



Department of
Primary Industries
Office of Water

RECYCLED WATER | GUIDANCE DOCUMENT

Recycled Water Management Systems



Published by the NSW Department of Primary Industries, Office of Water
NSW Guidelines for Recycled Water Management Systems
First published May 2015
ISBN 978-1-74256-764-8

More information

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Acknowledgments

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Cover image: Recycled water irrigation. Leonie Huxedurp

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Preface

Australia has seen an unprecedented growth in large scale water recycling schemes since the late 1990s. These have largely been driven by a decade of drought and policies to reduce pressure on climate dependent water resources where it is safe, affordable and environmentally sustainable.

Urban water reform is one of the key elements of the National Water Initiative (NWI). The six urban reform outcomes include:

- (i) provide healthy, safe and reliable water supplies
- (ii) increase water use efficiency in domestic and commercial settings
- (iii) encourage the reuse and recycling of wastewater where cost effective
- (iv) facilitate water trading between and within the urban and rural sectors
- (v) encourage innovation in water supply sourcing, treatment, storage and discharge and
- (vi) achieve improved pricing for metropolitan

Addressing the first and third outcome, the [Australian Guidelines for Water Recycling \(2006\)\(AGWR\)](#) introduced a risk-based framework for the management of recycled water schemes. This risk-based approach was a significant shift in guidance for the management of sewage treatment for the production of recycled water and mirrors the 'Framework' in the [Australian Drinking Water Guidelines \(2004\) \(ADWG\)](#).

The NSW Office of Water (the Office) encourages and adopts the AGWR framework for approving local water utility recycled water schemes under section 60 of the *Local Government Act 1993* or s292 of the *Water Management Act 2000*. Demonstrating compliance with the AGWR is ideally achieved with having a documented risk-based recycled water management system (RWMS) in place.

Local water utilities (LWUs) make decisions on preferred recycling options based on many factors - including economic and environmental sustainability, social benefits and protection of public health. Commercial and other considerations should be made ahead of the RWMS process and in the context of an [Integrated Water Cycle Management \(IWCM\) Strategy](#) and [best practice](#). Prior to the introduction of the AGWR, the NWI noted there were concerns that public health regulation had been excessively conservative, and/or too prescriptive, constituting an institutional barrier to IWCM. The AGWR provides a flexible, robust scientifically defensible and transparent method to manage a recycled water scheme whilst protecting public and environmental health.

Compliance with the NSW best practice management framework is a prerequisite for payment of an 'efficiency dividend' from the surplus of a utility's water supply or sewerage business to the council's general revenue. It is also a requirement for financial assistance towards the capital cost of backlog infrastructure under the NSW Government's Country Towns Water Supply and Sewerage Program.

Integrated systems usually rely less on limited natural water sources, produce less pollutant loads to the environment and have strong pricing signals and demand management measures. They thus encourage water conservation and efficient water use and enable the implementation of cost-effective water recycling.

NSW has over 100 local water utilities, many of whom undertake water recycling as part of their local water cycle management scenarios. This document distils the salient points of the AGWR for the NSW context and guides utilities in the application of the AGWR and development and implementation of an RWMS.

Key terms and abbreviations

ABS	Australian Bureau of Statistics
AGWR	Australian Guidelines for Water Recycling (weblink). Primary guidance for recycled water quality and management within Australia.
Annual Action Plan	An Annual Action Plan to Council is required following review of each utility's TBL performance report. This plan closes the 'planning loop' with the utilities strategic business plan and addresses any emerging issues or areas of under-performance.
Best-practice management framework (BPMF)	The NSW Best Practice Management of Water Supply and Sewerage Framework (weblink). This is the driver of reform of planning and management and for continuing productivity and performance improvement of water supply and sewerage in regional NSW. The Framework provides best-value sustainable water services and is based on the <i>Best-Practice Management of Water and Sewerage Guidelines</i> .
Best Practice management of Water and Sewerage Guidelines (BPMG)	The NSW Best Practice Management of Water Supply and Sewerage Framework (weblink) encourage continuing productivity and performance improvement through planning, regulation and pricing, supply security and performance monitoring.
C.t	A value used to measure disinfection effectiveness. It is calculated by multiplying disinfectant residual concentration of chlorine (C, in mg/L) by contact time (t, in minutes).
CCP	Critical Control Point: an activity, procedure or process at which control can be applied and which is essential to prevent a hazard or reduce it to an acceptable level.
Critical Control Monitoring Point	The point where monitoring is undertaken for a CCP. The monitoring point may be different to the control point.
DPI	Department of Primary Industries
Dual reticulation	The pipework used to supply recycled water to residences or commercial properties
EC	Electrical Conductivity
EPA	Environment Protection Authority (NSW)
EPL	Environment Protection Licence
Framework	Framework for Management of Recycled Water Quality and Use: Recycled water-specific quality assurance framework.
GIS	Geographic Information System
IERP	Incident and Emergency Response Plan
Improvement Plan	A Recycled Water Quality Management Improvement Plan or Continuous Improvement Plan as required under Element 12 of the Framework. (See Section 3.12)

