

Central NSW Shire Council



Risk-based Drinking Water Management System

Central River and Little Bore water supply systems

Version 4.0. Date 29th June 2012.

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DOCUMENT INFORMATION

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EXECUTIVE SUMMARY

PURPOSE OF THIS DOCUMENT

As part of a pilot program involving four NSW council local water utilities, Central NSW Council has partnered with NSW Health and the NSW Office of Water in developing a Drinking Water Management System consistent with the Framework for Management of Drinking Water Quality in the Australian Drinking Water Guidelines 2011 - "the Framework" (NHMRC/NRMMC 2011). The implementation of such a system is required to conform to the *Public Health Act 2010* (NSW) (the Act) (NSW Government 2010) and its supporting regulation (in development). The Act sets out the need for a *Quality Assurance Program* (QAP), which would ideally be consistent with the Framework as a model for best practice.

This document sets out in outline how Council conforms to the Framework at the time of writing and summarises the actions planned to increase the level of conformity with the Framework in future. The Framework, and this document, is structured into 12 Elements, 32 Components and 76 Actions. The document was developed using the following steps:

- Complete an on site audit (termed a Gap Analysis) of the current state of conformity with the Framework.
- Undertake actions to fill many of the identified gaps, including a system description, water quality data analysis, risk assessment workshop, risk management workshop and the development of procedures.
- Summarising the way in which Council conforms to the Framework through this document, largely by referencing other documents and systems.

PROCESS CONTROL AT CRITICAL CONTROL POINTS

The Critical Control Points (CCPs) and their associated monitoring and response procedures constitute the core of a DWMS. Therefore, the CCPs are summarised upfront within this document.

All operators are trained and made aware of the CCPs relating to the water supply systems that they work with. The CCP summaries are displayed prominently at treatment plants and at the Water Office of Council. Operators retain records of system performance against the CCP requirements and record the actions taken in response to excursions outside operational and critical limit criteria.

This DWMS covers two water supply systems: the Central River and Little Bore water supply systems. Some of the CCPs are common to both, whilst others are specific for each water supply system. Therefore, three CCP tables have been prepared. The first two CCP tables are specific for individual systems and deal with the headworks and treatment plants. The third CCP table is generic across Council and deals with distribution system process control.

It is important to note that the CCP tables are not exhaustive in that there are many other actions taken by Council and other stakeholders to protect and enhance drinking water quality. The CCPs are, however, those process steps that require the most attention and, wherever practicable, continuous monitoring linked to urgent response to excursions outside of the critical limits.

Further details of the CCPs and supporting operating procedures are given in Appendix A. Broader supporting information on CCPs, including calibration and maintenance of monitoring equipment, is given in the Operations and Maintenance Manual for Central NSW Shire Council.

ADDRESSING THE ADWG FRAMEWORK

The remainder of this document addressed the ADWG Framework, either directly, within the body of the document, or by reference to other documents and systems. It should be noted that, at the time of writing, there are some significant gaps between current practice and where Council and NSW Health would ideally be. Therefore, a key part of this document is the Improvement Plan (Section 3.12.2) which sets out numerous drinking water quality management improvement actions that Council will address in the coming years.

Critical Control Points and operational criteria for the Central River system

Critical Control Point	Hazard(s) of concern	Operational monitoring	Location of Measurement	Target	Operational limit	Critical limit
1. Raw water abstraction	Turbidity Pathogens	Raw water turbidity (via on line analyser and daily manual testing)	Sample line drawing from the raw water inlet pipe to the filtration plant	< 5 NTU	5 NTU	100 NTU
2. Powdered activated carbon dosing system	Cyanotoxins	Monitoring cyanobacteria (weekly)	Raw water dam	< 2,000 cells/mL <i>M. aeruginosa</i> or < 0.2 mm ³ /L all cyanobacteria	5,000 cells/mL <i>M. aeruginosa</i> or 0.4 mm ³ /L all cyanobacteria	50,000 cells/mL <i>M. aeruginosa</i> or 4 mm ³ /L toxigenic cyanobacteria or 10 mm ³ /L all cyanobacteria or cyanotoxins above guideline values
	Geosmin MIB	Taste and odour of water (checked daily pre-treatment (boiled) and post treatment)	Taps drawing from the raw water inlet pipe and clear water reservoir outlet	No taste & odour	Noticeable taste & odour	Not applicable
3. Pre-oxidation using chlorine	Iron Manganese	Free chlorine (on line as well as via daily manual testing)	Sample line drawing prior to coagulant dosing point	0.5 to 1 mg/L	< 0.5 mg/L	Not applicable
4. Coagulation, flocculation, sedimentation, media filtration	Turbidity Pathogens Iron Manganese	Filtered water turbidity (online as well as daily manual testing)	Sample line drawing from downstream of individual filtered water effluent pipes	< 0.15 NTU	0.2 NTU	> 0.5 NTU
5. Chlorine disinfection	Chlorine-sensitive pathogens Some cyanotoxins	Treated water free chlorine (on line as well as via daily manual testing)	Sample line drawing from the outlet of the clearwater storage	1.5 to 2 mg/L	0.7 to 3 mg/L	< 0.5 mg/L > 5 mg/L
	Taste and odour Disinfection by-products	Treated water pH (via daily manual testing)		7 to 7.5	6.5 to 8.5	< 6.0 > 9
6. Distribution reservoirs	Pathogens	Integrity of reservoirs (checked visually monthly)	Around the full perimeter and on top of the roof of the reservoir	Secure, vermin-proof and water proof	Evidence of breeches or potential breeches, e.g. holes that could permit entry of vermin, faeces or other water entry points	Evidence of contamination, e.g. bird or animal entry or adverse water quality results
		Free chlorine (via daily manual testing)	Sampling tap on the storage	> 0.5 mg/L	< 0.3 mg/L	< 0.2 mg/L

Critical Control Points and operational criteria for Little Bore system

Critical Control Point	Hazard(s) of concern	Operational monitoring	Location of Measurement	Target	Operational limit	Critical limit
1. Well head	Pathogens	Monthly inspection of well head	Well head and surrounding area	Intact fencing and casing and no nearby sources of contamination within 100 m	Any integrity breach of the fencing or casing	Evidence of contamination associated with an integrity breach, e.g. sewer or hazardous substance spill
2. Chlorine disinfection	Chlorine-sensitive pathogens Taste and odour Disinfection by-products	Free chlorine via thrice-weekly manual testing	Outlet of pressure tanks	1 to 3 mg/L	0.7 to 4 mg/L	< 0.5 mg/L > 5 mg/L
		pH via daily thrice-weekly testing	Outlet of pressure tanks	7 to 7.5	6.5 to 8	< 6.0 > 8.5

Critical Control Points and operational criteria for both the Central River and Little Bore systems

Critical Control Point	Hazard(s) of concern	Operation monitoring	Location of Measurement	Target	Operational limit	Critical limit
7. Distribution network	Pathogens	System pressure (or surrogate) (measured on line): reservoir minimum service levels and/or pump station low pressure set points	Reservoirs or pump stations, as applicable	Above low alarm set points (specific to each asset)	< low alarm set points (specific to each asset)	< low-low alarm set points (specific to each asset)
		Residual chlorine (sampled weekly)	Sampling tap at customer properties	> 0.3 mg/L	< 0.2 mg/L	< 0.1 mg/L
		Water clarity (after completing works involving loss of system pressure, e.g. mains breaks)	Sampling at flushing points (hydrants or taps at customer properties)	Water is clear following flushing	Any discolouration, odour or particles visible in the water following flushing	Any evidence of contamination of the works site, e.g. sewer or hazardous substance spill
8. Customer connections	Chemicals and pathogens	Backflow prevention devices for high and medium hazard connections (in line with the plumbing code)	Testing of testable devices at customer property connections annually	Connections are compliant and have been tested within the past 12 months	Connections lack a suitable device or it is over 15 months since the last test	Any evidence of contamination back flowing into the water supply
		Dual check valves in water meters within their design life	At head office where water meter records are retained	Meters are replaced within 80% of their service life	Meters have exceeded their service life	

1 INTRODUCTION

Central NSW Shire Council partnered with NSW Health and the NSW Office of Water in developing a drinking water quality management system consistent with the Framework for Management of Drinking Water Quality in the Australian Drinking Water Guidelines 2011 (ADWG) - “the Framework” (NHMRC/NRMMC 2011). The document has been developed to conform to the Part 3, Clause 25 of the *Public Health Act 2010* (NSW) (the Act) (NSW Government 2010) and the Part 5, Clause 27 of the Public Health Regulation (public consultation draft, 2011). The Act sets out the need for *Quality Assurance Programs* (QAP) and the Regulation sets out the need for the QAP to be consistent with relevant aspects of the Framework. The Framework was developed to guide the design of a structured and systematic approach for the management of drinking water quality and includes twelve elements that are considered good practice for systematic management of drinking water supplies. The Framework is effectively a quality management system that has been developed specifically for the water industry. The framework incorporates a preventive risk management approach from catchment to consumer.

2 DOCUMENT STRUCTURE

Each element of the Framework has a number of components with a corresponding set of actions (12 Elements, 32 Components and 76 Actions). This Drinking Water Management System (DWMS) document follows that structure (Table 2-1). In some cases, subordinate documents are referenced for further details.

Table 2-1. Framework for Management of Drinking Water Quality (ADWG).

<p>1. Commitment to Drinking Water Quality Management</p> <ul style="list-style-type: none"> Drinking water quality policy Regulatory and formal requirements Engaging stakeholders <p>2. Assessment of the Drinking Water Supply System</p> <ul style="list-style-type: none"> Water supply system analysis Assessment of water quality data Hazard identification and risk assessment <p>3. Preventive Measures for Drinking Water Quality Management</p> <ul style="list-style-type: none"> Preventive measures and multiple barriers Critical control points <p>4. Operational Procedures and Process Control</p> <ul style="list-style-type: none"> Operational procedures Operational monitoring Corrective action Equipment capability and maintenance Materials and chemicals <p>5. Verification of Drinking Water Quality</p> <ul style="list-style-type: none"> Drinking water quality monitoring Consumer satisfaction Short-term evaluation of results Corrective action 	<p>6. Management of Incidents and Emergencies</p> <ul style="list-style-type: none"> Communication Incident and emergency response protocols <p>7. Employee Awareness and Training</p> <ul style="list-style-type: none"> Employee awareness and involvement Employee training <p>8. Community Involvement and Awareness</p> <ul style="list-style-type: none"> Community consultation Communication <p>9. Research and Development</p> <ul style="list-style-type: none"> Investigative studies and research monitoring Validation of processes Design of equipment <p>10. Documentation and Reporting</p> <ul style="list-style-type: none"> Management of documentation and records Reporting <p>11. Evaluation and Audit</p> <ul style="list-style-type: none"> Long-term evaluation of results Audit of drinking water quality management <p>12. Review and Continual Improvement</p> <ul style="list-style-type: none"> Review by senior executive Drinking water quality management Improvement plan
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3 ADDRESSING THE ADWG FRAMEWORK

3.1 ELEMENT 1 - COMMITMENT TO DRINKING WATER QUALITY MANAGEMENT

3.1.1 DRINKING WATER QUALITY POLICY

ADWG Actions

- Formulate a drinking water quality policy endorsed by senior executives to be implemented throughout the organisation.
- Ensure that the policy is visible, communicated, understood and implemented by employees.

Council has developed a standalone *Drinking Water Quality Policy* that has been endorsed by a Council meeting and signed by the Council General Manager and Mayor (Figure 3-1).

