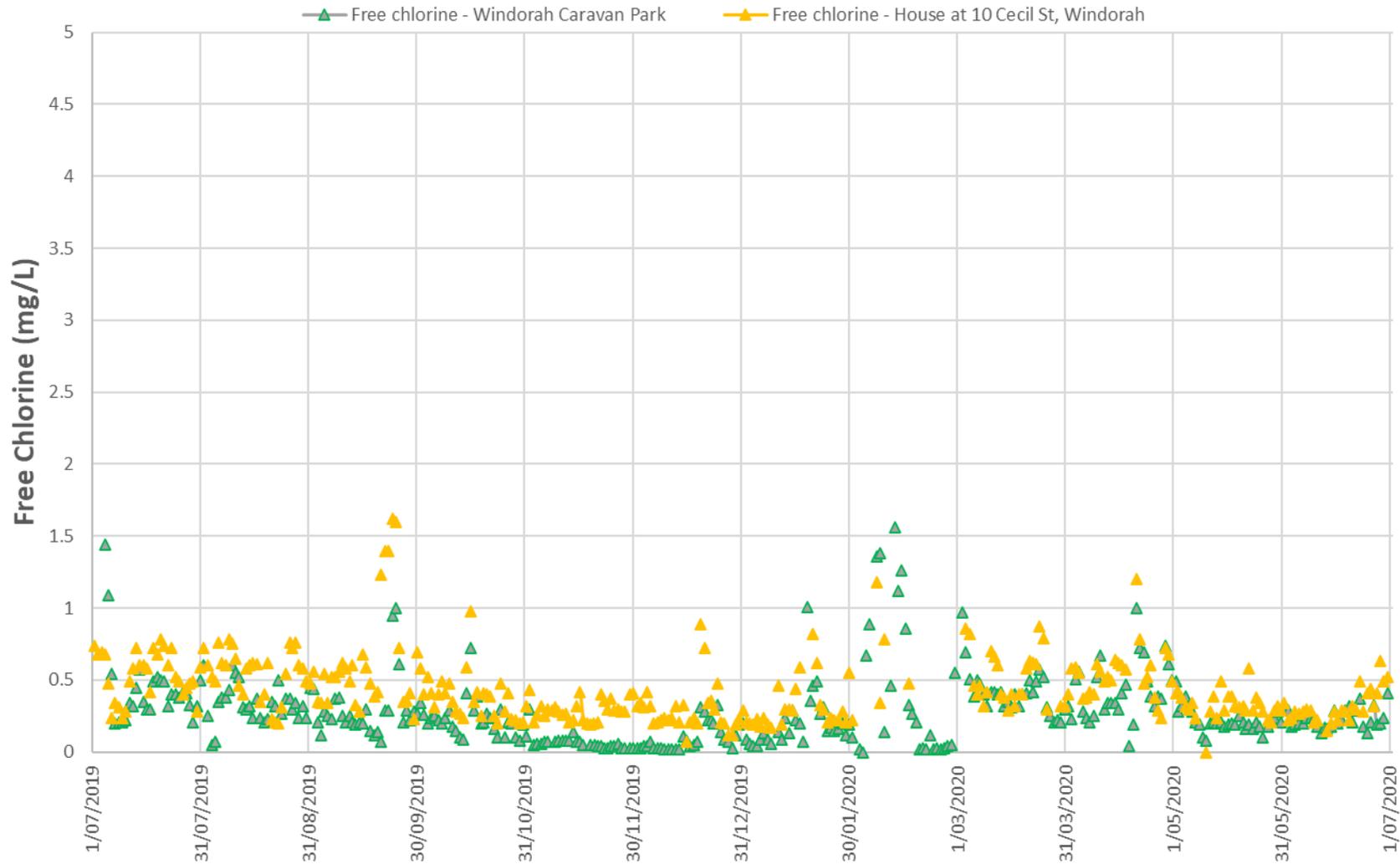




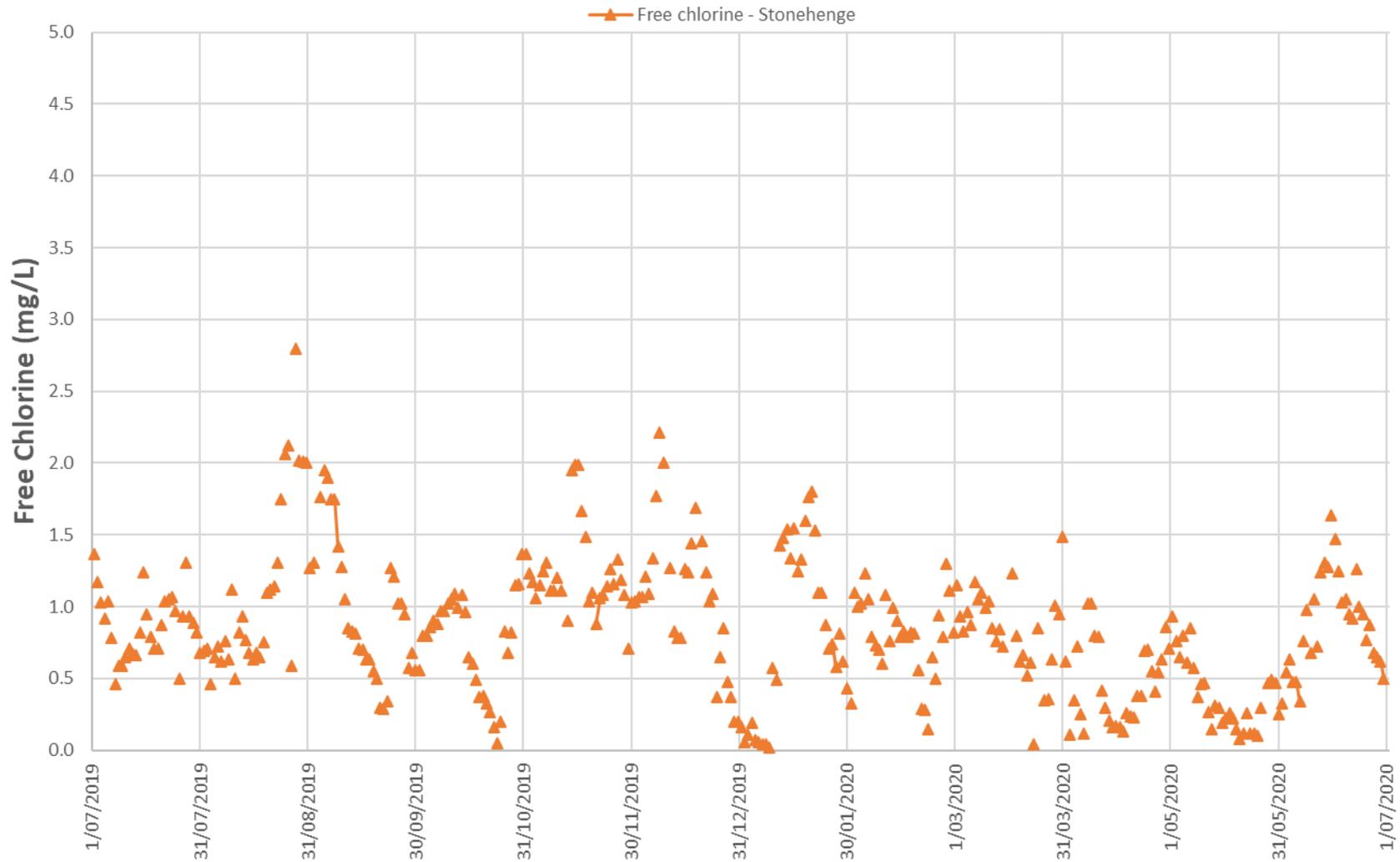
# FREE CHLORINE IN RETICULATION NETWORK



# FREE CHLORINE IN RETICULATION NETWORK



# FREE CHLORINE IN RETICULATION NETWORK



**Table 3 - Reticulation *E. coli* verification monitoring**

**CALCULATE PERCENTAGE USING A TWELVE (12) MONTH 'ROLLING' ANNUAL VALUE**

The *Public Health Regulation 2005* (the regulation) requires that 98 per cent of samples taken in a 12 month period should contain no *E. Coli*. This requirement is referred to as the 'annual value' in Schedule 3A of the regulation.

This requirement comes into effect once you have 12 months data and should be assessed every month based on the previous 12 months data (so that it is a 'rolling' assessment).

