



KEMPSEY
Shire Council

Drinking Water Management System

Annual Water Quality Report
2019-2020

Document control

Document Drinking Water Management System Annual Report

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Prepared by Bobbie Brenton, Water Quality Officer Kempsey Shire Council
 On behalf of
 Wes Trotter, Manager Water and Sewer Kempsey Shire Council

Approved by Robert Fish, Director Operations and Planning Kempsey Shire Council

Revision History

Version	Date	Details	Author	Reviewer
			Name and Position	Name and Position
0.1	11/05/2020	First Draft	Bobbie Brenton – Water Quality Officer	Wes Trotter – Manager Water and Sewer Scott Brown – Team Leader Water Treatment John Nelson – Coordinator Process Water and Sewer
0.2	15/05/2021	Final Draft	Bobbie Brenton – Water Quality Officer	Robert Fish - Director Operations and Planning
1.0	21/05/2021	Final	Bobbie Brenton – Water Quality Officer	<p>NSW Health and Kempsey Shire Council Yearly DWMS Review meeting</p> <p>North Coast Public Health Unit Tenille Lawrence Haskew - Senior Environmental Health Officer David Basso - Environmental Health Officer</p> <p>Kempsey Shire Council Robert Fish - Director Operations and Planning Wes Trotter – Manager Water and Sewer Craig Doyle – Acting Coordinator Process Water and Sewer Scott Brown – Team Leader Water Treatment Bobbie Brenton – Water Quality Officer</p>

Executive Summary

The NSW Guidelines for Drinking Water Management Systems (NSW Ministry of Health 2013) provide guidance on the implementation of a Drinking Water Management System, in accordance with the *Public Health Act 2010* (NSW), and the *Public Health Regulation 2012* (NSW). The NSW Guidelines are based on the Framework for Management of Drinking Water Quality, as outlined in the Australian Drinking Water Guidelines (ADWG) (NHMRC 2011).

Kempsey Shire Council (Council) updated the Drinking Water Management System (DWMS) after a comprehensive external review performed by VIRIDIS Consultants supported by NSW Health. This review was completed in June 2019 and adopted by Council in August 2019. The DWMS 2019 (VIRIDIS 2019) supersedes the DWMS 2014 (AECOM 2014).

Council manages eight (8) water supply systems, providing drinking water to Kempsey and the Lower Macleay, Crescent Head, Hat Head, South West Rocks, Stuarts Point, Willawarrin, Bellbrook and the Thunggutti Aboriginal Community.

Council has developed this report to provide an annual review of the performance of its water supply systems, for the reporting period of 1 of July 2019 to 30 of June 2020. This report addresses the guideline requirements for continuous evaluation and internal review for Council's DWMS and its water supply systems. Water quality performance is monitored through operational and laboratory testing. Exceptions in water quality are measured as performance against the Australian Drinking Water Guidelines (ADWG), Water Quality Indicators (WQI) and Critical Control Points (CCP) that are based on each supply system's operational design and limitations.

In the 2019-2020 reporting year, Council had an overall 64.6% reduction in the number of CCP exceptions reported compared to the previous 2018-2019 reporting year, despite observed percentage increase in the Hat Head and Thunggutti supply systems, the Crescent Head supply had significantly fewer CCP exceptions from the previous reporting year. In 2019-2020 a total of one-hundred and nine (109) Alert Level and five (5) Critical Limit exceptions were recorded from seven-thousand, one-hundred and eighty-five (7185) samples. This is compared to the three-hundred and two (302) Alert Level and six (6) Critical Limit exceptions from the previous year.

The Kempsey and Lower Macleay (KLM) and Crescent Head water supply systems are unfiltered supplies and continue to contribute to most water quality issues. Water quality CCP exceptions were dominated by Turbidity, pH and Chlorine residuals, which are not easily controlled in these unfiltered water supplies.

Five (5) recorded Critical Limits are reported in two (2) separate Water Quality incidents:

- December 2019 in the Thunggutti supply
- June 2020 in the Kempsey and Lower Macleay supply

Two-hundred and sixteen (216) ADWG and WQI exceptions were recorded across Councils' water supply systems. This is a 26.8% increase from the one-hundred and fifty-eight (158) exceptions recorded in the previous reporting year. The main contributing factors to this increase was the change in supply in the KLM system from the Sherwood bore field to Stuart McIntyre Dam (SMD) along with declining source water quality at the upriver supplies driven by severe drought conditions.

Eight (8) positive Total Coliform results across four (4) supply systems were reported by the NSW Forensic & Analytical Science Services (FASS) Laboratory to Council. On each occasion Council undertook microbiological re-sampling, performed a data review to confirm disinfection of the supply, investigated any anomalies and reported results to the NSW Health Local Public Health Unit (LPHU).

Council remained under the operational guidance of its Drought Management Plan (DMP) until April 2020; the DMP was activated during the 2018-2019 reporting period. Water Restriction Levels were in place across the entire shire for three-hundred and five (305) days, two-hundred and sixty-four (264) days were within the 2019-2020 reporting year.

The drought impacted not only water security, but also contributed to the decline in water quality across multiple supply systems; this was reflected in increases in ADWG and WQI exceptions and customer enquiries.

Council conducted a post review of the DMP. The Water Restriction Review 2019-2020 (May 2020) report addresses the actions initiated from the Drought Response Strategy and Drought Recovery Strategy sections of the DMP. The recommendation from the Water Restriction review was indorsed at the May 2020 Council meeting.

Commencing in October 2019, bushfires were ablaze in the western parts of the Shire. By Friday 8 November 2019, the bushfires were encroaching on multiple upriver communities. The township of Willawarrin was heavily impacted with multiple dwellings lost to fire. This supply had been reliant on water carting due to poor water quality since 2 October 2019. The bore fields were turned back on in the evening of 8 October to ensure water availability for firefighting by both the Rural Fire Service and local residents; water carting recommence the following day. Extensive power outages across all upriver communities posed challenges to Council for maintaining the operation of bore fields and treatment process. Intermittent water carting was additionally actioned to both the Bellbrook and Thungutti supply systems between 9 and 15 November 2019.

A Continuous Improvement (IP) plan was developed as part of the DWMS that documented all improvement actions identified during the risk assessments and subsequent reviews of the DWMS. Council has continued to implement these improvement actions via IP, with twenty (20) actions completed in this reporting year. Twelve (12) new tasks were identified and added to the IP and one-hundred and nine (109) tasks remain outstanding with twelve (12) of the outstanding tasks having a very high risks rating. Progression status for the completion of the outstanding tasks are:

- Sixty-eight (68) are in progress
- Twenty-three (23) are ongoing (have started with no change in status from last review)
- Six (6) yet to be started
- Twelve (12) New.

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1. Report Purpose

The *Public Health Act 2010* (NSW) requires that “a supplier of drinking water must establish, and adhere to, a quality assurance program that complies with the requirements prescribed by the regulations”. The NSW Guidelines for Drinking Water Management Systems (NSW Ministry of Health 2013) provides guidance on the implementation of a Drinking Water Management System, in accordance with the *Public Health Act 2010* (NSW) and the *Public Health Regulation 2012* (NSW). The NSW Guidelines are based on the Framework for Management of Drinking Water Quality, as outlined in the Australian Drinking Water Guidelines (ADWG) (NRMCC, NHMRC 2011).

Council updated the Drinking Water Management System (DWMS) after a comprehensive external review performed by VIRIDIS Consultants supported by NSW Health. This review was completed in June 2019 and adopted by Council in August 2019. The DWMS 2019 (VIRIDIS 2019) supersedes the DWMS 2014 (AECOM 2014).

Council has developed this report to provide an annual review of the performance of its water supply systems, for the reporting period 1 July 2019 to 30 June 2020. This report addresses the ADWG requirements for continuous evaluation and review of Council’s DWMS and the water supply systems.

2. Scheme Summary

Kempsey Shire Council is located on the north coast of NSW, covering an area of 3,380 square kilometres, between the Pacific Ocean to the east, Five Day Creek in the west, Grassy Head to the north and Kundabung to the south. The Shire encompasses the lower part of the catchment of the Macleay River which extends from the towns of Armidale, Guyra and Walcha from the west to South West Rocks in the east (Figure 2.1).

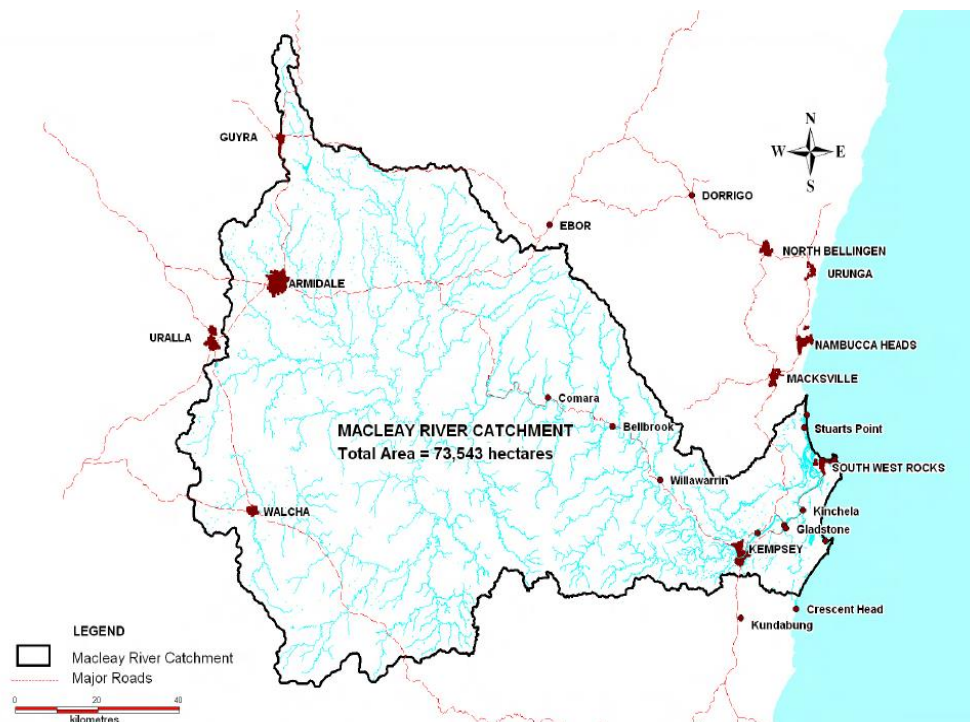


Figure 2.1 Macleay River Catchment

The Council district consists of six (6) town and village centres along the coastal stretch and three (3) villages west along the Macleay River, with its major population centre in Kempsey. The Kempsey Local Government area population, as determined from the 2016 Census, is 28,885 (Census 2016).

Council manages eight (8) water supply systems, providing drinking water to Kempsey and the Lower Macleay, Smithtown, Gladstone, Crescent Head, Hat Head, South West Rocks, Stuarts Point, Willawarrin, Bellbrook and the Thunggutti Aboriginal Community. Figure 2.2 provides a map of each of the supply systems for Council, with Thunggutti located 4km from Bellbrook village.

The Sherwood borefield is recharged from the Macleay River and local rainfall. There are two supply routes for the Kempsey and Lower Macleay (KLM) drinking water that is extracted from the Sherwood borefield. Raw water can supply directly from the Sherwood borefield via the Sherwood Lime Plant (pH adjustment and disinfection) to residents. Alternatively, water can be transferred from the Sherwood borefield to Stuart McIntyre Dam (SMD) Emergency Supply for storage, treatment, and supply to residents.

Drinking water for South West Rocks, Hat Head and Crescent Head is sourced from groundwater extracted from the Macleay Coastal Sands Aquifer, which is recharged by rainfall. Drinking water for Stuarts Point is supplied by a separate coastal aquifer and is also recharged by rainfall.

Bellbrook and Willawarrin drinking water is sourced from the Macleay River; Thunggutti drinking water is sourced from the Nulla Nulla Creek, a tributary of the Macleay River. Water is extracted for these supplies through shallow bores within or at the river/creek edge.

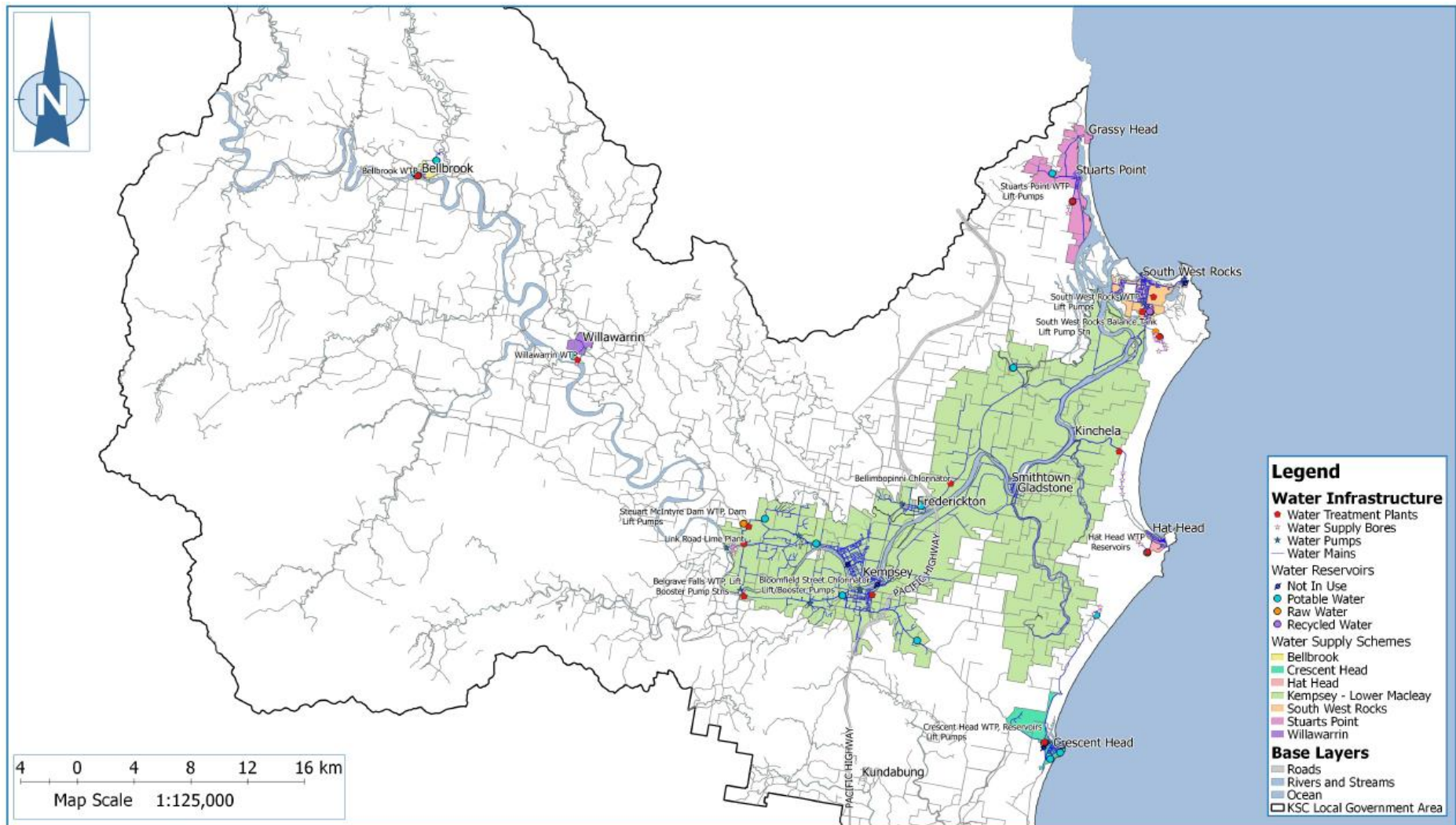


Figure 2.2 Kempsey Shire Water Supply Schemes

Table 2.1 provides a summary of each of the water supply systems and the upgrades that have occurred, or items planned during the reporting year. A detailed description of each supply system can be found in Council's DWMS (VIRIDIS 2019).

Table 2.1. Summary of Kempsey Shire Council Drinking Water Supply Systems

Supply System	Source Water	Treatment	System upgrades in 2019/20
Kempsey and Lower Macleay	Steuart McIntyre Dam	Chlorine (Sodium hypochlorite) dosing.	Installation of EnviroSonic ES300 - Ultrasound Algae Control on SMD
	Sherwood (Bypass of Dam)	Gas chlorine for disinfection and lime dosing for pH correction.	Working on application for Section 60 Endorsement for Option assessment and procurement for preparation of Concept Design.
Crescent Head	Groundwater, Maguires Crossing	Lime and CO ₂ dosing for increasing alkalinity and pH correction. Gas chlorination for disinfection.	Working on application for Section 60 Endorsement options Decommissioning of the Temporary Storage Tank to facilitate Construction of New WTP.
Hat Head	Groundwater, Hat Head National Park	Aerator for iron removal, soda ash for pH correction and chlorine gas for disinfection.	No additional upgrades
South West Rocks	Groundwater, Hat Head National Park	Aeration, membrane filtration, lime for pH correction, chlorine (sodium hypochlorite) and fluoridation.	IWCM plan development continuing for long term upgrade strategy. Membrane renewal and associated system modifications
Stuarts Point	Groundwater	Ferric dosing for coagulation and Iron and arsenic removal, sand filtration and chlorine gas for disinfection.	No additional upgrades
Willawarrin	Surface water from Macleay River (bore on edge of river for gravel bed extraction)	Chlorine (sodium hypochlorite) dosing.	Planning and commencement of Land Acquisition for design and Construction of a new WTP.
Bellbrook	Surface water from Macleay River (bore within river for gravel bed extraction)	Multi-media filtration including arsenic removal, soda ash for pH correction and chlorine (sodium hypochlorite) dosing.	Commencement planning of WTP augmentation
Thunggutti	Surface water from creek (bore on edge of river for gravel bed extraction)	Chlorine (sodium hypochlorite) dosing.	No additional upgrades

3. DWMS Document Review

The NSW Guidelines for DWMS require that all water suppliers review their DWMS and major components on an annual basis. The DWMS Annual Water Quality Report ensures that Council manages its DWMS as a quality system and demonstrates continuous review and improvement of the system.

Councils DWMS Risk Management Team undertakes annual reviews on the DWMS Risk Register and the DWMS Implementation Plan (IP). VIRIDIS Consultants commenced facilitation of the four yearly external review of Councils DWMS this included DWMS Documentation in May 2018. This was finalized in June 2019 and adopted by Council in August 2019.

Table 3.1 DWMS Document Revision History

Document	Version	Updates	Submitted to NSW Health?
DWMS	3	Thunggutti Water supply added, C.t. calculations completed, updated WQ & customer enquiry analysis, updated Risk Assessment, Implementation Plan & CCP Procedures	Submitted to LPHU - May 2016
	4	New DWMS Overall Manual and new DWMS Subplans for each supply. All systems c.t calculation verified and updated schematics, includes data analysis review and CCPs updated. Review and updated of Risk Register and Improvement Plan.	Submitted to LPHU - June 2019
CCP Procedures Crescent Head	V1	Updated as per 2015 Audit review outcomes	Submitted to LPHU in DWMS – May 2016
	V2	Draft CCP 2 (disinfection) changed to Free Chlorine instead of chloramination, July 17.	No
	V3	CCP ID numbering aligned with specific Control Point. Aligned pH alert level lower limit to <6.8. Adjusted Turbidity CCP limits for raw water.	Submitted to LPHU - June 2019
Hat Head	V1	Updated as per 2015 Audit review outcomes	Submitted to LPHU in DWMS – May 2016
	V2	CCP ID numbering aligned with specific Control Point. Aligned pH alert level lower limit to <6.8.	Submitted to LPHU - June 2019
South West Rocks	V1	Updated as per 2015 Audit review outcomes	Submitted to LPHU in DWMS – May 2016
	V2	CCP ID numbering aligned with specific Control Point. Aligned pH alert level lower limit to <6.8. Removed New Entrance reservoir and network as testing locations for Fluoridation CCP. Changed Disinfection CCP testing location from reservoir inlet to Reservoir Outlet to meet C.t.	Submitted to LPHU - June 2019
Stuarts Point	V1	Updated as per 2015 Audit review outcomes	Submitted to LPHU in DWMS – May 2016
	V2	CCP ID numbering aligned with specific Control Point. Changed Disinfection CCP testing location from CWT to Reservoir Outlet to meet C.t.	Submitted to LPHU - June 2019
Kempsey & Lower Macleay	V1	Updated as per 2015 Audit review outcomes	Submitted to LPHU in DWMS – May 2016
	V2	CCP ID numbering aligned with specific Control Point. Aligned pH alert level lower limit to <6.8 for “Sherwood Lime Plant in Use”. Development of Water Quality emergency protocols for supply transfer between Sherwood borefield and SMD	Submitted to LPHU - June 2019
Willawarrin	V1	Updated as per 2015 Audit review outcomes	Submitted to LPHU in DWMS – May 2016
	V2	CCP ID numbering aligned with specific Control Point.	Submitted to LPHU - June 2019
Bellbrook	V1	Updated as per 2015 Audit review outcomes	Submitted to LPHU in DWMS – May 2016
	V2	CCP ID numbering aligned with specific Control Point.	

			Submitted to LPHU - June 2019
Thungutti	V1	Updated as per 2015 Audit review outcomes	Submitted to LPHU in DWMS – May 2016
	V2	CCP ID numbering aligned with specific Control Point. Notes: updated regarding C.t for water supplied directly to consumers in high demand times.	Submitted to LPHU - June 2019
Risk Assessment	V1	Kempsey and Lower Macleay system risks added to a risk register 2012 Bellbrook, Willawarrin, Crescent Head, Hat Head, South West Rocks and Stuarts Point supplies added to risk register 2014 Updated as per Thungutti Water Supply Risk assessment. 2016	Unknown Submitted to LPHU as DWMS 2014 Submitted to LPHU in Thungutti workshop outcomes paper and revised DWMS – April 2016
	V2	August 2018 - Rationalised and consolidated the risk register (former separate KLM and separate other supplies registers into one),	LPHU in attendance of review and update of documentation 22 – 23 Aug 2018
	V2.1	Yearly internal review and update by DWMS risk team.	Submitted to LPHU apart of the 2017-2018 Annual Report
	V2.2	Update of risk register on June 2018 with LPHU and DPIE to identify risk with SMD when in use specifically relating to times of Drought for the development SMD Incident Flow Chart and updating CCPs for Dam use	LPHU in attendance of review and update of documentation 28 June 2019
	V2.3	Internal yearly review by Councils DWMS Risk Team September 2019	Submitted to LPHU apart of the 2018-2019 Annual Report
	V2.4	Internal review in June 2020 for the inclusion of the Kinchela Supply into Risk Register for development of CCPs for operational use as required	NO – CCPs and Sub plan still under development awaiting final system report from GHD
	V2.5	Internal yearly review by Councils DWMS Risk Team and Coordinators for Water Maintenance and Water Operations November 2020	Submitted to LPHU apart of the 2019-2020 Annual Report
	Implementation Plan	4	Reviewed in March 2017 to update status of tasks.
5		Reviewed in August 2018 to update status of tasks, Update of formatting and conciliation of duplicated actions. Facilitated by VIRIDIS as a part of the external DWMS review	LPHU in attendance of review and update 22 – 23 August 2018
5.1		Internal annual review by the DWMS risk team November 2018	Submitted to the LPHU as part of the 2017-2018 Annual Report
6		Internal annual review by the DWMS risk team and Coordinators for Water Maintenance and Water Operations and November 2019	Submitted to LPHU apart of the 2018-2019 Annual Report
7		Internal annual review by the DWMS risk team and Coordinators for Water Maintenance and Water Operations Nov 2020 - February 2021	Submitted to LPHU apart of the 2019-2020 Annual Report

4. Critical Control Points

A Critical Control Point (CCP) is defined as an “*activity, procedure or process at which control can be applied, and which is essential to prevent a hazard or reduce it to an acceptable level*” (NSW Ministry of Health 2013). These may be processes such as selective abstraction of raw water, filtration, disinfection or reservoir integrity. For each CCP, a parameter, such as chlorine residual, can be measured to verify the effectiveness of the process or identify when corrective action is required.

Operational Target, Alert Level and Critical Limits are determined for each CCP parameter to identify normal and out of normal operational conditions, where:

- **Operational Target** identifies the normal operational conditions,
- **Alert Level** indicates that the parameter is outside the normal conditions and corrective action may be required.
- **Critical Limit**, if exceeded, indicates that process control has been lost and safe water quality can no longer be guaranteed.

4.1 Data Collection and Monitoring

Monitoring of CCPs is undertaken throughout Council’s eight (8) supply systems, as per the requirements of Council’s Drinking Water Management System (DWMS). System specific CCP Standard Operating Procedures (SOP) Tables (Appendix A) have been established for:

- CCP1 - Abstraction from groundwater (Turbidity),
- CCP1 - Abstraction from Steuart Macintyre Dam (Turbidity along with Algae, Toxins, Taste and Odour)
- CCP2 - Filtration (Turbidity)
- CCP3 - Disinfection (Free Chlorine and pH)
- CCP4 - Fluoridation (South West Rocks at WTP and Gregory St Reservoir)
- CCP5 - Reservoirs (Reservoir Integrity)

Monitoring includes sample collection and analysis using laboratory and field instruments and real-time monitoring of online instrumentation for pre and post treated water (Table 4.1). Council’s telemetry system (ClearSCADA) additionally enables operators to remotely monitor the treatment plants and online instrumentation. Where online probes are used for monitoring, manual tests, calibration, and routine maintenance are undertaken to ensure the online probes are reading correctly.

Algae, along with Methylisoborneol (MIB) & Geosmin (Taste and Odour), samples are collected by Council on a routine basis. This sampling program, designed in 2016 and updated in June 2019, considers local conditions, historic data and aligns with the Blue-Green Algae Alert Level Framework. Samples are sent to the Port Macquarie-Hastings Council Laboratory for analysis.

Table 4.1 Critical Control Point Parameters, Locality and Monitoring Frequency for Councils' Eight Supply Systems

System	Critical Control Point	Parameters	Monitoring Location	Monitoring Frequency
Kempsey and Lower Macleay	KLM CCP1	Turbidity	Combined Raw water (Bores)	Continuous (online) & daily (Sherwood and SM Dam in use)
	KLM CCP1	Turbidity	Raw Water SM Dam active pump transfer pump	Daily (when SM Dam in use)
	KLM CCP1	Algae Biovolume, MIB & Geosmin	SM Dam tower and SM Dam sites 1, 2 and 3	Weekly/ fortnightly/ Monthly based on BGA Alert level framework (when SM Dam in use)
	KLM CCP3	Free Chlorine & pH	Greenhill Reservoir Outlet Greenhill, John Lane and Potters Hill Reservoir Outlets	Daily (Sherwood in use) Daily (SM Dam in use)
	KLM CCP5	Tank integrity	All Reservoirs ((6)	Monthly
Crescent Head	CH CCP1	Turbidity	Raw Water at Front Dam	Daily
	CH CCP3	Free Chlorine & pH	Back Beach Reservoir Outlet	Daily
	CH CCP5	Tank integrity	All Reservoirs (2)	Monthly
Hat Head	HH CCP1	Turbidity	Combined Raw Water – Inlet to plant	Daily
	HH CCP3	Free Chlorine & pH	Clear Water Leaving plant	Daily
	HH CCP5	Tank integrity	Reservoirs	Monthly
South West Rocks	SWR CCP1	Turbidity	Combined Raw Water – Inlet to plant	Continuous (online) & Daily
	SWR CCP2	Turbidity	Post Filtration at outlet leaving plant	Continuous (online) & Daily
	SWR CCP3	Free Chlorine & pH	Gregory St Reservoir Outlet	Daily
	SWR CCP4	Fluoride	Clear water leaving plant and Gregory St Reservoir outlet	Continuous (online) & Daily Daily
	SWR CCP5	Tank integrity	Reservoirs	Monthly
Stuarts Point	SP CCP1	Turbidity	Combined Raw Water – Inlet to plant	5 days/week
	SP CCP2	Turbidity	Post filtration at inlet to CWT	Continuous (online), 5 days/week
	SP CCP3	Free Chlorine	Stuarts Point Reservoir outlet	Continuous (online) & Daily
	SP CCP5	Tank integrity	Reservoirs	Monthly
Willawarrin	WW CCP1	Turbidity	Combined Raw water into plant	Daily
	WW CCP3	Free Chlorine	Willawarrin Reservoir outlet	Continuous (online) & Daily
	WW CCP5	Tank integrity	Reservoirs	Monthly
Bellbrook	BB CCP1	Turbidity	Raw water pre raw water tank	Continuous (online), 5 days/week
	BB CCP2	Turbidity	Post filtration before inlet to CWT	5 days/week
	BB CCP3	Free Chlorine & pH	CWT outlet	Continuous (online), 5 days/week
	BB CCP5	Tank integrity	Reservoirs	Monthly
Thunggutti	TH CCP1	Turbidity	Raw water inlet to plant	Continuous (online), 5 days/week
	TH CCP3	Free Chlorine	Thunggutti Reservoir outlet	Continuous (online), 5 days/week
	TH CCP5	Tank integrity	Reservoirs	Monthly

4.2 Non-Compliant Data

The CCP exceptions, either Alert Level or Critical Limit, are managed by the Water Operators by undertaking corrective actions following the CCP SOP Tables (Appendix A) and through communications with the Team Leader Water Treatment.

Water Operators enter operational monitoring results into Councils WaterOutlook data management system specific to each supply. If a result entered is outside of the Targeted CCP operational range WaterOutlook automatically records and notifies via email the Water Operators and Water Management team of the CCP exception (either Alert Level or Critical Limit). This email notification triggers the Water Operator to complete an "Incident Report" also within WaterOutlook.

WaterOutlook assigns the incident report an "Incident Batch Number" for future reference and sends out an email copy of the report to the Water Operators and the Water Management Team. The incident report provides a record of the reason for the exception, the corrective actions undertaken and whether any further actions are required to ensure this exception does not occur again.

WaterOutlook tabulates CCP exceptions in each supply into "Monthly Run Reports", these reports are further tabulated within WaterOutlook to produce "Water Quality Special Reports". The Water Quality Special Reports displays all monthly exceptions for each supply into a single table, tabulates a combined CCP monthly total and a running "year to date" (financial year) total. The CCP tables are used for reporting purpose to Council Management and to external stakeholders as required (Annual DWMS Water Quality report).

For reporting purposes Alert Levels and Critical Limits are recorded as a discrete number, i.e., once a CCP falls outside of the Alert Level range and is in the Critical Limit range it is recorded at a Critical Limit only and is not counted in the Alert Level totals.

4.3 Reporting

In 2019-2020 one-hundred and nine (109) CCP exceptions were reported. A reduction of one-hundred and ninety-nine (199) CCPs compared to the previous 2018-2019 report year.

One-hundred and four (104) being Alert Level and five (5) Critical Limit exceptions from seven-thousand, one hundred and eighty-five (7185) tests (Table 4.2).

Of Councils' eight (8) water supply systems, six (6) systems experienced CCP exceptions.

CCP exceptions for the year are discussed for the supply systems in which they occurred in, with reference to the details provided in Table 4.2.

CCP SOP tables for each supply system are provided in Appendix A.