In addition, Council has various corporate policies that are relevant to water supply in its Strategic Business Plan for Water Supplies. These cover some water quality issues, such as catchment management/protection and cross-connections controls.

Central NSW Council Drinking Water Quality Policy

Council is committed to providing safe, high-quality drinking water that consistently meets the requirements of NSW Health, NSW Office of Water, the Australian Drinking Water Guidelines and consumer expectations.

Council will work on an ongoing basis with our stakeholders to manage the multiple barriers that protect and maintain water quality water from catchment to consumer.

Priorities will be set using an objective, risk-based approach to water quality management, to improve the quality of water supplied and the reliability with which that quality is achieved.

A Quality Assurance Program, as required under Part 3, Clause 25 of the *Public Health Act 2010* is maintained which is documented in our Drinking Water Management System which has adopted the Framework for Management of Drinking Water Quality given in the Australian Drinking Water Guidelines.

All Water Division staff are responsible for understanding and working in accordance with relevant aspects of the Drinking Water Management System.

Drinking water quality monitoring will be conducted independently by NSW Health and we will report the results of that monitoring to the community.

The Drinking Water Management System is an operational management system that will be adequately resourced, maintained and improved indefinitely as a core and ongoing function of Council.

Dated: 1st July 2011. Signed: General Manager. Mayor.

Figure 3-1. Council Drinking Water Quality policy

3.1.2 REGULATORY AND FORMAL REQUIREMENTS

ADWG Actions

- Identify and document all relevant regulatory and formal requirements.
- Ensure responsibilities are understood and communicated to employees.
- Review requirements periodically to reflect any changes.

Council maintains a detailed summary of its Legislative Framework and associated requirements in its Strategic Business Plan for Water Supplies. Therefore, this DWMS has not reiterated that information. A summary of the legislative and formal requirements of most relevance to drinking water quality management is given here for ease of reference (Table 3-1). An action arising out of the Risk Assessment involves further establishing the regulatory and formal requirements for catchment management (Improvement Plan, Section 3.12.2).

Table 3-1. Regulatory and Formal Requirements summary (Strategic Business Plan has details).

<i>Regulatory or formal requirement</i>	<i>Relevance to drinking water quality</i>	<i>How Council meets this requirement</i>
<i>Public Health Act 2010 and Regulation (2011 draft) (NSW), Part 3, Clause 25.</i>	Sets out the need for Quality Assurance Programs and notes that the Australian Drinking Water Guidelines Framework provides the point of reference for developing such a program	Through this DWMS
Australian Drinking Water Guidelines (2011, or as revised from time to time)	Sets out appropriate practice for drinking water quality management within Australia	Through this DWMS
NSW Health Drinking Water Monitoring Program	Provides for independent testing by NSW Health of Council's treated water as supplied to consumers	Described in more detail under Section 3.5 of this DWMS.
Public Health (General) Regulation 2002 (NSW)	Requires Council to notify NSW Health if there is reason to suspect that drinking water quality might pose a risk to public health	Described in more detail under Section 3.6 of this DWMS.
NSW Code of Practice Plumbing and Drainage 3 rd Edition 2006	Sets out requirements for plumbing in Council's area of operations	Through Council's Plumbing Department
AUS SPEC 0071 Water supply - Reticulation and pump stations (Design)	Sets out the specifications for the design of Council drinking water reticulation system assets	Through Council's Engineering Department
Local Government (General) Regulation 2005 (NSW)	Sets out the requirements for on site sewage management systems (noting that these may be in the drinking water catchment) to be of an accredited (by NSW Health) design, to be registered with Council and to be subject to inspection	Through Council's Health and Building Department who maintain the register and undertake the inspections
<i>Protection of the Environment Operations Act 1997 (NSW)</i>	Sets out the requirements for the control of water pollution from certain activities (noting that these may be in the drinking water catchment) which are registered with the Office of Environment and Heritage	Through notification to OEH if concerns are raised
Local Environment Plan	Limits what can be developed and/or undertaken in a particular location (noting that these locations may be in the drinking water catchment)	Through Council's Planning Department which has drinking water catchment overlays that are used to ensure drinking water quality is considered when assessing development applications

3.1.3 ENGAGING STAKEHOLDERS

ADWG Actions

- Identify all the stakeholders who could affect, or be affected by, decision or activities of the drinking water supplier.
- Develop appropriate mechanisms and documentation for stakeholder commitment and involvement.
- Regularly updated the list or relevant agencies.

Council is not responsible for all aspects of drinking water quality management and is required to interact with multiple stakeholders to help support water quality provision. Council interacts on an as needs basis with stakeholders that influence source water quality, industry codes, standards and guidance and customers. Council engages with key stakeholder for specific purposes and projects. Council maintains a detailed summary of its stakeholders in its Strategic Business Plan for Water Supplies. Therefore, this DWMS has not reiterated that information but has provided a summary of the key stakeholders (Table 3-2).

NSW Health and the NSW Office of Water were invited to participate in the risk assessment process and the development of this DWMS (as discussed in the separate Risk Assessment Summary document). Both parties will be invited to take part in future risk assessment actions. NSW Health and Council respond together to water quality contamination events, such as the detection of *E. coli* in the distribution system – Council would always notify NSW Health immediately if there were any suspected or confirmed drinking water contamination.

There is no special arrangement in place for any particular group of customers, such as dialysis patients. It is understood that modern dialysis machines are designed with water storage tanks such that the water utility doesn't need to notify such customers in the event of water shut downs or other events.

Council is a member of ROC Water Utilities Alliance, which exists to advocate and improve operational efficiencies for its members, through the facilitation of projects, training, preparation of submissions, and the dissemination of information.

Senior staff and council meet the community to hear feedback on a quarterly basis, while the Council is a member of the Catchment Management Authority, which engages strongly with the community.

Table 3-2. Stakeholder summary (refer Strategic Business Plan for further details).

Stakeholder	Relevance to drinking water quality	How Council engaged with this party
NSW Health	Provides expertise, advice, regulatory requirements and water quality monitoring services to Council	Annual meetings with the Local Area Health Service to discuss the DWMS and progress on the Improvement Plan Participation of NSW Health in drinking water quality risk assessments, both the initial assessment and future review and updates Annual reporting to NSW Health on the DWMS and water quality test results Providing water samples for testing by NSW Health
NSW Office of Water	Provides expertise, advice and regulatory requirements to Council	Annual reporting to the Office of Water on performance of the Water Business Unit Inspections by the Office of Water of treatment plants and systems
Catchment Management Authority	Coordinates actions in the drinking water supply catchment	Council provides a representative that sits on the Catchment Management Authority and assists with its planning and delivery
ROC Water Utilities Alliance	Shares ideas and works to improve water quality management	Council takes part in the Alliance and works on project of joint interest and relevance

3.2 ELEMENT 2 - ASSESSMENT OF THE DRINKING WATER SUPPLY SYSTEM

3.2.1 WATER SUPPLY SYSTEM ANALYSIS

ADWG Actions

- Assemble a team with appropriate knowledge and expertise.
- Construct a flow diagram of the water supply system from catchment to consumer.
- Assemble pertinent information and document key characteristics of the water supply to be considered.
- Periodically review the water supply system analysis.

3.2.1.1 SYSTEM ASSESSMENT TEAM

Council assembled a team to complete a system description and water quality risk assessment for its water supply systems during September 2011. Council staff, government stakeholders and external specialists were involved in the process. A separate Risk Assessment Report was generated from the process which carries the full details. For ease of reference, the following Council roles and stakeholders that were involved in the workshop are noted in Table 3-3.

Table 3-3. Summary of stakeholders involved in the system assessment

<i>Organisation</i>	<i>Positions represented</i>
Council	Operations Manager
	Urban Services Coordinator and Overseer (two)
	Water Operators (three)
	Contract Project Engineer
	Environmental Health Officer
	Asset Manager
NSW Department of Health	Area Health Service Public Health Unit Environmental Health staff (three)
	NSW Health Water Unit representative
NSW Office of Water	Office of Water Inspector for the area
Independent technical consultant	Water engineering consultant involved in assisting Council develop procedures to support the DWMS
Water quality management system consultant	Facilitation and water quality risk assessment consultant to independently facilitate the workshop and assist Council develop the DWMS (team of two used)

3.2.1.2 PROCESS FLOW DIAGRAMS

Process flow diagrams were constructed for each water supply system as shown in Figure 3-2 (Central River) and Figure 3-3 (Little Bore).

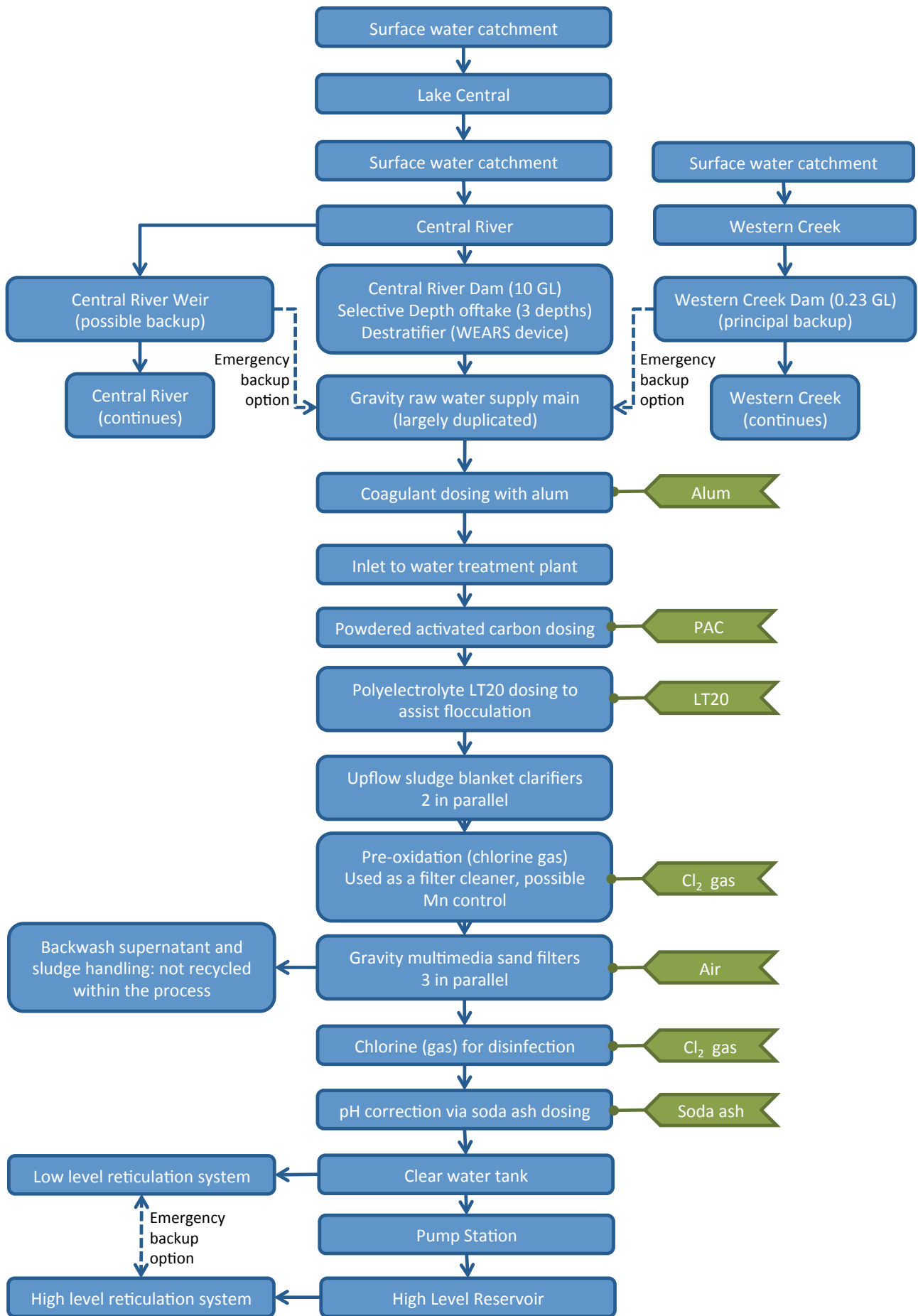


Figure 3-2. Conceptual process flow diagram of the Central River water supply system.