IWCM	Integrated Water Cycle Management: A water utility's 30-year IWCM Strategy identifies the water supply, sewerage and stormwater scenario which provides best value for money on the triple bottom line basis of social, environmental and economic considerations
LRV	Log Reduction Value: The reduction in pathogen concentrations from source through to the finished recycled water, measured in logs to the base 10 (\log_{10}).
LWU	Local water utility: A water utility exercising drinking water supply functions under the Local Government Act 1993 or the Water Management Act 2000 (a water supply authority, general purpose council or county council).
N	Nitrogen
NOW	NSW Office of Water, RWapprovals@dpi.nsw.gov.au or (02) 9842 8528
P	Phosphorus
pH	Value taken to represent acidity or alkalinity
PIPMP	Pollution Incident Response Management Plan
Preventive measure	Any planned action, activity or process that is used to prevent hazards from occurring or reduce them to acceptable levels.
Recipient	An end user of the recycled water as referenced to in the AGWR
Recycled water supplier	Any supplier of recycled water that required Section 60 approval under the <i>Local Government Act 1993</i> .
Risk Assessment Report	A report that summarises the water quality risks from source to end use
Risk Assessment Workshop	An independently facilitated (preferably external) interagency multidisciplinary water quality workshop conducted as part of Elements 2 and 3 of the Framework.
RWMS	Recycled Water Management System: The documents, procedures and other supporting information for the safe supply of recycled water.
RWMS coordinator	The person responsible for maintaining the currency of the RWMS
RWMS document	The document that records the procedures and files that makes up the Drinking Water Management System.
RWMS leader	The person responsible for the preparation and oversight of the RWMS
SCADA	Supervisory Control and Data Acquisition
Strategic Business Plan (SBP)	Strategic Business Plan: A 20 to 30 year strategic business plan and financial plan is a utility's peak planning document for water supply and sewerage in accordance with the NSW Water and Sewerage Strategic Business Planning Guidelines 2011 (weblink).
STP	Sewage treatment plant

UV

Ultra violet

TBL

Triple Bottom Line

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1 Introduction

1.1 Background

Historically, sewage effluent was disposed either via land or water. Interest in the recycling of sewage effluent has grown as climate dependant water sources have become less reliable and are under greater demand. Early guidance focussed on the management of environmental risks (e.g. DEC Environmental protection guidelines: *Use of Effluent for Irrigation 2004*). Public health risks arising from residential use of recycled water were managed through prescriptive treatment trains in the *NSW Guidelines for Urban and Residential use of Reclaimed Water* (NSW Recycled Water Coordination Committee 1993). This guidance placed a reliance on end point testing and monitoring.

With the recognition of the value of sewage effluent as a resource, more effluent has been recycled for a broader range of end uses. This shift has resulted in increases in potential public health impacts from the use of this water source.

The introduction of the *Australian Guidelines for Water Recycling: Managing Health and Environmental Risks* (Phase 1) (2006) (AGWR) introduced the preventive risk management approach and included health based targets which are robust and scientifically defensible. This guidance was based on the Framework in the Australian Drinking Water Guidelines (2004) (ADWG). This was a significant shift in guidance for the management of sewage treatment in the production of recycled water. The focus of the current guidance is the management and monitoring of risk from source to end use to ensure the water is suitable for the intended uses (“fit for purpose”). End point testing verifies that management and treatment processes are suitable.

The AGWR (2006) is part of a suite of national guidance within the National Water Quality Management Strategy. There are a number of other publications with the strategy that may also need to be considered including:

- Australian guidelines for water recycling: Managing health and environmental risks - (Phase 2) Augmentation of drinking water supplies - 2008
- Australian guidelines for water recycling: Managing health and environmental risks - (Phase 2) Stormwater harvesting and reuse - 2009
- Australian guidelines for water recycling: Managing health and environmental risks - (Phase 2) Managed aquifer recharge – 2009

1.2 Risk management approach

The AGWR contains the *Framework for Management of Recycled Water Quality and Use* (the Framework). The Framework provides a structured risk-based approach to recycled water management. The Framework comprises 12 Elements broken down into 36 Components and 85 Actions (Chapter 2 AGWR). Figure 1 illustrates how the implementation of these elements ensures the consistent safe supply of recycled water.

At the heart of the Framework are the day to day management activities that ensure recycled water:

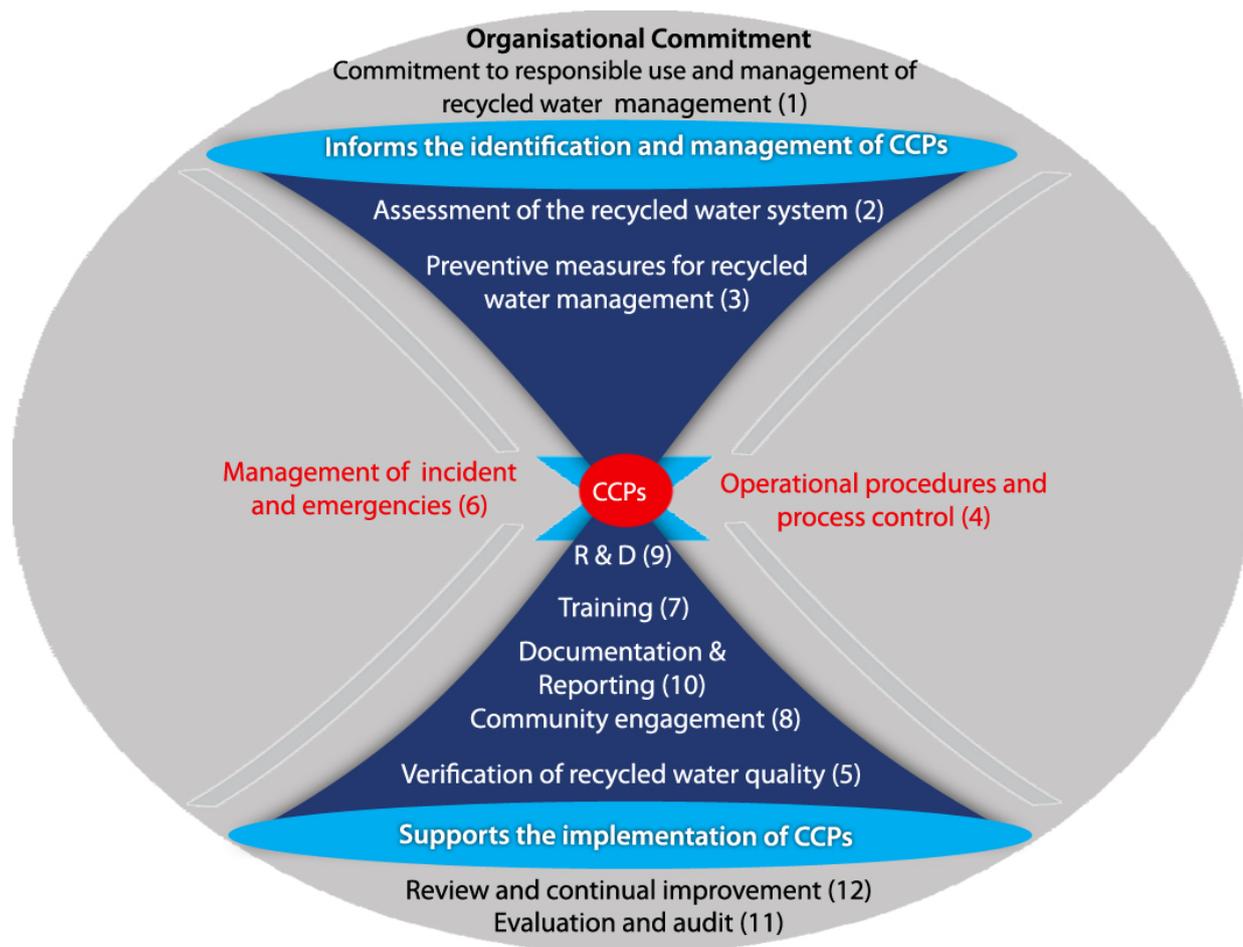
- is of suitable quality for the end uses (operational procedures and process control – Element 4, see section 3.4)
- that is unfit for purpose is not supplied to consumers (management of incidents and emergencies Element 6, see section 3.6).

