



Drinking Water Management System

Annual Report

1 August 2019 -
31 August 2020

Warrumbungle Shire Council

Date: March 2021

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Document control

Date	Version	Status	Person
22/03/2021	1.0	Internal draft	Jacinta Green (Consultant)
29/03/2021	1.1	Final	Jacinta Green (Consultant) in conjunction with Cornelia Wiebels, Manager - Warrumbungle Water

Executive Summary

This Annual Report documents Warrumbungle Shire Council's Drinking Water Management System (DWMS) implementation and drinking water performance from 1 August 2019 to 30 August 2020. Drinking water performance for the period is summarised below.

Critical Control Points

Critical control point exceedances are summarised in Table i-i. .

Table i-i. Critical control point (CCP), critical operational point (COP) and operational control point (OCP) exceedance summary

Number of CCP exceedances	CCP 1 Filtration	CCP 2 Disinfection (Hypo)	CCP3 Fluoridation	CCP 4 Reservoirs	CCP 5 Distribution Free chlorine	CCP 6 Distribution Turbidity (OCP)	COP pH
Coonabarabran		2	Not fluoridating			4	
Baradine	1	2	Not fluoridating		1	1	
Kenebri						1	
Bugaldie							
Mendooran	25	31	Not fluoridating		11	6	
Coolah			Not fluoridating				
Binnaway	8	1	Not fluoridating		7		
Dunedoo							

Water quality

NSW Health verification monitoring exceptions are summarised by system in Table .

Table i-ii. NSW Health verification data summary

System	Characteristic	Date	Exception value	Units
Coonabarabran	Turbidity	26/05/2020	12.2	NTU
		31/03/2020	7.97	NTU
		11/02/2020	7.95	NTU
Baradine	Turbidity	11/02/2020	7.95	NTU
		31/03/2020	7.97	NTU
		12/05/2020	11.4	NTU
		26/05/2020	12.2	NTU
Kenebri	Turbidity	12/05/2020	36.5	NTU
Bugaldie	Aluminium	23/09/2019	0.33	mg/L
	Chromium	23/09/2019	0.066	mg/L
	Free Chlorine	14/04/2020	0.12	mg/L
	Molybdenum	23/09/2019	0.068	mg/L
	Nickel	23/09/2019	0.28	mg/L
	Total Coliforms	14/04/2020	> 200	mpn/100 mL
Mendooran	Free Chlorine	6/01/2020	0.1	mg/L
	Iron	1/04/2020	0.82	mg/L
	Manganese	1/04/2020	0.74	mg/L

System	Characteristic	Date	Exception value	Units	
	Mercury	17/03/2020	0.0011	mg/L	
	Total Coliforms	6/01/2020	3	mpn/100 mL	
		17/02/2020	> 200	mpn/100 mL	
	Turbidity	1/04/2020	9.4	NTU	
Coolah	<i>E. coli</i>	21/09/2020	2	mpn/100 mL	
		23/09/2020	5	mpn/100 mL	
		30/09/2020	16	mpn/100 mL	
	Total Coliforms	21/09/2020	56	mpn/100 mL	
		6/01/2020	> 200	mpn/100 mL	
		23/09/2020	> 200	mpn/100 mL	
	Total Hardness as CaCO ₃	30/09/2020	100	mpn/100 mL	
		24/09/2019	457.7	mg/L	
9/03/2020		400.5	mg/L		
Binnaway	Free Chlorine	15/09/2020	421.3	mg/L	
		6/04/2020	0.15	mg/L	
	Total Coliforms	24/02/2020	0.16	mg/L	
		24/03/2020	1	mpn/100 mL	
		6/04/2020	78	mpn/100 mL	
	Total Hardness as CaCO ₃	14/01/2020	1	mpn/100 mL	
		24/09/2019	239.3	mg/L	
		16/01/2020	513.5	mg/L	
	Dunedoo	Mercury	9/03/2020	0.0011	mg/L
		pH	21/04/2020	1.62	
Total Coliforms		15/10/2019	3	mpn/100 mL	
		17/02/2020	> 200	mpn/100 mL	
		25/02/2020	21	mpn/100 mL	
Total Dissolved Solids (TDS)		9/03/2020	675	mg/L	
Total Hardness as CaCO ₃		24/09/2019	421.1	mg/L	
		15/09/2020	350	mg/L	
	9/03/2020	382.6	mg/L		
Turbidity	4/05/2020	6.61	NTU		

Continuous improvement plan

A summary of improvement plan progress summary is show in Table .

Table i-iii. Summary of water quality improvement plan progress

Priority	Closed	Complete	Implemented	In progress	Not started	To do per priority (% of total)
Very high	13	21		3		8%
High	56	59	19	24	2	16%
Medium	59	27	21	23	4	20%
Low	9	2	1	7	4	48%
Total	137	109	41	57	10	

Source: Item 21 Business paper 08-2020

DWMS Reviews

In lieu of regular (previously quarterly) DWMS review meetings, workshops were held to implement and update Council's DWMS Improvement Plan; workshop dates are listed in Table.

Table i-iv. Review of DWMS reviews

Date	Attendance	Scope	Findings	Actions
27 August 2019	Atom Consulting, Council	Review of DWMS Improvement Plan	49 items reviewed and updated	49 items closed, completed or implemented.
27 September 2019	Atom Consulting, Council	Review of DWMS Improvement Plan	42 items reviewed and updated	25 items closed, completed or implemented.
13 December 2019	Atom Consulting, Council	Review of DWMS Improvement Plan	111 items reviewed and updated	77 items closed, completed or implemented.
28 Feb 2020	Atom Consulting, Council	Review of DWMS Improvement Plan	91 items reviewed and updated	65 items closed, completed or implemented.
24 April 2020	Atom Consulting, Council	Review of DWMS Improvement Plan	90 items reviewed and updated	45 items closed, completed or implemented.
24 July 2020	Council	Review of DWMS Improvement Plan	18 items reviewed and updated	1 item closed

Reservoir inspections

Non-formalised inspections are undertaken weekly in all towns, including site security, roofing, bird-netting, telemetry aerials and chlorine check. Formalised checklists are in development.

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1 Report Purpose

This Annual Report documents Warrumbungle Shire Council's DWMS implementation for the period 1 August 2019 to 31 August 2020. It has been prepared to support the reporting (Element 10), evaluation (Element 11) and review and continual improvement (Element 12) requirements of the DWMS.

This report includes the following areas:

- Performance of critical control points
- Water quality review
- Consumer complaints
- Water quality incidents
- Staff development and training
- Improvement plan implementation

A review of system performance has been made against Australian Drinking Water Guidelines (2011), levels of service and other regulatory requirements (Element 1).

2 DWMS document control

Updates to the DWMS documentation have been summarised in **Error! Reference source not found..**

Table 2-1. DWMS document control

Document	Version	Updates	Submitted to NSW Health and date submitted?
Warrumbungle Shire Council Drinking Water Management System	October 2014	None	
CCP reference guide	June 2019	Updates to limits and protocols	As part of March 2019 quarterly DWMS review meeting
CCPs	This document	Realignment of CCP IDs across sites and processes	

3 Coonabarabran

3.1 Scheme summary

The Coonabarabran water supply system comprises:

- Source water: Castlereagh River (Timor Dam, Poundyard Weir), supplementary bores
- Treatment: WTP with coagulation (alum, polymer), flocculation, sedimentation (x2 lagoons), sand bed filtration (x2 filters), pH correction (lime), chlorine gas disinfection and fluoridation (currently off-line).
- Number of residential connections: 1152
- Number of non-residential connections: 238

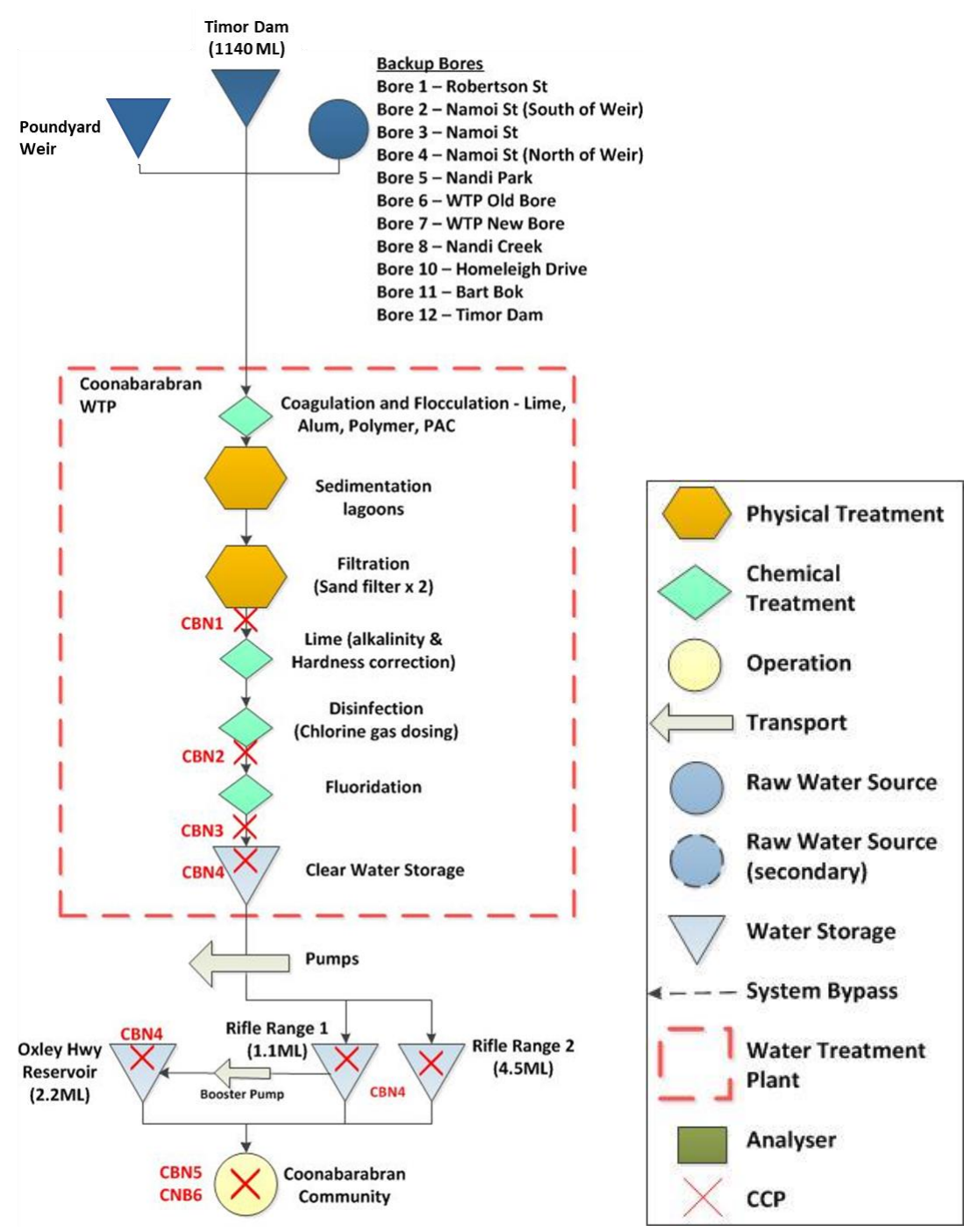


Figure 3-1. Water supply flow diagram – Coonabarabran

Improvement works undertaken from August 2019 to August 2020 for the Coonabarabran water supply include:

- New filter controls and valves on both filters and online turbidity meters installed
- New safety showers installed at Chlorine Room and Chemical Room
- New settle water pump installed
- New PLC installed
- New light weight lids and covers installed on all pits
- Repair Filter gulleys to stop bypassing of settled water

3.2 Critical control points

The CCPs for Coonabarabran are shown in Table 3-1. These CCPs are regularly reviewed in quarterly water quality meetings as part of the ORANA water utilities alliance. A summary of changes made is shown in Table 3-2

Table 3-1. Summary of critical control points and critical operational points – Coonabarabran

CCP ID	Critical Control Point	Control Parameter	Target	Alert Level	Critical Limit
CBN1	Filtration	Turbidity	<0.3 NTU	>0.5 NTU	>0.7 NTU
CBN2	Disinfection (gas)	Chlorine	2.0 – 3.0 mg/L	<1.8 mg/L, >3.5 mg/L	<1.5 mg/L, >4.0 mg/L
CBN2.5	Disinfection (gas)	Chlorine	2.5 – 3.5 mg/L	<2.3 mg/L, >3.7 mg/L	<2 mg/L, >4.5 mg/L
CBN3	Fluoridation	Fluoride	1 mg/L (leaving WFP, leaving reservoir and throughout distribution system)	> 1.1 mg/L < 0.9 mg/L for >24hrs	>1.5 mg/L <0.9 mg/L for >72hrs 0.0 mg/L for >24hrs
CBN4	Reservoirs	Reservoir integrity	No breach of integrity (hatches locked, no holes in meshing)	-	Breach of integrity identified
CBN5	Distribution	Chlorine	0.6 - 3.0 mg/L	< 0.4 mg/L, >3.5 mg/L	< 0.2 mg/L, or >4 mg/L
CBN6	Distribution (OCP)	NTU	<1.0 NTU	>1.0 NTU	>4.0 NTU

Table 3-2. Summary of critical control points changes – Coonabarabran

Date	CCP	Limit	Old	Current	Reason for change
Changes to CCPs	CBN 2.5	Target		2.5 – 3.5 mg/L	Water source changed from bore to dam. A new CCP was created to ensure historical data could be maintained.
		Alert Level		<2.3 mg/L, >3.7 mg/L	
		Critical Limit		<2 mg/L, >4.5 mg/L	

3.3 Critical limit exceedance

Critical limit exceedances in the reporting period are detailed in Table 3-3.

The fluoridation plant was offline during the reporting period.

CBN4 reservoir integrity - Inspections of the reservoir CCP are not currently being undertaken due to WHS issues. Development of a reservoir inspection SOP is included as an action item in the improvement plan and is currently in progress.

Table 3-3. Critical limit exceedances – Coonabarabran

Date	CBN1 Filtration	CBN2 Free chlorine	CBN2.5 Free chlorine	CBN3 Fluoridation	CBN4 Reservoirs	CBN5 Distribution CI	CBN6 Distribution NTU (OCP)	Reason	Immediate correction	Preventive Action
30/08/2019			1.09							
10/02/2020							7.95			
31/03/2020							17.91			
12/05/2020							11.40	Lack of water turn over due to winter	flush line	
20/05/2020						17.4				
23/06/2020							4.45			

3.4 Operational CCP, OCP and COP monitoring graphs.

Source (if not specified): Coonabarabran operational monitoring spreadsheet

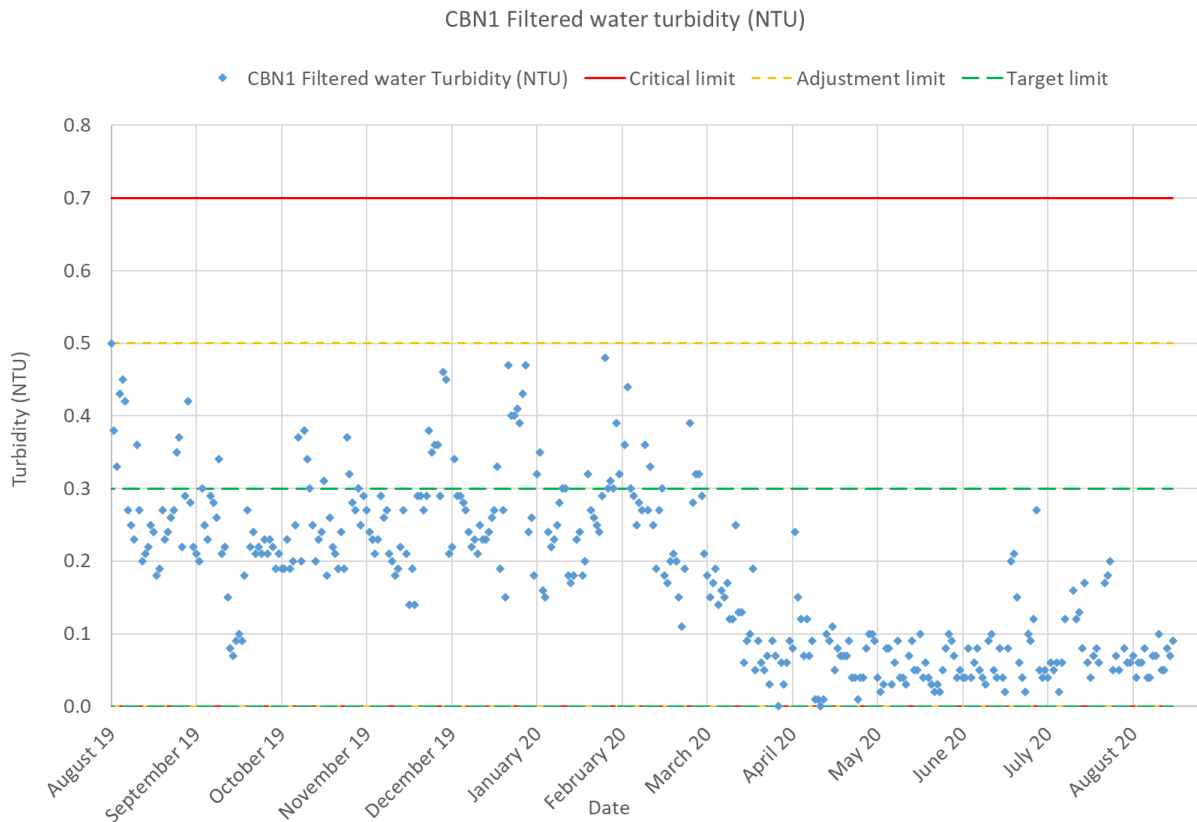


Figure 3-2: Coonabarabran - Filtered water turbidity CCP (CBN1)

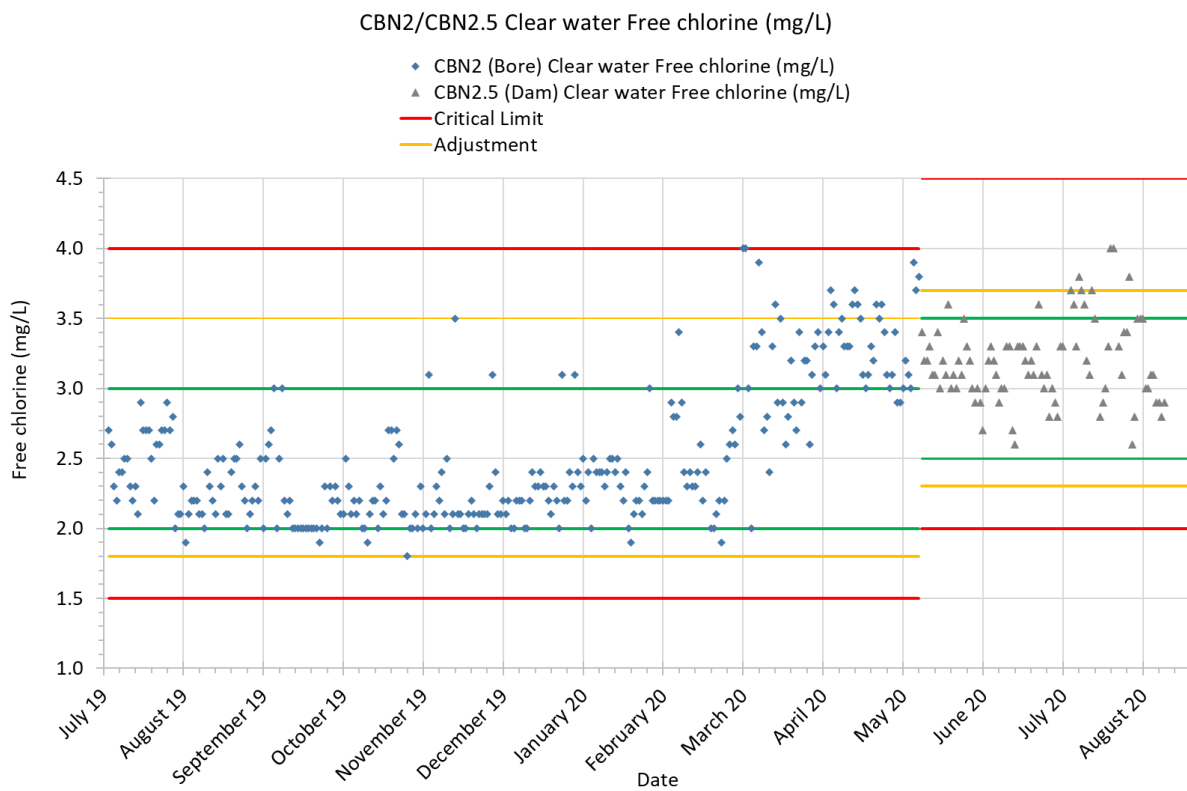


Figure 3-3: Coonabarabran - Clear water free chlorine (CBN2/CBN2.5)

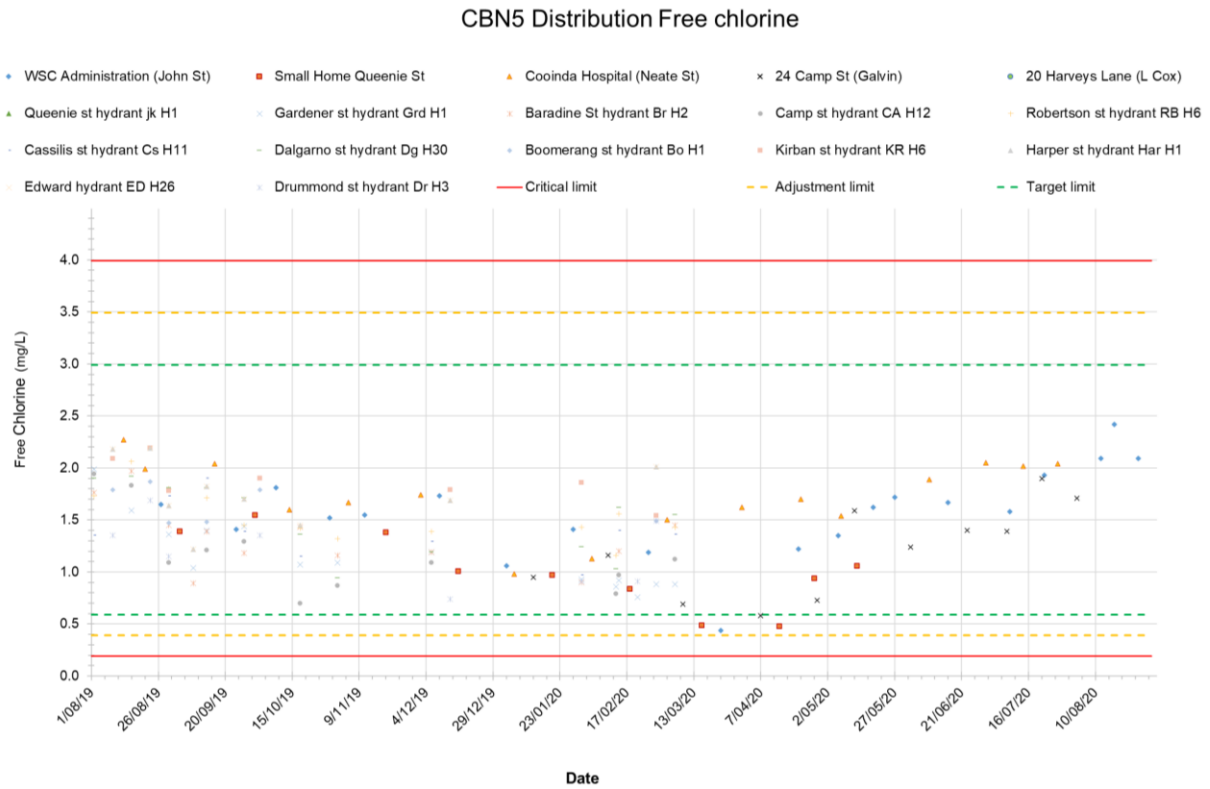


Figure 3-4: Coonabarabran - Distribution Free chlorine CCP (CBN5)

Source: Drinking Water Monitoring spreadsheet.

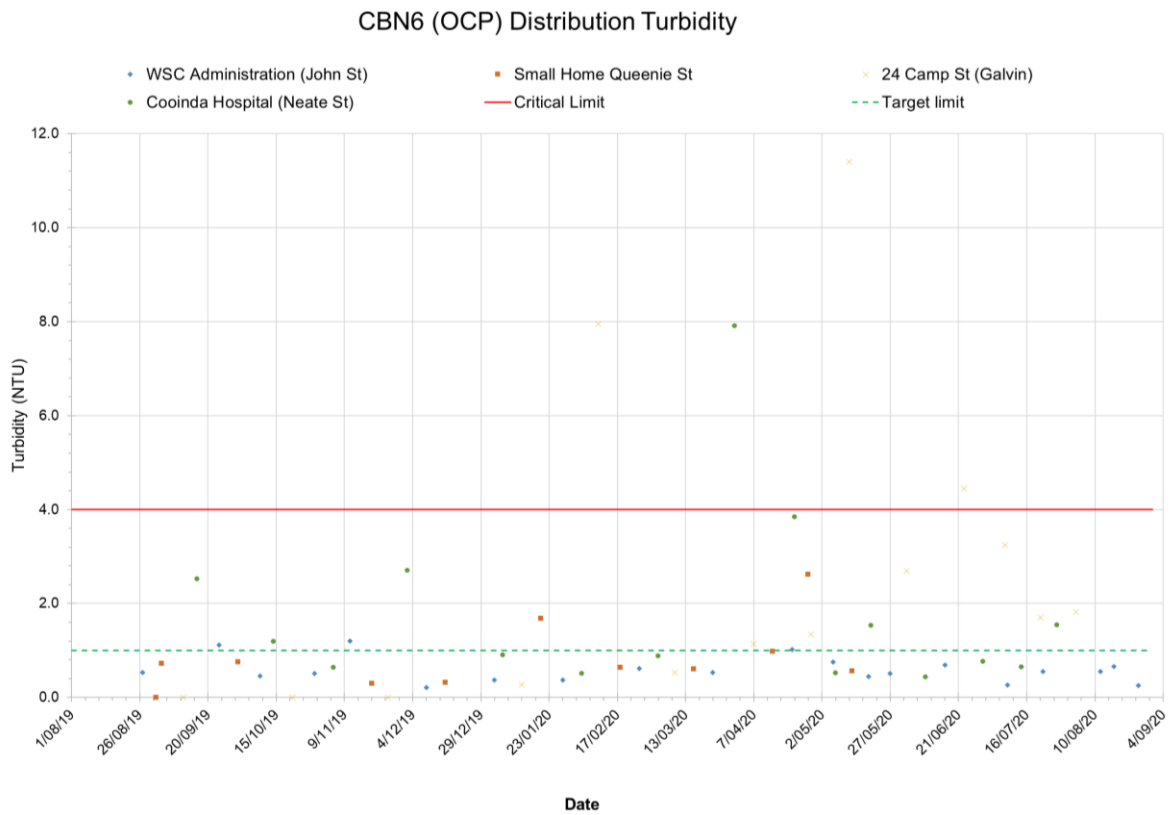


Figure 3-5: Coonabarabran - Distribution Turbidity (CBN6, OCP)

Source: Drinking Water Monitoring spreadsheet.

COP Raw, settled, filtered, clear and reticulated water pH

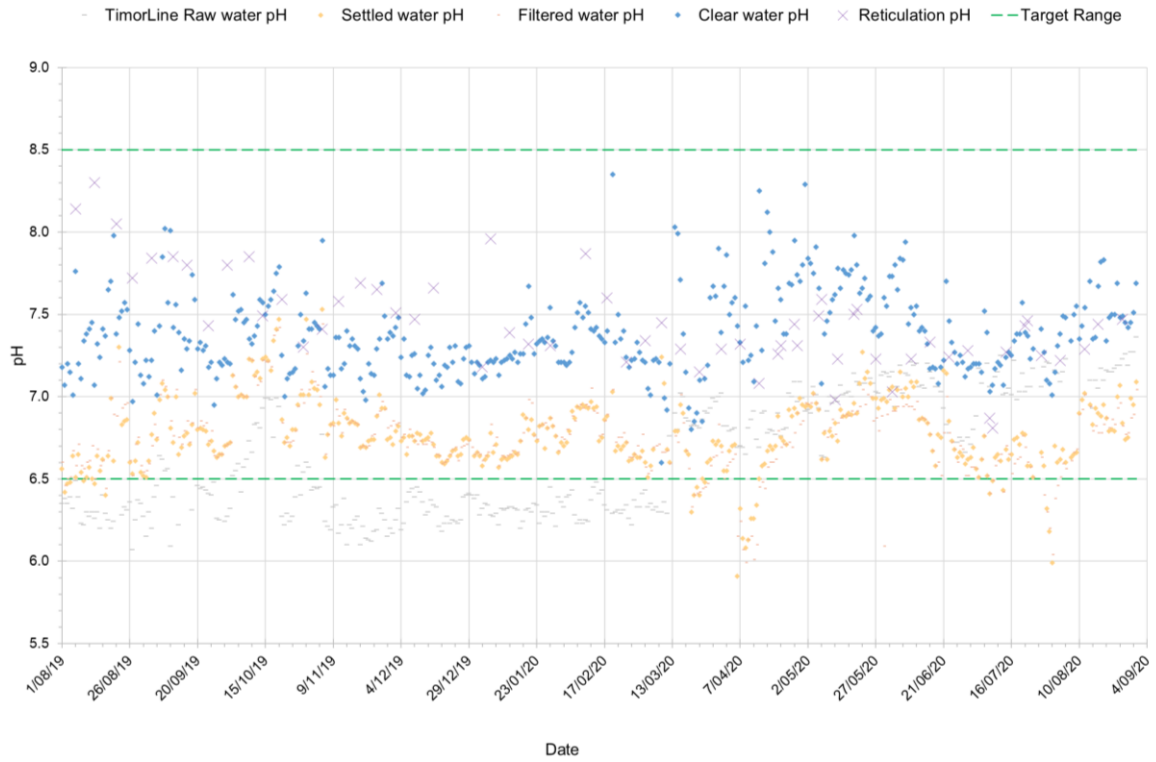


Figure 3-6: Coonabarabran pH (COP)

A data point, pH 0.42 recorded on 4/2/2020 from Coinda Hospital (Neate St) was removed as a suspected data entry error.

3.5 Water quality

This section includes a review of water quality data for the Coonabarabran water supply system from the reporting period, 1 August 2019 to 31 August 2020, including data collected as part of the NSW Health drinking water monitoring system program.

3.5.1 Data collection

The Coonabarabran scheme operational water quality monitoring plan is shown in Table 3-4.

Table 3-4. Monitoring undertaken for Coonabarabran water supply system

Process	CCP/OCP	Parameter	Unit	Frequency
Timor line Raw water		Turbidity	NTU	Daily
		Colour	HU	Daily
		pH		Daily
Poundyard Raw water		Turbidity	NTU	Daily
		Colour	HU	Daily
		pH		Daily
		Iron	mg/L	Weekly
		Manganese	mg/L	Weekly
All bores Raw Water		Iron	mg/L	Weekly
		Manganese	mg/L	Weekly
Settled water		Turbidity	NTU	Daily
		Colour	HU	Daily
		pH		Daily
Filtered water	CBN1	Turbidity	NTU	Daily
		Colour	HU	Daily
		pH		Daily
Clear water		Turbidity	NTU	Daily
		Colour	HU	Daily
		pH		Daily
	CBN2	Free chlorine	mg/L	Daily (when operational)
	CBN2.5	Free chlorine	mg/L	Daily (when operational)
	CBN3	Fluoride	mg/L	Daily (when operational)
Reticulation	CBN5	Free chlorine	mg/L	Weekly
		Total Chlorine	mg/L	Weekly
		pH		Weekly
	CBN6 (OCP)	Turbidity	mg/L	Weekly

3.5.2 Water quality issues

Monitoring of Coonabarabran water supply system detected four exceedances of ADWG aesthetic guidelines with high turbidity detected in February 2020, March 2020 and two detections in May 2020 (Figure 3-5). There were no ADWG health guideline exceedances detected.

3.6 Consumer water quality complaints/enquiries

A summary of customer complaints and enquiries is shown in Table 3-5. There was 1 water quality complaint concerning water in Coonabarabran causing a skin condition (December 2019).

Table 3-5. Summary of water quality customer complaints / enquiries – Coonabarabran

Complaints/Enquires	Type	Number
Water Quality	Complaints	1
Water Main (leaks /bursts)	Enquiry	39
Water (pressure / lack of water)	Enquiry	10
Water restrictions	Complaints	5
Water Meter	Enquiry	21

3.7 Water quality incidents/emergencies

There were no water quality incidents or emergencies in the Coonabarabran water supply system in the reporting period.

3.8 Reservoir inspections

Non-formalised inspections are undertaken weekly including site security, roofing, bird-netting, telemetry aerals and chlorine check.

Formalised checklists are in development.

There were no issues found within the reporting period.

4 Baradine

4.1 Scheme summary

The Baradine water supply system comprises:

- Source water: Bore
- Treatment: WTP with aeration, pH correction (soda ash), flocculation (PACl, electrolyte), clarification, sand bed filtration (x1 filter), backwash/sludge lagoons, chlorine gas disinfection and fluoridation (currently off-line).
- Distribution note: rising main = distribution main, reservoir inlet = reservoir outlet
- Number of residential connections: 320
- Number of non-residential connections: 51

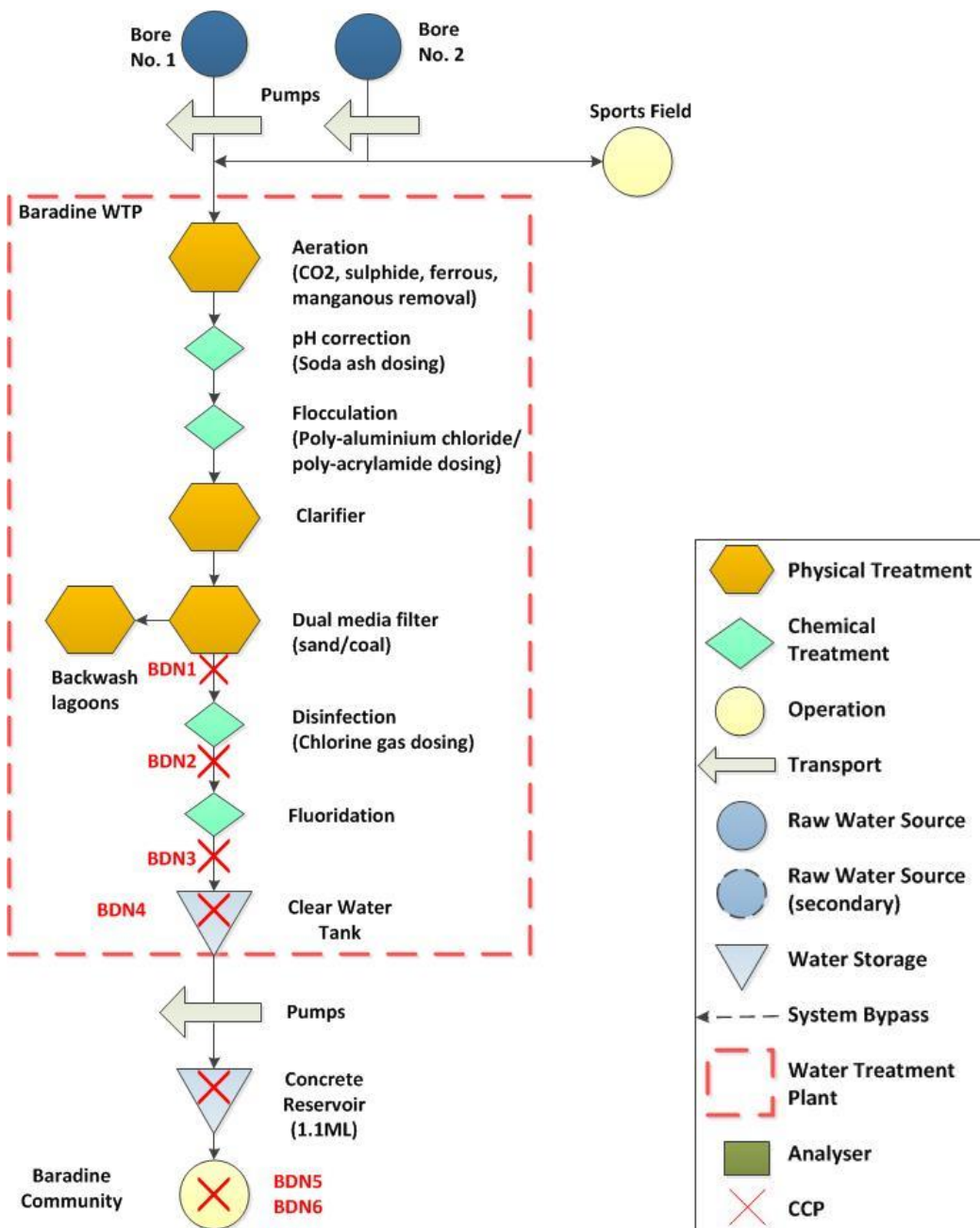


Figure 4-1: Water supply flow diagram – Baradine

Improvement works undertaken from August 2019 to August 2020 for the Baradine water supply include:

- New Chlorine Gas dosing system, Analyser and scales
- New standby dosing pumps installed
- Filter has been topped up with granulated carbon to replace missing filter media

4.2 Critical control points

The CCPs for Baradine are shown in Table 4-1Table 3-1. These CCPs are regularly reviewed in quarterly water quality meetings as part of the ORANA water utilities alliance. There were no changes to the CCPs for Baradine during the reporting period.