Drinking water scheme: Jundah

Year	2019 to 2020											
Month	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
No. of samples collected	12	4	8	12	4	8	8	8	8	8	8	9
No. of samples collected in which <i>E. coli</i> is detected (i.e. a failure)	0	0	0	0	0	0	0	0	0	0	0	0
No. of samples collected in previous 12 month period	82	74	78	78	74	78	78	80	84	88	92	97
No. of failures for previous 12 month period	0	0	0	0	0	0	0	0	0	0	0	0
% of samples that comply	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Compliance with 98% annual value	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Drinking water scheme: Windorah

Year	2019 to 2020											
Month	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
<b>No. of samples collected</b>	8	8	8	12	4	8	16	4	12	12	4	8
<b>No. of samples collected in which <i>E. coli</i> is detected (i.e. a failure)</b>	0	0	0	0	0	0	0	0	0	0	0	0
<b>No. of samples collected in previous 12 month period</b>	94	91	87	87	83	87	95	88	96	104	100	104
<b>No. of failures for previous 12 month period</b>	0	0	0	0	0	0	0	0	0	0	0	0
<b>% of samples that comply</b>	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
<b>Compliance with 98% annual value</b>	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Drinking water scheme: Stonehenge

Year	2019 to 2020											
Month	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
No. of samples collected	12	4	12	8	4	8	11	4	8	8	4	11
No. of samples collected in which <i>E. coli</i> is detected (i.e. a failure)	0	0	0	0	0	0	0	0	0	0	0	0
No. of samples collected in previous 12 month period	98	94	102	98	94	98	101	98	90	87	87	94
No. of failures for previous 12 month period	0	0	0	0	0	0	0	0	0	0	0	0
% of samples that comply	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Compliance with 98% annual value	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

External laboratory check of E.coli and coliforms

<b>Sample Site</b>	<b>Units</b>	<b>Coliforms</b>	<b>E. coli</b>	<b>Date Sampled</b>
Jundah WTP	MPN/100ml	2,400	<1	18/12/2019
Windorah WTP	MPN/100ml	<1	<1	18/12/2019
Stonehenge WTP	MPN/100ml	<1	<1	18/12/2019