This is managed through critical control points (CCPs). Section 3.3.1 and [Critical Control Point Information sheet](#) contain further information in the development and monitoring of CCPs.

The identification and management of CCPs is informed by the assessment of the recycled water system (Element 2, see section 3.2) and preventive measures for recycled water management (Element 3, see section 3.3).

Overarching is the organisational commitment to the responsible use and management of recycled water management (Element 1, see section 3.1). The Framework, like all management systems is underpinned by evaluation and audit (Element 11, see section 3.11) and review and continual improvement (Element 12, see section 3.12).

Figure 1. Diagram showing relationship of the Framework Elements



The NSW Office of Water (NOW) recommend that utilities develop, submit and implement a Recycled Water Management System (RWMS) addressing the 12 elements of the AGWR in order to be granted scheme approval under s60 of the *Local Government Act 1993* (LGA) or s292 of the *NSW Water Management Act 2000* (WMA). The purpose of developing a RWMS is to ensure risks are systematically identified and appropriately managed. The RWMS contains review and audit timetables to ensure the system maintains its currency. Annual reports are to be submitted to the NSW Office of Water as evidence of implementation.

1.3 Purpose

This document provides guidance on the development and implementation of a RWMS for recycled water suppliers in NSW including local water utilities (under the *NSW Local Government Act, 1993*) and water supply authorities (under the *NSW Water Management Act, 2000*). This guidance should be read in conjunction with Chapters 2-6, and Appendices 3-5 of the AGWR.

2 Steps to develop a recycled water management system

A RWMS system is a collection of documents, procedures, processes, data and other activities and records that support the safe use of recycled water. The following documents are required when submitting a RWMS for s60 approval:

- RWMS manual or roadmap document
- CCP tables (See Table 14)
- utility's trade waste policy
- recycled water policy
- legally binding end user agreements (where relevant).

To optimise the development of a RWMS, and draw on the experience from the Drinking Water Management System (DWMS) process, it is worthwhile considering linkages between the DWMS and RWMS. While there will be RWMS-specific requirements such as CCPs, common R/DWMS linkages and actions might include:

- Adding recycled water specific requirements into the legal and formal (compliance) register.
- Adding recycled water specific stakeholders into the stakeholder register.
- Adding recycled water specific training and skills requirements into human resource records such as the skills matrix and position descriptions.
- Adding recycled water incidents to the incident management protocols.
- Using systems established for drinking water community consultation and communication for recycled water.
- Managing recycled water specific documents and records through already established systems.

Where documents are used as part of the RWMS and DWMS it is important that the documents meet the requirements of the *Public Health Act (2010)*.

A RWMS document template is available to assist utilities to document their recycled water management system. The template is structured on the Framework Elements, Components and Actions. A recycled water supplier can complete the template to create its own RWMS document.

Table 1 summarises *what* needs to be included in the RWMS. The requirements for each element are explained in further detail in Section 3. The remainder of the chapter focuses on *how* to develop a RWMS.

Table 1. Requirements for developing a RWMS document

Element	What needs to be complete prior to submission to NOW
Element 1: Commitment to responsible use and management of recycled water quality	<p>Review your organisation's planning documents (see Table 3) and record in the RWMS document.</p> <p>Review regulatory and formal requirements.</p> <p>Ensure recycled water arrangements are in place with recipients with appropriate conditions including monitoring and review periods.</p> <p>Record how your organisation satisfies Element 1 and how these requirements are communicated to staff.</p> <p>Identify areas for improvement and record in the Improvement Plan (Element 12).</p>
Element 2: Assessment of the recycled water system	<p>A risk assessment of the recycled water system must be undertaken:</p> <ul style="list-style-type: none"> • Identify the source including the location and current use. • Assemble a team to undertake the risk assessment.