Table 4-1. Summary of critical control points – Baradine

CCP ID	Critical Control Point	Control Parameter	Target	Alert Level	Critical Limit
BDN1	Filtration	Turbidity	<0.3 NTU	>0.5 NTU	>0.8 NTU
BDN2	Disinfection (gas)	Chlorine	1.4 – 1.9 mg/L	<1.2 mg/L, >2.5 mg/L	<1.0 mg/L, >4.0 mg/L
BDN3	Fluoridation	Fluoride	1 mg/L (leaving WTP, leaving reservoir and throughout distribution system)	< 0.9 mg/L for >24hrs > 1.1 mg/L	<0.9 mg/L for >72hrs >1.5 mg/L 0.0 mg/L for >24hrs
BDN4	Reservoirs	Reservoir integrity	No breach of integrity (hatches locked, no holes in meshing)	-	Breach of integrity identified
BDN5	Distribution	Chlorine	>0.8 mg/L, <2.0 mg/L	<0.5 mg/L, >2.5 mg/L	<0.2 mg/L, >4.0 mg/L
BDN6	Distribution (OCP)	NTU	<1.0 NTU	>1.0 NTU	>4.0 NTU

4.3 Critical limit exceedance

The fluoridation plant was offline during the reporting period.

Table 4-2. Critical limit exceedances – Baradine

Date	BDN1 Filtration (Turbidity)	BDN2 Disinfection gas (Chlorine level)	BDN3 Fluoridation	BDN4 Reservoir Integrity	BDN5 Distribution CI	BDN6 Distribution NTU (OCP)	Reason	Immediate correction	Preventive Action
25/11/2019					Hi		Chlorine overdose caused by valve failure	Ordered new valve	
12/12/2019		0.98							
21/7/2020						0.9			
6/8/2020	0.84								
30/8/2020		0.95							

4.4 Operational CCP, OCP and COP monitoring graphs

Source (if not specified), Baradine operational monitoring spreadsheet

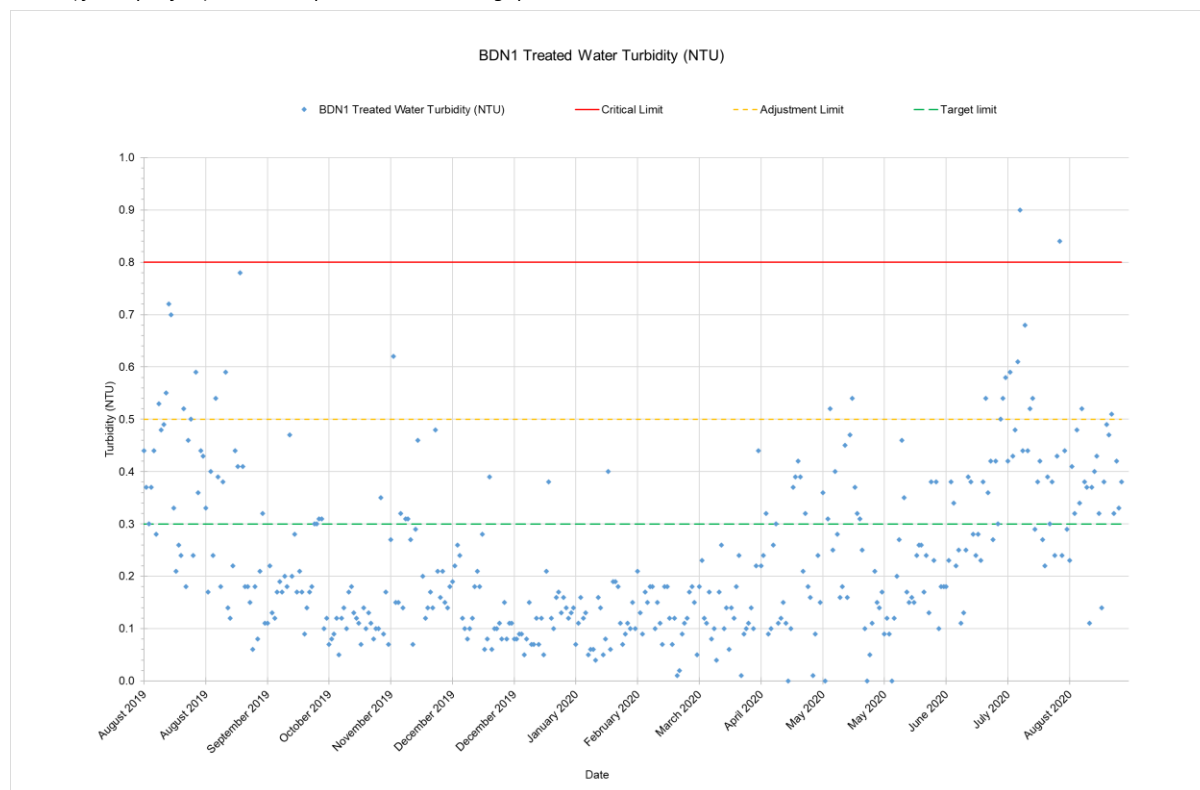


Figure 4-2: Treated water turbidity (BDN1) – Baradine

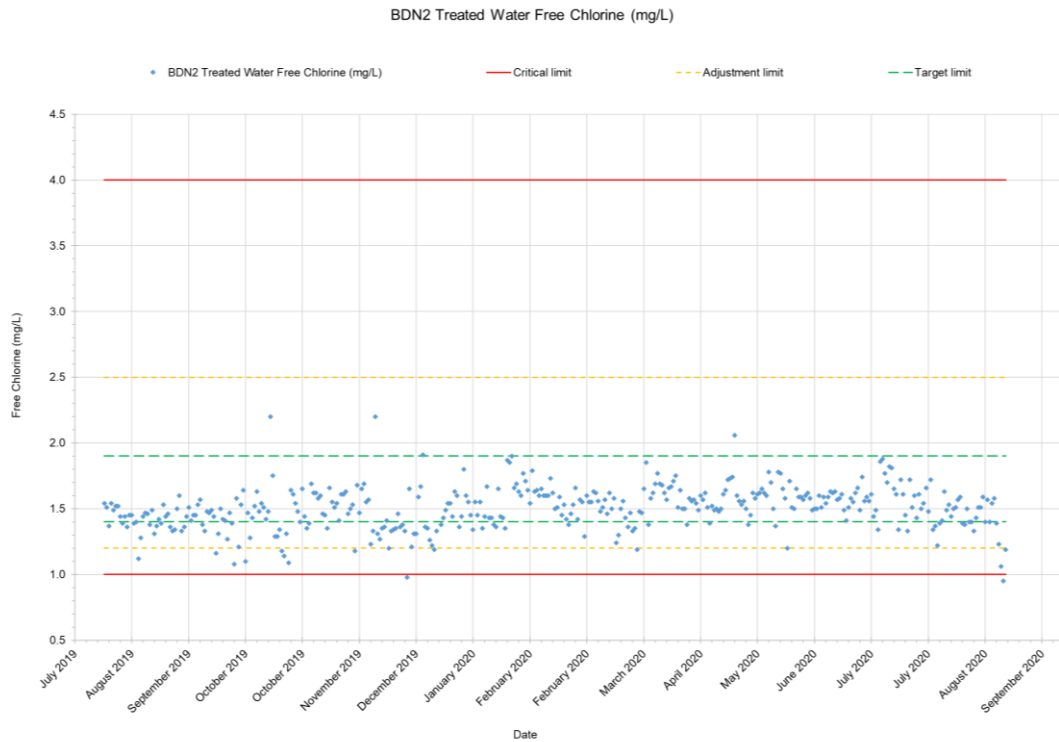


Figure 4-3: Treated water free chlorine (BDN2) – Baradine

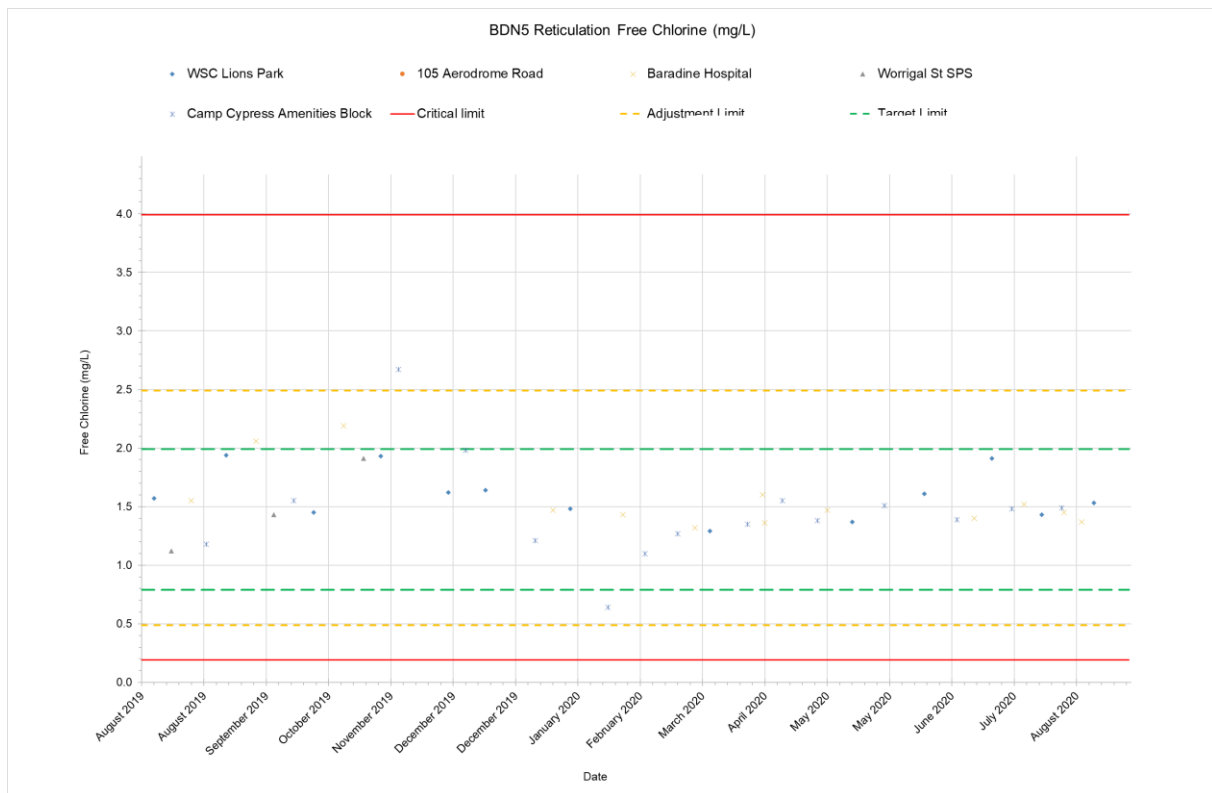


Figure 4-4: Reticulation free chlorine (BDN5) – Baradine.

Source: Drinking Water Monitoring spreadsheet.

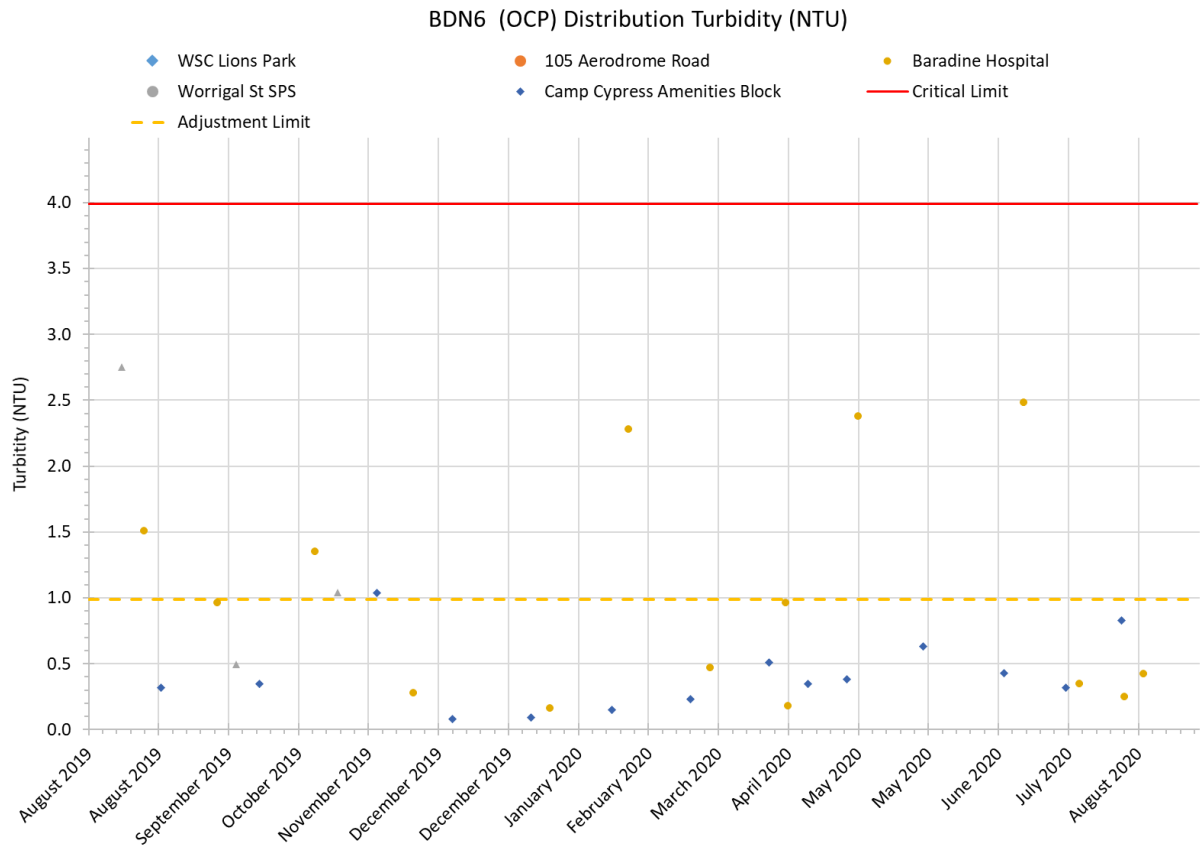


Figure 4-5: Distribution turbidity (BDN6, OCP) – Baradine

Source: Drinking Water Monitoring spreadsheet.

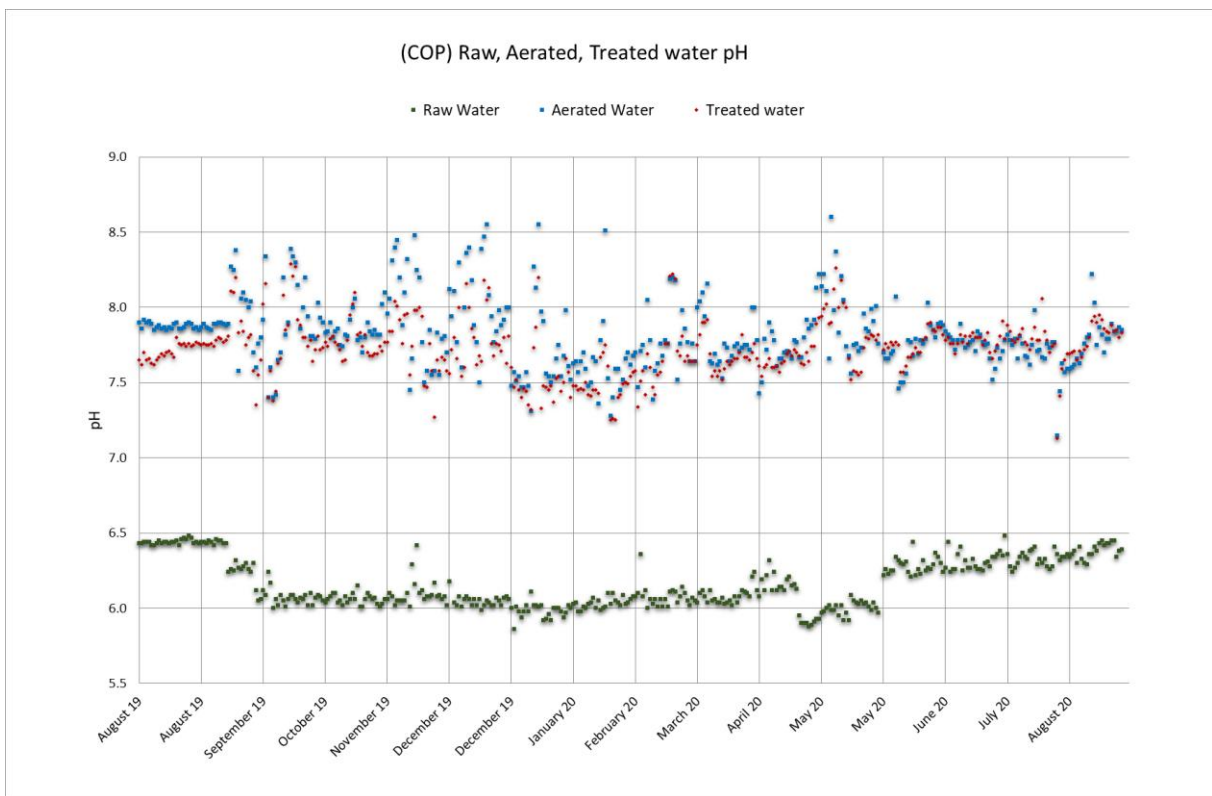


Figure 4-6: Baradine treated water pH (COP)

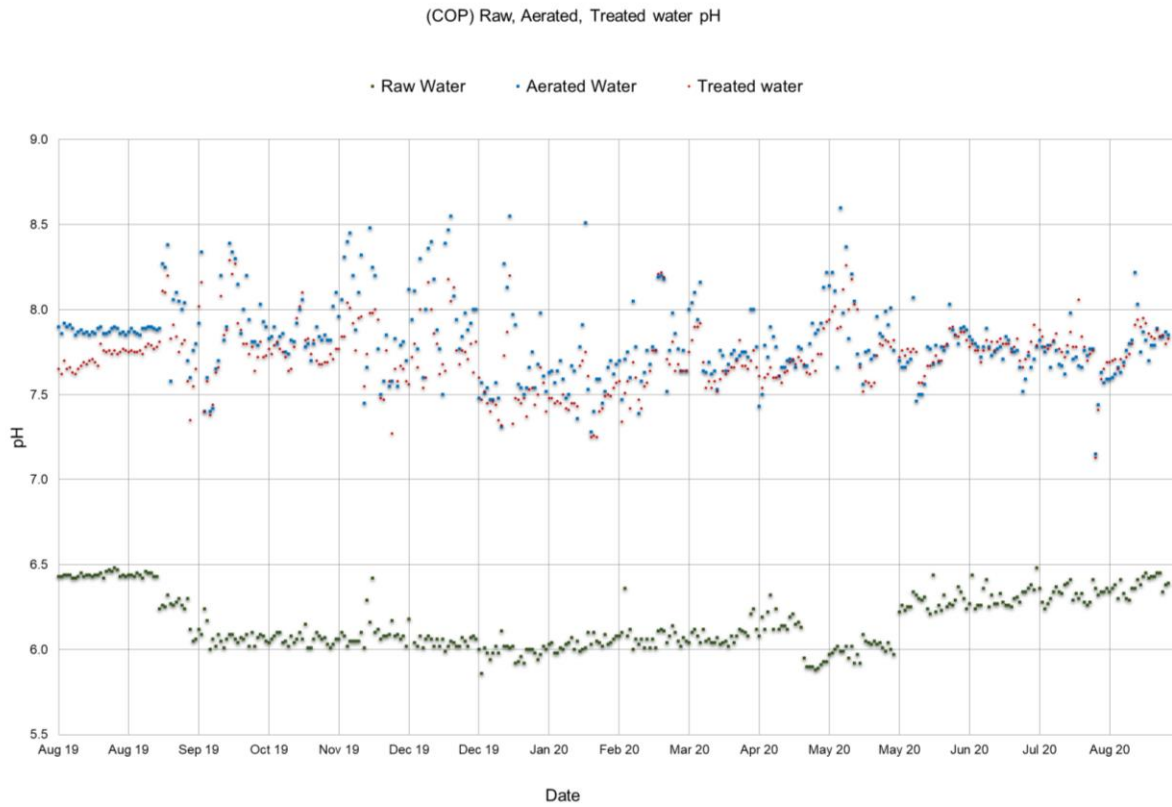


Figure 4-7: Baradine reticulation pH (COP)

Source: Drinking Water Monitoring spreadsheet.

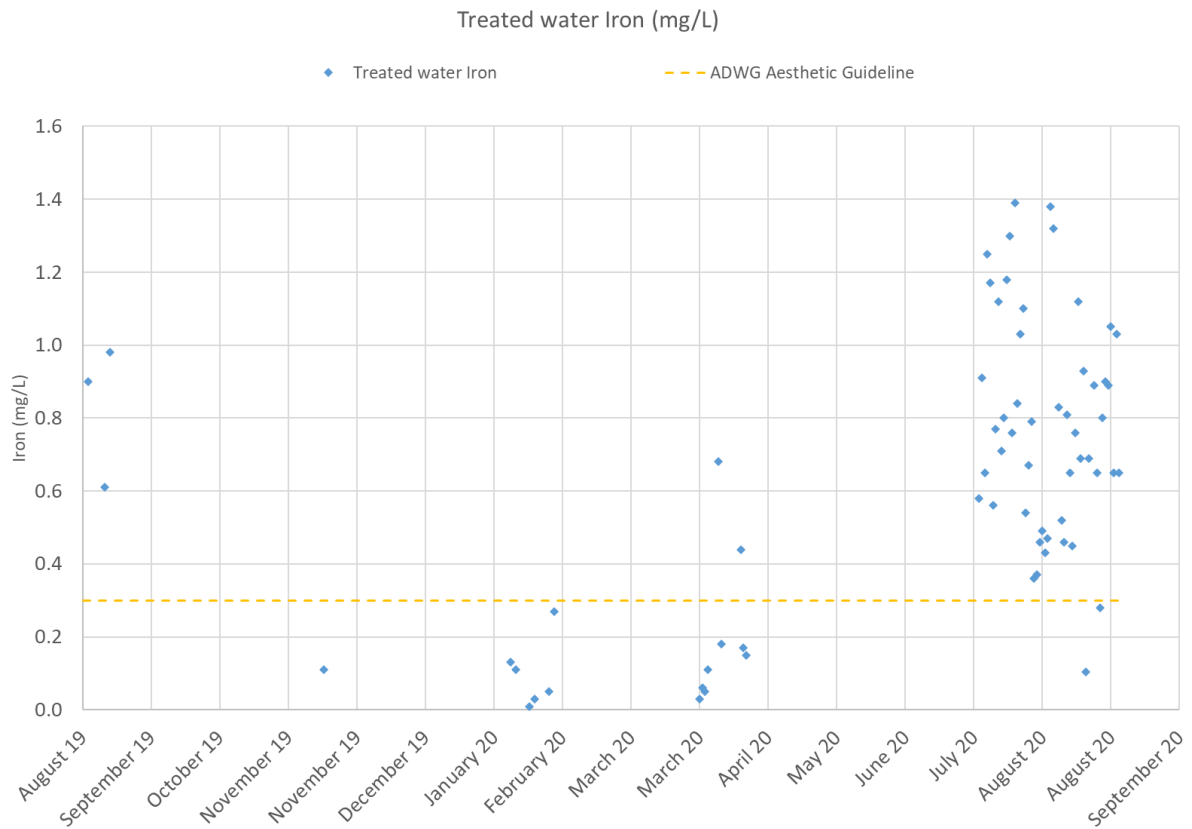


Figure 4-8: Treated water iron – Baradine

Source: NSW Health Water Quality Monitoring database

4.5 Water quality

This section includes a review of water quality data for the Baradine water supply system from the reporting period, 1 August 2019 to 30 August 2020, including data collected as part of the NSW Health drinking water monitoring system program.

4.5.1 Data collection

The Baradine scheme operational water quality monitoring plan is shown in Table 4-3.

Table 4-3. Monitoring undertaken for Baradine water supply system

Process	CCP /OCP	Parameter	Unit	Frequency
Raw water		pH		Daily
Aerated Water		pH		Daily
Treated water		pH		Daily
	BDN2	Free Chlorine	mg/L	Daily
	BDN1	Turbidity	NTU	Daily
		Iron	mg/L	Weekly
		Manganese	mg/L	Weekly
Reticulation	BDN5	Free Chlorine	mg/L	Weekly
		Total Chlorine	Mg/L	Weekly
	COP	pH		Weekly
	BDN6	Turbidity	NTU	Weekly

4.5.2 Water quality issues

Monitoring of Baradine water supply detected one ADWG health exceptions with one Total coliform detect occurring in August 2020.

4.6 Consumer water quality complaints/enquires

A summary of customer complaints and enquiries is shown in Table 4-4. There was one water quality complaint of dirty water in July 2020.

Table 4-4. Summary of water quality customer complaints / enquiries – Baradine

Complaints/Enquires	Type	Number
Water Quality	Complaints	1
Water (pressure / lack of water)	Enquiry	1
Water Main (leaks /bursts)	Enquiry	5

4.7 Water quality incidents/emergencies

There were no water quality incidents or emergencies in the Baradine water supply system in the reporting period.

4.8 Reservoir inspections

Non-formalised inspections are undertaken weekly including site security, roofing, bird-netting, telemetry aerals and chlorine check.

Formalised checklists are in development.

There were no issues found within the reporting period.

5 Kenebri

5.1 Scheme summary

The Kenebri water supply system comprises:

- Source water: Bore
- Chlorination disinfection only (NaOCl)
- Number of residential connections: 15
- Number of non-residential connections: none

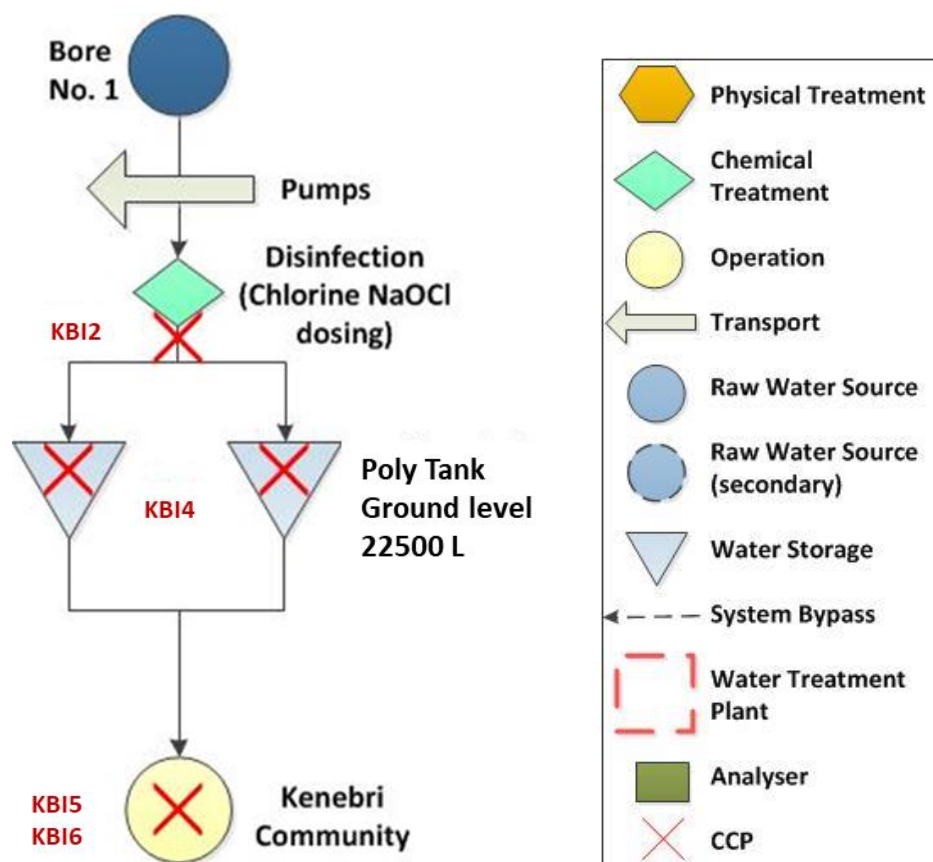


Figure 5-1: Water supply flow diagram – Kenebri

Improvement works undertaken from September 2019 to September 2020 for the Kenebri water supply include:

- New tanks installed and pump system
- Old tanks removed

5.2 Critical control points

The CCPs for Kenebri are shown in Table 5-1. These CCPs are regularly reviewed in quarterly water quality meetings as part of the ORANA water utilities alliance. A summary of changes made is shown in Table 5-2.

Table 5-1. Summary of critical control points – Kenebri

CCP ID	Critical Control Point	Control Parameter	Target	Alert Level	Critical Limit
KBI2	Disinfection (hypo)	Chlorine	1.5 – 2.3 mg/L	<1.2 mg/L, >2.8 mg/L	<1.0 mg/L, >4.0 mg/L
KBI4	Reservoirs	Reservoir integrity	No breach of integrity (hatches locked, no holes in meshing)	-	Breach of integrity identified
KBI5	Distribution	Chlorine	1.0- 2.0 mg/L	< 0.4 mg/L, >2.5 mg/L	< 0.2 mg/L, >4.0 mg/L
KBI6	Distribution (OCP)	NTU	<1.0 NTU	>1.0 NTU	>4.0 NTU

No changes to CCP limits, however the CCP IDs have been reidentified to align a specific CCP ID with a specific process type across all treatment plants. The alignment of CCP IDs with specific processes is summarised in **Error! Reference source not found.**

Table 5-2. Summary of critical control points alignment changes – Kenebri

CCP	Existing	Current
Disinfection (hypo)	KBI1	KBI2
Reservoirs	KBI2	KBI4
Distribution Chlorine	KBI3	KBI5
Distribution NTU (OCP)	KBI4	KBI6

5.3 Critical limit exceedance

A summary of critical limit exceedances is shown in Table 5-3.

Table 5-3. Critical limit exceedances – Kenebri

Date	KBI2 Disinfection	KBI4 Reservoirs	KBI5 Distribution CI	KBI6 Distribution NTU (OCP)	Reason	Immediate correction	Preventive Action
12/5/2020				36.5			

5.4 Operational CCP, OCP and COP monitoring graphs

Source (if not specified), Coonabarabran operational monitoring spreadsheet

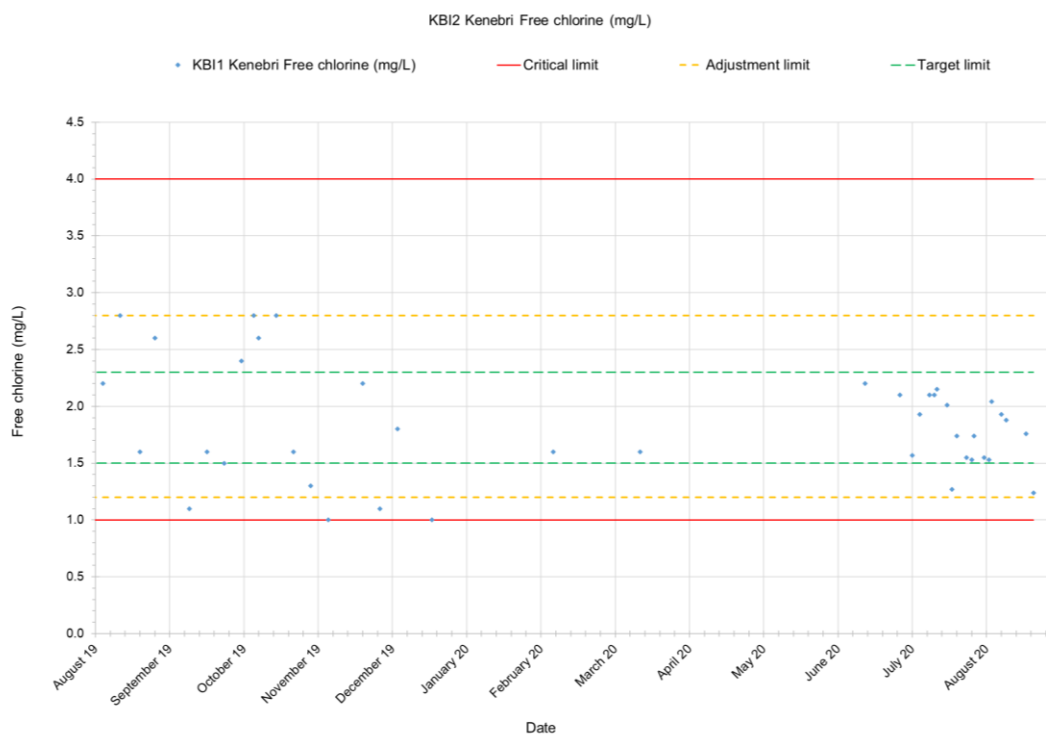


Figure 5-2: Treated water free chlorine (KBI2) – Kenebri

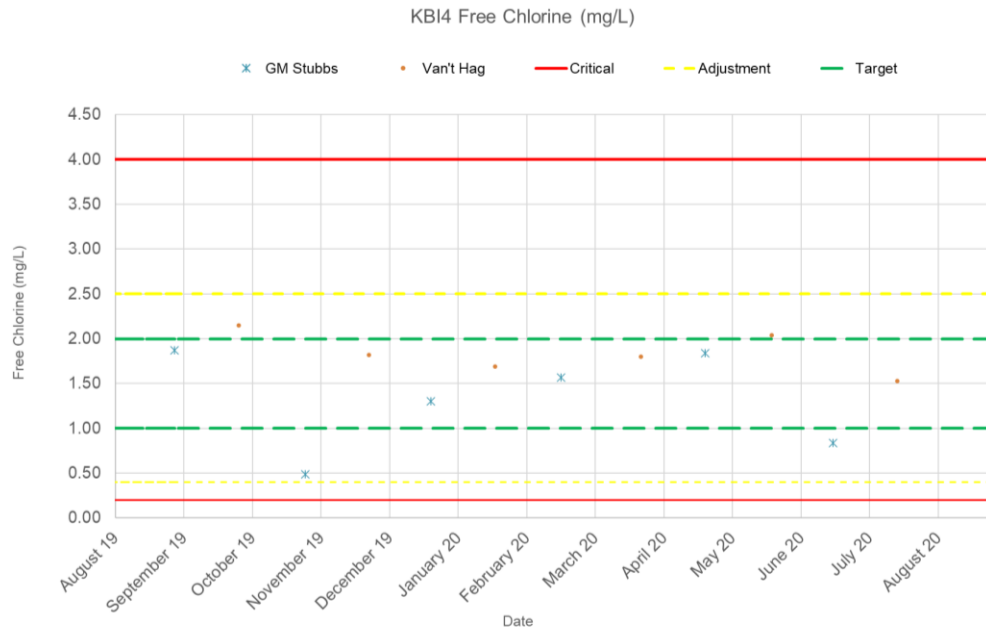


Figure 5-3: Reticulation free chlorine (KBI5) – Kenebri

Source: Drinking Water Monitoring spreadsheet.