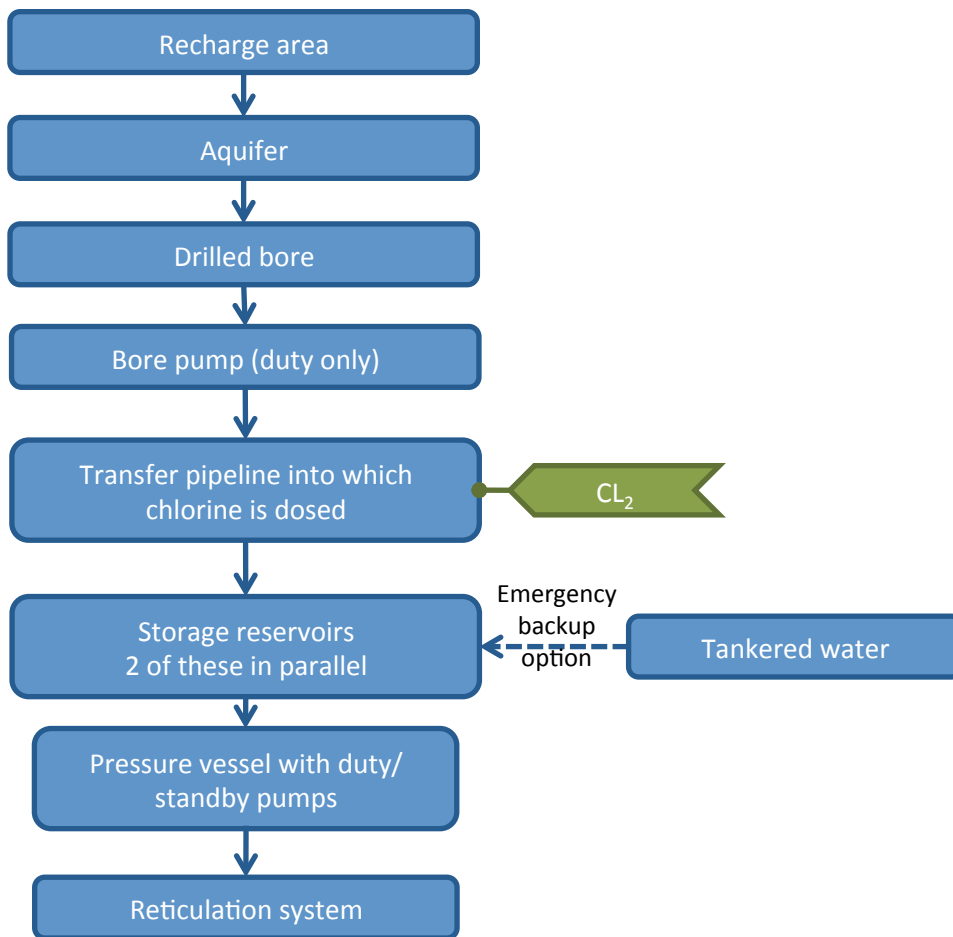


Figure 3-3. Conceptual process flow diagram of the Little Bore water supply system.

3.2.1.3 PERTINENT INFORMATION AND KEY CHARACTERISTICS

A map and overview of the schemes is provided in Figure 3-4, Table 3-4 and in the following sections.

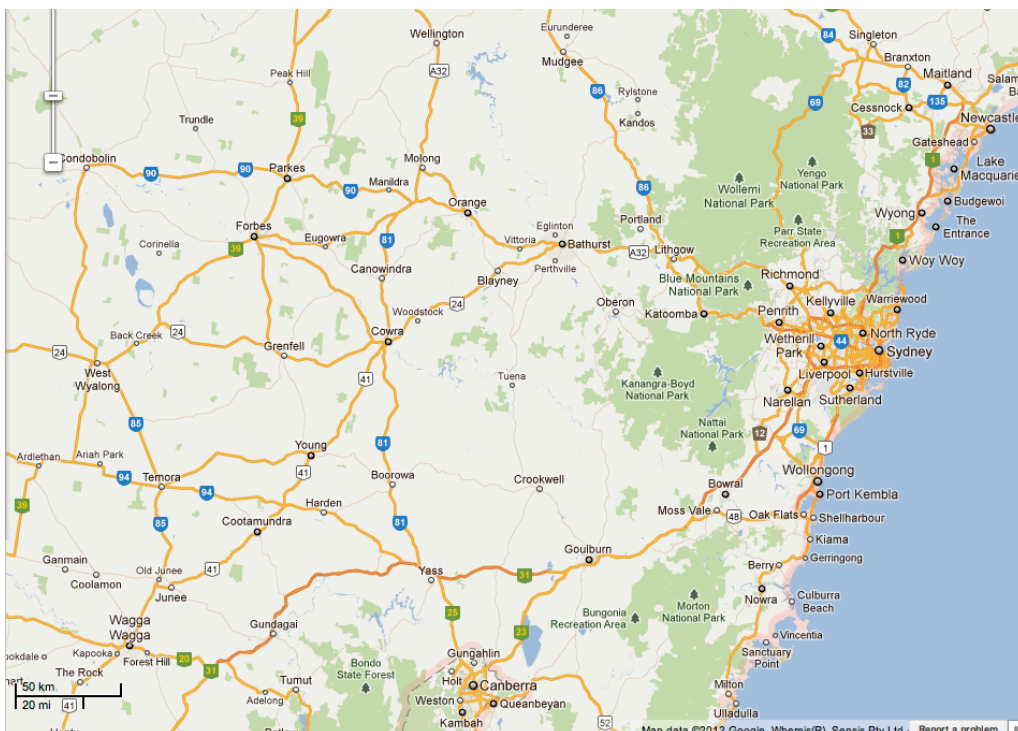


Figure 3-4. Map of water supply schemes (de-identified, shown here for illustration only).

Table 3-4. Water supply system – overview description.

SYSTEM COMPONENT	Central River system	Little Bore system
Population Served	1569 (2006 census)	40 (estimate) 16 rural residential properties
Water Source	Open rural residential, grazing and horticultural catchments Central River Western Creek (backup)	Bore (recently drilled) Pump station (two pumps, second pump provides hot standby and peak)
Raw Water Storage	Central River Dam (1 GL capacity) Central River Weir (backup) Western Creek Dam (backup) (0.23 GL capacity)	Aquifer
Water Treatment	Dual gravity main to treatment plant Central Water Treatment Plant: <ul style="list-style-type: none"> • Alum dosing to begin coagulation and flocculation • Powdered activated carbon dosing for taste and odour and toxin removal • Polyelectrolyte LT20 dosing to assist flocculation • Upflow sludge blanket clarifiers (2 parallel) for clarification • Pre-oxidation (chlorine gas) to assist Mn removal • Gravity multimedia sand filters (3 parallel) for filtration • Chlorine (gas) for disinfection • pH correction via soda ash dosing 	Chlorine disinfection
Storage After Treatment	Clear water storage/ chlorine contact tank, low level (1.4 ML) Pump station High Level (1.6 ML) closed, bird-mesh protected storages.	Two concrete storages (each 91 kL).
Distribution of Product	Reservoir-pressurised pipes of various diameters and materials and approximately 22 km in length	Pump-pressurised reticulation system
Any Special Controls Required	None	None

Water sources

The Central Scheme can be supplied from the Central River via the Central River Weir, the Central River Dam (1 GL capacity) and from Western Creek via the Western Creek Dam (0.23 GL capacity). All of these water sources are located well upstream of the township. Western Creek Dam is now considered to be a backup dam that is seldom used in practice, like the Central Creek Weir. The catchment (which has been mapped by Council and for which maps can be readily produced by the Council GIS group) includes:

- Recreational activities on the upstream lake.
- Stock grazing.
- Horticulture activities (orchards: apple, stone fruit, cherries; vineyards).
- Forestry (including pine).
- Small unsewered towns and residences including scattered rural housing with septic tanks.

Central River Dam is approximately 8 metres deep and stratifies at about 3 metres below the surface. Unless destratified, the dam stratifies severely during the summer months. There are three optional draw-

off depths from the dam and the water depth targeted to supply is typically 2 to 4 m below the dam surface – to avoid algae. A WEARS device destratification unit has been installed in the reservoir.

Some irrigators pump directly from the dam using electric powered pumps. Cattle and sheep can access the dam directly. There are aquatic bird populations on the dam. Dissolved oxygen dam profiles are conducted once per week. Taste and odour tests are conducted with boiled water along with visual tests, and algal counts are undertaken weekly. There is a Catchment Management Plan in place. Council has developed the *Central Water Supply Catchment Management Plan Policy* and conducts weekly inspections of the dam area.

Due to the limited size of Central River Dam (only a few days storage), water must be taken at all times and hence selective abstraction of water can only be used as a short term measure, should a water quality issue occur.

Water is delivered to the Central Water Treatment Plant by a mostly duplicated gravity main of over 20 km in length. There is a raw water turbidity meter on line and the feed to the water treatment plant is shut-off at above 30 NTU. The duplication of the pipe provides supply backup.

The Little Bore water supply source draws from the aquifer that has been designed to provide 4.5 kL per lot. Water carting is used to service the town in the event of a process loss at the source.

Water treatment

Water is fully treated at Central Water Treatment Plant. Raw water is delivered to the treatment plant via gravity. The plant has an estimated 1.9 to 2.4 ML/d peak production capacity. Average daily demand is 0.7 ML/d and peak daily demand is between 1.4 and 2.1 ML/day. The plant does not run continuously; it runs for anywhere between 3 and 10 hours a day. There is no fluoridation at the plant although community consultation is taking place in relation to fluoridation. The treatment steps are listed above in Table 3-4 and the process is summarised here:

- Water from Central River Dam is dosed with an aluminium chlorohydrate solution prior to the addition of powdered activated carbon (PAC) (if and as required) and polyelectrolyte.
- The dosed water is then directed to two up-flow clarifiers operating in parallel.
- Sludge collection cones collect settled aluminium chlorohydrate sludge and direct sludge to a neighbour's dam.
- Following clarification, the water enters three sand filters for final polishing.
- The backwashing of the filters occurs daily and in addition is manually triggered by the operators when the head loss across the bed is 2 m.
- The backwash is air scour assisted and occurs separately at each filter in sequence. It is a manual process with the waste also discharged to the neighbour's dam and not to the head of the plant.
- Chlorine is added to the water entering the filters to help oxidise soluble manganese for its subsequent removal in the filters.
- Chlorine is also added to filtered water prior to its discharge to the treated water clearwater storage.
- There are duty and standby chlorine cylinders and pumps with auto changeover.
- Soda ash is dosed following the addition of chlorine, to increase the pH.

At Central Water Treatment Plant on line telemetered monitoring takes place to cover the following points:

- raw water turbidity (100 NTU intake shut off);
- filtered water turbidity for individual filters (with a 0.5 NTU shut off point);
- head loss across the filters (to control backwash at 2 m);
- chemical pump alarms for alum and electrolyte; and
- pH and online chlorine monitoring on the outlet of the clearwater reservoir (with 0.5 mg/L shut off).