Element	What needs to be complete prior to submission to NOW
	<ul style="list-style-type: none"> • Draw a flow diagram of the system from source to end use. • Review and analyse water quality data. • Undertake hazard identification, preventive measure identification and a risk assessment. • Record the risk assessment outcomes in a Risk Assessment Report. <p>In the RWMS document, record the details of the risk assessment process and append the Risk Assessment Report.</p>
Element 3: Preventive measures for recycled water management	<p>Critical control points (CCP) must be identified based on the risk assessment findings.</p> <p>Critical limits must be set.</p> <p>Record the details of the CCPs and critical limits in the RWMS document and ensure that the information is in place and easy to see, at the CCP location or control room.</p>
Element 4: Operational procedures and process control	<p>Record procedures for:</p> <ul style="list-style-type: none"> • Managing critical control points and the communication protocol for a CCP exceedance. • Operational monitoring and corrections. • Chemical and equipment procurement, delivery and testing. • Calibration, operation and maintenance of critical treatment equipment. <p>Include references to the above procedures in the RWMS document.</p>
Element 5: Verification of recycled water quality and environmental performance	<p>The RWMS document must reference an implemented comprehensive monitoring program of the system and environmental end points including data review.</p> <p>The RWMS document must note how the recycled water supplier ensures recipients comply with their user agreements.</p>
Element 6: Management of incidents and emergencies	<p>Develop a contact list for incidents and emergencies.</p> <p>Record in the RWMS document where controlled copies of the contact list are kept.</p> <p>Reference the protocols to be followed in case of an incident or emergency.</p> <p>Document contingency arrangements for recycled water management or disposal (e.g. due to contamination or other off-spec quality)</p> <p>Record in the RWMS.</p>
Element 7: Operator, contractor and end user awareness and training	<p>In the RWMS document record the management, review and record keeping processes for operator, contractor and recipient training.</p> <p>Reference to the management of training, including records kept and the review processes in place, should be made in the RWMS document.</p> <p>The RWMS document must include how the recycled water supplier improves and maintains employees' and contractors' awareness of recycled water quality and environmental issues.</p>
Element 8: Community involvement and awareness	<p>The recycled water supplier must record in the RWMS document how it engages with the community on recycled water quality issues. The level of engagement should be system specific.</p>
Element 9: Validation, research and development	<p>A program to validate / verify the initial operation of the recycled water plant must be developed, submitted to NOW and then undertaken.</p> <p>Review the Risk Assessment outcomes for actions to investigate recycled water quality or improve knowledge of the system.</p> <p>In the RWMS document, record all water quality investigations in which the recycled water supplier is involved.</p> <p>In the RWMS document, record processes for equipment and plant validation.</p> <p>Confirm the disinfection C.t where chlorine / chloramine is used as the primary disinfectant.</p>
Element 10: Documentation and reporting	<p>Record in the RWMS document record keeping procedures and systems to be used by the recycled water supplier.</p> <p>Record how monitoring results (operational monitoring, incidents, emergencies and recycled water quality reviews) and responses are to be reported to management and external parties.</p>
Element 11: Evaluation and audit	<p>Record the processes by which the recycled water supplier undertakes long-term evaluation of its recycled water quality data and records actions for whether improvements are required in the RWMS document.</p> <p>The recycled water supplier should record how it satisfies internal and external auditing requirements of this element including a schedule for internal and external audits.</p>

Element	What needs to be complete prior to submission to NOW
Element 12: Review and continuous improvement	<p>Recycled water suppliers should review the effectiveness of the management system and its implementation, at least annually, to ensure that it maintains currency with the recycled water system. A record of this review and actions arising from the review should be kept.</p> <p>A complete review of all management systems should occur every four years in line with the review of the Strategic Business Plan or IWCM.</p> <p>The scheduled dates for these reviews should be included in the RWMS document.</p>

Suppliers operating multiple systems

Recycled water suppliers serving more than one recycled water supply system/scheme may prepare a single RWMS document. However, Elements 2, 3, 4 and 5 must be addressed for each system.

2.1 Steps to Develop a RWMS

The information summarised in Table 1 is what needs to be included in a RWMS (with further details provided in Section 3). However, it is unlikely that a utility will start documenting at Element 1 and work through to Element 12.

This section describes how a recycled water supplier might develop a RWMS. The process for developing a RWMS will depend upon the individual recycled water supplier's driver for developing the RWMS: Four scenarios have been identified in this guidance as examples:

- The existing recycled water system does not have s60 (or s292) approval for recycling.
- A utility planning for water recycling using existing treatment facilities.
- A new recycled water management plant being constructed and/or secondary treatment processes are being upgraded and the water is to be used for recycling (without supply via dual pipe network).
- A utility planning a dual pipe system to supply recycled water.

The Framework is about ensuring that risks are managed appropriately. Figure 2 to Figure 5 illustrate the stages that can be followed when developing a RWMS under these different circumstances.

2.2 Developing a RWMS for an Existing Recycling System

Utilities that have not obtained s60 (or s292) approval for supplying recycled water to recipients are advised to follow the following stages illustrated in Figure 2 to prepare their RWMS. This process is also suitable for utilities adding an additional end use or recipient to their system.

Figure 2. Stages for developing a RWMS for an existing recycling system



Stage 1: Engagement

The following should be completed as part of Stage 1:

- Discuss the recycling scheme and the information requirements of the *Preliminary Recycling Checklist* (see Appendix A) with local NOW officer.
- Identify recycled water end uses, recipients and on-site controls. Determine the pathogen log reduction requirements for those uses (see [information sheet](#)). This may require an exposure assessment (see section 3.2.1).

-
- Undertake a historical water balance to verify supply and demand requirements. If adding a new recipient or end use, update the water balance to ensure storages are still adequately sized and that demand will not outstrip supply.
 - Develop or update a flowchart that is representative of the whole recycled water system from source to end use.
 - Complete and submit the *Preliminary Recycling Checklist* (see Appendix A) to NOW who will provide feedback.