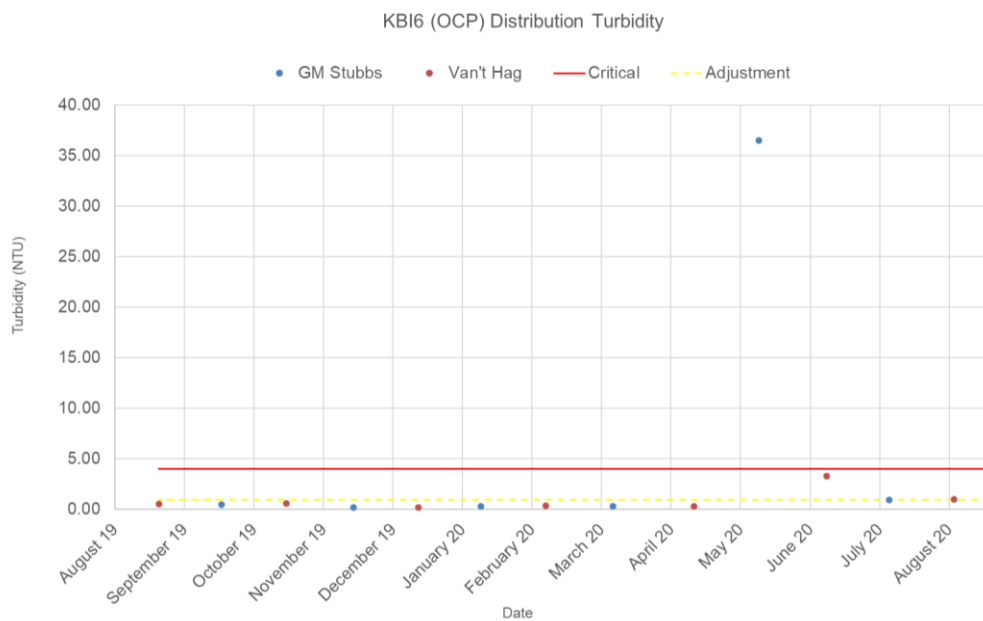


Figure 5-4: Distribution Turbidity (KBI6, OCP)

Source: Drinking Water Monitoring spreadsheet.

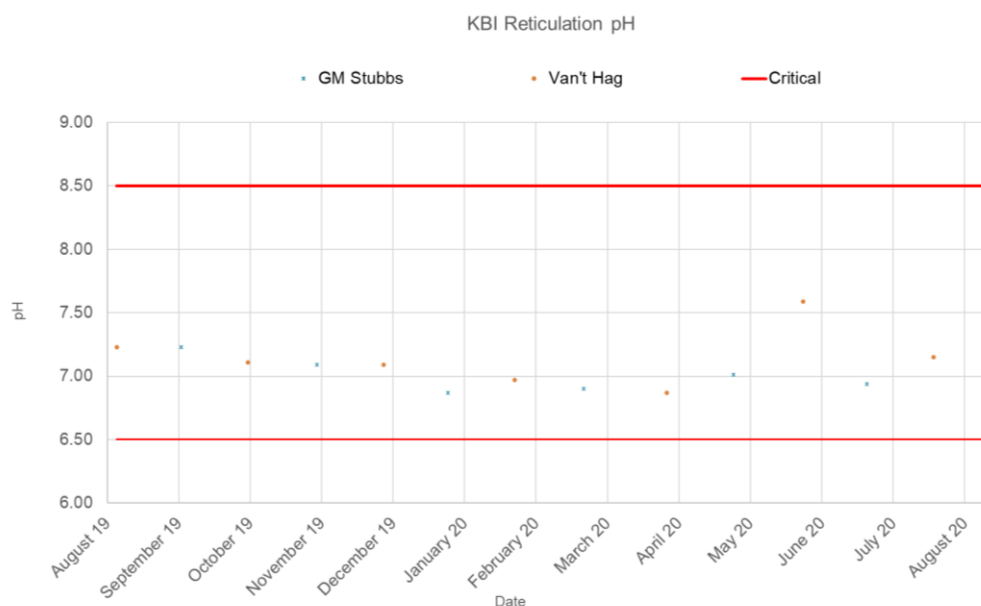


Figure 5-5: Kenebri reticulation pH (COP).

Source: Drinking Water Monitoring spreadsheet.

5.5 Water quality

This section includes a review of water quality data for the Kenebri water supply system from the reporting period, 1 August 2019 to 31 August 2020, including data collected as part of the NSW Health drinking water monitoring system program.

5.5.1 Data collection

The Kenebri scheme operational water quality monitoring plan is shown in Table 5-4.

Table 5-4. Monitoring undertaken for Kenebri water supply system

Process	CCP/OCP	Parameter	Unit	Frequency
Treated water	KB2	Free Chlorine	mg/L	Weekly
Reticulation	KBI5	Free Chlorine	mg/L	Monthly
		Total Chlorine	mg/L	Monthly
		pH		Monthly
	KBI6 (OCP)	Turbidity	NTU	Monthly

5.5.2 Water quality issues

Monitoring of Kenebri water supply system detected no exceptions with ADWG health and aesthetic guidelines. There was one sample where turbidity exceeded the recommended NTU of 5 (NTU of 36.5 reported on 12 May 2020).

5.6 Consumer water quality complaints/enquires

A summary of customer complaints and enquiries is shown in Table 5-5. There were no water quality complaints in Kenebri.

Table 5-5. Summary of water quality customer complaints / enquiries – Kenebri

Complaints/Enquires	Type	Number
Water Quality	Enquiry	1
Water Main (leaks /bursts)	Enquiry	6
Water (pressure / lack of water)	Enquiry	2
Water Meter	Enquiry	1

5.7 Water quality incidents/emergencies

There were no water quality incidents or emergencies in the Kenebri water supply system in the reporting period.

5.8 Reservoir inspections

Non-formalised inspections are undertaken weekly including site security, roofing, bird-netting, telemetry aerials and chlorine check.

Formalised checklists are in development.

There were no issues found within the reporting period.

6 Bugaldie

6.1 Scheme summary

The Bugaldie water supply system comprises:

- Source water: Bore
- Chlorination disinfection only (NaOCl)
- Number of residential connections: 12
- Number of non-residential connections: none

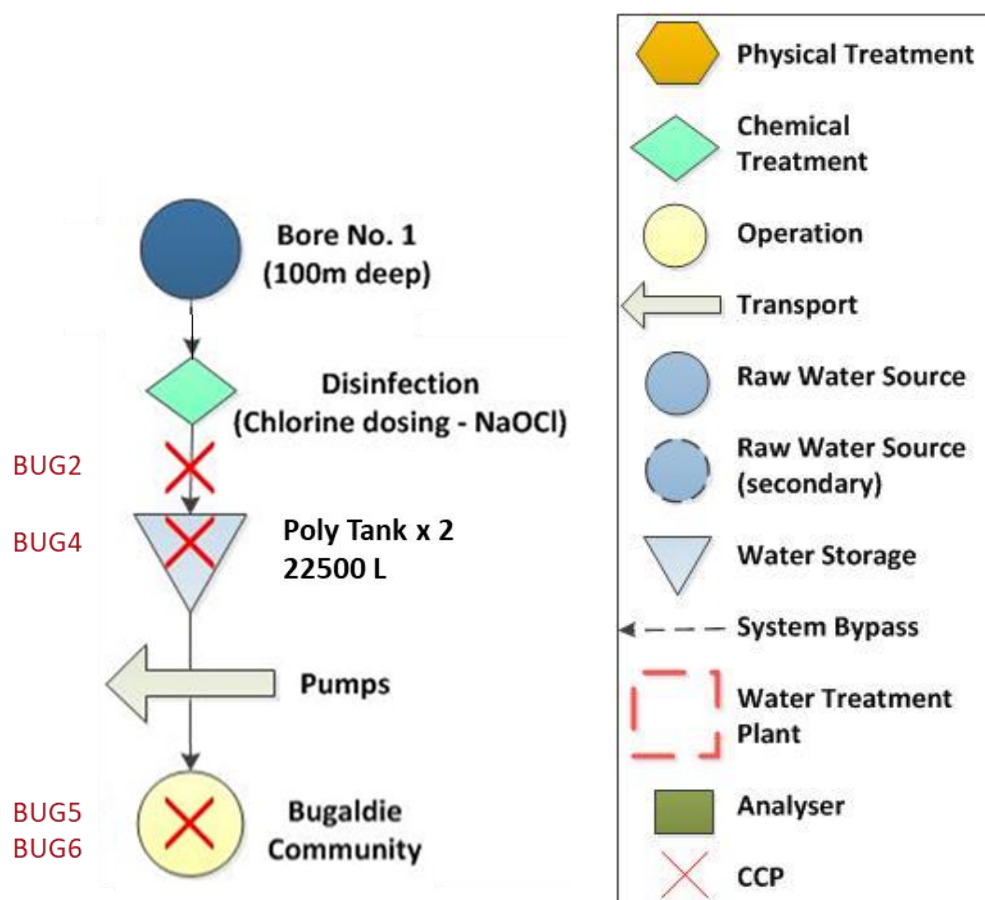


Figure 6-1: Water supply flow diagram – Bugaldie

Improvement works undertaken from August 2019 to August 2020 for the Bugaldie water supply include:

- Telemetry Upgrades
- Reservoir upgrades
- Upgrades to chlorine room

6.2 Critical control points

The CCPs for Bugaldie are shown in Table 6-1. These CCPs are regularly reviewed in quarterly water quality meetings as part of the ORANA water utilities alliance. A summary of changes made is shown in Table 6-2.

Table 6-1. Summary of critical control points – Bugaldie

CCP ID	Critical Control Point	Control Parameter	Target	Alert Level	Critical Limit
BUG2	Disinfection (Hypo)	Chlorine	1.5 – 2.3 mg/L	< 1.2 mg/L >2.8 mg/L	< 1.0 mg/L, >4.0 mg/L
BUG4	Reservoirs	Reservoir integrity	No breach of integrity (hatches locked, no holes in meshing)	-	Breach of integrity identified
BUG5	Distribution	Chlorine		< 0.4 mg/L >2.5mg/L	< 0.2 mg/L, >4.0 mg/L
BUG6	Distribution (OCP)	NTU	<1.0 NTU	>1.0 NTU	>4.0 NTU

Table 6-2. Summary of critical control points changes – Bugaldie

Date	CCP	Limit	Old	New	Reason for change
	BUG5 Distribution chlorine	Target		1.0 – 2.0 mg/L	Target limit for BUG5 was missing.

The CCP IDs have been reidentified to align a specific CCP ID with a specific process type across all treatment plants. The alignment of CCP IDs with specific processes is summarised in **Error! Reference source not found.**

Table 6-3. Summary of critical control points alignment changes – Bugaldie

CCP	Existing	Current
Disinfection (hypo)	BUG1	BUG2
Reservoirs	BUG2	BUG4
Distribution Chlorine	BUG3	BUG5
Distribution NTU (OCP)	BUG4	BUG6

6.3 Critical limit exceedance

There were no CCP limit exceedances for Bugaldie in the reporting period.

6.4 Operational CCP, OCP and COP monitoring graphs

Source (if not specified), Bugaldie operational monitoring spreadsheets

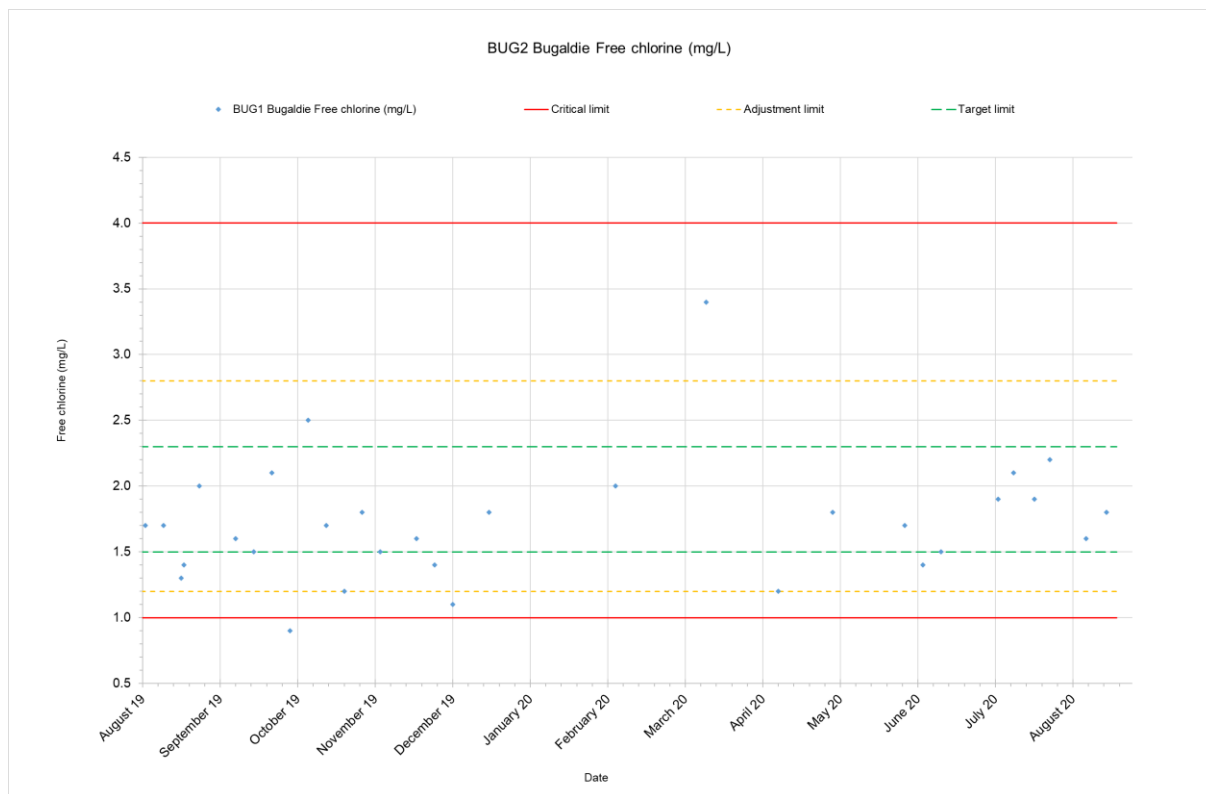


Figure 6-2: Reservoir free chlorine (BUG2) – Bugaldie

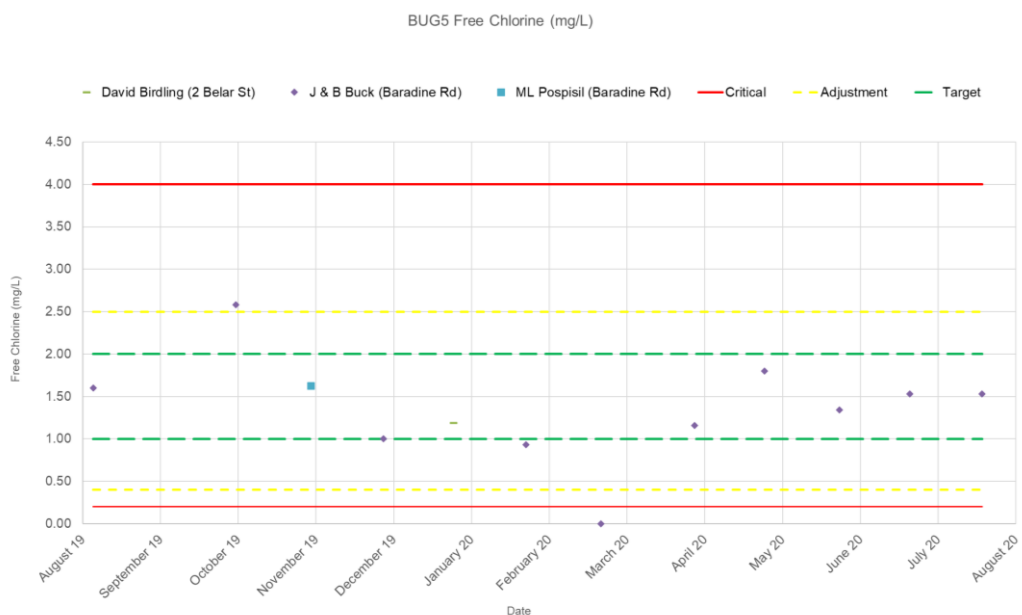


Figure 6-3: Reticulation free chlorine (BUG5) – Bugaldie.

Source: Drinking Water Monitoring spreadsheets.

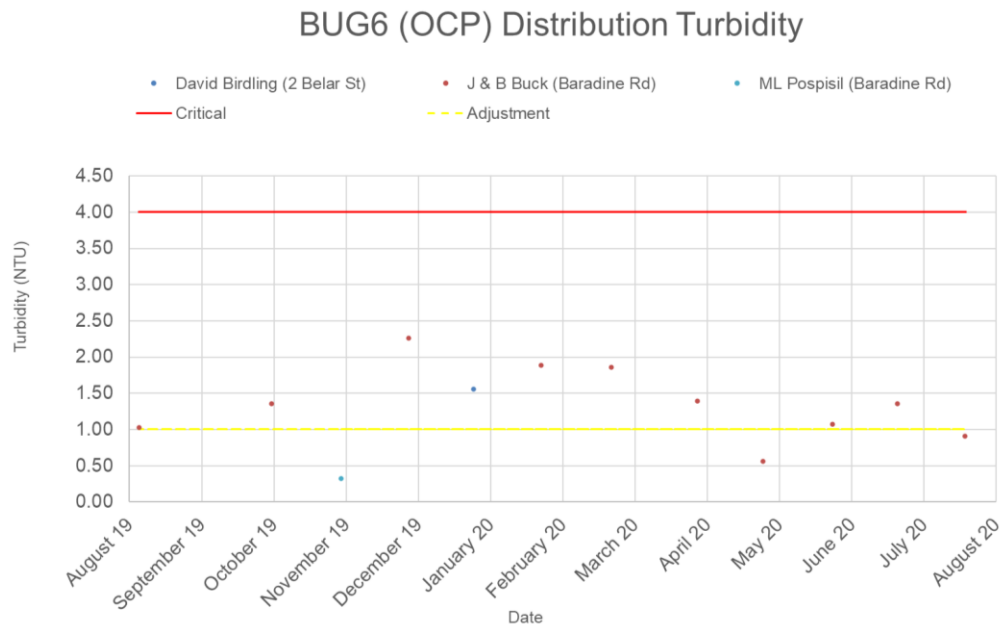


Figure 6-4: Distribution turbidity (BUG6, OCP) – Bugaldie

Source: Drinking Water Monitoring spreadsheet.

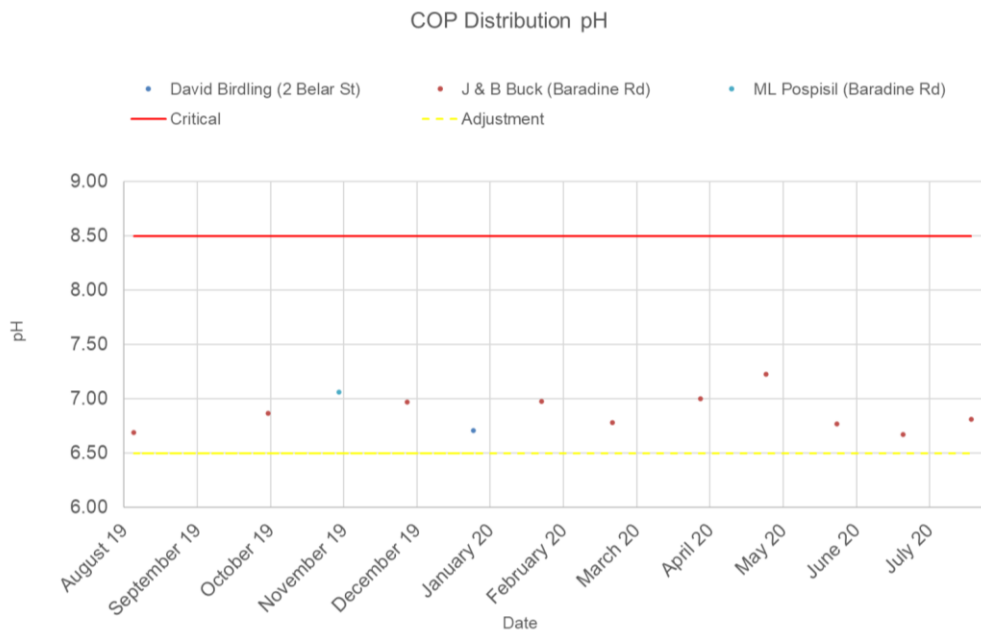


Figure 6-5: Bugaldie reticulation pH (COP)

Source: Drinking Water Monitoring spreadsheet.

6.5 Water quality

This section includes a review of water quality data for the Bugaldie water supply system from the reporting period, 1 August 2019 to 31 August 2020, including data collected as part of the NSW Health drinking water monitoring system program.

6.5.1 Data collection

The Bugaldie scheme operational water quality monitoring plan is shown in Table 6-4.

Table 6-4. Monitoring undertaken for Bugaldie water supply system

Process	CCP/OCP	Parameter	Unit	Frequency
Treated water	BUG2	Free Chlorine	mg/L	Weekly
Reticulation	BUG5	Free Chlorine	mg/L	Monthly
		Total Chlorine	mg/L	Monthly
		pH		Monthly
	BUG6 (OCP)	Turbidity	NTU	Monthly

6.5.2 Water quality issues

Monitoring of Bugaldie water supply detected exceptions for the follow:

Three exceptions against the ADWG Health guidelines

- High levels of Chromium (0.066 mg/L on 27 September 2019, guideline value 0.05 mg/L).
- High levels of Molybdenum (0.68 mg/L on 27 September 2019, guideline value 0.05 mg/L).
- High levels of Nickel (0.28 mg/L on 27 September 2019, guideline value 0.02 mg/L).

One exception against ADWG Aesthetic guidelines with

- High levels of Aluminium (0.33 mg/L on 27 September 2019, guideline value 0.2 mg/L).

Two other exceptions with

- Detection of total coliforms (>200 on 15 April 2020).
- Low levels of free chlorine (0.12 mg/L, on 15 April 2020, guideline value 0.2 – 5 mg/L).

6.6 Consumer water quality complaints/enquires

There were no water quality complaints at Bugaldie.

6.7 Water quality incidents/emergencies

There were no water quality incidents or emergencies in the Bugaldie water supply system in the reporting period.

6.8 Reservoir inspections

Non-formalised inspections are undertaken weekly including site security, roofing, bird-netting, telemetry aerials and chlorine check.

Formalised checklists are in development.

There were no issues found within the reporting period.

7 Mendooran

7.1 Scheme summary

The Mendooran water supply system comprises:

- Source water: Castlereagh River, back-up bore
- Treatment: WTP with oxidation (KMnO₄), flocculation (PACl), Aeration (cascade), sedimentation (x2 lagoons), sand bed filtration (x2 filters), disinfection (NaOCl) and fluoridation (not yet commissioned).
- Number of residential connections: 231
- Number of non-residential connections: none

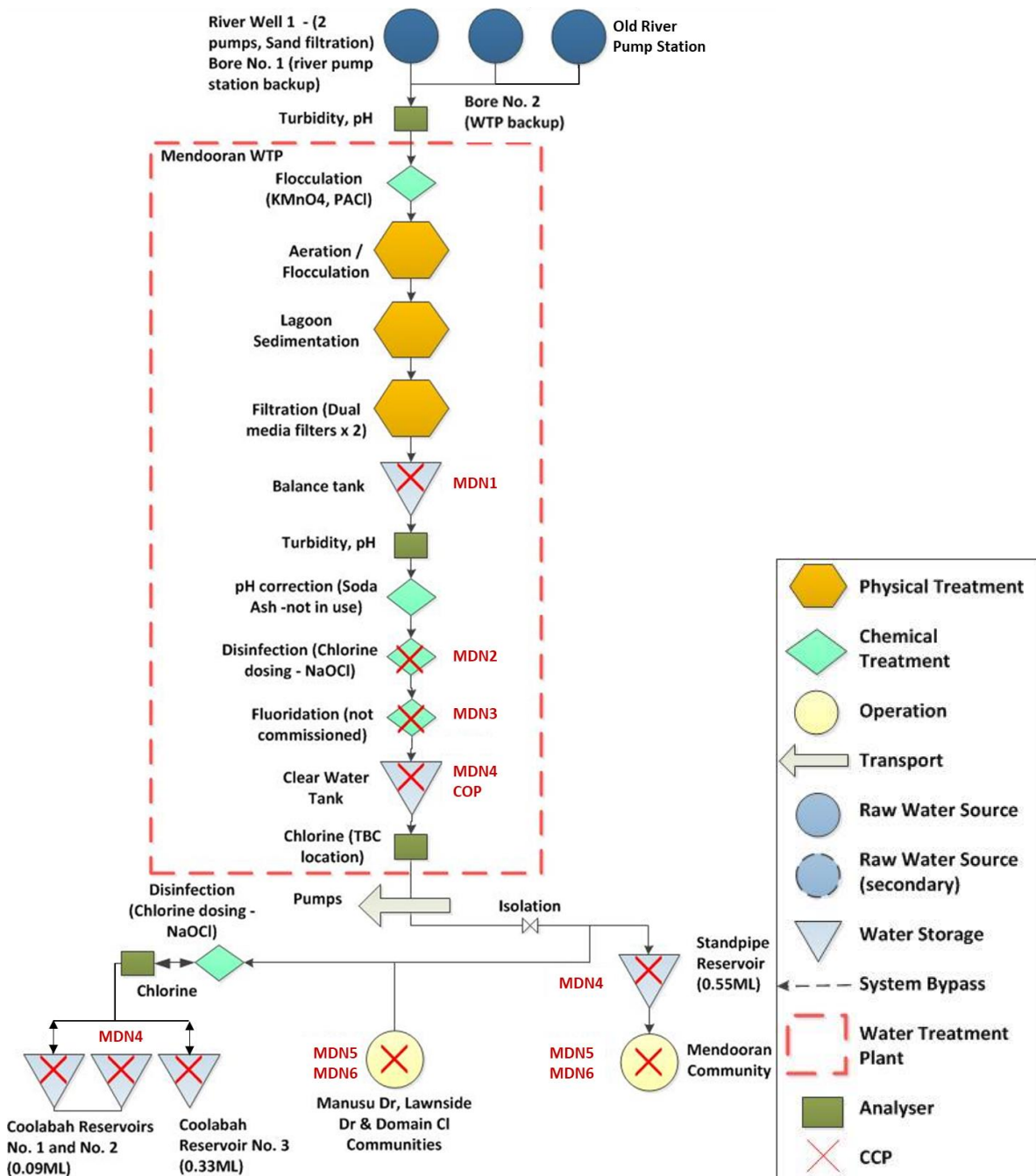


Figure 7-1: Water supply flow diagram – Mendooran

Improvement works undertaken from August 2019 to August 2020 for the Mendooran water supply include:

- New bore
- Telemetry Upgrades
- Reservoir upgrades
- Upgrades to chlorine room

7.2 Critical control points

The CCPs for Mendooran are shown in Table 7-1. These CCPs are regularly reviewed in quarterly water quality meetings as part of the ORANA water utilities alliance. A summary of changes made is shown in Table 7-2.

Table 7-1. Summary of critical control points – Mendooran

CCP ID	Critical Control Point	Control Parameter	Target	Alert Level	Critical Limit
MDN1	Filtration	Turbidity	<0.2 NTU	>0.3 NTU	>0.5 NTU
MDN2	Disinfection (hyppo)	Chlorine	1.5- 3.0 mg/L	<1.2 mg/L, >3.5 mg/L	<1.0 mg/L, >4.0 mg/L
MDN3	Fluoridation	Fluoride	1 mg/L (leaving WTP, leaving reservoir and throughout distribution system)	< 0.9 mg/L for >24hrs > 1.1 mg/L	>1.5 mg/L, <0.9 mg/L for >72hrs 0.0 mg/L for >24hrs
MDN4	Reservoirs	Reservoir integrity	No breach of integrity (hatches locked, no holes in meshing)	-	Breach of integrity identified
MDN5	Distribution	Chlorine	0.7 – 2.0 mg/L	<0.4, >3.0 mg/L	< 0.2 mg/L, >4.0 mg/L
MDN6	Distribution (OCP)	Turbidity	<1.0	>1.0	>4.0
COP	Final pH (COP)	pH	7.5 – 8.3	<7.0, >8.4	<6.5, >8.5

Table 7-2. Summary of critical control points alignment changes – Mendooran

The CCP IDs have been reidentified to align a specific CCP ID with a specific process type across all treatment plants. The alignment of CCP IDs with specific processes is summarised in **Error! Reference source not found.**

CCP	Old	Current
Reservoirs	MDN3	MDN4
Distribution Chlorine	MDN4	MDN5
Distribution NTU (OCP)	MDN7	MDN6
Final pH	MDN5	COP

There were no other changes to the CCPs.

7.4 Critical limit exceedances

A summary of critical limit exceedances for Mendooran water supply system is shown in Table 7-3.

Note: where multiple exceedances occurred on the same day at different monitoring points, only the maximum reading has been recorded in this table.

Table 7-3. Critical limit exceedances – Mendooran

Date	MDN1 Filtration	MDN2 Disinfection	MDN3 Fluoridation	MDN4 Reservoirs	MDN5 Distribution Chlorine	MDN6 Distribution NTU (OCP)	COP Distribution PH	Reason	Immediate correction	Preventative measures
21/08/2019		4.71								
22/08/2019		5.24			4.42					
25/08/2019		4.11								
26/08/2019		4.31			4.03					
27/08/2019		4.15								
28/08/2019		4.04								
20/10/2019		0.71						blockage		clean and maintains
28/10/2019	0.517							Algae bloom	change water supply	change water supply to decrease the risk of algae bloom coming into hotter weather
31/10/2019	0.668	4.11						Algae bloom	change water supply	change water supply to decrease the risk of algae bloom coming into hotter weather
1/11/2019	0.561							Algae bloom	change water supply	change water supply to decrease the risk of algae bloom coming into hotter weather
2/11/2019	0.508							Algae bloom	change water supply	change water supply to decrease the risk of algae bloom coming into hotter weather
5/11/2019					0.06			Algae bloom	change water supply	change water supply to decrease the risk of algae bloom coming into hotter weather
8/11/2019	0.55							Algae bloom	change water supply	change water supply to decrease the risk of algae bloom coming into hotter weather
9/11/2019	0.781							Algae bloom	change water supply	change water supply to decrease the risk of algae bloom coming into hotter weather
10/11/2019	0.579							Algae bloom	change water supply	change water supply to decrease the risk of algae bloom coming into hotter weather
11/11/2019	0.612	4.03						Algae bloom	change water supply	change water supply to decrease the risk of algae bloom coming into hotter weather
12/11/2019		4.31				8.48		Algae bloom	change water supply	change water supply to decrease the risk of algae bloom coming into hotter weather

Date	MDN1 Filtration	MDN2 Disinfection	MDN3 Fluoridation	MDN4 Reservoirs	MDN5 Distribution Chlorine	MDN6 Distribution NTU (OCP)	COP Distribution PH	Reason	Immediate correction	Preventative measures
13/11/2019		4.09						Algae bloom	change water supply	change water supply to decrease the risk of algae bloom coming into hotter weather
14/11/2019		4.12				6.08		Algae bloom	change water supply	change water supply to decrease the risk of algae bloom coming into hotter weather
15/11/2019	0.546	4.37				4.01		Algae bloom	change water supply	change water supply to decrease the risk of algae bloom coming into hotter weather
20/11/2019		4.06						Algae bloom	change water supply	change water supply to decrease the risk of algae bloom coming into hotter weather
23/11/2019	0.763							Algae bloom	install pump to circulate water around the lagoon	change water supply to decrease the risk of algae bloom coming into hotter weather
24/11/2019	0.701							Algae bloom	install pump to circulate water around the lagoon	change water supply to decrease the risk of algae bloom coming into hotter weather
25/11/2019	0.701							Algae bloom	install pump to circulate water around the lagoon	change water supply to decrease the risk of algae bloom coming into hotter weather
26/11/2019	0.535							Algae bloom	install pump to circulate water around the lagoon	change water supply to decrease the risk of algae bloom coming into hotter weather
27/11/2019	0.709									
29/11/2019		4.13								
3/12/2019		4.09								
4/12/2019		4.54								
5/12/2019		4.30								
6/12/2019		4.30								
8/12/2019		4.01								
12/12/2019	0.61									
13/12/2019		4.33								
16/12/2019	0.504									
17/12/2019	0.554									
20/12/2019	0.5									
27/12/2019						4.66				
2/01/2020						13.1 0		algae at the plant cause the chlorine in retic to be used up	flushing line	increase chlorine at plant and remove algae for WTP
6/01/2020	0.612							Chlorine line block at plant causing low	flushing line	installing the chlorine reader at the plant causing plant to shutdown when low chlorine is detected

Date	MDN1 Filtration	MDN2 Disinfection	MDN3 Fluoridation	MDN4 Reservoirs	MDN5 Distribution Chlorine	MDN6 Distribution NTU (OCP)	COP Distribution PH	Reason	Immediate correction	Preventative measures
								chlorine into retic		
7/01/2020	0.568							algae at the plant cause the chlorine in retic to be used up	flushing line	increase chlorine at plant and remove algae for WTP
8/01/2020	0.611							algae at the plant cause high NTU reading	increase backwash time/ change dosing rate	install pump at lagoon to reticulate the water
9/01/2020	0.518					6.90		algae at the plant cause high NTU reading	increase backwash time/ change dosing rate	install pump at lagoon to reticulate the water
10/01/2020	0.509							algae at the plant cause high NTU reading	increase backwash time/ change dosing rate	install pump at lagoon to reticulate the water
11/01/2020		4.77			4.18			increase chlorine at plant to increase retic chlorine	None	don't allow the retic chlorine to get low
12/01/2020		5.36			4.93			increase chlorine at plant to increase retic chlorine	None	don't allow the retic chlorine to get low
13/01/2020		5.64			4.72			increase chlorine at plant to increase retic chlorine	None	don't allow the retic chlorine to get low
17/01/2020	0.73									
18/01/2020	0.81									
19/01/2020	0.91									
20/01/2020	0.64									
21/01/2020	0.63									
22/01/2020	0.64									
23/01/2020	0.64									
20/02/2020					4.98			turn up because Ntu in the water was using the chlorine since then ntu has decrease to normal level	turn down the pump	
25/02/2020					4.02			Chlorine from plant was making to Mansu Res	turn off pump	

Date	MDN1 Filtration	MDN2 Disinfection	MDN3 Fluoridation	MDN4 Reservoirs	MDN5 Distribution Chlorine	MDN6 Distribution NTU (OCP)	COP Distribution PH	Reason	Immediate correction	Preventative measures
								cause it to over dose		
1/03/2020					4.10					
11/03/2020	0.521									
15/03/2020					5.75					
16/03/2020					4.15					
3/08/2020	0.541							Operator error		Writing a procedural manual for replacement technical officer to double check operator entries.