For Little Bore, raw water is pumped directly via the Pump Station and is disinfected by chlorine. There are two pumps, the second pump providing a hot standby and peak demand flow rate pump.

Water distribution

For the at Central Water Treatment Plant system, treated water is transferred by a gravity main to a clear water storage low level reservoir (1.36 ML capacity, dated 1928) which directly supplies low level areas of the town. Water is pumped via a Pumping Station to the second High Level reservoir that supplies the high level areas of the town. Both reservoirs are roofed and bird-proofed. The reservoirs both have telemetered continuously monitored low level alarms. The reservoirs are inspected and reported upon by a diving company. Residual chlorine levels are tested daily and remain greater than 0.1 mg/L, even at the extremities of town due to the relatively small distribution system.

For the Little Bore system, the scheme supplies 16 rural residential properties. Treated water is stored in two concrete storages (each 91 kL) and supplied via a reticulation system.

3.2.1.4 PERIODIC REVIEW

The information contained within this document is current at the time of writing. The information will need to be periodically reviewed and updated. The information will be formally reviewed annually and updated in response to significant system changes.

3.2.2 ASSESSMENT OF WATER QUALITY DATA

ADWG Actions

- Assemble historical data from source waters, treatment plants and finished water supplied to consumers (over time and following specific events).
- List and examine exceedances.
- Assess data using tools such as control charts and trend analysis to identify trends and potential problems.

Water quality data is summarised in a separate document (Risk Assessment Workshop Summary).

3.2.3 HAZARD IDENTIFICATION AND RISK ASSESSMENT

The hazard identification and risk assessment is discussed in a separate document (Risk Assessment Workshop Summary). In summary, a number of risks rated “high” for the surface water source even with the current controls in place, i.e. at the “residual risk” level. Specifically, these risks were:

- Malicious contamination of the source water reservoir.
- Malicious contamination of the treated water reservoirs.
- Failure to dose powdered activated carbon in time when required.
- Inability to backwash the filters when required due to the nature of the backwashing process.
- Pathogen breakthrough through filters due to a range of underlying causes.
- Failure of process monitoring devices to provide accurate signals, due to a range of underlying causes.

No risks rated high at the “residual risk” level for the bore water source. However, a number of risks rated “moderate” for either the bore water or surface water source, including, but not limited to:

- Pathogen breakthrough through disinfection filters due to a range of underlying causes.
- Contaminants from spills in the catchment.
- Pathogen or contaminant breakthrough through filters due to a range of underlying causes such as chemical under- or over-dosing.
- Raw water bypass valve being operated leading to plant bypass.
- Backflow from contaminated sources within the distribution system.
- Treatment chemical contamination.

Section 3.12 of the DWMS captures Improvement Actions to address many of these risks.

3.3 ELEMENT 3 - PREVENTIVE MEASURES FOR DRINKING WATER QUALITY MANAGEMENT

3.3.1 PREVENTIVE MEASURES AND MULTIPLE BARRIERS

ADWG Actions

- Identify existing preventative measures from catchment to consumer for each significant hazard or hazardous event and estimate the residual risk.
- Evaluate alternative or additional preventative measures where improvement is required.
- Document the preventative measures and strategies into a plan addressing each significant risk.

In practice, this component of the Framework was addressed simultaneously with the above component (Section 3.2.3).

3.3.1.1 IDENTIFY EXISTING PREVENTIVE MEASURES AND ESTIMATE RESIDUAL RISK

An overview of the preventive measures is discussed in a separate document (Risk Assessment Workshop Summary).

3.3.1.2 EVALUATE ALTERNATIVE OR ADDITIONAL PREVENTIVE MEASURES

The preventive measures for the water supply system explicitly encompassed within the risk assessment have been considered adequate to control the identified risks, but with room for improvement. Improvement processes and other follow up actions were recorded where risks were considered to need additional mitigation, as shown in the separate Risk Assessment Summary document, and as captured in the Improvement Plan (Section 3.12.2).

3.3.1.3 DOCUMENT THE PREVENTIVE MEASURES AND STRATEGIES INTO A PLAN

The preventive measures and strategies for addressing the significant risks are summarised in the following section that deals with Critical Control Points. It is important to note that the CCP tables are not exhaustive in that there are many other actions taken by Council and other stakeholders to protect and enhance drinking water quality. The CCPs are, however, those process steps that require the most attention and, wherever practicable, continuous monitoring linked to urgent response to deviations outside of the critical limits. Preventive measures that were not identified as CCPs have not been further developed as part of this iteration of the DWMS. However, ongoing work on recognising, formalising, and, where required, enhancing and better implementing those various programs is planned as part of the Improvement Plan (Section 3.12.2). Examples of preventive measures that are not captured as CCPs, and that are not explicitly captured elsewhere within the DWMS, but that are nonetheless important to manage drinking water quality, include the following:

- Development assessment and control via the Local Environmental Plan.
- Catchment management via the Catchment Management Authority – various environmental and catchment management activities to improve water quality.
- Council's program of regulating, (assessing, inspecting and enforcing) on site sewage management system compliance.
- Compliance with plumbing codes of practice both in relation to Council's activities and the regulation (assessing, inspecting and enforcing) of activities of others.

3.3.2 CRITICAL CONTROL POINTS

ADWG Actions

- Assess preventative measures from catchment to consumer to identify critical control points.
- Establish mechanisms for operational control.
- Document critical control points, critical limits and target criteria.

The Critical Control Points (CCPs) and their associated monitoring and response procedures constitute the core of a DWMS. This DWMS covers two water supply systems: the Central River and Little Bore water supply systems. Some of the CCPs are common to both, whilst others are specific for each water supply system. Therefore, three CCP tables have been prepared. The first two CCP tables are specific for individual systems and deal with the headworks and treatment plants (Central River in Table 3-5 and Little Bore in Table 3-6). The third CCP table is generic across Council and deals with distribution system process control (Table 3-7). Further details of the CCPs and supporting operating procedures are given in Appendix A. Broader supporting information on CCPs, including calibration and maintenance of monitoring equipment, is given in the Operations and Maintenance Manual for Central NSW Shire Council.

3.3.2.1 ASSESS PREVENTIVE MEASURES TO IDENTIFY CRITICAL CONTROL POINTS

The preventive measures in place for the water supply are listed as part of the risk assessment (as shown in the separate Risk Assessment Summary document). By reviewing these preventive measures, critical control points (CCPs), as summarised in Table 3-5 to Table 3-7, were identified on the following basis:

- Preventive measures are present that significantly reduce moderate, high or very maximum significant risks;
- Operational parameters can be identified that can be monitored and for which critical limits can be set;
- It is possible to monitor the operational monitoring parameters frequently enough to reveal any failures in a timely manner; and
- Procedures for corrective action can be implemented in a timely response to deviation from defined critical limits.

3.3.2.2 ESTABLISH MECHANISMS FOR OPERATIONAL CONTROL

The controls required for each CCP were defined during the workshop, and further fine-tuned after the workshop. The controls are summarised in the process control tables (Table 3-5 to Table 3-7).

3.3.2.3 DOCUMENT CCPs, CRITICAL LIMITS AND TARGET CRITERIA

Council has documented its CCPs and critical limits in Table 3-5 to Table 3-7. In this context, these terms are used as follows:

- Targets represent the target to be aimed for by the operator for each CCP.
- Operational limits have been defined that occur somewhere between the target value and critical limit. Deviation outside the adjustment limit indicates a possible trend towards the critical limit and may be symptomatic of a loss of control. Therefore, some adjustment is required to bring the process back under control if the operational limit is exceeded.
- Critical limits are performance criteria that separate acceptability from unacceptability in terms of hazard control and drinking water safety. Deviation outside the critical limits indicates a loss of control of the process and creates a situation in which confidence in the safety of the water may be lost.

Further and full details of the operation of the CCPs are given in separate standard operating procedures managed by Council (Appendix A).

Table 3-5. Critical Control Points and operational criteria for the Central River system

Critical Control Point	Hazard(s) of concern	Operational monitoring	Location of Measurement	Target	Operational limit	Critical limit
1. Raw water abstraction	Turbidity Pathogens	Raw water turbidity (via on line analyser and daily manual testing)	Sample line drawing from the raw water inlet pipe to the to filtration plant	< 5 NTU	5 NTU	100 NTU
2. Powdered activated carbon dosing system	Cyanotoxins	Monitoring cyanobacteria (weekly)	Raw water dam	< 2,000 cells/mL <i>M. aeruginosa</i> or < 0.2 mm ³ /L all cyanobacteria	5,000 cells/mL <i>M. aeruginosa</i> or 0.4 mm ³ /L all cyanobacteria	50,000 cells/mL <i>M. aeruginosa</i> or 4 mm ³ /L toxigenic cyanobacteria or 10 mm ³ /L all cyanobacteria or cyanotoxins above guideline values
	Geosmin MIB	Taste and odour of water (checked daily pre-treatment (boiled) and post treatment)	Taps drawing from the raw water inlet pipe and clear water reservoir outlet	No taste & odour	Noticeable taste & odour	Not applicable
3. Pre-oxidation using chlorine	Iron Manganese	Free chlorine (on line as well as via daily manual testing)	Sample line drawing prior to coagulant dosing point	0.5 to 1 mg/L	< 0.5 mg/L	Not applicable
4. Coagulation, flocculation, sedimentation, media filtration	Turbidity Pathogens Iron Manganese	Filtered water turbidity (online as well as daily manual testing)	Sample line drawing from downstream of individual filtered water effluent pipes	< 0.15 NTU	0.2 NTU	> 0.5 NTU
5. Chlorine disinfection	Chlorine-sensitive pathogens Some cyanotoxins	Treated water free chlorine (on line as well as via daily manual testing)	Sample line drawing from the outlet of the clearwater storage	1.5 to 2 mg/L	0.7 to 3 mg/L	< 0.5 mg/L > 5 mg/L
	Taste and odour Disinfection by-products	Treated water pH (via daily manual testing)		7 to 7.5	6.5 to 8.5	< 6.0 > 9
6. Distribution reservoirs	Pathogens	Integrity of reservoirs (checked visually monthly)	Around the full perimeter and on top of the roof of the reservoir	Secure, vermin-proof and water proof	Evidence of breeches or potential breeches, e.g. holes that could permit entry of vermin, faeces or other water entry points	Evidence of contamination, e.g. bird or animal entry or adverse water quality results
		Free chlorine (via daily manual testing)	Sampling tap on the storage	> 0.5 mg/L	< 0.3 mg/L	< 0.2 mg/L

Table 3-6. Critical Control Points and operational criteria for Little Bore system

Critical Control Point	Hazard(s) of concern	Operational monitoring	Location of Measurement	Target	Operational limit	Critical limit
1. Well head	Pathogens	Monthly inspection of well head	Well head and surrounding area	Intact fencing and casing and no nearby sources of contamination within 100 m	Any integrity breach of the fencing or casing	Evidence of contamination associated with an integrity breach, e.g. sewer or hazardous substance spill
2. Chlorine disinfection	Chlorine-sensitive pathogens Taste and odour Disinfection by-products	Free chlorine via thrice-weekly manual testing	Outlet of pressure tanks	1 to 3 mg/L	0.7 to 4 mg/L	< 0.5 mg/L > 5 mg/L
		pH via daily thrice-weekly testing	Outlet of pressure tanks	7 to 7.5	6.5 to 8	< 6.0 > 8.5

Table 3-7. Critical Control Points and operational criteria for both systems

Critical Control Point	Hazard(s) of concern	Operation monitoring	Location of Measurement	Target	Operational limit	Critical limit
7. Distribution network	Pathogens	System pressure (or surrogate) (measured on line): reservoir minimum service levels and/or pump station low pressure set points	Reservoirs or pump stations, as applicable	Above low alarm set points (specific to each asset)	< low alarm set points (specific to each asset)	< low-low alarm set points (specific to each asset)
		Residual chlorine (sampled weekly)	Sampling tap at customer properties	> 0.3 mg/L	< 0.2 mg/L	< 0.1 mg/L
		Water clarity (after completing works involving loss of system pressure, e.g. mains breaks)	Sampling at flushing points (hydrants or taps at customer properties)	Water is clear following flushing	Any discolouration, odour or particles visible in the water following flushing	Any evidence of contamination of the works site, e.g. sewer or hazardous substance spill
8. Customer connections	Chemicals and pathogens	Backflow prevention devices for high and medium hazard connections (in line with the plumbing code)	Testing of testable devices at customer property connections annually	Connections are compliant and have been tested within the past 12 months	Connections lack a suitable device or it is over 15 months since the last test	Any evidence of contamination back flowing into the water supply
		Dual check valves in water meters within their design life	At head office where water meter records are retained	Meters are replaced within 80% of their service life	Meters have exceeded their service life	

3.4 ELEMENT 4 - OPERATIONAL PROCEDURES AND PROCESS CONTROL

3.4.1 OPERATIONAL PROCEDURES

ADWG Actions

- Identify procedures required from processes and activities from catchment to consumer.
- Document all procedures and compile into an operations manual.