Stage 2: Assess and confirm system capability

Assess potential treatment log reduction values (see section 3.2.5 and the information sheet *Calculating Log Reduction Values*). This assessment should consider indicative log reduction values (Table 8), validation information (e.g. pre-validated UV units, calculation of C.t) and other scientific data. In the assessment of log reduction requirements, no more than 4 log reductions can be considered for single process units and no more than 3 log reductions (in total) can be attributed to non-treatment barriers used for non-agricultural irrigation.

If the scheme has a significant gap between log reduction requirements and the indicative log reduction treatment capability and non-treatment barriers, it is likely that capital investment for additional barriers will be required to meet this deficit. Advise NOW of the gap between the log reduction requirement and the indicative treatment capacity.

Critical Control Points (CCPs) should then be identified and critical limits set (See [Critical Control Points information sheet](#)).

If your scheme has verification data consistent with Table 16, and supporting operational data, assemble the data and provide to NOW who will review and comment on adequacy. If the system has not undertaken verification testing then develop and submit a verification plan to NOW. Then undertake verification testing of the system, including monitoring CCP limits as specified in the verification plan.

Prepare a verification report based on the results of the verification testing. The verification report should be made available to all relevant parties prior to the risk assessment being held.

Stage 3: Risk assessment and mitigation

Undertake a risk assessment of the recycled water system (See Section 3.2.6.)

Confirm CCPs, critical limits and identify additional preventive measures. Develop procedures for corrections and corrective actions to re-establish process control following failure to meet target criteria or critical limits.

Step 4: Develop RWMS

Develop the RWMS including supporting documentation in line with *the NSW Guidance for Recycled Water Management Systems*.

Step 5: Section 60 approval

Submit the RWMS and supporting documentation to NOW for approval.

2.3 Planning for recycling using Existing Treatment Facilities

Utilities that are planning to supply recycled water to recipients from existing treatment facilities are advised to follow the stages outlined in Figure 3 to prepare their RWMS to obtain s60 (or s292) approval.

Figure 3. Stages for developing a RWMS for an existing treatment plant

The requirements of this are very similar to those described in section 2.2 *Developing a RWMS for an existing recycling system*, with the exception that early engagement with NOW should be undertaken prior to any works being undertaken or supply of recycled water.

A recycled water balance should be undertaken as part of the early engagement stage to ensure that supply and demand requirements are identified in the planning stages. It is necessary to quantify these volumes to ensure any infrastructure (e.g. distribution pipes and storage) are appropriately designed and sized, and the scheme is environmentally and financially viable. Examining seasonal demand will ensure that any storage volumes have been adequately allowed for.

2.4 Developing a RWMS for a New Plant or Major Upgrade

Utilities that are building a new plant or undergoing a major upgrade are advised to follow the stages in Figure 4 to prepare their RWMS. If the proposed end use is supply of recycled water through dual reticulation for residential use or multiple commercial uses then the stages in section 2.5 should be followed.

Figure 4. Stages for developing a RWMS for a new plant or major upgrade

Stage 1: Early engagement

The following should be completed as part of Stage 1:

- Discuss the recycling scheme with local NOW officer and the information requirements of the *Preliminary Recycling Checklist* (see Appendix A).
- Identify recycled water end uses and on-site controls. Determine the pathogen log reduction requirements for those uses. This may require an exposure assessment (see section 3.2.1).
- Undertake a water balance to ensure that supply and demand requirements are identified in the planning stages. It is necessary to quantify these volumes to assess that the scheme is appropriately designed and sized and is financially viable. Examining seasonal demand will ensure that appropriate storage volumes have been adequately allowed for.
- Complete and submit the *Preliminary Recycling Checklist* (see Appendix A) to NOW who will provide feedback.

Stage 2: Concept development

As part of the concept development the following should be undertaken:

- Determine appropriate treatment to meet log reduction value requirements. Consider scientific data in the assessment of treatment options including validation information. Validation of treatment processes should be used to demonstrate log reduction values will be met; this can be done through use of published data or direct testing (see section 3.9.1). A National Validation Framework (NATVAL) is currently under development which will provide a consistent approach to the validation process. Ensure treatment systems are matched to the expected water quality e.g. chlorine demand, UVT, turbidity and colour

- In the assessment of log reduction requirements no more than 4 log reductions can be considered for single process units.
- Develop a flowchart that is representative of the whole recycled water system from source to end use.
- Identify CCPs, monitoring points, necessary monitoring equipment and set critical limits.
- The need for community engagement should be assessed and a community engagement program developed as appropriate.

Stage 3: Risk assessment and mitigation

Once the treatment concept has been developed a water quality risk assessment of the recycled water system should be undertaken (see section 3.2.6). As part of this process, CCPs and critical limits should be confirmed and additional preventive measures identified. Procedures for corrections and corrective actions to re-establish process control following failure to meet target criteria or critical limits should be documented. Improvement actions should be identified. Changes to the concept design may be required.

The risk assessment, and the actions arising from it, should be reviewed at the detailed design stage to ensure the appropriate actions have been undertaken and no new hazards or hazardous events have arisen through design changes. A record of the review should be kept and submitted as part of the documentation.

Stage 4: Develop RWMS

The RWMS including supporting documentation should be developed. As part of the commissioning process:

- The risk assessment and actions should be reviewed to ensure all actions previously identified have been addressed and no new hazards or hazardous events have arisen through design or construction changes. A record of the review should be kept and submitted as part of the documentation.
- The system diagram including monitoring points should be updated to reflect the as-built design including the CCP monitoring points (including instrument numbers).
- The set-points of the critical limits should match the documentation
- A verification plan should be prepared and submitted to NOW for approval. Commissioning verification should be undertaken.

Stage 5: s60 approval

Submit the RWMS and supporting documentation to NOW for approval.