Table 4.2 Summary of Councils' supply systems total 2019-2020 yearly Critical Control Point exceptions with comparison to 2018-2019 totals

Supply System	CCP Numbers	Control Point	Hazard	Control Parameter	2018-2019			2019- 2020			CCP reduced/Increased from previous year				
					Alert Level	Critical Limit	Total No samples	Alert Level	Critical Limit	Total No samples	Alert Level	Critical Limit	Combined Total		
Kempsey and Lower Macleay	KLM CCP1	Raw Water Abstraction (Bores)	All Pathogens	Turbidity	0	0	329	0	0	220	-	-	-		
	KLM CCP1*	Raw Water Abstraction (SMD)	All Pathogens	Turbidity	0	0	17	4	0	335	+4	-	+4		
	KLM CCP1*	Raw Water Abstraction (SMD)	Toxins	Algae	Biovolume	0	0	3	5	2	48	+5	+2	+7	
				Taste & Odour	MIB		0	N/A	3	6	N/A	48	+6	-	+6
					Geosmin		0	N/A	3	4	N/A	48	+4	-	+4
	KLM CCP3*	Disinfection (SMD)	Chlorine sensitive pathogens	Chemicals	Free Chlorine	21	0	36	0	0	680	-21	-		
					pH	0	0	36	16	0	680	+16	-		
	KLM CCP3**	Disinfection (Bores)	Chlorine sensitive pathogens	Chemicals	Free Chlorine	2	0	339	0	0	8	-2	-	-2	
					pH	29	0	339	0	0	8	-29	-	-29	
	KLM Combined Total					52	0	1105	35	2	1979	-23	+2	-15	
KLM CCP % to number of Samples					4.7%	0%	4.7%	1.8%	0.1%	1.9%					
Crescent Head	CH CCP1	Raw water Abstraction Front Dam Rising Main***	All Pathogens	Turbidity	68	3	209	16	0						
					107	0	357			326	-159	-3	-162		
				Sub Total	175	3	566								
	CH CCP3	Disinfection	Chlorine sensitive pathogens	Chemicals	Free Chlorine	57	2	362	3	0	694	-54	-2	-57	
					pH	4	0	362	22	0		+18	-	+18	
CH Combined Total					236	5	1290	41	0	1020	-195	-5	-200		
CH CCP % to number of Samples					18.2%	0.3%	18.5%	4.0%	0%	4.0%					

Supply System	CCP Numbers	Control Point	Hazard	Control Parameter	2018-2019			2019- 2020			CCP reduced/Increased from previous year			
					Alert Level	Critical Limit	Total No samples	Alert Level	Critical Limit	Total No samples	Alert Level	Critical Limit	Combined Total	
Hat Head	HH CCP1	Raw Water Abstraction	All Pathogens	Turbidity	0	0	260	0	0	202	0	-	0	
	HH CCP3	Disinfection	Chlorine sensitive pathogens	Free Chlorine	0	0	260	0	0	228	-	-	-	
					0	0	260	7	0	228	+7	-	+7	
	HH Combined Total					0	0	780	7	0	658	+7	-	+7
	HH CCP % to number of Samples					0%	0%	0%	1.1%	0%	1.1%			
South West Rocks	SWR CCP1	Raw Water Abstraction	All Pathogens	Turbidity	0	0	236	0	0	333	-	-	-	
	SWR CCP2	Filtration	All Pathogens	Turbidity	0	0	234	0	0	327	-	-	-	
	SWR CCP3	Disinfection	Chlorine sensitive pathogens	Free Chlorine	4	0	352	0	0	309	-4	-	-4	
					0	0	325	0	0	309	-	-	-	
	SWR CCP4	Fluoridation	Chemical	Fluoride	1	0	997	0	0	578	-1	-	-1	
	SWR Combined Total					5	0	2144	0	0	1856	-5	-	-5
SWR CCP % to number of Samples					0.2%	0%	0.2%	0%	0%	0%				
Stuarts Point	SP CCP1	Raw Water Abstraction	All Pathogens	Turbidity	0	0	245	0	0	211	-	-	-	
	SP CCP2	Filtration	All Pathogens	Turbidity	0	0	245	0	0	238	-	-	-	
	SP CCP3	Disinfection	Chlorine Sensitive pathogens	Free Chlorine	0	0	245	0	0	220	-	-	-	
	SP Combined Total					0	0	735	0	0	669	-	-	-
	SP CCP % to number of Samples					0%	0%	0%	0%	0%	0%			
Willawarrin	WW CCP1	Raw Water Abstraction	All Pathogens	Turbidity	1	1	272	2	0	56	+1	-1		

Supply System	CCP Numbers	Control Point	Hazard	Control Parameter	2018-2019			2019- 2020			CCP reduced/Increased from previous year		
					Alert Level	Critical Limit	Total No samples	Alert Level	Critical Limit	Total No samples	Alert Level	Critical Limit	Combined Total
	WW CCP2	Disinfection	Chlorine sensitive pathogens	Free Chlorine	2	0	293	0	0	125	+2	-	+2
	WW Combined Total				3	1	565	2	0	181	-1	-1	-2
	WW % to number of Samples				0.4%	0.1%	0.5%	1.1%	0%	1.1%			
Bellbrook	BB CCP1	Raw Water Abstraction	All Pathogens	Turbidity	0	0	273	2	0	125	+2	-	+2
	BB CCP2	Filtration	All Pathogens	Turbidity	0	0	287	0	0	45	0	-	0
	BB CCP3	Disinfection	Chlorine Sensitive pathogens	Free Chlorine	6	0	287	4	0	138	-2	-	-2
								1	0	138	+1	-	+1
	BB Combined Total				6	0	847	7	0	446	+1	-	+1
BB % to number of Samples				0.7%	0%	0.7%	1.6%	0%	1.6%				
Thungutti	TH CCP1	Raw Water Abstraction	All Pathogens	Turbidity	0	0	279	1	3	149	+1	+3	+4
	TH CCP2	Disinfection	Chlorine sensitive pathogens	Free Chlorine	0	0	272	11	0	227	+11	-	+11
	TH Combined Total				0	0	551	12	3	376	+12	+3	+15
	TH % to number of Samples				0%	0%	0%	3.2%	0.8%	4.0%			
All Supply Systems	Total Sum all Critical Control Points				302	6	7657	104	5	7185	-198	-1	-199
	% to number of Samples				3.9%	0.1%	4.0%	1.4%	0.1%	1.5%			

Note 1: Multiple exceptions occurring on the same day are recorded as discrete events at each CCP point as they occur. The Total Alert Level, Critical Limit and Combined Yearly Total is the sum of each discrete exception occurrence on any given day from each individual category.

Note 2: Once a CCP exceeds the Alert Level value it is recorded at a Critical Limit only and is not counted in the Alert Level totals.

Note 3: * KLM CCP1 (SMD) – 2018-2019 in use for 18 days : 2019-2020 in use for 358 days

Note 4: ** KLM CCP3 (Bores) - 2018-2019 in use for 347 days : 2019-2020 in use for 8 days

Note 5: *** CH CCP1 Rising main removed as a CCP location in 2019 DWMS review & adoption.

4.3.1 Kempsey and Lower Macleay (KLM) Supply System

Thirty-five (35) Alert Level and two (2) Critical Limits exceptions occurred from one-thousand, nine-hundred and seventy-nine (1979) samples (Table 4.2). The two (2) Critical Limit exceptions were observed at the Raw Water Abstraction CCP1 SMD for Algae Biovolume and discussed in Section 8, Water Quality Incident or Emergency.

All Alert Level exceptions occurred whilst the KLM supply was sourced from SMD; and thirty-one (31) of these occurred during a period of drought.

- KLM CCP1 SMD MIB x 6
- KLM CCP1 SMD Geosmin x4
- KLM CCP1 SMD turbidity x 4
- KLM CCP1 SMD Algae Biovolumes x 5
- KLM CCP1 SMD pH x 16

Ten (10) Taste and Odour Alert Level exceptions were recorded (results >2 ng/L); four (4) Geosmin and six (6) MIB. The Geosmin Alert Level exceptions were reported from samples collected on 17 September 2019 (3ng/L) and 1, 9 and 15 October 2019 (4 ng/L, 6 ng/L and 5 ng/L respectively). MIB Alert Levels were from weekly samples collected over a six (6) week period from 21 January to 25 February 2020; (4ng/L, 5ng/L, 7ng/L, 6ng/L, 5ng/L and 3ng/L respectively). Taste and Odour Alert Levels are set for aesthetic qualities only and are not health related. The ten (10) Taste and Odour Alert Levels occurred during a drought event (refer to Section 8 Water Quality incident and emergency), Council monitored the weekly results whilst supply was sourced from SMD, changing supply to the Sherwood Borefield was not an option.

Two (2) of five (5) KLM CCP1 SMD Algae Biovolume Alert Levels occurred on the 21 Jan 2020 ($0.3 \text{ mm}^3\text{L}^{-1}$) and 11 February 2020 ($0.22 \text{ mm}^3\text{L}^{-1}$). Algae Biovolume levels were reported at below detection level from Laboratory results from samples collected on the 18 February 2020 and remained below the Alert Level of $0.2 \text{ mm}^3\text{L}^{-1}$ until May 2020.

A single Alert Level Turbidity CCP (KLM CCP1 SMD) of 3.13 NTU occurred on the 6 January 2020; the CCP returned within target the following day and no further action was taken apart from monitoring daily operation testing at this CCP location.

The remaining three (3) Alert Level Turbidity CCP (KLM CCP1 SMD) occurred in June 2020; 12, 16 and 17 with results of 3.18 NTU, 3.33 NTU and 3.63 NTU respectively. The Turbidity alerts were caused from increasing Algae Biovolumes within SMD that started to occur in mid May 2020 (Appendix B graphs). The Algae Biovolume reached Alert Level in May and continued to rise to a Critical Limit in June. This event is discussed in Section 8 Water Quality Incidents and Emergency which lead to the change of supply from SMD to the Sherwood Borefield.

Sixteen (16) pH Alert Level exceptions were reported. Four (4) pH CCPs occurred at the Greenhill reservoir and twelve (12) at the John Lane reservoir. The exceptions range from 8.01 pH to 8.17 pH with fifteen (15) occurring during drought conditions. SMD supply currently does not have pH correction. Next internal review of the DWMS will address the omission of pH when supply is from SMD.

4.3.2 Crescent Head Supply System

The Crescent Head supply had a significant reduction in the total number of CPPs exceptions from the 2018-2019 reporting year. Alert Level CCPs were reduced by one-hundred and ninety-five (195) from two-hundred and thirty-six (236) exceptions to forty-one (41) (Table 4.2).

No Critical Limits exceptions were recorded in 2019-2020, a reduction of five (5) instances from 2018-2019 (Table 4.2).

The dramatic reduction in Alert CCPs is attributed to the adoption and implementation of Councils updated DWMS 2019; historically, Council had been reporting on two abstraction (turbidity) CCP locations; raw water from the front dam and treated water from the rising main to the Back Beach reservoir. The latter (water that is chlorinated, and pH adjusted) does not meet the objectives of a raw water abstraction CCP and was removed. Though the adoption of the DWMS 2019 has decreased the overall number of Alert Level CCPs, at CCP3 Disinfection pH numbers increased; this is discussed below.

The Forty-one (41) Alert Level exceptions occurred from one-thousand and twenty (1020) samples. Sixteen (16) Turbidity exceptions from the Raw Water Abstraction Control Point (Front Dam); Three (3) Free Chlorine and twenty-two (22) pH exceptions at the Disinfection Control Point (Back Beach reservoir) (Table 4.2).

In February 2020 drought breaking rains occurred, and the region began to experience more frequent rain for the rest of the reporting year. Runoff into the Front Dam from more frequent wet weather exacerbated the already naturally high turbid waters abstracted from the Maguire's Crossing Bore field. Fifteen (15) of the sixteen (16) Alert level CCP1 Turbidity expectations coincided with rain with the single non rain influenced exception of a marginal Alert Level of 4.09 NTU (Alert Level occurring at > 4.00 NTU) occurred on the 3 September 2019. Rain influenced exceptions details are:

- 3mm on the 12 January 2020 returned result of 4.33 NTU 13 January 2020
- 471mm between 6 to 27 February 2020 had six (6) exceptions during this period; minimum of 4.35 NTU and maximum of 4.99 NTU
- 184mm between 23 to 31 March 2020 and 37.5 mm between 4 and 11 April 2020 had five (5) exceptions during this period; minimum of 4.20 NTU and maximum 4.47 NTU
- 5mm over 26 and 27 May 2020 returned Turbidity of 4.38 NTU on 27 May 2020

The naturally occurring high Turbidity at abstraction also influences the Operational Targets of other parameters including Free Chlorine and pH. The three (3) Free Chlorine Alert Level exceptions were all in the lower alert level range (>0.5mg/L - <0.7mg/L). Two (2) of which coincided with the rain event in February 2020.

On the 8 and 9 of February 2020 Free Chlorine dropped to 0.68mg/L and 0.67 mg/L respectively; combined factors of increased Turbidity in the Front Dam, along with chlorine decay in the reservoir due to lower water consumption. Corrective actions involved manually increasing chlorine levels in the Back Beach reservoir by adding 8 Calcium Hypochlorite pills along with 5 litres of Sodium Hypochlorite and monitoring Free Chlorine levels in the network.

The low chlorine event on the 27 April 2020 (0.61mg/L) was caused by low water consumption with the service reservoir not required filling for more than 24 hours. Decay in chlorine resulted in levels dropping below the minimum Operational Target. Apart from monitoring Free Chlorine residuals in the network, the automated fill trigger level was imminent and Free Chlorine residuals returned to operational target upon the reservoir fill.

Previously the Alert Level for pH for the Crescent Head supply was > 8.3 pH with no lower pH Alert level set. The updated DWMS 2019 standardised pH Operational Targets, Alert levels and Critical Limits across all of Councils water supply systems, this standardisation lowered the upper pH Alert level in this supply from >8.3 pH to >8.00 pH resulting in a larger capture of pH Alert Limits then previous reporting years (Table 4.2).

All twenty-two (22) pH exceptions occurred in the upper Alert Level range and are the result of balancing this supply systems raw water that is naturally low in pH (yearly average 6.50 pH) against maintaining the water at an optimal Total Alkalinity of between 30 ppm and 40 ppm. To achieve this, lime is dosed to increase pH after the Front Dam storage, Carbon Dioxide (CO₂) gas is injected into the water to lower the increase buffering effect of the lime to achieve desired Total Alkalinity range. At times, this balancing act pushes pH into the upper Alert Level range.

Ongoing corrective action to mitigate the high Turbidity whilst balancing Free Chlorine and pH within the Crescent Head supply system, includes continuous monitoring of the borefield to determine the best bore for water extraction, continuous monitoring of Front Dam and network and gravity feed to the Front Dam from the borefield. Geofabric bags were installed prior to the Front Dam in January 2019 to help further reduce Turbidity inputs. Future proposed action is to include a pre-treatment process of the source water from Maguires with membranes and Granular Activated Carbon (GAC) for suspended solids and organics removal. Construction of a Water Treatment Plant for Crescent Head is in the design planning stage.

4.3.3 Hat Head Supply System

No Critical Limit exceptions occurred in the Hat Head supply during the 2019-2020 reporting year (Table 4.2).

There were seven (7) Alert Level exceptions during 2019-2020 from six-hundred and fifty-eight (658) samples (Table 4.2). This was an increase of seven (7) from 2018-2019. All Alert Level exceptions occurred at CCP3 Disinfection (pH). This is a 1.1% increase from the previous reporting year.

Similarity to the Crescent Head supply pre implementation of DWMS 2019 the Hat Head supply for pH only had one pH CCP criteria. In the Hat Head supply opposed to the Crescent Head supply this was for the low pH (Alert Level <6.9 pH and Critical Limit <6.5 pH). The DWMS 2019 rectified this with both lower and upper pH Alert Level and Critical Limits being reported on (refer to Appendix A: Table A.3.2).

Two (2) Alert Level pH in the upper pH range was recorded on the 3 and 4 October 2019 (8.22 pH and 8.05 pH respectively). Corrective actions taken on the 3 October was adjustment (lowering) the dosing rate into soda ash tank 1, pH returned to operational target over the next 48hours.

Five (5) Alert Level pH in the lower pH range was reported in early 2020

- January
 - 27/01/2020 = 6.73 pH
 - 28/01/2020 = 6.73 pH
 - 30/01/2020 = 6.61 pH
- February
 - 05/02/2020 = 6.65 pH
 - 21/02/2020 = 6.77 pH

Corrective action for the exceptions in January included soda ash adjusting from 48 to 51 on the 27 January with further increased adjustment on the 30 January from 51 to 65. The injection port was inspected and daily monitoring continued post aeration tank; pH returned to operational target on the on the 31 January (6.81 pH).

Early February pH began to drop again, on 5 February corrective actions included the switch over to soda ash tank No2, whilst No 1 tank was drained and re-batched to stabilise the system.

The exception on the 21 February was caused from a blockage in the dosing line that had occurred (and cleared) the previous day. The system self-corrected over the next 24hours.

4.3.4 South West Rocks Supply System

No Critical Limit or Alert Level exceptions occurred in the South West Rocks supply during the 2019-2020 reporting year (Table 4.2). This is a 0.2% reduction from the previous reporting year.

4.3.5 Stuarts Point Supply System

No Critical Limit or Alert Level exceptions occurred in the Stuarts Point supply during the 2019-2020 reporting year (Table 4.2). This supply has not recorded any exceptions for the past two reporting years.

4.3.6 Willawarrin Supply System

No Critical Limit exceptions occurred in the Willawarrin supply during the 2019-2020 reporting year (Table 4.2).

The Willawarrin supply had two (2) CCP Alert Level exceptions, from one-hundred and eighty-one (181) samples, one (1) less reported from the previous reporting year (Table 4.2).

Both Alert Level exceptions occurred at CCP1 Abstraction (Turbidity) whilst Bore 3 was in use (31 August 2019 and 2 September 2019; 1.19 NTU and 1.08 NTU respectively). The persistent and ongoing drought conditions in 2019 started to impact upriver water supplies with both the availability of water and the quality of the water. Water abstraction was changed from Bore 3 to Bore 1 on 10 September due to the lower Turbidity, Iron and Arsenic concentrations within Bore 1. Bore 1 remained in used until 2 October, then water carting commencement (supplied by KLM system) due to the deterioration of water quality that included the consistent breakthrough of Iron and Manganese into the network that was above aesthetic ADWG. Water Carting remained in place for two-hundred and sixty-one (261) days until 18 June 2020. Further details about the drought are discussed in section 8 Water Quality Incident or Emergency.

4.6.7 Bellbrook Supply System

No Critical Limit exceptions occurred in the Bellbrook supply during the 2019-2020 reporting year (Table 4.2).

Seven (7) Alert Level CCP were recorded across multiple CCP locations from four-hundred and forty-six samples (446), an increase of one (1) from the previous reporting year (Table 4.2).

Two (2) Alert Level CCP1 Abstraction (Turbidity) were reported on the 28 and 29 October 2019 (9.32 NTU and 6.34 NTU respectively). A small amount of rain the previous week in the upper reaches of the catchment caused the increase in Turbidity, where the water operator followed SOP procedures to ensure that no breakthrough in the filtration system entered the network. Turbidity levels

returned to Operational Targets the following day (3.36 NTU). This WTP has automatic interlocks that shut the plant down if Turbidity levels reach the Critical Limit of 20 NTU.

Five (5) CCP3 Disinfectant (Free Chlorine = 4 and pH = 1) were reported during the 2019-2020. Two (2) low Alert Level Free Chlorine exceptions occurred on 22 October 2019 (0.99 mg/L) and on 14 November 2019 (0.93mg/L). For both instances Free Chlorine concentrations had fallen just below the lower Alert Level of <1 mg/L; Water Operator followed CCP SOP that included checking dosing equipment and confirming adequate disinfection throughout the network. Two (2) high Alert Level Free Chlorine of 3.7mg/L were reported late in the reporting year on 26 and 30 of June 2020. On 24 June correspondence was sent to the water team from the attending Water Operator informing that the plant was being turned off overnight due to issues with the analyses and Manganese levels over design specifications, the Water Operator also had concerns about low chlorine residuals in the network. Chlorine dosing rate to the Clear Water Tank was increased on 25 June after the plant was turned off overnight to combat increases in Manganese and hence increased Turbidity, Free Chlorine residues leaving the reservoir between the 26 and 30 of June had an average of 1.6 mg/L. Chlorine dosing pumps were adjusted down on the 30 June 2020.

A single low Alert Level pH CCP (<6.8 pH) exception occurred on the 10 October 2019 of 6.71 pH. Upon inspection of the injection port a small blockage was found and cleared.

4.3.8 Thungutti Supply System

The Thungutti supply had fifteen (15) CCP exceptions that was reported from three-hundred and seventy-six (376) tests. Three (3) exceptions were reported as Critical Limits and discussed in section 8 Water Quality Incident or Emergency. Of the twelve (12) Alert Level exceptions a single CCP1 Abstraction (Turbidity) exception occurred in conjunction with the Critical Limit exceptions and details are also captured in Section 8. The remaining eleven (11) Alert Level exceptions were reported as low Alert Levels (<0.8mg/L) for CCP3 Disinfection (Free Chlorine).

Since Thungutti's incorporation into Councils DWMS in 2016 no CCP exceptions have been reported within this supply. During the 2019 – 2020 reporting, Kempsey Shire along with the rest of NSW endured severe drought conditions. The drought impacted both water quality and quantity in the Thungutti supply. Water carting to Thungutti occurred for forty three (43) days from 10 December 2019 to 21 January 2020; water was sourced from both the Bellbrook and KLM systems.

In mid-November 2019 Bushfires in the region disrupted power supply to the WTP and water carting to the reservoir ensured water supply to the community, after power was restored, balancing chlorine levels was problematic with three (3) exceptions reported on 19 to 22 November and again on the 26 November (lowest result being 0.60 mg/L Free Chlorine on the 19 November). During this period CCP SOPs were followed and adjustment to dosing equipment made. Monitoring of the network during this period confirmed disinfection was maintained.

Three (3) Alert Level exceptions on the 26 and 27 January 2020 (0.46 mg/L and 0.56 mg/L) and 3 February 2020 (0.7mg/L) coincided with power outages. Free Chlorine levels returned to Operational Targets the once power was restored the system self-corrected over a 24hour period. Monitoring of the network confirmed disinfection was maintained to the community.

On 21 February 2020 Free Chlorine residual dropped to 0.54 mg/L from a four (4) day average of 0.85 mg/L. Adjustment to the dosing rate corrected the drop in Free Chlorine and monitoring of the network to confirm maintenance of disinfection.

Two (2) marginal Alert Levels on the 20 and 21 March 2020 (0.79 mg/L and 0.72 mg/L respectively) self-corrected with Free Chlorine levels returning to Operational Targets on the 22 March (0.87 mg/L).

5. Reservoir Inspections

Council has sixteen (16) above ground storage reservoirs. Maintaining Reservoir integrity is included as a CCP for each of Council's water supplies, as this is the last point of contact with the water, where control can be affected prior to the network. Maintaining reservoir integrity is critical to a water supply system, to ensure that no contaminants, such as vermin, stormwater or bird faeces, can freely access the treated stored water. Cleaning and inspection of the reservoirs is crucial to water supply ensuring that the water quality is not contaminated, or sediments are not disturbed.

5.1 Data Collection and Monitoring

Council's reservoirs are inspected on a monthly basis by operational staff who complete the "Reservoir Inspection Check List" that is a function of the WaterOutlook program. Any reported issues trigger email notification to the Water Management Team. Tracking of completed inspections can be viewed in a generated "Reservoir inspection" report which also provides a link to the physical report via individual report batch number.

Reservoirs are also inspected by contractors on a two year rotation, for cleaning and detailed internal and external integrity inspections. These findings are collated, reported and tracked within the contractor's web database "ASAM RT".

5.2 Reporting

Fifteen (15) of the sixteen (16) reservoirs have been inspected and cleaned within the last twenty four months, with the exception of the Green Hill reservoir (inspected only) which is unable to be isolated for cleaning purposes. Table 5.1 lists the findings from the previous and most recent inspections that still require rectification or were rectified in 2019-2020.

Table 5.1 Reservoir Inspection Report Summary

Date	Reservoirs	Findings	Corrective actions
12/05/2015	Crescent Head Big Nobby	Several roof sheets @ 12 o'clock are poorly attached and will blow off in a strong wind event	Completed – Sheets screwed down in 2019
06/08/2019		<p>A lot of the aluminium wire ventilation mesh is corroded and should be replaced when the fascia support sections are upgraded</p> <p>The existing level indicator system needs to be removed to seal the tank against vermin access</p>	Work delayed due to EME radiation hazard
13/05/2015	Stuarts Point	Corrosion present on the internal ladder.	In Progress – Internal Ladder to be replaced/repared in conjunction with in planned internal refurbishment to commence in May 2021.
7/07/2017	Willawarrin	There is no secure compound around the tank.	In Progress - Planning occurring for a WTP at Willawarrin and the construction will include the construction of a secure compound for the WTP and Reservoir. Currently awaiting on land acquisition to build the plant.
12/02/2018	Greenhill	There is no mesh under the roof vents and small birds are entering into the Tank	Mesh was put around vents in 2019-2020
		The two mechanical roof vents need to have mesh fitted to keep out birds and vermin	Work still to be completed
3/08/2019	Potters Hill	The level indicator pulley system needs to be removed to better seal the tank against vermin entry	Level indicator has been sealed 2019-2020
4/08/2019	Hat Head No2	There is corrosion present on the sketch plate area. This needs to be recoated ASAP to prevent further damage from occurring	Work still to be completed
5/08/2019	John Lane	There is significant corrosion appearing around the sketch plate area. The bitumen sealing material is packed too high and water is ponding and contributing to the deterioration	Work still to be completed

6. ADWG and Water Quality Indicators

The Australian Drinking Water Guidelines (ADWG) (NHMRC 2011) provide an authoritative reference that defines what is safe and good water quality and how this can be achieved and assured, using the latest and best available scientific evidence. The ADWG provide detailed information on the measurable characteristics of drinking water, including microbiological, physical and chemical aspects, and these are grouped into two different types:

- A **health guideline** value – that is the concentration or measure of a water quality characteristic that, based on present knowledge, does not result in any significant risk to the health of the consumer over a lifetime of consumption.
- An **aesthetic guideline** value – that is the concentration or measure of a water quality characteristic that is associated with acceptability of water to the consumer, such as, appearance, taste and odour.

Additional Water Quality Indicators (WQI) recommended by NSW Health include Total Coliforms and Free Chlorine residuals. A positive Total Coliforms result when used in operational monitoring, may indicate inadequate treatment, breakdowns in system integrity, or the presence of biofilms. Low Free Chlorine of <0.2mg/L is an indication that disinfection of the system may be compromised or lost.

Fluoride is monitored as per the Fluoridation Code (NSW Health 2018); an overdosing incident is the result of the fluoride concentration exceeding 1.5 mg/L in the treated water entering the network and operational exceptions is defined by any failure to maintain the fluoride concentration above 0.9 mg/L. The ADWG health limit is 5 mg/L.

6.1 Data Collection and Monitoring

Council participates in NSW Health's sponsored Drinking Water Monitoring Program; network monitoring is undertaken on a routine basis to ensure that Council's customers receive safe and acceptable water quality. Council tests drinking water for thirty-two (32) health, aesthetic and other recommended characteristics. These samples are taken from twenty-five (25) sample sites within the Council's area of operation, all of which are post-treatment. The water quality characteristics that are monitored as part of this program are specified by NSW Health. Council liaises with NSW Health regarding the total number of samples required for each supply system and the frequency of collection; a yearly sampling schedule is produced by Council to ensure the expected frequency of sampling is met. Results are recorded in the NSW Drinking Water Database and reported against the ADWG and NSW Health recommended indicators (WQI). A summary of the water quality data for each supply system, obtained directly from the NSW Drinking Water Database, is provided in Appendix C.

In addition to monitoring undertaken as part of NSW Health's Drinking Water Monitoring Program, Council also independently monitors water quality parameters as part of our daily operations (pre- and post-treatment at the water supply systems). Results are recorded within WaterOutlook for each individual supply.

6.2 Non-Compliant data

For the NSW Health sponsored monitoring, NSW Forensic & Analytical Science Services (FASS) Laboratory advises Council immediately via email of any health guideline limit exceptions including positive results for Total Coliforms following sample analysis. For microbiological exceptions Council's standard procedure is to investigate and undertake immediate re-sampling and notify NSW Health Local Public Health Unit (LPHU).

The WaterOutlook application triggers an alert for anomalies found outside of the ADWG and WQI in relation to the daily operations monitoring. Water Operators complete a report within WaterOutlook (cause, action, preventive measures) with email notification sent to the Water Management Team. Monthly ADGW/WQI reports are produced within WaterOutlook that tabulates results into the system that they occurred providing a monthly total with a running “year to date” totals for each supply. External communication to the NSW Health LPHU of daily results is limited to a gross and/or consistent exceedance.

6.3 Reporting

A total of two-hundred and sixteen (216) ADWG and WQI exceptions from both reporting platforms were recorded across Councils’ Water Supply systems (Table 6.1 and 6.2). This is a 26.8% increase from the one hundred and fifty-eight (158) exceptions recorded in the previous reporting year. The main contributing factors to this increase was the change in supply in the KLM system from the Sherwood bore field to SMD along with declining source water quality at the upriver supplies driven by severe drought conditions.

The KLM supply had one-hundred and eighty-four (184) exceptions, Crescent Head seven (7), Hat Head one (1), South West Rocks eight (8), Stuarts Point two (2) and Willawarrin fourteen (14). The Bellbrook and Thunggutti supplies recorded no exceptions in this reporting year (Table 6.1 and 6.2).

The ADWG and WQI exceptions are discussed for the supply systems in which they occurred.

Table 6.1 Total ADWG and NSW Health recommended indicators non-compliant water quality results from NSW Health sponsored Monitoring program 1st July 2019 to 30 June 2020

Supply Area	Parameter								Total
	Total Coliforms *	Free Chlorine**	pH	Turbidity	Fluoride***	Iron	Manganese****	Nickel	
	No detection (WQI)	< 0.2 mg/L (WQI)	< 6.5 – > 8.5 (A)	>5 NTU (H)	<0.9 - >1.2 mg/L (WQI)	≥ 0.3 mg/L (A)	≥ 0.1 mg/L (A) ≥ 0.3 mg/L (H)	≥ 0.02 mg/L (H)	
Kempsey & Lower Macleay	4	14	8	0	N/A	0	0	1	27
Crescent Head	0	3	0	0	N/A	0	0	0	3
Hat Head	1	0	0	0	N/A	0	0	0	1
South West Rocks	0	0	1	0	0	0	0	1	2
Stuarts Point	2	0	0	0	N/A	0	0	0	2
Willawarrin	1	0	0	0	N/A	0	0	1	2
Bellbrook	0	0	0	0	N/A	0	0	0	0
Thunggutti	0	0	0	0	N/A	0	0	0	0
Combined Total	8	17	9	0	0	0	0	3	37

*Total Coliform no ADWG set however a positive result is an indicator for further investigation.

**Free Chlorine no minimum ADWG set however minimum level of 0.2 mg/L recommend for maintaining disinfection.

*** Fluoride levels based on Fluoride code; Health ADWG set at ≥5 mg/L

**** Manganese Aesthetic ADWG reported only

A – Aesthetic ADWG

H - Health ADWG

WQI – No ADWG available, guidelines are based on best practice or codes of practice

Table 6.2 Total ADWG and NSW Health recommended indicators non-compliant water quality from Operational Monitoring program 1st July 2019 to 30 June 2020

Parameter	Chlorine (Free) *	Chlorine (Total)	pH	Turbidity	Fluoride **	Iron	Manganese* **	Totals
Guidelines	< 0.2 mg/L (WQI)	≥ 5 mg/L (H)	< 6.5 - > 8.5 (A)	≥ 5 NTU (H)	< 0.9 - > 1.2 mg/L (WQI)	≥ 0.3 mg/L (A)	≥ 0.1 mg/L (A) ≥ 0.3 mg/L (H)	
Kempsey and Lower Macleay								
Number of Exceedances	96	1	52	8	N/A	0	0	157
Number of Tests	2022	2933	2983	2969	N/A	3	3	10913
Rate of Exceedances	4.75%	0.03%	1.74%	0.27%	N/A	0%	0%	1.44%
Crescent Head								
Number of Exceedances	4	0	0	0	N/A	0	0	4
Number of Tests	730	1075	731	1063	N/A	11	5	3615
Rate of Exceedances	0.55%	0%	0%	0%	N/A	0%	0%	0.11%
Hat Head								
Number of Exceedances	0	0	0	0	N/A	0	0	0
Number of Tests	181	536	307	514	N/A	32	14	1584
Rate of Exceedances	0%	0%	0%	0%	N/A	0%	0%	0%
South West Rocks								
Number of Exceedances	1	0	5	0	0	0	0	6
Number of Tests	571	880	570	866	83	23	19	3012
Rate of Exceedances	0.18%	0%	0.88%	0%	0%	0%	0%	0.20%
Stuarts Point								
Number of Exceedances	0	0	0	0	N/A	0	0	0
Number of Tests	498	718	718	689	N/A	29	29	2681
Rate of Exceedances	0%	0%	0%	0%	N/A	0%	0%	0%
Willawarrin								
Number of Exceedances	1	0	0	0	N/A	0	11	12
Number of Tests	130	443	443	442	N/A	5	13	1476
Rate of Exceedances	0.77%	0%	0%	0%	N/A	0%	84.62%	0.81%
Bellbrook								
Number of Exceedances	0	0	0	0	N/A	0	0	0
Number of Tests	325	325	324	323	N/A	0	0	1297
Rate of Exceedances	0%	0%	0%	0%	N/A	0%	0%	0%
Thungutti								
Number of Exceedances	0	0	0	0	N/A	0	0	0
Number of Tests	21	276	276	274	N/A	0	0	847
Rate of Exceedances	0%	0%	0%	0%	N/A	0%	0%	0%
Totals								
Number of Exceedances	102	1	59	0	0	0	11	179
Number of Tests	4478	7186	6352	7140	83	103	83	25425
Rate of Exceedances	2.28%	0.01%	0.90%	0.11%	0%	0%	13.25%	0.70%

*Free Chlorine no minimum ADWG set however minimum level of 0.2 mg/L recommend for maintaining disinfection.

**Fluoride levels based on Fluoride code; Health ADWG set at ≥ 5 mg/L

*** Manganese Aesthetic ADWG reported only

A – Aesthetic ADWG

H - Health ADWG

WQI –Guidelines are based on Codes of Practice or recommendations from NSW Health

6.3.1 Kempsey and Lower Macleay (KLM) Supply System

The KLM supply had a combined total of one-hundred and eighty-four (184) ADGW and WQI exceptions from the two monitoring program platforms in the 2019-2020 reporting year. An increase of one-hundred and seventy-seven (177) from 2018-2019 and a direct by-product from managing KLM water security during an extreme drought event. For three-hundred and fifty-eight (358) days during 2019-2020 reporting period, the KLM supply was using its emergency reserves water from SMD. Council transferred to this source on 12 June 2019 and did not resume “normal” supply from the Sherwood borefield until 22 June 2020.

Water Quality Challenges of SMD are well documented:

- seasonal algae outbreaks (Appendix B: Figures B.1 and B.2)
- fluctuating Taste and Odour Compounds (up 115 ug/L; Appendix Figure B.2)
- increased Turbidity (correlating to algae blooms)
- high pH

The water quality of SMD challenged Council’s ability of maintaining consistency in the supply within Operational Targets when no pre-treatment facilities are available. Long reaches and the ends of network lines are known problematic areas for low water usage that influences declines in disinfection and increasing pH. Regular flushing helps maintain water Operational Targets; towards the end of 2019 and beginning of 2020 when Council moved into level 2 and Level 3 water restrictions, flushing was reduced to reactive opposed to proactive as a water conservation measure in response to increasing water security pressures from the persistent drought. When drought breaking rains eventuated in February 2020 the KLM supply had a day zero estimated of just over 4 months’ supply remaining.

Exception breakdown for 2019-2020

NSW Health sponsored monitoring program; twenty-seven (27) events (Table 6.1 and Appendix C; Table C.1)

- Four (4) Total Coliforms WQI
 - 17 December 2019; KS01-342 Mid North Cost Correction Centre, result of 22 mpn/100mL
 - 14 and 28 January 2020; KS01-124 SWR Road Jerseyville, result of 4 mpn/100mL and 3 mpn/100 mL respectively
 - 3 March 2020; KS01-128 Aldavilla Zone, result of >200 mpn/100 mL
- Fourteen (14) Free Chlorine WQI <0.2mg/L
 - Events occurring at ends of the network (KS01-124 SWR Road Jerseyville, KS01-126 South Kempsey Service Centre, KS01-348 Settlers way, KS01-127 Euroka Zone)
- Eight (8) pH ADWG aesthetic >8.5 pH
 - Events occurring at ends of the network (KS01-126 South Kempsey Service Centre and KS01-432 Gowings Hill Road)
- One (1) Nickel ADWG health \geq 0.02 mg/L
 - 2 June 2020; KS01-125 Kinchela St (Gladstone), result of 0.0418 mg/L

For each Total Coliform event, Council, upon receiving email notification from FASS, conducted investigations that included confirmation of water quality at the exception locations and from the supply reservoirs. The LPHU was notified and consulted with via phone and followed up email within

24hrs; microbiological resampling was performed at each location. All resample results returned <1 mpn mg/L for both E. coli and Total Coliform; no further action was warranted for each event.