## Appendix B – Implementation of the DWQMP Risk Management Improvement Program

**Table 4 – Progress against the risk management improvement program in the approved DWQMP**

# JUNDAH

Process Step	Primary hazard	Source of Hazard/Event	Primary Preventive Measure	Residual Risk Level	Immediate	Short Term	Long Term	Comments	Status
Water source - Thomson River	Protozoa (Crypto/Giardia) (Source Water)	On-site sewage management system discharges and failures	Media Filter	Extreme 20	Filter upgrade investigation (e.g. new filter media or new filters). Revise critical control points against filter output data				Investigation by Consultant to assess necessary improvements has been completed. Recommendation is to replace the WTP due to its outdated treatment capability and remaining useful life. Further progress on this action will be subject to the availability of future funding.
Water source - Thomson River	Protozoa (Crypto/Giardia) (Source Water)	Unrestricted access to livestock or wild/feral animals/birds	Media Filter	Extreme 20	Filter upgrade investigation (e.g. new filter media or new filters). Revise critical control points against filter output data				Refer to Status above.
Water source - Thomson River	Turbidity	Drought, bushfire, runoff	Coag and settling tank	High 12		Investigate turbidity readings being inputted to SCADA, with plant shut-down and alarm options		Potential evidence of filter bypass. Backwashing 3-4 times per day on some days. Filter ripening taking excessive time period. Filter media needs replacing	Investigation by Consultant to assess necessary improvements has been completed. Recommendation is to replace the WTP due to its outdated treatment capability and remaining useful life. Further progress on this action will be subject to the availability of future funding.
Water source - Thomson River	Colour	Naturally occurring in raw water		High 12	Council to complete investigation to ascertain variation in water colour, related to DOM levels, and the impact of this on disinfection by-products			Historical WQ data indicates high raw water true colour, which may indicate high DOC, which may be impacting on disinfection by-products	Test results for raw water DOC on all three schemes in February 2017 and December 2018 has shown that the level of DOC falls within the range of 4.8 - 5.8 mg/L. Testing of THMs was also undertaken at the same time for all three schemes, with total THM levels being < 220 µg/L at all sites. This is below the ADWG level. Council will continue to monitor the level of THMs in accordance with the approved DWQMP.
Media Filter	Protozoa (Crypto/Giardia) (Source Water)	Inadequate filter operation or backwashing, mudball formation	Filter backwash	Extreme 20	Filter upgrade investigation (e.g. new filter media or new filters). Revise critical control points against filter output data. Investigate filter to waste during ripening period	Investigate incorporating turbidity inline monitoring into process optimisation, as well as remote inline monitoring information available on SCADA platform		Potential evidence of filter operational issues, with media filter relatively old. Backwashing 3-4 times per day on some days, however backwash based on visual cues rather than output turbidity. Filter settling after backwash indicates issues within filter. Filter ripening taking excessive time period. Filter media needs replacing. 2017/2018 average filter output turbidity 0.5 NTU, 95th percentile 1.31 NTU	Investigation by Consultant to assess necessary improvements has been completed. Recommendation is to replace the WTP due to its outdated treatment capability and remaining useful life. Further progress on this action will be subject to the availability of future funding.
Media Filter	Protozoa (Crypto/Giardia) (Source Water)	Excessive filter flow rates, filter preferential flow	Filter units flow paced	High 12	Filter upgrade investigation (e.g. new filter media or new filters)			Based on possibility of filter breakthrough occurring following backwash	Refer to Status above.
Chlorine dosing	Bacteria/Virus (Reticulation)	Pump failure/underdosing	Chlorine dosing rate low level alarm SMS message	Extreme 20	Investigate liquid hypo dosing in 44L drums to replace granular chlorine. Investigate chlorine storage shed options. Chlorine pump operation needs to be automated. Chlorine meter to be calibrated.	Consult with process engineer to consider additional chlorine dosing on output of blue tank into town.		Currently dosing granular calcium hypochlorite. Layering of calcium hypochlorite solution within chlorine tank causing issues with consistency of chlorine dosing. Extremely long detention time in clear water tank and reservoir results in extreme degradation of chlorine, especially during periods of high temperatures. Operator reported dosing chlorine at 10 mg/L, with negligible free chlorine subsequently detected in network. Chlorine c.t. confirmed as adequate, with baffle factor of 0.1	Council is now dosing from smaller volumes of liquid hypo. Other actions are yet to be completed.
Chlorine dosing	Chlorine	Overdosing	Chlorine meter alarm	High 12	Council to perform total chlorine analysis during sampling	Explore options for inline chlorine dosing meter to be interfaced into a SCADA system		Elevated free chlorine in network unlikely due to excessive detention time in clear water tank and reservoir before distribution to network, resulting in excessive chlorine deterioration, especially in higher temperatures. Chlorine differential between two tanks can be as high as 6 mg/L between the clear water tank and the reservoir. Based on dosing rates, total chlorine levels in network need to be explored	Council has included total chlorine testing as part of its regime. Other actions subject to future funding.