Project phases and RWMS development stages

The relationship between project phases, RWMS process stages and the framework elements for a new plant or major upgrade is shown in Table 2.

Table 2. Relationship between project phases for a new plant or major upgrade, RWMS stages and the framework elements

Project Phase	RWMS Development Stage	Framework Element
Planning	Stage 1: Early Engagement - Submit checklist (Appendix A) to NOW	Element 1: Commitment to responsible use and management of recycled water quality
Option development	Stage 2: Concept development - determine appropriate treatment requirements	Element 2: Assessment of the recycled water supply system

Project Phase	RWMS Development Stage	Framework Element
Concept design HAZOP, CHAIR	Stage 2: Concept development – develop system flow chart. Identify CCPs and limits, monitoring points and equipment Stage 3: Undertake a recycled water quality risk assessment workshop	Element 2: Assessment of the recycled water supply system
Detailed design HAZOP, CHAIR	Stage 3: Desktop review of the recycled water quality risk assessment.	Element 2: Assessment of the recycled water supply system Element 3: Preventative measures for recycled water management Element 4: Operational procedures and process control
Post Construction Review actions of HAZOP/CHAIR	Stage 3: Desktop review of recycled water quality risk assessment.	Element 2: Assessment of the recycled water supply system Element 6: Management of incidents and emergencies Element 7: Operator, contractor and end user awareness Element 8: Community involvement and awareness
Commissioning	Stage 4: Commissioning verification monitoring Stage 4: Develop RWMS Stage 5: Submit s60 for approval	Element 5: Verification of recycled water quality and environmental performance Element 9: Research and development Element 10: Documentation and reporting Element 11: Evaluation and audit Element 12: Review and continual improvement
Operation	Receive s60 approval prior to start of operations Ensure all components of the RWMS are implemented	All as part of the on-going RWMS implementation

2.5 Recycled Water Supplied through a Dual Reticulation System

Utilities that are building a dual reticulation or third pipe system to supply recycled water are advised to follow the stages in Figure 5 to prepare their RWMS. Utilities considering converting a raw water dual pipe system to a recycled water dual pipe system should also follow these stages.

Figure 5. Stages for developing a RWMS for a third pipe system



The requirements are very similar to those described in Section 2.4 *Developing a RWMS for a new plant or major upgrade*, with the exception that:

- An on-site validation plan may be required for equipment that has not been pre-validated or if equipment will be operated outside of their validated range. See [validation information sheet](#) for more information. If required, the need for a validation plan should be determined during the concept development stage and validation testing will need to be conducted prior to supply.

-
- An operational audit will need to be carried out prior to finalisation of the RWMS. The draft RWMS should be submitted once developed. NOW in consultation with NSW Health, will provide a scope for an operational audit based on the draft RWMS. This audit will need to be undertaken by an approved independent auditor. The audit report should be submitted to NOW. A final version of the RWMS should then be completed and submitted for approval.

These additional requirements are to manage the increased public health risks arising from the proximity of the recycled water infrastructure to the drinking water infrastructure.

2.6 S60 for Sewage treatment systems and Other Approvals

A separate s60 approval is required for sewage treatment systems. NSW Office of Water also provides guidance on obtaining s60 approval for sewage treatment systems, which is available on their [website](#).

The s60 approval for recycling is separate to any planning approvals a recycled water supplier may need to obtain.

3 Requirements for a recycled water management system

Section 3 provides guidance for preparing a RWMS document in the NSW context for s60 approval by NOW.

3.1 Element 1: Commitment to responsible use and management of recycled water quality

This element involves the development of a recycled water quality policy, understanding regulatory and formal requirements and understanding and engaging with stakeholders.

What needs to be done:

- Review your organisation's planning documents (see Table 3) and record in the RWMS document.
- Review regulatory and formal requirements.
- Ensure recycled water arrangements are in place with recipients with appropriate conditions including monitoring and review periods.
- Record how your organisation satisfies Element 1 and how these requirements are communicated to staff.
- Identify areas for improvement and record in the Improvement Plan (Element 12).

3.1.1 Regulatory and formal requirements

The NSW Office of Water website (weblink) is a good starting point for information relating to requirements that apply to recycled water.

Sections 56-66 of the *Local Government Act 1993* (LG Act) sets out provisions in relation to flood retarding basins, water supply, sewerage works and facilities. Under these provisions, a non-metropolitan council must obtain Ministerial approval prior to undertaking certain works. This approval has been delegated to the NSW Office of Water (NOW). NOW has also been delegated the direction powers under section 61.

Water supply authorities must also obtain approval to construct, maintain and operate water management works and other associated works in accordance with section 292 of the *Water Management Act 2000* and clause 116 of the *Water Management (General) Regulation 2011*.

Under section 60(c) of the LG Act, a council must obtain approval to provide for sewage from its area to be discharged, treated or supplied to any person.

NOW has adopted the framework outlined in the AGWR for assessing s60 applications for approval to treat and supply recycled water under the LG Act¹.

If a water recycling scheme has been operating historically without an approval, a retrospective approval cannot be given. However, utilities should obtain an approval for ongoing operation such schemes. In such cases, contact NOW to discuss transitional arrangements.

¹ NOW also adopts AGWR to assess s292 applications for approval to treat and discharge recycled water under the *Water Management Act 2000*.

A local water utility which demonstrates best practice management by achieving the outcomes required by the *NSW Best-Practice Management of Water Supply and Sewerage Framework* will have effective and sustainable water supply and sewerage businesses. The 19 requirements of this framework are shown in the [Best-Practice Management of Water Supply and Sewerage Guidelines](#). Compliance with the NSW best practice management framework is a prerequisite for payment of an 'efficiency dividend' from the surplus of a utility's water supply or sewerage business to the council's general revenue.