Nickel re-sampling was performed on 16 June 2020 with the result (<0.0066 mg/L) within the ADWG Health Guideline Value of 0.02 mg/L after Council received notification from FASS (11/06/2020). Since 2018 Council has had re-occurring Nickel results above the ADWG from across multiple supply systems. Each re-sample, the results have returned below the ADWG. Ongoing investigations of eliminating potential source of nickel when sampling in the network has included:

- Checking of sample site fittings are non-nickel base coated
- Sampling raw water in the KLM of Nickel levels (KLM supply has had the most re-occurring events with results above the ADWG, including when water carting to other supplies (Willawarrin)
- Eliminating repair works of pipes as a possible source of contamination – cross compared work orders location against sample locations when exceptions been recorded

Council operational monitoring program; one hundred and fifty-seven (157) events (Table 6.2)

- Ninety-six (96) Free Chlorine WQI <0.2mg/L
 - Events occurring at ends of the network (KS01-124 SWR Road Jerseyville, KS01-126 South Kempsey Service Centre, KS01-348 Settlers way, and KS01-127 Euroka Zone)
- One (1) Total Chlorine ADWG health \geq 5 mg/L
 - This event occurred at Potters Hill Reservoir on 27 January 2020 and is discussed in Section 8 Water Quality Incident and Emergency.
- Fifty-two (52) pH ADWG aesthetic > 6.5 pH
 - Events occurring at ends of the network (KS01-126 South Kempsey Service Centre and KS01-432 Gowings Hill Road)
- Eight (8) Turbidity ADWG health \geq 5 NTU
 - Each of the Turbidity events were caused from main breaks. On completion of repairs the service lines were flushed to remove any residual dirty water. Whilst on supply from SMD Turbidity average across the KLM supply was 1.1 NTU.

6.3.2 Crescent Head Supply System

The Crescent Head supply had a combined total of seven (7) WQI exceptions from the two monitoring program platforms in 2019-2020 (Table 6.1 and 6.2); down from twenty-five (25) from 2018-2019.

No bacteriological (Total Coliforms or E.coli) exceptions were reported (Table 6.1 and Appendix C: Table C.2); A reduction of four (4) for events from the 2018-2019.

Three (3) exceptions were reported In the NSW Health Monitoring program in 2019-2020 opposed to the eleven (11) in the previous year. All exceptions were for Free Chlorine WQI (< 0.2 mg/L) (Table 6.1).

Councils operational monitoring program reported a further four (4) Free Chlorine WQI exceptions (Table 6.2).

All exceptions occurred at KS05-321 Loftus Road and KS05-122 Stewart St, Crescent Head. Corrective actions for low Free Chlorine residuals include:

- checking of dosing equipment

- testing reservoir outlets
- flushing of affected mains and monitoring the network downstream of the supply reservoir.

Ongoing high Turbidity and high levels of Dissolved Organic Carbon in the supply from poor source water quality, lack of filtration and long detention times make it difficult to maintain a chlorine residual at the extremities of the mains in the Crescent Head supply.

An NSW Health directive for a regular flushing program of this system has been implemented at Loftus Road to help maintain chlorine levels in the extremities of the network and a yearly pigging program has also been implemented for the Loftus Road service line.

Design tender plans of a multiple barrier filtration WTP for the Crescent Head supply has begun.

6.3.3 Hat Head Supply System

The Hat Head supply had a single exception (Table 6.1 and 6.2). This is an 91% reduction from the previous year's eleven (11) exceptions. The exception, a Total Coliform of 1 mpn/100 ml was reported via the NSW Health sponsored monitoring program from samples collected on the 21 April 2020 at KS08 -124 Caravan Park.

On receiving notification from FASS via email (23/04/2020), Council conducted investigations that included confirmation of water quality at the exception location and from the supply reservoir, LPHU notification via phone and email (23/04/2020), and microbiological resampling conducted. Resample results (dated 27/04/2020) returned <1 mpn mg/L for both E. coli and Total Coliforms; no further action was warranted.

6.3.4 South West Rocks Supply System

The South West Rocks supply had a combined total of eight (8) exceptions from the two monitoring program platforms (Table 6.1 and 6.2); no change from the previous year.

No bacteriological (Total Coliforms or E.coli) exceptions were reported (Table 6.1 and Appendix C: Table C.4); A reduction of three (3) for events from 2018-2019.

The exceptions breakdown is, one (1) Free Chlorine, six (pH) and one (1) Nickel (Table 6.1 and 6.2).

A single pH and the Nickel exception was recorded via the NSW Health Monitoring program

- 19 November 2019; KS07 – 126 Little Bay, pH result of 8.51 pH (marginal - no action taken)
- 1 October 2019; KS07 – 122 Horseshoe Bay, Nickel result of 0.04 mg/L

On receiving email notification from FASS (8/10/2019) and contacting the LPHU, Council arranged resampling (9/10/2019), with these results being reported below the ADWG (0.01mg/L – guideline value of 0.02mg/L). Investigations into re-occurring Nickel events are ongoing as per details outlined in 6.3.1 Kempsey and Lower Macleay Supply.

The remaining six (6) exceptions being reported via Councils operational monitoring all were reported at KS07 – 126 Little Bay.

- Five (5) high range pH (>8.5 pH) between 10 October and 30 October 2019
- One (1) Free Chlorine (0.19 mg/L) on 27 December 2019

KS07 – 126 Little Bay is located at the end of the network and is a known problematic area for low water usage which poses challenges for maintaining disinfection levels and increasing pH due to its long reach. Regular flushing helps maintain water operational targets; towards the end of 2019 and

beginning of 2020 Council reduced flushing to reactive opposed to proactive as a water conservation measure in response to increasing water security pressures from the persistent drought. As a result of the water saving measures, Council saw an increase in pH exceptions at this location.

6.3.5 Stuarts Point Supply System

The Stuarts Point supply had two (2) exceptions during 2019-2020 (Table 6.1 and 6.2), no change from the previous year. Both exceptions were Total Coliforms recorded via the NSW Health monitoring program (Appendix C; Table C.5).

- 22 October 2019; KS06-124 Fishermans Reach, Total Coliform result of 2 mpn/100mL
- 15 April 2020; KS06-123 Grassy Head, Total Coliform result of 1 mpn/100mL

On receiving notification from FASS via email (24/10/2019 and 17/04/2020), Council conducted investigations that included confirmation of water quality at the exception locations and from the supply reservoir; the LPHU was notified via phone and email (24/10/2019 and 17/04/2020). Additional details from the Investigation of the event at Grassy Head, found that the sample location had been isolated due to nearby works in a toilet block and had created a dead end in the line for over a week. The Water Operator had to re-open the valve to perform testing; though the line was flushed prior to sampling the inactivity of use was a likely contributing factor to the positive microbiological result. Microbiological resampling was conducted for both exception events and results (dated 28/10/2019 and 20/04/2020) returned <1 mpn mg/L for both E. coli and Total Coliforms; no further action was warranted.

6.3.6 Willawarrin Supply System

The Willawarrin supply had a combined total of fourteen (14) exceptions during 2019-2020 (Table 6.1 and 6.2), this is a significant reduction from the one-hundred and five (105) exceptions during 2018-2019. The large reduction was due to water carting from the KLM supply for two-hundred and sixty-one (261) days in response to drought impacts of water deterioration, both water quality and quantity of the systems source water. Water carting to this supply commenced on 2 October 2019 to 18 June 2020.

Monitoring from NSW Health program recorded two (2) of the exceptions events (Table 6.1 and Appendix C; Table C.6) a Total Coliform result of 6 mpn/100mL on the 28 April 2020 and a Nickel result of 0.0268 mg/L on the 9 June 2020. Both events occurring at KS04-123 Willawarrin School and whilst the supply was under water carting from KLM system.

In response to the Total Coliform, Council received email notification from FASS (30/4/2020) and began initial responses by reconfirming water quality at the school and from the supply reservoir. LPHU was contacted by phone and email (30/04/2020) and microbiological re-sampling conducted (4/05/2020). Secondary microbiological results return as <1 mpn/100mL for both E. coli and Total Coliforms; no further action was warranted.

Resampling was performed on 23 June 2020 (result of <0.0004 mg/L) for the Nickel event after Council received notification from FASS (17/06/2020) and consulted with LPHU on the same day. An investigation to persistent Nickel exceptions across Council is ongoing.

The remaining twelve (12) recorded exceptions from Councils operational monitoring (Table 6.2) was a single Free Chlorine and eleven (11) Manganese.

The low Free Chlorine WQI (0.06 mg/L) occurred at KS04-123 Willawarrin school on 13 December 2020. Free Chlorine residuals in the supply reservoir had been dropping (0.58mg/L on 12/12/2020 and 0.65mg/L on 13/12/2020). Corrective actions included manual dosing of the reservoir (supply

under water carting) to bring Free Chlorine up to 2.0 mg/L and a flush of the service line at the school.

The eleven (11) Manganese ADWG exceptions; all aesthetic ≥ 0.1 mg/L and not health ≥ 0.5 mg/L, were reported from both the Reservoir outlet and across all the network monitoring locations. The persistence of Manganese and its slow increase in concentration combined with increasing water quality complaints from the residences dictated the move for the commencement and continual water carting to this supply during the drought. Ongoing fortnightly Water Quality testing of the bores where additionally returning iron levels consistently over the aesthetic ADWG (≥ 0.3 mg/L).

Future WTP upgrades are to include filtration options for Manganese and iron removal as well as pH correction.

6.3.7 Bellbrook Supply System

No ADWG or WQI exceptions were recorded in the Bellbrook supply.

Water was carted to this supply intermittently between 9 and 17 November 2019 during the bushfire emergency and for a further one-hundred and fifty eight (158) days from 13 January 2020 to 18 June 2020 due to a combination of Manganese and Iron concentration in the raw water exceeding plant design specifications then increased Turbidity also above the plant design caused from persistent dirty water in the Macleay River from drought breaking rains.

6.3.8 Thungutti Supply System

No ADWG or WQI exceptions were recorded in the Thungutti supply.

Water was carted to this supply intermittently between 9 and 17 November 2019 during the bushfire emergency and for a further thirty three (33) days from 20 December 2019 to 21 January 2020 when Nulla Creek ran dry from drought conditions.

7. Customer Enquiries

Customer enquiries are received by Council's Customer Services Section. Customer enquiries are recorded and saved in Civic View, which automatically notifies the Team Leader Water Process who delegates responsibilities to action as appropriate. Where appropriate, a Water Process Operator will contact the customer, attend the location, undertake sampling and testing and provide feedback to the customer on the results. The operator will then coordinate a response to these results as appropriate to ensure that the drinking water continues to meet the ADWG guidelines and NSW Health recommended indicators.

Table 7.1 provides a summary of the customer enquiries for the KLM water supply and Table 7.2 provides a summary of the customer enquiries for Councils other seven water supply. Appendix D provides descriptors for each supply area within the KLM supply.

Table 7.1 Customer Enquires for the KLM Water Supply System 2019-2020

KLM Supply Areas	Dirty	Air or Cloudy	Taste & Odour	Illness	Loss of Supply	Other	Annual Total
Kempsey	3	0	0	0	1	0	4
West Kempsey	9	0	3	0	3	1	16
Aldavilla	3	2	1	0	6	0	12
Smithtown/Gladstone	1	0	0	0	7	0	8
Belmore River	1	0	0	0	1	0	2
Kinchela	1	0	0	0	2	0	3
Frederickton	2	0	1	0	1	0	4
South Kempsey	6	0	2	0	11	0	19
East Kempsey	3	0	0	0	8	1	12
KLM Total	29	2	7	0	40	2	80

Table 7.2 Customer Enquires for Council's Water Supply Systems excluding KLM 2019-2020

Supply System	Dirty	Air or Cloudy	Taste & Odour	Illness	Loss of Supply	Other	Annual Total
Crescent Head	2	1	0	0	1	0	4
Hat Head	0	0	0	0	3	0	3
South West Rocks	2	0	0	0	2	0	4
Stuarts Point	1	0	0	0	0	0	1
Willawarrin	15	0	0	0	3	0	18
Bellbrook	1	0	0	0	0	0	1
Thungutti	0	0	0	0	0	0	0
Combined Total	21	1	0	0	9	0	31

A total of one-hundred and eleven (111) customer enquiries were recorded by Council for this reporting year an increase of thirty-seven (37) enquires from 2018-2019. The majority of these were in the KLM supply with eighty (80) enquires received.

No customer enquiries were recorded in the Thungutti water supply.

Customer enquiries for all other supply systems for the year are discussed within the supply system in which they occurred.

7.1 Kempsey and Lower Macleay Supply System

The KLM supply had eight (80) customer enquiries. Loss of supply had the highest number with forty (40). South Kempsey recorded eleven (11), West Kempsey nine (9), East Kempsey and Smithtown three (3), Aldavilla two (2) and Kempsey and Kinchela areas one (1) each (Table 7.1).

Twenty-nine (29) dirty water enquires, an increase from sixteen (16) in the previous year; the majority of these in the West Kempsey area nine (9), South Kempsey six (6), Kempsey CBD, Aldavilla and East Kempsey three (3), Frederickton two (2) and single enquiry for Smithtown, Belmore River and Kinchela zones (Table 7.1).

The Aldavilla area recorded two (2) air or cloudy enquiries, there were seven (7) taste and odour enquires; West Kempsey three (3), South Kempsey two (2), and one (1) each at Aldavilla and

Frederickton. Two (2) “other” enquires were reported one (1) each in the West and East Kemspey zones. For the latter two indicators there was no reports for these two indices in 2018-2019. (Table 7.1).

The main contributing element to the received enquiries of loss of supply, dirty water and air or cloudy were due broken mains throughout the KLM supply and programmed main renewal projects. Major main breaks during the year include:

- 16 December 2019 impacting residents in South and East Kempsey, Belmore River, Austral Edan, Verges Creek and surrounding areas.
- 28 January 2020 impacting residents between Summer Island and Macleay Valley Way Clybucca
- 19 February 2020 impacting South Kempsey, Euroka, Burnt Bridge, Pipers Creek and Gowings Hill Rd.
- 27 March 2020 impacting East Kemspey
- 28 May 2020 impacting Kinchela and surrounding areas

No taste and odour was reported in 2018-2019, the change of supply to SMD for 2019-2020 where taste and odour compounds (MIB and Geosmin) may have been detectable to some members of the community that have low tolerance thresholds, typically taste and odour compounds are detectable at 2 ug/L (refer to Appendix B: Figure B.2).

A “other” water enquires in July 2019 involved higher than normal chlorine at the hospital that was impacting the renal dialysis unit. Council increased dosing at the main supply reservoir to ensure disinfection though the supply due to the naturally higher turbidity in SMD, this increase (though well below the ADWG) was causing chlorine breakthrough in renal dialysis equipment. Council troubled shot the issue with the hospitals renal department and advised the instrument supply technician to check the system and a potential replacement of the granulated activate carbon. The second other enquiry was a report of salty water coming through the taps in the house and in the attached dairy, a flush at the meter resolved the issue.

7.2 Crescent Head Supply System

The Crescent Head supply received four (4) customer enquiries for the year, this is two (2) less than the previous year. Enquires reported for two (2) dirty water and a single air or cloudy and single loss of supply (Table 7.2).

The dirty water enquiries were two (2) separate events (October 2019 and June 2020) and were resolved by on site water quality testing after a line flush at the meter for 15 minutes. The residence at Skyline Crescent was also given Nappi San to rewash stained clothing and the resident at Pacific Street had concerns of regularly having to change their taps filter.

A single loss of supply reported as a pressure loss on 1 July 2019, investigation found that a valve had been turned off, a flush also performed to help draw water back through the line.

A taste and odour enquiry in April 2020 was from a resident at Belmore St who was dissatisfied with the taste of the water. Water Operators performed water quality tests, results were all within the ADWG. The Crescent Head supply is unfiltered and has naturally high organics that can impact aesthetics such as taste and odour. A new Water Treatment Plant with pre-treatment, including filtration is in the design phase.

7.3 South West Rocks Supply System

Four (4) customer enquires in the South West Rocks supply were reported, a reduction of two (2) from the previous year. Two (2) dirty water and two (2) loss of supply. (Table 7.2).

Dirty water was reported in October 2019 at Mertens Place and June 2020 at Waiabar Avenue. Both enquiries were resolved with onsite water quality tests and instigating service line flushing to the meter at each residence

October 2019 a loss of supply was reported at Rafferty Crescent, a leak was identified and a repair to the service line performed.

23 January 2020 at Dennis Crescent a loss of supply was reported as a drop in pressure. The meter had been replaced in late December 2019 and since its replacement the residence reported ongoing pressure issues, Council performed a 10 Litre test and rectified the problem.

7.4 Stuarts Point Supply System

A single dirty enquiry was reported in the Stuarts Point supply, a reduction of five (5) enquires from the previous year. (Table 7.2).

15 November 2019 resident on Fishermans Reach Road advised that the water is causing his vegetables to turn yellow and was also happening at their daughter's property. The resident advised that a biologist looked at the soil and confirmed everything is fine, the biologist suggested that it could be something that council are doing to the water. Council attended site and performed water quality tests and reviewed recent chemical results from the NSW Health monitoring program, all water quality results were found to be reported within ADWG, the resident was advised of water quality tests.

7.5 Willawarrin Supply System

The Willawarrin supply received eighteen (18) customer enquiries during the reporting year, this is an increase of fourteen (14) from the previous year. Fifteen (15) dirty water and three (3) loss of supply (Table 7.2).

Dirty water enquires steadily increased in numbers from July, one (1), August, six (6) and September, eight (8). The persistent dirty water was emanating from Iron breakthrough into the network from the drought driven increases of Iron levels above the aesthetic ADWG (≥ 0.3 mg/L). The Willawarrin supply is unfiltered, and the source water is naturally high in Iron and Manganese that can cause water discolouration. Council began water carting to Willawarrin on 2 October 2020. Up to the commencement of water carting Council was regularly flushing the network to remove Iron and Manganese build up in the service lines, Council also provided Nappi San to residents who had experience laundry staining.

A main break in October coincided with two (2) loss of supply enquires from residents in Main Street. The third loss of supply enquiry was in November 2019 during the bush fire emergency. Council had to re-initiate supply from bore fields during the evening to maintain water pressure for firefighting purposes. Water Carting from the KLM supply resumed the next morning.

7.6 Bellbrook Supply System

The Bellbrook supply had a single dirty water (Table 7.2) enquiry on 21 November 2019 from a resident located on Main Street, Bellbrook. The resident advised Council of brown water in all their taps. Council attended site and performed water quality tests and proceeded to flush the customer's line at the meter until the water ran clear.

8. Water Quality Incident or Emergency

A water quality incident or emergency is an event where a controlled response is required to ensure that Council continues to protect public health. Although preventative strategies, such as CCP procedures, have been developed by Council, some events cannot be anticipated or controlled. These events need a managed response to ensure the incident is responded to adequately, investigated following the event, and preventative actions are implemented to reduce the risk of the event re-occurring.

Kempsey Shire Council had five (5) recorded Critical Limits in two (2) separate incidents for this reporting period. An ADWG health exception was reported, and Council remained under the operational guidance of its Drought Management Plan (DMP) until April 2020; the DMP was activated during the 2018-2019 reporting period. These four (4) Water quality incidents and emergency events are summarised in Table 8.1.

Table 8.1 Summary of Water Quality Incident or Emergency

Details of incident/emergency	Actions and Preventive actions undertaken	Investigation & recommendations
<p>December 2019 – Thungutti Supply Three Critical Limit abstraction CCP1 results of 1.1 NTU, 1.01 NTU and 1.78 NTU on 2, 3 and 6 December was recorded along with a Alert Level of 0.88 NTU on the 5 December in the Thungutti Supply. SOP CCPs were followed and confirmed that no impacts on supply water were observed. Higher than normal turbidity and air coming through the plant was caused from the bore water level being low (Nulla Creek dry from ongoing drought conditions).</p>	<p>6/12/2019 – 07:28. Start of Email chain from Water Operator to Water Management, outlining continual Critical Limits at raw water from 2/12/2020, Chlorine residual in network maintained though situation can change if turbidity over 1 NTU in raw water persists and potential for bore to collapse due to low water level.</p> <p>08:08 confirmation that reservoir levels around 13% a day, decision to fill the reservoir in the afternoon and then inhibiting the plant, Water Carting to commence on Monday 9/12/2019</p> <p>Process engineer contacted with DPIE regarding concerns from the residents about non-local water being used to supply the reservoir and was advised that it could be discuss it at upcoming meeting on Tuesday (10/12/2019).</p> <p>9/12/2019 – water carting commencement to supply – when possible supply from come from Bellbrook system and then KLM supply.</p> <p>10/12/2019 – DPIE and LPHU notified of commencement of water carting to Thungutti and recorded in the minutes of the NSW Aboriginal Communities Water and Sewer Program quarterly meeting with Council and NSW Health</p>	<p>Water Carting to continue to the Thungutti Community whilst Nulla Creek remains dry. Carted water where feasible to be sourced from Bellbrook over the KLM supply</p> <p>Water Carting remained in place for 33 days with supply resuming with abstracted water from Nulla Creek on the 21 January 2020.</p>
<p>January 2020 – KLM Supply A mixing failure of calculated Slug dose of 30L of Sodium Hypochlorite and 15 Calcium Hypochlorite pills to increase Free Chlorine to operational target of 1.8mg/L resulting in high Total Chlorine readings over ADWG at</p>	<p>Morning Monday 27th - Phone call to report to support Water Operator and Team Leader of ADWG exceedance at outlet of Potters Hill Reservoir Free Chlorine = 6 mg/L and Total Chlorine = 6.7 mg/L.</p>	<p>Future supplementary chlorine “slug” dosing to be administrated via the pump into the overhead fill allowing for adequate mixing opposed to direct administration into the Reservoir roof hatch. This aims to reduce the likelihood of supplementary</p>

<p>the Potters Hill Reservoir outlet on Monday 27 January 2020.</p> <p>A drop in Free Chlorine over two days at Potters Hill reservoir was identified by the water operator on Sunday 26 January 2020 and a manual slug dose of the reservoir was performed to return Free Chlorine to operating targets. Dosing calculation was confirmed with support Water Operator before administration.</p> <p>Additional Background information Supply for the KLM system was from Steuart McIntyre Dam. Under this operational configuration Greenhill, John Lane and Potters Hill Reservoir outlets are CCP locations for disinfection (CCP3). However, the direct line from Steuart McIntyre Dam to Potters Hill Res was not in operation voiding the CCP on the outlet of Potters Hill as it was being sub fed from the Greenhill Reservoir. The outlet sampling location of Potters Hill Reservoir in this context is considered a network site and hence this notification incident report is for an ADWG (Health) exceedance relating to Total Chlorine and not a Critical Limit exceedance for CCP3.</p>	<p>Closing of Tozer St valve and removal of the pill basket to stop further escalation.</p> <p>Field Incident report completed and sent to Water management Team.</p> <p>Monitoring of Reservoir outlet to confirm corrected actions. Reservoir Outlet results at 3:00pm Free Chlorine = 2.15 mg/L and Total Chlorine = 2.7 mg/L.</p>	<p>chlorine dosing to remain unmixed from the reservoir outlet into network</p> <p>LPHU notified via email on 27 January 2020</p> <p>Full Incident report emailed to LPHU on 30 January 2020</p> <p>Toolbox debrief conducted on 19 February 2020 with all Water Operational staff of the incident and implantation of preventative action learning outcomes.</p>
<p>June 2020 – Kempsey and Lower Macleay Supply Increase in nutrient loading in SMD from source water (Sherwood Borefield) causing growth in algal populations above Critical Limit trigger values for CCP1 Raw Water SMD Algae Biovolumes</p> <p>2/06/2020 - Alert Level Algal Biovolume result of 0.26 mm³L⁻¹ (Level 1 Algal framework) 10/06/2020 - Critical Limit Algal Biovolume result of 1.2 mm³L⁻¹ (Level 2 Algal framework) 16/06/2020 - Critical Limit Algal Biovolume result of 2.4 mm³L⁻¹ (Level 2 Algal framework)</p>	<p>25/05/2020 - Fill transfer from Sherwood borefield to SMD ceased to reduce nutrient loading feeding Algae. Lab Report H20 1250 received Sunday 24/05/2020 showed increase in biovolume from 0.05mm³L⁻¹ (H20 1178) to 0.24mm³L⁻¹ Alert Level 1.</p> <p>Initiation of supply change - 19/06/2020 10:56 – Lab WQ report H20 1434 sampled 16/06/2020 received via email - Critical Limit result 2.4 mm³L⁻¹ result doubled from H20 1394 critical Limit result of 1.2 mm³L⁻¹</p> <p>11:00 – Water Manager directed Water Management Team to begin preparation for source water supply change from SMD to borefield/Lime Plant configuration.</p> <p>11:15 – Water & Sewer Coordinator Phone call and email notification to Water departments of intent of change supply and begin immediate preparations for change date Monday 22/06/2020</p> <p>12:23 – WQO phone call notification of intent to change source water for KLM supply to NSW Health (message left with Tenille Lawrence).</p> <p>13:27 – WQO Follow up email to NSW Health</p> <p>13:59 – WQO received phone call from NSW Health; requested DWMS</p>	<p>1/06/2020 & 9/06/2020 - Consistent return of Lab WQ reports H20 1303 and H20 1352 with Biovolume remaining at Alert Level 1 – Missed opportunity / failure in process to Increase algal sampling frequency to twice a week as sampling schedule for SMD online and Algae alert at Alert Level 1</p> <p>14/06/2020 - Lab WQ report H20 1394 sampled collected 10/06/2020 received via email on a Sunday – Critical Limit Algal biovolumes – Missed opportunity/failure in process to begin conversation to initiate supply change back to direct supply from Sherwood Borefield – (lab results received on a Sunday due to sampling performed on a Wednesday and not a Tuesday - June long weekend)</p> <p>08/07/2020 - 12:30 – Review meeting with water departments Co-coordinators and Team Leaders to discuss supply changeover with the aim to identify what worked well, what didn't and areas for improvement.</p> <p>Corrective Actions – as per debrief meeting on 8/7/2020. Emailed to Water Department coordinators 17/7/2020 for actioning</p> <p>29/7/2020 - Debrief meeting with DWMS Risk Team - Lessons learnt</p> <ul style="list-style-type: none"> • Capturing informal conversations about daily processes that are needed for process control documentation

	documentation sent to NSW Health. Documents sent via email at 15.06	<ul style="list-style-type: none"> • Increase algal sampling frequency based on sample schedule for Alert and Critical limit returned results • Actioning Algal reports upon receipt from Lab • Communication between Council departments for community notification
<p>Drought Watch and Drought Emergency</p> <p>In response to ongoing drought conditions that placed increased water security stressors on Council's water supply resources, the General Manager (GM), in accordance with advice received from the Drought Management Team (DMT), activated Council's Drought Management Plan (DMP) on 21 May 2019.</p> <p>Water Restriction Levels were in place across the entire shire for a total of 305 days, 264 within the 2019-2020 reporting year. Level 3 was the highest restriction level initiated by Council and was in place for 85 days from 2 December 2019 to 24 February 2020.</p> <p>The Macleay River ceased flowing on 7 November 2019 for 66 days before flows re-commenced on 12 January 2020.</p> <p>Transfer of supply for the KLM system from the Sherwood Bore Field to SMD emergency supply occurred on 13 June 2019. Water Quality monitoring frequency of SMD increased to an operationally active regime, this included the Algal Monitoring Program based on the Management Strategies for Cyanobacteria (Blue Green Algae (BGA)) framework. Council installed an EnviroSonic Ultrasound Algae Control System in October 2019 at SMD as a potential algae control mechanism in response to concerns of algal blooms in SMD whilst being the only source of water for the KLM supply.</p> <p>On 15 January 2020, the KLM supply level at SMD was at 56.1% volume capacity with a Day Zero estimate of 4.5 month's supply remaining.</p> <p>Water Carting to the Willawarrin supply commenced on 2 October 2019 and ceased on the 18 Jun 2020.</p> <p>In November 2019, upriver communities were impacted by bushfires with a State of Emergency declared in the Kempsey Shire LGA. During the height of the bushfire emergency intermittent water carting was supplied to both the Bellbrook and Thungutti supply systems between 9 and 15 November 2019.</p> <p>Additional water carting continued to the Thungutti supply for 33 days between 20 December 2019 to 21 January 2020 due to Nulla Creek drying up due to drought conditions.</p> <p>Water carting to the Bellbrook supply commenced on 13 January 2020 and ceased on the 18 June 2020.</p> <p>A water restriction review report was completed in May 2020 and tabled at the May 2020 monthly Council meeting . This report addressed the actions initiated from the Drought Response Strategy and Drought Recovery Strategy sections of the DMP.</p>		

9. Monitoring and Testing

9.1 Aboriginal Communities Water & Sewage Program

Five (5) discrete Aboriginal Communities are identified within the drinking water supply areas of Council. Council partnerships with DPIE and NSW Health to deliver the NSW Aboriginal Communities Water and Sewer Program for the following communities:

- Bellbrook (Thungutti)
- Greenhill (West Kempsey)
- Burnt Bridge (South Kempsey)
- Loftus Rd (Crescent Head)
- Figtree (South West Rocks)

9.1.1 Pesticide Testing

Pesticide monitoring from water supplies servicing discrete Aboriginal communities is funded by the NSW Aboriginal Communities Water and Sewer Program every five (5) years.

No pesticide testing was conducted in 2019-2020. Table 9.1 provides a summary of last conducted monitoring and when next schedule sampling is due for each community. Pesticide analysis testing includes:

- Acidic Herbicides – Method CET8B

- Glyphosate – Method CET17A
- Organochlorine & Organophosphorus by LCMSMS – Method CET43A
- Organochlorine, Organophosphorus & Synthetic Pyrethroid Pesticides by GCMSM – Method CET7D
- Triazines/Phenylurea & Carbamates – Methods CET19C

Table 9.1 Summary Pesticide Monitoring at Aboriginal communities and selected supply systems

Catchment	Location	Last Sampled	Comments	Scheduled Next
Thunggutti	Network	2017	No Pesticides Detected from 1 sample	2022
Crescent Head	Network (Loftus Rd)	2019	No Pesticides Detected from 1 sample	2024
South West Rocks	Network (Figtree)	Feb 2017 to Dec 2017	No Pesticides Detected from 12 samples	2022
KLM	Burnt Bridge or Greenhill	Dec 2017	No Pesticides Detected	2022

9.1.2 Inspections and Water Quality Testing to ADWG

Along with pesticide monitoring, the water supply and sewerage systems at the Aboriginal communities are inspected by the Department of Planning, Industry, and Environment (DPIE) under the NSW Aboriginal Communities Water and Sewer Program. The water quality results for each community is taken during quarterly inspections (Table 9.2) indicate that the water meets the required ADWG and NSW Health recommended indicators for the parameters tested.

Table 9.2. Result Summary of Water Quality results conducted during Department of Industry Inspection

Community	Sample Location	Date Inspected	Turbidity (NTU)	Free Chlorine (mg/L)	Total Chlorine (mg/L)	pH	Colour (pt/Co)
Fig Tree	R8 SPS	11/12/2019	0.38	1.82	1.9	7.50	<5
New Burnt Bridge	SPS K25	12/12/2019	0.47	0.2	0.63	8.03	1
Greenhill	SPS 29	12/12/2019	0.98	1.71	1.91	8.38	1
Loftus Road	Standpipe at SPS C4	11/12/2019	2.8	0.11	0.21	7.00	<15
Thunggutti	Network	10/12/2019	0.4	0.61	0.69	7.26	9

10. Continuous Improvement – Implementation Plan

Council's Implementation Plan (IP) was developed as part of the DWMS to document the improvement actions identified during the detailed risk assessment of the drinking water supplies. The Improvement Plan encompasses Element 12 of the DWMS and demonstrates Council's commitment to continual improvement of its water supply services from a quality and safety perspective.

Since completion of the DWMS in 2014, the IP has been reviewed yearly by the Risk Management Team. Table 10.1 provides an overview of the IP reviews with a summary of progress of the actions.

Table 10.1. Summary table of Implementation Plan Reviews

Review Date	Removed*	Completed	In progress	Ongoing (no change in status)	Not Started	Items Added	Total Ongoing
Nov 2014 & Jan 2015	4	7	49	Not Reported	111	23	171
Aug & Sept 2015	4	8	75	Not Reported	83	0	157
April 2016	N/A	N/A	N/A	N/A	N/A	16	173
March 2017	N/A	24	73	64	65	0	202
August 2018	14	54	51	27	28	0	106
Oct 2019	48	23	63	24	7	18	112
November 2020	19	20	68	23	6	12	109

*Removed items are the number of items that have been completed in the previous year review. The figures from "Completed" and "Removed" may not match due to confirmation in the current review year that the task has been completed. If an item is deemed "not-completed" its status is changed back into "in progress"

A summary of the ongoing actions in the DWMS IP has been included in Appendix E that includes the risk ranking, status of tasks, progress, and comments. It indicates the dates where tasks have been added and references the reason for the addition or removal from the plan.

The IP has been further analysed to determine the progress on tasks by risk ranking; this is provided in Table 10-2. During the November 2020 review nineteen (19) tasks were removed as they were confirmed as completed from the October 2019 review. Seven (7) of these tasks had a risk ranking of high to very high. A further twenty (20) tasks were assessed as completed, which nine (9) were risk rated as high or very high.

Of the one-hundred and nine (109) ongoing tasks, twenty-nine (29) tasks (ongoing & not started) did not change in status as no progress was undertaken since the previous review; Three (3) of which have a "very high" risk rating.

To date, twelve (12) very high risks tasks are outstanding.

Table 10.2. Progress on actions based on risk value (November 2020)

Residual Risk	Removed	Completed	In progress	Ongoing (no change in status)	Not Started	New	Total	Tasks Remaining
Very High	1	2	6	2	1	3	15	12
High	6	7	30	6	2	3	34	41
Medium	6	7	20	8	2	3	46	33
Low	6	4	12	7	1	3	33	23
Total	19	20	68	23	6	12	148	109

Internal reviews of the IP progress will continue to be undertaken annually by Council in conjunction with the annual review of the Risk Register. Any new actions that are identified in the Risk Register are added into the IP. As actions are completed their status is changed to "completed" and remain in the IP for one review cycle before being marked as "remove" and taken off the IP. Table 10.3 provides a summary of the actions that have been completed and Table 10.4 provides a summary of those removed from the last review undertaken in November 2020.