Chlorine dosing	Chlorate	Breakdown of chlorine solution		High 12	Risk of overdose due to calcium hypo solutions layering needs to be balanced against the chlorate risk. Gas is considered problematic from a WHS standpoint.	Council to explore options for all treatment plants – e.g. consider upgrades to mitigate against this and other risks.		Chlorate management has to be balanced against effective disinfection.	Council is now dosing from smaller volumes of liquid hypo. Council has also modified the source of water used for backwashing, so that treated water circulation is improved.
Chlorine dosing	Disinfection by-products (THMs)	High DOC in raw water		High 12	Council to complete investigation to ascertain variation in water colour, related to DOM levels, and the impact of this on disinfection by-products			High colour content may indicate high DOC, which could be leading to elevated THM formation	Test results for raw water DOC on all three schemes in February 2017 and December 2018 has shown that the level of DOC falls within the range of 4.8 - 5.8 mg/L. Testing of THMs was also undertaken at the same time for all three schemes, with total THM levels being < 220 µg/L at all sites. This is below the ADWG level. Council will continue to monitor the level of THMs in accordance with the approved DWQMP.
Clear water tank	Protozoa (Crypto/Giardia) (Retic)	Animal access including birds, amphibians, reptiles or rodents	Secure hatches	High 12	Incorporate hatch inspection in plant daily check-list. Undertake inspection of clear water tank to identify location of seepage, and rectify			Hatches noted as present on clear water tank, however one hatch was found open during inspection. Seepage also noted at base of clear water tank	Reservoir hatch is now checked to ensure it remains closed. Council has allocated funding in 2020/21 to replace the liner and roof of the ground level reservoir, which should address the seepage issue.
Reservoir	Bacteria/Virus (Reticulation)	Excessive water detention leading to chlorine deterioration	Monitoring and control of network free chlorine levels	Extreme 20		Investigate re-routing of filter backwash water source from clear water tank to reservoir (blue tank). Consult process engineer to consider additional chlorine dosing point after reservoir. Investigate short circuiting within blue tank, consider inflow spreader, as well as high level input riser pipe		Chlorine has excessive detention time in clear water tank and reservoir before distribution to network, resulting in excessive chlorine deterioration, especially in higher temperatures. Chlorine differential between two tanks can be as high as 6 mg/L between the clear water tank and the reservoir, with chlorine dosing reported at 10 mg/L but inadequate chlorine in reservoir. May be contributing to elevated chlorate levels. Further compounded by media filter backwash sourced from clear water tank, which results in water with less water age and higher chlorine residual being used for backwash, instead of sourcing water from reservoir	Re-routing of filter backwash water has been completed. Other actions subject to future funding.
Reservoir	Bacteria/Virus (Reticulation)	Cross connections/backflow	Separate potable and non-potable networks	High 10		One-way valve to be put on outlet of blue tank to ensure no backflow possible from network			Yet to commence
Whole of system	All hazards	Inadequate online monitoring or control	Inline turbidity and chlorine meter	High 15	Service and calibrate inline turbidity meter, alarms to be set up based on new WTP set-points	Investigate output of chlorine and turbidity meter to be automated online		Turbidity analyser not operational during site visit due to calibration issues. Difficulty in accessing calibration standards due to isolated locality. Chlorine and turbidity inline analysers recently checked against handheld meters, inline meter accuracy issues detected	Council has had a technician come to site in November 2019 but the inline analysers are yet to return to full function. Further work is required on this item. Other actions subject to future funding.
Whole of system	All hazards	Inadequate operators/staff training	WTP operators completed Cert III in water industry treatment	High 12	Council consider developing more detailed SOP with photos to provide guidance to fill-in staff. Council also to consider possibility of engaging relief operators during site operator absences			From discussions with operators, water quality incidents mostly occur when designated plant operator is away from site due to leave, sickness, etc.	Development of SOPs yet to commence. Council has been proactive in identifying and arranging relief operators for planned site operator absences.
Whole of system	All hazards	Not having operational procedures developed/available	DWQMP procedures developed	High 15	Develop CCP documents including target, adjustment and critical limits, with defined rectification actions. Develop new SOP for each WTP. Develop sampling and testing SOP. Develop incident response protocol			Large amounts of operational and maintenance tasks are not documented, leading to issues if plant operator unavailable. Current operational thresholds within DWQMP operating plan are not complied with, and are not achievable, especially with the current impact of chlorine degradation occurring between dosing and distribution.	CCP documents have been developed. Development of SOPs yet to commence.