As part of the development of the DWMS, Council reviewed the need for specific procedures. At the time of writing, not all of the procedures that were identified as being required have been developed. However, a prioritised set of procedures has been drafted.

The Operations and Maintenance Manual for Central NSW Shire Council provides detailed operating procedures for the filtration plant and bore. However, in some respects, the Manual is out of date and serves the purpose as a reference document rather than a guide to day-to-day operations. Therefore, concise operational procedures have been developed to guide operators at the day-to-day level. The current draft of the procedures that have been developed are given as Appendix A of this document.

3.4.2 OPERATIONAL MONITORING

ADWG Actions

- Develop monitoring protocols for operational performance of the water supply system, including the selection of operational parameters and criteria and the routine analysis of results.
- Document monitoring protocols into an operational monitoring plan.

Operational monitoring protocols were integrated with the operating procedures for the preventive measures. The current draft of the procedures that have been developed are given as Appendix A of this document.

3.4.3 CORRECTIVE ACTION

ADWG Actions

- Establish and document procedures for corrective actions to control excursions in operational parameters.
- Establish rapid communication systems to deal with unexpected results.

Corrective action responses to excursions in operational monitoring parameters were integrated with the operating procedures for the preventive measures. The current draft of the procedures that have been developed are given as Appendix A of this document.

3.4.4 EQUIPMENT CAPABILITY AND MAINTENANCE

ADWG Actions

- Ensure that equipment performs adequately and provides sufficient flexibility and process control.
- Establish a program for regular inspection and maintenance of all equipment, including monitoring equipment.

3.4.4.1 ENSURE EQUIPMENT PERFORMS ADEQUATELY

During the risk assessment, the adequacy of existing equipment was considered in the context of its ability to manage water quality risks. Examples of items specifically considered as part of the assessment are:

- Reliability of equipment in the event of power failures.
- The ability of the system to respond to water quality changes due to, e.g., floods or cyanobacteria.
- Reliability of equipment to prevent bypass of the treatment plant.
- Reliability of telemetry and on line monitoring systems.
- Overall capability of preventive measures, working in combination, to mitigate significant maximum risks (refer Section 3.9).

Areas where the adequacy of equipment was considered below the ideal level for safe, reliable process operation were noted in the Improvement Plan (3.12.2). For new equipment, Council adopts a tendering process that involves appropriately qualified and experienced persons, (either in house or contracted, as applicable) in developing specifications and reviewing tenders against those specifications at the tender and delivery phase. The objective is to ensure that equipment purchased by council performs adequately and provides sufficient flexibility and process control.

3.4.4.2 ESTABLISH INSPECTION AND MAINTENANCE

Council uses its Asset Management System to schedule the inspection and maintenance of equipment and assets. In general, all council assets are subject to some programmed inspections and maintenance.

With respect to monitoring equipment, all monitoring instruments are included within the asset register that is covered by the Asset Management System. Furthermore, additional, regular inspection and maintenance, including calibration, is undertaken by Council operators. For instance, operators test water quality each day and compare the readings from on-line instruments with those from hand held instruments used by the operators. If results deviate significantly from those measured by operators, as judged by operators, instrument checking, cleaning and calibration (if required) is undertaken. As a general principle, all critical limit monitoring that is subject to on line monitoring (refer to Appendix A and Section 3.3.1) is backed up by daily operator testing to provide such a check. This includes the following instruments:

- Raw water turbidity monitoring turbidity meter.
- Pre-oxidation free chlorine analyser.
- Filtered water turbidity analysers (three in number, one for each filter).
- Clearwater outlet free chlorine analyser.
- Reservoir level gauges (that control reservoir fill and hence maintain system at positive pressure).
- Pressure gauges (that control water pump stations and hence maintain system at positive pressure).

Records of asset inspections and maintenance undertaken under the direction of the Asset Management System are retained within the Asset Management System. In addition, records are kept by operators via their daily Plant Logs of their own activity. At present, there is no pre-defined tolerance to enable systematic identification of deviations between hand-held and on line instruments. However, it is intended that a log sheet will be developed that includes a location to document the readings taken by operators as well as the tolerable deviations (refer Improvement Plan, Section 3.12.2).

3.4.5 MATERIAL AND CHEMICALS

ADWG Actions

- Ensure only approved materials and chemicals are used.
- Establish documented procedures for evaluating chemicals, material and suppliers.

Materials

Council requires conformity with plumbing regulations, industry codes of practice and standards to guide product selection and installation, with relevant codes and legislation being:

- NSW Code of Practice Plumbing and Drainage 3rd Edition 2006 (which calls up relevant aspects of the AS/NZS 3500 Plumbing and Drainage Standards). This is enforced by Council's Plumbing Department for works undertaken by others, and adhered to by Council's Engineering Department for work undertaken by Council.
- AUS SPEC 0071 Water supply - Reticulation and pump stations (Design) (which calls up relevant aspects of the WSA Water Supply Code and AS/NZS 4020 Products for use in contact with drinking water). This is enforced by Council's Engineering Department both for works undertaken by others, e.g. developers, and adhered to by Council's Engineering Department for work undertaken by Council.

Chemicals

The treatment chemicals used by Council are summarized in (Table 3-8). All chemicals purchased by Council must be sourced via contract and must come from an approved supplier under the ROC purchasing arrangements. Suppliers must meet the ROC quality control and quality assurance requirements in order to be listed with the ROC approved supplier list. These requirements were developed through consideration of Chapter 8 of the ADWG (2011) and include meeting specifications for contaminants and processes for quality assurance and quality control that must be in place by the supplier.

Process monitoring at CCPs provides additional assurance for many possible failure modes. For example, incorrectly formulated or dosed chemicals typically do not perform adequately leading to process malfunction and critical limit nonconformities. Chemical deliveries are attended by trained water treatment plant operators. The risk of delivery error is reduced both by the presence of the operator and by controls on filling points, such as labelling and the use of secure fittings. Simple tests, such as visual inspection and tests of pH and specific gravity, are conducted on chemicals when received. A certificate of delivery is completed for each delivery that is received that records batch number, delivery vehicle and other pertinent details relevant to drinking water quality, as well as occupational health and safety. A certificate of analysis is required with each delivery – in practice some chemical suppliers are not yet meeting this requirement and an Improvement Action has been created to promote all suppliers to do so (refer Improvement Plan, Section 3.12.2).

Table 3-8. Summary of treatment chemicals used.

Chemical	Use	Dosing concentrations	Notes
Polyaluminium chlorohydrate	Primary coagulant	11-26 ppm	Flow paced dosed per volume of raw water.
Powdered Activated Carbon (PAC)	Treat taste and odour and potential toxins	When problematic: 4-5% solution. When under control: 3% solution	Flow paced dosing. Only used when cyanobacteria at the dam are an issue. Dosed according to the level needed to remove taste and odour of treated water at the filtration plant.
Polyelectrolyte LT20	Flocculant aid	0.05 ppm	Flow paced dosing to coagulated water.
Chlorine gas	Disinfectant and manganese oxidation	3 to 8 ppm	Dosed to inlet to the filters (manual) and filtered water (flow paced).
Sodium hypochlorite	Disinfectant	3 to 8 ppm	Dosed at the bore water supply and to provide top up chlorination in reservoirs
Soda Ash (Sodium carbonate)	pH correction	0 or 17-17.5 ppm	Flow paced, used only on occasions when pH is less than 7.3 in treated water.

3.5 ELEMENT 5 - VERIFICATION OF DRINKING WATER QUALITY

3.5.1 DRINKING WATER QUALITY MONITORING

ADWG Actions

- Determine the characteristic to be monitored in the distribution system and in water as supplied to the consumer.
- Establish and document a sampling plan for each characteristic, including the location and frequency of sampling.
- Ensure monitoring data is representative and reliable.

Reliable verification monitoring is undertaken by the accredited laboratories of the NSW Division of Analytical Laboratories through the NSW Health Drinking Water Monitoring Program with results being recorded on the NSW Drinking Water Database. The program is specified by NSW Health. The samples are collected by Council staff with the sampling program being designed to cover the full range of water qualities present in Council's water supply systems. Samples are submitted in accordance with the "Guide for Submitting Water Samples to DAL for Analysis".

The results of the program are maintained by NSW Health and Council can access this program via the recently updated database. The program is described in more detail in Section 5 of the Council Strategic Business Plan for Water Supplies and by NSW Health at http://www.health.nsw.gov.au/publichealth/environment/water/drinkwater_nsw.asp.

3.5.2 CONSUMER SATISFACTION

Action

- Establish a consumer complaint and response program including appropriate training of employees.

Consumer satisfaction is generally verified by an absence of complaints. Consumer satisfaction nonconformities include consumer enquiries relating to taste, odour, colour, air, particles, pressure, flow and suspected illness. Consumer complaints relating directly to water quality (taste, odour, dirty water, air in water), suspected water safety concerns and potential indirect water quality issues (low pressure) are received by the Council general switchboard and recorded. If contact staff members are able to resolve consumer enquiries, no further action may be required. Consumer complaint calls may be directed to operational staff. The target for customer levels of service are stated in Section 5 of the Strategic Business Plan for Water Supplies. Consumer Complaints are reported annually to the NSW Office of Water which in turn reports the consumer complaints in its annual performance and benchmarking reports.

3.5.3 SHORT TERM EVALUATION OF RESULTS

ADWG Actions

- Establish procedures for daily review of drinking water quality monitoring data and consumer satisfaction.
- Develop reporting mechanisms internally and externally where required.

Water quality test results from the Division of Analytical Laboratories are reported to Council's Operations Manager the day that the results become available within the laboratory. The target for assessing the acceptability of water quality results is the relevant ADWG guideline value. The Operations Manager compares the results received with the guideline values and records and actions any exceedances.

Consumer complaints that cannot be readily resolved in liaison with staff at the Council switchboard are reported promptly to Council operators for review and resolution.

3.5.4 CORRECTIVE ACTION

ADWG Actions

- Establish and document procedures for corrective action in response to non-conformance or consumer feedback.
- Establish rapid communication systems to deal with unexpected events.