7.5 Operational CCP, COP and OCP monitoring graphs

Source (if not specified), Mendooran operational monitoring spreadsheet

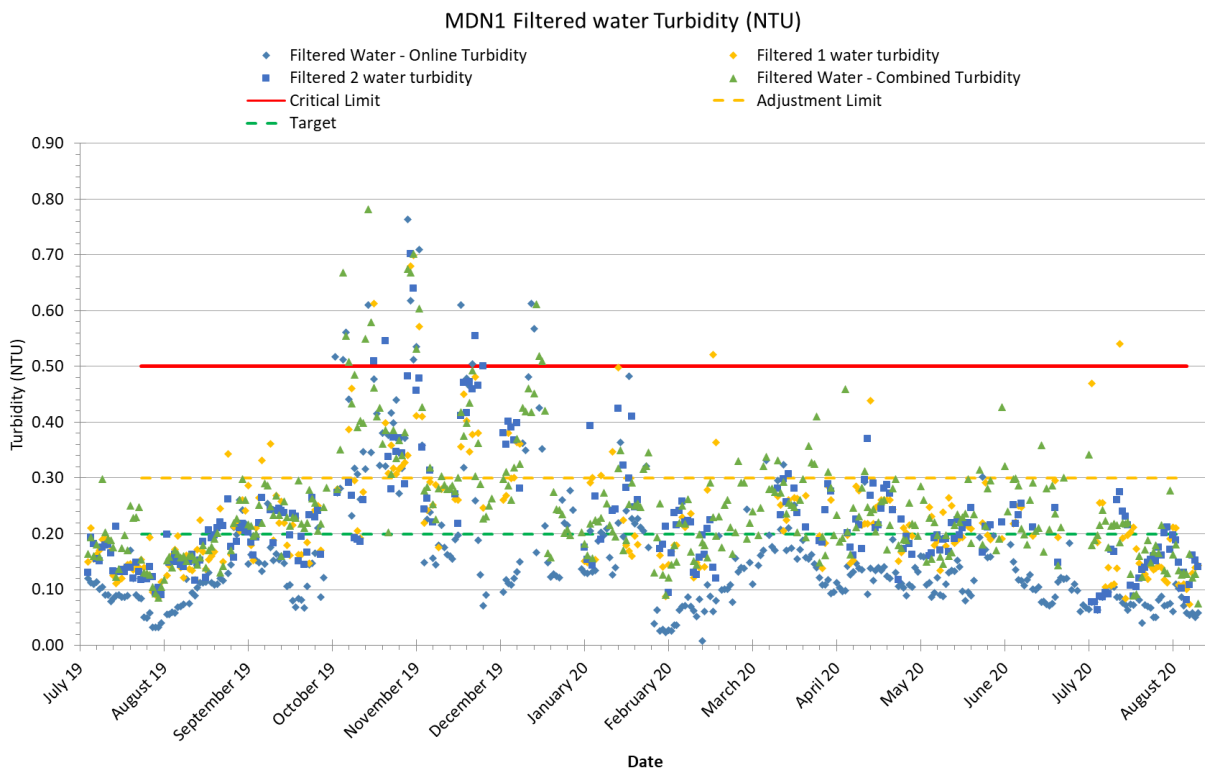


Figure 7-2: Filtered water turbidity (MDN1) – Mendooran

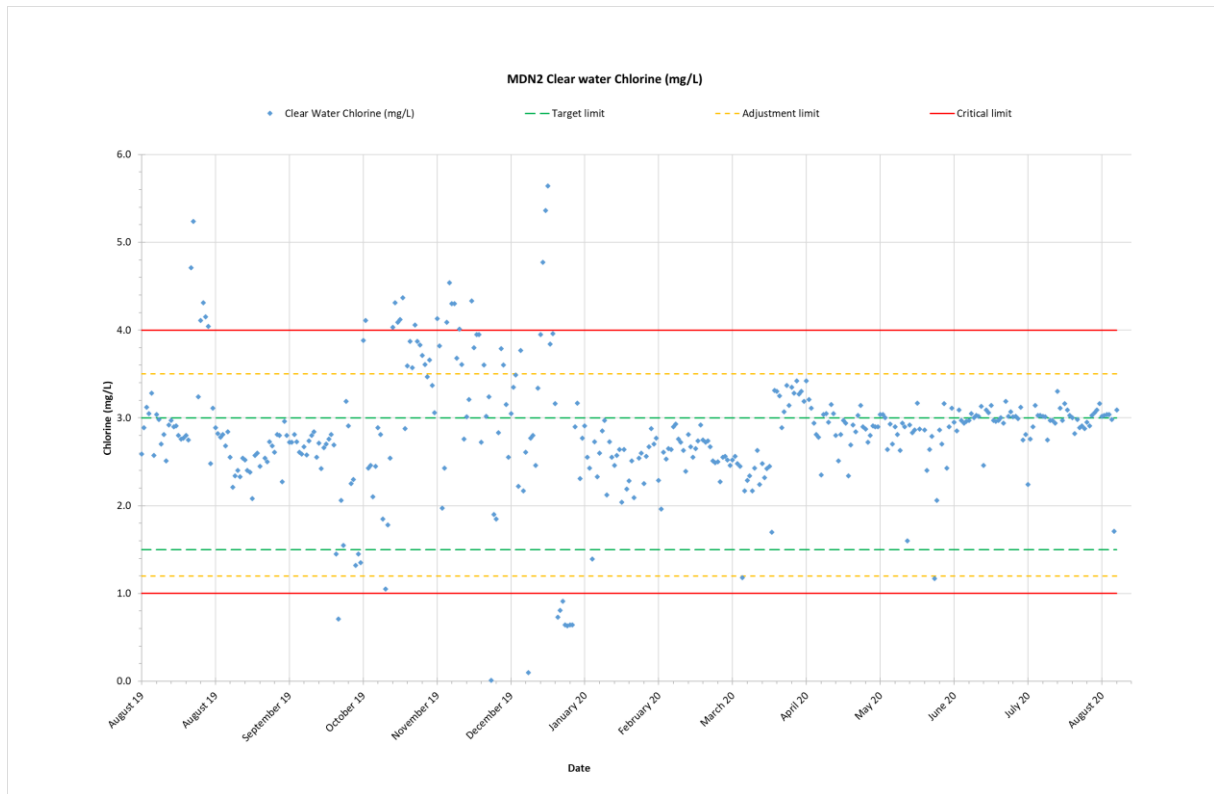


Figure 7-3: Clear water free chlorine (MDN2) – Mendooran

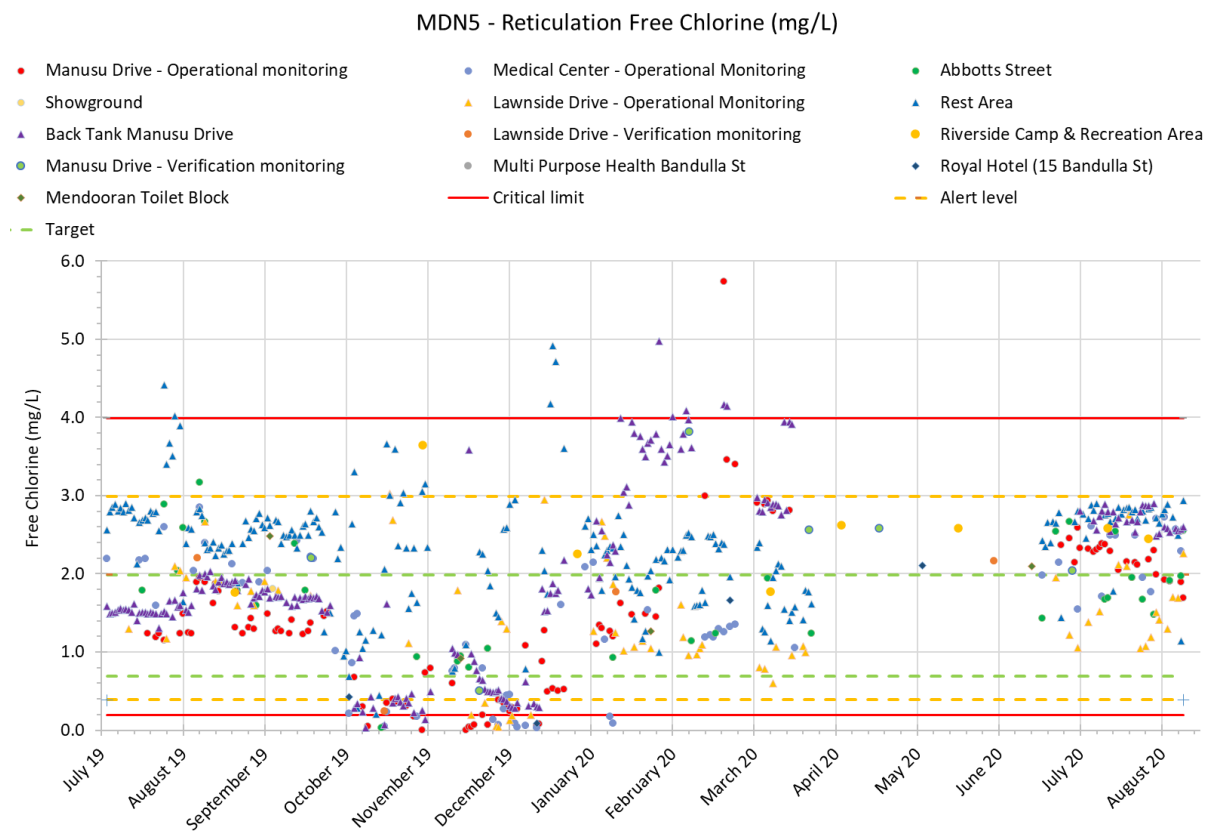


Figure 7-4: Distribution Free chlorine (MDN5) – Mendooran

Source: Drinking Water Monitoring spreadsheet.

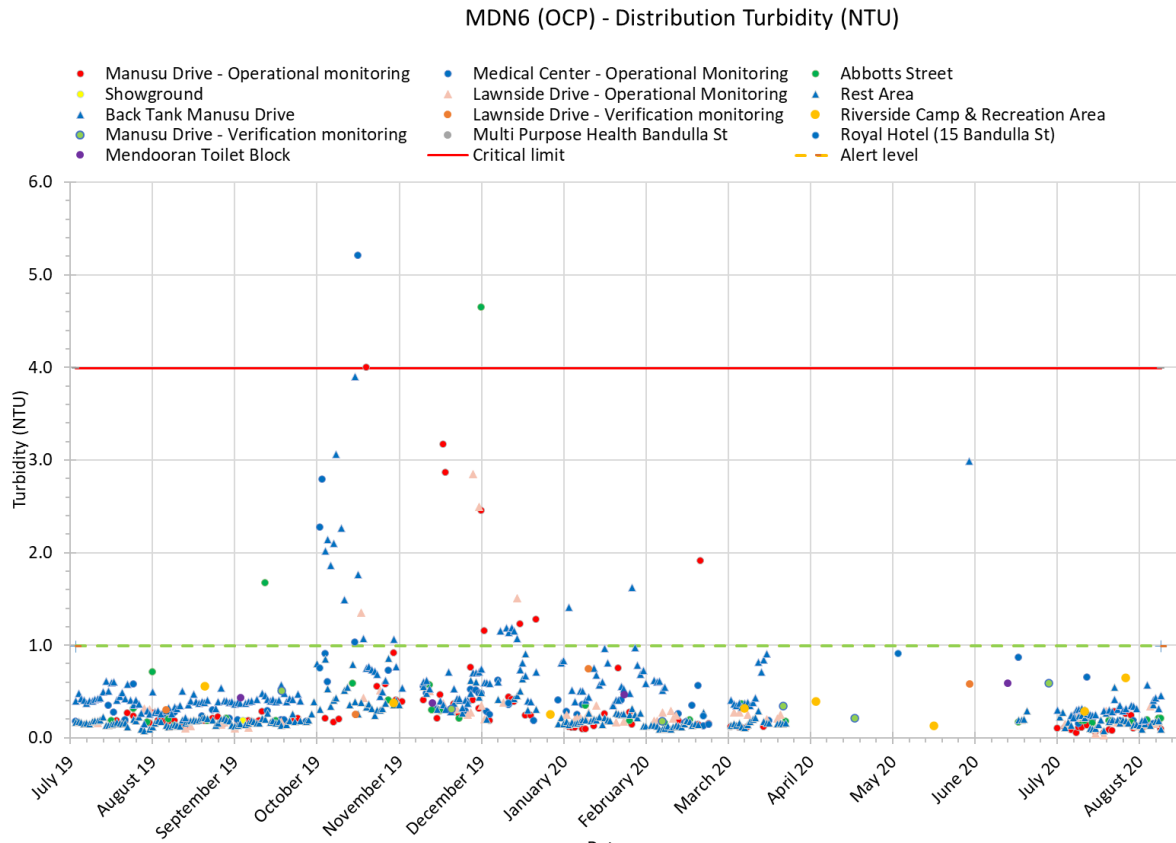


Figure 7-5: Reticulation turbidity (MDN6, OCP) – Mendooran

Source: Drinking Water Monitoring spreadsheet.

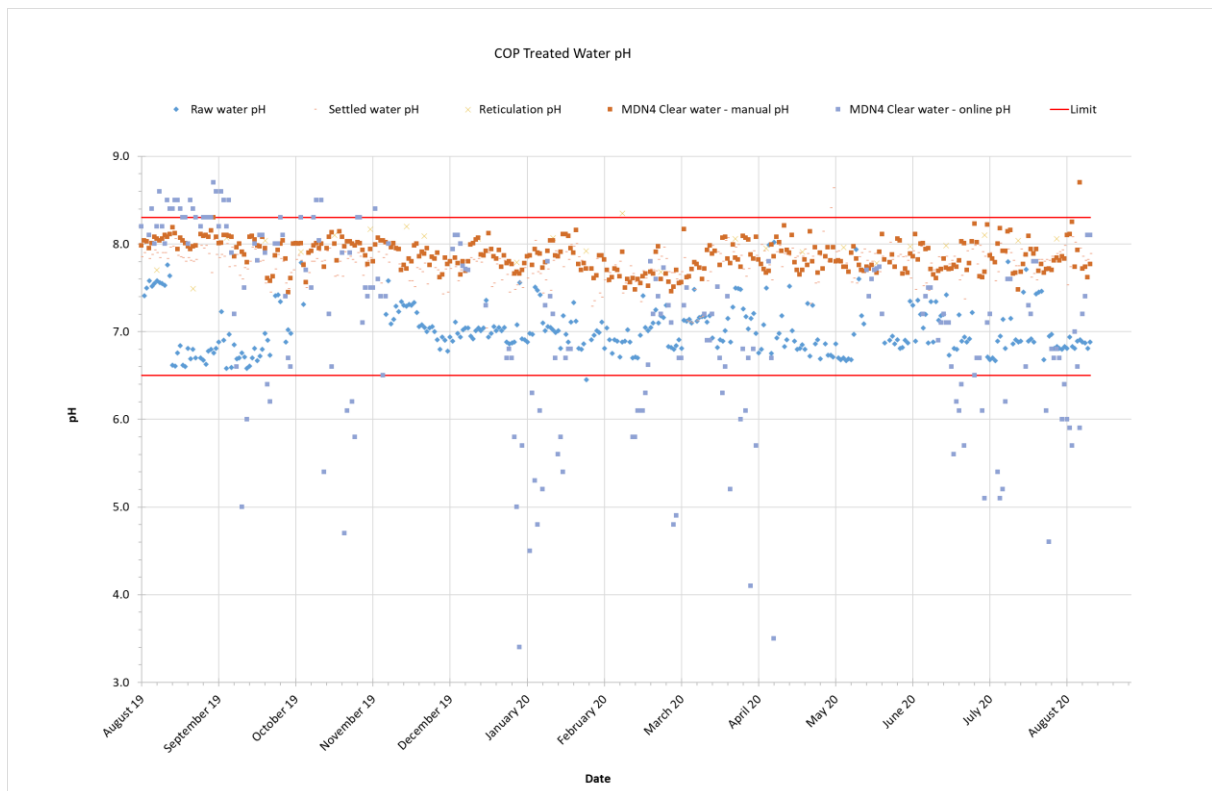


Figure 7-6: Mendooran operational pH (COP)

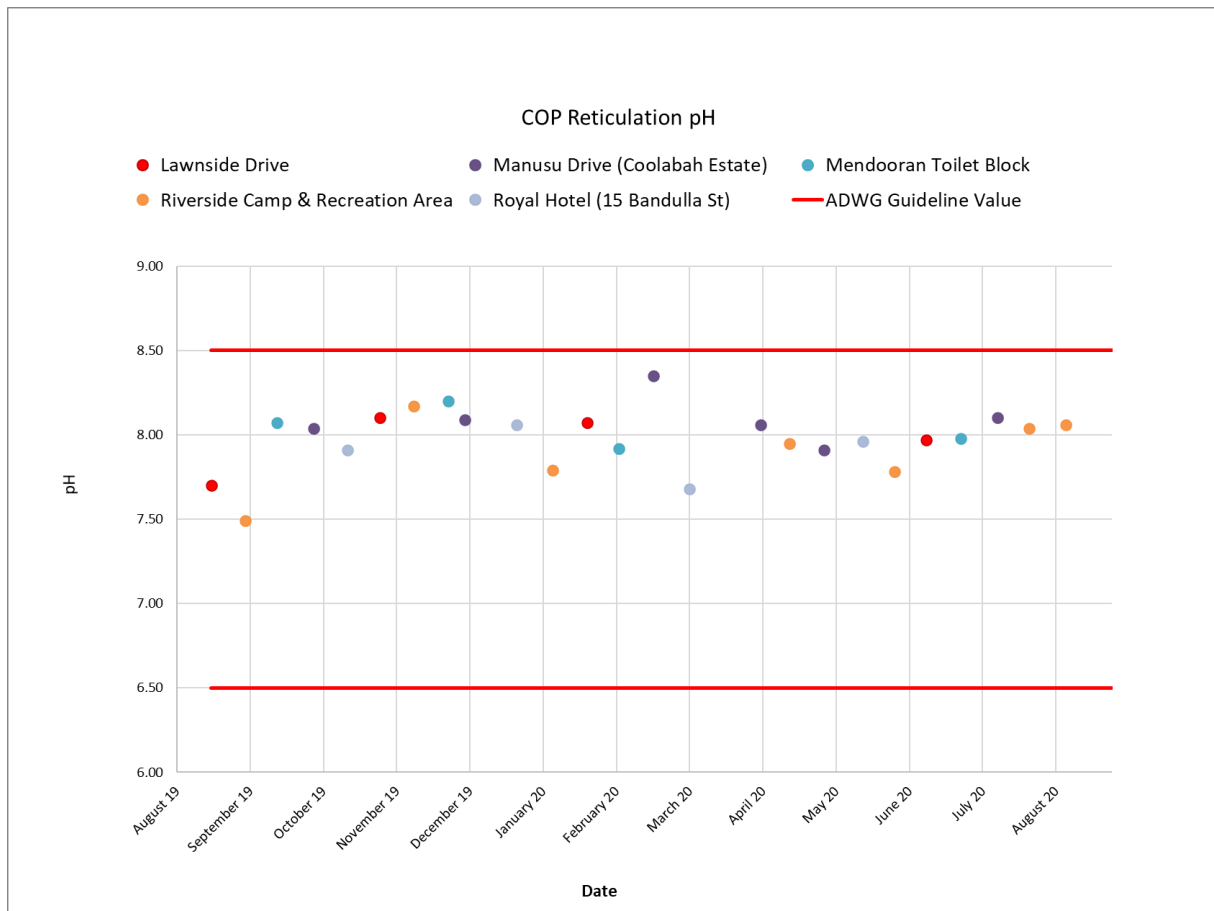


Figure 7-7: Mendooran reticulation pH (COP).

Source: Drinking Water Monitoring spreadsheet.

7.6 Water quality

This section includes a review of water quality data for the Mendooran water supply system from the reporting period, 1 August 2019 to 31 August 2020, including data collected as part of the NSW Health drinking water monitoring system program.

7.6.1 Data collection

The Mendooran scheme operational water quality monitoring plan is shown in Table 7-4.

Table 7-4. Monitoring undertaken for Mendooran water supply system

Process	CCP/COP/OCP	Parameter	Units	Frequency
Raw water		pH		Daily
		Turbidity	NTU	Daily
		Manganese	mg/L	Weekly
		Iron	mg/L	Weekly
Settled water		pH		Daily
		Colour		Daily
		Turbidity	NTU	Daily
Filtered water		pH	NTU	Daily
	MDN1	Turbidity	NTU	Daily
	MDN1	Turbidity	NTU	Online
Clear water	MDN5 (COP)	pH		Daily / online
		Turbidity	NTU	Daily
	MDN2	Chlorine	mg/L	Daily
		Manganese	mg/L	Daily
		Iron	mg/L	Daily
	MDN4	Free Chlorine	mg/L	Weekly
Reticulation		pH		Weekly
	MDN7 (OCP)	Turbidity	NTU	Weekly

7.6.2 Water quality issues

Monitoring of Mendooran water supply detected exceptions for the follow:

Two exceptions against the ADWG Health guidelines

- High levels of Manganese (0.74 mg/L on 1/4/2020, guideline value 0.5 mg/L)
- High levels of Mercury (0.0011 mg/L on 17/3/2020, guideline value 0.001 mg/L)

One exception against ADWG Aesthetic guidelines with

- High levels of Iron (0.82 mg/L on 1/4/2020, guideline value 0.3 mg/L),

Four other exceptions with

- Detection of total coliforms twice (3 on 6/1/2002 and >200 on 17/02/2020, but it should be noted this sample was taken from the Mendooran Park Toilet block)
- Low levels of free chlorine (0.01 mg/L, on 6/1/2002 guideline value 0.2 – 5 mg/L)
- High Turbidity (9.4 NTU on the 1/4/2020, guideline value 5 NTU)

7.7 Consumer water quality complaints/enquires

A summary of customer complaints and enquiries is shown in Table 7-5. There were no water quality complaints in Mendooran.

Table 7-5. Summary of water quality customer complaints / enquiries – Mendooran

Complaints/Enquires	Type	Number
Water Quality	Enquiries	2
Water Meter	Enquiries	7
Water Main (leaks/burst)	Enquiries	2
Water (pressure / lack of water)	Enquiries	4

7.8 Water quality incidents/emergencies

There were no water quality incidents or emergencies in the Mendooran water supply system in the reporting period.

7.9 Reservoir inspections

Non-formalised inspections are undertaken weekly including site security, roofing, bird-netting, telemetry aerials and chlorine check.

Formalised checklists are in development.

There were no issues found within the reporting period.

8 Coolah

8.1 Scheme summary

The Coolah water supply system comprises:

- Source water: Bore
- Chlorination disinfection only (gas); fluoridation not yet commissioned
- Number of residential connections: 393
- Number of non-residential connections: 94

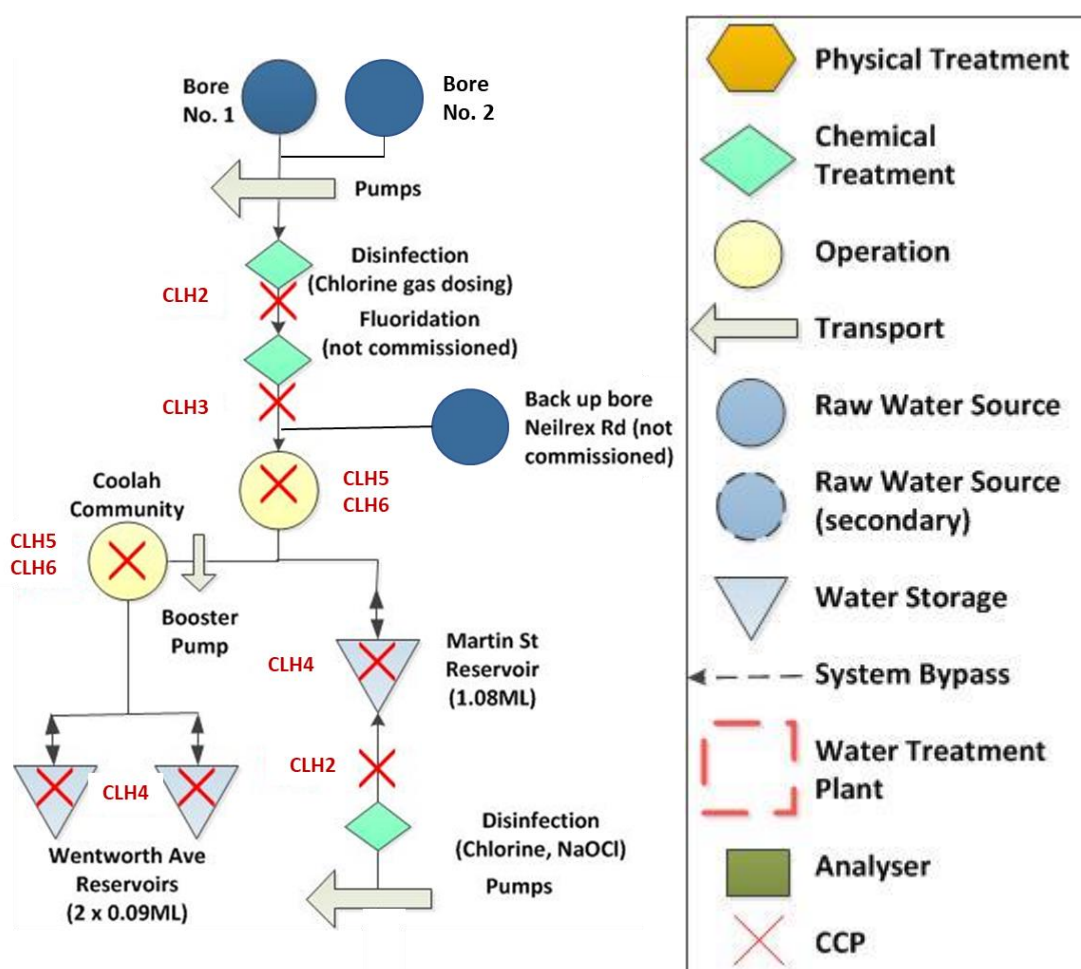


Figure 8-1: Water supply flow diagram – Coolah

Improvement works undertaken from August 2019 to August 2020 for the Coolah water supply include:

- New Bore
- Sealing of Coolah bore
- Coolah reservoirs refurbishments
- Telemetry Upgrades
- Upgrades to chlorine room

8.2 Critical control points

The CCPs for Coolah are shown in Table 8-1. These CCPs are regularly reviewed in quarterly water quality meetings as part of the ORANA water utilities alliance. A summary of changes made is shown in Table 8-2.

Table 8-1. Summary of critical control points – Coolah

CCP ID	Critical Control Point	Control Parameter	Target	Alert Level	Critical Limit
CLH2	Disinfection (gas)	Chlorine	1.0 – 2.2 mg/L	<0.7 mg/L, >3.0 mg/L	<0.4 mg/L, >4.0 mg/L
CLH3	Fluoridation	Fluoride	1 mg/L (leaving WFP, leaving reservoir and throughout distribution system)	0.9 mg/L for >24hrs 1.1 mg/L	<0.9 mg/L for >72hrs >1.5 mg/L 0.0 mg/L for >24hrs
CLH4	Reservoirs	Reservoir integrity	No breach of integrity (hatches locked, no holes in meshing)	-	Breach of integrity identified
CLH5	Distribution	Chlorine	1.0 – 2.0 mg/L	<0.7 mg/L, >3.0 mg/L	< 0.2 mg/L, >4.0 mg/L
CLH6	Distribution (OCP)	Turbidity	<1.0 NTU	>1.0 NTU	>4.0 NTU

Table 8-2. Summary of critical control points alignment changes – Coolah

The CCP IDs have been reidentified to align a specific CCP ID with a specific process type across all treatment plants. The alignment of CCP IDs with specific processes is summarised **Error! Reference source not found.**

CCP	Existing	Current
Disinfection (gas)	CLH1	CLH2
Reservoirs	CLH2	CLH4
Distribution Chlorine	CLH4	CLH5
Distribution NTU (OCP)	CLH5	CLH6

No changes to CCP limits

The fluoridation plant was offline during the reporting period.

8.3 Critical limit exceedances

There were no Critical limit exceedances of CCP's, OCP's or COPs at the Coolah Water Treatment Plant.

8.4 Operational CCP, OCP an COP monitoring graphs

Source (if not specified), Coolah operational monitoring spreadsheet

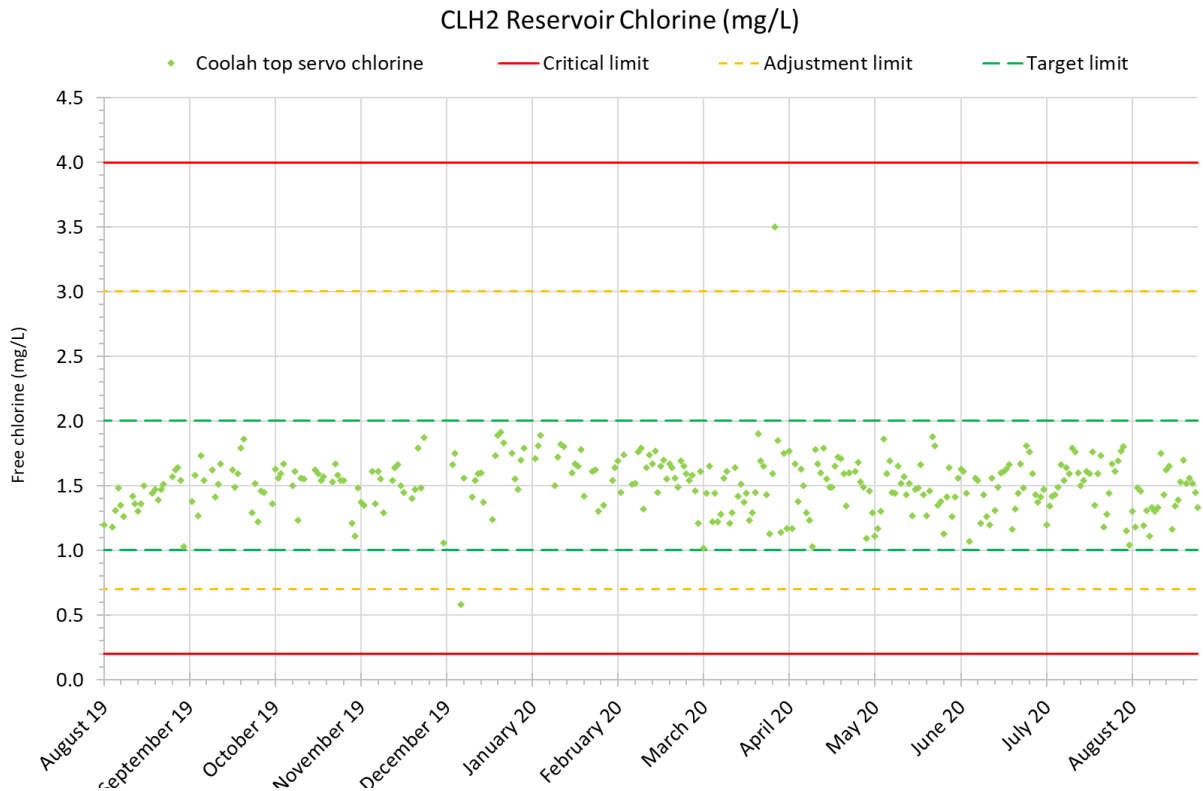


Figure 8-2: Chlorine disinfection (CLH2) – Coolah

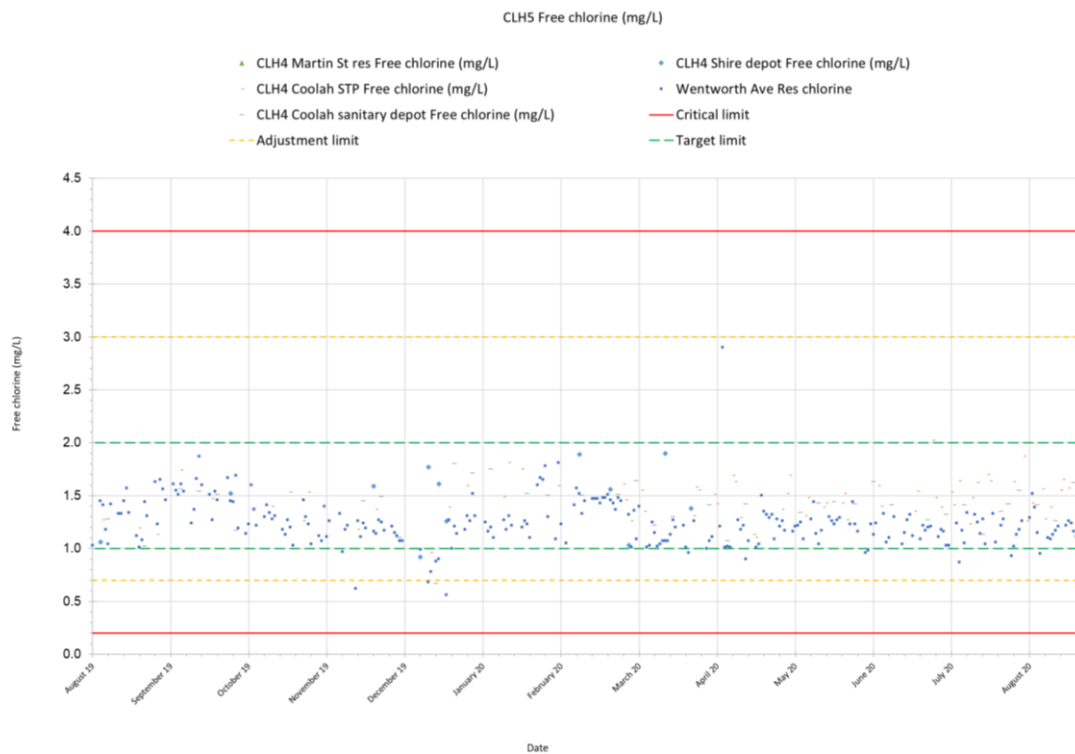


Figure 8-3: Reticulation free chlorine (CLH5) – Coolah

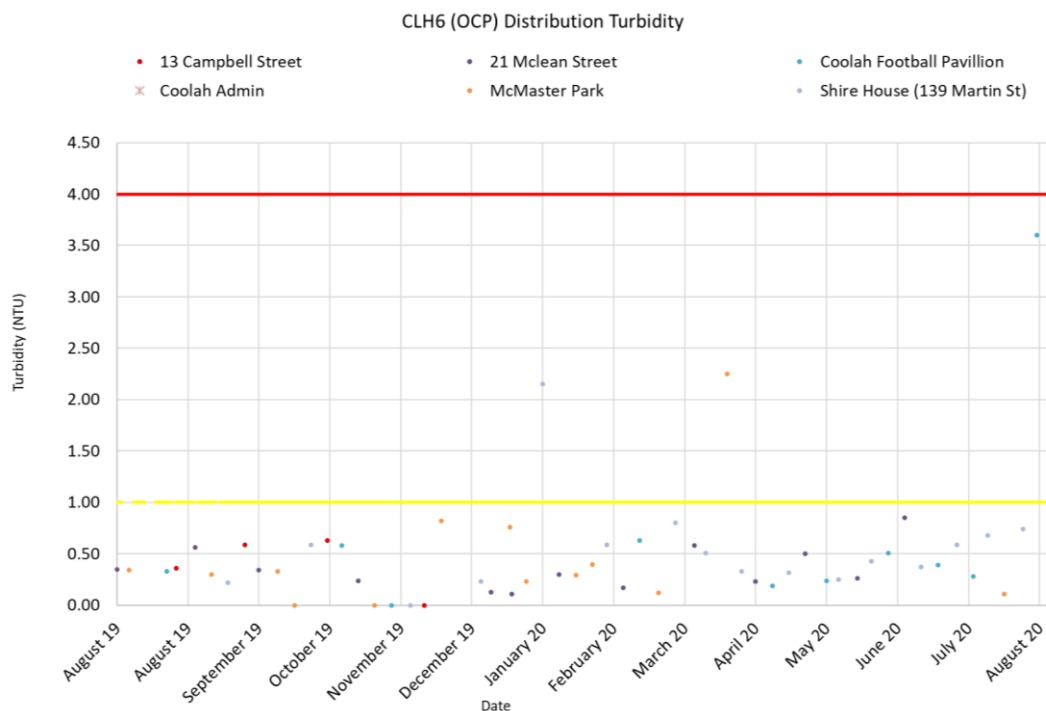


Figure 8-4: Reticulation turbidity (CLH6, OCP) – Coolah

Source: Drinking Water Monitoring spreadsheet.