Table 10.3 Summary of Completed tasks in Implementation Plan (October 2019)

Action No.	Supply System	Residual Risk	Outstanding Actions	When Added	Comments
2.21	Kem	M	Consider undertaking a monthly monitoring program for indicator microbiological levels at take-off point of SMD,	2012	Has been done, will be formalised 31/10/2019 - Check schedule and then close off once confirmed 23/12/2020 - micro sample taken weekly
2.32	Kem	L	Include SMD perimeter and water surface inspections into site management procedures to monitor and minimise native and feral animal access to storage.	2012	4/11/2019 - will be added to WaterOutlook WTL to confirm that perimeter fences are in WaterOutlook SMD 2/weekly inspection
2.72	Kem	H	Alternative power to be installed for power outages on pressurised zones (Burnt Bridge, Bloomfield St & Everinghams Lane) or investigate alternative water supplies (i.e. tank on tower).	2012	7/11/2019 - to be implemented need to check for power point for generator and/or permanent on site back up power supplier 5/2/21 - All sites converted for generator plug in in event power outages
2.87	All	VH	Procurement controls to be introduced through stores to ensure that all sourced materials are fit for contact with potable water, conform to plumbing regulations, and industry standards and practices, to guide product selection and installation.	2012	Under procurement mid ROC process, checklist to be developed, 7/11/2019 - this is already incorporated in procurement and is always under constant review. Check list not feasible to be devolved under a system outside of council single control.
2.91	Kem	VH	"KSC to establish a centralised water quality data base for the recording of operational and compliance monitoring, including response to WQ incidents and abnormal results. Field operators need online data entry facilities and automated notification for abnormal results. Implement a regime of regular review water quality results, including daily entry of data by operators and at least weekly review by TO	2012	Outlook water system is under development 7/11/2019 - WaterOutlook developed for the SWR system and will be rolled out across other systems from Nov 2019 18/2/21 - WaterOutlook has been rolled out for Water monitoring data - this action can be closed out

			The data base is to have the ability to produce reports, trend graphs and alert notifications (including site events). "		
3.14	All (bores)	H	SOP required around the monitoring and selection of best water quality bores	2014	"SOP to be developed 10/2/21 - SOP not required. Bore selection is driven by water quality at each bore and conversions between WO and TLW when WQ begins to deteriorate - this action is to be closed off
3.19	SWR, SP, BB	H	Develop an SOP for chlorine top-up dosing into clear water tanks	2014	SOP in development 10/2/21 - This action/SOP is being incorporated into new action 7.05 slug dosing reservoirs SOP that includes confirmation of calculations by the Team Leader and/or Senior Water Operator - this action is being closed off"
3.22	HH, SP, CH, SWR	L	Develop SOP for chlorine - managing increased water demand/supply during holiday periods	2014	SOP for demand management 10/2/2021 this is managed by daily operations checks and review of trends, chlorine is adjusted accordingly. SOP not required and this action is closed off
3.6	ALL	M	Develop a comprehensive public and media communications strategy and include draft public and media notifications and leverage, where possible, existing mechanisms by which council communicates with the community. Define communication protocols with the involvement of relevant agencies and include in the protocols a contact list of relevant agencies and businesses and their relevant key people and update contact details (also include in DWMS).	2014	Council to investigate and check if community strategic plan. Social media (FB) used currently. 10/2/2021 - Communication team has their own strategy in place to inform the community, Key contacts are in the DWMS contact list. This action is being closed off this action was developed before the new DWMS was implemented and DWMS has protocols for external contacts and when they are contacted
3.88	ALL	L	"Develop internal audit procedures and schedules appropriate to functionality of council and the water supply systems. Identify appropriate personnel to undertake the internal audit and provide training in auditing."	2014	Undertaken informally, systems continuously audited, SOP for internal audit to be developed to ensure process is documented

					<p>21/11/2019 - Water Systems currently done informally Council has recently hired a Internal Auditor and systems at a higher level are currently being develop</p> <p>10/02/2021 - Departmental audits are being completed and are soon to be captured in Councils new VAULT system for findings, actions and their outcomes Council internal reports are kept in Councils Share point system Council has a qualified internal auditor and departmental audits are carried out by staff who are SME. This action is completed and can be closed off</p>
3.97	ALL	M	An SOP for plant start up following a period of shutdown needs to be developed	Dec-14	<p>SOP to be developed</p> <p>10/2/2021 - This action is being incorporated into each plants operation SOP that is in the progress of being developed. This action can be closed off</p>
4.09	All	H	Council needs to ensure that a log is kept of all changes to SCADA limits and ensure that security controls are in place for changes to CCP levels. Council should also consider an approval process for making these process adjustments.	Dec-14	<p>All changes logged automatically, including who changed it (the event page)</p> <p>21/11/2019 - Need to double check that dosing set points affecting the CCPs are clamped and that alarms are reviewed</p> <p>5/2/21 - the ongoing review of setpoints is incorporated into action No 3.76. All other parts of this action is completed as noted</p>
4.1	All	L	Council currently only have one test kit for testing hypo strength, and this is located at the Dam. Council should consider purchasing another kit for the upriver sites.	Dec-14	<p>Will be ordered, may be required for each plant that uses hypo</p> <p>21/11/2019 -confirmation of purchase of additional kits required</p>

					10/2/2021 Kits have been purchased, kits are located at SMD and SWR . - this action is completed and can be closed off
4.11	All	M	Council to contact Port Macquarie Lab to determine protocols for micro sampling on weekends if required during a CCP failure.	Dec-14	<p>Protocol to be discussed, formalising process will be considered</p> <p>21/11/2019 - Process in place with Port Lab. Need to develop SOP for confirmation of steps in the event of CCP failure and taking a non-routine micro sample on the weekend</p> <p>10/2/2021 - this protocol is already captured in the DWMS - incident management plan. A SOP is not required. This action can be closed off</p>
5.05	BB	M	Proper signage should be displayed in the chemical storage areas instead of marker pen written signage on the storage tanks and hazardous chemical signage should be improved	Apr-16	<p>21/11/2019 - TLW & PE to conduct an audit of all signage to confirm all correct signage is in place</p> <p>10/2/2021 - this action has been completed and can be closed off</p>
5.14	Th	H	Integrate SCADA onsite & Door alarms connected to SCADA	Apr-16	<p>21/11/2019 - this will be incorporated with the roll out of upgrades across all sites</p> <p>10/2/2021 - This action has been confirmed that it is captured in New Action No 7.06 for all supplies not just Thungutti</p>
6.03	SMD	H	Investigate options for Destratification (other than aeration)	Nov-19	<p>Re-visit based on outcome of emergency treatment plant at SMD</p> <p>10/2/2021 - Council is no longer in drought and emergency plant is now not being looked at - however Council is in concept stage at SMD new treatment plant where technologies will mitigate against destratification and aeration needed - this action is no longer needed and can be closed off</p>

6.04	SMD	H	Confirm inspections For SMD are included in the site management procedure - relating to access and contamination from animals	Nov-19	inspections to be included in site management procedure. (JN to confirm - then remove 16/09/19) 10/2/2021 - Inspections are included in 4.12.4. this action can be closed off
6.14	WW	M	When filling Willawarrin reservoir from a tanker, the tanker should have a spray nozzle diffuser attached/installed to reduce sediment stirring	Nov-19	18/2/21 - Spray Nozzle in Reservoir - completed can be removed next review
7	KLM	M	Inspections of aeration line - Create frequency plan of aeration line inspection by divers	Nov-20	PE - To incorporate into the reservoir cleaning plan 10/2/2021 - this action has been completed and can be closed off

Table 10.4 Summary of removed tasks in Implementation Plan (October 2019)

Action No.	Supply System	Residual Risk	Outstanding Actions	When Added	Comments
1.01	All	L	"Develop a KSC Drinking Water Policy and integrate into the Strategic Business Plan.	2012	WQ statement from 2013 exists, though Thungutti not included as scheme, some re-wording required (when comes the time for review) Will be updated when SBP is reviewed (will happen soon) DWMS full review completed in June 2019 with Water Policy updated to include Thungutti and signed by GM and Mayor - Singed off by Council Aug 19 meeting
1.07	All	H	Incident & Emergency Response Plan to be developed which includes communication, responses and reporting requirements and provide appropriate training for all staff on the introduction of the Plan. Identify an appropriate person to handle all incident and emergency communications and	2012	Business Continuity Plan will capture a lot of these elements, currently being undertaken for the whole of Council. 30/10/2019 - BCP plan updated in 2019 - DWMS updated in June 2019 which contains incident response place and

			ensure they are appropriately trained. The Plan is to identify key supply zones and detailed emergency contact list. Identify possible water quality related incidents and emergency scenarios. Develop a process for investigation following incidents and emergencies and document this process. Include in this process a mechanism for revision of any emergency protocols, where an investigation demonstrates it is required. Establish a rapid communication system (for internal and external communication) to deal with unexpected events.		stakeholder contacts - WO were a part of the review process and implementing the current DWMS. 23/12/2020 - this has been confirmed and yearly review of stakeholders is captures in Action No. 1.02
2.18	Kem	L	Update the SMD Management Plan Alert Level Framework to include Bio volumes and cell numbers notification, and T&O alert levels, sampling guidelines for seasons and alert levels	2012	This was completed during the 2019 DWMS update
2.3	Kem	L	Review and update the SMD Bushfire prevention plan.	2012	Completed a part of the DWMS review and flow chart for Water Supply triggers 23/12/2020 - SMD Bushfire plan sits with the OM Dam Manual & is reviewed annually this action is captured in 1.02
2.95	ALL	M	Develop a formal requirement register covering all responsibilities water related activities, including requirements for the management of water quality. This register should then be referenced in this section of the DWMS and stored in TRIM. Develop, document and implement a formal process for reviewing formal requirements every 12 months or where there are any changes to councils' activities of formal requirements.	2014	Will be included in the DWMS document as a table. 7/11/2019 - this has been captured in the review process and signed off by council in August 2019
2.97	ALL	M	Ensure all staffs position descriptions include the relevant formal requirements for the management of water quality, including responsibilities under the DWMS and ensure they are reviewed annually with performance reviews	2014	Currently being reviewed 7/11/2019 - KSC as a whole have updated all PDs in early 2019.

3.27	All	H	Develop an SOP for commissioning procedures to limit potential taste and odour issues possibly due to new coatings or pipework.	2014	SOP to be developed 19-11-2019 this action is to be removed as it will be covered in SOP for new main commissioning. Coatings are not used in internal mains lining and Council has two NACE coating inspectors
3.31	ALL	H	KSC to develop a Document Register within TRIM that includes responsible person and review date triggers. This register should be updated in the DWMS when changed. Develop a procedure or system within TRIM that manages document control for all DWMS documentation (i.e. ensure the currency, accessibility and appropriate review DWMS documents).	2014	Being undertaken through TRIM No escalation, may be a process, needs to be checked 19/11/2019 All documents relating to the management of the DWMS are recorded in the DWMS document register. This register is maintained by the WQO and updated in TRIM when updates are made.
3.33	ALL	M	Where operational manuals for treatment plants do not exist, Council should develop these and/or replace out of date manuals.	2014	O&M manuals exist for every plant being reviewed, in conjunction with SOPs 19/11/2019 - Operations are linked in the GIS system and there are hard copies available on the F:Drive. SOP are separate to the operational manuals as these are technical schematics supplied by the plant manufacturer
3.57	ALL	M	Council may consider developing a process where customer feedback is directly integrated into the daily monitoring spreadsheet, which also captures daily water quality data.	2014	Customer complaint database must be developed. Currently actions aren't captured, Water section must work with customer service to develop this. 19/11/2019 - Water Quality complaints are captured and reported on in the Monthly and Yearly Reports. Other feedback when it occurs is filtered to the team via the MWS, and WTL and reported on as it occurs. No other process deemed necessary for development.
3.68	ALL	M	Consider the implementation of a Long term operator competency program	2014	Workshops for WIOA attended.

					19/11/2019 National certification scheme for operators is being used by council. This action has been implemented and can be closed off
3.77	ALL	L	As part of councils' review of the DWMS risk assessment, review and discuss the effectiveness of existing processes and procedures in managing water quality. The review should draw on external research and information, the risk assessment, water quality analysis and organisational experience. With any changes in conditions, processes and procedures should be revalidated.	2014	Currently undertaken as part of implementation project 2018 19/11/2019 - this action is already being performed during the DWMS annual review and adhoc reviews as required
3.79	ALL	L	Develop a policy on validation of new or upgraded water supply infrastructure. This should include witness, demonstration and commissioning requirements that are designed to ensure the infrastructure delivers the expected water quality results.	2014	All new upgrades must be approved by DoI, section 60. Whenever a new project is commenced, a checklist is used at inception. Also captured under tender specification. Ensure appropriate legal and contractual arrangements in place. 19/11/2019 Inspections are carried out by Council for new private main connections. Validation of designed, construction and commissioning of new supply infrastructure is captured in the tender process and contracts. Council has a standardised specification standard. This section also is captured in Councils Project Management Framework.
3.83	ALL	L	Review existing documentation on the water supply systems and ensure all are captured on councils' document management system. Verify documents are up-to-date.	2014	Need for a technical officer to undertake this 19/11/2019 - All DWMS documents are recorded on the DWMS document register. This is maintained by the WQO. Other Water documents for Maintenance and Operations are listed in the where do I find it register.
3.94	ALL	M	Redundant sample sites (i.e., with no data attached to them) to be removed from NSW Health sampling database.	2014	21//11/2019 - data not deleted but placed in archive. During the 201/2019 review samples sites were changed and this has been updated in the NSW Health database and archived data as required

3.99	BB	H	Chlorine dosing system needs to be set up with the capability to do chlorine dose flow checks and calibrations BB	Dec-14	Chemical audit sheet to be considered/actioned 21/11/2019 this has been done
4.07	KLM	H	Chlorine samples are currently being collected at the outlet to the reservoirs, this needs to be changed to the inlet to the reservoir on the rising main for each reservoir	Dec-14	Will be confirmed with C.t. calculations (Viridis) 21/11/2019. C.t calculations has been confirmed and samples remain mostly on the outlet of the Reservoirs as most act as a Clear Water Tank
5.09	Th	H	Council to review & summarise the pathogen testing done for Thunggutti in a previous NSW Health Project and include the testing results in the DWMS	Apr-16	Council to investigate 21/11/2019 - Thunggutti formally adopted into DWMS in 2019

11. Review of DWMS Implementation

Council adopted a DWMS in September 2014, an internal DWMS Implementation review was conducted in March 2017 by Aqualift Project Delivery (in-house contractor).

In May 2018 VIRIDIS Consultants on behalf of NSW Health commenced facilitation of an external review of Councils DWMS with completion in June 2019.

The DWMS 2019 was implemented from July 2019 for the 2019-2020 reporting year.

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Appendix A Summary of Critical Control Points (CCP) for each Supply System

Table A.1a CCP Kempsey and Lower Macleay Water Supply – Sherwood Lime Plant in use

System	CCP ID	Control Point	Indicator Parameter	Testing Location	Frequency	Target	Alert Level	Critical Limit	Justification for critical limit
Kempsey and Lower Macleay	Sherwood Lime Plant in use								
	CCP1	Raw Water Abstraction	Turbidity	Combined bore water to Sherwood Lime Plant	Continuous online	<1 NTU	1 NTU	2 NTU	There is no filtration undertaken, critical limit provides an interim barrier to control contaminant/ microbial load. Plant is shut off at critical limit.
	CCP2	Filtration	Turbidity	NA	NA	NA	NA	NA	NA
	CCP3	Disinfection	Free Chlorine pH	Outlet of Reservoir – Greenhill	Daily grab	1.2 mg/L pH 7.5	<0.9 mg/L or > 3 mg/L pH <6.8 or >8.0	<0.6 mg/L or >4 mg/L pH <6.5 or >8.5	Lower chlorine critical limit ensures that C.t is met at the monitoring location. Upper chlorine critical limit ensures that total chlorine does not get >5 mg/L (health limit). pH correction undertaken. Lower pH critical limit protects asset corrosion. Upper pH critical limit ensures efficiency of chlorination is not compromised (ADWG).
	CCP4	Fluoridation	Fluoride	NA	NA	NA	NA	NA	NA
CCP5	Reservoir	Reservoir integrity	All Reservoirs	Monthly	No breach of integrity	Any sign of integrity breach	Evidence of contamination	Ensures treated water does not get contaminated.	

Table A.1a.1 SOP for KLM CCP1 Turbidity at Raw Water Abstraction - Sherwood Lime Plant in use

Water Scheme	Kempsey and Lower Macleay – Sherwood Lime Plant in use		
CCP ID	CCP1		
What is the control point?	Raw Water Abstraction	What are the hazards?	All pathogens
What is being monitored?	Turbidity	Monitoring Frequency:	Continuous online
Monitoring location	Sherwood Lime Plant (SLP) inlet pre disinfection		
What will initiate response?	Confirmation of result with immediate grab sample re-test		

Operating Target <1 NTU	Alert Level 1 NTU	Critical Limit 2 NTU
<ul style="list-style-type: none"> Observe weather and flood warnings Routine site and operational checks Instrument calibration and records maintained Monitor and measure raw water turbidity daily Equipment correlation checks (Bench meter instruments cross checked results against similar instruments) Calibration of online instruments (Programmed Instrument Maintenance Program conducted by Instrument Technicians and external contractors) Visual checks at Bore sites and Bore water monitoring program Individual Bore testing 	<p>Corrective actions</p> <p>General:</p> <ul style="list-style-type: none"> Confirm with immediate grab sample re-test Contact Team Leader Consider shutting SLP down Complete '<i>Initial Incident Report Form</i>', following confirmation of online result with grab sample Check Recharge Channel for any water quality impacts such as flooding Check borefield for signs of damage to bore or any impacts to sites areas around bores Investigate operating bores in use at time of sampling to identify source of increased turbidity levels Check individual production Bores for turbidity & iron and isolate where required <u>Make arrangements</u> for isolation & repairs to problem bore Check readiness of alternate supply 	<p>Corrective actions</p> <ul style="list-style-type: none"> Follow Alert Level steps Contact Team Leader Team Leader to inform Process Engineer or Manager as soon as possible. Shutdown the system Switch to alternate supply, if possible Check turbidity levels downstream to validate any infiltration to receiving reservoirs Process Engineer or Manager to call local PHU as soon as possible. Contact DoI for operational advice as needed. Implement additional response actions (e.g. boil water alert) in consultation with local PHU. Complete '<i>Initial Incident Report Form</i>', following confirmation of online result with grab sample.

Table A.1a.2 SOP for KLM CCP3 Free Chlorine and pH at Disinfection - Sherwood Lime Plant in use

Water Scheme	Kempsey and Lower Macleay - Sherwood Lime Plant in use		
CCP ID	CCP3		
What is the control point?	Disinfection and pH correction	What are the hazards?	Chlorine sensitive pathogens
What is being monitored?	Free chlorine residual & pH	Monitoring Frequency:	Daily grab (7 days)
Monitoring location	Reservoir(s) outlet: Greenhill		
What will initiate response?	Confirmation of result with immediate grab sample re-test		

Operating Target	Alert Limit	Critical Limit
Free chlorine 1.2 mg/L pH 7.5	Free chlorine <0.9 or >3 mg/L pH <6.8 or >8.0	Free chlorine <0.6 or >4 mg/L pH <6.5 or >8.5
<ul style="list-style-type: none"> • Routine site and operational checks at Dosing Plant • Equipment correlation checks (Bench meter instruments cross checked results against similar instruments) • Chemical dosing rate checks • Disinfection residual checks performed at the outlet of Reservoir • Instrument calibration and records maintained • Chemical procurement and delivery requirements • Calibration of online instruments (Programmed Instrument Maintenance Program conducted by Instrument Technicians and external contractors) • Regular inspection of the lime dosing system including cleaning of injection lines for change over • Flow meter checks • Redox probes within Reservoirs 	<p>Corrective actions</p> <ul style="list-style-type: none"> • Confirm result with an immediate re-sample. • Validate disinfection levels (using high ranges or dilution methods if required) • Contact Team Leader • Check disinfection levels from primary dosing and adjust as required • Check raw water conditions • Check disinfection levels in Reservoir and manually dose if required (Refer Reservoir Manual Chlorine Dose Calculator) • Check integrity of Reservoir for any breaches or unauthorised access • Check primary dosing equipment (circulation pumps, injection point) • Consider scouring, flushing and sampling in the network where appropriate • Complete 'Initial Incident Report Form', following confirmation of online result with grab sample. 	<p>Corrective actions</p> <ul style="list-style-type: none"> • Follow Alert Level steps • Test for total chlorine if free chlorine is >4 mg/L. Total chlorine should not be >5 mg/L. • Contact Team Leader • Team Leader to inform Process Engineer or Manager as soon as possible. • Consider taking micro-sample for low disinfection levels • Process Engineer or Manager to call local PHU as soon as possible. • Contact DoI for operational advice as needed. • Implement additional response actions (e.g. boil water alert) in consultation with local PHU. • Complete 'Initial Incident Report Form', following confirmation of online result with grab sample.

Table A.1a.3 SOP for KLM CCP5 Reservoir Integrity - Sherwood Lime Plant in use

Water Scheme	Kempsey and Lower Macleay - Sherwood Lime Plant in use		
CCP ID	CCP5		
What is the control point?	Reservoir	What are the hazards?	All pathogens and all chemicals
What is being monitored?	Reservoir integrity	Monitoring Frequency:	Monthly
Monitoring location	All service reservoirs		
What will initiate response?	Any sign of reservoir integrity breach		

Operating Target No breach of integrity	Adjustment Limit Any sign of integrity breach	Critical Limit Evidence of contamination
<ul style="list-style-type: none"> Reservoir inspection program (routine) with records maintained Scheduled contractor reservoir cleaning and inspection program 	<p>Corrective actions</p> <ul style="list-style-type: none"> Conduct visual inspection (outside & inside) Check disinfection levels in Reservoir and top up if required (Refer to Reservoir Manual Chlorine Dose Calculator) Increase chlorine dose at plant, if needed Contact Team Leader Repair breach of integrity. Increase inspections until repaired Consider notifying local PHU Complete 'Initial Incident Report Form' 	<p>Corrective actions</p> <ul style="list-style-type: none"> Follow Alert Level corrective actions Contact Team Leader Team Leader to inform Process Engineer or Manager as soon as possible. Take micro-sample if required Remove contaminants, if safe to do so Process Engineer or Manager to call local PHU as soon as possible. Contact Dol for operational advice as needed. Implement additional response actions (e.g. boil water alert) in consultation with local PHU. Complete 'Initial Incident Report Form'

Table A.1b CCP Kempsey and Lower Macleay Water Supply – SMD in use

System	CCP ID	Control Point	Indicator Parameter	Testing Location	Frequency	Target	Alert Level	Critical Limit	Justification for critical limit	
Kempsey and Lower Macleay	Steuart McIntyre Dam in use									
	CCP1	Raw Water Abstraction	Turbidity	Combined Bore Water to SM Dam Inlet Race	Continuous online / daily grab	<1 NTU	3 NTU	5 NTU	There is no filtration undertaken, critical limit provides an interim barrier to control contaminant/ microbial load into SM Dam.	
		Raw Water Abstraction	Turbidity	SM Dam outlet from an active transfer pump	Daily grab	<1 NTU	3 NTU	5 NTU	There is no filtration undertaken, critical limit provides an interim barrier to control contaminant/ microbial load. Plant is shut off at critical limit.	
		Raw Water Abstraction	Taste & Odour MIB / Geosmin Algae Biovolumes (Toxins)	SM Dam Tower and SM Dam sites 1, 2, & 3	As per Algae Monitoring Plan	Not detectable Not detectable Below Detection Limit	N/A >2 ug/L Alert Level 1	N/A N/A Alert Level 2	Algae Biovolume critical limit is based on the Water Directorate Alert Level Framework for management of cyanobacteria in drinking water. Taste and Odour along with MIB and Geosmin has no set critical limit, as these indicators in detectable levels are aesthetic in nature and not health related.	
	CCP2	Filtration	Turbidity	NA	NA	NA	NA	NA	NA	
Kempsey and Lower Macleay	CCP3	Disinfection	Free Chlorine pH	Outlet of Reservoirs – Greenhill, John Lane, Potters Hill	Daily grab	1.8 mg/L pH 7.5	<1.0 mg/L or > 3 mg/L pH <6.8 or >8.0	<0.6 mg/L or >4 mg/L pH <6.5 or >8.5	Lower chlorine critical limit ensures that C.t is met at the monitoring location. Upper chlorine critical limit ensures that total chlorine does not get >5 mg/L (health limit). No pH correction readily available. Lower pH critical limit protects asset corrosion. Upper pH critical limit ensures efficiency of chlorination is not compromised (ADWG).	
	CCP4	Fluoridation	Fluoride	NA	NA	NA	NA	NA	NA	
	CCP5	Reservoir	Reservoir integrity	All Reservoirs	Monthly	No breach of integrity	Any sign of integrity breach	Evidence of contamination	Ensures treated water does not get contaminated.	

Table A.1b.1 SOP for KLM CCP1 Turbidity at Raw Water Abstraction at Inlet Race - SMD in use

Water Scheme	Kempsey and Lower Macleay – Steuart McIntyre Dam in use		
CCP ID	CCP1		
What is the control point?	Raw Water Abstraction	What are the hazards?	All pathogens
What is being monitored?	Turbidity	Monitoring Frequency:	Continuous online / daily grab (7 days)
Monitoring location	Online instrument / daily grab (combined bore water) to SM Dam Inlet Race		
What will initiate response?	Confirmation of result with immediate grab sample re-test from the SM Dam Inlet Race		

Operating Target <1 NTU	Alert Level 3 NTU	Critical Limit 5 NTU
<ul style="list-style-type: none"> Observe weather and flood warnings Routine site and operational checks Instrument calibration and records maintained Monitor and measure raw water turbidity daily Equipment correlation checks (Bench meter instruments cross checked results against similar instruments) Calibration of online instruments (Programmed Instrument Maintenance Program conducted by Instrument Technicians and external contractors) Visual checks at Bore sites and Bore water monitoring program Individual Bore testing 	<p>Corrective actions</p> <ul style="list-style-type: none"> Confirm with immediate grab sample re-test Contact Team Leader Consider ceasing supply to SM Dam Following confirmation of online result with grab sample. Check Recharge Channel for any water quality impacts such as flooding Check borefield for signs of damage to bore or any impacts to sites areas around bores Investigate operating bores in use at time of sampling to identify source of increased turbidity levels Check individual production bores for turbidity & iron and isolate where required <u>Make arrangements</u> for isolation & repairs to problem bore Check readiness of alternate supply Complete 'Initial Incident Report Form', following confirmation of online result with grab sample. 	<p>Corrective actions</p> <ul style="list-style-type: none"> Follow Alert Level steps Contact Team Leader Team Leader to inform Process Engineer or Manager as soon as possible. Cease borefield supply to SM Dam Check turbidity levels at SM Dam monitoring locations and at Active Transfer Pump to validate any infiltration to receiving reservoirs Check and confirm SM Dam volume for <u>sufficient</u> level as a supply source Process Engineer or Manager to call local PHU as soon as possible Contact Dol for operational advice as needed. Implement additional response actions (e.g. boil water alert) in consultation with local PHU Consider switch to Sherwood Lime Plant (alternative supply), if possible Complete 'Initial Incident Report Form', following confirmation of online result with grab sample.

Table A.1b.2 SOP for KLM CCP1 Turbidity Raw Water Abstraction at Active Pump Transfer – SMD in use

Water Scheme	Kempsey and Lower Macleay – Stuart McIntyre Dam in use		
CCP ID	CCP1		
What is the control point?	Raw Water Abstraction	What are the hazards?	All pathogens
What is being monitored?	Turbidity	Monitoring Frequency:	daily grab (7/days)
Monitoring location	SM Dam outlet from an active transfer pump		
What will initiate response?	Confirmation of result with immediate grab sample re-test		

Operating Target <1 NTU	Alert Level 3 NTU	Critical Limit 5 NTU
<ul style="list-style-type: none"> Routine site and operational checks Instrument calibration and records maintained Monitor and measure raw water turbidity daily Equipment correlation checks (Bench meter instruments cross checked results against similar instruments) Maintain dam at required water level Weekly <u>shore line</u> monitoring for points of erosion (by boat and vehicle) Routine testing from Dam Routine monitoring of compressor run times (7days/wk) and visual checks and maintenance of Aeration line Aeration system to be run for approx. 7 hours during night to mix water body 	<p>Corrective actions</p> <ul style="list-style-type: none"> Confirm with immediate grab sample re-test Contact Team Leader Increase visual monitoring for the formation of surface scum Check online temperature and DO trends to determine if dam has inverted Increase algae monitoring from different levels of offtakes as per Algae Monitoring Plan Select the most suitable offtake level Check aeration line for correct operation Adjust aeration system operational times Increase algae monitoring if algae detected with inclusion of toxin monitoring Adjust disinfection levels at treatment site. Check Sherwood Lime plant in readiness for alternate supply Undertake chlorine decay testing Consider moving into a higher water restriction level Source funding and availability of emergency containerised WTP Contact PHU and DoI Complete 'Initial Incident Report Form' 	<p>Corrective actions</p> <ul style="list-style-type: none"> Contact Team Leader Team Leader to inform Process Engineer or Manager as soon as possible. Process Engineer or Manager to call local PHU as soon as possible. Check turbidity levels downstream to validate any infiltration to receiving reservoirs Review pH Review algae species and toxicity Undertake chlorine decay testing Consider starting Sherwood Lime Plant (alternative supply) if possible Consider Boil water alert (based on pH, algae, and chlorine decay testing) until emergency containerised WTP is sourced. Consider moving into a higher water restriction level Contact DoI for operational advice as needed Consider obtaining emergency containerised WTP Complete 'Initial Incident Report Form'.

Table A.1b.3 SOP for KLM CCP1 Algae, Taste and Odour at Raw Water Abstraction @ In Dam – SMD in use

Water Scheme	Kempsey and Lower Macleay – Stuart McIntyre Dam in use		
CCP ID	CCP1		
What is the control point?	Raw Water Abstraction	What are the hazards?	Taste and Odour compounds, Algae levels and Toxins
What is being monitored?	Algae Counts, Taste & Odour, & MIB/Geosmin levels	Monitoring Frequency:	As per Algal Monitoring Programme
Monitoring location	SM Dam Tower and Monitoring sites 1, 2 and 3		
What will initiate response?	Operator (in field monitoring) or Team Leader (in response to Laboratory results)		

Operating Target No detected T&O or MIB/Geosmin Algae biovolume below Limit	Alert Level Noticeable T&O or MIB/Geosmin > 2 ug/L Algae biovolume at Alert Level 1	Critical Limit Algae biovolume at Alert Level 2
<ul style="list-style-type: none"> Maintain dam at approximately 53m AHD (96% level) when possible. Observe weather warnings Weekly visual monitoring for algal blooms (boat and vehicle) Instrument calibration and records maintained Equipment correlation checks (Bench meter instruments cross checked results against similar instruments) Algae monitoring as per the Algal Monitoring Programme Weekly Operator odour test from grab sample (conducted at same time Tb test) Routine monitoring of compressor run times Aeration system to be run for approx.7 hours during night to mix water body Routine monitoring for nutrients of raw water entering the dam (both in-house and external laboratory testing) 	<p>Corrective actions</p> <ul style="list-style-type: none"> Contact Team Leader Conduct in-house odour testing of raw & boiled water by operational staff Review the aeration operation rates and adjust as required Consider benthic algae inspection and sampling Increase visual monitoring for the formation of surface scum (boat and vehicle) Increase algae monitoring as per Algal Monitoring Programme with inclusion of toxin monitoring Select the most suitable offtake level for use Adjust aeration system operational times Check Sherwood Lime plant in readiness for operation Contact local PHU and DoI Consider moving into a higher water restriction level Source availability and funding of emergency containerised WTP Complete 'Initial Incident Report Form' 	<p>Corrective actions</p> <ul style="list-style-type: none"> Follow Alert Level steps Contact Team Leader Team Leader to inform Process Engineer or Manager Process Engineer or Manager to contact local PHU and DoI Consider starting Sherwood Lime Plant (alternative supply) Consider moving into a higher water restriction level Consider obtaining emergency containerised WTP Complete 'Initial Incident Report Form'

Table A.1b.4 SOP for KLM CCP3 Free Chlorine and pH Disinfection at multiple reservoirs – SMD in use

Water Scheme	Kempsey and Lower Macleay – Stuart McIntyre Dam in use		
CCP ID	CCP3		
What is the control point?	Disinfection and pH correction	What are the hazards?	Chlorine sensitive pathogens
What is being monitored?	Free chlorine residual & pH	Monitoring Frequency:	Daily grab (7 days)
Monitoring location	Reservoir(s) outlet: Greenhill, John Lane, Potters Hill		
What will initiate response?	Confirmation of result with immediate grab sample re-test		

Operating Target	Alert Limit	Critical Limit
SMD – chlorine 1.8 mg/L pH 7.5	SMD - <1.0 or >3 mg/L pH <6.8 or >8.0	SMD – chlorine <0.6 or >4 mg/L pH <6.5 or >8.5
<ul style="list-style-type: none"> • Routine site and operational checks at Dosing Plant • Equipment correlation checks (Bench meter instruments cross checked results against similar instruments) • Chemical dosing rate checks • Disinfection residual checks performed at the outlet of Reservoir • Instrument calibration and records maintained • Chemical procurement and delivery requirements • Calibration of online instruments (Programmed Instrument Maintenance Program conducted by Instrument Technicians and external contractors) • Regular inspection of the lime dosing system including cleaning of injection lines for change over • Flow meter checks • Redox probes within Reservoirs 	<p style="color: #ff0000;">Corrective actions</p> <ul style="list-style-type: none"> • Confirm result with an immediate re-sample. • Validate disinfection levels (using high ranges or dilution methods if required) • Contact Team Leader • Check disinfection levels from primary dosing and adjust as required • Check raw water conditions • Check disinfection levels in Reservoir and manually dose if required (Refer Reservoir Manual Chlorine Dose Calculator) • Check integrity of Reservoir for any breaches or unauthorised access • Check primary dosing equipment (circulation pumps, injection point) • Consider scouring, flushing and sampling in the network where appropriate • Complete 'Initial Incident Report Form', 	<p style="color: #ff0000;">Corrective actions</p> <ul style="list-style-type: none"> • Follow Alert Level steps • Test for total chlorine if free chlorine is >4 mg/L. Total chlorine should not be >5 mg/L. • Contact Team Leader • Team Leader to inform Process Engineer or Manager as soon as possible. • Take micro-sample for low disinfection levels • Process Engineer or Manager to call local PHU as soon as possible. • Contact DoI for operational advice as needed. • Consider boil water alert in consultation with local PHU. • Consider moving into a higher water restriction level • Consider obtaining emergency containerised WTP. • Complete 'Initial Incident Report Form',

Table A.1b.5 SOP for KLM CCP5 Reservoir Integrity - SMD in use

Water Scheme	Kempsey and Lower Macleay - Steuart McIntyre Dam in use		
CCP ID	CCP5		
What is the control point?	Reservoir	What are the hazards?	All pathogens and all chemicals
What is being monitored?	Reservoir integrity	Monitoring Frequency:	Monthly
Monitoring location	All service reservoirs		
What will initiate response?	Any sign of reservoir integrity breach		

Operating Target No breach of integrity	Adjustment Limit Any sign of integrity breach	Critical Limit Evidence of contamination
<ul style="list-style-type: none"> Reservoir inspection program (routine) with records maintained Scheduled contractor reservoir cleaning and inspection program 	<p>Corrective actions</p> <ul style="list-style-type: none"> Conduct visual inspection (outside & inside) Check disinfection levels in Reservoir and top up if required (Refer to Reservoir Manual Chlorine Dose Calculator) Increase chlorine dose at plant, if needed Contact Team Leader Repair breach of integrity. Increase inspections until repaired Consider notifying local PHU Complete 'Initial Incident Report Form' 	<p>Corrective actions</p> <ul style="list-style-type: none"> Follow Alert Level corrective actions Contact Team Leader Team Leader to inform Process Engineer or Manager as soon as possible. Take micro-sample if required Remove contaminants, if safe to do so Process Engineer or Manager to call local PHU as soon as possible. Contact DoI for operational advice as needed. Implement additional response actions (e.g. boil water alert) in consultation with local PHU. Complete 'Initial Incident Report Form'

Table A.2 CCP Crescent Head Water Supply

Scheme	CCP ID	Control Point	Control Parameter	Testing Location	Frequency	Target	Alert Level	Critical Limit	Justification for critical limit
Crescent Head	CCP1	Raw Water Abstraction	Turbidity	Front Dam	Daily grab	<1 NTU	4 NTU	5 NTU	There is no filtration undertaken, critical limit provides an interim barrier to control contaminant/ microbial load. Plant is shut off manually at critical limit.
	CCP2	Filtration	Turbidity	NA	NA	NA	NA	NA	NA
	CCP3	Disinfection	Free Chlorine	Back Beach Reservoir Outlet	Daily grab	1.5 mg/L pH 7.5	<0.7 or >3 mg/L pH <6.8 or >8.0	<0.5 or >4 mg/L pH <6.5 or >8.5	Lower chlorine critical limit ensures that C.t is met at the monitoring location. Upper chlorine critical limit ensures that total chlorine does not get >5 mg/L (health limit). Lower pH critical limit protects asset corrosion. Upper pH critical limit ensures efficiency of chlorination is not compromised (ADWG).
	CCP4	Fluoridation	Fluoride	NA	NA	NA	NA	NA	NA
	CCP5	Reservoirs	Reservoir integrity	All reservoirs	Monthly	No breach of integrity	Any sign of integrity breach	Evidence of contamination	Ensures treated water does not get contaminated.