Customer complaints

Consumer complaints are resolved on an urgent basis whereby complaints that cannot be readily resolved in liaison with staff at the Council switchboard are reported promptly to Council operators. The Council operators investigate and solve the problem. Council reports on the time taken to resolve consumer complaints as a key performance indicator under the Strategic Business Plan.

Drinking water quality monitoring exceedances

Drinking water quality monitoring nonconformities trigger a notification by the laboratory to the Operations Manager. Depending on the nature of the exceedance, the response may include re-testing (using the "Form for urgent sample submission to DAL"), investigation and, in some cases, notification to NSW Health which may result in boil water or water avoidance notices to consumers. In relation to health-related parameters, Council responds in line with the requirements of NSW health with respect to the protocols listed under Section 3.6.2, below.

3.6 ELEMENT 6 - MANAGEMENT OF INCIDENT AND EMERGENCIES

3.6.1 COMMUNICATION

ADWG Actions

- Define communication protocols with the involvement of relevant agencies and prepare a contact list of key people, agencies and businesses.
- Develop a public and media communication strategy.

In response to specific water quality issues, Council follows the guidance of NSW Health, which, as noted under Corrective Action (Section 3.5.4), follows pre-defined protocols, and as noted under Section 3.6.2. If the Corrective Action fails to contain the situation and broader notification is required, Council continues to follow the guidance of NSW Health with respect to its recommended response protocols (Section 3.6.2). Contacts of key staff are kept within the Council's general Disaster Plan. In general, any water quality incident would be handled initially by the Operations Manager, and Council and other agencies would be brought in to assist as required.

3.6.2 INCIDENT AND EMERGENCY RESPONSE PROTOCOLS

ADWG Actions

- Define potential incident and emergencies and document procedures and response plans with the involvement of relevant agencies.
- Train employees and regularly test emergency response plans.
- Investigate and incident or emergencies and revise protocols as necessary.

Council has a general Disaster Plan but no specific water quality incident response plan. Other than the response protocols noted below, that have been prepared as guidance by other parties, Council does not have its own specific incident response protocols for foreseeable water quality incidents and would place a heavy reliance on the Public Health Unit to support Council. An Improvement Action has been recorded for Council to develop contingency plans for incidents and emergencies related to drinking water quality (Improvement Plan, Section 3.12.2). In the interim, the following protocols are accessible to Council to guide the response of Council and the Public Health Unit in the event of water quality incidents:

- NSW Health Response Protocol: for the management of physical and chemical quality.
- NSW Health Response Protocol: for the management of microbiological quality of drinking water.
- NSW Health Response Protocol: following failure in water treatment or detection of *Giardia* or *Cryptosporidium* in drinking water.
- NSW Health Drinking Water Monitoring Program December 2005. Appendix 2 NSW Health Response Protocols (except where superseded by the above, more recent, protocols):
 - NSW Health Response protocol for the management of microbiological quality of drinking water:
 - Action on the detection of *E. coli* or coliform bacteria.
 - Action in response to a failure in treatment or disinfection, or rapidly changing source water quality.
 - Corrective actions following the detection of contamination or treatment/disinfection failure.
 - Contamination investigation and sanitary survey - assessing the need for a boil water alert.
 - Factors to consider before issuing a boil water alert.
 - Factors to consider before issuing a boil water alert.
 - NSW Health Response protocol for the management of physical and chemical quality of drinking water:

- Action on the exceedance of guideline values.
- Risk assessment and considerations for public notification.
- Public notification considerations.

One of most common responses to foreseeable drinking water quality problems is to issue a boil water notice or provide other notification. Notices would only be issued in liaison with the NSW Health Public Health Unit, and with consideration being given to the relevant guidance from NSW Health Water Unit, noted above. In practice, Council would most likely have to physically issue a boil water notice and in preparing such notices would make use of the NSW Health templates as starting points in preparing such notices:

- Example Boil water alert for *Cryptosporidium* and or *Giardia* contamination
- Example Boil Water Alert *E. coli* Contamination

In relation to cyanobacteria (blue-green algae), Council has adopted the Interim Blue-green Algae Management Protocols, NSW Water Directorate, November 2009. Incidents are managed with reference to this protocol and in liaison with the Central West Regional Algal Coordinating Committee (RACC) of the NSW Office of Water.

Council has not undertaken formal training in relation to water quality incident response but intends to undertake exercises with other councils and NSW Health in future (Improvement Plan, Section 3.12.2).

3.7 ELEMENT 7 - EMPLOYEE AWARENESS AND TRAINING

3.7.1 EMPLOYEE AWARENESS AND INVOLVEMENT

ADWG Actions

- Develop mechanisms and communication procedures to increase employees' aware of and participation in drinking water quality management.

Council has a policy of ensuring staff are appropriately skilled and trained, as detailed in Section 2.4 of the Strategic Business Plan for Water Supplies. One action proposed for the next 12 months is to provide drinking water quality awareness training to key Council staff to inform them of this DWMS and of the *Public Health Act 2010* (NSW) and associated Regulation (Improvement Plan, Section 3.12.2).

3.7.2 EMPLOYEE TRAINING

ADWG Actions

- Ensure that employees, including contractors, maintain the appropriate experience and qualification.
- Identify training need and ensure resources are available to support training programs.
- Document training and maintain records of all employee training.

Council has very experienced staff with extensive system knowledge, with Level 1 Water Operations. Training records for staff are retained by staff, and these are managed centrally through the Human Resources section of Council (*Development Appraisal System (DAS)*). Training requirements are reviewed annually for OHS and drinking-water related requirements. Staff have their own Position Descriptions and Personal Development Plans relating to their training needs and training records.

Employee training occurs through both internal and external training courses using workshops, inductions, presentations, toolbox meetings, handover meetings, operations meetings and distribution meetings.

Line supervisors are responsible for ensuring operators have the required experience and knowledge to do their jobs, including undertaking tasks in such a way that drinking water quality is protected.

Staff have taken part in the NSW Office of Water training programs. In addition, staff have taken part in refresher training.

3.8 ELEMENT 8 - COMMUNITY INVOLVEMENT AND AWARENESS

3.8.1 COMMUNITY CONSULTATION

ADWG Actions

- Assess requirements for effective community involvement.
- Develop a comprehensive strategy for community consultation.

Council undertakes community consultation on an as needs basis relating to water supply system improvements. However, there is no general water quality consultation process in place at this time.

3.8.2 COMMUNICATION

ADWG Actions

- Develop an active two way communication program to inform consumers and promote awareness of drinking water quality issues.

At the time of writing there is not active two-way communication program specifically dealing with drinking water quality issues. However, Council is directly accountable to the public through control by elected officials. Council meeting minutes are published and made available to residents. Council tracks correspondence to that if consumers contact council to seek information in relation to water quality, Council systematically responds to that request for information. Council's water quality performance is published annually as part of the NSW Office of Water performance monitoring programs.

3.9 ELEMENT 9 - RESEARCH AND DEVELOPMENT

3.9.1 INVESTIGATIVE STUDIES AND RESEARCH MONITORING

ADWG Actions

- Establish programs to increase understanding of the water supply system
- Use information to improve management of the water supply system

Council supports the NSW Water Directorate and staff members remain up to date through their involvement in industry bodies including the Australian Water Association and the Institute of Engineers and their attendance at industry seminars and conferences. However, Council does not have any particular research program in place.

3.9.2 VALIDATION OF PROCESSES

ADWG Actions

- Validate processes and procedures to ensure that they are effective at controlling hazards.
- Revalidate process periodically or when variation in conditions occurs.

Validation involves gathering objective evidence that the treatment should be effective in providing safe, quality water. General validation of the system is listed in Table 3-9.

3.9.3 DESIGN OF EQUIPMENT

ADWG Actions

- Validate the selection and design of new equipment and infrastructure to ensure continuing reliability.

Council acknowledges the importance of ensuring that equipment and infrastructure performs to meet the intended requirements. Council relies on external consultants, the NSW Office of Water and NSW Health to validate the selection and design of new equipment required for upgrades and process improvements.

Table 3-9. General validation of the system.

Item validated	Validation	Reference
Effectiveness of control measure combinations	The overall effectiveness of control measure combinations is validated based on a combination of system design specifications, design engineer expertise, judgement by the operators as well as with reference to industry guidance and practice. The control measure combinations have been systematically reviewed as part of the risk assessment. The control measure combinations in place have been judged to be adequate for the short-term. Improvement actions have been initiated where risks are considered inadequately controlled for the long-term. Therefore, control measure combinations are either considered adequate, or are subject to review with possible shortcomings having been identified and flagged for action.	Risk assessment spreadsheet showing the cross-check of identified significant risks against existing control measure combinations (as shown in the separate Risk Assessment Summary document).
Filtered water turbidity	Individual filtered water effluent performance targets have been set in accordance with the ADWG 2011 recommendation of 0.2 NTU as the target value, above which action is required, and 0.5 NTU as maximum value.	ADWG (2011)
Disinfection critical limits	Critical limits for disinfection are set based on a combination of system design specifications, design engineer expertise, judgement by the operators as well as with reference to industry guidance and practice. Explicit guidance is not always conformed to at all sites and judgement is used to inform critical limits. ADWG recommend turbidity of ≤ 1 NTU during disinfection. ADWG recommend a chlorine concentration (measured in mg/L) multiplied by contact time (measured in minutes) (CT) of ≥ 15 mg•min/L with a pH of between 6.5 to 8.5. Council is currently reviewing the CT value achieved in its drinking water supplies but the Ct is estimated to be approximately in line with the ADWG (Improvement Plan, Section 3.12.2).	ADWG (2011)
Closed storage controls	Throughout all systems, treated drinking water storages are kept closed to birds, vermin and ready access by humans. In most cases, operators check security and proofing at approximately weekly intervals at all storages. The process is considered adequate in water supply systems where Council reliably maintains disinfectant residuals.	Judgement of the risk assessment team
Reticulation system controls	Work undertaken by system operators is considered to be consistent with current good industry practice and adequate for control of the risks identified. Pressure maintenance is controlled using pumps, clearwater tanks and service reservoirs as assessed using pressure or level. Verification of system pressure takes place indirectly through flow rate testing from time to time by operators. If customers complain of low pressure, or no water, operators test and rectify any low pressure zones. Flushing is undertaken as the principal means of removing possible contamination from water mains following any type of works, including for Council connections and repair and replacement.	Judgement of the risk assessment team

3.10 ELEMENT 10 - DOCUMENTATION AND REPORTING

3.10.1 MANAGEMENT OF DOCUMENTATION AND RECORDS

ADWG Actions

- Document information pertinent to all aspects of drinking water quality management.
- Develop a document control system to ensure current versions are in use.
- Establish a records management system and ensure that employees are trained to fill out records.
- Periodically review and revise as necessary.

Not all critical operational procedures are fully documented. To the extent considered acceptable, staff members are permitted to adopt their own ways of achieving the documented drinking water quality management objectives. In such circumstances, Council relies on staff experience, understanding and judgement as to how objectives are achieved rather than on adherence to documented procedures. The complexity, variability, remote and outdoor nature of many tasks makes the use of documented procedures impractical in many circumstances. Operator induction, initial and refresher training, mentoring and supervision and the maintenance of experienced staff are used to retain control of processes. The documents that are developed are summarised in Appendix A.

3.10.2 REPORTING

ADWG Actions

- Establish procedures for effective internal and external reporting.
- Produce an annual report to be made available to consumers, regulatory authorities and stakeholders.

Internal reporting

Internal reporting is undertaken through a number of reports e.g. Council monthly, quarterly and annual reports on the water supply system under the Strategic Business Plan reporting requirements.