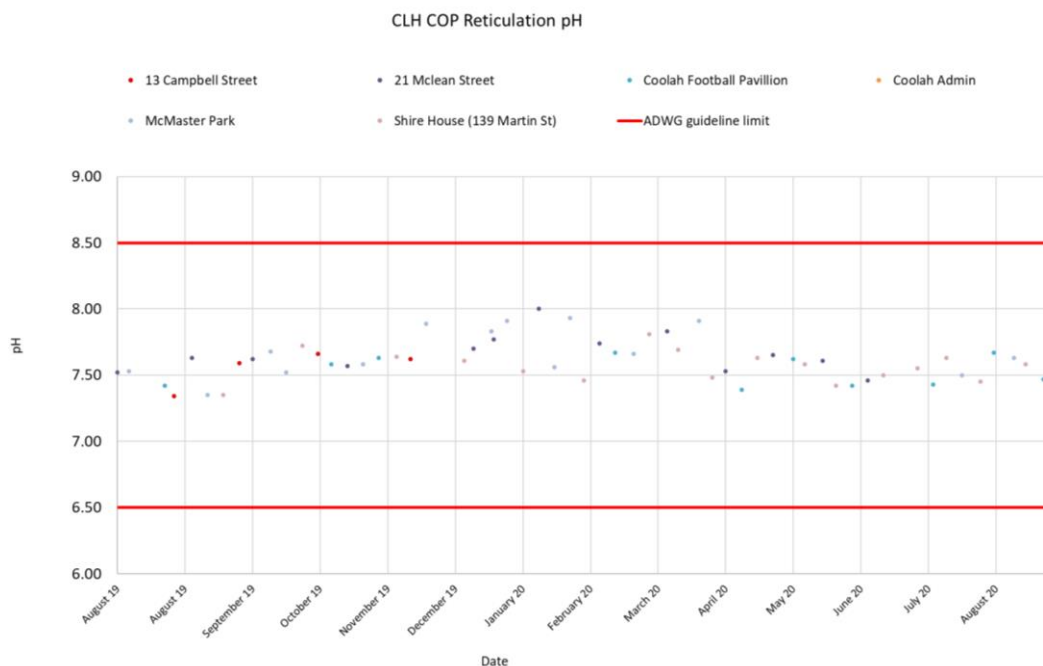


Figure 8-5: Coolah reticulation pH (COP)

Source: Drinking Water Monitoring spreadsheet.

pH Coolah Football Pavillion of 13/7/2020 removed as both had been recorded as "lo"

8.5 Water quality

This section includes a review of water quality data for the Coolah water supply system from the reporting period, 1 August 2019 to 31 August 2020, including data collected as part of the NSW Health drinking water monitoring system program.

8.5.1 Data collection

The Coolah scheme operational water quality monitoring plan is shown in Table 8-3.

Table 8-3. Monitoring undertaken for Coolah water supply system

Process	Critical Control Points	Parameter	Units	Frequency
Martin St res	CLH4	Free chlorine	mg/L	24/7 via Chloroclam
		pH		Daily
Coolah top servo	CLH1	Free chlorine	mg/L	Daily
		pH		Daily
	CLH6	NTU		Daily
Wentworth Ave Reservoir	CLH4	Free chlorine	mg/L	3/week
		pH		3/week
	CLH6	NTU		3/week
Coolah Shire depot	CLH4	Free chlorine	mg/L	Twice weekly
		pH		Twice weekly
	CLH6	NTU		Twice weekly
Coolah STP	CLH4	Free chlorine	mg/L	Weekly
		pH		Weekly
Coolah sanitary depot	CLH4	Free chlorine	mg/L	Weekly
		pH		Weekly

8.5.2 Water quality issues

Monitoring of Coolah water supply detected three exceptions as follows:

Two exceptions against ADWG Aesthetic guidelines with

- Total hardness on 2 occasions (457.7 on 24/9/2020 and 400.5 on 9/3/2020, guideline value 200 mg/L)

One other exception with

- Detection of total coliforms on 1 occasion (202 on 6/01/2020, guideline value 0).

8.6 Consumer water quality complaints/enquires

A summary of customer complaints and enquiries is shown in Table 8-4. There was one water quality complaint of poor tasting in March 2020.

Table 8-4. Summary of water quality customer complaints / enquiries – Coolah

Complaints/Enquires	Type	Number
Water Quality	Complaints	1
Water Main (leaks /bursts)	Complaints	1
	Enquiry	34
Water (pressure / lack of water)	Enquiry	6
Water restrictions	Enquiry	1
Water Meter	Enquiry	42

8.7 Water quality incidents/emergencies

A summary of incidents in the Coolah water supply are shown in Table 8-5.

Table 8-5. Summary of incident and emergencies, recommendations, and preventive actions

Details of incident/emergency	Investigation recommendations	Preventive action undertaken
<i>E. coli</i> detected in Coolah reservoir on 17 January 2019 Boil water alert	Possum was found in the reservoir	Cleaning and vermin proofing of reservoirs Reservoir inspection SOP in progress

8.8 Reservoir inspections

Non-formalised inspections are undertaken weekly including site security, roofing, bird-netting, telemetry aerials and chlorine check.

Formalised checklists are in development.

There were no issues found within the reporting period.

9 Binnaway

9.1 Scheme summary

The Binnaway water supply system comprises:

- Source water: Castlereagh River
- Treatment: WTP with flocculation (alum), sedimentation (x2 lagoons), sand bed filtration (x2 filters), pH correction (soda ash), chlorine gas disinfection and fluoridation (currently off-line).
- Number of residential connections: 289
- Number of non-residential connections: 1

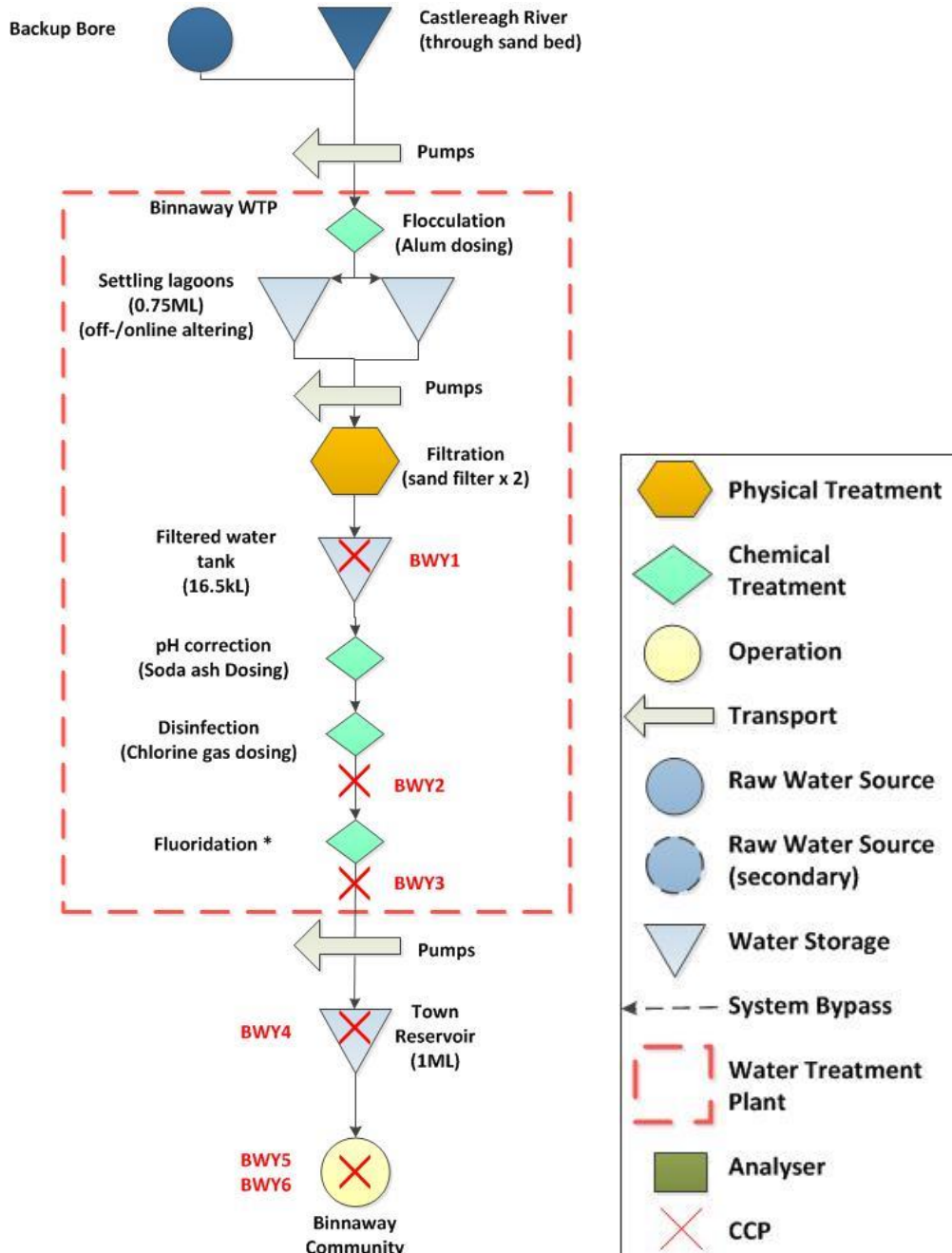


Figure 9-1: Water supply flow diagram – Binnaway

Improvement works undertaken from August 2019 to August 2020 for the Binnaway water supply include:

- New Chlorine Gas dosing system, Analyser and scales
- New PLC

9.2 Critical control points

The CCPs for Binnaway are shown in Table 9-1. These CCPs are regularly reviewed in quarterly water quality meetings as part of the ORANA water utilities alliance. A summary of changes made is shown in Table 9-2.

Table 9-1. Summary of critical control points – Binnaway

CCP ID	Critical Control Point	Control Parameter	Target	Alert Level	Critical Limit
BWY1	Filtration	Turbidity	<0.2 NTU	>0.3 NTU	>0.5 NTU
BWY2	Disinfection (gas)	Chlorine	2.0 mg/L – 3.2 mg/L	<1.5 mg/L, >3.6 mg/L	<1.0 mg/L, > 4.0 mg/L
BWY3	Fluoridation	Fluoride	1 mg/L (leaving WFP, leaving reservoir and throughout distribution system)	< 0.9 mg/L for >24hrs > 1.1 mg/L	<0.9 mg/L for >72hrs >1.5 mg/L 0.0 mg/L for >24hrs
BWY4	Reservoirs	Reservoir integrity	No breach of integrity (hatches locked, no holes in meshing)	-	Breach of integrity identified
BWY5	Distribution	Chlorine	0.8 – 2.0 mg/L	< 0.5 mg/L, >2.5 mg/L	< 0.2 mg/L, >4.0 mg/L
BWY6	Distribution (OCP)	Turbidity	<1.0 NTU	>1.0 NTU	>4.0 NTU

Table 9-2. Summary of critical control points changes – Binnaway

No changes to CCP limits

Critical control point performance for the reporting period is graphed in Appendix G.

The fluoridation plant was offline during the reporting period.

9.3 Critical limit exceedances

There were 21 CCP exceedances throughout the reporting period for Binnaway WTP. On six days throughout January and February 2020, there were simultaneous breaches of BWY1 Turbidity, all NTU over 0.54 NTU and BWY5 Free Chlorine less than 0.2 mg/L. All were related to rain events increases the river water turbidity and thus increasing chlorine demand. Free Chlorine continued to record less than 0.2 mg/L on six additional occasions throughout February and March 2020. On 6 April 2020 both BWY6 Reticulation Turbidity (4.54 NTU) and BWY5 Free Chlorine (<0.2) were recorded requiring flushing. On 21 April, low BWY5 Free Chlorine was recorded in a low use dead end. And on 6 August 2020 BWY2 Disinfection Free Chlorine was low recording 0.5.

Date	BWY1 Filtration	BWY2 Disinfection	BWY3 Fluoridation	BWY4 Reservoirs	BWY5 Distribution Chlorine	BWY6 Distribution NTU (OCP)	COP Distribution PH	Reason	Immediate correction	Preventive measures
4/11/2019					0.07					
12/01/2020	0.55							Rain has caused the river water to increase turbidity	adjusted chemical to improve performance of plant	
25/01/2020	0.86							Rain has caused the river water to increase turbidity	adjusted chemical to improve performance of plant	
28/01/2020	0.69				<0.2			Rain has caused the river water to increase turbidity	adjusted chemical to improve performance of plant	
29/01/2020	0.60							Rain has caused the river water to increase turbidity	adjusted chemical to improve performance of plant	
1/02/2020	0.58									
2/02/2020	0.57									
11/02/2020					0.10					
24/02/2020					0.16					
9/03/2020					<0.2					
18/03/2020	0.69									
20/03/2020	0.67									
5/04/2020					0.15			needed flushing	flush	
21/04/2020					<0.2			Deadend with low use	flush	
5/08/2020		0.50								

9.4 Operational CCP, OCP and COP monitoring graphs

Source (if not specified), Binnaway operational monitoring spreadsheet

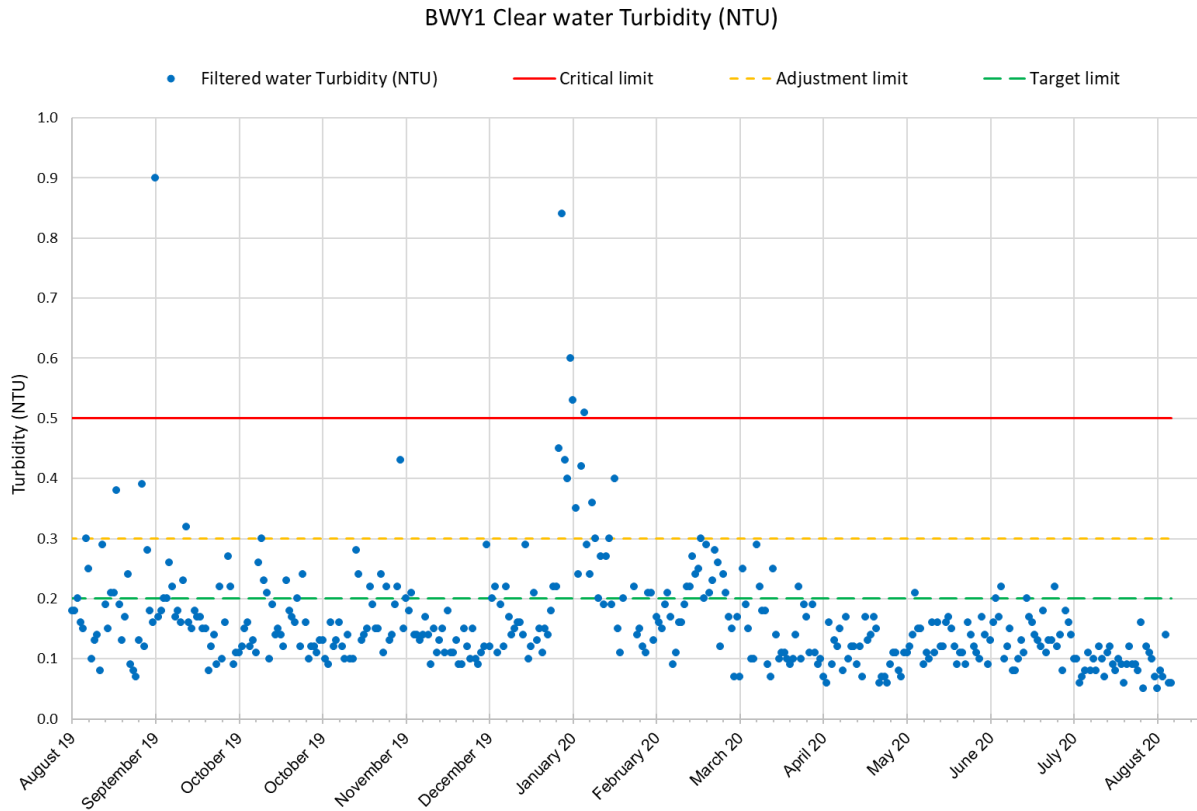


Figure 9-2: Filtered water turbidity (BWY1) – Binnaway

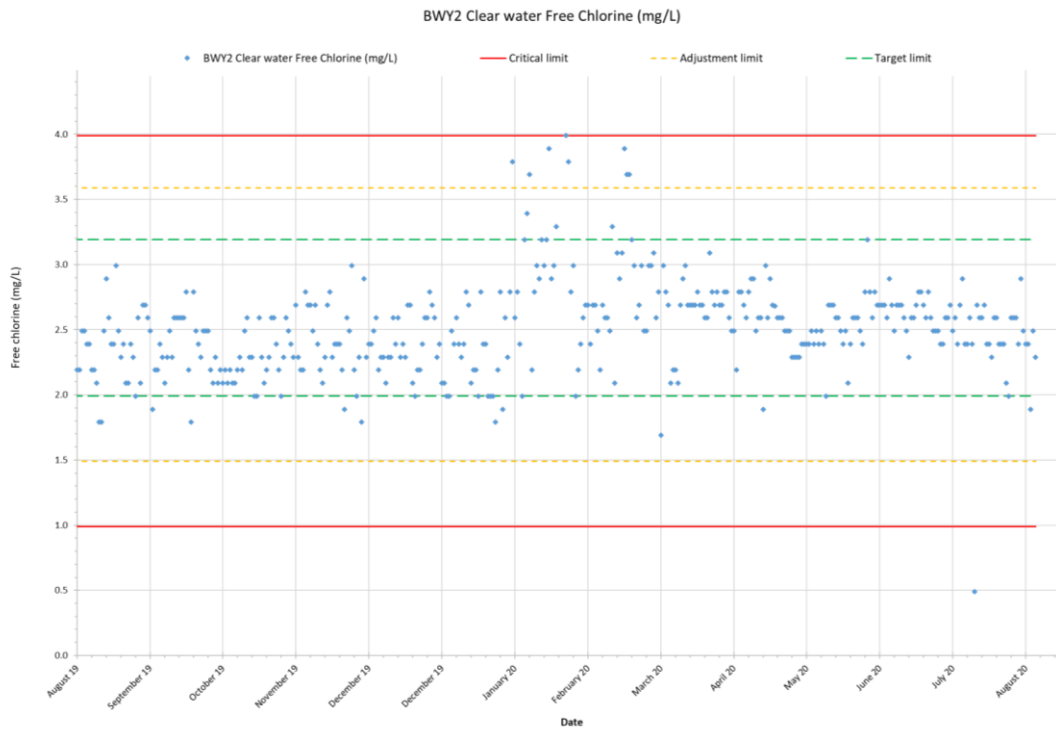


Figure 9-3: Clear water free chlorine (BWY2) – Binnaway

BWY 5 Reticulation Free Chlorine

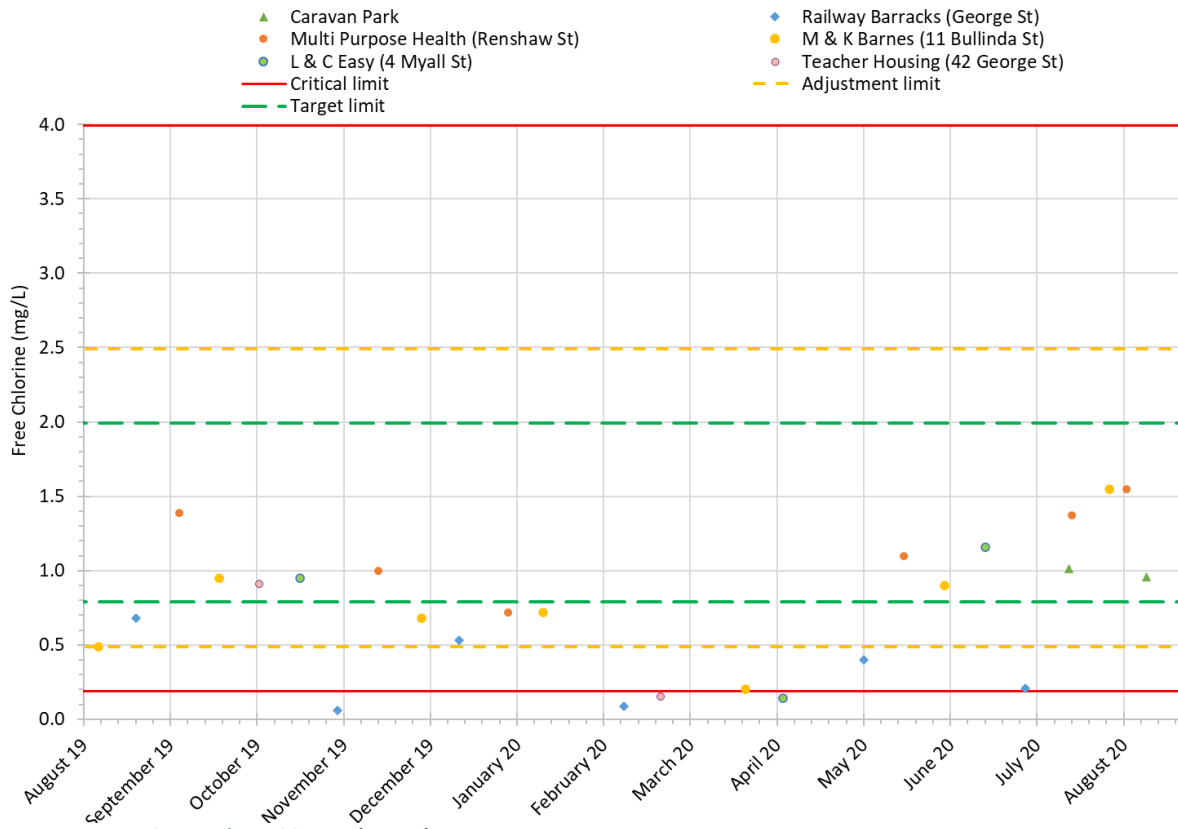


Figure 9-4: Distribution free chlorine (BWY5) – Binnaway

Source: Drinking Water Monitoring spreadsheet.

BWY6 Distribution Turbidity (OCP)

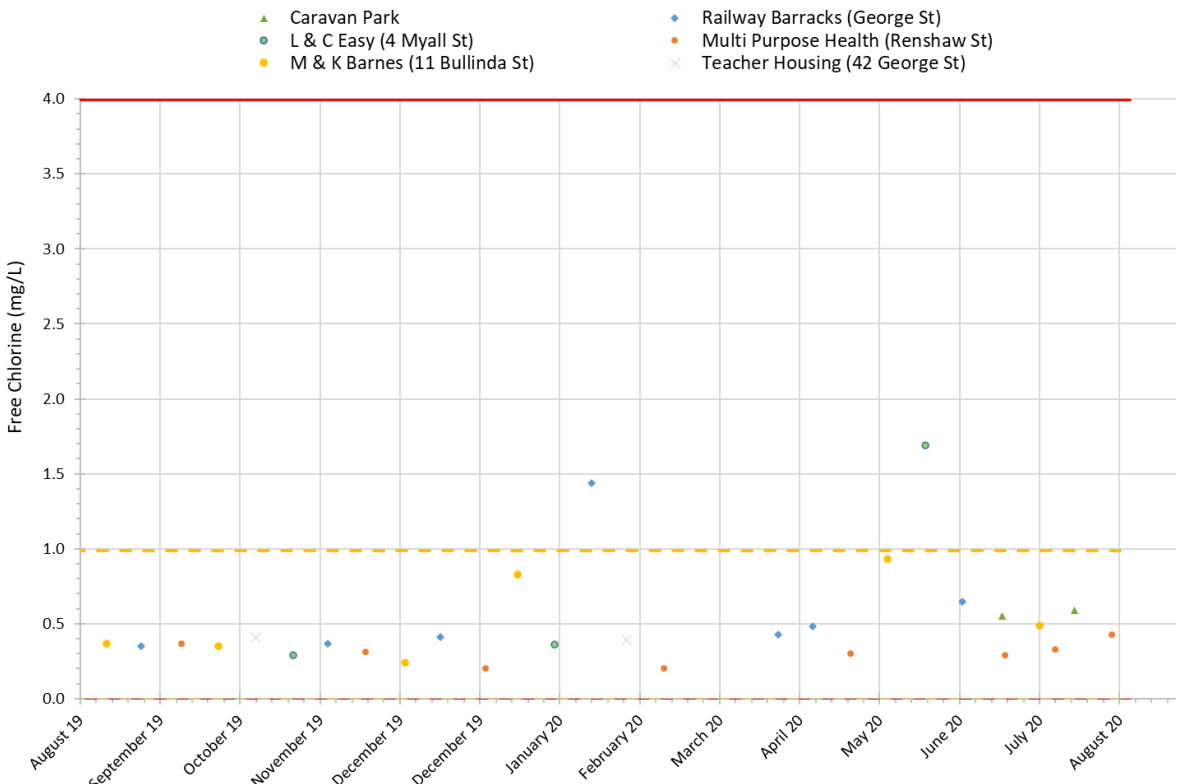


Figure 9-5: Distribution turbidity (BWY6, OCP) – Binnaway

Source: Drinking Water Monitoring spreadsheet.

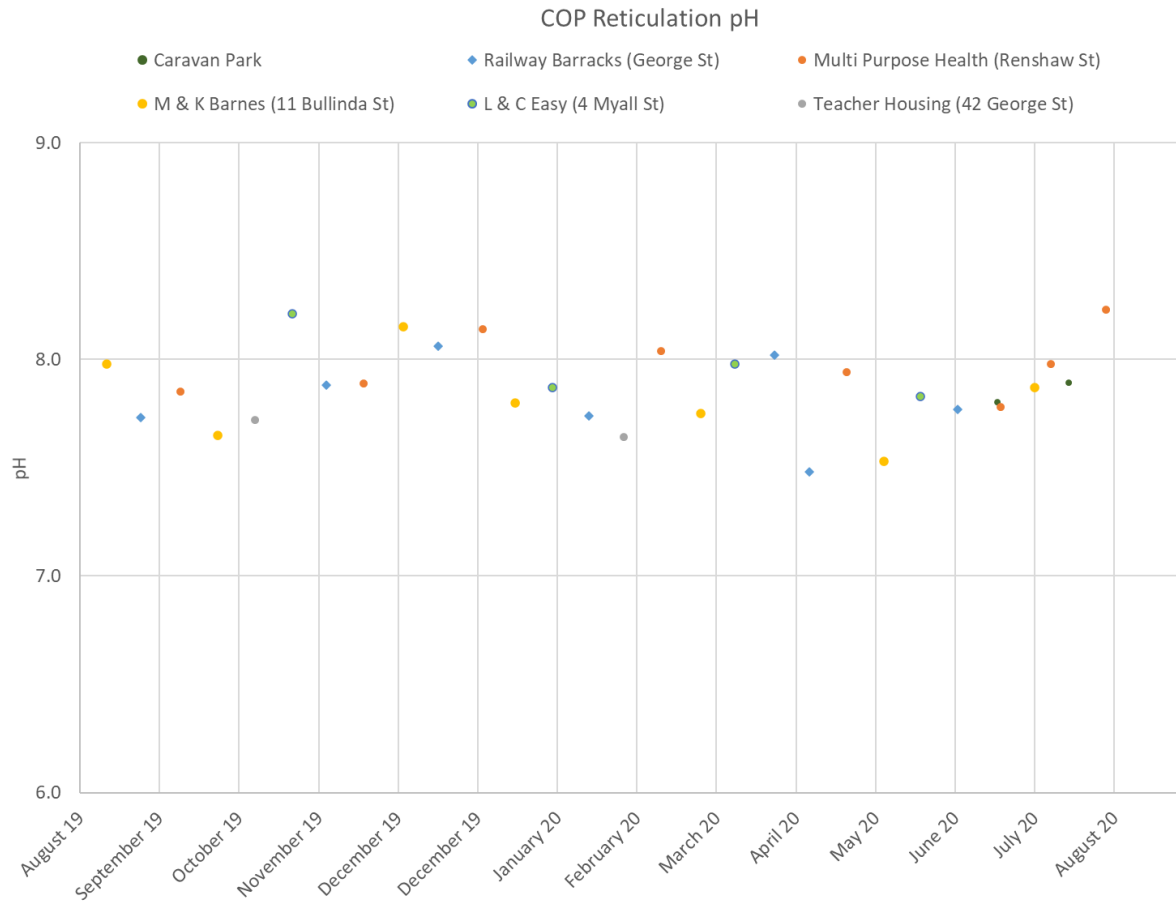


Figure 9-6: Binnaway reticulation pH (COP)

Source: Drinking Water Monitoring spreadsheet.

9.5 Water quality

This section includes a review of water quality data for the Binnaway water supply system from the reporting period, 1 August 2019 to 31 August 2020, including data collected as part of the NSW Health drinking water monitoring system program.

9.5.1 Data collection

The Binnaway scheme operational water quality monitoring plan is shown in Table 9-3.

Table 9-3. Monitoring undertaken for Binnaway water supply system

Process	CCP/OCP	Parameter	Unit	Frequency
Raw water		Turbidity	NTU	Daily
		Colour	HU	Daily
		pH		Daily
Settled water		Turbidity	NTU	Daily
		Colour	HU	Daily
		pH		Daily
		Temp		Daily
Filtered water	BWY1	Turbidity	NTU	Daily
		Colour	HU	Daily
		pH		Daily
		Turbidity	NTU	Daily
Clear water		Colour	HU	Daily
		pH		Daily
	BWY2	Free chlorine	mg/L	Daily
	BWY5	Free chlorine	mg/L	Weekly
		Total Chlorine	mg/L	Weekly
Reticulation	BWY6 (OCP)	Turbidity	NTU	Weekly
		pH		Weekly

9.5.2 Water quality issues

Monitoring of Binnaway water supply detected 7 exceptions for the following:

There were no ADWG Health guideline exceptions.

Two ADWG Aesthetic guidelines exceptions

- Total Hardness as CaCO₃ on two occasions. 239 mg/L on 24/9/2019, and 513.5 mg/L on 16/1/2020, guideline value 200 mg/L)

Five other exceptions with

- Detection of total coliforms on three occasions (1 cfu on 14/1/2020, 1 cfu on 24/3/2020, and 78 cfu's on 6/4/2020, guideline value 0)
- Low levels of Free Chlorine on two occasions (0.15 mg/L, on 6/4/2020 and 0.16 mg/L on 24/2/2020 guideline value 0.2 – 5 mg/L)

9.6 Consumer water quality complaints/enquires

A summary of customer complaints and enquiries is shown in Table 9-4. There was one water quality complaint in Binnaway (February 2020).

Table 9-4. Summary of water quality customer complaints / enquiries – Binnaway

Complaints/Enquires	Type	Number
Water Quality	Complaints	1
	Enquiry	2
Water (pressure / lack of water)	Enquiry	1
Water Main (leaks /bursts)	Enquiry	2
Water Meter	Enquiry	7

9.7 Water quality incidents/emergencies

There were no water quality incidents or emergencies in the Binnaway water supply system in the reporting period.

9.8 Reservoir inspections

Non-formalised inspections are undertaken weekly including site security, roofing, bird-netting, telemetry aerials and chlorine check.

Formalised checklists are in development.

There were no issues found within the reporting period.