Note: Daily grab is taken 7 days/week

Table A.2.1 SOP for CH CCP1 Turbidity Raw Water Abstraction at Front Dam

Water Scheme	Crescent Head		
CCP ID	CCP1		
What is the control point?	Raw Water Abstraction	What are the hazards?	All pathogens
What is being monitored?	Turbidity	Monitoring Frequency:	Daily grab (7 days)
Monitoring location	Front Dam		
What will initiate response?	Confirmation of result with immediate follow up test		

Operating Target <1 NTU	Alert Level 4 NTU	Critical Limit 5 NTU
<ul style="list-style-type: none"> • Routine site and operational checks • Equipment correlation checks (Bench meter instruments cross checked results against similar instruments). • Monitor and measure raw water turbidity daily at the Front Dam, weekly at the combined Balance Tank and weekly at individual Bores • Visual checks at Bore sites and Bore water monitoring program • Visual Inspections for Algae in Dam daily 	<p>Corrective actions</p> <ul style="list-style-type: none"> • Repeat manual test to confirm result • Investigate bore integrity and Collection Tank for contamination • Test turbidity for each bore and Collection Tank and isolate problem bore if required. • Contact Team Leader • Check turbidity at Back Beach Reservoir. • Check Total Chlorine levels at Back Beach Reservoir (refer to Chlorination SOP) • Increase Total Chlorine dose at plant, if needed • Initiate an incident algal monitoring program in Front Dam if required. • Complete 'Initial Incident Report Form', following confirmation with grab sample. 	<p>Corrective actions</p> <ul style="list-style-type: none"> • Follow Alert Level steps • Contact Team Leader • Team Leader to inform, Process Engineer or Manager as soon as possible. • Isolate and contain source of high turbidity • Shutdown the Dosing Plant • Consider alternative water supply/storage where possible (i.e. Onsite Raw water tanks) • Maintain appropriate disinfection levels in the network • Check turbidity levels downstream to validate any infiltration to Dosing (if automatic shutdown has failed) • Consider isolation & scour the Collection Tank • Process Engineer or Manager to call local PHU as soon as possible • Contact DoI for operational advice as needed. • Implement additional response actions (e.g. boil water alert) in consultation with local PHU. • Complete 'Initial Incident Report Form', following confirmation with grab sample

Table A.2.2 SOP for CH CCP3 Free Chlorine and pH Disinfection at Back Beach Reservoir

Water Scheme	Crescent Head		
CCP ID	CCP3		
What is the control point?	Disinfection (chlorine gas and Calcium Hypochlorite pills) and pH correction (lime & CO ₂)	What are the hazards?	Chlorine sensitive pathogens
What is being monitored?	Free chlorine residual & pH	Monitoring Frequency:	Daily grab (7 days)
Monitoring location	Back Beach Reservoir outlet		
What will initiate response?	Confirmation of result with immediate follow up test		

Operating Target 1.5 mg/L pH 7.5	Alert Limit <0.7 or >3 mg/L pH <6.8 or >8.0	Critical Limit <0.5 or >4 mg/L pH <6.5 or >8.5
<ul style="list-style-type: none"> Routine site and operational checks at Dosing Plant Equipment correlation checks (Bench meter instruments cross checked results against similar instruments. Chlorine gas, CO₂ & lime dose rate checks Disinfection residual checks performed at the outlet of Reservoir Instrument calibration and records maintained Chemical procurement and delivery requirements Regular inspection of the lime dosing system including cleaning of injection lines for change over Chemical storage levels monitoring 	<p>Corrective actions</p> <ul style="list-style-type: none"> Confirm result with an immediate re-sample. Validate disinfection levels (using high ranges or dilution methods if required) Check primary dosing equipment and gas cylinder weight (physically by rocking) Contact Team Leader Check disinfection levels from primary dosing and adjust as required Check raw water conditions Check disinfection levels in Reservoir and manually dose if required (Refer Reservoir Manual Chlorine Dose Calculator) Check integrity of Reservoir for any breaches or unauthorised access Consider scouring, flushing and sampling in the network where appropriate Complete 'Initial Incident Report Form', following confirmation with grab sample 	<p>Corrective actions</p> <ul style="list-style-type: none"> Follow Alert Level steps Test for total chlorine if free chlorine is >4 mg/L. Total chlorine should not be >5 mg/L. Contact Team Leader Team Leader to inform Process Engineer or Manager as soon as possible. Consider taking micro-sample for low disinfection levels Process Engineer or Manager to call local PHU as soon as possible. Contact DoI for operational advice as needed. Implement additional response actions (e.g. boil water alert) in consultation with local PHU. Complete 'Initial Incident Report Form', following confirmation with grab sample.

Table A.2.3 SOP for CH CCP5 Reservoir Integrity at all Reservoirs

Water Scheme	Crescent Head		
CCP ID	CCP5		
What is the control point?	Reservoir	What are the hazards?	All pathogens and all chemicals
What is being monitored?	Reservoir integrity	Monitoring Frequency:	Monthly
Monitoring location	All service reservoirs (Back Beach & Big Nobby)		
What will initiate response?	Any sign of reservoir integrity breach		

Operating Target No breach of integrity	Adjustment Limit Any sign of integrity breach	Critical Limit Evidence of contamination
<ul style="list-style-type: none"> Reservoir inspection program (routine) with records maintained Scheduled contractor reservoir cleaning and inspection program 	<p>Corrective actions</p> <ul style="list-style-type: none"> Conduct visual inspection (outside & inside) Check disinfection levels in Reservoir and top up if required (Refer to Reservoir Manual Chlorine Dose Calculator) Increase chlorine dose at plant, if needed Contact Team Leader Repair breach of integrity Consider notifying local PHU Complete 'Initial Incident Report Form' 	<p>Corrective actions</p> <ul style="list-style-type: none"> Follow Alert Level corrective actions Contact Team Leader Team Leader to inform Process Engineer or Manager as soon as possible. Take micro-sample if required Remove contaminants, if safe to do so Process Engineer or Manager to call local PHU as soon as possible. Contact DoI for operational advice as needed. Implement additional response actions (e.g. boil water alert) in consultation with local PHU. Complete 'Initial Incident Report Form'

Table A.3 CCP Hat Head Water Supply

Scheme	CCP ID	Control Point	Control Parameter	Testing Location	Frequency	Target	Alert Level	Critical Limit	Justification for critical limit
Hat Head	CCP1	Raw Water Abstraction	Turbidity	Raw Water Inlet	Continuous online / grab sample	<1 NTU	2 NTU	4 NTU	There is no filtration undertaken, critical limit provides an interim barrier to control contaminant/ microbial load. Plant is shut off at critical limit.
	CCP2	Filtration	Turbidity	NA	NA	NA	NA	NA	NA
	CCP3	Disinfection	Free Chlorine	Clear water to retic leaving dosing plant	Continuous online / grab sample	1 mg/L pH 7.5	<0.6 or >3 mg/L pH <6.8 or >8.0	<0.5 or >4 mg/L pH <6.5 or >8.5	Lower chlorine critical limit ensures that C.t is met at the monitoring location. Upper critical chlorine limit ensures that total chlorine does not get >5 mg/L (health limit). Lower pH critical limit protects asset corrosion. Upper pH critical limit ensures efficiency of chlorination is not compromised (ADWG).
	CCP4	Fluoridation	Fluoride	NA	NA	NA	NA	NA	NA
	CCP5	Reservoirs	Reservoir integrity	All reservoirs	Monthly	No breach of integrity	Any sign of integrity breach	Evidence of contamination	Upon advice from NSW Health. Ensures treated water does not get re-contaminated.

Note: Grab sample is taken daily (7 days/week). Raw Water Abstraction and Disinfection CCPs have continuous online monitoring.

Table A.3.1 SOP for HH CCP1 Turbidity Raw Water Abstraction at Plant Inlet

Water Scheme	Hat Head		
CCP ID	CCP1		
What is the control point?	Raw Water Abstraction	What are the hazards?	All pathogens
What is being monitored?	Turbidity	Monitoring Frequency:	Continuous online / daily grab (7 days)
Monitoring location	Raw Water Inlet to dosing plant		
What will initiate response?	Confirmation of online result with grab sample		

Operating Target <1 NTU	Alert Level 2 NTU	Critical Limit 4 NTU
<ul style="list-style-type: none"> Routine site and operational checks Instrument calibration and records maintained Monitor and measure raw water turbidity daily Equipment correlation checks (Bench meter instruments cross checked results against similar instruments) Calibration of online instruments (Programmed Instrument Maintenance Program conducted by Instrument Technicians and external contractors) Visual checks at Bore sites and Bore water monitoring program Aeration system maintenance & operation Balance Tank cleaning program 	<p>Corrective actions</p> <ul style="list-style-type: none"> Confirm or cross check online turbidity with portable instrument and clean if needed Contact Team Leader Check Balance Tank for turbidity and iron levels Check diffuser/ aeration operation within Balance Tank Check individual production Bores for turbidity & iron and isolate where required Dose chlorine to Reservoirs and/or increase dose at plant, if needed Consider shutting dosing plant down Complete '<i>Initial Incident Report Form</i>', following confirmation of online result with grab sample. 	<p>Corrective actions</p> <ul style="list-style-type: none"> Follow Alert Level steps Contact Team Leader Team Leader to inform Process Engineer or Manager as soon as possible. Shut down the treatment plant Check turbidity levels downstream to validate any infiltration to dosing plant (if automatic shutdown has failed) Consider isolation & scour the Balance Tank Process Engineer or Manager to call local PHU as soon as possible. Contact DoI for operational advice as needed. Implement additional response actions (e.g. boil water alert) in consultation with local PHU. Complete '<i>Initial Incident Report Form</i>', following confirmation of online result with grab sample.

Table A.3.2 SOP for HH CCP3 Free Chlorine and pH Disinfection at outlet of Reservoirs

Water Scheme	Hat Head		
CCP ID	CCP3		
What is the control point?	Disinfection (Chlorine gas) & pH correction (Soda ash)	What are the hazards?	Chlorine sensitive pathogens
What is being monitored?	Free chlorine residual & pH	Monitoring Frequency:	Continuous (online) / daily grab (7 days)
Monitoring location	Clear water to reticulation – leaving dosing plant		
What will initiate response?	Confirmation of online result with grab sample		

Operating Target 1mg/L pH 7.5	Alert Limit <0.6 or >3 mg/L pH <6.8 or >8.0	Critical Limit <0.5 or >4 mg/L pH <6.5 or >8.5
<ul style="list-style-type: none"> Routine site and operational checks at DOSING PLANT Equipment correlation checks (Bench meter instruments cross checked results against similar instruments) Soda ash and chlorine gas dose rate checks Disinfection residual checks performed at the outlet of Reservoir Instrument calibration and records maintained Chemical procurement and delivery requirements Calibration of online instruments (Programmed Instrument Maintenance Program conducted by Instrument Technicians and external contractors) Regular inspection of the Soda ash dosing system Chemical storage levels monitoring 	<p>Corrective actions</p> <ul style="list-style-type: none"> Confirm or cross check online result with portable instrument Validate disinfection levels (using high ranges or dilution methods if required) Check primary dosing equipment and adjust as required Contact Team Leader Check disinfection levels from primary dosing and adjust as required Check raw water conditions Check disinfection levels in Reservoir and manually dose if required (Refer Reservoir Manual Chlorine Dose Calculator) Check integrity of Reservoir for any breaches or unauthorised access Consider scouring, flushing and sampling in the network where appropriate Complete 'Initial Incident Report Form', following confirmation of online result with grab sample. 	<p>Corrective actions</p> <ul style="list-style-type: none"> Follow Alert Level steps Test for total chlorine if free chlorine is >4 mg/L. Total chlorine should not be >5 mg/L. Contact Team Leader Team Leader to inform Process Engineer or Manager as soon as possible. Consider taking micro-sample for low disinfection levels Process Engineer or Manager to call local PHU as soon as possible. Contact Dol for operational advice as needed. Implement additional response actions (e.g. boil water alert) in consultation with local PHU. Complete 'Initial Incident Report Form', following confirmation of online result with grab sample.

Table A.3.3 SOP for HH CCP5 Reservoir Integrity at all Reservoirs

Water Scheme	Hat Head		
CCP ID	CCP5		
What is the control point?	Reservoir	What are the hazards?	All pathogens and all chemicals
What is being monitored?	Reservoir integrity	Monitoring Frequency:	Monthly
Monitoring location	All service reservoirs		
What will initiate response?	Any sign of reservoir integrity breach		

Operating Target No breach of integrity	Adjustment Limit Any sign of integrity breach	Critical Limit Evidence of contamination
<ul style="list-style-type: none"> Reservoir inspection program (routine) with records maintained Scheduled contractor reservoir cleaning and inspection program 	<p>Corrective actions</p> <ul style="list-style-type: none"> Conduct visual inspection (outside & inside) Check disinfection levels in Reservoir and top up if required (Refer to Reservoir Manual Chlorine Dose Calculator) Increase chlorine dose at plant, if needed Contact Team Leader Repair breach of integrity Consider notifying local PHU Complete '<i>Initial Incident Report Form</i>' 	<p>Corrective actions</p> <ul style="list-style-type: none"> Follow Alert Level corrective actions Contact Team Leader Team Leader to inform Process Engineer or Manager as soon as possible. Take micro-sample if required Remove contaminants, if safe to do so Process Engineer or Manager to call local PHU as soon as possible. Contact DoI for operational advice as needed. Implement additional response actions (e.g. boil water alert) in consultation with local PHU. Complete '<i>Initial Incident Report Form</i>'

Table A.4 CCP South West Rocks Water Supply

Scheme	CCP ID	Control Point	Indicator Parameter	Testing Location	Frequency	Target	Alert Level	Critical Limit	Justification for critical limit
South West Rocks	CCP1	Raw Water Abstraction	Turbidity	Inlet to WTP	Continuous online / daily grab	<5 NTU	10 NTU	20 NTU	Plant is shut off for turbidity >20 NTU for membrane protection. [Note: online result is verified with grab sample].
	CCP2	Filtration	Turbidity	After filters at WTP / on main after transfer pump	Continuous online / daily grab	<0.1 NTU	0.5 NTU	1 NTU	Critical limit ensures solids removal and that effectiveness of chlorination is maintained. Protozoa risk is low as source is bores. [Note: online result is verified with grab sample].
	CCP3	Disinfection	Free Chlorine pH	Reservoir outlet	Daily grab	1.2 mg/L pH 7.5	<0.8 or >3 mg/L pH <6.8 or >8.0	<0.6 mg/L or >4 mg/L pH <6.5 or >8.5	Lower chlorine critical limit ensures that C.t is met at the monitoring location. Upper chlorine critical limit ensures that total chlorine does not get >5 mg/L (health limit). Lower pH critical limit protects asset corrosion. Upper pH critical limit ensures efficiency of chlorination is not compromised (ADWG).
	CCP4	Fluoridation	Fluoride	Leaving WTP & Gregory St Res Outlet	Continuous online / daily grab	1 mg/L	<0.9 mg/L for >72 hrs OR >1.2 mg/L	>1.5 mg/L	One of the monitoring points is located downstream of dosing but prior to any reservoir/tank, as per Fluoridation Code. Critical limit is set at the health guideline value.
	CCP5	Reservoir	Reservoir integrity	All Reservoirs	Monthly	No breach of integrity	Any sign of integrity breach	Evidence of contamination	Ensures treated water does not get contaminated.

Note: Grab sample is taken daily (7 days/week). Raw water abstraction, Filtration and Fluoridation CCPs have continuous online monitoring.

Table A.4.1 SOP for SWR CCP1 Turbidity Raw Water Abstraction at Inlet to WTP

Water Scheme	South West Rocks		
CCP ID	CCP1		
What is the control point?	Raw Water Abstraction	What are the hazards?	All pathogens
What is being monitored?	Turbidity	Monitoring Frequency:	Continuous online / daily grab (7 days)
Monitoring location	Inlet to WTP		
What will initiate response?	Confirmation of online result with grab sample		

Operating Target <5 NTU	Alert Level 10 NTU	Critical Limit 20 NTU
<ul style="list-style-type: none"> Routine site and operational checks Instrument calibration and records maintained Monitor and measure raw water turbidity Equipment correlation checks (Bench meter instruments cross checked results against similar instruments). Calibration of online instruments (Programmed Instrument Maintenance Program conducted by Instrument Technicians and external contractors) Visual checks at Bore sites and Bore water monitoring program Aeration system maintenance & operation Balance Tank cleaning program 	<p>Corrective actions</p> <ul style="list-style-type: none"> Confirm or cross check online turbidity with portable instrument and clean if needed Contact Team Leader Check Balance Tank for turbidity and iron levels Check diffuser/ aeration operation within Balance Tank Check individual production Bores for turbidity & iron and isolate where required Consider shutting WTP down Complete '<i>Initial Incident Report Form</i>', following confirmation of online result with grab sample. 	<p>Corrective actions</p> <ul style="list-style-type: none"> Follow Alert Level steps Contact Team Leader Team Leader to inform Process Engineer or Manager as soon as possible. Ensure automatic interlock has shut down the treatment plant, otherwise shutdown the system Check turbidity levels downstream to validate any infiltration to WTP (if automatic shutdown has failed) Consider isolation & scour the Balance Tank Process Engineer or Manager to call local PHU as soon as possible. Contact Dol for operational advice as needed. Implement additional response actions (e.g. boil water alert) in consultation with the local PHU. Complete '<i>Initial Incident Report Form</i>', following confirmation of online result with grab sample.

Table A.4.2 SOP for SWR CCP2 Turbidity Filtration at Outlet of filters

Water Scheme	South West Rocks		
CCP ID	CCP2		
What is the control point?	Membrane Filtration	What are the hazards?	All pathogens
What is being monitored?	Turbidity	Monitoring Frequency:	Continuous online / daily grab (7 days)
Monitoring location	After filters at WTP / on main after transfer pump		
What will initiate response?	Confirmation of online result with grab sample		

Operating Target <0.1 NTU	Alert Limit 0.5 NTU	Critical Limit 1 NTU
<ul style="list-style-type: none"> Routine site and operational checks Instrument calibration and records maintained Calibration of online instruments (Programmed Instrument Maintenance Program conducted by Instrument Technicians and external contractors) Daily automatic backwashing and extended backwashing of membranes Regular MIT and Manual initiated clean, ensure membrane replacement and repair program is current and up to date Actions related to coagulants, pH correction, screen at head of plant, pH correction of membrane sump, etc. Note: Results are recorded and actioned as per GE membrane recommendations Chemical procurement and delivery requirements 	<p>Corrective actions</p> <ul style="list-style-type: none"> Confirm or cross check online turbidity with manual instrument Check trans-membrane pressure and initiate a CIP if required Check turbidity of raw water into plant Check upstream chemical dosing Isolation of modules that may be leaking and repair ASAP to ensure full treatment capacity of membrane train Contact Team Leader Complete 'Initial Incident Report Form', following confirmation of online result with grab sample. 	<p>Corrective actions</p> <ul style="list-style-type: none"> Follow Alert Level steps Contact Team Leader Team Leader to inform Process Engineer or Manager as soon as possible. Automatic shutdown of treatment plant Check Reservoir Turbidity, if automatic shutdown has failed Consider isolation & scour of the Reservoir where appropriate Check turbidity in distribution and flush mains if appropriate Process Engineer or Manager to call local PHU as soon as possible. Contact Dol for operational advice as needed. Implement additional response actions (e.g. boil water alert) in consultation with PHU. Complete 'Initial Incident Report Form', following confirmation of online result with grab sample.

Table A.4.3 SOP for SWR CCP3 Free Chlorine and pH Disinfection at Reservoir

Water Scheme	South West Rocks		
CCP ID	CCP3		
What is the control point?	Disinfection (sodium hypochlorite) and pH correction (lime)	What are the hazards?	Chlorine sensitive pathogens
What is being monitored?	Free chlorine & pH	Monitoring Frequency:	Daily grab (7 days)
Monitoring location	Gregory Street Reservoir outlet		
What will initiate response?	Confirmation of result with immediate follow up grab sample test		

Operating Target 1.2 mg/L pH 7.5	Alert Limit <0.8 or >3 mg/L pH <6.8 or >8.0	Critical Limit <0.6 or >4 mg/L pH <6.5 or >8.5
<ul style="list-style-type: none"> Routine site and operational checks at WTP. Equipment correlation checks (Bench meter instruments cross checked results against similar instruments). Lime and Sodium Hypochlorite dose rate checks Disinfection residual checks performed at the outlet of Reservoir Instrument calibration and records maintained Chemical procurement and delivery requirements Calibration of online instruments (Programmed Instrument Maintenance Program conducted by Instrument Technicians and external contractors) Regular inspection of the lime dosing system including cleaning of injection lines for change over Chemical storage levels monitoring 	<p>Corrective actions</p> <ul style="list-style-type: none"> Confirm result with an immediate re-sample. Validate disinfection levels (using high ranges or dilution methods if required) Check primary dosing equipment and hypo concentration and adjust as required Contact Team Leader Check disinfection levels from primary dosing and adjust as required Check upstream processes (mixing tanks, pH correction, membrane filters) Check raw water conditions Check disinfection levels in Reservoir and top up if required (Refer Reservoir Manual Chlorine Dose Calculator) Check integrity of Reservoir for any breaches or unauthorised access Consider scouring, flushing and sampling in the network where appropriate Complete 'Initial Incident Report Form', following confirmation of result with another test. 	<p>Corrective actions</p> <ul style="list-style-type: none"> Follow Alert Level steps Test for total chlorine if free chlorine is >4 mg/L. Total chlorine should not be >5 mg/L. Contact Team Leader Team Leader to inform Process Engineer or Manager as soon as possible. Consider taking micro-sample for low disinfection levels Process Engineer or Manager to call local PHU as soon as possible. Contact DoI for operational advice as needed. Implement additional response actions (e.g. boil water alert) in consultation with local PHU. Complete 'Initial Incident Report Form', following confirmation of result with another test.

Table A.4.4 SOP for SWR CCP4 Fluoride Fluoridation at WTP post dosing and Gregory St Reservoir

Water Scheme	South West Rocks		
CCP ID	CCP4		
What is the control point?	Fluoridation	What are the hazards?	Over or under-dose of fluoride
What is being monitored?	Fluoride concentration	Monitoring Frequency:	Continuous online / daily grab (7days)
Monitoring location	Monitoring point is downstream of dosing but prior to reservoir and outlet of Gregory St Reservoir		
What will initiate response?	Confirmation of online result with grab sample		

Operating Target 1 mg/L	Alert Limit <0.9 for >72 hrs OR >1.2 mg/L	Critical Limit >1.5 mg/L
<ul style="list-style-type: none"> • Visual inspection of the system • Raw water testing as required • Daily measurement of volume treated, and weight fluoride dosed with calculation of average daily fluoride concentration • Daily testing at outlet to water filtration plant (after transfer pumps) and outlet from Gregory St reservoir • Flow meter calibrations (MCT & KSC Techs) • Chemical procurement and delivery requirements • Weekly testing in distribution system • Weight records for Fluoride dosing • Regular service by contractor 	<p>Corrective actions</p> <ul style="list-style-type: none"> • Confirm or cross check online result with manual instrument • Confirm calculations • Conduct screw feeder and pump drop tests • Confirm current WTP flow rate and fluoride dosing rate • Adjust fluoride powder screw feeder • Test concentration leaving WTP more frequently • Consider temporarily shutting down fluoride dosing system • Contact Team Leader • Complete 'Initial Incident Report Form', following confirmation of online result with grab sample. • Complete Form 5 and submit to local PHU & NSW Health if fluoride level is <0.9 mg/L for more than 72hrs (3 consecutive days) 	<p>Corrective actions</p> <ul style="list-style-type: none"> • Follow Alert Level steps • Shutdown fluoride dosing system • Contact Team Leader • Team Leader to inform Process Engineer or Manager as soon as possible. • Test fluoride in Reservoirs and reticulation • Identify cause & rectify problem • Refer to Fluoride Overdose Response Plan • Process Engineer or Manager to call local PHU as soon as possible. • Contact DoI for operational advice as needed. • Complete 'Initial Incident Report Form', following confirmation of online result with grab sample.

Table A.4.5 SOP for SWR CCP5 Reservoir Integrity at all Reservoirs

Water Scheme	South West Rocks		
CCP ID	CCP5		
What is the control point?	Reservoir	What are the hazards?	All pathogens and all chemicals
What is being monitored?	Reservoir integrity	Monitoring Frequency:	Monthly
Monitoring location	All service reservoirs (Gregory St & New Entrance)		
What will initiate response?	Any sign of reservoir integrity breach		

Operating Target No breach of integrity	Adjustment Limit Any sign of integrity breach	Critical Limit Evidence of contamination
<ul style="list-style-type: none"> Reservoir inspection program (routine) with records maintained Scheduled contractor reservoir cleaning and inspection program 	<p>Corrective actions</p> <ul style="list-style-type: none"> Conduct visual inspection (outside & inside) Check disinfection levels in Reservoir and top up if required (Refer to Reservoir Manual Chlorine Dose Calculator) Increase chlorine dose at plant, if needed Contact Team Leader Repair breach of integrity Consider notifying local PHU Complete '<i>Initial Incident Report Form</i>' 	<p>Corrective actions</p> <ul style="list-style-type: none"> Follow Alert Level corrective actions Contact Team Leader Team Leader to inform Process Engineer or Manager as soon as possible. Take micro-sample if required Remove contaminants, if safe to do so Process Engineer or Manager to call local PHU as soon as possible. Contact Dol for operational advice as needed. Implement additional response actions (e.g. boil water alert) in consultation with local PHU. Complete '<i>Initial Incident Report Form</i>'

Table A.5 CCP Stuarts Point Water Supply

System	CCP ID	Control Point	Control Parameter	Testing Location	Frequency	Target	Alert Level	Critical Limit	Justification for critical limit
Stuarts Point	CCP1	Raw Water Abstraction	Turbidity	Raw Water Sample point (prior to pH and pre-disinfection)	Grab sample	<0.5 NTU	3 NTU	5 NTU	Plant is shut off at critical limit.
	CCP2	Filtration	Turbidity	Post filtration (inlet to clearwater tank)	Continuous online / grab sample	<0.3 NTU	0.8 NTU	1 NTU	Critical limit ensures solids removal and that effectiveness of chlorination is maintained. Protozoa risk is low as source is bores. [Note: online result is verified with grab sample].
	CCP3	Disinfection	Free Chlorine	Stuarts Point Reservoir Outlet	Continuous online / grab sample	1 mg/L	<0.8 or >3mg/L	<0.6 or >4 mg/L	Lower chlorine critical limit ensures that C.t is met at the monitoring location. Upper chlorine critical limit ensures that total chlorine does not get >5 mg/L (health limit). No pH correction undertaken. [Note: online result is verified with grab sample].
	CCP4	Fluoridation	Fluoride	NA	NA	NA	NA	NA	NA
	CCP5	Reservoirs	Reservoir integrity	All reservoirs	Monthly	No breach of integrity	Any sign of integrity breach	Evidence of contamination	Ensures treated water does not get contaminated.

Note: Grab sample is taken daily (7 days/week). Disinfection and Filtration CCPs have continuous online monitoring.

Table A.5.1 SOP for SP CCP1 Turbidity Raw Water Abstraction at WTP before disinfection

Water Scheme	Stuarts Point		
CCP ID	CCP1		
What is the control point?	Raw Water Abstraction	What are the hazards?	All pathogens
What is being monitored?	Turbidity	Monitoring Frequency:	Daily grab (5 days)
Monitoring location	Raw Water Sample point (prior to pH and pre-disinfection)		
What will initiate response?	Confirmation of result with immediate follow up grab sample test		

Operating Target <0.5 NTU	Alert Level 3 NTU	Critical Limit 5 NTU
<ul style="list-style-type: none"> Routine site and operational checks Instrument calibration and records maintained Monitor and measure raw water turbidity daily at the CCP1 monitoring point and 2/weekly at individual bores Equipment correlation checks (Bench meter instruments cross checked results against similar instruments) Calibration of online instruments (Programmed Instrument Maintenance Program conducted by Instrument Technicians and external contractors) Visual checks at Bore sites and Bore water monitoring program Clearwater Tank cleaning program 	<p>Corrective actions</p> <ul style="list-style-type: none"> Confirm result by re-testing Contact Team Leader Re-adjust chemical dosing to accommodate lowered flow rate if appropriate Check Clearwater Tank for turbidity and iron levels Check individual production Bores for turbidity & iron and isolate where required Consider shutting WTP down Complete 'Initial Incident Report Form', following confirmation of result with re-test sample. 	<p>Corrective actions</p> <ul style="list-style-type: none"> Follow Alert Level steps Contact Team Leader Team Leader to inform Process Engineer or Manager as soon as possible. Shutdown the system Check turbidity levels downstream to validate any infiltration to WTP Consider isolation & scour the Clearwater Tank Process Engineer or Manager to call local PHU as soon as possible. Contact DoI for operational advice as needed. Implement additional response actions (e.g. boil water alert) in consultation with local PHU. Complete 'Initial Incident Report Form', following confirmation of result with re-test sample.

Table A.5.2 SOP for SP CCP2 Turbidity Filtration at WTP post filtration

Water Scheme	Stuarts Point		
CCP ID	CCP2		
What is the control point?	Filtration	What are the hazards?	Heavy metals and pathogens
What is being monitored?	Turbidity	Monitoring Frequency:	Continuous online & daily grab (5 days)
Monitoring location	Post filtration (inlet to clearwater tank)		
What will initiate response?	Confirmation of online result with grab sample		

Operating Target <0.1 NTU	Alert Limit 0.5 NTU	Critical Limit 1 NTU
<ul style="list-style-type: none"> Routine site and operational checks Instrument calibration and records maintained Calibration of online instruments (Programmed Instrument Maintenance Program conducted by Instrument Technicians and external contractors) Ferric chloride dosing equipment and dosage rate checks Chemical procurement and delivery requirements 	<p>Corrective actions</p> <ul style="list-style-type: none"> Confirm or cross check online turbidity with manual instrument Visually check water quality on top of filters Adjust <u>air-line</u> and check air-line is working Check for filter blockage Check turbidity of raw water into plant Check upstream chemical dosing Contact Team Leader Complete '<i>Initial Incident Report Form</i>', following confirmation of online result with grab sample. 	<p>Corrective actions</p> <ul style="list-style-type: none"> Follow Alert Level steps Contact Team Leader Team Leader to inform Process Engineer or Manager as soon as possible. Automatic shutdown of treatment plant Check Reservoir Turbidity, if automatic shutdown has failed Consider isolation & scour of the Clearwater tank where appropriate Check turbidity in Reservoir and distribution and flush mains if appropriate Process Engineer or Manager to call local PHU as soon as possible. Contact DoI for operational advice as needed. Implement additional response actions (e.g. boil water alert) in consultation with local PHU. Complete '<i>Initial Incident Report Form</i>', following confirmation of online result with grab sample.