External Reporting

Council reports externally through, for instance, the:

- NSW Health - compliance reports relating to drinking water quality monitoring results.
- NSW Office of Water - Water Supply and Sewerage NSW Performance Report and Benchmarking Report relating to drinking water quality monitoring results and consumer complaints.
- Regional State of the Environment Report relating to catchment management.
- ROC Water Utilities Alliance relating to common initiatives.

3.11 ELEMENT 11 EVALUATION AND AUDIT

3.11.1 LONG-TERM EVALUATION OF RESULTS

ADWG Actions

- Collect and evaluate long term data to assess performance and identify problems.
- Document and report results.

Council undertakes reviews of the monitoring results to assess the performance of the system against numerical guideline values as part of Office of Water and NSW Health reporting requirements. This includes:

- Council Annual Report
- NSW Health - compliance reports relating to drinking water quality monitoring results.
- NSW Office of Water - Water Supply and Sewerage NSW Performance Report and Benchmarking Report relating to drinking water quality monitoring results and consumer complaints.
- Regional State of the Environment Report relating to catchment management.
- ROC Water Utilities Alliance relating to common initiatives.
- Strategic Business Plan report

3.11.2 AUDIT OF DRINKING WATER QUALITY MANAGEMENT

ADWG Actions

- Establish processes for internal and external audits
- Document and communicate audit results

The drinking water management system will be internally and externally audited once the requirements of NSW Health for auditing of these DWMS documents have been clarified. In the meantime, it is noted that NSW Health can audit the document at any time so that Council maintains this DWMS in an audit-ready state.

3.12 ELEMENT 12 - REVIEW AND CONTINUAL IMPROVEMENT

3.12.1 REVIEW BY SENIOR EXECUTIVE

ADWG Actions

- Senior executive review of the effectiveness of the management system.
- Evaluate the need for change.

Council undertakes a review of the effectiveness of the management system and the underlying policies as part of the development of the Annual Report, Strategic Business Plan and the Water Supply and Sewerage NSW Performance and Benchmarking Reports.

3.12.2 DRINKING WATER QUALITY MANAGEMENT IMPROVEMENT PLAN

ADWG Actions

- Develop a drinking water quality management improvement plan.
- Ensure that the plan is communicated and implemented and that improvements are monitored for effectiveness.

A detailed list of Improvement Actions has been identified following the risk assessment workshop (given in the separate Risk Assessment Summary document). In addition, an Improvement Plan has been developed to capture additional improvements identified in the body of this document (Table 3-10). The allocation of actions and associated timeframes given in this version of the document are indicative and have yet to be agreed with the responsible parties. Where relevant, directly related risks have been identified using their reference numbers as given in the Risk Assessment Summary document, provided separately.

Table 3-10. Improvement Plan

Action No.	Action details.	Risk No. (if relevant)	Allocation	Timeframe
1.	Further establish the regulatory and formal requirements for catchment management and ensure that Council is protecting the catchment to the maximum degree practicable within its powers.		Operations Manager	December 2012
2.	Recognise, formalise, and, where required, enhance and better implement preventive measures that have fallen outside of the core set of CCPs.		Contract Engineer	October 2012
3.	Develop a log sheet for daily checks by operators that deals with calibration and includes the stated calibration frequencies and tolerances.		Contract Engineer	October 2012
4.	Develop incident and emergency response protocols related to drinking water quality incidents.		Operations Manager	June 2013
5.	Conduct joint water quality training incidents with other stakeholders.		Operations Manager	June 2013 Then biennially

Action No.	Action details.	Risk No. (if relevant)	Allocation	Timeframe
6.	Provide awareness training in drinking water quality management and the DWMS to all relevant council staff.		Contract Engineer	June 2013 Then biennially
7.	Review enhancing filtration to conform more reliably to the ADWG 2011 value of 0.2 NTU individual filter effluent turbidity for sources at risk of <i>Cryptosporidium</i> contamination (e.g. unprotected catchments).		Operations Manager	June 2013
8.	Review the C•t value achieved in the drinking water disinfection units against the recommendations of the ADWG (at least 0.5 mg/L after at least 30 minutes contact time).		Contract Engineer	June 2012
9.	Require chemicals delivered to Council to come with Certificates of Analysis for each batch supplied to demonstrate that these chemicals have been tested in accordance with the recommendations in Chapter 8 of the ADWG.		Operations Manager	June 2013
10.	Enhance this document by providing further details of how Council meets the ADWG Framework		Operations Manager	End 2012 Then annually
11.	Check with Health and Building to ensure that the Septic Safe program is being appropriately implemented.	Central River 1	Contract Engineer	June 2012
12.	Check how council controls new intensive developments, e.g. dairies, feedlots etc. and review the adequacy of these controls.	Central River 1	Contract Engineer	June 2012
13.	Clarify the catchment zoning in the LEP and review the adequacy of the controls arising from this zoning.	Central River 1	Contract Engineer	June 2012
14.	Attempt to fence dam to keep pre-weaned calves out: note agreement with landholder may preclude this.	Central River 1	Operations Manager	End 2012
15.	Review incident notification procedures by first-responders to see how Council would find out in the event of a spill in the catchment.	Central River 3	Operations Manager	June 2012
16.	Review targeting pesticide testing to peak application periods monthly baseline plus post rain events with the Public Health Unit.	Central River 4	Contract Engineer	End 2012
17.	Conduct a risk assessment of the alternate source options to establish the criteria for using these sources if required	Central River 7 and 8	Operations Manager	June 2013
18.	Review the need for a reminder in case of rented properties that draw untreated water from the pipeline. Perhaps using the bill or some other means.	Central River 12	Contract Engineer	End 2012

Action No.	Action details.	Risk No. (if relevant)	Allocation	Timeframe
19.	Review whether or not dialysis patients might be present in the area and how they might be notified.	Central River 20	Operations Manager	June 2013
20.	Review the pre-oxidation strategy and review the risk of disinfection by products. Consider DBP testing - available through NSW Health at no cost to Council.	Central River 28	Contract Engineer	End 2013
21.	Consider developing a contingency plan for the risk of filter breakthrough.	Central River 31	Contract Engineer	End 2012
22.	Investigate removing the sluice valve or engineering out the risk of plant bypass.	Central River 40	Operations Manager	June 2013
23.	Speed up implementation of Council's backflow prevention policy to ensure retrofit to high and medium hazard connections of suitable testable, registered, monitored devices.	Central River 50 and Little Bore 12	Contract Engineer	End 2013
24.	Check and enhance, if required, how chemical quality is controlled.	Central River 58	Contract Engineer	June 2013
25.	Implement strategies to retain key staff. For instance, improve documentation and automation in case of emergency backup operators are needed; form alliances with other operators; introduce multi-skilling within Council; improve Council's recognition and value of staff.	Central River 60	Operations Manager	June 2013
26.	Clarify that the bore water source is confined.	Little Bore 1	Operations Manager	June 2013
27.	Clarify the state of the bore casing.	Little Bore 1	Operations Manager	June 2013
28.	Install new telemetered alarm systems for pressure, levels and chlorine for the Little Bore water supply system.	Little Bore 4	Contract Engineer	June 2013
29.	Develop improved procedures and complete procedures where others are required		Operations Manager	June 2013

4 REFERENCES

Central NSW Shire Council. 2012. Summary of Drinking Water Quality Risk Assessment Workshop. Working Draft Version 4, June 2012. Shown as a separate Risk Assessment Summary document.

Central NSW Shire Council. 2008. Strategic Business Plan. Water Supply Schemes.

Central NSW Shire Council. 2010. 2010/2011 Management Plan.

Central NSW Shire Council. 2011. 2011/2012 Management Plan.

ABC. 2008. Report for Central Treatment Plant. Review of Treatment Processes. Report to Central Shire Council.

XYZ. 2009. Joint Integrated Water Cycle Management (IWCM) Study. Final Report, Rev 2. Report to ROC.

123. 2010. Regional State of the Environment Report 2009-2010. For ROC Councils.

NHMRC/NRMMC (National Health and Medical Research Council/ Natural Resource Management Ministerial Council) (2011) Australian Drinking Water Guidelines (ADWG) National Water Quality Management Strategy (abbreviated in this paper as ADWG 2011).

NSW Government. 2010. Public Health Act 2010 No 127, An Act with respect to public health. Assented to by the Legislature of New South Wales on 7 December 2010.

APPENDIX A OPERATING PROCEDURES

The following procedures have been drafted at the time of writing and are given in this Appendix. These procedures are subject to being improved, and additional procedures are being developed, as noted in the Improvement Plan (Section 3.12.2 of this document).

Name	Type	System	Version	Status
Central River CCP 1 – Raw water abstraction	Critical Control Point Procedure	Central River	2	Draft
Central River CCP 2 – Powdered activated carbon dosing system	Critical Control Point Procedure	Central River	2	Draft
Central River CCP 4 – Coagulation, flocculation, sedimentation, filtration	Critical Control Point Procedure	Central River	2	Draft
Central River CCP 5 – Chlorine disinfection	Critical Control Point Procedure	Central River	2	Draft
Central River CCP 6 – Distribution Reservoirs	Critical Control Point Procedure	Central River	2	Draft
Little Bore CCP 2 – Chlorine disinfection	Critical Control Point Procedure	Little Bore	2	Draft
Recommissioning Alternative Water Source	Standard Operating Procedure	Central River	2	Draft
Changing flow rate through the plant	Standard Operating Procedure	Central River	2	Draft
Reservoir Inspection	Standard Operating Procedure	Central River	2	Draft
Little Bore Water Supply System Inspection	Standard Operating Procedure	Little Bore	2	Draft
Plant Walkaround and Visual Inspection	Standard Operating Procedure	Central River	2	Draft

Central River CCP 1 – Raw water abstraction

What is being measured?	Raw Water Turbidity
Where/how is it measured?	Sample line drawing from the raw water inlet pipe to the to filtration plant / via on line analyser and daily manual testing
What are the hazards?	Turbidity, pathogens
What are the preventive measures?	Selective abstraction to avoid excessively turbid water

Target
< 5 NTU

Operational Limit
5 NTU

Critical Limit
100 NTU

Corrective actions

- Inspect raw water turbidity levels
- Sampling and testing
- Plant walkaround and visual inspection

- Check recent weather events and rainfall
- Jar test, adjust dosages if necessary
- Inspect clarifier operation, check need for desludge
- Ensure filters are backwashed
- Inspect dam and WEARS mixer
- Lower plant flow rate

- Contact NOW Inspector (XXXX XXXX)
- Increase frequency of regular operations, closely monitor all process parameters

Central River CCP 2 – Powdered activated carbon dosing system

What is being measured?	Cyanobacteria; Taste and odour
Where/how is it measured?	Raw water – Taste & odour (checked daily pre-treatment (boiled) and post treatment), cyanobacteria monitoring (weekly)
What are the hazards?	Cyanotoxins, MIB, Geosmin
What are the preventive measures?	PAC dosing system

Target	Operational Limit	Critical Limit
<p>< 2,000 cells/mL <i>M. aeruginosa</i> or < 0.2 mm³/L all cyanobacteria No taste & odour</p>	<p>5,000 cells/mL <i>M. aeruginosa</i> or 0.4 mm³/L all cyanobacteria Noticeable taste & odour</p>	<p>50,000 cells/mL <i>M. aeruginosa</i> or 4 mm³/L toxigenic cyanobacteria or 10 mm³/L all cyanobacteria or cyanotoxins above guideline values</p>