10 Dunedoo

10.1 Scheme summary

The Dunedoo water supply system comprises:

- Source water: Bore
- Chlorination disinfection only (NaOCl); fluoridation not needed due to natural occurrence
- Number of residential connections: 388
- Number of non-residential connections: 81

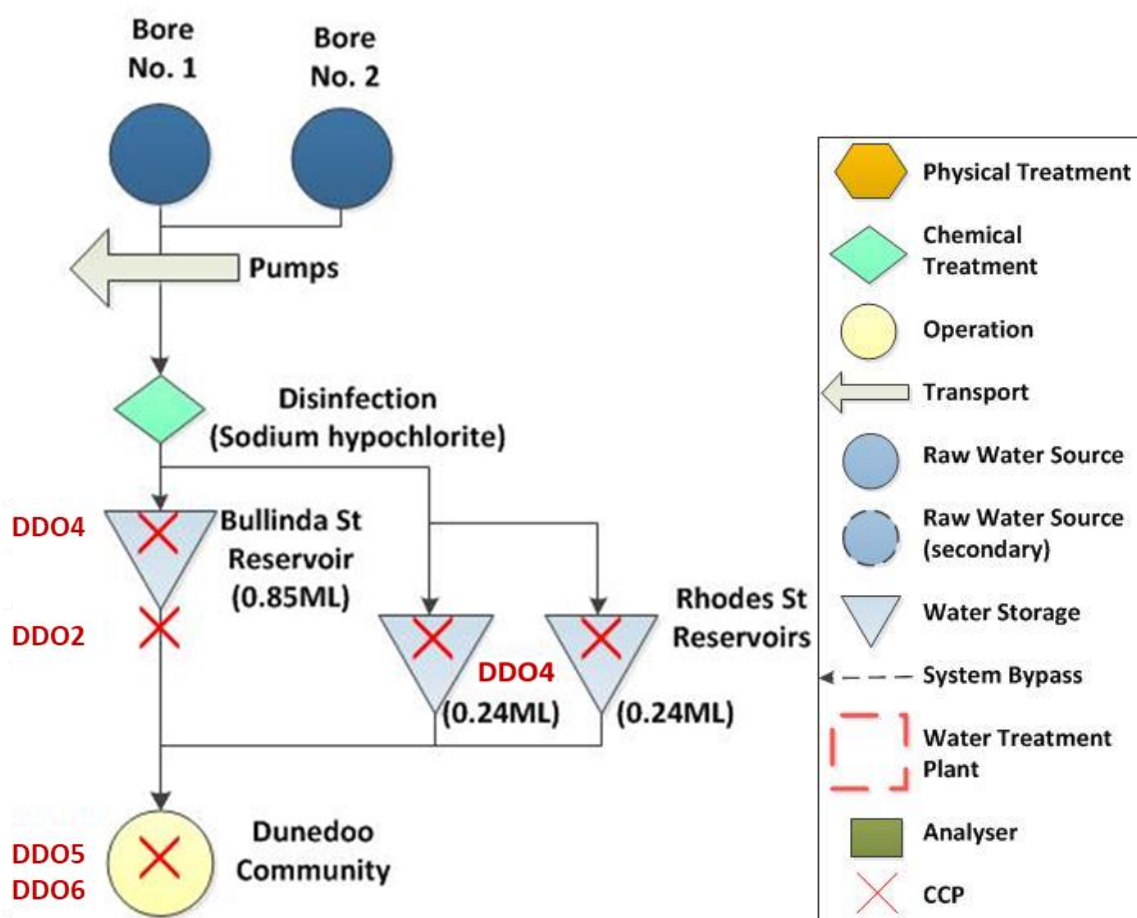


Figure 10-1: Water supply flow diagram – Dunedoo

Improvement works undertaken from August 2019 to August 2020 for the Dunedoo water supply include:

- Telemetry Upgrades
- Reservoir upgrades
- Upgrades to chlorine room

10.3 Critical control points

The CCPs for Dunedoo are shown in Table 10-1. These CCPs are regularly reviewed in quarterly water quality meetings as part of the ORANA water utilities alliance. A summary of changes made is shown in Table 10-2.

Table 10-1. Summary of critical control points and critical operational points – Dunedoo

CCP ID	Critical Control Point	Control Parameter	Target	Alert Level	Critical Limit
DDO2	Disinfection (hypo)	Chlorine	1.1 – 2.2 mg/L	<0.9 mg/L, >3.0 mg/L	<0.7 mg/L, >4.0 mg/L
DDO4	Reservoirs	Reservoir integrity	No breach of integrity (hatches locked, no holes in meshing)	-	Breach of integrity identified
DDO5	Distribution	Chlorine	1.0 – 2.0 mg/L	<0.5 mg/L, >3.0 mg/L	< 0.2 mg/L, >4.0 mg/L
DDO6	Distribution (OCP)	NTU	<1.0 NTU	>1.0 NTU	>4.0 NTU

Table 10-2. Summary of critical control points alignment changes – Dunedoo

The CCP IDs have been reidentified to align a specific CCP ID with a specific process type across all treatment plants. The alignment of CCP IDs with specific processes is summarised in Table i.i.

CCP	Existing	Current
Disinfection (gas)	DDO1	DDO2
Reservoirs	DDO2	DDO4
Distribution Chlorine	DDO3	DDO5
Distribution NTU (OCP)	DDO4	DDO6

No other changes to Critical control point limits

10.4 Critical limit exceedance

There were no CCP exceptions for the Dunedoo water supply system

10.5 Operational (CCP, OCP, and COP) monitoring graphs

Source (if not specified), Dunedoo operational monitoring spreadsheet

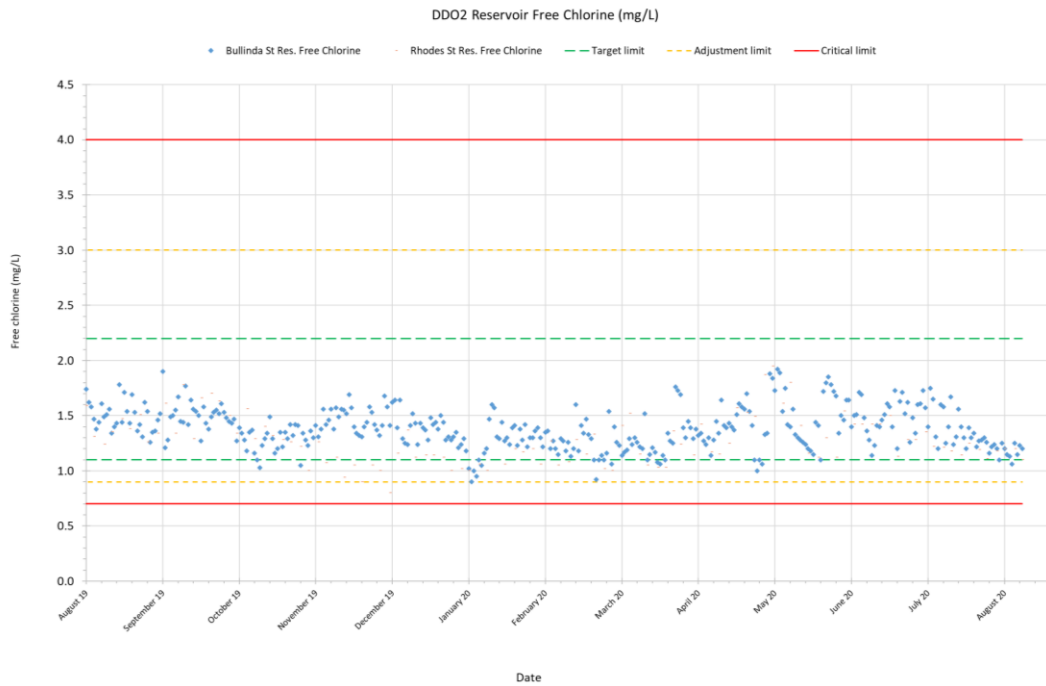


Figure 10-2: Reservoir free chlorine (DDO2) – Dunedoo

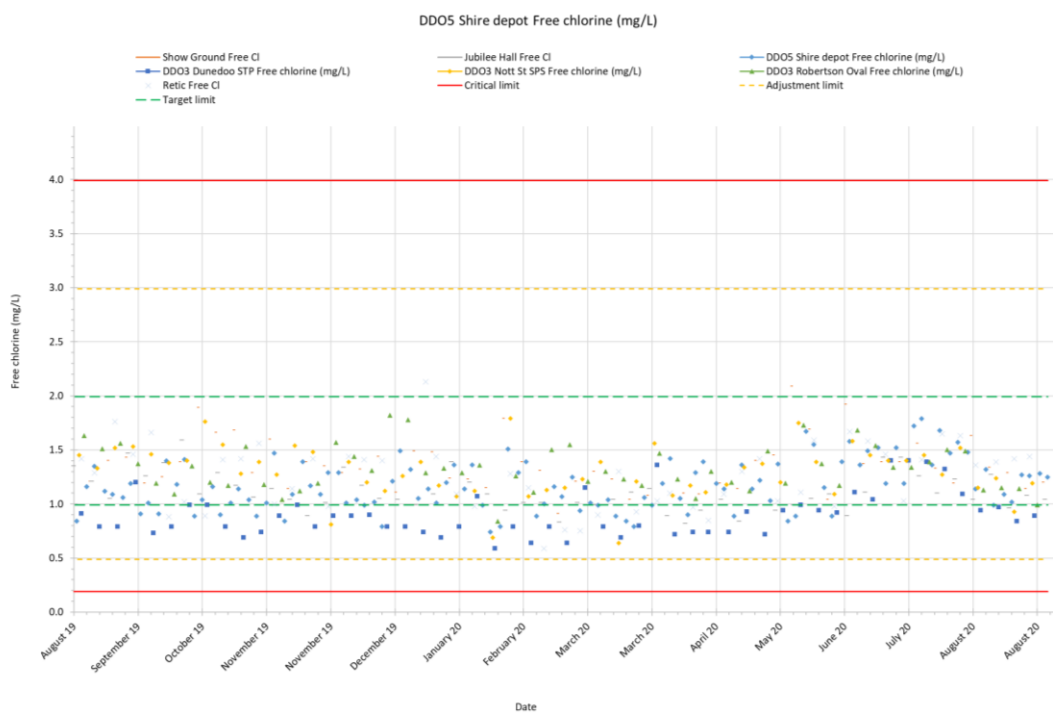


Figure 10-3: Distribution free chlorine (DDO5) – Dunedoo

Source: Drinking Water Monitoring spreadsheet.

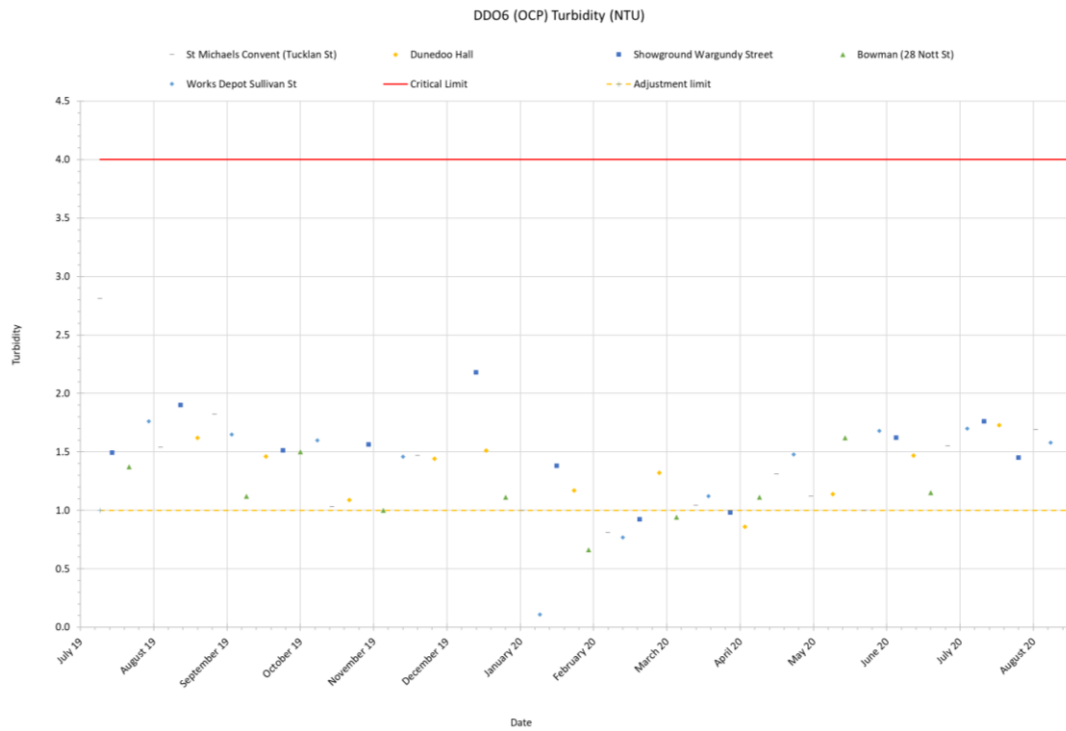


Figure 10-4: Distribution turbidity (DDO6, OCP) – Dunedoo

Source: Drinking Water Monitoring spreadsheet.

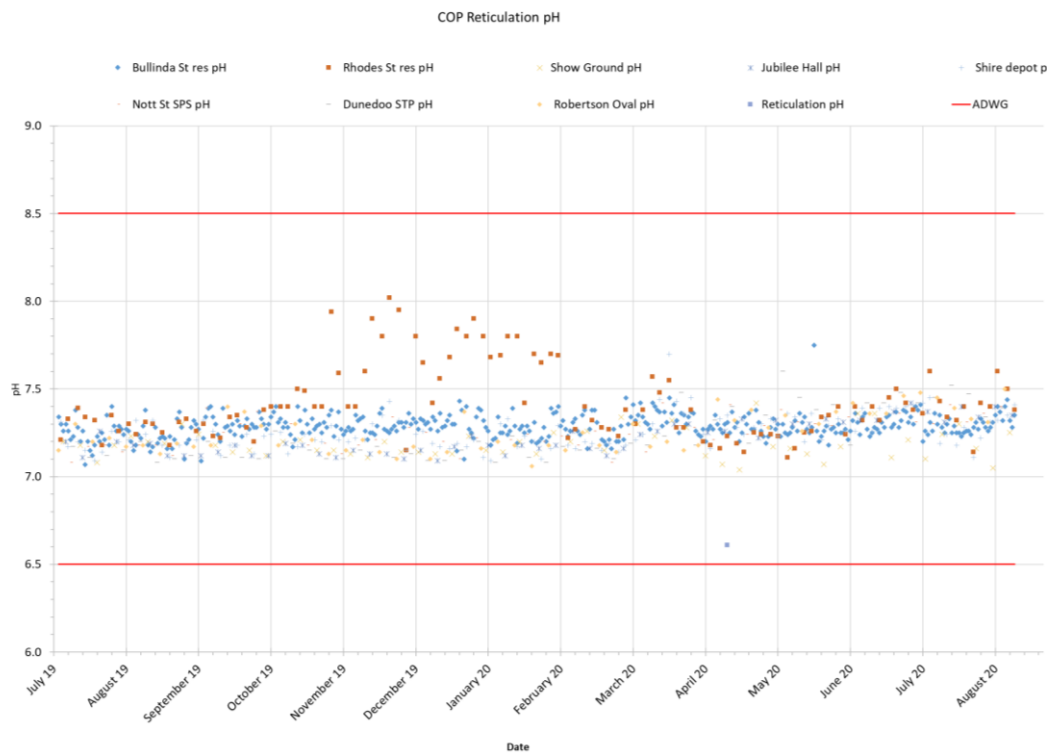


Figure 10-5: Dunedoo reticulation pH (COP)

Source: Dunedoo Operational Monitoring spreadsheet and Drinking Water Monitoring spreadsheet.

10.6 Water quality

This section includes a review of water quality data for the Dunedoo water supply system from the reporting period, 1 August 2019 to 31 August 2020, including data collected as part of the NSW Health drinking water monitoring system program.

10.6.1 Data collection

The Dunedoo scheme operational water quality monitoring plan is shown in Table 10-3.

Table 10-3. Monitoring undertaken for Dunedoo water supply system

Process	CCP/OCP	Parameter	Unit	Frequency
Reservoir	DDO4	Free chlorine	mg/L	Daily
	DDO6 (OCP)	Turbidity	NTU	Weekly
	COP	pH		Daily
Reticulation	DDO5	Free chlorine	mg/L	Weekly
	COP	pH		Weekly
	DDO6 (OCP)	Turbidity		

10.6.2 Water quality issues

Monitoring of Dunedoo water supply detected exceptions for the following:

One exception against the ADWG Health guidelines

- High levels of Mercury (0.0011 mg/L on 9 March 2020, guideline value 0.001 mg/L)

Four exceptions against ADWG Aesthetic guidelines with

- Total hardness on 2 occasions (421.1 mg/L on 24/9/2019 and 382.6 mg/L on 9/3/2020, guideline value 200 mg/L)
- Low pH on one occasion (1.62 on 21/04/2020, guideline 6.5-8.5) *suspect this was a misread
- Total Dissolved Solids (TDS) on one occasion (675 mg/L on 9/3/2020, guideline 600 mg/L)

Three other exceptions with

- Detection of total coliforms on three occasions, (3 on 15/10/2019, >200 on 17/02/2020, and 21 on 25/02/2020 guideline value 0)

10.7 Consumer water quality complaints/enquires

A summary of customer complaints and enquiries is shown in Table 10-4.

Table 10-4. Summary of water quality customer complaints / enquiries – Dunedoo

Complaints/Enquires	Type	Number
Water Main (leaks /bursts)	Enquiry	32
Water (pressure / lack of water)	Complaints	1
	Enquiry	7
Water Meter	Enquiry	11

10.8 Water quality incidents/emergencies

There were no water quality incidents or emergencies in the Dunedoo water supply system in the reporting period.

10.9 Reservoir inspections

Non-formalised inspections are undertaken weekly including site security, roofing, bird-netting, telemetry aerials and chlorine check.

Formalised checklists are in development.

There were no issues found within the reporting period.

11 Staff development and training

A summary of training undertaken by water staff from 1 August 2019 to 31 August 2020 is shown in Table 11-1.

Table 11-1. Summary of staff training

Row Labels	Name
Assessing Team Competencies	Andrew Milford
	Craig Whitty
	Dean Hartley
	Graham Richardson
	Jason Rand
Backhoe/Loader Training & VOC	Jason Rand
Certificate III Water Operations – TAFE (ongoing)	Dean Lewin
	Jessee Ravelly
Chemical (Pesticide) Accreditation	Graham Richardson
DPI Water - Water Treatment for Engineers	Cornelia Wiebels
Due Dilligence (StateCover)	Cornelia Wiebels
	Craig Whitty
	Graham Richardson
	Phillip Hensby
Evaluation, Supplier Selection & Contract Establishment Training	Andrew Milford
	Cornelia Wiebels
	Martin Gordon
Excavator Operator Training & VOC	Simon McMillan
Jar testing Training	Andrew Milford
	Andrew Park
	David Birdling
	Jessee Revelly
	Stephen Drew
	Trevor Anasatasis
Load Restraint Training	Cody Larance
	Dean Lewin
	Graham Richardson
	Jason Rand
	John Smith
	Karyna Hawkes

Row Labels	Name
	Kelvin Williams
	Martin Gordon
	Mathew Gilbert
	Nick Willoughby
	Philip Paul
	Scott Watton
	Simon McMillan
	Stephen Drew
	Trevor Anasatas
Managing Performance and Productivity	Cornelia Wiebels
	Graham Richardson
	Martin Gordon
Pool Chemical Handling	Craig Whitty
	Dean Hartley
Stepping into Supervising	Andrew Milford
	Craig Whitty
	Dean Lewin
	Jason Rand
	Phillip Hensby
Traffic Control Combo	Cody Larance
	Scott Watton
Training Services NSW Supervisor Workshop (for those supervising trainees and apprentices)	Dean Lewin
	Graham Richardson
	Martin Gordon

12 DWMS continuous improvement plan

Council's improvement plan was consolidated and then reviewed in three facilitated meetings (June, July and August 2019). The current water quality improvement plan is attached to this report.

Table 12-1. Water quality improvement plan status

Priority	Closed	Complete	Implemented	In progress	Not started	To do per priority (% of total)
Very high	13	21		3		8%
High	56	59	19	24	2	16%
Medium	59	27	21	23	4	20%
Low	9	2	1	7	4	48%
Total	137	109	41	57	10	

Source: Item 21 Business paper 08-2020

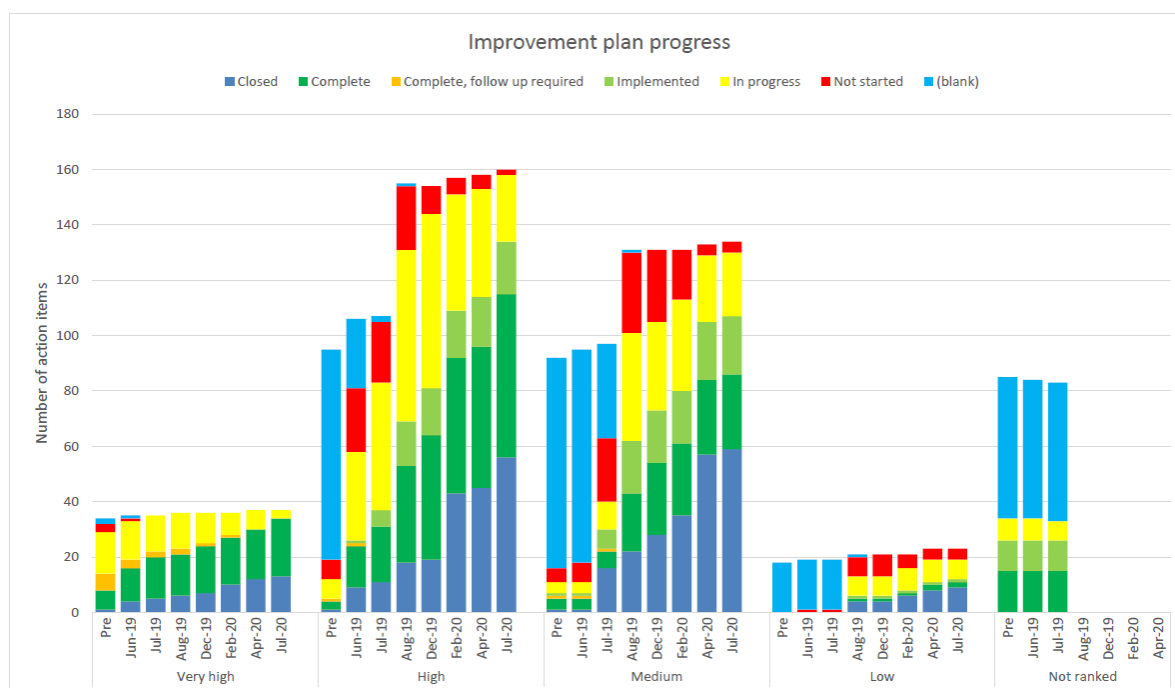


Figure 12-1: Improvement plan progress

Source: Improvement Plan Summary and Progress July 2020

13 Review of DWMS implementation

A summary of DWMS reviews is included in Table 13-1.

Table 13-1. Summary of reviews

Date	Attendance	Scope	Findings	Actions
27 August 2019	Atom Consulting, Council	Review of DWMS Improvement Plan	49 items reviewed and updated	49 items closed, completed or implemented.
27 September 2019	Atom Consulting, Council	Review of DWMS Improvement Plan	42 items reviewed and updated	25 items closed, completed or implemented.
13 December 2019	Atom Consulting, Council	Review of DWMS Improvement Plan	111 items reviewed and updated	77 items closed, completed or implemented.
28 Feb 2020	Atom Consulting, Council	Review of DWMS Improvement Plan	91 items reviewed and updated	65 items closed, completed or implemented.
24 April 2020	Atom Consulting, Council	Review of DWMS Improvement Plan	90 items reviewed and updated	45 items closed, completed or implemented.
24 July 2020	Council	Review of DWMS Improvement Plan	18 items reviewed and updated	1 item closed

Appendix A Coonabarabran water quality data

A.1 Water quality data summary

Table 13-2: Coonabarabran operational monitoring data summary

Source: Coonabarabran operational monitoring spreadsheet

Source/Sample Point	Parameter	Min	Avg	Max	Lower critical limit	Upper critical limit	No. of samples	CCP
Raw Water	Turbidity (NTU)	-	4.64	46.50			381	
	Colour (HU)	-	2	15			389	
	pH	-	6.53	7.36			381	
Settled Water	Turbidity (NTU)	0.18	0.95	17.20			390	
	Colour (HU)	-	-	-			390	
	pH	5.91	6.77	7.53			387	
Filtered water	Turbidity (NTU)	-	0.19	0.50	0.0	0.7	391	CBN1
	Filtered water Colour (HU)	-	-	-			391	
	Filtered water pH	5.99	6.75	7.44			391	COP
Treated Water Quality								
Clear water	Turbidity (NTU)	0.02	0.38	1.61	0.0	4.0	390	
	Colour (HU)	-	-	-			391	
	pH	6.60	7.38	8.35			391	COP
Clear water (Bore)	Free chlorine (mg/L)	1.80	2.51	4.00	1.5	4.0	304	CBN2
Clear water (Dam)	Free chlorine (mg/L)	1.90	2.99	4.00	2.0	4.5	304	CBN2.5
Reticulation Monitoring								
WSC Administration (John St)	Free chlorine (mg/L)	0.45	1.58	2.43	0.2	4	20	CBN5
	Total Chlorine (mg/L)	0.45	1.73	2.73			15	
	Turbidity (NTU)	0.21	0.58	1.20		4	20	CBN6
	pH	6.81	7.37	7.85	6.5	8.5	20	COP
Small Home Queenie St	Free chlorine (mg/L)	0.49	1.02	1.56	0.2	4	10	CBN5
	Total Chlorine (mg/L)	0.53	0.90	1.18			7	
	Turbidity (NTU)	0.30	0.92	2.62		4	10	CBN6
	pH	7.08	7.50	7.84	6.5	8.5	10	COP
24 Camp St (Galvin)	Free chlorine (mg/L)	0.59	1.22	1.91	0.2	4	11	CBN5
	Total Chlorine (mg/L)	0.72	1.34	2.02			11	
	Turbidity (NTU)	0.27	3.32	11.40		4	11	CBN6
	pH	6.87	7.28	7.87	6.5	8.5	11	COP
Cooinda Hospital (Neate St)	Free chlorine (mg/L)	0.99	2.67	17.40	0.2	4	17	CBN5
	Total Chlorine (mg/L)	1.05	1.85	2.30			11	
	Turbidity (NTU)	0.43	1.71	7.91		4	17	CBN6
	pH	7.23	7.54	8.30	6.5	8.5	16	COP

A.2 Verification monitoring summary

Verification data taken from the NSW Health database, from 1 August 2019 to 31 August 2020 was analysed for the Coonabarabran water system. Any microbiological readings '< 1' were taken as zero, all other less than readings were taken as half of their upper limits, that is '< 0.1' became '0.05'. Values listed as greater than were taken as their lower limit, '> 200' became '200'. A summary of key verification data is shown in Table 13-2.

There were ADWG aesthetic guideline exceedances for Turbidity (highlighted blue), a graphic representation can be found in Figure 3-5 in the main body of this report.

Table 13-3: Coonabarabran verification monitoring data summary

Source: NSW Health Water Quality Monitoring database

Characteristic	Guideline Value (Health or Aesthetic)	Min	5 th %ile	Median	95 th %ile	Max	Samples	Exceptions
Aluminium (mg/L)	0.2 A	0.03	0.03	0.0500	0.07	0.07	2	0%
Antimony (mg/L)	0.003 H	0.00005	0.00005	0.0003	0.0005	0.0005	2	0%
Arsenic (mg/L)	0.01 H	0.0005	0.0005	0.0005	0.0005	0.0005	2	0%
Barium (mg/L)	2 H	0.029	0.029	0.0297	0.0304	0.0304	2	0%
Boron (mg/L)	4 H	0.0074	0.0074	0.0287	0.05	0.05	2	0%
Cadmium (mg/L)	0.002 H	0.00005	0.00005	0.0002	0.00025	0.00025	2	0%
Calcium (mg/L)		21.4	21.4	23.7500	26.1	26.1	2	0%
Chloride (mg/L)	250 A	11	11	11.5000	12	12	2	0%
Chromium (mg/L)	0.05 H	0.0005	0.0005	0.0015	0.0025	0.0025	2	0%
Copper (mg/L)	2 H	0.0025	0.0025	0.0098	0.017	0.017	2	0%
<i>E. coli</i>	0 H	0	0	0.0000	0	0	62	0%
Fluoride (mg/L)	1.5 H	0.05	0.05	0.0500	0.05	0.05	2	0%
Free chlorine (mg/L) ¹		0.45	0.59	1.5550	2.1	2.43	62	0%
Iodine (mg/L)		0.01	0.01	0.0100	0.01	0.01	2	0%
Iron (mg/L)	0.3 A	0.04	0.04	0.0400	0.04	0.04	2	0%
Lead (mg/L)	0.01 H	0.0005	0.0005	0.0008	0.001	0.001	2	0%
Magnesium (mg/L)	-	4.23	4.23	4.6400	5.05	5.05	2	0%
Manganese (mg/L)	0.5 H	0.01	0.01	0.0171	0.0241	0.0241	2	0%
Mercury (mg/L)	0.001 H	0.00005	0.00005	0.0002	0.0004	0.0004	2	0%
Molybdenum (mg/L)	0.05 H	0.0003	0.0003	0.0014	0.0025	0.0025	2	0%
Nickel (mg/L)	0.02 H	0.0004	0.0004	0.0027	0.005	0.005	2	0%
Nitrate (mg/L)	50 H	1	1	1.0000	1	1	2	0%
Nitrite (mg/L)	3 H	0.05	0.05	0.0500	0.05	0.05	2	0%
pH (Chemical sampling)	6.5-8.5 A	7.7	7.7	7.8000	7.9	7.9	2	0%
pH (Microbial sampling)	6.5-8.5 A	6.81	7.03	7.4300	7.96	8.3	62	0%
Selenium (mg/L)	0.01 H	0.001	0.001	0.0023	0.0035	0.0035	2	0%
Silver (mg/L)	0.1 H	0.0002	0.0002	0.0006	0.001	0.001	2	0%
Sodium (mg/L)	180 A	9	9	10.0000	11	11	2	0%
Sulfate (mg/L)	250 A	16	16	18.0000	20	20	2	0%
Temperature (oC)		13	13.1	17.9000	25.8	27.2	36	0%
Total Chlorine (mg/L)	5 H	0.45	0.72	1.7000	2.36	2.8	62	0%
Total Coliforms (cfu/100 mL)		0	0	0.0000	0	0	62	0%
Total Dissolved Solids (TDS) (mg/L)	600 A	63	63	80.5000	98	98	2	0%
Total Hardness as CaCO ₃ (mg/L) ²	200 A	70.9	70.9	78.4500	86	86	2	0%
True Colour (Hazen Units (HU))	15 A	0.5	0.5	2.7500	5	5	2	0%
Turbidity (Chemical sampling)	5 A	0.6	0.6	1.3000	2	2	2	0%

Characteristic	Guideline Value (Health or Aesthetic)	Min	5 th %ile	Median	95 th %ile	Max	Samples	Exceptions
Turbidity (Microbial sampling)	5 A	0.2	0.25	0.6550	7.95	12.2	62	6.45%
Uranium (mg/L)	0.017 H	0.0001	0.0001	0.0013	0.0025	0.0025	2	0%
Zinc (mg/L)	3 A	0.005	0.005	0.0275	0.05	0.05	2	0%

Note 1. The ADWG has a Health limit for chlorine of 5mg/L, with recommendation for a free chlorine residual above 0.2 mg/L in the reticulation

Note 2. ADWG recommend 200 mg/L hardness as CaCO₃ as an upper limit to minimise the build-up of scale. A lower limit of 60 mg/L is desirable for avoiding corrosion by soft water.

Appendix B Baradine water quality data

B.1 Water quality data summary

Table 13-4: Baradine operational monitoring data summary

Source: Baradine operational monitoring spreadsheet

Source/Sample Point	Parameter	Min	Avg	Max	Lower critical limit	Upper critical limit	No. of samples	CCP
Raw Water	pH	5.86	6.16	6.48			395	
	NTU	- 0.00	0.06	0.67			227	
Aerated Water	pH	7.15	7.82	8.60			396	
Settled water	pH	7.07	7.82	8.42			326	
	NTU	0.02	0.42	6.60			326	
Treated water	pH	7.13	7.72	8.29			396	
	Free Chlorine (mg/L)	0.95	1.51	2.20	1.00	4.00	396	BDN2
	Turbidity (NTU)	-	0.23	0.90		0.80	396	BDN1
Reticulation	Free Chlorine (mg/L)	-	0.29	2.70	0.20	4.00	270	BDN5
WSC Lions Park	Free Chlorine (mg/L)	1.30	1.61	1.95	0.20	4.00	13	BDN5
	Total Chlorine (mg/L)	1.32	1.70	2.18			13	
	pH	7.59	7.84	8.10			13	
Baradine Hospital	Free Chlorine (mg/L)	1.33	1.56	2.20	0.20	4.00	13	BDN5
	Total Chlorine (mg/L)	1.35	1.64	2.27			13	
	pH	7.45	7.78	8.06			14	
Worrigal St SPS	Free Chlorine (mg/L)	1.13	1.50	1.92	0.20	4.00	3	BDN5
	Total Chlorine (mg/L)	1.62	1.79	2.06			3	
	pH	7.43	7.87	8.17			3	
Camp Cypress Amenities Block	Free Chlorine (mg/L)	0.65	1.46	2.68	0.20	4.00	15	BDN5
	Total Chlorine (mg/L)	1.01	1.56	2.83			15	
	NTU	0.09	0.72	4.88				
	pH	7.48	7.85	8.08			15	
1 Maccquarie Street	Free Chlorine (mg/L)	1.06	1.54	2.70	0.20	4.00	15	BDN5
	Total Chlorine (mg/L)	1.06	1.59	2.74			15	

B.3 Verification monitoring summary

For the new WTP Verification data taken from the NSW Health database, from 1 September 2019 to 30 September 2020 was analysed for the Baradine water system. Any microbiological readings '< 1' were taken as zero, all other less than readings were taken as half of their upper limits, that is '< 0.1' became '0.05'. Values listed as greater than were taken as their lower limit, '> 200' became '200'. A summary of key verification data is shown in Table 13-5.

The ADWG microbial exceedance is highlighted orange and a visual representation can be found in Figure 13-1, this appendix.