Table A.5.3 SOP for SP CCP3 Free Chlorine Disinfection at Clear Water Tank

Water Scheme	Stuarts Point		
CCP ID	CCP3		
What is the control point?	Disinfection (chlorine gas) & pH correction (soda ash) when in use	What are the hazards?	Chlorine sensitive pathogens
What is being monitored?	Free chlorine residual	Monitoring Frequency:	Continuous online & daily grab (7 days)
Monitoring location	Stuarts Point Reservoir outlet		
What will initiate response?	Confirmation of online result with grab sample		

Operating Target 1 mg/L	Alert Limit <0.8 or >3 mg/L	Critical Limit <0.6 or >4 mg/L
<ul style="list-style-type: none"> Routine site and equipment <u>checks</u> at WTP Instrument calibration and records maintained Equipment correlation checks (Bench meter instruments cross checked results against similar instruments) Calibration of online instruments (Programmed Instrument Maintenance Program conducted by Instrument Technicians and external contractors) Soda ash and chlorine gas dose rate checks Disinfection residual checks performed at the outlet of Reservoir Chemical procurement and delivery requirements Chemical storage levels monitoring 	<p>Corrective actions</p> <ul style="list-style-type: none"> Confirm or cross check online result with manual instrument Validate disinfection levels (using high ranges or dilution methods if required) Check pre and post chlorine dosing Check the flow rates coming into plant Contact Team Leader Check disinfection levels from primary dosing and adjust as required Check upstream processes (mixing tanks, pH correction, membrane filters) Check raw water conditions Check disinfection levels in Reservoir and top up if required (Refer Reservoir Manual Chlorine Dose Calculator) Check integrity of CWT for any breaches or unauthorised access Consider scouring, flushing and sampling in the network where appropriate Complete '<i>Initial Incident Report Form</i>', following confirmation of online result with grab sample. 	<p>Corrective actions</p> <ul style="list-style-type: none"> Follow Alert Level steps Test for total chlorine if free chlorine is >4 mg/L. Total chlorine should not be >5 mg/L. Contact Team Leader Team Leader to inform Process Engineer or Manager as soon as possible. Consider taking micro-sample for low disinfection levels Process Engineer or Manager to call local PHU as soon as possible. Contact DoI for operational advice as needed. Implement additional response actions (e.g. boil water alert) in consultation with local PHU. Complete '<i>Initial Incident Report Form</i>', following confirmation of online result with grab sample.

Table A.5.4 SOP for SP CCP5 Reservoir Integrity at all Reservoirs

Water Scheme	Stuarts Point		
CCP ID	CCP5		
What is the control point?	Reservoir	What are the hazards?	All pathogens and all chemicals
What is being monitored?	Reservoir integrity	Monitoring Frequency:	Monthly
Monitoring location	All service reservoirs		
What will initiate response?	Any sign of reservoir integrity breach		

Operating Target No breach of integrity	Adjustment Limit Any sign of integrity breach	Critical Limit Evidence of contamination
<ul style="list-style-type: none"> Reservoir inspection program (routine) with records maintained Scheduled contractor reservoir cleaning and inspection program 	<p>Corrective actions</p> <ul style="list-style-type: none"> Conduct visual inspection (outside & inside) Check disinfection levels in Reservoir and top up if required (Refer to Reservoir Manual Chlorine Dose Calculator) Increase chlorine dose at plant, if needed Contact Team Leader Repair breach of integrity Consider notifying local PHU Complete 'Initial Incident Report Form' 	<p>Corrective actions</p> <ul style="list-style-type: none"> Follow Alert Level corrective actions Contact Team Leader Team Leader to inform Process Engineer or Manager as soon as possible. Take micro-sample if required Remove contaminants, if safe to do so Process Engineer or Manager to call local PHU as soon as possible. Contact Dol for operational advice as needed. Implement additional response actions (e.g. boil water alert) in consultation with local PHU. Complete 'Initial Incident Report Form'

Table A.6 CCP Bellbrook Water Supply

System	CCP ID	Control Point	Control Parameter	Testing Location	Frequency	Target	Alert Level	Critical Limit	Justification for critical limit
Bellbrook	CCP1	Raw Water Abstraction	Turbidity	Inlet to treatment plant prior to raw water tank	Continuous online / grab sample	<5 NTU	5 NTU for more than 20min	20 NTU	Plant is shut off for turbidity >20 NTU. [Note: online result is verified with grab sample].
	CCP2	Filtration	Turbidity	After filters at WTP	Grab sample	<0.5 NTU	0.8 NTU	1 NTU	Critical limit ensures solids removal and that effectiveness of chlorination is maintained.
	CCP3	Disinfection	Free Chlorine pH	Clear water tank outlet	Continuous online / grab sample	1.5 mg/L pH 7.5	<1 or >3.0 mg/L pH <6.8 or >8.0	<0.8 or >4 mg/L pH <6.5 or >8.5	Lower chlorine critical limit ensures that C.t is met at the monitoring location. Upper chlorine critical limit ensures that total chlorine does not get >5 mg/L (health limit). pH correction undertaken. Lower pH critical limit protects asset corrosion. Upper pH critical limit ensures efficiency of chlorination is not compromised (ADWG) [Note: online result is verified with grab sample].
	CCP4	Fluoridation	Fluoride	NA	NA	NA	NA	NA	NA
	CCP5	Reservoirs	Reservoir integrity	All reservoirs	Monthly	No breach of integrity	Any sign of integrity breach	Evidence of contamination	Ensures treated water does not get contaminated.

Table A.6.1 SOP for BB CCP1 Turbidity Raw Water Abstraction at Inlet to Plat

Water Supply System	Bellbrook		
CCP ID	CCP1		
What is the control point?	Raw Water Abstraction	What are the hazards?	All pathogens
What is being monitored?	Turbidity	Monitoring Frequency:	Continuous online / daily grab sample (5 days)
Monitoring location	Pre raw water tank		
What will initiate response?	Confirmation of online result with grab sample		
Operating Target <5 NTU	Alert Level 5 NTU for more than 20min	Critical Limit 20 NTU	
<ul style="list-style-type: none"> • Routine site and operational checks • Weather and flood warnings observations • Conduct routine Bore maintenance program • Routine site and operational checks • Instrument calibration and records maintained • Monitor and measure raw water turbidity • Equipment correlation checks (Bench meter instruments cross checked results against similar instruments.) • Calibration of online instruments (Programmed Instrument Maintenance Program conducted by Instrument Technicians and external contractors) • Raw Water Tank cleaning program • Annual checks for plant auto shut down 	<p>Corrective actions</p> <ul style="list-style-type: none"> • Attend site and confirm or cross check online turbidity with portable instrument. • Check River for any water quality impacts, such as flooding. • Check bore for signs of damage to bore or any impacts to sites areas around bores. • Make arrangements for isolation & repairs to problem bore (if issue). • Increase monitoring of raw water turbidity levels until system returns to normal • If flooding is impacting the River, consider plans to commence water carting and consider early shutdown of plant. • Contact Team Leader. • Complete '<i>Initial Incident Report Form</i>' following confirmation of online result with grab sample. 	<p>Corrective actions</p> <ul style="list-style-type: none"> • Follow Alert Level steps. • Contact Team Leader • Team Leader to inform Process Engineer or Manager as soon as possible. • Ensure automatic interlock has shut down the treatment plant, otherwise shutdown the system. • Ensure that Bore pumps are stopped (and are unavailable to automatic start up). • Management to consider the need to initiate an incident response • Process Engineer or Manager to call local PHU as soon as possible. • Contact DoI for operational advice as needed. • Implement additional response actions (e.g. water carting, boil water alert) in consultation with the local PHU. • Complete '<i>Initial Incident Report Form</i>', following confirmation of online result with grab sample. 	

Table A.6.2 SOP for BB CCP2 Turbidity Filtration at WTP after filters

Water Supply System	Bellbrook		
CCP ID	CCP2		
What is the control point?	Filtration	What are the hazards?	Heavy metals and pathogens
What is being monitored?	Turbidity	Monitoring Frequency:	Daily grab sample (5 days)
Monitoring location	After filters at WTP		
What will initiate response?	Confirmation of result with immediate follow up test		

Operating Target <0.5 NTU	Alert Limit 0.8 NTU	Critical Limit 1 NTU
<ul style="list-style-type: none"> Routine site and operational checks Instrument calibration and records maintained Media replacement program (as required) Calibration of online instruments (Programmed Instrument Maintenance Program conducted by Instrument Technicians and external contractors) Annual checks for plant auto shut down Maintenance cleaning of Raw Water Tank 	<p>Corrective actions</p> <ul style="list-style-type: none"> Confirm result with immediate follow up test Look at pressure differentials across filters Verify turbidity of Raw Water Check upstream chemical dosing Contact Team Leader Complete '<i>Initial Incident Report Form</i>' following confirmation of online result with grab sample. 	<p>Corrective actions</p> <ul style="list-style-type: none"> Follow Alert Level steps Contact Team Leader Team Leader to inform Process Engineer or Manager as soon as possible Verify turbidity in Clearwater Tank, and if it exceeds 1 NTU, consult with Team Leader on actions required (e.g. empty and scour tank) Check turbidity in Bellbrook Reservoir and if exceeds 1 NTU consider actions with Team Leader Management to consider the need to initiate an incident response. Process Engineer or Manager to notify local PHU as soon as possible Contact DoI for operational advice as needed Implement additional response actions (e.g. boil water alert) in consultation with local PHU Complete '<i>Initial Incident Report Form</i>' following confirmation of online result with grab sample

Table A.6.3 SOP for BB CCP3 Free Chlorine Disinfection at out of Clear Water Tank

Water Supply System	Bellbrook		
CCP ID	CCP3		
What is the control point?	Disinfection	What are the hazards?	Chlorine sensitive pathogens
What is being monitored?	Free Chlorine & pH	Monitoring Frequency:	Continuous online/ daily grab sample (5 days)
Monitoring location	Clearwater Tank outlet		
What will initiate response?	Confirmation of online result with grab sample		
Operating Target 1.5 mg/L pH 7.5	Alert Limit <1 or >3.0 mg/L pH <6.8 or >8.0	Critical Limit <0.8 or >4 mg/L pH <6.5 or >8.5	
<ul style="list-style-type: none"> Routine site and equipment checks at WTP Instrument calibration and records maintained Equipment correlation checks (Bench meter instruments cross checked results against similar instruments) Calibration of online instruments (Programmed Instrument Maintenance Program conducted by Instrument Technicians and external contractors) Sodium hypochlorite and soda ash dosing rate checks Disinfection residual checks performed at the outlet of CWT Chemical procurement and delivery requirements 	<p>Corrective actions</p> <ul style="list-style-type: none"> Confirm online result with grab sample Validate disinfection levels (using high ranges or dilution methods if required) Check primary dosing equipment and hypo concentration and adjust as required Contact Team Leader Check raw water conditions Check upstream processes (pH correction & filtration) Check disinfection levels in Reservoir and top up if required (Refer Reservoir Manual Chlorine Dose Calculator) Check integrity of CWT for any breaches or unauthorised access Conduct sampling and flushing in the network as required Complete '<i>Initial Incident Report Form</i>' following confirmation of online result with grab sample 	<p>Corrective actions</p> <ul style="list-style-type: none"> Follow Alert Level corrective steps Test for total chlorine if free chlorine is >4 mg/L. Total chlorine should not be >5 mg/L. Contact Team Leader Team Leader to inform Process Engineer or Manager as soon as possible. Consider taking micro-sample for low disinfection levels Process Engineer or Manager to contact local PHU as soon as possible Contact DoI for operational advice as needed. Implement additional response actions (e.g. boil water alert) in consultation with local PHU. Complete '<i>Initial Incident Report Form</i>', following confirmation of online result with grab sample. 	

Table A.6.4 SOP for BB CCP5 Reservoir Integrity at all Reservoirs

Water Scheme	Bellbrook		
CCP ID	CCP5		
What is the control point?	Reservoir	What are the hazards?	All pathogens and all chemicals
What is being monitored?	Reservoir integrity	Monitoring Frequency:	Monthly
Monitoring location	All service reservoirs		
What will initiate response?	Any sign of reservoir integrity breach		
Operating Target No breach of integrity	Adjustment Limit Any sign of integrity breach	Critical Limit Evidence of contamination	
<ul style="list-style-type: none"> Reservoir inspection program (routine) with records maintained Scheduled contractor reservoir cleaning and inspection program 	<p>Corrective actions</p> <ul style="list-style-type: none"> Conduct visual inspection (outside & inside) Check disinfection levels in Reservoir and top up if required (Refer to Reservoir Manual Chlorine Dose Calculator) Increase chlorine dose at plant, if needed Contact Team Leader Repair breach of integrity Consider notifying local PHU Complete '<i>Initial Incident Report Form</i>' 	<p>Corrective actions</p> <ul style="list-style-type: none"> Follow Alert Level corrective actions Contact Team Leader Team Leader to inform Process Engineer or Manager as soon as possible. Take micro-sample if required Remove contaminants, if safe to do so Process Engineer or Manager to call local PHU as soon as possible. Contact DoI for operational advice as needed. Implement additional response actions (e.g. boil water alert) in consultation with local PHU Complete '<i>Initial Incident Report Form</i>' 	

Table A.7 CCP Willawarrin Water Supply

System	CCP ID	Control Point	Control Parameter	Testing Location	Frequency	Target	Alert Level	Critical Limit	Justification for critical limit
Willawarrin	CCP1	Raw Water Abstraction	Turbidity	Raw water rising main prior to chlorine injection	Daily grab	<0.6 NTU	1 NTU	2 NTU	There is no filtration undertaken, critical limit provides an interim barrier to control contaminant/ microbial load. Plant is shut off at critical limit.
	CCP2	Filtration	Turbidity	NA	NA	NA	NA	NA	NA
	CCP3	Disinfection	Free Chlorine	Willawarrin reservoir outlet	Continuous online / daily grab	1 mg/L	<0.6 or >3.0 mg/L	<0.4 or >4 mg/L	Lower critical chlorine limit ensures that C.t is met at the monitoring location. Upper critical chlorine limit ensures that total chlorine does not get >5 mg/L (health limit). No pH correction undertaken. [Note: online result is verified with grab sample].
	CCP4	Fluoridation	Fluoride	NA	NA	NA	NA	NA	NA
	CCP5	Reservoirs	Reservoir integrity	All reservoirs	Monthly	No breach of integrity	Any sign of integrity breach	Evidence of contamination	Upon advice from NSW Health. Ensures treated water does not get re-contaminated.

Note: Grab sample is taken daily (7 days/week). Disinfection CCP has continuous online monitoring.

Table A.7.1 SOP for WW CCP1 Turbidity Raw Water Abstraction at Raw Water Rising Main

Water Scheme	Willawarrin		
CCP ID	CCP1		
What is the control point?	Raw Water Abstraction	What are the hazards?	All pathogens
What is being monitored?	Turbidity	Monitoring Frequency:	Daily grab (7 days)
Monitoring location	Raw water rising main prior to chlorine injection		
What will initiate response?	Confirmation with immediate follow up grab sample		

Operating Target <0.6 NTU	Alert Level 1 NTU	Critical Limit 2 NTU
<ul style="list-style-type: none"> Weather and flood warning observations Routine site and operational checks Instrument calibration and records maintained Monitor and measure raw water turbidity Equipment correlation checks Calibration of online instruments (Programmed Instrument Maintenance Program conducted by Instrument Technicians and external contractors) Visual checks at Bore sites and Bore water monitoring program Operational requirement to maintain Willawarrin Reservoir as full as possible at close of business day 	<p>Corrective actions</p> <ul style="list-style-type: none"> Confirm result with portable instrument Check turbidity and disinfection levels in Reservoir Attend site and check river quality and river levels Contact Team Leader Check individual production Bores for turbidity & iron (scour to waste during tests) and isolate where required Shut down bore pumps if required Flush rising main to remove highly turbid water (using scour at plant) Consider shutting Dosing Plant down Initiate water carting protocol (on standby) Complete 'Initial Incident Report Form', following confirmation of result with re-test sample. 	<p>Corrective actions</p> <ul style="list-style-type: none"> Follow Alert Level steps Contact Team Leader Team Leader to inform Process Engineer or Manager as soon as possible. Continue water carting until raw water turbidity drops below 1 NTU Shutdown the system Check turbidity levels downstream to validate any infiltration to Dosing Plant Consider isolation & scour the Balance Reservoir Process Engineer or Manager to call local PHU as soon as possible. Contact Dol for operational advice as needed. Implement additional response actions (e.g. boil water alert) in consultation with PHU. Complete 'Initial Incident Report Form', following confirmation of result with re-test sample.

Table A.7.2 SOP for WW CCP3 Free Chlorine Disinfection at Reservoir

Water Scheme	Willawarrin		
CCP ID	CCP3		
What is the control point?	Disinfection	What are the hazards?	Chlorine sensitive pathogens
What is being monitored?	Free chlorine residual	Monitoring Frequency:	Continuous online/daily grab (7 days)
Monitoring location	Willawarrin reservoir outlet		
What will initiate response?	Confirmation of online result with grab sample		

Operating Target 1 mg/L	Alert Limit <0.6 or >3.0 mg/L	Critical Limit <0.4 or >4 mg/L
<ul style="list-style-type: none"> • Routine site and equipment <u>checks</u> • Instrument calibration and records maintained • Calibration of online instruments (Programmed Instrument Maintenance Program conducted by Instrument Technicians and external contractors) • Sodium Hypochlorite dose rate checks • Disinfection residual checks performed at the outlet of Reservoir • Chemical procurement and delivery requirements • Sodium Hypochlorite chemical handling and dilution 1:5 requirements • Calibration of online instruments (Programmed Instrument Maintenance Program conducted by Instrument Technicians and external contractor) • Chemical storage levels monitoring 	<p>Corrective actions</p> <ul style="list-style-type: none"> • Confirm online result with grab sample. • Validate disinfection levels (using high ranges or dilution methods if required) • Check primary dosing equipment and hypo concentration and adjust as required • Contact Team Leader • Check disinfection levels from primary dosing and adjust as required • Check raw water conditions • Check disinfection levels in Reservoir and top up if required (Refer Reservoir Manual Chlorine Dose Calculator) • Check integrity of Reservoir for any breaches or unauthorised access • Consider scouring, flushing and sampling in the network where appropriate • Complete 'Initial Incident Report Form', following confirmation of online result with grab sample. 	<p>Corrective actions</p> <ul style="list-style-type: none"> • Follow Alert Level steps • Test for total chlorine if free chlorine is >4 mg/L. Total chlorine should not be >5 mg/L. • Contact Team Leader • Team Leader to inform Process Engineer or Manager as soon as possible. • Consider taking micro-sample for low disinfection levels • Process Engineer or Manager to call local PHU as soon as possible. • Contact Dol for operational advice as needed. • Implement additional response actions (e.g. boil water alert) in consultation with local PHU. • Complete 'Initial Incident Report Form', following confirmation of online result with grab sample.

Table A.7.3 SOP for WW CCP5 Reservoir Integrity at Reservoir

Water Scheme	Willawarrin		
CCP ID	CCP5		
What is the control point?	Reservoir	What are the hazards?	All pathogens and all chemicals
What is being monitored?	Reservoir integrity	Monitoring Frequency:	Monthly
Monitoring location	All service reservoirs		
What will initiate response?	Any sign of reservoir integrity breach		

Operating Target No breach of integrity	Adjustment Limit Any sign of integrity breach	Critical Limit Evidence of contamination
<ul style="list-style-type: none"> Reservoir inspection program (routine) with records maintained Scheduled contractor reservoir cleaning and inspection program <p>Note: Water caters have access to Reservoir during high turbidity events</p>	<p>Corrective actions</p> <ul style="list-style-type: none"> Conduct visual inspection (outside & inside) Check disinfection levels in Reservoir and top up if required (Refer to Reservoir Manual Chlorine Dose Calculator) Increase chlorine dose at plant, if needed Contact Team Leader Repair breach of integrity Consider notifying local PHU Complete 'Initial Incident Report Form' 	<p>Corrective actions</p> <ul style="list-style-type: none"> Follow Alert Level corrective actions Contact Team Leader Team Leader to inform Process Engineer or Manager as soon as possible. Take micro-sample if required Remove contaminants, if safe to do so Process Engineer or Manager to call local PHU as soon as possible. Contact DoI for operational advice as needed. Implement additional response actions (e.g. boil water alert) in consultation with local PHU. Complete 'Initial Incident Report Form'

Table A.8 Thungutti Water Supply

System	CCP ID	Control Point	Control Parameter	Testing Location	Frequency	Target	Alert Level	Critical Limit	Justification for critical limit
Thungutti	CCP1	Raw Water Abstraction	Turbidity	Inlet to treatment plant	Continuous online / grab sample	<0.5 NTU	0.8 NTU	1 NTU	There is no filtration undertaken, critical limit provides an interim barrier to control contaminant/ microbial load. Plant is shut off at critical limit. [Note: online result is verified with grab sample].
	CCP2	Filtration	Turbidity	NA	NA	NA	NA	NA	NA
	CCP3	Disinfection	Free Chlorine	At reservoir outlet (bores should be run during off peak usage time – night)	Continuous online / Grab sample	1.0 mg/L	<0.8 or >3.0 mg/L	<0.3 or >4 mg/L	Lower critical chlorine limit ensures that C.t is met at the monitoring location. Upper critical chlorine limit ensures that total chlorine does not get >5 mg/L (health limit). No pH correction undertaken. [Note: online result is verified with grab sample].
	CCP4	Fluoridation	Fluoride	NA	NA	NA	NA	NA	NA
	CCP5	Reservoirs	Reservoir integrity	All reservoirs	Monthly	No breach of integrity	Any sign of integrity breach	Evidence of contamination	Upon advice from NSW Health. Ensures treated water does not get contaminated.

Note: Grab sample is taken 5 days/week (Mon-Fri). Raw Water Abstraction and Disinfection CCPs have continuous online monitoring.

Table A.8.1 SOP for TH CCP1 Turbidity Raw Water Abstraction at Inlet to WTP

Water Scheme	Thungutti		
CCP ID	CCP1		
What is the control point?	Raw Water Abstraction	What are the hazards?	All pathogens
What is being monitored?	Turbidity	Monitoring Frequency:	Continuous online & daily grab (5 days)
Monitoring location	Inlet to Dosing Plant – raw water pre disinfection		
What will initiate response?	Confirmation of online result with grab sample		
Operating Target <0.5 NTU	Alert Level 0.8 NTU	Critical Limit 1 NTU	
<ul style="list-style-type: none"> Weather and flood monitoring observations Routine site and operational checks Instrument calibration and records maintained Monitor and measure raw water turbidity Equipment correlation checks Calibration of online instruments (Programmed Instrument Maintenance Program conducted by Instrument Technicians and external contractors) Visual checks at Bore site and Bore water monitoring program 	<p>Corrective actions</p> <ul style="list-style-type: none"> Confirm result with portable instrument Clean turbidity sensor if needed Contact Team Leader Check creek for any water quality impacts, such as flooding Check individual production Bores for turbidity & iron and isolate where required Consider shutting Dosing Plant down Shutdown bore pumps (if required) and organise repairs (if required) Consider flushing rising main to remove highly turbid water Complete '<i>Initial Incident Report Form</i>', following confirmation of online result with grab sample. 	<p>Corrective actions</p> <ul style="list-style-type: none"> Follow Alert Level steps Contact Team Leader Team Leader to inform Process Engineer or Manager as soon as possible. Ensure automatic interlock has shut down the treatment plant, otherwise shutdown the system Check turbidity levels downstream to validate any infiltration to the reservoirs (if automatic shutdown has failed) Commence and continue water carting until raw water turbidity drops to below 1 NTU Consider isolation & scour the Reservoir/s Process Engineer or Manager to call local PHU as soon as possible. Contact DoI for operational advice as needed. Implement additional response actions (e.g. boil water alert) in consultation with local PHU. Complete '<i>Initial Incident Report Form</i>', following confirmation of online result with grab sample. 	

Table A.8.2 SOP for TH CCP3 Free Chlorine Disinfection at Inlet Reservoir

Water Scheme	Thungutti		
CCP ID	CCP3		
What is the control point?	Disinfection (sodium hypochlorite)	What are the hazards?	Chlorine sensitive pathogens
What is being monitored?	Free chlorine residual	Monitoring Frequency:	Continuous online & daily grab (5 days)
Monitoring location	At reservoir outlet (bores are run during off peak usage time – night)		
What will initiate response?	Confirmation of online result with grab sample		

Operating Target	Alert Limit	Critical Limit
1 mg/L	<0.8 or >3.0 mg/L	<0.3 or >4 mg/L
<ul style="list-style-type: none"> Routine site and equipment checks Instrument calibration and records maintained Calibration of online instruments (Programmed Instrument Maintenance Program conducted by Instrument Technicians and external contractors) Sodium Hypochlorite dose rate checks Disinfection residual checks performed at the outlet of Reservoir Chemical procurement and delivery requirements Chemical storage levels monitoring 	<p>Corrective actions</p> <ul style="list-style-type: none"> Confirm online result with grab sample Validate disinfection levels (using high ranges or dilution methods if required) Check primary dosing equipment and hypo concentration and adjust as required Contact Team Leader Check disinfection levels from primary dosing and adjust as required Check raw water conditions Check disinfection levels in Reservoir and top up if required (Refer Reservoir Manual Chlorine Dose Calculator) Check integrity of Reservoir for any breaches or unauthorised access Consider scouring, flushing and sampling in the network where appropriate Complete 'Initial Incident Report Form', following confirmation of online result with grab sample. 	<p>Corrective actions</p> <ul style="list-style-type: none"> Follow Alert Level steps Test for total chlorine if free chlorine is >4 mg/L. Total chlorine should not be >5 mg/L. Contact Team Leader Team Leader to inform Process Engineer or Manager as soon as possible. Consider taking micro-sample for low disinfection levels Process Engineer or Manager to call local PHU as soon as possible. Contact DoI for operational advice as needed. Implement additional response actions (e.g. boil water alert) in consultation with local PHU. Complete 'Initial Incident Report Form', following confirmation of online result with grab sample.

Table A.8.3 SOP for TH CCP5 Reservoir Integrity at Reservoir

Water Scheme	Thungutti		
CCP ID	CCP5		
What is the control point?	Reservoir	What are the hazards?	All pathogens and all chemicals
What is being monitored?	Reservoir integrity	Monitoring Frequency:	Monthly
Monitoring location	All service reservoirs		
What will initiate response?	Any sign of reservoir integrity breach		

Operating Target No breach of integrity	Adjustment Limit Any sign of integrity breach	Critical Limit Evidence of contamination
<ul style="list-style-type: none"> Reservoir inspection program (routine) with records maintained Scheduled contractor reservoir cleaning and inspection program Note: Water caters have access to Reservoir during high turbidity events 	<p>Corrective actions</p> <ul style="list-style-type: none"> Conduct visual inspection (outside & inside) Check disinfection levels in Reservoir and top up if required (Refer to Reservoir Manual Chlorine Dose Calculator) Increase chlorine dose at plant, if needed Contact Team Leader Repair breach of integrity Consider notifying local PHU Complete '<i>Initial Incident Report Form</i>' 	<p>Corrective actions</p> <ul style="list-style-type: none"> Follow Alert Level corrective actions Contact Team Leader Team Leader to inform Process Engineer or Manager as soon as possible. Take micro-sample if required Remove contaminants, if safe to do so Process Engineer or Manager to call local PHU as soon as possible. Contact DoI for operational advice as needed. Implement additional response actions (e.g. boil water alert) in consultation with local PHU. Complete '<i>Initial Incident Report Form</i>'

Appendix B Stuart McIntyre Dam Algae Monitoring

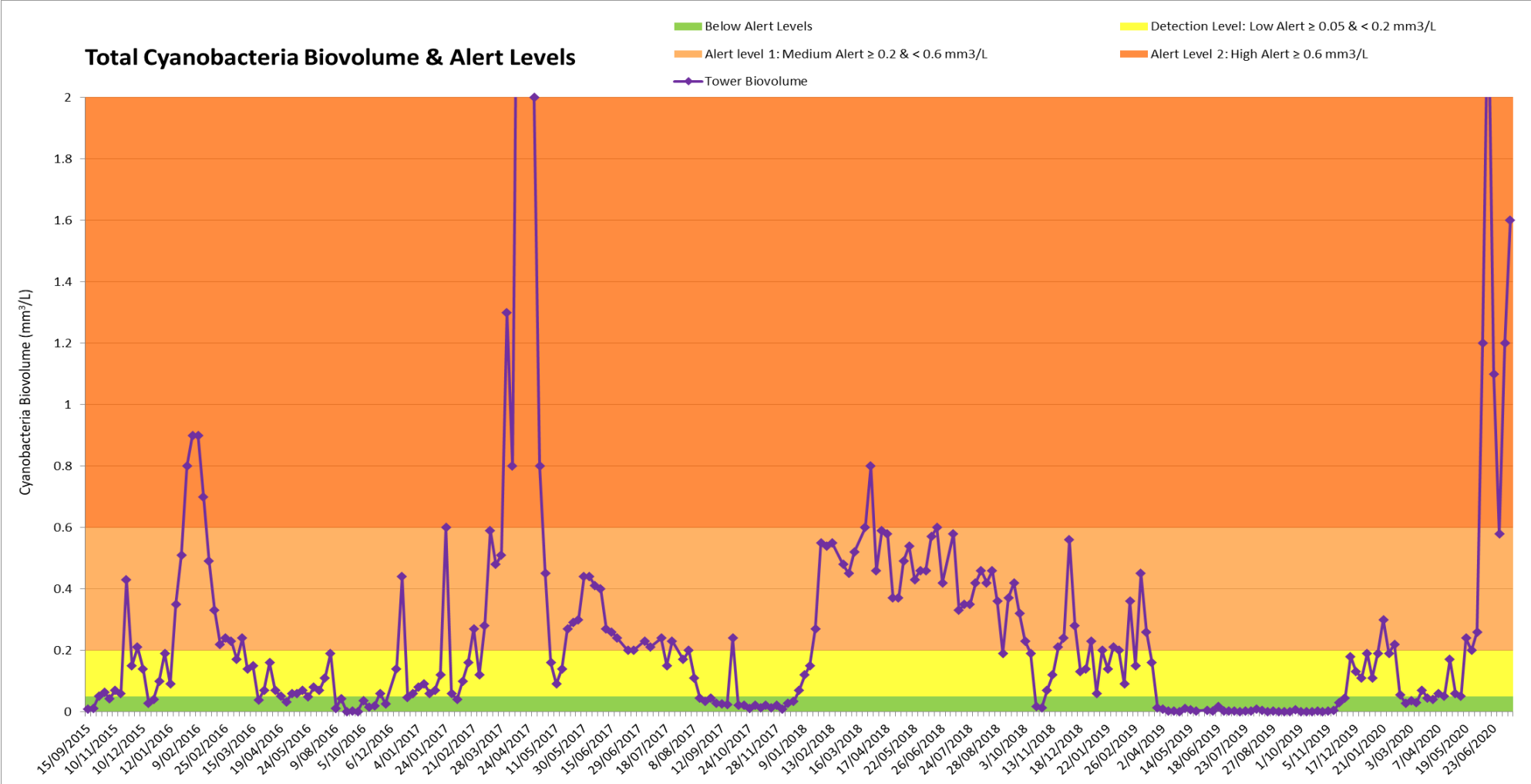


Figure B.1: Stuart McIntyre Dam Total Cyanobacteria Biovolume and Alert Levels (Sep 2015 to June 2020)

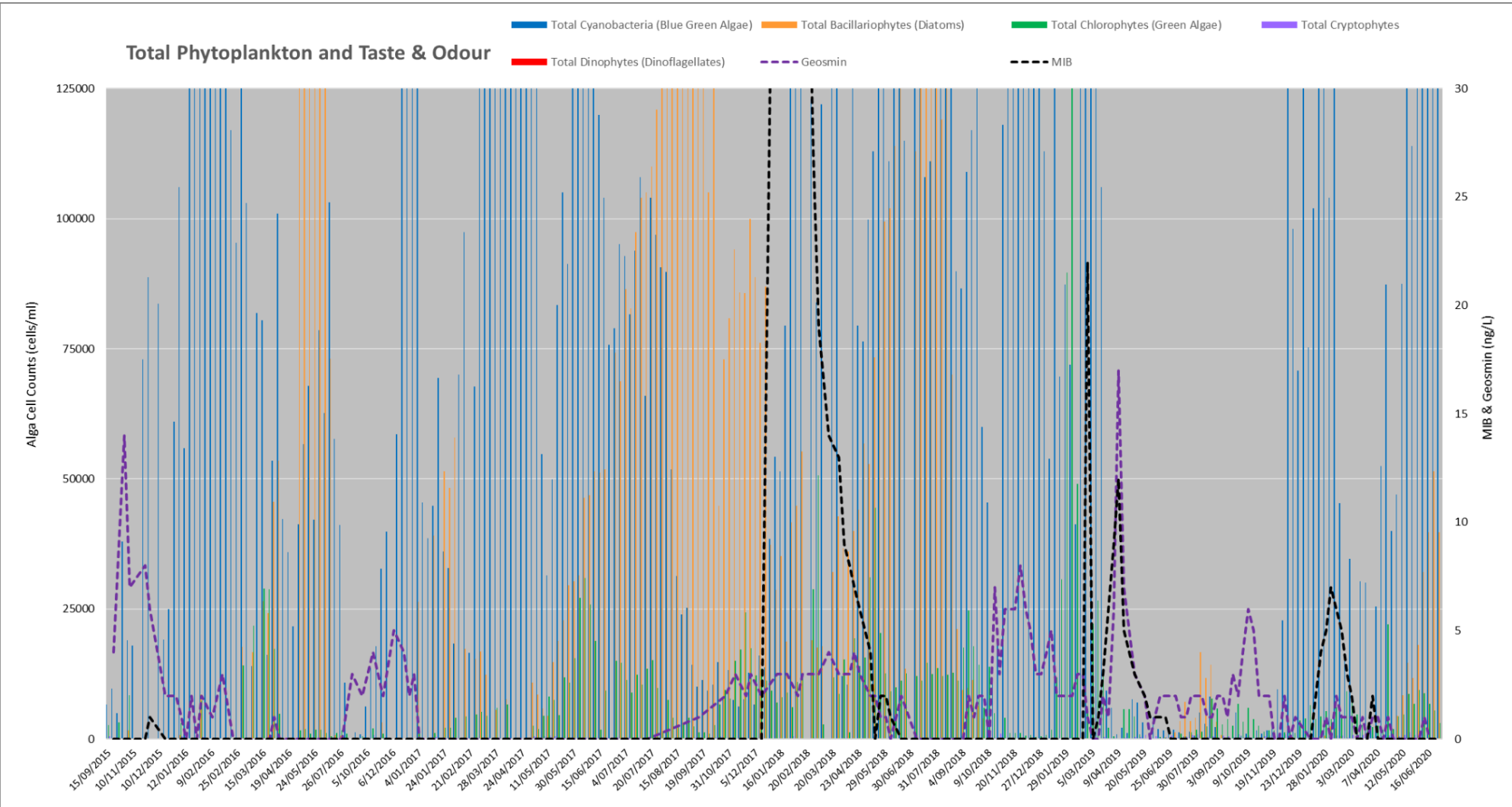


Figure B.2: Total Phytoplankton and Taste and Odour Results at Tower Intake (July 2015 to June 2020). Algae samples taken from boat using 5 m integrated collection method.