Corrective actions

<ul style="list-style-type: none"> • Dam and WEARS mixer inspection • Daily water drinking test for T&O 	<ul style="list-style-type: none"> • Begin PAC dosing • Sample raw water and send for testing • Purchase different PAC if required 	<ul style="list-style-type: none"> • Contact Public Health Unit (XXXX XXXX) • Consider plant shutdown • Consider community notification
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Central River CCP 4 – Coagulation, flocculation, sedimentation, filtration

What is being measured?	Individual Filtered Water Turbidity
Where/how is it measured?	Sample line drawing from downstream of individual filtered water effluent pipes / online turbidimeter as well as daily manual testing
What are the hazards?	Turbidity, Pathogens, Iron, Manganese
What are the preventive measures?	Coagulation, flocculation, sedimentation, media filtration

<p>Target</p> <p>< 0.15 NTU</p>	<p>Operational Limit</p> <p>0.2 NTU</p>	<p>Critical Limit</p> <p>> 0.5 NTU</p>
<ul style="list-style-type: none"> • Inspect turbidity levels • Sampling and testing • Plant walkaround and visual inspection • Jar testing (weekly) • Equipment checks 	<ul style="list-style-type: none"> • Check filter head loss, backwash if necessary • Inspect clarifier operation and sludge blanket • Test raw water turbidity • Check equipment and dosages • Jar test • Adjust dosages if necessary • Detailed process inspection • Inspect catchment and dam • Contact NOW Inspector (XXXX XXXX) • Sample and test filtered water turbidity regularly to check actions 	<ul style="list-style-type: none"> • Contact Public Health Unit (XXXX XXXX) • Notify at-risk consumers • Monitor chlorine residuals to ensure they remain at required levels • Consider microbial sampling • Continue adjustment actions until turbidity is lowered

Central River CCP 5 – Chlorine disinfection

What is being measured?	Clear Water Free Chlorine
Where/how is it measured?	Sample line drawing from the outlet of the clearwater storage / on line analyser and daily check testing
What are the hazards?	Chlorine-sensitive pathogens, some cyanotoxins, taste and odour, disinfection by-products, chlorine
What are the preventive measures?	Chlorine dosing system

Target
1.5 to 2 mg/L

Operational Limit
0.7 to 3 mg/L

Critical Limit
< 0.3 or > 5 mg/L

Corrective actions

<ul style="list-style-type: none"> Inspect free chlorine levels Sampling and testing Plant walkaround and visual inspection Equipment checks Carry out and refer to chlorine decay tests as required 	<ul style="list-style-type: none"> Inspect chlorination system Adjust chlorine dosage at plant Test raw water true colour and manganese Inspect reservoir (refer to SOP) Consider direct reservoir dosing Consider reducing plant flow Test free chlorine regularly 	<ul style="list-style-type: none"> Contact Public Health Unit (XXXX XXXX) Test free chlorine in reticulation Take samples and test for <i>E. coli</i> Dose chlorine directly into reservoirs Flush network to draw chlorinated water through Consider plant shutdown Consider boil water alert
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Central River CCP 6 – Distribution Reservoirs

What is being measured?	Integrity of reservoirs
Where/how is it measured?	Around the full perimeter and on top of the roof of the reservoir / checked visually monthly
What are the hazards?	Pathogens (due to recontamination)
What are the preventive measures?	Exclusion of water ingress during rain events by keeping the roof watertight. Exclusion of vermin by keeping vermin-proofing intact. Exclusion of persons by keeping the asset secure. Ongoing preventive maintenance.

<p>Target</p> <p>Secure, vermin-proof and water proof</p>	<p>Operational Limit</p> <p>Evidence of breaches or potential breaches</p> <p>e.g. holes that could permit entry of vermin, faeces or other water entry points</p>	<p>Critical Limit</p> <p>Evidence of contamination</p> <p>e.g. bird or animal entry or adverse water quality</p>
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Corrective actions

<ul style="list-style-type: none"> • Inspect bird proofing for holes • Check gate and/or hatch is locked • Inspect roofing for deterioration • Check overhanging trees and branches • Check for evidence of animals nesting • Check for leaks (staining, water pools) • Inspect fencing for holes and damage 	<ul style="list-style-type: none"> • Contact Water and Sewer Coordinator to organise repairs • Sample and test chlorine residual • Consider microbial testing 	<ul style="list-style-type: none"> • Contact PHU (XXXX XXXX) if water quality issue is suspected (eg low chlorine residual)
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Little Bore CCP 2 – Chlorine disinfection

What is being measured?	Treated Water Free Chlorine
Where/how is it measured?	Outlet of pressure tanks / thrice weekly manual testing
What are the hazards?	Chlorine-sensitive pathogens, taste and odour, disinfection by-products, chlorine
What are the preventive measures?	Chlorine dosing system

Target
1 to 3 mg/L

Operational Limit
0.7 to 4 mg/L

Critical Limit
< 0.5 or > 5 mg/L

Corrective actions

- Inspect free chlorine levels
- Sampling and testing
- System inspection
- Equipment checks
- Carry out and refer to chlorine decay tests as required

- Increase chlorine dosage
- Test raw water iron and manganese
- Sample and test from each reservoir, take one res offline or reduce levels if necessary
- Inspect pressure tank (refer to SOP)
- Consider direct reservoir dosing
- Test free chlorine and inspect system daily

- Contact Public Health Unit (XXXX XXXX)
- Consider boil water alert
- Test free chlorine in reticulation
- Take samples and test for *E. coli*
- Dose chlorine directly into pressure tank
- Flush network to draw chlorinated water through

Recommissioning Alternative Water Source

Description:	Recommissioning Backup Dam (or another source) as the major source of raw water to supply to the Water Treatment Plant
To be carried out by:	Water operations team, including Water Operations Manager
Why:	If usual water source is contaminated in some way, such as chemical or fuel spill in catchment, very low operating level, poor water quality, severe cyanobacteria event

- 1. Collect water quality information on existing source for use in decision making**
- 2. Collect water quality information for alternative source**

- a. Water level
- b. Turbidity
- c. Colour
- d. pH
- e. Calcium hardness
- f. Iron and manganese
- g. Cyanobacteria and *E. coli* concentrations
- h. Visual inspection

If decision is made to switch to new water supply

- 1. Commission alternative supply**
 - a. Collect scheme drawings and diagrams from WTP
 - b. Identify which valves need to be open and closed
 - c. Flush main to remove stagnant water before directing to WTP
- 2. Change WTP operating conditions**
 - a. Carry out usual daily sampling and testing for raw water
 - b. Carry out jar test, adjust dosages as necessary
 - c. Inspect pressure and flow rate of raw water
- 3. Ongoing inspections while operating from alternative source**
 - a. Inspect trunnion at dam and check level setting
 - b. Continue testing water quality regularly and note any changes
 - c. WTP inspections and clarifier/filter operations

Changing flow rate through the plant

Description:	Increasing or decreasing the raw water flow rate into the plant to operate at a different production rate
To be carried out by:	Plant operator and plant supervisor
Why:	Decreased flow: To deal with poor raw water quality, changes in raw water pipework Increased flow: To produce more water in a hurry e.g. fire emergency

1. Carry out raw water quality testing and jar tests to determine expected chemical dose rates
 - a. Perform calculation to work out required dosages at new rate
 -
2. Change position of manual and automatic valves to adjust flow rate to desired level
 -
3. Adjust chemical dosages
 - a. Alchlor (coagulant)
 - b. Poly
 - c. PAC
 - d. Soda ash
 - e. Chlorine gas rate
 -
4. Regular plant inspection with increased frequency
 - a. Check clarifier operation
 - b. Check filter head loss
 - c. Water quality, particularly chlorine residual at reservoir

Reservoir Inspection

Description:	Regular inspection of treated water service reservoirs for any signs of damage, forced entry, or animals.
To be carried out by:	Reticulation Crew/Council Rangers/Operators
Frequency:	Monthly

1. Inspection of security at reservoir

- a. Check gate is closed and padlocked
- b. Check fence for any holes, lifted wire, cut barbs etc
- c. Check ladders and ladder cages are padlocked

2. Inspection of reservoir grounds

- a. Check for overhanging branches, overgrown grass, other plants
- b. Check ground for any signs of thrown items, such as big rocks, smashed glass bottles, bullets
- c. Check ground for any animal poo or other signs of animals

3. Inspection of reservoir – walk all the way around

- a. Check for any signs of leaks (staining, damp patches, puddles)
- b. Check for damage to the walls from rocks or other items
- c. Check mesh/netting (if installed) for any holes
- d. Check for any signs of animal entry

4. Inspection of roof – try and see top of roof if possible without climbing

- a. Check hatch is closed
- b. Check for any damage to the roof from rocks or other items
- c. Check for any signs of animals, particularly birds nesting

Little Bore Water Supply System Inspection

Description:	Procedure for the inspection and testing of the operation and water quality for the Little Bore water supply system
To be carried out by:	Duty water operator
Frequency:	Weekly

1. Get required equipment from WTP

- a. Sample bottles
- b. Photometer kit
- c. Turbidimeter kit
- d. Recording sheet
- e. Find location of site on map

2. Visual reservoir inspection

- a. Refer to Reservoir Inspection SOP

3. Clean bore strainer

- a. Turn bore pump to OFF, regardless of if it's running or not
- b. Unclip camlock fittings
- c. Remove strainer, rinse under water coming out of pipe
- d. Reassemble and return to service

4. Inspect and record meter readings on recording sheet

- a. Hours run for both pressure pumps
- b. Hours run bore pump
- c. Total flow and weekly flow from bore pump
- d. Inspect control board for faults/alarms etc

5. Inspect chlorination system

- a. Check if gas bottle is empty and has switched over
 - i. If yes, organise for new bottle to be ordered
- b. Check if chlorine is dosing (if bore pump operating)

- c. Manually run bore pump for 1 min, check chlorine is dosing correctly

6. Sample water and check pressure system.

- a. Turn on sample tap, fill sample bottle with water (then test water while doing below)
- b. Listen for pressure pumps to start operating / look for pump run indication light
- c. Check pressures in pressure tanks, should be about xxx kPa.
- d. Drain pressure tanks once every three weeks, or if pump is starting and stopping too often.
 - i. To drain tank, isolate tank and open drain valve, return to service.
- e. Switch standby pressure pump to manual, run for 1 min to test operation, switch back to auto.

7. Test sampled water

- a. Free chlorine and total chlorine
- b. pH
- c. Calcium hardness
- d. Turbidity
- e. Record all results recording sheet

8. Record all observations in log book

- a. Any observations and changes
- b. Any cleaning/draining etc
- c. Water quality results

9. Final plant inspection

- a. Ensure bore pump and pressure pumps are on auto, and valves are returned to normal operating position

Central River WTP Walkaround and Visual Inspection

Description:	Regular visual inspection of whole WTP and basic equipment, and checking of listed systems
To be carried out by:	Plant Operator
Frequency:	Daily

1. Whole of plant inspection

- a. Plant security
- b. Water leaks
- c. Chemical leaks

2. Filters

- a. See **Filter Inspection SOP**

3. Flocculation system inspection

- a. Dosing points
- b. Flash mixers
- c. Flocculator drives
- d. Floc size

4. Mechanical equipment

- a. Blowers
- b. Backwash pumps
- c. Compressors

5. Chemical systems

- a. Soda ash system
- b. Coagulant system
- c. Chlorine
- d. Dosing pump and feeder drop tests (each pump once weekly)
 - i. See **Dosing Pump Drop Test SOP**
 - ii. See **Dry Feeder Drop Test SOP**

6. Switchboard

- a. Faults
- b. SCADA