Local water utilities are required to undertake planning activities that satisfy Element 1 of the AGWR Framework. These activities include:

- **Integrated Water Cycle Management (IWCM) strategy:** Local water utilities should prepare an IWCM strategy to meet Best Practice Guidelines. A water utility's 30-year IWCM Strategy identifies the water, sewerage and stormwater scenario that provides best value for money on a triple bottom line basis (social, environmental and economic considerations). The IWCM strategy should be prepared every 8 years (weblink).
- **Strategic Business Plan (SBP):** Financial Plan and Asset Management Plans(weblink): Local water utilities should prepare a SBP every 8 years (and 4 years after the IWCM strategy) as described in the NSW Water and Sewerage Strategic Business Planning Guidelines 2011 (weblink). Components of the SBP meet a number of the actions within Element 1. The regular review and revision of the SBP meets the requirements for periodic review in the Framework. When the SBP is reviewed, ensure:
 - the mission statement includes public health, environmental health and recycled water quality objectives
 - that levels of service include public health, environmental health and recycled water quality objectives
 - public health, environmental health and recycled water quality implications are included in the operating environment review
 - your organisation's responsibilities captured in other documents such as Codes of Practice, Standards and Guidelines are considered as part of the operation environment review²
 - actions in the Improvement Plan (Element 12) are included the planning process.
- **Annual Performance Monitoring:** The NSW Office of Water publishes an annual performance monitoring report (NSW Water Supply and Sewerage Performance Monitoring Report - weblink). This report includes preparation of an annual Action Plan to review the utilities performance and identify and address any emerging issues or areas of under-performance. Appendix C of the report covers the implementation of best practice requirements, the areas relevant to the RWMS are:
 - general compliance with STP environment protection licences
 - (1) Strategic Business Plan (Complete and current 20 to 30 year SBP and Financial Plan)
 - (2d) Appropriate trade waste fees and charges
 - (2f) Liquid trade waste regulation policy³ and approvals implemented
 - (4) Integrated Water Cycle Management Strategy commenced

² Especially given that many of the national and state guidelines may have legal effect.

³ NSW Government (2009) Liquid Trade Waste Regulation Guidelines (website). Publisher: Department of Water and Energy. The guideline specifically notes the impacts of trade waste including aspects relevant to recycled water should trade waste not be managed incorrectly including compromising worker health and safety, adversely affecting the environment, causing harm to public health and safety and compromising opportunities for water recycling and biosolids reuse.

- utilities are also required to report on the volume of effluent recycled (NWI indicator W27).
- **Annual Benchmarking Report** (weblink): The annual process of reporting on water supply and sewerage benchmarking (NSW Government and Local Government NSW (2014) 2012-13 Water Supply And Sewerage NSW Benchmarking Report) also includes information relevant for the RWMS including:
 - recycled water (% of effluent recycled) – sewerage
 - NSW urban water supplied (including recycled water)
 - environmental incidents, management systems, capital investment – sewerage (where preparation of a sewerage Environmental Management Plan is relevant to the RWMS process).
- The **POEO Act** establishes Environment Protection Licences (EPLs) to minimise and control the impact of activities on the surrounding environment and human health. Under the POEO Act, the EPA is the relevant authority for an activity whenever:
 - (a) the activity is listed on Schedule 1 of the POEO Act
 - (b) a licence to control water pollution from the activity has been granted, or
 - (c) a public authority is carrying out the activity or is occupying the premises where the activity occurs.

Scheduled sewage treatment systems are required to hold an EPL and unscheduled sewage treatment systems may have a licence to regulate water pollution.

The EPL licence conditions, among other things, relate to pollution prevention and monitoring and EPL holders must comply with the conditions including:

 - Pollutant concentration limits and monitoring requirements;
 - Prepare a [pollution incident response management plan/s](#).
 - Publish and/or make pollution monitoring data available.
- Effluent reuse (or water recycling) is not specifically listed in the Schedule, therefore it does not generally have to be licensed. For those activities on Schedule 1 where relevant, the licence may include conditions controlling effluent reuse (in most cases the reuse application is effluent irrigation). Under the POEO Act it is an offence to cause or permit any surface or groundwater pollution unless a person holds a licence that regulates the activity that caused the pollution and is operating in accordance with the conditions of the licence.

Table 3. Link between NSW planning documents and Element 1 of the Framework

Document	Document Reference		Link to Framework Component
NSW Water and Sewerage Strategic Business Planning Guidelines	Section 6	Mission Statement	Recycled Water Quality Policy
	Section 7	Levels of Service	
	Section 5	Operating Environment Review	Regulatory and Formal Requirements
	Appendix D	Legislative Framework	
	Section 9.4	Consumer and Community Involvement	Engaging Stakeholders
	Section 5.1	Institutional Arrangements for Service Provision	
	D4	Approved by Council	Endorsed by Senior Executives
Planning and	Sec 1.5 (p9)	Community Engagement Strategy	Engaging

Document	Document Reference		Link to Framework Component
Reporting Guidelines for Local Government in NSW			Stakeholders
Integrated Water Cycle Management	Integrated Water Cycle Management Check List 2014 Topic 3.1	Operating Environment Compliance	Regulatory and Formal Requirements
	Integrated Water Cycle Management Check List 2014 Topic 7M	Levels of Service	Engaging Stakeholders
	NSW Office of Water (2010) Evaluation of Integrated Water Cycle Management Scenarios. Information Sheet 6.	Includes information on social considerations to be taken into account in the scenario assessment	Engaging Stakeholders
	NSW Office of Water (2010) The role and purpose of the Project Reference Group. Information Sheet 4.	Includes information on what constitutes a project reference group or PRG.	Engaging Stakeholders

3.1.2 End User Agreements

Where a third party recipient is involved, the success of a recycled water scheme may depend on how arrangements between suppliers and recipients of recycled water schemes are undertaken.