Appendix C Water Quality Data

Data from Kempsey Shire Council network sampling sites has been collected from NSW Health Database covering the eight drinking water supply systems. Results in each monitoring program (Physical-Chemical Monitoring, Microbiological Monitoring and Fluoride Monitoring) are attributed to specific sampling regimes. Turbidity, pH and Fluoride are monitored in two sections, due to the difference in sampling regimes (indicated by the sample count) results of the analysts vary between monitoring programmes.

Fluoride is tested in all supply systems as a standard chemical test as a part of the Physical-Chemical Monitoring and is noted as * Fluoride – Calculated from all supply systems (includes fluoride dosed and non-dosed systems). Fluoride Monitoring only occurs in the fluoride dosed supply system of South West Rocks and is noted as ** Fluoride – Calculated from the South West Rocks supply fluoride dosed system only.

Table C.1 Kempsey & Lower Macleay Supply System Water Quality Data

Characteristic	Guideline Value	Units	Mean	Min	Max	Sample Count	Exception Count	% Meeting Guidelines
Chemistry								
Aluminium	0.2	mg/L	0.03	0.01	0.07	14	0	100
Antimony	0.003	mg/L	0.0004	0.0002	0.0005	14	0	100
Arsenic	0.01	mg/L	0.0013	0.0005	0.005	14	0	100
Barium	2	mg/L	0.017	0.011	0.0209	14	0	100
Boron	4	mg/L	0.0329	0.0165	0.05	14	0	100
Cadmium	0.002	mg/L	0.0001	0.00005	0.00025	14	0	100
Calcium	10000	mg/L	10.81	0.05	13.8	14	0	100
Chloride	250	mg/L	25.1	22	27	14	0	100
Chromium	0.05	mg/L	0.0023	0.0005	0.01	14	0	100
Copper	2	mg/L	0.0108	0.002	0.043	14	0	100
*Fluoride	1.5	mg/L	0.0614	0.05	0.11	14	0	100
Iodine	0.5	mg/L	0.02	0.02	0.02	14	0	100
Iron	0.3	mg/L	0.10	0.05	0.18	14	0	100
Lead	0.01	mg/L	0.0006	0.0001	0.001	14	0	100
Magnesium	10000	mg/L	5.038	4.04	5.69	14	0	100
Manganese	0.5	mg/L	0.0051	0.0025	0.011	14	0	100
Mercury	0.001	mg/L	0.0003	0.00005	0.0009	14	0	100
Molybdenum	0.05	mg/L	0.0022	0.0002	0.0107	14	0	100
Nickel	0.02	mg/L	0.0068	0.0002	0.0418	14	1	92.86
Nitrate	50	mg/L	0.75	0.5	1	14	0	100
Nitrite	3	mg/L	0.05	0.05	0.05	14	0	100
pH	6.5 - 8.5		7.88	7.7	8.4	14	0	100
Selenium	0.01	mg/L	0.0026	0.001	0.0035	14	0	100
Silver	0.1	mg/L	0.0005	0.0001	0.001	14	0	100
Sodium	180	mg/L	18.2	15	20	14	0	100
Sulfate	500	mg/L	7.1	4	10	14	0	100
Total Dissolved Solids (TDS)	600	mg/L	107.2	65	207	14	0	100
Total Hardness as CaCO3	200	mg/L	47.7	22.3	57.4	14	0	100
True Colour	15	Hazen Units	1.5	0.5	3	14	0	100
Turbidity	5	NTU	1.3	0.5	2.7	14	0	100
Uranium	0.017	mg/L	0.0011	0.00005	0.0025	14	0	100
Zinc	3	mg/L	0.03	0.01	0.05	14	0	100
Microbiology								
E. coli	0	mpn/100 mL	0	0	0	172	0	100
Total Coliforms	0	mpn/100 mL	1.32	0.09	2.8	179	0	100
Free Chlorine	0.2 - 5	mg/L	1.03	0.02	2.3	179	14	92.18
Total Chlorine	5	mg/L	1.34	0	202	172	4	97.67
pH	6.5 - 8.5		7.78	7.19	8.86	179	8	95.53
Temperature	30	C	21.6	13	31.2	179	1	99.44
Turbidity	5	NTU	1.01	0.25	4.59	179	0	100

Table C.2 Crescent Head Supply System Water Quality Data

Characteristic	Guideline Value	Units	Mean	Min	Max	Sample Count	Exception Count	% Meeting Guidelines
Chemistry								
Aluminium	0.2	mg/L	0.12	0.1	0.14	3	0	100
Antimony	0.003	mg/L	0.0002	0.00005	0.0005	3	0	100
Arsenic	0.01	mg/L	0.0007	0.0005	0.001	3	0	100
Barium	2	mg/L	0.0036	0.0025	0.0042	3	0	100
Boron	4	mg/L	0.0276	0.016	0.05	3	0	100
Cadmium	0.002	mg/L	0.0001	0.00005	0.00025	3	0	100
Calcium	10000	mg/L	7.9	0.1	13.9	3	0	100
Chloride	250	mg/L	46	41	50	3	0	100
Chromium	0.05	mg/L	0.0015	0.001	0.0025	3	0	100
Copper	2	mg/L	0.004	0.001	0.01	3	0	100
*Fluoride	1.5	mg/L	0.05	0.05	0.05	3	0	100
Iodine	0.5	mg/L	0.01	0.01	0.01	3	0	100
Iron	0.3	mg/L	0.12	0.1	0.13	3	0	100
Lead	0.01	mg/L	0.0005	0.0001	0.001	3	0	100
Magnesium	10000	mg/L	1.38	1.2	1.52	3	0	100
Manganese	0.5	mg/L	0.003	0.0025	0.0037	3	0	100
Mercury	0.001	mg/L	0.0003	0.00005	0.0004	3	0	100
Molybdenum	0.05	mg/L	0.001	0.0001	0.0025	3	0	100
Nickel	0.02	mg/L	0.0021	0.0002	0.005	3	0	100
Nitrate	50	mg/L	0.5	0.5	0.5	3	0	100
Nitrite	3	mg/L	0.05	0.05	0.05	3	0	100
pH	6.5 - 8.5		7.1	6.8	7.4	3	0	100
Selenium	0.01	mg/L	0.0027	0.001	0.0035	3	0	100
Silver	0.1	mg/L	0.0004	0.0001	0.001	3	0	100
Sodium	180	mg/L	15	14	17	3	0	100
Sulfate	500	mg/L	1.2	0.5	2	3	0	100
Total Dissolved Solids (TDS)	600	mg/L	823	62	101	3	0	100
Total Hardness as CaCO3	200	mg/L	25.4	6.1	39.6	3	0	100
True Colour	15	Hazen Units	5	2	7	3	0	100
Turbidity	5	NTU	1.5	0.5	2.5	3	0	100
Uranium	0.017	mg/L	0.0009	0.0001	0.0025	3	0	100
Zinc	3	mg/L	0.03	0.02	0.04	3	0	100
Microbiology								
E. coli	0	mpn/100 mL	0	0	0	64	0	100
Total Coliforms	0	mpn/100 mL	0	0	0	64	0	100
Free Chlorine	0.2 - 5	mg/L	0.8129	0.03	1.99	68	3	95.59
Total Chlorine	5	mg/L	1.0649	0.14	2.2	68	0	100
pH	6.5 - 8.5		7.3179	6.66	7.91	68	0	100
Temperature	30	C	21.4265	13.4	28.9	68	0	100
Turbidity	5	NTU	2.0276	1.06	4.22	68	0	100

Table C.3 Hat Head Supply System Water Quality Data

Characteristic	Guideline Value	Units	Mean	Min	Max	Sample Count	Exception Count	% Meeting Guidelines
Chemistry								
Aluminium	0.2	mg/L	0.14	0.11	0.16	2	0	100
Antimony	0.003	mg/L	0.0003	0.00005	0.0005	2	0	100
Arsenic	0.01	mg/L	0.0035	0.001	0.006	2	0	100
Barium	2	mg/L	0.0125	0.01	0.0149	2	0	100
Boron	4	mg/L	0.0326	0.0151	0.05	2	0	100
Cadmium	0.002	mg/L	0.0002	0.00005	0.00025	2	0	100
Calcium	10000	mg/L	2.3	1.6	2.9	2	0	100
Chloride	250	mg/L	69	68	70	2	0	100
Chromium	0.05	mg/L	0.0018	0.001	0.0025	2	0	100
Copper	2	mg/L	0.0098	0.0025	0.017	2	0	100
*Fluoride	1.5	mg/L	0.05	0.05	0.05	2	0	100
Iodine	0.5	mg/L	0.01	0.01	0.01	2	0	100
Iron	0.3	mg/L	0.205	0.19	0.22	2	0	100
Lead	0.01	mg/L	0.0007	0.0003	0.001	2	0	100
Magnesium	10000	mg/L	3.55	3.54	3.56	2	0	100
Manganese	0.5	mg/L	0.0048	0.0036	0.006	2	0	100
Mercury	0.001	mg/L	0.0003	0.0001	0.0004	2	0	100
Molybdenum	0.05	mg/L	0.0019	0.0013	0.0025	2	0	100
Nickel	0.02	mg/L	0.0048	0.0046	0.005	2	0	100
Nitrate	50	mg/L	0.5	0.5	0.5	2	0	100
Nitrite	3	mg/L	0.05	0.05	0.05	2	0	100
pH	6.5 - 8.5		7.3	7	7.6	2	0	100
Selenium	0.01	mg/L	0.0028	0.002	0.0035	2	0	100
Silver	0.1	mg/L	0.0006	0.0001	0.001	2	0	100
Sodium	180	mg/L	41	37	44	2	0	100
Sulfate	500	mg/L	11	11	11	2	0	100
Total Dissolved Solids (TDS)	600	mg/L	130	129	131	2	0	100
Total Hardness as CaCO ₃	200	mg/L	20.25	18.7	21.8	2	0	100
True Colour	15	Hazen Units	4	4	4	2	0	100
Turbidity	5	NTU	0.7	0.2	1.2	2	0	100
Uranium	0.017	mg/L	0.0013	0.00005	0.0025	2	0	100
Zinc	3	mg/L	0.018	0.005	0.03	2	0	100
Microbiology								
E. coli	0	mpn/100 mL	0	0	0	25	0	100
Total Coliforms	0	mpn/100 mL	0.04	0	1	25	1	96
Free Chlorine	0.2 - 5	mg/L	0.97	0.23	1.6	27	0	100
Total Chlorine	5	mg/L	1.06	0.26	1.68	27	0	100
pH	6.5 - 8.5		7.47	6.69	7.91	27	0	100
Temperature	30	C	20.9	15.8	26.3	27	0	100
Turbidity	5	NTU	0.54	0.24	1.51	26	0	100

Table C.4 South West Rocks Supply System Water Quality Data

Characteristic	Guideline Value	Units	Mean	Min	Max	Sample Count	Exception Count	% Meeting Guidelines
Chemistry								
Aluminium	0.2	mg/L	0.05	0.03	0.07	14	0	100
Antimony	0.003	mg/L	0.0003	0.00005	0.0005	14	0	100
Arsenic	0.01	mg/L	0.0018	0.0005	0.007	14	0	100
Barium	2	mg/L	0.0116	0.0078	0.015	14	0	100
Boron	4	mg/L	0.0326	0.0137	0.05	14	0	100
Cadmium	0.002	mg/L	0.0002	0.00005	0.00025	14	0	100
Calcium	10000	mg/L	12.00	0.05	14.4	14	0	100
Chloride	250	mg/L	334	33	35	14	0	100
Chromium	0.05	mg/L	0.002	0.0005	0.009	14	0	100
Copper	2	mg/L	0.0099	0.0005	0.035	14	0	100
Fluoride	1.5	mg/L	0.93	0.87	1	14	0	100
Fluoride (WU result)	1.5	mg/L	0.98	0.9	1.05	13	0	100
Fluoride Ratio	0.8 - 1.2	mg/L	1.06	1.01	1.13	13	0	100
Iodine	0.5	mg/L	0.01	0.01	0.01	14	0	100
Iron	0.3	mg/L	0.0218	0.005	0.09	14	0	100
Lead	0.01	mg/L	0.0006	0.0001	0.001	14	0	100
Magnesium	10000	mg/L	1.53	0.63	1.93	14	0	100
Manganese	0.5	mg/L	0.0019	0.0004	0.0058	14	0	100
Mercury	0.001	mg/L	0.0002	0.00005	0.0004	14	0	100
Molybdenum	0.05	mg/L	0.0018	0.00005	0.009	14	0	100
Nickel	0.02	mg/L	0.0058	0.0002	0.04	14	1	92.86
Nitrate	50	mg/L	0.5	0.5	0.5	14	0	100
Nitrite	3	mg/L	0.05	0.05	0.05	14	0	100
pH	6.5 - 8.5		7.7	7.5	8.1	14	0	100
Selenium	0.01	mg/L	0.0023	0.001	0.0035	14	0	100
Silver	0.1	mg/L	0.0006	0.0001	0.001	14	0	100
Sodium	180	mg/L	19	16	20	14	0	100
Sulfate	500	mg/L	4	3	6	14	0	100
Total Dissolved Solids (TDS)	600	mg/L	92	51	185	14	0	100
Total Hardness as CaCO3	200	mg/L	36.3	7.4	43.2	14	0	100
True Colour	15	Hazen Units	0.89	0.5	2	14	0	100
Turbidity	5	NTU	0.43	0.05	1.7	14	0	100
Uranium	0.017	mg/L	0.0013	0.00005	0.0025	14	0	100
Zinc	3	mg/L	0.0243	0.005	0.05	14	0	100
Microbiology								
E. coli	0	mpn/100 mL	0	0	0	66	0	100
Total Coliforms	0	mpn/100 mL	1.07	0.39	1.67	70	0	100
Free Chlorine	0.2 - 5	mg/L	0.96	0.31	1.61	70	0	100
Total Chlorine	5	mg/L	0	0	0	66	0	100
pH	6.5 - 8.5		7.62	7.23	8.51	70	1	98.57

Characteristic	Guideline Value	Units	Mean	Min	Max	Sample Count	Exception Count	% Meeting Guidelines
Temperature	30	C	21.46	15.6	28.4	70	0	100
Turbidity	5	NTU	0.61	0.02	0.62	70	0	100
Fluoride Operational Monitoring								
Fluoride (daily WU)	0.9 - 1.5	mg/L	1.01	0.9	1.16	350	0	100
Fluoride (weekly WU)	0.9 - 1.5	mg/L	1.00	0.9	1.1	97	0	100

Table C.5 Stuarts Point Supply System Water Quality Data

Characteristic	Guideline Value	Units	Mean	Min	Max	Sample Count	Exception Count	% Meeting Guidelines
Chemistry								
Aluminium	0.2	mg/L	0.006	0.005	0.02	12	0	100
Antimony	0.003	mg/L	0.0002	0.00005	0.0005	12	0	100
Arsenic	0.01	mg/L	0.0013	0.0005	0.005	12	0	100
Barium	2	mg/L	0.0124	0.009	0.015	12	0	100
Boron	4	mg/L	0.0331	0.0197	0.05	12	0	100
Cadmium	0.002	mg/L	0.0001	0.00005	0.00025	12	0	100
Calcium	10000	mg/L	43.60	0.05	58.7	12	0	100
Chloride	250	mg/L	35.3	30	37	12	0	100
Chromium	0.05	mg/L	0.0017	0.0005	0.006	12	0	100
Copper	2	mg/L	0.022	0.005	0.075	12	0	100
*Fluoride	1.5	mg/L	0.05	0.05	0.05	12	0	100
Iodine	0.5	mg/L	0.01	0.01	0.01	12	0	100
Iron	0.3	mg/L	0.0158	0.005	0.03	12	0	100
Lead	0.01	mg/L	0.0012	0.0003	0.0039	12	0	100
Magnesium	10000	mg/L	2.69	2.11	3.34	12	0	100
Manganese	0.5	mg/L	0.0012	0.00015	0.0025	12	0	100
Mercury	0.001	mg/L	0.0003	0.00005	0.0004	12	0	100
Molybdenum	0.05	mg/L	0.0014	0.0004	0.0025	12	0	100
Nickel	0.02	mg/L	0.0036	0.0005	0.01	12	0	100
Nitrate	50	mg/L	0.5	0.5	0.5	12	0	100
Nitrite	3	mg/L	0.05	0.05	0.05	12	0	100
pH	6.5 - 8.5		7.7	7.2	8.1	12	0	100
Selenium	0.01	mg/L	0.0025	0.001	0.0035	12	0	100
Silver	0.1	mg/L	0.0005	0.0001	0.001	12	0	100
Sodium	180	mg/L	15.7	13	18	12	0	100
Sulfate	500	mg/L	5	4	8	12	0	100
Total Dissolved Solids (TDS)	600	mg/L	164.8	96	193	12	0	100
Total Hardness as CaCO ₃	200	mg/L	120.0	11.7	160.3	12	0	100
True Colour	15	Hazen Units	1.0	0.5	2	12	0	100
Turbidity	5	NTU	0.50	0.05	1.7	12	0	100
Uranium	0.017	mg/L	0.0012	0.0002	0.0025	12	0	100
Zinc	3	mg/L	0.08	0.01	0.17	12	0	100
Microbiology								
E. coli	0	mpn/100 mL	0	0	0	55	0	100
Total Coliforms	0	mpn/100 mL	0.05	0	2	55	2	96.36
Free Chlorine	0.2 - 5	mg/L	1.03	0.35	1.29	57	0	100
Total Chlorine	5	mg/L	1.12	0.49	1.37	57	0	100
pH	6.5 - 8.5		7.52	7.34	7.95	57	0	100
Temperature	30	C	20.9	13.9	27	57	0	100
Turbidity	5	NTU	0.27	0.08	0.89	55	0	100

Table C.6 Willawarrin Supply System Water Quality Data

Characteristic	Guideline Value	Units	Mean	Min	Max	Sample Count	Exception Count	% Meeting Guidelines
Chemistry								
Aluminium	0.2	mg/L	0.020	0.005	0.03	14	0	100
Antimony	0.003	mg/L	0.0005	0.0003	0.001	14	0	100
Arsenic	0.01	mg/L	0.0017	0.0005	0.004	14	0	100
Barium	2	mg/L	0.0127	0.005	0.0169	14	0	100
Boron	4	mg/L	0.0323	0.0151	0.05	14	0	100
Cadmium	0.002	mg/L	0.0001	0.00005	0.00025	14	0	100
Calcium	10000	mg/L	10.69	0.05	13.8	14	0	100
Chloride	250	mg/L	22	12	27	14	0	100
Chromium	0.05	mg/L	0.0018	0.0005	0.006	14	0	100
Copper	2	mg/L	0.0145	0.005	0.035	14	0	100
*Fluoride	1.5	mg/L	0.06	0.05	0.1	14	0	100
Iodine	0.5	mg/L	0.02	0.01	0.02	14	0	100
Iron	0.3	mg/L	0.09	0.03	0.18	14	0	100
Lead	0.01	mg/L	0.0007	0.0002	0.002	14	0	100
Magnesium	10000	mg/L	4.59	3.5	5.41	14	0	100
Manganese	0.5	mg/L	0.0189	0.0025	0.051	14	0	100
Mercury	0.001	mg/L	0.0003	0.00005	0.0004	14	0	100
Molybdenum	0.05	mg/L	0.0017	0.0001	0.0073	14	0	100
Nickel	0.02	mg/L	0.0053	0.0002	0.0268	14	1	92.86
Nitrate	50	mg/L	0.7	0.5	1	14	0	100
Nitrite	3	mg/L	0.06	0.05	0.2	14	0	100
pH	6.5 - 8.5		7.6	7	7.9	14	0	100
Selenium	0.01	mg/L	0.0024	0.001	0.0035	14	0	100
Silver	0.1	mg/L	0.0005	0.0001	0.001	14	0	100
Sodium	180	mg/L	17	11	21	14	0	100
Sulfate	500	mg/L	6	4	9	14	0	100
Total Dissolved Solids (TDS)	600	mg/L	96	52	187	14	0	100
Total Hardness as CaCO ₃	200	mg/L	45.6	19.2	56.7	14	0	100
True Colour	15	Hazen Units	1.5	0.5	5	14	0	100
Turbidity	5	NTU	1.25	0.05	4.5	14	0	100
Uranium	0.017	mg/L	0.0011	0.00005	0.0025	14	0	100
Zinc	3	mg/L	0.0293	0.005	0.06	14	0	100
Microbiology								
E. coli	0	mpn/100 mL	0	0	0	26	0	100
Total Coliforms	0	mpn/100 mL	0.2	0	6	26	1	96.15
Free Chlorine	0.2 - 5	mg/L	0.85	0.3	2.05	27	0	100
Total Chlorine	5	mg/L	1.0	0.4	2.2	27	0	100
pH	6.5 - 8.5		7.45	6.68	7.89	27	0	100
Temperature	30	C	21.5	15.8	28.4	27	0	100
Turbidity	5	NTU	1.4	0.4	4.7	27	0	100

Table C.7 Bellbrook Supply System Water Quality Data

Characteristic	Guideline Value	Units	Mean	Min	Max	Sample Count	Exception Count	% Meeting Guidelines
Chemistry								
Aluminium	0.2	mg/L	0.018	0.005	0.04	12	0	100
Antimony	0.003	mg/L	0.0007	0.0002	0.001	12	0	100
Arsenic	0.01	mg/L	0.0009	0.0005	0.002	12	0	100
Barium	2	mg/L	0.0121	0.008	0.0172	12	0	100
Boron	4	mg/L	0.034	0.0126	0.05	12	0	100
Cadmium	0.002	mg/L	0.0002	0.00005	0.00025	12	0	100
Calcium	10000	mg/L	8.95	0.05	13.7	12	0	100
Chloride	250	mg/L	21	15	28	12	0	100
Chromium	0.05	mg/L	0.0016	0.0005	0.0025	12	0	100
Copper	2	mg/L	0.0113	0.005	0.02	12	0	100
*Fluoride	1.5	mg/L	0.05	0.05	0.05	12	0	100
Iodine	0.5	mg/L	0.01	0.01	0.02	12	0	100
Iron	0.3	mg/L	0.0417	0.005	0.13	12	0	100
Lead	0.01	mg/L	0.0007	0.0001	0.001	12	0	100
Magnesium	10000	mg/L	4.15	2.69	5.53	12	0	100
Manganese	0.5	mg/L	0.0047	0.00015	0.0102	12	0	100
Mercury	0.001	mg/L	0.0003	0.00005	0.0008	12	0	100
Molybdenum	0.05	mg/L	0.0014	0.0002	0.0025	12	0	100
Nickel	0.02	mg/L	0.0029	0.0002	0.005	12	0	100
Nitrate	50	mg/L	0.8	0.5	1	12	0	100
Nitrite	3	mg/L	0.05	0.05	0.05	12	0	100
pH	6.5 - 8.5		7.8	7.5	8	12	0	100
Selenium	0.01	mg/L	0.0023	0.001	0.0035	12	0	100
Silver	0.1	mg/L	0.0006	0.0001	0.001	12	0	100
Sodium	180	mg/L	17	13	21	12	0	100
Sulfate	500	mg/L	5	2	8	12	0	100
Total Dissolved Solids (TDS)	600	mg/L	86	57	114	12	0	100
Total Hardness as CaCO ₃	200	mg/L	39.4	19.8	57	12	0	100
True Colour	15	Hazen Units	1.1	0.5	2	12	0	100
Turbidity	5	NTU	0.54	0.05	1.7	12	0	100
Uranium	0.017	mg/L	0.0013	0.00005	0.0025	12	0	100
Zinc	3	mg/L	0.024	0.005	0.05	12	0	100
Microbiology								
E. coli	0	mpn/100 mL	0	0	0	27	0	100
Total Coliforms	0	mpn/100 mL	0	0	0	27	0	100
Free Chlorine	0.2 - 5	mg/L	1.13	0.23	1.82	29	0	100
Total Chlorine	5	mg/L	1.36	0.66	2.14	29	0	100
pH	6.5 - 8.5		7.59	7.13	8.07	29	0	100
Temperature	30	C	22.2	14.8	29.6	29	0	100
Turbidity	5	NTU	0.81	0.03	2.55	29	0	100

Table C.8 Thungutti Supply System Water Quality Data

Characteristic	Guideline Value	Units	Mean	Min	Max	Sample Count	Exception Count	% Meeting Guidelines
Chemistry								
Aluminium	0.2	mg/L	0.005	0.005	0.005	2	0	100
Antimony	0.003	mg/L	0.0003	0.0001	0.0005	2	0	100
Arsenic	0.01	mg/L	0.0008	0.0005	0.001	2	0	100
Barium	2	mg/L	0.0165	0.016	0.017	2	0	100
Boron	4	mg/L	0.0374	0.0247	0.05	2	0	100
Cadmium	0.002	mg/L	0.0002	0.00005	0.00025	2	0	100
Calcium	10000	mg/L	8.8	8.1	9.5	2	0	100
Chloride	250	mg/L	20	20	20	2	0	100
Chromium	0.05	mg/L	0.0015	0.0005	0.0025	2	0	100
Copper	2	mg/L	0.1335	0.116	0.151	2	0	100
*Fluoride	1.5	mg/L	0.05	0.05	0.05	2	0	100
Iodine	0.5	mg/L	0.01	0.01	0.01	2	0	100
Iron	0.3	mg/L	0.01	0.01	0.01	2	0	100
Lead	0.01	mg/L	0.0006	0.0002	0.001	2	0	100
Magnesium	10000	mg/L	5.11	4.8	5.42	2	0	100
Manganese	0.5	mg/L	0.0013	0.00015	0.0025	2	0	100
Mercury	0.001	mg/L	0.0002	0.00005	0.0004	2	0	100
Molybdenum	0.05	mg/L	0.0013	0.0001	0.0025	2	0	100
Nickel	0.02	mg/L	0.0027	0.0004	0.005	2	0	100
Nitrate	50	mg/L	0.75	0.5	1	2	0	100
Nitrite	3	mg/L	0.05	0.05	0.05	2	0	100
pH	6.5 - 8.5		6.8	6.8	6.8	2	0	100
Selenium	0.01	mg/L	0.0023	0.001	0.0035	2	0	100
Silver	0.1	mg/L	0.0006	0.0001	0.001	2	0	100
Sodium	180	mg/L	14	13	14	2	0	100
Sulfate	500	mg/L	11	8	13	2	0	100
Total Dissolved Solids (TDS)	600	mg/L	83	79	87	2	0	100
Total Hardness as CaCO ₃	200	mg/L	43	40	46	2	0	100
True Colour	15	Hazen Units	0.5	0.5	0.5	2	0	100
Turbidity	5	NTU	0.325	0.05	0.6	2	0	100
Uranium	0.017	mg/L	0.0013	0.0001	0.0025	2	0	100
Zinc	3	mg/L	0.015	0.01	0.02	2	0	100
Microbiology								
E. coli	0	mpn/100 mL	0	0	0	27	0	100
Total Coliforms	0	mpn/100 mL	0	0	0	27	0	100
Free Chlorine	0.2 - 5	mg/L	1.18	0.43	1.88	28	0	100
Total Chlorine	5	mg/L	1.31	0.62	2.04	28	0	100
pH	6.5 - 8.5		6.92	6.55	7.88	28	0	100
Temperature	30	C	21.5	16.2	28.2	28	0	100
Turbidity	5	NTU	0.5696	0	4.7	28	0	100

Appendix D Customer Enquiry Supply Area Descriptions

Table D.1 Customer Enquiry Supply Area Descriptions for KLM Supply System

Supply System	Supply Areas
Kempsey	Kempsey CBD
West Kempsey	West Kempsey & Greenhill
Aldavilla	Aldavilla & Yarravel
Smithtown/Gladstone	Smithtown, Gladstone, Bellimbopinni, Austral Eden
Belmore River	Belmore River
Kinchela	Kinchela, Jerseyville, Rainbow Reach, Summer Island, Seven Oaks & Plumbers Lane
Frederickton	Frederickton, Everinghams Lane, Clybucca
South Kempsey	Dondingalong, Euroka, Burnt Bridge, South Kempsey Service Centre
East Kempsey	East Kempsey, Verges Creek

Appendix E Continuous Improvement - Implementation Plan as of October 2019

Action No.	Supply System	Residual Risk	Outstanding Actions	When Added	Status	Comments	Action
1.02	All	L	Develop a comprehensive stakeholder/relevant agencies list which identifies all stakeholders who could affect, or be affected by, decisions or activities of the drinking water supplier, identifying the accountabilities and responsibilities of relevant agencies. The list should be stored in the TRIM DWMS document register and referenced in the DWMS and the IERP.	2012	Ongoing	<p>List exists, but not completed (not formally), will need to be formalised, will also be included in the DWMP</p> <p>Completed in 2019 DWMS update silt of stakeholder in Overall Manual</p> <p>2020 - change from completed to an annual review and update of the Overall manual of the stakeholders and Emergency contacts (page 10) - this should be aligned with the DESP document</p>	PE - this is a ongoing yearly action
1.04	All Kem	H	KSC is to prepare a chemical supply contract that incorporates quality assurance program for the supply of treatment chemicals, and an SOP for the acceptance and delivery of chemicals to treatment sites, including check sheet.	2012	Ongoing	<p>Under procurement mid ROC process, checklist to be developed, and chemical quality SOP to be developed including QC testing</p> <p>30/10/19 - SOP currently being developed - Need to make a list of Chemicals that can be spot tested and develop procedure.</p> <p>23/12/2020 - there is a chemical supply contract with specifications already in place, the SOPs and quality checks still need to be developed (should include a request of certificate of analysis for every delivery)</p>	TLW to have completed by next review date in 2021

1.05	All	H	KSC to prepare a drinking water monitoring/verification program that identifies the verification and operational monitoring conducted on the water supply. Documented drinking water quality monitoring controls to be incorporated Standard operational procedures are to be prepared on the sampling and testing program.	2012	Ongoing	Work undertaken, however usable spreadsheets need to be developed & reviewed 30/10/2019 - WaterOutlook look currently being rolled out to capture operational WQ data. Table 3 in each Sup plan captures WQ operational requirements with target levels - SOP are currently being developed for operational and verification monitoring 23/12/2020 - SOPs only remain on this action	TLW to have completed by next review date in 2021
2.01	Kem	L	KSC to address the long term need for the Belgrave Falls facility and to remove redundant infrastructure if deemed non-operational.	2012	Ongoing	Needs to be fenced, more water quality testing to be undertaken. Decision to be made whether or not to decommission this. Some concerns regarding salinity, Alkalinity, also iron. SWA analysis to be undertaken. 31-10-2019 further discussion about the act's future based on pending WQ testing 23/12/2020 - WQ testing done all OK waiting on IWCM outcomes	Waiting on IWCM
2.02	Kem	L	Management to determine the viability of maintaining Kinchela as an emergency supply as the site has operational issues and cannot become operational in a short term.	2012	Ongoing	23/12/2020 - Some upgrades have been complete on the back of the 2019/2020 drought, waiting on final report from GHD and implementation of the recommendations	MWS - Actions per final report recommendations
2.04	All	M	Develop a map of high-risk septic tank locations within the catchment for review by DC (Development and Compliance) for integration into their Septic Tank monitoring program.	2012	Ongoing	Work undertaken, awaiting finalisation 31-10-2019 - Outside Water department this sits with Development and Compliance 23/102020 - WQO to talk to CD and GIS team to have a risk layers in GIS	WQO - to chase up with Jack if this has been completed

2.05	All	M	Upgrade existing GIS mapping systems with water infrastructure such as pipelines, easements, valve locations, sampling locations Develop a GIS mapping layer identifying high priority risk zones within catchment.	2012	Ongoing	Will be captured by new GIS 23/12/2020 - TLW to work with GIS team for sampling locations be put into a layers - other items done also refer to above action regarding septic in catchment areas particularly upriver communities	Will be captured by new GIS 23/12/2020 - TLW to work with GIS team for sampling locations be put into a layer - other items done also refer to above action (2.04) regarding septic in catchment areas particularly upriver communities
2.07	Kem	M	Develop and implement a catchment risk program to identify pathogens of concern in conjunction with NSW Health	2012	Ongoing	Work undertaken, summary not written, and awaiting finalisation. Council to contact Water Futures to discuss finalisation. 23/12/2020 - Report completed, NSW Health Dan Deer to develop a one off sampling project	MWS - to liaise with Dan Deer and NSW Health
2.09	Kem	M	Water treatment plant installation for KLM to control pathogens, turbidity, agricultural chemicals and algae.	2012	Ongoing	Expression of interest being completed for concept design for Safe & Secure 31-10-2019 - Funding for emergency plant of 10ML waiting for NSW gov approval. Plant is designed for ease of future expansion to 20ML - If funding granted plant potentially operational by end of July 2020 23/12/2020 - Funding of \$4Mill approved for permanent water treatment plant, options assessment report endorsed by DPIE, Concept design tender let and completion due end of 2022	
2.12	All	M	KSC to prepare a flood response protocol for the protection of the water supply (including Bore operation). SOP to be developed on the operation of the bores and recharge channel.	2012	Ongoing	23/12/2020 = Develop a flood response SOP that covers all supply systems	TLW - to assign the development of a SOP
2.15	Kem	M	KSC to purchase land surrounding the bore field when the opportunity arises, to isolate external risks.	2012	Ongoing	31/10/2019 - This is a long term action 23/12/2020 - Desktop evaluations completed - some adjustments needed. Council Paper to Council before June 2021	MWS ongoing