# WINDORAH

Process Step	Primary hazard	Source of Hazard/Event	Primary Preventive Measure	Residual Risk Level	Immediate	Short Term	Long Term	Comments	Status
Water source - Cooper Creek Waterholes	Protozoa (Crypto/Giardia) (Source Water)	Septic system overflows, discharges and failures	Media filter	Extreme 20	Investigate filter media replacement			Backwash manually instigated. Backwash based on turbidity, or minimum frequency of every second day. Filter performance currently not meeting ADWG threshold for effective filter performance for protozoa removal (<0.2 NTU)	Council has secured funding in 2020/21 to fully replace the Windorah WTP. A Contractor is to be appointed in mid-late January 2021 to undertake this work, with the treatment plant expected to be in full operation by September 2021.
Water source - Cooper Creek Waterholes	Protozoa (Crypto/Giardia) (Source Water)	Unrestricted access to livestock or wild/feral animals/birds	Media filter	Extreme 20	Investigate filter media replacement			Cattle able to access raw water source. Campers often located adjacent to raw water off-takes	Refer to Status above.
Water source - Cooper Creek Waterholes	Colour	Naturally occurring in raw water	Mixed media filter (activated carbon)	High 12	Council to complete investigation to ascertain variation in water colour, related to DOM levels, and the impact of this on disinfection by-products			Historical WQ data indicates high raw water true colour	Test results for raw water DOC on all three schemes in February 2017 and December 2018 has shown that the level of DOC falls within the range of 4.8 - 5.8 mg/L. Testing of THMs was also undertaken at the same time for all three schemes, with total THM levels being < 220 µg/L at all sites. This is below the ADWG level. Council will continue to monitor the level of THMs in accordance with the approved DWQMP. The proposed new WTP will address the issues arising from the historic true colour levels.
Coagulation /flocculation	Turbidity	Inadequate mixing or inadequate clarifier detention time	Static inline mixer; flow limited at approx. 2.3 L/s	High 12		Council to investigate price of replacement package unit for clarifier and media filters		Carry-over of floc currently occurring from settling tank	The proposed new WTP will address this issue.
Media Filter	Protozoa (Crypto/Giardia) (Source Water)	Inadequate filter operation or backwashing, mudball formation	Turbidity monitoring	Extreme 20	Turbidity meter to be serviced to ensure it is operating correctly. Need to set critical limits within meter, and alarm. Alarms currently set to trigger excessively. Council to explore options to optimise instrumentation and alarm responses	Council to investigate price of replacement package unit for clarifier and media filters		Following on from backwash, filter media does not settle well. Currently having issues with in-line turbidity meter. Average filter output turbidity 0.39 NTU, with 95th percentile 0.72 NTU	Council has had a technician come to site in November 2019 but the inline analysers are yet to return to full function. Further work is required on this item. The proposed new WTP will address the immediate and short term actions.
Media Filter	Protozoa (Crypto/Giardia) (Source Water)	Excessive filter flow rates, filter preferential flow	Filter flow rate limited by plant design	High 10	Replace filter media. Check inlets			Backwash currently manually operated. Backwash tank fed from high level res. Backwash tank has large amount of algal growth	The proposed new WTP will address this issue.
Media Filter	Turbidity	Media loss	Media inspection and replacement	High 10		Council to investigate price of replacement package unit for clarifier and media filters		Filter media periodically replaced	Refer to Status above.
Chlorine dosing	Bacteria/ Virus (Reticulation)	Pump failure/underdosing	Spare chlorine dosing pump maintained on-site	Extreme 20		Investigate option to link chlorine dosing rate to chlorine in-line meter		Need to record chlorine dosing rate. Chlorine sampling and testing issues (refer to discussion below)	Refer to Status above.
Chlorine dosing	Bacteria/ Virus (Reticulation)	Inadequate chlorine c.t.	Clear water tank and reservoir	High 10	Develop CCPs with set thresholds and rectification actions			Maintaining chlorine dosing above 0.7 mg/L ensures adequate chlorine c.t. Current WTP target chlorine dosing threshold = 1.5 mg/L. However, targets often not achieved in practice	CCP documents have been developed.