Table 13-5: Baradine verification monitoring data summary

Source: NSW Health Water Quality Monitoring database

Characteristic	Guideline Value (Health or Aesthetic)		Min	5 th %ile	Median	95 th %ile	Max	Samples	Exceptions
Aluminium (mg/L)	0.2	A	0.05	0.05	0.0500	0.05	0.05	2	0 0%
Antimony (mg/L)	0.003	H	0.00005	0.00005	0.0001	0.00005	0.00005	2	0 0%
Arsenic (mg/L)	0.01	H	0.0005	0.0005	0.0005	0.0005	0.0005	2	0 0%
Barium (mg/L)	2	H	0.0875	0.0875	0.1011	0.1147	0.1147	2	0 0%
Boron (mg/L)	4	H	0.007	0.007	0.0083	0.0096	0.0096	2	0 0%
Cadmium (mg/L)	0.002	H	0.00005	0.00005	0.0001	0.00005	0.00005	2	0 0%
Calcium (mg/L)	10000		7.4	7.4	7.6000	7.8	7.8	2	0 0%
Chloride (mg/L)	250	A	36	36	37.0000	38	38	2	0 0%
Chromium (mg/L)	0.05	H	0.0005	0.0005	0.0005	0.0005	0.0005	2	0 0%
Copper (mg/L)	2	H	0.029	0.029	0.0355	0.042	0.042	2	0 0%
E. coli (mpn/100 mL)	0	H	0	0	0.0000	0	0	56	0 0%
Fluoride (mg/L)	1.5	H	0.13	0.13	0.1300	0.13	0.13	2	0 0%
Free Chlorine (mg/L)	0.2 - 5		0.65	1.11	1.4900	2.2	2.7	55	0 0%
Iodine (mg/L)	0.5		0.02	0.02	0.0200	0.02	0.02	2	0 0%
Iron (mg/L)	0.3	A	0.01	0.01	0.0150	0.02	0.02	2	0 0%
Lead (mg/L)	0.01	H	0.0001	0.0001	0.0002	0.0002	0.0002	2	0 0%
Magnesium (mg/L)	10000		4.48	4.48	4.5900	4.7	4.7	2	0 0%
Manganese (mg/L)	0.5	H	0.001	0.001	0.0018	0.0025	0.0025	2	0 0%
Mercury (mg/L)	0.001	H	0.0004	0.0004	0.0004	0.0004	0.0004	2	0 0%
Molybdenum (mg/L)	0.05	H	0.0001	0.0001	0.0001	0.0001	0.0001	2	0 0%
Nickel (mg/L)	0.02	H	0.0002	0.0002	0.0002	0.0002	0.0002	2	0 0%
Nitrate (mg/L)	50	H	0.5	0.5	0.5000	0.5	0.5	2	0 0%
Nitrite (mg/L)	3	H	0.05	0.05	0.0500	0.05	0.05	2	0 0%
pH ()	6.5 - 8.5	A	7	7.45	7.8350	8.08	8.1	56	0 0%
Selenium (mg/L)	0.01	H	0.0035	0.0035	0.0035	0.0035	0.0035	2	0 0%
Silver (mg/L)	0.1	H	0.0001	0.0001	0.0001	0.0001	0.0001	2	0 0%
Sodium (mg/L)	180	A	56	56	59.0000	62	62	2	0 0%
Sulfate (mg/L)	500	A	4	4	4.5000	5	5	2	0 0%
Temperature (C)	30	A	12.3	13.1	18.4500	26.1	28.6	32	0 0%
Total Chlorine (mg/L)	5	H	1.01	1.16	1.5900	2.27	2.83	55	0 0%
Total Coliforms (mpn/100 mL)	0		0	0	0.0000	0	1	56	1 2%
Total Dissolved Solids (TDS) (mg/L)	600	A	192	192	196.0000	200	200	2	0 0%
Total Hardness as CaCO ₃ (mg/L)	200	A	36.9	36.9	37.8500	38.8	38.8	2	0 0%
True Colour (Hazen Units (HU))	15	A	0.5	0.5	1.2500	2	2	2	0 0%
Turbidity (NTU)	5		0.05	0.08	0.4350	2.39	4.88	56	0 0%
Uranium (mg/L)	0.017	H	0.00005	0.00005	0.0001	0.0001	0.0001	2	0 0%

Characteristic	Guideline Value (Health or Aesthetic)	Min	5 th %ile	Median	95 th %ile	Max	Samples	Exceptions
Zinc (mg/L)	3 A	0.02	0.02	0.0200	0.02	0.02	2	0 0%

Note 1. The ADWG has a Health limit for chlorine of 5mg/L, with recommendation for a free chlorine residual above 0.2 mg/L in the reticulation

Note 2. ADWG recommend 200 mg/L hardness as CaCO₃ as an upper limit to minimise the build-up of scale. A lower limit of 60 mg/L is desirable for avoiding corrosion by soft water.

B.4 Verification monitoring exceedances

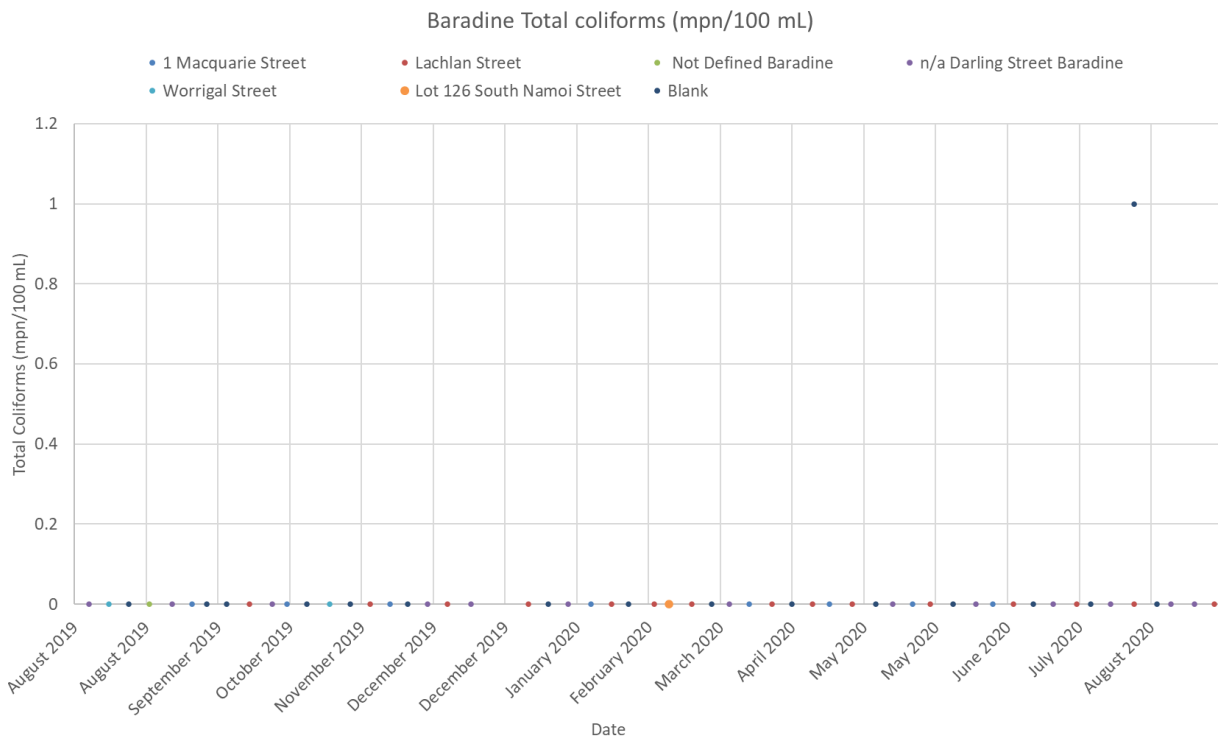


Figure 13-1: Baradine verification monitoring: Total coliforms

Source: NSW Health Water Quality Monitoring database

Appendix C Kenebri water quality data

C.1 Water quality data summary

Table 13-6: Kenebri operational monitoring data summary

Source: Coonabarabran operational monitoring spreadsheet and Kenebri Health Data download

Source/Sample Point	Parameter	Min	Avg	Max	Lower critical limit	Upper critical limit	No. of samples	CCP
Kenebri	Free chlorine (mg/L)	1.00	1.84	2.80	1.0	4.0	41	KBI2
Reticulated Water Quality								
GM Stubbs	Free Chlorine (mg/L)	.49	1.5	2.7	0.20	4	7	KBI5
	Total Chlorine (mg/L)	.52	1.6	2.95			7	
	pH	6.87	7.05	7.23			9	
Van't Hag	Free Chlorine (mg/L)	1.53	1.84	2.15	0.20	4	6	KBI5
	Total Chlorine (mg/L)	1.61	1.92	2.32			6	
	pH	6.87	7.03	7.15			6	

C.2 Verification monitoring summary

For the new WTP Verification data taken from the NSW Health database, from 1 August 2019 to 31 August 2020 was analysed for the Kenebri water system. Any microbiological readings '< 1' were taken as zero, all other less than readings were taken as half of their upper limits, that is '< 0.1' became '0.05'. Values listed as greater than were taken as their lower limit, '> 200' became '200'. A summary of key verification data is shown in Table 13-7

There were ADWG aesthetic guideline exceedances for Turbidity (highlighted blue), a graphic representation can be found in Figure 5-4 in the main body of this report.

Table 13-7: Kenebri verification monitoring data summary

Source: NSW Health Water Quality Monitoring database

Characteristic	Guideline Value (Health or Aesthetic)		Min	5 th %ile	Median	95 th %ile	Max	Samples	Exceptions	Min
Aluminium (mg/L)	0.2	A	0.005	0.005	0.0075	0.01	0.01	2	0	0
Antimony (mg/L)	0.003	H	0.00005	0.00005	0.0003	0.0005	0.0005	2	0	0
Arsenic (mg/L)	0.01	H	0.002	0.002	0.0025	0.003	0.003	2	0	0
Barium (mg/L)	2	H	0.191	0.191	0.1988	0.2066	0.2066	2	0	0
Boron (mg/L)	4	H	0.0503	0.0503	0.0752	0.1	0.1	2	0	0
Cadmium (mg/L)	0.002	H	0.00005	0.00005	0.0002	0.00025	0.00025	2	0	0
Calcium (mg/L)	10000		14.8	14.8	15.05	15.3	15.3	2	0	0
Chloride (mg/L)	250	A	176	176	184.5	193	193	2	0	0
Chromium (mg/L)	0.05	H	0.001	0.001	0.0018	0.0025	0.0025	2	0	0
Copper (mg/L)	2	H	0.009	0.009	0.009	0.009	0.009	2	0	0
<i>E. coli</i>	0	H	0	0	0	0	0	13	0	0
Fluoride (mg/L)	1.5	H	0.22	0.22	0.22	0.22	0.22	2	0	0
Free chlorine (mg/L) ¹			0.49	0.49	1.8	2.68	2.68	13	0	0
Iodine (mg/L)			0.12	0.12	0.14	0.16	0.16	2	0	0
Iron (mg/L)	0.3	A	0.01	0.01	0.015	0.02	0.02	2	0	0
Lead (mg/L)	0.01	H	0.0003	0.0003	0.0007	0.001	0.001	2	0	0
Magnesium (mg/L)	-		8.11	8.11	8.43	8.75	8.75	2	0	0

Characteristic	Guideline Value (Health or Aesthetic)		Min	5 th %ile	Median	95 th %ile	Max	Samples	Exceptions	Min
Manganese (mg/L)	0.5	H	0.0004	0.0004	0.0015	0.0025	0.0025	2	0	0
Mercury (mg/L)	0.001	H	0.00005	0.00005	0.0004	0.0008	0.0008	2	0	0
Molybdenum (mg/L)	0.05	H	0.0001	0.0001	0.0013	0.0025	0.0025	2	0	0
Nickel (mg/L)	0.02	H	0.0002	0.0002	0.0026	0.005	0.005	2	0	0
Nitrate (mg/L)	50	H	1	1	1.5	2	2	2	0	0
Nitrite (mg/L)	3	H	0.05	0.05	0.05	0.05	0.05	2	0	0
pH – Chemical Sampling	8.5	A	7	7	7.1	7.2	7.2	2	0	0
pH – Microbial Sampling	8.5	A	6.87	6.87	7.01	7.23	7.23	13	0	0
Selenium (mg/L)	0.01	H	0.002	0.002	0.0028	0.0035	0.0035	2	0	0
Silver (mg/L)	0.1	H	0.0001	0.0001	0.0006	0.001	0.001	2	0	0
Sodium (mg/L)	180	A	138	138	142	146	146	2	0	0
Sulfate (mg/L)	250	A	11	11	12	13	13	2	0	0
Temperature (°C)			30	14	14	15.6000	24.2	24.2	6	0
Total Chlorine (mg/L)	5	H	0.52	0.52	1.8	2.95	2.95	13	0	0
Total Coliforms (cfu/100 mL)		A	0	0	0	0	0	13	0	0
Total Dissolved Solids (TDS) (mg/L)	600	A	326	326	400	474	474	2	0	0
Total Hardness as CaCO₃ (mg/L)²	200	A	70.4	70.4	72.3	74.2	74.2	2	0	0
True Colour (Hazen Units (HU))	15	A	0.5	0.5	0.5	0.5	0.5	2	0	0
Turbidity - Chemical sampling (NTU)	5	A	0.05	0.05	1.675	3.3	3.3	2	0	0
Turbidity – Microbial sampling (NTU)	5	A	0.2	0.2	0.47	36.5	36.5	13	1	7.69
Uranium (mg/L)	0.017	H	0.0001	0.0001	0.0013	0.0025	0.0025	2	0	0
Zinc (mg/L)	3	A	0.02	0.02	0.035	0.05	0.05	2	0	0

Note 1. The ADWG has a Health limit for chlorine of 5mg/L, with recommendation for a free chlorine residual above 0.2 mg/L in the reticulation

Note 2. ADWG recommend 200 mg/L hardness as CaCO₃ as an upper limit to minimise the build-up of scale. A lower limit of 60 mg/L is desirable for avoiding corrosion by soft water.

Appendix D Bugaldie water quality data

D.1 Water quality data summary

Table 13-8: Bugaldie operational monitoring data summary

Source: Drinking Water monitoring spreadsheet

Source/Sample Point	Parameter	Min	Avg	Max	Lower critical limit	Upper critical limit	No. of samples	CCP
Reticulated Water Quality								
David Birdling (2 Belar St)	Free Chlorine (mg/L)	1.19	1.19	1.19	0.2	4	1	BUG5
	Total Chlorine (mg/L)	1.2	1.2	1.2			1	
	pH	6.71	6.71	6.71			1	
J & B Buck (Baradine Rd)	Free Chlorine (mg/L)	.93	1.49	2.58	0.2	4	9	BUG5
	Total Chlorine (mg/L)	.17	1.47	2.96				
	pH	6.67	6.9	7.23				
ML Pospisil (Baradine Rd)	Free Chlorine (mg/L)	1.63	1.63	1.63	0.2	4	1	BUG5
	Total Chlorine (mg/L)	1.81	1.81	1.81			1	
	pH	7.06	7.06	7.06			1	

D.2 Verification monitoring summary

For the new WTP Verification data taken from the NSW Health database, from 1 August 2019 to 31 August 2020 was analysed for the Bugaldie water system. Any microbiological readings '< 1' were taken as zero, all other less than readings were taken as half of their upper limits, that is '< 0.1' became '0.05'. Values listed as greater than were taken as their lower limit, '> 200' became '200'. A summary of key verification data is shown in Table 13-9. **Reference source not found.**

ADWG aesthetic guideline exceedances are highlighted blue and ADWG health exceedances or microbiological detections are highlighted orange. Exceedances for Aluminium, Chromium, Molybdenum and Nickel have not been graphed as the sample size <5. Graphic representation of the Free Chlorine exceedance can be found in Figure 6-3, main body of this report, and graphic representation of exceedances for Total Coliforms can be found in Figure 13-2, this appendix.

Table 13-9: Bugaldie verification monitoring data summary

Source: NSW Health Water Quality Monitoring database

Characteristic	Guideline Value (Health or Aesthetic)	Min	5 th %ile	Median	95 th %ile	Max	Samples	Exceptions
Aluminium (mg/L)	0.2 A	0.005	0.005	0.0200	0.33	0.33	3	1 33.33%
Antimony (mg/L)	0.003 H	0.00005	0.00005	0.0005	0.0005	0.0005	3	0 0%
Arsenic (mg/L)	0.01 H	0.0005	0.0005	0.0010	0.001	0.001	3	0 0%
Barium (mg/L)	2 H	0.081	0.081	0.0872	0.095	0.095	3	0 0%
Boron (mg/L)	4 H	0.0087	0.0087	0.05	0.05	0.05	3	0 0%
Cadmium (mg/L)	0.002 H	0.00005	0.00005	0.0003	0.00025	0.00025	3	0 0%
Calcium (mg/L)	-	15.5	15.5	16.2	16.5	16.5	3	0 0%
Chloride (mg/L)	250 A	43	43	45	45	45	3	0 0%
Chromium (mg/L)	0.05 H	0.001	0.001	0.0025	0.066	0.066	3	1 33.33%
Copper (mg/L)	2 H	0.011	0.011	0.04	0.046	0.046	3	0 0%
<i>E. coli</i>	0 H	0	0	0	0	0	14	0 0%
Fluoride (mg/L)	1.5 H	0.26	0.26	0.29	0.3	0.3	3	0 0%
Free chlorine (mg/L) ¹		0.12	0.12	1.53	3.03	3.03	13	1 7.69%
Iodine (mg/L)		0.02	0.02	0.02	0.03	0.03	3	0 0%

Characteristic	Guideline Value		Min	5 th %ile	Median	95 th %ile	Max	Samples	Exceptions	
	(Health or Aesthetic)									
Iron (mg/L)	0.3	A	0.01	0.01	0.09	0.22	0.22	3	0	0%
Lead (mg/L)	0.01	H	0.001	0.001	0.001	0.0022	0.0022	3	0	0%
Magnesium (mg/L)	-		11.81	11.81	12.56	12.86	12.86	3	0	0%
Manganese (mg/L)	0.5	H	0.0025	0.0025	0.0025	0.0065	0.0065	3	0	0%
Mercury (mg/L)	0.001	H	0.00005	0.00005	0.0001	0.0008	0.0008	3	0	0%
Molybdenum (mg/L)	0.05	H	0.0014	0.0014	0.0025	0.068	0.068	3	1	33.33%
Nickel (mg/L)	0.02	H	0.0009	0.0009	0.005	0.28	0.28	3	1	33.33%
Nitrate (mg/L)	50	H	1	1	1	2	2	3	0	0%
Nitrite (mg/L)	3	H	0.05	0.05	0.05	0.05	0.05	3	0	0%
pH – Chemical sampling	8.5	A	6.8	6.8	6.8	6.9	6.9	3	0	0%
pH – Microbiology sampling	8.5	A	6.67	6.67	6.81	7.06	7.06	13	0	0%
Selenium (mg/L)	0.01	H	0.001	0.001	0.002	0.0035	0.0035	3	0	0%
Silver (mg/L)	0.1	H	0.0001	0.0001	0.001	0.001	0.001	3	0	0%
Sodium (mg/L)	180	A	33	33	37	37	37	3	0	0%
Sulfate (mg/L)	250	A	2	2	2	3	3	3	0	0%
Temperature (oC)			23	11.7	11.7	15.7000	23.3	23.3	7	0%
Total Chlorine (mg/L)	5	H	0.94	0.94	1.63	3.9	3.9	13	0	0%
Total Coliforms (cfu/100 mL)			0	0	0	202	202	14	1	7.14%
Total Dissolved Solids (TDS) (mg/L)	00	A	101	101	120	176	176	3	0	0%
Total Hardness as CaCO ₃ (mg/L) ²	2	A	87.3	87.3	92.9	93.4	93.4	3	0	0%
	0									
	0									
True Colour (Hazen Units (HU))	1	A	0.5	0.5	0.5	0.5	0.5	3	0	0%
	5									
Turbidity - Chemical sampling (NTU)	5	A	0.1	0.1	0.2	4.1	4.1	3	0	0%
Turbidity - Microbiology sampling (NTU)	5	A	0.32	0.32	1.375	2.26	2.26	14	0	0%
Uranium (mg/L)	0.017	H	0.00005	0.00005	0.0025	0.0025	0.0025	3	0	0%
Zinc (mg/L)	3	A	0.03	0.03	0.04	0.2	0.2	3	0	0%

Note 1. The ADWG has a Health limit for chlorine of 5mg/L, with recommendation for a free chlorine residual above 0.2 mg/L in the reticulation

Note 2. ADWG recommend 200 mg/L hardness as CaCO₃ as an upper limit to minimise the build-up of scale. A lower limit of 60 mg/L is desirable for avoiding corrosion by soft water.

D.3 Verification monitoring exceedances

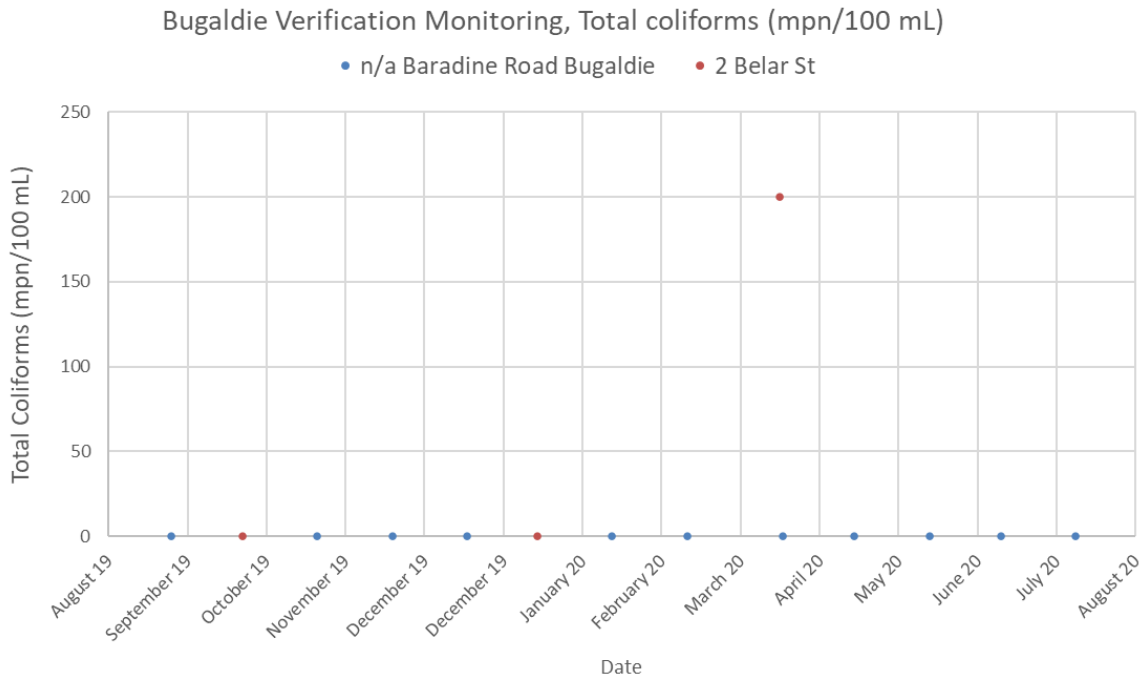


Figure 13-2: Bugaldie verification total coliforms

Source: NSW Health Water Quality Monitoring database

Appendix E Mendooran water quality data

E.1 Water quality data summary

Table 13-10: Mendooran operational monitoring data summary

Source: Mendooran operational monitoring spreadsheet

Source/Sample Point	Parameter	Min	Avg	Max	Lower critical limit	Upper critical limit	No. of samples	CCP
Raw Water Quality	pH	6.45	7.00	8.02			341	
	Turbidity (NTU)	0.19	2.52	27.70			339	
	Manganese (mg/L)	0.14	0.97	2.21			19	
	Iron (mg/L)	0.03	0.11	0.40			19	
Pre dose	PAC-AC (mg/L)	25.00	34.81	45.00			394	
Settled Water Quality	pH	7.04	7.78	8.64			394	
	Manganese (mg/L)	0.01	0.31	0.85			18	
	Iron (mg/L)	0.00	0.03	0.32			18	
	Turbidity (NTU)	0.09	1.10	7.54			380	
Filtered water, online	Turbidity (NTU)	0.01	0.16	0.76	0	0.5	377	MDN1
Clear Water Quality	pH	7.45	7.88	8.70	6.5	8.5	394	COP
	Chlorine (mg/L)	0.01	2.82	5.64	1	4	393	MDN2
	Manganese (mg/L)	0.00	0.02	0.13			32	
	Iron (mg/L)	0.00	0.01	0.13			32	
	Turbidity (NTU)	0.07	0.23	0.86			384	MDN6
Reticulation Water Quality								
Manusu Drive (Coolabah Estate)	Free Chlorine (mg/L)	0.01	1.43	5.75	0.2	4	107	MDN5
	Turbidity (NTU)	0.06	0.72	13.10		4	103	MDN6
	pH	7.57	8.19	8.41	6.5	8.5	107	COP
Medical Centre	Free Chlorine (mg/L)	0.04	1.45	2.86	0.2	4	65	MDN5
	Turbidity (NTU)	0.14	0.50	5.22		4	62	MDN6
	pH	7.68	8.08	8.25	6.5	8.5	65	COP
Abbotts Street	Free Chlorine (mg/L)	0.04	1.77	3.18	0.2	4	34	MDN5
	Turbidity (NTU)	0.14	0.44	4.66		4	33	MDN6
	pH	7.72	8.10	8.33	6.5	8.5	35	COP
Showground	Free Chlorine (mg/L)	1.82	1.82	1.82	0.2	4	1	MDN5
	Turbidity (NTU)	0.20	0.20	0.20		4	1	MDN6
	pH	8.20	8.20	8.20	6.5	8.5	1	COP
Lawnside Drive	Free Chlorine (mg/L)	0.05	1.46	3.03	0.2	4	69	MDN5
	Turbidity (NTU)	0.04	0.34	2.86		4	65	MDN6
	pH	7.70	8.07	8.25	6.5	8.5	69	COP
Rest Area	Free Chlorine (mg/L)	0.21	2.36	4.93	0.2	4	243	MDN5
	Turbidity (NTU)	0.08	0.24	0.91		4	235	MDN6
	pH	7.53	8.00	8.25	6.5	8.5	242	COP
Back Tank Manusu Tank	Free Chlorine (mg/L)	0.04	1.93	4.98	0.2	4	209	MDN5
	Turbidity (NTU)	0.16	0.60	3.91		4	208	MDN6
	pH	7.98	8.26	8.50	6.5	8.5	205	COP
Verification monitoring data								
Lawnside Drive	Free Chlorine (mg/L)	0.26	1.61	2.22	0.2	4	4	MDN5
	Total Chlorine (mg/L)	0.59	1.88	2.67			4	
	Turbidity (NTU)	0.26	0.48	0.76		4	4	MDN6
	pH	7.70	7.96	8.10	6.5	8.5	4	COP

Source/Sample Point	Parameter	Min	Avg	Max	Lower critical limit	Upper critical limit	No. of samples	CCP
Riverside Camp & Recreation Area	Free Chlorine (mg/L)	1.77	2.47	3.66	0.2	4	8	MDN5
	Total Chlorine (mg/L)	1.78	2.80	4.87			8	
	Turbidity (NTU)	0.14	0.38	0.66		4	8	MDN6
	pH	7.49	7.90	8.17	6.5	8.5	7	COP
Royal Hotel (15 Bandulla Street)	Free Chlorine (mg/L)	0.10	1.08	2.12	0.2	4	4	MDN5
	Total Chlorine (mg/L)	0.13	1.22	2.31			4	
	Turbidity (NTU)	0.24	0.58	0.92		4	4	MDN6
	pH	7.68	7.90	8.06	6.5	8.5	4	COP
Manusu Drive (Coolabah Estate)	Free Chlorine (mg/L)	0.52	2.30	3.83	0.2	4	6	MDN5
	Total Chlorine (mg/L)	0.83	2.51	3.92			6	
	Turbidity (NTU)	0.19	0.37	0.60		4	6	MDN6
	pH	7.91	8.09	8.35	6.5	8.5	6	COP
Mendooran Toilet Block	Free Chlorine (mg/L)	0.93	1.70	2.49	0.2	4	4	MDN5
	Total Chlorine (mg/L)	1.31	1.84	2.62			4	
	Turbidity (NTU)	0.39	0.48	0.60		4	4	MDN6
	pH	7.92	8.04	8.20	6.5	8.5	4	COP

E.2 Verification monitoring summary

For the new WTP Verification data taken from the NSW Health database, from 1 August 2019 to 31 August 2020 was analysed for the Mendooran water system. Any microbiological readings '< 1' were taken as zero, all other less than readings were taken as half of their upper limits, that is '< 0.1' became '0.05'. Values listed as greater than were taken as their lower limit, '> 200' became '200'. A summary of key verification data is shown in ADWG aesthetic guideline exceedances are highlighted blue and ADWG health exceedances or microbiological detections are highlighted orange. Exceedances for Iron, Manganese, and Mercury have not been graphed as the sample size <5.

Graphic representation of the Free Chlorine exceedances can be found in Figure 7-4, and Turbidity Figure 7-5, in the main body of this report, and graphic representation of exceedances for Total Coliforms can be found in Figure 13-3, this appendix.

Table 13-11

ADWG aesthetic guideline exceedances are highlighted blue and ADWG health exceedances or microbiological detections are highlighted orange. Exceedances for Iron, Manganese, and Mercury have not been graphed as the sample size <5.

Graphic representation of the Free Chlorine exceedances can be found in Figure 7-4, and Turbidity Figure 7-5, in the main body of this report, and graphic representation of exceedances for Total Coliforms can be found in Figure 13-3, this appendix.

Table 13-11: Mendooran verification monitoring data summary

Characteristic	Guideline Value (Health or Aesthetic)	Min	5 th %ile	Median	95 th %ile	Max	Samples	Exceptions
Aluminium (mg/L)	0.2 A	0.01	0.01	0.02	0.12	0.12	3	0 0%
Antimony (mg/L)	0.003 H	0.00005	0.00005	0.0001	0.0001	0.0001	3	0 0%
Arsenic (mg/L)	0.01 H	0.001	0.001	0.000	0.001	0.001	3	0 0%
Barium (mg/L)	2 H	0.161	0.161	0.160	0.2777	0.2777	3	0 0%
Boron (mg/L)	4 H	0.0198	0.0198	0.0203	0.023	0.023	3	0 0%
Cadmium (mg/L)	0.002 H	0.00005	0.00005	0.0001	0.00005	0.00005	3	0 0%
Calcium (mg/L)	-	22.6	22.6	23	24.4	24.4	3	0 0%
Chloride (mg/L)	250 A	108	108	132	138	138	3	0 0%
Chromium (mg/L)	0.05 H	0.0005	0.0005	0.0005	0.001	0.001	3	0 0%
Copper (mg/L)	2 H	0.0005	0.0005	0.0010	0.024	0.024	3	0 0%
<i>E. coli</i>	0 H	0	0	0	0	0	28	0 0%
Fluoride (mg/L)	1.5 H	0.05	0.05	0.11	0.24	0.24	3	0 0%

Characteristic	Guideline Value (Health or Aesthetic)		Min	5 th %ile	Median	95 th %ile	Max	Samples	Exceptions
Free chlorine (mg/L) ¹			0.1	0.26	2.15	3.66	3.83	28	1 4%
Iodine (mg/L)			0.05	0.05	0.06	0.06	0.06	3	0 0%
Iron (mg/L)	0.3 A		0.01	0.01	0.01	0.82	0.82	3	1 33%
Lead (mg/L)	0.01 H		0.0001	0.0001	0.0001	0.0002	0.0002	3	0 0%
Magnesium (mg/L)	-		14.35	14.35	14.5	14.51	14.51	3	0 0%
Manganese (mg/L)	0.5 H		0.0004	0.0004	0.0006	0.74	0.74	3	1 33%
Mercury (mg/L)	0.001 H		0.0004	0.0004	0.0004	0.0011	0.0011	3	1 33%
Molybdenum (mg/L)	0.05 H		0.0002	0.0002	0.0007	0.0008	0.0008	3	0 0%
Nickel (mg/L)	0.02 H		0.0002	0.0002	0.0011	0.0011	0.0011	3	0 0%
Nitrate (mg/L)	50 H		0.5	0.5	1	3	3	3	0 0%
Nitrite (mg/L)	3 H		0.05	0.05	0.05	0.05	0.05	3	0 0%
pH – Chemical Analysis	8.5 A		7	7	8	8	8	3	0 0%
pH – Microbial Analysis	8.5 A		7.49	7.68	8.045	8.35	8.42	28	0 0%
Selenium (mg/L)	0.01 H		0.0035	0.0035	0.0035	0.0035	0.0035	3	0 0%
Silver (mg/L)	0.1 H		0.0001	0.0001	0.0001	0.0001	0.0001	3	0 0%
Sodium (mg/L)	180 A		77	77	81	83	83	3	0 0%
Sulfate (mg/L)	250 A		8	8	8	10	10	3	0 0%
Temperature (oC)			20	10.9	10.9	16.0500	27.6	27.6	14 0
Total Chlorine (mg/L)	5 H		0.13	0.59	2.3	3.92	4.87	28	0 0%
Total Coliforms (cfu/100 mL)			0	0	0	3	302	28	2 7%
Total Dissolved Solids (TDS) (mg/L)	600 A		303	303	308	362	362	3	0 0%
Total Hardness as CaCO ₃ (mg/L) ²	200 A		115.5	115.5	117.9	120.6	120.6	3	0 0%
True Colour (Hazen Units (HU))	15 A		0.5	0.5	1	5	5	3	0 0%
Turbidity (NTU) – Chemical Analysis	5 A		0.4	0.4	0.7	9.4	9.4	3	1 33%
Turbidity (NTU) – Microbial Analysis	5		0.14	0.19	0.385	0.76	0.92	28	0 0%
Uranium (mg/L)	0.017 H		0.00005	0.00005	0.0002	0.0002	0.0002	3	0 0%
Zinc (mg/L)	3 A		0.05	0.05	0.05	0.05	0.05	3	0 0%

Source: NSW Health Water Quality Monitoring database

Note 1. The ADWG has a Health limit for chlorine of 5mg/L, with recommendation for a free chlorine residual above 0.2 mg/L in the reticulation

Note 2. ADWG recommend 200 mg/L hardness as CaCO₃ as an upper limit to minimise the build-up of scale. A lower limit of 60 mg/L is desirable for avoiding corrosion by soft water.