2.16	All	M	Fencing around bore pumps to restrict animal access. Restrict use of bores where animal access is possible until fencing able to be undertaken	2012	Ongoing	Pending on land purchase for Sherwood 23/12/2020 - Implementation of perimeter fences to be placed on OP plan by WTL	
2.17	All	H	Initiate a Bore inspection and preventative maintenance program.	2012	Ongoing	31-10-2019 - The Bore Inspections have been captured as a monthly task in WaterOutLook which is in the rollout stage - COMPLETED To be developed and actioned by Trades - testing currents, checking the low levels, checking for hots spots, flow switches etc 23/12/2020 - ongoing	ME - To be developed and actioned by Trades team - testing currents, checking the low levels, checking for hots spots, flow switches etc
2.19	Kem	L	Program regular maintenance for the SMD off-take gates.	2012	Ongoing	no mechanisms for these operate to maintain tasks to be documented, 31/10/2019 - Council yet decide of a Asset management system platform, decision pending in the next 6 months 23/12/2020 - Asset management plan developed but current maintenance repairs are being task to TLW	as 23/12/20 notes
2.25	Kem	M	Revegetation around SMD to reduce sediment and nutrient loads during wind and rainfall events.	2012	In progress	2017 comments relevant 31/10/2019 Rip Rap wall installed on dam foreshore - ongoing some area yet to be completed 23/12/2020 - this is ongoing	
2.26	Kem	M	Include the selection of off takes in to the SMD Operational Manual.	2012	In progress	Work has been done, however needs to be documented 31-10-2019 - notes - offtake is determined by WQ gates are locked in set levels built at time of construction 31/10/2019 - When Dam is online the water off take level is to be captured in WaterOutLook - When KLM system is operation in WaterOutLook this action can be removed 23/12/2020 - Offtakes are to be added into to WaterOutlook WTL to check where in the program this should be added	WQO & TLW ensure field is available in the WaterOutLook app to capture SMD water off take level
2.28	Kem	L	A routine maintenance schedule for the SMD aeration line blowers to be developed and incorporated into the AMS	2012	In progress	Will be captured in AMS, maintenance schedules on hard copies, will be integrated electronically 23/12/2020 - To be included in AMS	

2.29	Kem	L	Develop a response procedure for water source changes in KLM.	2012	In progress	SOP written, requires review 23/12/2020 - WTL to finalise review process	
2.31	Kem	L	To monitor animal numbers and introduce an 'animal control' program in the secured SMD area when required.	2012	Ongoing	Number of Kangaroos decreased, inspections undertaken, fenced and blocked off, ongoing task 1/11/2019 - sufficient controls are in place and kangaroo numbers have been reduced and numbers are continually monitored - ACTION CLOSED 23/12/2020 - Risk Team decided for this to be an ongoing action to keep an eye on animal numbers - animal control program are initiate as required WTL to investigate if this should sit in the OM Dam Manual	WTL - to investigate if this should sit in the OM Dam Manual
2.35	All	H	Online monitoring to be installed at Sherwood Lime plant & Greenhill Reservoir to measure and control chlorine dosing. Chlorine gas cylinder scales need to be installed and connected SCADA for remote monitoring. And automatic shutoff for chlorine cylinders	2012	In progress	4/11/2019- further information regarding if we need to have online chorine at Sherwood (potential new plant and asset no longer needed. Still need online for Green Hill 23/12/2020 - PE = Chlorine audit to be undertaken to comply with new Aust Standards ME - as above 2019 comments	as 23/12/2020 notes
2.37	Kem	L	Install online pH monitoring after treatment at the Sherwood Lime plant.	2012	In progress	4/11/2019 - on hold until confirmation of new plant at dam - if so will no longer be required 23/12/2020 - pH monitoring to be installed at Greenhill regardless of new plant at SMD, money has been allocated	as 23/12/2020 notes
2.38	Kem	M	Alarms to be installed on SMD Hypo dosing pumps including the installation of automated duty standby dosing pumps. Item change to - Ensure that duty pump is available at Greenhill Res only, Alarms are already in place	2012	Ongoing	Alarms currently in place and duty standby not considered as a requirement due to upgrade. 4/11/2019 - standby pumps do need to be installed , check that alarms are operational 3/02/2021 -critical to have standby pump installed for Greenhill, but Belgrave and JL can stay with one dosing pump - ME to action as a reactive job	as 03/02/2021 notes

2.39	All	VH	Introduce a 'permit to work' approval system for all maintenance and isolations at key dosing sites. Improve communications between KSC business units for prior notification for all contractor works programmed and include training of all staff on the prior notification of works programmed and site visiting requirements - access permit introduction.	2012	Ongoing	4/11/2019 - Waiting on AMS and MMS to be confirmed and rolled out 03.02.21 - MWS to discuss and provide update with SAP (Erin)	SAP - Erin to provide update of timeline for implementation
2.4	Kem	L	Introduce a treatment chemical stocktake system to monitor chemical stocks and turnover rates.	2012	Ongoing	Stock is ordered as needed, will be in ongoing list 4/11/2019 - This will be captured in WaterOutLook and removed shortly 3-2-21 - this is to look at chlorine cylinders and how much we are charged - there is no documentation to what is being dropped off at the stores - stock register. KSC also awaiting on chemical report from Murray Thompson in relation to moving, handling of chlorine bottles	TLW & PE - to roll out into WaterOutlook and investigate storage handling after report is
2.41	Kem	L	Install automatic level sensors and alarms for Critical low level on Hypochlorite storage tanks or replace hypo system with chlorine gas system.	2012	In progress	SMD chlorine upgrade project underway 3-2-21 - SMD upgrade project will incorporate chlorine project - currently in concept design	MWS to provide project update
2.42	Kem/All	H	Back to base security alarm system required for all treatment facilities.	2012	In progress	4/11/2019 - BMS into SCADA investigation - scoping yet to begin 3-2-21 - Facility management is responsible for security alarming at all facility - in progress	Now - Sits within Facility Management

2.44	Kem	H	Investigate the possibility of emergency power sources for chemical dosing and transfer pumps to maintain supply and dosing for major reservoirs.	2012	In progress	SWR set up for generator, however investigation outcome was that due to the size required, generators are unrealistic 4/11/2019 - new plant at KLM designed for generator backup Additional consultation needed between Council and Power supplier regarding maximum time that power can be interrupted Future scoping of additional booster pump station for Green Hill Res water security.	ME & PE - Additional consultation needed between Council and Power supplier regarding maximum time that power can be interrupted Future scoping of additional booster pump station for Green Hill Res water security.
2.49	All	M	Include inspections after all storm event within the Reservoir Inspection Procedure.	2012	In progress	Will be captured in an SOP 4/11/2019 - SOPs are currently being developed and Storm even to be included on the Reservoir Inspection SOP 3-2-21 - in progress to be developed	TLW - to pass info onto water operators who are writing the SOPs
2.5	All	L	Modification required of inlet/outlets on reservoirs or installation of diversion plates, to prevent sediment disturbance.	2012	In progress	Mixer at Clybucca and John Lane completed, back beach nozzle also installed. 4/11/2019 - This Action is ongoing as new issues are identified 3/2/21 - ongoing as required pending of arising issues	PE - to provide quarterly updates
2.52	Kem	M	Develop priority planning for online chlorine monitoring and secondary dosing at key reservoirs and implement into capital works program.	2012	In progress	ORP probes installed, chlorine analysers on three reservoirs 4/11/2019 - Scoping being undertaking to include integration of secondary dosing at all Res yet to have this ability 3/2/21 ongoing and pending budget availability	PE & ME - to compare scoping process with assistance from TO
2.54	Kem	H	Interlock control placed on all primary disinfection systems where there is online monitoring of chlorine installed on the reservoirs.	2012	In progress	Investigation required, may not be feasible 3/2/21 - investigation yet to be scheduled	PE & ME to investigate and scope

2.56	All	VH	Flow meter monitoring or derived flow monitoring on outlet of reservoirs.	2012	In progress	Need to be confirmed 4/11/2019 - Captured current outlet meters in WaterOutlook, Scope installing of flow meters in identified gaps 3/2/21 - exiting meters been captured in WO - ongoing identification of gaps of where metres on outlets may be required	PE, ME & OE - Captured current outlet meters in WaterOutlook, Scope installing of flow meters in identified gaps TLW - capture meter locations to ensure capture into WaterOutlook
2.58	Kem	VH	Propose a water carting fill station installation at Clybucca to encourage turnover of reservoir.	2012	In progress	Investigation is ongoing 4/11/2019 - MWS working on grants - for water stations for one per scheme 3/2/2021 - this projects is underway - Clybucca is not on the program, locations include Armidale Rd, Belmore River - Gladstone, Gregory - SWR, River St (moved to Armidale road), South St (replaced), Stuarts point	
2.59	All	VH	To formulate a WQ induction program for all contract staff that have access to water supply facilities and conduct in house training for maintenance staff on WQ protection.	2012	In progress	Is undertaken, however may not be formalised 4/11/2019 - SOPs to be developed for maintenance/operational staff 3/2/21 - SWIMS to be finalised then SOPs to be developed	OE - SOPs to be developed for maintenance/operational staff
2.6	Kem	H	Include SOP for alternative or emergency supplies or water restriction implementation if taking Greenhill Res offline in an emergency.	2012	In Progress	SOP to be developed 4/11/2019 - A desk top plan needs to be completed - then a system check 5/2/21 - Yet to be started	PE & OE A desk top plan needs to be completed including asset capabilities- then a system audit check A GIS layer needs to be added for isolation valves of supply water system A plan to be confirmed and in place by 30/6/2020 - yet to be started

2.62	All	H	Upgrade telemetry at reservoir sites and include a review of the critical levels set and associated alarms for individual reservoirs.	2012	In progress	Council is currently undertaking related work, will be applied to water section 4/11/2019 All Reservoir levels done except for Thunggutti - Ongoing review of critical levels 3/2/21 - Thunggutti completed review of res critical levels are ongoing	PE & ME - Res levels at Thunggutti needed - Ongoing review of critical levels
2.64	All	VH	KSC to maintain an up to date register of high risk connections.	2012	In progress	4/11/2019 - this could have already been completed - MWS and WQO to try and locate 10/2/2021 - OE to confirm that high risk connection are identified and documented	
2.65	All	VH	KSC to ensure compliance to plumbing codes for back flow prevention and high risk areas via a reporting system Consider backflow prevention device inspection program for external/private customers, including maintaining a register	2012	In progress	4/11/2019 - to provide annual report on backflow Compliance Compliance section - external customers are responsible for maintaining and confirming the backflow devices are compliant by having a plumber check and certify them. These records are kept with the compliance section and chase up and ensure requirements are being meet and maintained a register of compliance 5/2/21 0 WQO to chase up compliance for reporting in Annual report	WQO - to Chase up with DC
2.66	All	H	Maintenance crews require separate repair equipment and clothing for water main works and wash down & disinfection procedures TBD for equipment that cannot be duplicated.	2012	In progress	SOP to be developed and regularly truck audits conducted to ensure disinfection carried and used 5/2/21 - In construction crews only have been separated out to Water and sewer, SOPs to be developed	OE - SOP to be developed and regularly truck audits conducted to ensure disinfection carried and used
2.67	All	H	Storage of water main repair & installation materials to be improved to prevent contamination from vermin, debris and faecal material.	2012	In progress	SOP to be developed 7/11/2019 - SOP still in the development stage 5/2/21 - SOP still in development	OE - SOP to be developed

2.68	All	H	Develop an SOP for chlorination of mains after repairs, to include a sampling and testing regime after repair work is completed. Train staff on SOP	2012	In progress	SOP to be developed 5/2/21 - Budget recommended to be developed for NTU and Cl2 instruments for maintenance crews. SOPs to be developed	OE - SOP to be developed need to include what post-test are feasible and equipment required
2.73	All	H	KSC to Initiate a routine maintenance program for all supply pressure pumps and records to be stored in appropriate storage location.		In progress	7/11/2019 - this is being captured in the WaterOutLook rollout 10/2/2021 - was assigned to TLW but moved to ME design of preventative maintenance program	Bobbie talk to Phill about this
2.75	All	H	Maintenance staff to be trained on valve operation and flushing after repairs including an implementation of a valve 'Check Sheet' with tagging system.	2012	In progress	Training completed, tagging system not completed 7/11/2019 - lock out tag out been implemented - however training yet to be performed and the check sheet has been included in the work order completion sheet 5/2/21 - LOTO training has been carried out (current staff, missing gaps for new starts) - SOP to be developed	OE - SOP still needs to be developed and all training for LOTO
2.76	All	H	Control biofilm levels within the network by conducting a regular mains cleaning program. Problem areas to be placed on routine flushing programs with the linking of mains where possible and 'dead ends' minimised in new developments.	2012	In progress	Some mains cleaning undertaken in known problem areas 7/11/2019 - pigging program being implemented Flushing programme has yet to be developed and placed on temporarily hold whilst water restriction are in place 10/2/2021 - Pigging program to commence	
2.77	All	H	Review customer complaints to identify dirty main areas.	2012	Ongoing	Tracked in Monthly WQ report 7/11/2019 - yet to be developed - potential for the tracking of problem clusters for preventative maintenance to be actioned 5/2/21 - Can this be automatically mapped in new synergy soft reports WQO to investigate	OE & WQO - to be added into Water Outlook and then sent to for GIS layer build

2.8	Kem	L	KSC to investigate a notification procedure to inform carters if there is a main breaks or supply issue for fill stations (4 fill stations for all of KSC). DC to inform Water division of auditing of carters.	2012	In progress	7/11/2019 - this is two separate actions 1. develop and formalized communication between Water team and Rates for water carter's notification when supply issues from Reservoirs 2. Devolvement and Compliance to report on audits of water carters 5/2/21 - as notes above	OE - 1. develop SOP for communication to TLW and rates of supply loss 2. WQO to contact Development and Compliance about obtaining water caters audit results
2.81	All	L	Communication procedure to be initiated between KSC and Rural Fire services for prior notification of RFS exercises to prevent disturbances of mains.	2012	To be started	MoU existed, however requires update 18/2/2021 - OE to develop plan	TOW - to provide update
2.82	All	VH	All new mains to be inspected and have a disinfection program and verification before connection.	2012	In progress	SOP to be developed 7/11/2019 this is being done however SOP needs to be created 5/2/21 0 SOP to be developed	OE - develop SOP based on current work practices
2.84	Kem	H	Introduce a 'water by agreement' (WBA) to customers on rising main that the WQ may be variable for drinking (highly chlorinated). Annual notification sent to customers reminding them of the WBA.	2012	To be started	Needs to be confirmed 10/2/2021 - yet to be started. Chris Seam may have some additional information	MWS - to provide update as required
2.85	All	H	Upgrade the telemetry and SCADA system and online monitoring for all sites to improve operational monitoring capabilities and response times. On call staff to regularly check SCADA for system alarms. Duplicate (mirrored service) for monitoring for key sites. To increase in-house staff knowledge of the system and introduce security access levels.	2012	Ongoing	Staff Knowledge completed, rest to be undertaken 7/11/2019 - ongoing 5/2/21 - this action is a rolling project with scheduled upgrades each financial year	

2.89	All	H	Asset Management Condition Assessment and Replacement program to include the whole of supply. Continue developing the existing asset registers to develop an electronic database that includes details such as age of infrastructure; expected life; last service date; maintenance frequency; manufacturer; recorded failures; responsibility for maintenance; operational procedures; and records for maintenance of equipment. This should include any monitoring instrumentation. Develop capability of AMS to integrate with trades maintenance schedules, and to provide notification when scheduled maintenance due.	2012	In progress	Water maintenance own water assets and this will be incorporated into a new AMS and MMS 10/2/2021 - ongoing - as comments above	MWS - to provided update
2.9	Kem	H	Develop a program for installation of Security (CCTV) on high risk sites, on priority basis and implement into Capital works program.	2012	In progress	Long term action, will be considered as budget is secured. 10/2/2021 - started to be rolled out	MWS - to provide update based n budget availability and risk assessment of what is a high risk site
3.08	All	H	Consider additional filling points (backflow prevention compliant) for water carters and tankers (with future recycled water filling option i.e., non-potable). Consider a strategy for community information.	2014	In progress	10/2/2021 - new fill station locations have been identified and rollout to be begin. Carters will be notified as each station comes line - ongoing	
3.13	ALL	H	CCP monitoring locations should be identified and appropriately labelled on each treatment site	2014	In Progress	7/1/2019 - in progress and inclusion of retic monitoring sites 10/02/21 - in progress for signs to be made and then places at appropriate locations	TLW - facilitate with WO about roll out of signage

3.15	HH	H	Develop an SOP for maintenance of aeration towers and cleaning procedure for the Hat Head aeration tower that includes: * adequate isolation procedures * sufficient flushing prior to recommissioning	2014	In Progress	SOP to be developed 10/2/2021 - in progress	TLW - to provide up date on SOP development
3.18	HH	H	Develop an SOP for Soda ash batching	2014	In Progress	SOP to be developed 10/2/2021 - in progress	TLW - to provide update on SOP development
3.21	SWR	H	SOP is required for neutralising after soak clean Items added to action 2021 - Contamination from chemical spill into membrane sump - incorrect chemical cleaning practises (not neutralising correctly) Check that there are SOPs if not need to add to SOP development list	2014	In Progress	SOP in review, a high priority 10/2/2021 this SOP is 90% completed	TLW - to provide update on SOP development
3.28	All	H	Council should consider doing a review of existing SOPs to identify where SOPs are required and where gaps are. This review should include a review of existing control measures documented in the Risk Assessments and ensure that these are adequately documented or identified as gaps if not documented. Ensure that all documents are registered into the Document Register in TRIM. Staff will need to undertake competency based training on all SOP's	2014	In Progress	Will be undertaken as part of review 2018 19/11/2019 this task will be closed off once the SOPs have been developed. The DWMS review that was completed in June 2019 covered the identification of SOP gaps 18/2/21 - SOPs have been identified and assigned to the TLW for development	WQO - to oversee the development of SOPs across the operations, process and maintenance groups

3.29	All	H	Council should develop or review daily task lists at each treatment plant to ensure general operations are covered.	2014	In Progress	Will be included in Water Outlook system, connected with electronic check sheets 19/11/2019 - WaterOutlook transfer has started, and operational tasks have been reviewed in the 2019 DWMS 10/2/2021 - TLW is currently developing a weekly scheduled Brocken into daily tasks that need to be completed at each WTP, tracking of daily tasks will be captured in WaterOutLook	TLW to facilitate
3.3	All	M	A high turnover of staff can result in loss of operational knowledge resulting in operational gaps. Council should develop a procedure for succession planning for key staff members.	2014	In Progress	Succession planning is a whole of Council and is being considered 19/11/2019 informal system in place to upskill staff in acting positions. Council is in the process of developing a succession plan. 10/2/2021 - a work force plan is currently being developed	MWS - to provide updates as required
3.38	CH, HH, SP	M	Consider upgrading the chlorine dosing systems to include automatic shutdowns & shutoff valves, flow switches, scales etc., and integration with SCADA system and automation	2014	In Progress	19/11/2019 - upgrades have started at this water plants 5/2/21 -HH initial safety upgrade completed CH to be part of the new treatment plant. SP - ongoing	
3.47	CH	L	Council to undertake investigations of a dedicated rising main for Big Nobby Reservoir.	Aug-19	In progress	21/11/2019 - MWS to provide update if this is feasible 10/2/2021 - OE to liaise with W&S planning to see if a new main is feasible	OE- to provide update as required
3.48	All	M	Continue removal or replacement of internal ladders with FRP	2014	In progress	All concrete reservoirs been done, good progress (NE, HH, BB, NB, WW done in 2017/18), ladders will be done when refurbishments are undertaken 19/11/2019 - this project is ongoing, and progress and schedules are captures in both ASAM and councils reservoir progress document	TO - to continue to provide updates as required

3.7	ALL	L	Council may consider providing water quality data on resident's rates notices and/or publishing some of this data on their website	2014	In progress	Used to be on the website, but was removed when NSW Health removed theirs, decision to be made by GM 19/11/2019 decision yet to made 10/2/2021 - Council has begun to place some WQ information on Councils WEB page and additional information is currently being developed and rolled out	
3.76	ALL	M	Council should strongly consider investing in online monitoring at all CCPs. This would provide greater process control, as immediate notification would be provided in the event an alert limit is exceeded. Importantly, it would also provide the opportunity of an immediate response in the event a critical limit is exceeded (such as triggering a plant shut down). Online monitoring would also provide useful data for analysis of performance of processes used to control hazards at CCPs and would improve understanding of the WTP's effectiveness more generally.	2014	In progress	19/11/2019 - this is ongoing with some of the CCPs having already been captured onto Clear SCADA 5/2/21 - ongoing and incorporated into yearly sub plan review	ME - to provide ongoing status update ME - to double check that dosing set points affecting the CCPs are clamped and that alarms are reviewed
3.84	ALL	L	Council should consider implementing a monthly water quality performance report to be supplied to councillors and uploaded to Councils website.	2014	Ongoing	currently undertaken, summary provided Director only 10/2/2021 - This is started to be rolled out with some information being displayed on the Web page and communicated weekly via Councils Facebook page	WQO, TLW & PE to discuss what data and what format to be web displayed
3.98	BB	M	Current location of final turbidity analyser to be confirmed, and relocated if required to sample location, post filters and prior to pH correction. BB	Dec-14	In progress	21/11/2019 - This will be captured and actioned when the plant is upgraded 10/2/2021 - as 2019 notes	TLW - to provide status update

4.01	All	H	Operators to ensure that reservoir inspections are occurring monthly as required, currently they are not occurring regularly	Dec-14	In progress	<p>Monthly inspection sheets are stored in F:Drive and Reviewed by WQO</p> <p>21/11/2019 - this is also being transferred into WaterOutlook</p> <p>2/10/2021 - Reservoir inspection reporting has been transferred into WaterOutlook, which generates reminders to the WO for completion - Lack of completion to be addressed at team meetings</p>	TLW & to continue to check inspections sheets and transfer into the WaterOutlook program
4.04	KLM	M	Confirm that the HMI trends at SM Dam are available and establish a setup of downloading trend data regularly and recording, for historical purposes, until Clear SCADA is established at this site.	Dec-14	In progress	<p>Clear SCADA established</p> <p>21/11/2019 - this is set up however "ME" to confirm data capture is historized</p> <p>5/2/21 -Trends are now in Clear SCADA and historized since 2016 - will be improved in the new SCADA standard</p>	ME - to confirm data capture is historized
4.05	KLM	L	New raw water sample location to be established in pump room on Greenhill line, prior to disinfection dosing. Could use existing soda ash dosing point. Currently sampling from 8 m sample at dam which is not ideal.	Dec-14	In progress	<p>Soda Ash point currently being used, permanent point will be put in as upgrades are done</p> <p>21/11/2019 - A dedicated sample location to be identified and installed</p> <p>10/2/2021 - in progress</p>	TLW - to identify sample tap location and organise installation
4.14	All	M	Develop a list of priority meters and power supplies that should be maintained by Council to be used during incident response if required	Dec-14	In progress	<p>Develop a list of emergency power needed by Council during incident response</p> <p>21/11/2019 - ongoing</p> <p>5/2/21 - currently sizing power requirements for every Council assets (e.g., treatment plants and pump stations) this is to go into the BCP</p>	ME - to provide status update on sites required generators in emergency times
4.15	All	M	Clear SCADA to include reservoir volume as well as level	Dec-14	In progress	<p>Will be incorporated into Clear SCADA,</p> <p>21/11/2019 - ongoing ME to investigate</p> <p>5/2/21 - ongoing</p>	

4.17	All	M	An audit of all chemical dosing interlocks for each treatment plant should be undertaken	Dec-14	In progress	Already undertaken, actions to be followed up 21/11/2019 - Need to re-check all audit findings then develop & implemented any actions 5/2/21 - to be looked at - refer to 2019 comments	TLW, PE & ME - Need to re-check all audit findings then develop & implemented any actions
4.18	All	M	Consider developing an SOP which is a risk based approach to determining whether a Bacto sample is warranted following a mains break.	Dec-14	To be started	SOP will be developed 21/11/2019 - not started yet 18/2/21 0 yet to be started	OE - to develop and provide progress update
5.02	All	H	There was no Hazardous substances register, Pollution Incident Response Management Plan or emergency documentation stored on site. A SDS register was on site but it was out of date. The PIRMP needs to be distributed to all WTP's and in the vehicles of the operators. A Hazardous substances register and updated SDS's also need to be provided on this site. Explore the capabilities to utilise KMS.	Apr-16	In Progress	21/11/2019 - need to locate or developed a hazardous substance register. Council BCP recently updated that covers pollution incident responses and emergency protocols The rest needs to developed. 10/2/2021 -SDS have been updated and are in date - - PIRMP currently being updated and training ng to be given to WO (by WQO) - Outstanding action is updating of the Hazardous goods register (TLW)	
5.03	HH	L	There were no instructions on site for number of soda ash bags to be loaded when batching up the soda ash and the operator was not clear on how many to use. A simple SOP, or work instruction, should be developed for this and be available on site.	Apr-16	In progress	SOP for batching up will be developed 21/11/2019 - SOP yet to be developed 10/2/2021 - SOP in development	TLW - to delegate to WO for development

5.04	HH	M	Investigations should also be made into the condition of the Zeolite filter at the base of the aeration tower, which is unlikely to have ever been replaced and should be replaced routinely, as per the directions in the O&M Manuals. The Zeolite will help to absorb iron prior discharge into the balance tank	Apr-16	In Progress	Council to investigate if this is required 21/11/2019 - ongoing 10/2/2021 - There is no Zeolite at HH. Investigate pre-dose chlorine for iron oxidization	PE - to investigate and provide update
5.06	BB, Th, WW	L	The dilution instructions for the Hypo are written on the storage container and the manual backwash instructions for the arsenic filter is taped to the filter. These should be developed into controlled SOP's and maintained in the O&M Manual	Apr-16	In progress	SOP to be developed 21/11/2019 - Hypo SOP has been started Arsenic filter SOP yet to be started 10/2/2021 - SOP in progress	TLW - to provide update
5.11	Th	VH	Permanent ladder access to both reservoirs Safety rail around second reservoir and replace swimming pool fencing on first reservoir and replace with safe access railing (pool fence collects debris on top of the reservoir) Consider security fencing around reservoirs Overflow is an open hole with a mesh covering, this needs to be fixed.	Apr-16	Ongoing	Overflow completed, rest to be undertaken 21/11/2019 - consultation to occur at next quarterly meeting with Health and DoI 10/2/2021 - quotes and proposal to be sent to DPIE	PE -to raise at next meeting and then provide update
5.12	Th	L	Reservoir diagrams of all valves, taps, pipes, scouring options and interconnections required Separate scours for each reservoir required (to be done)	Apr-16	In progress	21/11/2019 - PE investigate scouring options at Reservoir 10/2/2021 Investigation yet to begin	PE - to investigate and provide update

5.13	Th	H	Consider Security fencing around Treatment Plant Buildings	Apr-16	In progress	21/11/2019 - consultation to occur at next quarterly meeting with Health and Dol 10/2/2021 - further discussion required	PE - to investigate and provide update
6	KLM, CH, SP, WW BB Th	M	Chemicals from agricultural runoff near bores - Consult with NSW Health for sponsored sampling programme to test all bores 6monthly over 2 year period to develop base line for protection actions. This could include hydrocarbon testing to capture potential fuel ingress	Nov-19	To be started	Develop a project brief and send to NSW Health if not approved by Health consider adding into our sampling monitoring program 10/2/2021 - Project brief to developed	TLW & WQO to action
6.01	KLM	H	Investigate installation of online monitoring at SMD for nutrients e.g., TN & TP	Nov-19	In progress	To re-assess pending approval of emergency treatment plant. May need to consider move to balance tank 5/2/21 - if online Nutrient monitoring required will be implemented in new treatment plant	
6.02	ALL	H	Development of SOP for testing methodologies of Iron and Manganese	Nov-19	In progress	Development of all spot field methodologies 10/2/2021 - SOP in development	TLW - to pass onto WO
6.05	HH & KNCH	H	Aeration at Hat Head - update maintenance programme to a 6 monthly frequency opposed to yearly	Nov-19	In progress	6 month inspection to be added with a separate yearly clean. This is to be captured in the plant SOP 10/2/2021 - SOP in progress, scheduled to be included in the overall plant SOP	TLW to Action
6.06	SWR	M	Failure of blowers at borefield affecting downstream process Development of SOPs for Blower inspections and investigate automatic plant shut down on interlocks into Clear SCADA	Nov-19	In progress	5/2/21 - Not yet started	ME - investigate SCADA interlocks TLW - to action development of SOP

6.07	SWR	M	Regular Scour programme of delivery line into WTP from borefield	Nov-19	In progress	Develop scour programme - Some engineering controls need to be developed for capture of contaminated water EPA is happy with filter bag to stormwater 5/2/2021 - SWR & Crescent Head done yearly, other supplies are pending on \$\$\$\$	PE, OE & TLW to collaborate
6.08	BB, SWR, SP	M	Update and/or development of SOPs for use of coagulants and other chemicals at treatment plants. This Should include the process for Jar Testing - in context of Equipment failure resulting in under dosing chlorine and not precipitating iron and arsenic (chlorine added for oxidation and Coagulation for arsenic)	Nov-19	In progress	18/2/21 - In progress	TLW - to action
6.09	SWR & BB	M	Manganese & Iron issue in borefield Long term options are WTP extension with the inclusion of additional pre-treatments	Nov-19	In progress	10/2/2021 - BB WTP augmentation is being sort for the plant, this will include review of crypto risk and options for manganese and iron removal SWR long term options are ongoing	MWS to investigate
6.1	SP	M	reject water from the clarifier enters inlet stream investigate corrective actions to minimise reject water entering clarifier.	Nov-19	In progress	PE - need to install E1 pump station for reject water ME - trades to investigate leak 5/2/21 - initial investigation has begun	PE & ME - action as per comments
6.12	SWR	H	investigation required for SWR for CIP - Consider installation of new membrane cleaning tank with hot water	Nov-19	In progress	quotes received for new tank and bund and prep work on chemical storage area 10/2/21 - New neutralization tank installed - progressing with CIP connection to new tank	PE - ongoing

6.13	SWR	M	Fluoride - Investigation of design limit so system cannot overdose and set at that level	Nov-19	In progress	ME - is investigating TLW to confirm that you can't overdose - once confirmed this action can be closed 18/2/21 - Still to be confirmed	ME- ongoing
6.16	All	H	investigate having the hatch alarms connected to SCADA for all locations -	Nov-19	In progress	5/2/21 - to be scope and but into OP plan	ME & TLW to action
6.17	ALL	VH	review optimal operating water levels to confirm accuracy (report recently undertaken) to be checked then remove task F:\UTILITIES\DRAFT New Water Services\WATER SCHEMES\POTABLE WATER\RESERVOIRS	Nov-19	To be started	PE to confirm data and update if required 10/2/2021 - review of the spreadsheet required	PE - to investigate and provide update
6.19	All	H	Consider a notification through customer service/Facebook to customers that will experience loss of supply due to power outages at booster pump stations and consider emergency power generation role out plan	Nov-19	In progress	Collaboration between PE, ME and Comms group. Plan to be developed for emergency generator rollout across critical assets 5/2/21- generators are request as required & Comms group is notified if required Outstanding action is the Investigation to continue for emergency generator rollout	PE & ME to action
6.2	ALL	H	Review old flushing program and remodel - initiate after drought breaks	Nov-19	To be started	18/2/21 - to be started	TLW
7.01	KLM	H	Automated overflow cone valve testing program	Nov-20	New	10/2/2021 -This in in the budget for 21-22, completion by June 22	

7.02	ALL	H	investigate installing of aqua-jetter/mixer on required Reservoirs (PH, FREDO, New Entrance, upgrade of BB from static and JL)	Nov-20	New	10/2/2021 -Need's investigation of scope of works and to be incorporated into future budgets	
7.04	SWR	M	- Update entry signage protocols - electronic key entry only - Check if Master key opens room (it should not) - Check key on double door access	Nov-20	New	10/2/2021 -Electronic access has been completed - Dec2020 Fluoride Master Key with TLW TLW to confirm that all parts have been completed and then this action can be closed off	
7.05	ALL	L	When performing manual slug dosing of reservoirs/Clear Water Tanks the Team Leader or Senior Water Operator need to be informed beforehand to double check dose rate calculations	Nov-20	New	10/2/2021 - SOP to be developed and then Tool boxed to team also to be added to Water Outlook	
7.06	ALL	M	- add plant power generator sizes to the BCP plan for in the event of loss of power at treatment plants due to storm events or planned outages.	Nov-20	New	10/2/2021 - further investigation required	
7.06	ALL	VH	Investigate having the door alarms connected to SCADA for all locations - Check has been completed then remove	Nov-20	New	10/2/2021 - Investigate to confirm alarms on all Water Assets treatment plant main access doors and begin scope of works investigation for alarms on reservoir hatches	
7.07	ALL	VH	Investigate of cameras on key assets	Nov-20	New	10/2/2021 - Started to investigate sites and proposed money allocation been requested into the 22-23 budget for SWR and the SMD at this stage	
7.06	ALL	M	Develop re-order sheets for each plant with identification at what minimal chemical levels should be carried	Nov-20	New	10/2/2021 - Develop SOP that covers all plants minimal Chemical levels and for it to be listed. This list then to be incorporated into SCADA as an alert alarm for when to re-order	
7.07	ALL	H	review SCADA alarms at each plant (Hat Head STP is completed)	Nov-20	New	10/2/2021 -Ongoing review of all SCADA systems and Plant functional description across all water and sewer	
7.08	ALL	VH	Tender instrumentation services	Nov-20	New	10/2/2021 - In progress of writing tender plan for the preventative maintenance of all water instrumentation	

7.09	SP	L	Online monitoring to be installed at Stuart Point combined raw water at CCP1 for automatic shutdown capabilities	Feb-21	New	18/2/2021 - To be investigated	
7.1	SP	L	Stuarts Point supply Automatic Shutdown interlocks on Turbidity at CCP2 post filtration	Feb-21	New	18/2/2021 - To be investigated	