Chlorine dosing	Chlorate	Excessive storage tank detention	Water storage turnover	High 12		Council to explore options for all treatment plants – e.g. consider upgrades to mitigate against this and other risks.		Current dosing post-filter causes large amounts of chlorine degradation, especially in summer, resulting in excessive chlorine dosing, but inadequate chlorine in network. This is also contributing to elevated chlorate concentrations.	The proposed new WTP will address this issue.
Chlorine dosing	Disinfection by-products	High colour in raw water	Mixed media filter (activated carbon)	High 12		Council to complete investigation to ascertain variation in water colour, related to DOM levels, and the impact of this on disinfection by-products		No assessment of filter on colour/DOC removal: high colour content may be indicating high DOC content, leading to elevated THM formation	Test results for raw water DOC on all three schemes in February 2017 and December 2018 has shown that the level of DOC falls within the range of 4.8 - 5.8 mg/L. Testing of THMs was also undertaken at the same time for all three schemes, with total THM levels being < 220 µg/L at all sites. This is below the ADWG level. Council will continue to monitor the level of THMs in accordance with the approved DWQMP. The proposed new WTP will address the issues arising from the historic true colour levels.
Clear water tank/reservoir	Protozoa (Crypto/Giardia) (Retic)	Animal access including birds, amphibians, reptiles or rodents	Tank hatches	High 15	Clear water tank requires works to ensure integrity to reduce access from vectors.	Council to consider replacement of clear water tank		Unprotected access to clear water tank identified during site visit. Swallows currently nesting under clear water tank platform	Council has provided funding in 2020/21 to replace the roof of the ground level tank.
Reticulation	Bacteria/ Virus (Reticulation)	New mains	New mains hygiene practices	High 15	Council provide training to plumbers in mains installation SOP. More hygienic storage facility for pipes and fittings to be determined			Fittings were seen during site visit stowed under bird nests beneath high level tank, with bird faecal matter observed on the fittings	Yet to commence.
Reticulation	Bacteria/ Virus (Reticulation)	Build-up of sediments, slime or biofilm	Maintenance of network chlorine residual	High 10	Council operator to undertake network free chlorine testing regime to ensure current monitoring points are representative of network chlorine levels, and of consistency of chlorine levels	Council to investigate requirements for additional chlorine dosing in network following network chlorine study		Air scouring of network completed	Network monitoring is now undertaken at two different sites on alternating days. Further monitoring sites are yet to be included. The most recent air scouring of the network was completed in October 2020.
Whole of system	All hazards	Inadequate online monitoring or control	Inline turbidity and chlorine meter	High 15	Inline turbidity and chlorine meters need to be calibrated and there performance validated.	Output of chlorine and turbidity meter to be automated online, alarms to be set up based on new WTP set-points			Council has had a technician come to site in November 2019 but the inline analysers are yet to return to full function. Further work is required on this item. The proposed new WTP will address this issue.
Whole of system	All hazards	Inadequate operators/staff training	WTP operators completed Cert III in water industry treatment	High 12	Council consider developing more detailed SOP with photos to provide guidance to fill-in staff. Council also to consider possibility of engaging relief operators during site operator absences			From discussions with operators, water quality incidents mostly occur when designated plant operator is away from site due to leave, sickness, etc.	Development of SOPs to be undertaken as part of the new WTP project. Council has been proactive in identifying and arranging relief operators for planned site operator absences.
Whole of system	All hazards	Not having operational procedures developed/available	DWQMP procedures developed	High 15	Develop CCP documents including target, adjustment and critical limits, with defined rectification actions. Develop new detailed O&M plan for WTP. Develop sampling and testing SOP. Develop incident response protocol			During the on-site visit, it was evident that additional training needs to be undertaken on WQ sampling and testing procedures. Large amounts of operational and maintenance tasks are not documented, leading to issues if plant operator unavailable	CCP documents have been developed. Development of SOPs to be undertaken as part of the new WTP project.