E.3 Verification monitoring exceedances

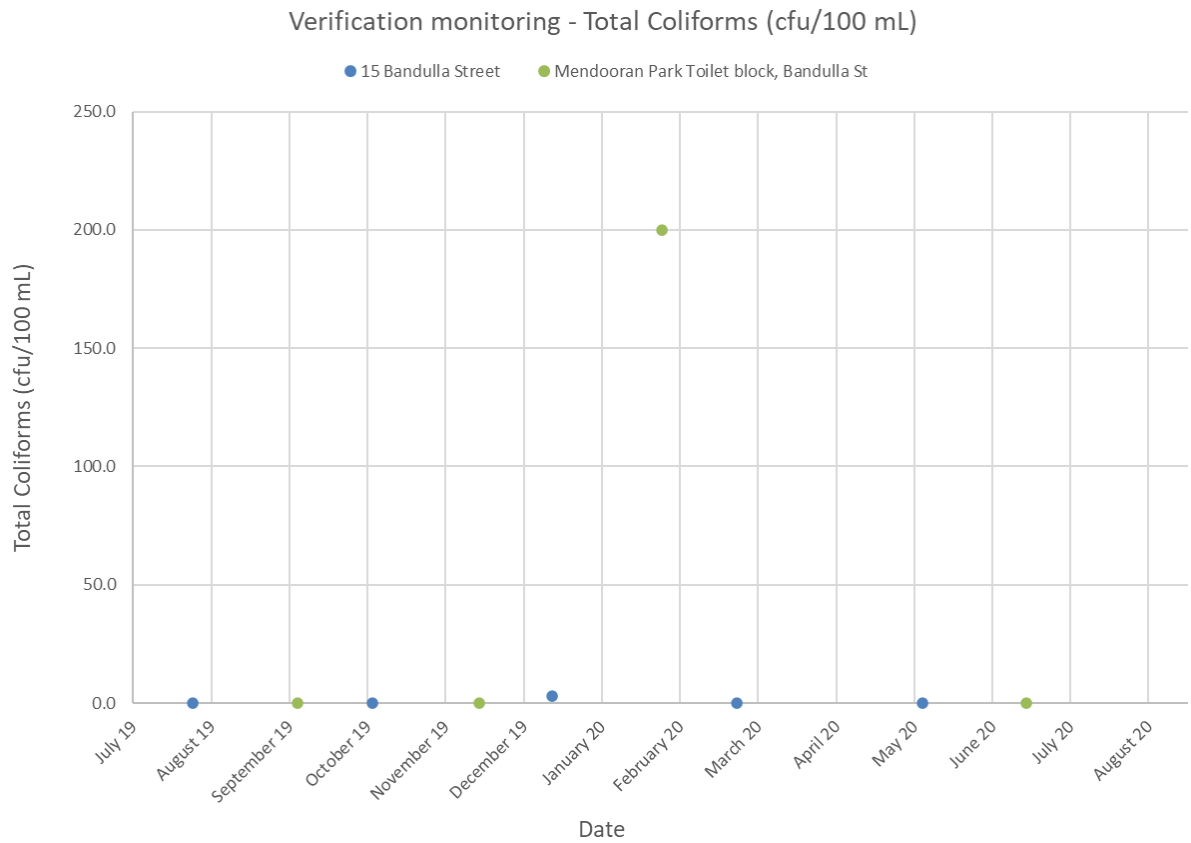


Figure 13-3: Mendooran verification exceedances - Total coliforms

Source: NSW Health Water Quality Monitoring database

Appendix F Coolah water quality data

F.1 Water quality data summary

Table 13-12: Coolah operational monitoring data summary

Source: Coolah operational monitoring spreadsheet

Source/Sample Point	Parameter	Min	Avg	Max	Lower critical limit	Upper critical limit	No. of samples	CCP
Reservoir Water Quality								
Coolah top servo	Free chlorine (mg/L)	0.58	1.50	3.50	0.40	4.00	356	CLH1
	pH	6.97	7.49	8.25	6.50	8.50	356	
	Turbidity (NTU)	0.01	0.52	1.61	-	4.00	157	
Reticulated Water Quality								
Shire depot	Free chlorine (mg/L)	0.92	1.46	1.90	0.20	4.00	14	CLH5
	Turbidity (NTU)	1.23	5.86	7.55	1.00	4.00	12	
	pH	1.41	5.30	7.98			12	
Wentworth Ave res	Free chlorine (mg/L)	0.56	1.25	2.90	0.20	4.00	292	CLH5
	Turbidity (NTU)	0.01	0.46	1.97		4.00	103	CLH6
	pH	7.17	8.09	8.95	-	4.00	292	
Coolah STP	Free chlorine (mg/L)	0.01	1.34	2.02	0.20	4.00	88	CLH5
	Turbidity (NTU)	0.05	0.97	7.54	1.00	4.00	41	CLH6
	pH	1.29	7.27	8.37	6.50	8.50	82	
Coolah sanitary depot	Free chlorine (mg/L)	0.14	1.31	1.80	0.20	4.00	46	CLH5
	Turbidity (NTU)	0.14	0.55	1.82	1.00	4.00	19	CLH6
	pH	7.02	7.57	8.97	6.50	8.50	44	
Verification monitoring								
13 Campbell Street	Free chlorine (mg/L)	1.64	1.77	1.88	0.20	4.00	3	CLH5
	Total Chlorine (mg/L)	1.85	2.01	2.29			3	
	Turbidity (NTU)	0.36	0.53	0.63	1.00	4.00	3	CLH6
	pH	7.34	7.55	7.66			4	
21 Mclean Street	Free chlorine (mg/L)	1.29	1.61	2.10	0.20	4.00	12	CLH5
	Total Chlorine (mg/L)	1.62	2.34	2.81			13	
	Turbidity (NTU)	0.23	0.27	0.56	1.00	4.00	13	CLH6
	pH	7.52	7.60	7.63			13	
Coolah Admin	Total Chlorine (mg/L)	2.47	2.47	2.47			1	
	Turbidity (NTU)	0.23	0.23	0.23			1	CLH6
	pH	7.61	7.61	7.61			1	
Coolah Football Pavillion	Free chlorine (mg/L)	1.16	1.67	2.07	0.20	4.00	9	CLH5
	Total Chlorine (mg/L)	2.46	2.50	2.80			10	
	Turbidity (NTU)	0.23	0.23	0.23			10	CLH6
	pH	7.42	7.59	7.63			11	
McMaster Park	Free chlorine (mg/L)	0.79	1.34	1.63	0.20	4.00	13	CLH5
	Total Chlorine (mg/L)	1.05	2.18	2.47			13	
	Turbidity (NTU)	0.23	0.27	0.53	1.00	4.00	13	CLH6
	pH	7.61	7.61	7.61			1	
Shire House (139 Martin St)	Free chlorine (mg/L)	0.48	1.63	1.94	0.20	4.00	17	CLH5
	Total Chlorine (mg/L)	1.66	2.40	2.47			17	
	Turbidity (NTU)	0.22	0.25	0.59	1.00	4.00	17	CLH6
	pH	7.35	7.60	7.72			18	

F.2 Verification monitoring summary

For the new WTP Verification data taken from the NSW Health database, from 1 August 2019 to 31 August 2020 was analysed for the Coolah water system. Any microbiological readings '< 1' were taken as zero, all other less than readings were taken as half of their upper limits, that is '< 0.1' became '0.05'. Values listed as greater than were taken as their lower limit, '> 200' became '200'.

A summary of key verification data is shown in Table 13-13.

ADWG aesthetic guideline exceedances are highlighted blue and ADWG health exceedances or microbiological detections are highlighted orange. Exceedances for Total Hardness has not been graphed as the sample size <5. Graphic representation of exceedances for Total Coliforms can be found in Figure 13-4, this appendix.

Table 13-13: Coolah verification monitoring data summary

Source: NSW Health Water Quality Monitoring database

Characteristic	Guideline Value (Health or Aesthetic)	Min	5 th %ile	Median	95 th %ile	Max	Samples	Exceptions
Aluminium (mg/L)	0.2 A	0.01	0.01	0.0150	0.02	0.02	2	0 0%
Antimony (mg/L)	0.003 H	0.00005	0.00005	0.0003	0.0005	0.0005	2	0 0%
Arsenic (mg/L)	0.01 H	0.001	0.001	0.0010	0.001	0.001	2	0 0%
Barium (mg/L)	2 H	0.0151	0.0151	0.0166	0.018	0.018	2	0 0%
Boron (mg/L)	4 H	0.0111	0.0111	0.0306	0.05	0.05	2	0 0%
Cadmium (mg/L)	0.002 H	0.00005	0.00005	0.0002	0.00025	0.00025	2	0 0%
Calcium (mg/L)	10000	68.1	68.1	71.45	74.8	74.8	2	0 0%
Chloride (mg/L)	250 A	60	60	60	60	60	2	0 0%
Chromium (mg/L)	0.05 H	0.001	0.001	0.0018	0.0025	0.0025	2	0 0%
Copper (mg/L)	2 H	0.047	0.047	0.1905	0.334	0.334	2	0 0%
E. coli (mpn/100 mL)	0 H	0	0	0	0	0	60	0 0%
Fluoride (mg/L)	1.5 H	0.05	0.05	0.05	0.05	0.05	2	0 0%
Free Chlorine (mg/L)	0.2 - 5	0.79	1.18	1.64	2.06	2.11	53	0 0%
Iodine (mg/L)	0.5	0.01	0.01	0.01	0.01	0.01	2	0 0%
Iron (mg/L)	0.3 A	0.005	0.005	0.0125	0.02	0.02	2	0 0%
Lead (mg/L)	0.01 H	0.001	0.001	0.0029	0.0048	0.0048	2	0 0%
Magnesium (mg/L)	10000	55.97	55.97	60.885	65.8	65.8	2	0 0%
Manganese (mg/L)	0.5 H	0.0005	0.0005	0.0015	0.0025	0.0025	2	0 0%
Mercury (mg/L)	0.001 H	0.0001	0.0001	0.0003	0.0004	0.0004	2	0 0%
Molybdenum (mg/L)	0.05 H	0.0003	0.0003	0.0014	0.0025	0.0025	2	0 0%
Nickel (mg/L)	0.02 H	0.001	0.001	0.003	0.005	0.005	2	0 0%
Nitrate (mg/L)	50 H	5	5	5	5	5	2	0 0%
Nitrite (mg/L)	3 H	0.05	0.05	0.05	0.05	0.05	2	0 0%
pH - Chemical samples	6.5 - 8.5 A	7.6	7.6	7.6	7.6	7.6	2	0 0%
pH - Microbial samples	6.5 - 8.5 A	7.07	7.35	7.62	7.93	8.07	54	0 0%
Selenium (mg/L)	0.01 H	0.001	0.001	0.0023	0.0035	0.0035	2	0 0%
Silver (mg/L)	0.1 H	0.0001	0.0001	0.0006	0.001	0.001	2	0 0%
Sodium (mg/L)	180 A	33	33	35	37	37	2	0 0%

Sulfate (mg/L)	500	A	6	6	6.5	7	7	2	0	0%
Temperature (C)	30	A	9.8	11.1	15.65	26.6	28.9	28	0	0%
Total Chlorine (mg/L)	5	H	0.39	1.05	1.72	2.47	2.8	55	0	0%
Total Coliforms (mpn/100 mL)	0		0	0	0	0	202	60	1	2%
Total Dissolved Solids (TDS) (mg/L)	600	A	321	321	398.5	476	476	2	0	0%
Total Hardness as CaCO ₃ (mg/L)	200	A	400.5	400.5	429.1	457.7	457.7	2	2	100%
True Colour (Hazen Units (HU))	15	A	0.5	0.5	0.75	1	1	2	0	0%
Turbidity (NTU) - chemical samples	5		0.05	0.05	0.875	1.7	1.7	2	0	0%
Turbidity (NTU) - Microbial samples	5		0.11	0.13	0.36	2.15	3.6	55	0	0%
Uranium (mg/L)	0.017	H	0.0014	0.0014	0.002	0.0025	0.0025	2	0	0%
Zinc (mg/L)	3	A	0.05	0.05	0.06	0.07	0.07	2	0	0%

Note 1. The ADWG has a Health limit for chlorine of 5mg/L, with recommendation for a free chlorine residual above 0.2 mg/L in the reticulation

Note 2. ADWG recommend 200 mg/L hardness as CaCO₃ as an upper limit to minimise the build-up of scale. A lower limit of 60 mg/L is desirable for avoiding corrosion by soft water.

F.3 Verification monitoring exceedances

Source: NSW Health Water Quality Monitoring database

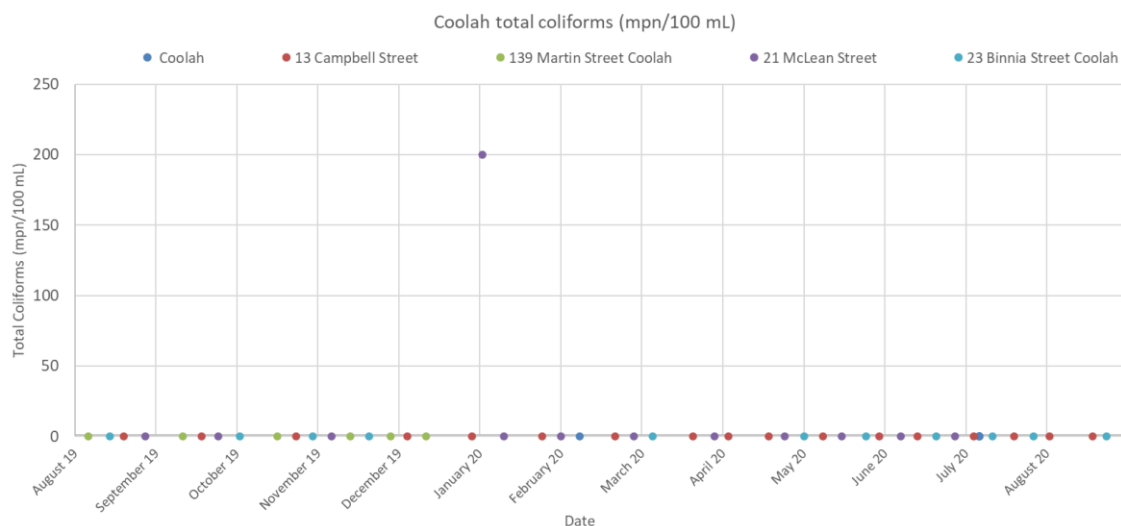


Figure 13-4: Coolah verification monitoring - total coliforms

Source: NSW Health Water Quality Monitoring database

Appendix G Binnaway water quality data

G.1 Water quality data summary

Table 13-14: Binnaway operational monitoring data summary

Source: Binnaway operational monitoring spreadsheet

Process	Parameter	Min	Avg	Max	Lower critical limit	Upper critical limit	No. of samples	CCP
Raw Water Quality	Turbidity (NTU)	0.69	6.10	74.60			395	
	Colour (HU)	10.00	24.65	70.00			369	
	pH	6.47	7.11	7.51			395	
Settled Water Quality	Turbidity (NTU)	0.50	2.10	22.50			395	
	Colour (HU)	0.00	11.82	55.00			369	
	pH	4.48	6.83	9.81			395	
Filtered Water Quality	Turbidity (NTU)	0.05	0.16	0.90			394	
	Colour (HU)	0.00	0.00	0.00			395	
	pH	6.38	6.81	7.61			395	
Clear Water Quality	Turbidity (NTU)	0.06	0.21	0.86	0.00	0.50	394	BWY1
	Free Chlorine	0.50	2.51	4.00	1.0	4.0	394	BWY2
	Colour (HU)	0.00	0.00	0.00			394	
	pH	6.33	7.54	8.30			394	
Reticulation								
Railway Barracks	Free Chlorine	0.00	0.29	0.69	0.2	4.0	7	BWY5
	Total Chlorine	0.10	0.43	1.09			7	
	Turbidity (NTU)	0.36	0.60	1.45			7	BWY6
	pH	7.48	7.81	8.06			7	
Multi Purpose Health	Free Chlorine	0.00	1.03	1.56	0.2	4.0	7	BWY5
	Total Chlorine	0.27	1.24	1.80			7	
	Turbidity (NTU)	0.21	0.31	0.44			8	BWY6
	pH	7.78	7.98	8.23			8	
M & K Barnes (11)	Free Chlorine	0.21	0.79	1.56	0.2	4.0	7	BWY5
	Total Chlorine	0.32	1.06	1.88			7	
	Turbidity (NTU)	0.25	1.04	4.04			7	BWY6
	pH	7.53	7.82	8.15			7	
Teacher Housing (42)	Free Chlorine	0.16	0.54	0.92	0.2	4.0	2	BWY5
	Total Chlorine	0.26	0.62	0.98			2	
	Turbidity (NTU)	0.40	0.41	0.42			2	BWY6
	pH	7.64	7.68	7.72			2	
L & C Easy (4 Myall St)	Free Chlorine	0.00	0.57	1.17	0.2	4.0	4	BWY5
	Total Chlorine	0.12	0.78	1.38			4	
	Turbidity (NTU)	0.30	1.73	4.54			4	BWY6
	pH	7.83	7.97	8.21			4	
Caravan Park	Free Chlorine	0.97	1.00	1.02	0.20	4.00	2	BWY5
	Total Chlorine	1.13	1.16	1.19			2	
	Turbidity (NTU)	0.56	0.58	0.60		4.00	2	BWY6
	pH	7.80	7.85	7.89			2	

G.2 Verification monitoring summary

For the new WTP Verification data taken from the NSW Health database, from 1 August 2019 to 31 August 2020 was analysed for the Binnaway water system. Any microbiological readings '< 1' were taken as zero, all other less than readings were taken as half of their upper limits, that is '< 0.1' became '0.05'. Values listed as greater than were taken as their lower limit, '> 200' became '200'. A summary of key verification data is shown in ADWG aesthetic guideline exceedances are highlighted blue and ADWG health exceedances or microbiological detections are highlighted orange. Graphic representation of exceedances for Free Chlorine can be found in Figure 9-4, main document. Total Hardness has not been graphed as the sample size <5. Graphic representation of exceedances for Total Coliforms can be found in Figure 13-5 Figure 13-2, this appendix.

Table 13-15.

ADWG aesthetic guideline exceedances are highlighted blue and ADWG health exceedances or microbiological detections are highlighted orange. Graphic representation of exceedances for Free Chlorine can be found in Figure 9-4, main document. Total Hardness has not been graphed as the sample size <5. Graphic representation of exceedances for Total Coliforms can be found in Figure 13-5 Figure 13-2, this appendix.

Table 13-15: Binnaway verification monitoring data summary

Source: NSW Health Water Quality Monitoring database

Characteristic	Guideline Value (Health or Aesthetic)		Min	5 th %ile	Median	95 th %ile	Max	Samples	Exceptions	
Aluminium (mg/L)	0.2	A	0.005	0.005	0.02	0.02	0.02	3	0	0%
Antimony (mg/L)	0.003	H	0.00005	0.00005	0.0001	0.0005	0.0005	3	0	0%
Arsenic (mg/L)	0.01	H	0.0005	0.0005	0.001	0.001	0.001	3	0	0%
Barium (mg/L)	2	H	0.1079	0.1079	0.1430	0.1889	0.1889	3	0	0%
Boron (mg/L)	4	H	0.0194	0.0194	0.0361	0.05	0.05	3	0	0%
Cadmium (mg/L)	0.002	H	0.00005	0.00005	0.0001	0.0002	0.0002	3	0	0%
Calcium (mg/L)	10000		30.4	30.4	46	94	94	3	0	0%
Chloride (mg/L)	250	A	70	70	115	171	171	3	0	0%
Chromium (mg/L)	0.05	H	0.0005	0.0005	0.001	0.0025	0.0025	3	0	0%
Copper (mg/L)	2	H	0.0025	0.0025	0.003	0.007	0.007	3	0	0%
E. coli (mpn/100 mL)	0	H	0	0	0	0	0	25	0	0%
Fluoride (mg/L)	1.5	H	0.1	0.1	0.12	0.29	0.29	3	0	0%
Free Chlorine (mg/L)	0.2 - 5		0.15	0.16	0.96	1.56	1.99	22	2	91%
Iodine (mg/L)	0.5		0.03	0.03	0.03	0.06	0.06	3	0	0%
Iron (mg/L)	0.3	A	0.005	0.005	0.01	0.01	0.01	3	0	0%
Lead (mg/L)	0.01	H	0.0005	0.0005	0.001	0.0017	0.0017	3	0	0%
Magnesium (mg/L)	10000		19.03	19.03	30.22	67.7	67.7	3	0	0%
Manganese (mg/L)	0.5	H	0.0011	0.0011	0.0025	0.0078	0.0078	3	0	0%
Mercury (mg/L)	0.001	H	0.00005	0.00005	0.0004	0.0004	0.0004	3	0	0%
Molybdenum (mg/L)	0.05	H	0.0002	0.0002	0.0006	0.0025	0.0025	3	0	0%
Nickel (mg/L)	0.02	H	0.0002	0.0002	0.0009	0.005	0.005	3	0	0%
Nitrate (mg/L)	50	H	0.5	0.5	1	42	42	3	0	0%
Nitrite (mg/L)	3	H	0.05	0.05	0.05	0.05	0.05	3	0	0%
pH - Chemical Analysis	6.5 - 8.5	A	7.6	7.6	7.7	8.1	8.1	3	0	0%
pH - Microbial Analysis	6.5 - 8.5	A	6.98	7.36	7.87	8.21	8.23	24	0	0%
Selenium (mg/L)	0.01	H	0.001	0.001	0.0035	0.0035	0.0035	3	0	0%
Silver (mg/L)	0.1	H	0.0001	0.0001	0.0001	0.001	0.001	3	0	0%
Sodium (mg/L)	180	A	52	52	75	107	107	3	0	0%
Sulfate (mg/L)	500	A	50	50	70	74	74	3	0	0%
Temperature (C)	30	A	12.3	12.3	14	26.3	26.3	14	0	0%
Total Chlorine (mg/L)	5	H	0.12	0.26	1.115	1.88	2.29	24	0	0%

Characteristic	Guideline Value (Health or Aesthetic)		Min	5 th %ile	Median	95 th %ile	Max	Samples	Exceptions	
Total Coliforms (mpn/100 mL)	0		0	0	0	1	78	25	3	12%
Total Dissolved Solids (TDS) (mg/L)	600	A	293	293	430	564	564	3	0	0%
Total Hardness as CaCO3 (mg/L)	200	A	154.3	154.3	239.3	513.5	513.5	3	2	67%
True Colour (Hazen Units (HU))	15	A	0.5	0.5	0.5	1	1	3	0	0%
Turbidity (NTU) - Chemical analysis	5		0.05	0.05	1.1	2.3	2.3	3	0	0%
Turbidity (NTU) - Microbial analysis	5		0.1	0.21	0.39	4.04	4.54	24	0	0%
Uranium (mg/L)	0.017	H	0.0002	0.0002	0.0007	0.0025	0.0025	3	0	0%
Zinc (mg/L)	3	A	0.04	0.04	0.05	0.08	0.08	3	0	0%

Note 1. The ADWG has a Health limit for chlorine of 5mg/L, with recommendation for a free chlorine residual above 0.2 mg/L in the reticulation

Note 2. ADWG recommend 200 mg/L hardness as CaCO3 as an upper limit to minimise the build-up of scale. A lower limit of 60 mg/L is desirable for avoiding corrosion by soft water.

G.3 Verification monitoring exceedances

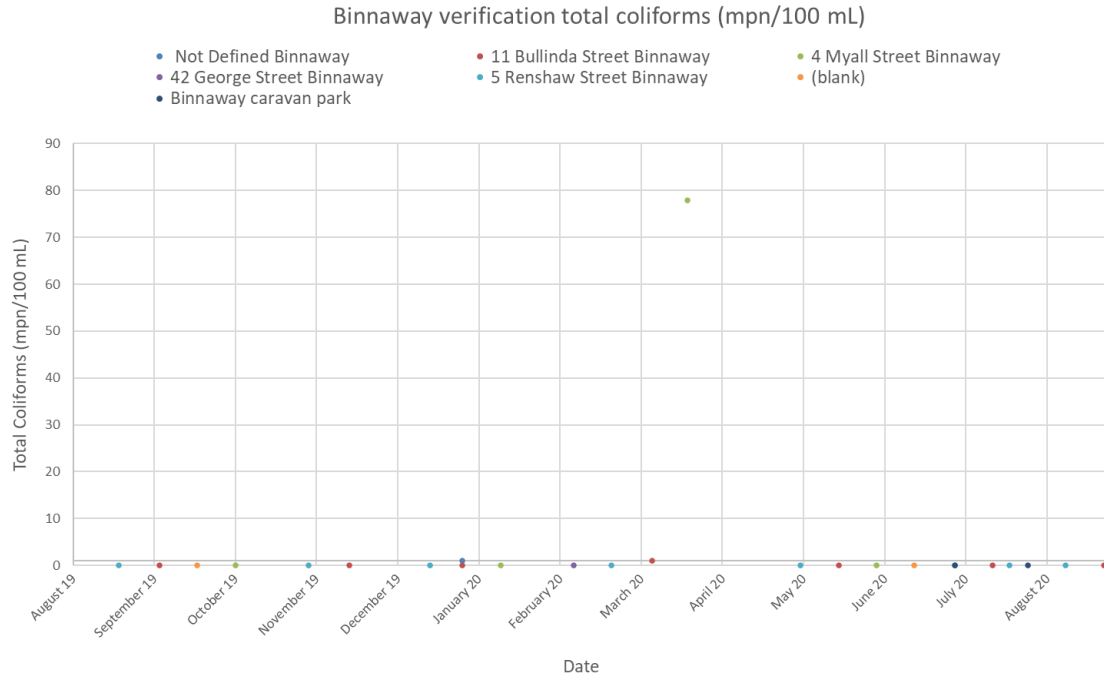


Figure 13-5: Binnaway verification total coliforms

Source: NSW Health Water Quality Monitoring database

Appendix H Dunedoo water quality data

H.1 Water quality data summary

Table 13-16.: Dunedoo operational monitoring data summary

Source: Dunedoo operational monitoring spreadsheet

Source/Sample Point	Parameter	Min	Avg	Max	Lower critical limit	Upper critical limit	No. of samples	CCP
Reservoir Water Quality								
Bullinda St res	Free chlorine (mg/L)	0.90	1.39	1.92	0.7	4.0	397	DDO1
	Turbidity (NTU)	0.01	0.26	0.87			35	
	pH	4.24	7.28	7.75			397	
Rhodes St res	Free chlorine (mg/L)	0.80	1.28	1.95	0.7	4.0	114	DDO1
	pH	7.11	7.42	8.02			114	
Reticulated Water Quality								
Showground	Free chlorine (mg/L)	0.92	1.37	2.10			57	DDO5
	Turbidity (NTU)	0.01	0.52	1.52		4	14	DDO6
	pH	7.04	7.19	7.42			57	COP
Jubilee Hall	Free chlorine (mg/L)	0.83	1.12	1.60			57	DDO5
	Turbidity (NTU)	0.03	0.63	2.12		4	14	DDO6
	pH	7.09	7.22	7.42			57	COP
Shire depot	Free chlorine (mg/L)	0.75	1.18	1.80	0.2	4.0	114	DDO5
	Turbidity (NTU)	0.03	0.34	1.20		4	28	DDO6
	pH	7.09	7.25	7.70			114	COP
Nott St SPS	Free chlorine (mg/L)	0.65	1.32	1.80	0.2	4.0	56	DDO5
	Turbidity (NTU)	0.02	0.39	1.12		4	13	DDO6
	pH	7.08	7.25	7.42			56	COP
Dunedoo STP	Free chlorine (mg/L)	0.60	0.91	1.41	0.2	4.0	56	DDO5
	Turbidity (NTU)	0.03	0.51	1.21		4	13	DDO6
	pH	7.08	7.23	7.60			56	COP
Robertson Oval	Free chlorine (mg/L)	0.85	1.34	1.83	0.2	4.0	57	DDO5
	Turbidity (NTU)	0.02	0.50	1.10		4.0	13	DDO6
	pH	7.06	7.25	7.50			57	COP
Verification monitoring								
St Michaels Convent (Tucklan St)	Free Chlorine (mg/L)	0.77	1.27	2.10	0.2	4.0	397	DDO5
	Total Chlorine (mg/L)	1.54	6.65	7.63			397	
	Turbidity (NTU)	0.81	1.40	2.81		4	397	DDO6
	pH	0.14	1.57	6.61			397	COP
Dunedoo Hall	Free Chlorine (mg/L)	0.86	1.24	1.47	0.2	4.0	397	DDO5
	Total Chlorine (mg/L)	6.98	7.48	7.85			397	
	Turbidity	0.86	1.35	1.73		4.0	397	DDO6
	pH	0.18	0.35	0.61			397	COP
Showground Wargundy Street	Free Chlorine (mg/L)	0.91	1.45	2.14	0.2	4.0	383	DDO5
	Total Chlorine (mg/L)	1.49	7.02	7.91			383	
	Turbidity (NTU)	0.92	1.52	2.18		4.0	397	DDO6
	pH	0.10	0.76	3.32			383	COP
Bowman (28 Nott St)	Free Chlorine (mg/L)	0.60	1.08	1.60	0.2	4.0	383	DDO5
	Total Chlorine (mg/L)	1.37	6.91	7.75			383	
	Turbidity (NTU)	0.11	0.42	0.70		4.0	383	DDO6
	pH	0.66	1.16	1.62			397	COP

Source/Sample Point	Parameter	Min	Avg	Max	Lower critical limit	Upper critical limit	No. of samples	CCP
Works Depot Sullivan St	Free Chlorine (mg/L)	0.76	1.33	1.68	0.2	4.0	383	DDO5
	Total Chlorine (mg/L)	1.76	6.87	7.59			383	
	Turbidity (NTU)	0.11	1.36	1.76		4.0	397	
	pH	0.15	0.75	3.47			383	COP

H.2 Verification monitoring summary

Verification data is taken from the NSW Health database, and data from 1 August 2019 to 31 August 2020 was analysed for the Dunedoo water system. Any microbiological readings '< 1' were taken as zero, all other less than readings were taken as half of their upper limits, that is '< 0.1' became '0.05'. Values listed as greater than were taken as their lower limit, '> 200' became '200'. A summary of key verification data is shown in Table 13-17.

ADWG aesthetic guideline exceedances are highlighted blue and ADWG health exceedances or microbiological detections are highlighted orange. Exceedances for Mercury, Total Dissolved Solids, and Total Hardness have not been graphed (sample size <5). Graphic representation for exceedances for pH can be found in Figure 10-5, main document, but see refer to Note 3 (Table 13-17). Graphic representation for exceedances for Turbidity can be found in Figure 10-4, main document. Graphic representation of exceedances for Total Coliforms can be found in Figure 13-6/Figure 13-2, this appendix.

Table 13-17: Dunedoo verification monitoring data summary

Source: NSW Health Water Quality Monitoring database

Characteristic	Guideline Value (Health or Aesthetic)	Min	5 th %ile	Median	95 th %ile	Max	Samples	Exceptions
Aluminium (mg/L)	0.2 A	0.005	0.005	0.0075	0.01	0.01	2	0 0%
Antimony (mg/L)	0.003 H	0.00005	0.00005	0.0003	0.0005	0.0005	2	0 0%
Arsenic (mg/L)	0.01 H	0.001	0.001	0.0015	0.002	0.002	2	0 0%
Barium (mg/L)	2 H	0.0899	0.0899	0.0975	0.105	0.105	2	0 0%
Boron (mg/L)	4 H	0.0817	0.0817	0.0909	0.1	0.1	2	0 0%
Cadmium (mg/L)	0.002 H	0.00005	0.00005	0.0002	0.0002	0.00025	2	0 0%
Calcium (mg/L)	-	65.7	65.7	69.6	73.5	73.5	2	0 0%
Chloride (mg/L)	250 A	192	192	193	194	194	2	0 0%
Chromium (mg/L)	0.05 H	0.002	0.002	0.0023	0.0025	0.0025	2	0 0%
Copper (mg/L)	2 H	0.013	0.013	0.037	0.061	0.061	2	0 0%
<i>E. coli</i>	0 H	0	0	0	0	0	55	0 0%
Fluoride (mg/L)	1.5 H	0.53	0.53	0.535	0.54	0.54	2	0 0%
Free chlorine (mg/L) ¹		0.6	0.86	1.31	1.68	2.14	54	0 0%
Iodine (mg/L)		0.06	0.06	0.07	0.08	0.08	2	0 0%
Iron (mg/L)	0.3 A	0.005	0.005	0.005	0.005	0.005	2	0 0%
Lead (mg/L)	0.01 H	0.0008	0.0008	0.0009	0.001	0.001	2	0 0%
Magnesium (mg/L)	-	53.08	53.08	55.38	57.68	57.68	2	0 0%
Manganese (mg/L)	0.5 H	0.00015	0.00015	0.0013	0.0025	0.0025	2	0 0%
Mercury (mg/L)	0.001 H	0.0001	0.0001	0.0006	0.0011	0.0011	2	1 50%
Molybdenum (mg/L)	0.05 H	0.0023	0.0023	0.0024	0.0025	0.0025	2	0 0%
Nickel (mg/L)	0.02 H	0.0011	0.0011	0.0031	0.005	0.005	2	0 0%
Nitrate (mg/L)	50 H	2	2	2	2	2	2	0 0%
Nitrite (mg/L)	3 H	0.05	0.05	0.05	0.05	0.05	2	0 0%

Characteristic	Guideline Value (Health or Aesthetic)		Min	5 th %ile	Median	95 th %ile	Max	Samples	Exceptions
pH – Chemical analysis	8.5	A	7.3	7.3	7.5	7.7	7.7	2	0 0%
pH – Microbial analysis ²	8.5	A	1.62	7.02	7.535	7.84	7.91	54	1 2%
Selenium (mg/L)	0.01	H	0.001	0.001	0.0023	0.0035	0.0035	2	0 0%
Silver (mg/L)	0.1	H	0.0001	0.0001	0.0006	0.001	0.001	2	0 0%
Sodium (mg/L)	180	A	94	94	96	98	98	2	0 0%
Sulfate (mg/L)	250	A	22	22	23.5	25	25	2	0 0%
Temperature (oC)			21	0.34	14.4	19.050	26	27	28 0
Total Chlorine (mg/L)	5	H	0.11	0.66	1.43	1.89	2.18	55	0 0%
Total Coliforms (cfu/100 mL)			0	0	0	3	202	55	3 5%
Total Dissolved Solids (TDS) (mg/L)	600	A	443	443	559	675	675	2	1 50%
Total Hardness as CaCO ₃ (mg/L) ³	200	A	382.6	382.6	401.85	421.1	421.1	2	2 1%
True Colour (Hazen Units (HU))	15	A	0.5	0.5	0.5	0.5	0.5	2	0 0%
Turbidity (NTU) – Chemical analysis	5	A	0.05	0.05	0.725	1.4	1.4	2	0 0%
Turbidity (NTU) – Microbial analysis	5	A	0.05	0.13	0.47	3.47	6.61	55	1 2%
Uranium (mg/L)	0.017	H	0.0015	0.0015	0.002	0.0025	0.0025	2	0 0%
Zinc (mg/L)	3	A	0.05	0.05	0.065	0.08	0.08	2	0 0%

Note 1. The ADWG has a Health limit for chlorine of 5mg/L, with recommendation for a free chlorine residual above 0.2 mg/L in the reticulation

Note 2. On the 21/4/2020 the pH reading from 152 Bolaro Street is recorded as 1.62. Removing this outlier (based on the likelihood of being an incorrect reading) removes any exceedances from pH.

Note 3. ADWG recommend 200 mg/L hardness as CaCO₃ as an upper limit to minimise the build-up of scale. A lower limit of 60 mg/L is desirable for avoiding corrosion by soft water.

H.3 Verification monitoring exceedances

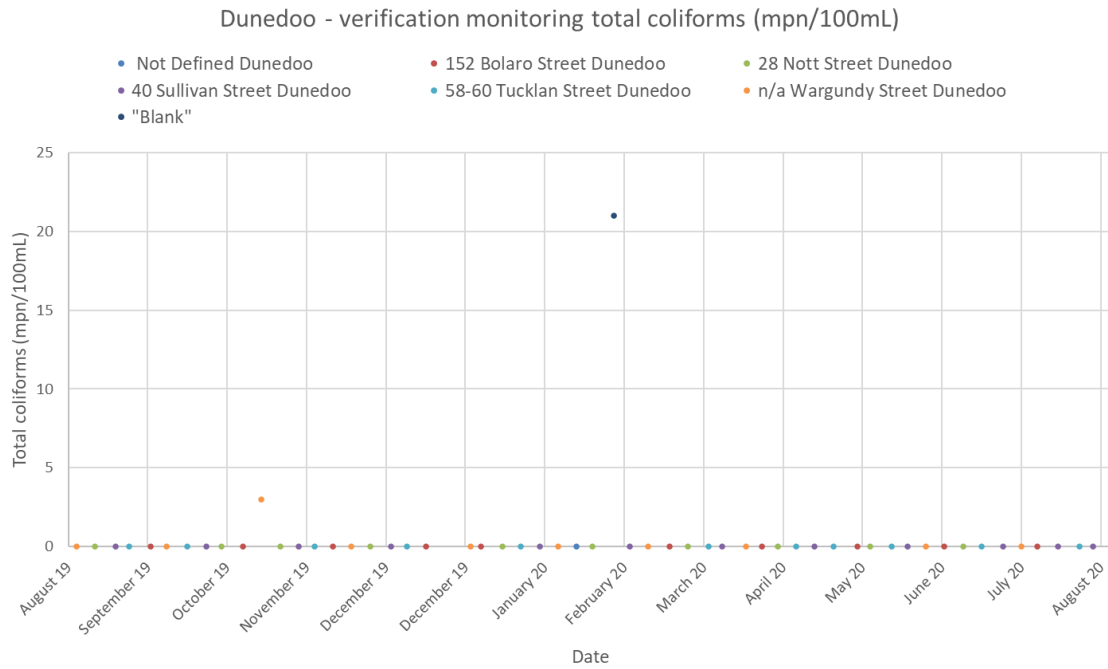


Figure 13-6: Dunedoo verification total coliforms

Source: NSW Health Water Quality Monitoring database