# STONEHENGE

Process Step	Primary hazard	Source of Hazard/Event	Primary Preventive Measure	Residual Risk Level	Immediate	Short Term	Long Term	Comments	Status
Water source - Thomson River Weir	Protozoa (Crypto/Giardia) (Source Water)	On-site sewage management system discharges and failures; Unrestricted access to livestock or wild/feral animals/birds	GAC filter	Extreme 20	Investigate options for optimisation of filter operation. Options include liaising with process engineer regarding installation of sand filter	Council to investigate options for new WTP for Stonehenge		GAC filter media approximately 12 months old. No spare retained on-site. Filter operation currently not optimised to meet ADWG target for effective protozoan removal (<0.2 NTU)	Council has secured funding in 2020/21 to replace the existing filter and improve the clarification and disinfection stage of the treatment process.
Pressure filter	Protozoa (Crypto/Giardia) (Source Water)	Inadequate filter operation or backwashing	Turbidity monitoring	Extreme 20	Investigate with process engineer options for optimisation of filter operation. Options include additional sand filter or additional GAC filter in series with current GAC filter			GAC filter media approximately 12 months old. No spare GAC retained on-site. Filter operation currently not optimised to meet ADWG target for effective protozoan removal (<0.2 NTU). Average filter output turbidity 1.1 NTU, indicating not meeting turbidity requirement for effective disinfection	Refer to Status above.
Pressure filter	Protozoa (Crypto/Giardia) (Source Water)	Excessive filter flow rates, filter preferential flow	Turbidity monitoring	High 10	Investigate with process engineer options for upgrade of filter unit; e.g. additional GAC filter or sand filter in series with current GAC filter			No means to inspect media to determine filter effectiveness, or if filter preferential flow is occurring	Refer to Status above.
Pressure filter	Turbidity	Media loss	Turbidity monitoring	High 10	Investigate with process engineer options for upgrade of filter unit; e.g. additional GAC filter or sand filter in series with current GAC filter			Media loss has occurred previously. No way to check media level within filter unit (enclosed unit)	Refer to Status above.
Chlorine dosing	Bacteria/ Virus (Reticulation)	Pump failure/underdosing	Critical control points	Extreme 20	Explore option to install sodium hypochlorite disinfection. Redevelop CCP documents with refined target, adjustment and critical limits	Investigate incorporating chlorine meter output to new SCADA platform, displaying levels and alarms		Consistency of chlorine dosing impacted by granular chlorine layering within tank. Chlorine tank turnover approximately 1 week, however layering is causing issues with chlorine dosing concentration consistency	Yet to commence
Chlorine dosing	Chlorate	Excessive storage tank detention		High 12		Council to explore options for all treatment plants – e.g. consider upgrades to mitigate against this and other risks.		Current dosing causes large amounts of chlorine degradation due to heat and storage time, especially in summer, resulting in excessive chlorine dosing, but inadequate chlorine in network. This is also contributing to elevated chlorate concentrations.	Council has secured funding in 2020/21 to replace the existing filter and improve the clarification and disinfection stage of the treatment process.
Reservoirs	Bacteria/ Virus (Reticulation)	Excessive water age		Extreme 20		Investigate options for additional chlorine dosing point on water main into town following WTP tanks		Current dosing causes large amounts of chlorine degradation due to heat and storage time, especially in summer, resulting in excessive chlorine dosing, but inadequate chlorine in network. This is also contributing to elevated chlorate concentrations.	Council has secured funding in 2020/21 to replace the existing filter and improve the clarification and disinfection stage of the treatment process.
Reservoirs	Bacteria/ Virus (Reticulation)	Build-up of sediments, slime or biofilm	Periodic tank inspection and cleaning (external consultant, diver using underwater vacuum)	High 15	Investigate re-routing of high level res intake and outlet to ensure no stirring of sediment	Incorporate tank cleaning for Stonehenge in conjunction with Jundah tank cleaning. Develop tank cleaning procedure for Stonehenge to ensure no disruption to town water supply			Yet to commence
Whole of system	All hazards	Inadequate online monitoring or control	Inline turbidity and chlorine meter	High 15		Investigate inadequate interface between in-line meters and SCADA; alarms and connectivity/accessibility to be refined by BSC. WQ meter calibration system to be developed		Inline turbidity and chlorine meters recently checked against handheld meters, accuracy of inline meters confirmed. Ongoing QC program required	Yet to commence as further funding required.
Whole of system	All hazards	Inadequate back-up options	Chlorine and coag dosing pump spares maintained	High 10	Explore option to install sodium hypochlorite disinfection.			Equipment spares maintained on-site. However, site operator indicated quality issues exist between different batches of calcium hypochlorite tablets	Council has secured funding in 2020/21 to replace the existing filter and improve the clarification and disinfection stage of the treatment process. This project will consider the change to sodium hypochlorite.
Whole of system	All hazards	Inadequate operators/staff training	WTP operators completed Cert III in water industry treatment	High 12	Council consider developing more detailed SOP with photos to provide guidance to inform staff. Council also to consider possibility of engaging relief operators during site operator absences			From discussions with operators, water quality incidents mostly occur when designated plant operator is away from site due to leave, sickness, etc. Risk score is based on these occasions	A relief Operator is now in place. Development of SOPs to be undertaken as part of the proposed upgrade.
Whole of system	All hazards	Not having operational procedures developed/available	DWQMP procedures developed	High 15	Develop CCP documents including target, adjustment and critical limits, with defined rectification actions. Develop new SOP for each WTP. Develop sampling and testing SOP. Develop incident response protocol			Large amounts of operational and maintenance tasks are not documented, leading to issues if plant operator unavailable. Current operational thresholds within DWQMP operating plan are not complied with, and are not achievable, especially with the current impact of chlorine degradation occurring between dosing and distribution.	CCP documents have been developed. Development of SOPs to be undertaken as part of the proposed upgrade.