The key for both suppliers and customers of recycled water is risk prevention to ensure that harm or damage is avoided in the first place. This requires having an effective management system to identify and control risks to the public and the environment at the point of use of the treated recycled water, including a recycled water management plan or system that follows the AGWR and user agreement/s.

User agreements between the supplier of recycled water and the recipient/s sets out the negotiated terms under which the scheme will operate. The recycled water user agreement may establish:

- the rights and obligations of the parties
- who should perform certain duties, when, and who bears the costs
- who bears the risks associated with supply and use of the recycled water
- who should insure or be indemnified against claims in relation to these risks, and
- the commercial terms under which recycled water is supplied.

3.2 Element 2: Assessment of the recycled water supply system

It is essential to identify the source of the recycled water because this will influence the type and amount of hazard present. The intended uses of each specific recycled water scheme must be defined, to determine the water quality required and the management measures that need to be implemented to achieve the required quality. It is also important to consider inadvertent or unauthorised use of the water, because this may result in higher than intended exposure to humans and the receiving environment.

A team experienced in recycled water quality, treatment and environment should undertake a risk assessment of the system considering both public health and environmental impacts. Historical water quality data should be reviewed and the recycled water system, from source to end use, documented before undertaking the recycled water quality risk assessment.

For systems with multiple sites or multiple recipients or where there is a potential risk to public health (including moderate or high exposure end uses such as municipal irrigation, toilet flushing, irrigation of food crops that will be eaten raw) the risk assessment must be undertaken in a workshop format. NOW recommends that an external facilitator be engaged for the risk assessment workshop.

For a system where the risk to public and environmental health is minimal, a desktop risk assessment study may be undertaken. This includes sites that have restricted public access (e.g. private land) and low exposure end uses, for example:

- Sustainable irrigation of produce that will be cooked or processed prior to consumption
- Sustainable irrigation of pasture for livestock or crops for fodder
- Sustainable irrigation of woodlots

In cases where there may be risk to livestock or animal health, the assessment may include DPI livestock or animal health specialists.

What needs to be done:

A risk assessment of the recycled water system must be undertaken:

- Identify the source including their location and current use.
- Assemble a team to undertake the risk assessment.
- Draw a flow diagram of the system from source to end use.
- Review and analyse water quality data.
- Undertake hazard identification, preventive measure identification and risk assessment for public health and environmental risks including animal health as appropriate.
- Record the risk assessment outcomes in a Risk Assessment Report.
- In the RWMS document, record the details of the risk assessment process and append the Risk Assessment Report.

3.2.1 Identify the source of recycled water, intended uses, receiving environments and routes of exposure

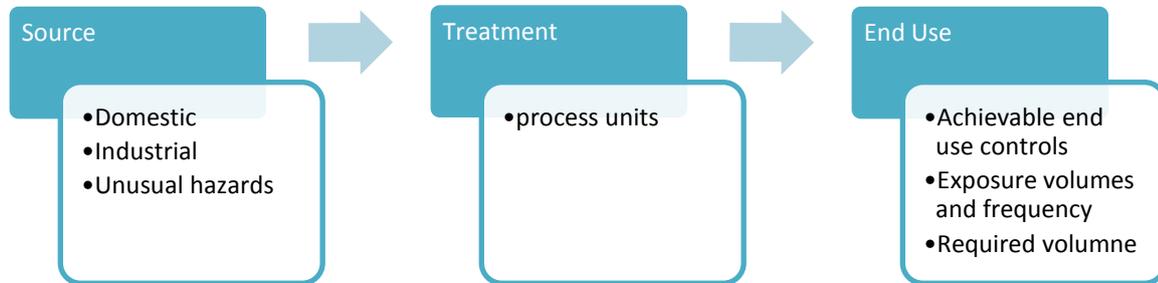
The following needs to be undertaken:

- Identification of all wastewater sources including their locations and current use.
- Assessment of source wastewater quality including potential hazards.
- Quantity of wastewater available from each of the sources expressed as a total daily volumetric flow rate and as average and peak demand flow rates.

- Identify the recipients and intended uses of the water. If the intended use is not covered in the AGWR, an exposure assessment that considers the exposure volumes and the frequency of exposure will need to be undertaken (see Exposure Assessment below). DPI (2004) has provided guidance on soil and landform and soil requirements for effluent reuse (weblink)

This should be recorded in the Risk Assessment Paper.

Figure 6. Matching source to end use



Exposure assessment

The AGWR have documented log reduction values (LRV) for typical exposures (AGWR Table 3.7 and Table 3.8). Table 4 summarises the LRV targets for typical end uses.

Table 4. Log reduction targets for typical end uses

End Use	Log Reduction Targets		
	Protozoa	Virus	Bacteria
Fire fighting (fire & rescue)	5.1	6.5	5.3
Dual reticulation and municipal irrigation	5.0	6.4	5.1
Commercial food crops	4.8	6.1	5.0
Municipal use — open spaces, sports grounds, golf courses, trees, shrubs, public gardens, dust suppression or unrestricted access and application	3.7	5.2	4.0
Non-food crops — trees, turf, woodlots, flowers, pasture etc.	3.7	5.2	4.0

Source: Adapted from AGWR Table 3.7 and Table 3.8

If the exposures are not known, which is common for industrial uses of recycled water, an exposure assessment will need to be undertaken. The assessment will need to identify the volume of recycled water the workers are exposed to, the routes of exposure (such as inhalation, ingestion and dermal contact) and how frequently this exposure occurs. AGWR Table 3.3 list indicative exposures associated with some recycled water uses. When undertaking exposure assessments it is very important to consider inadvertent uses of the recycled water (e.g. hand and face washing). AGWR Appendix 2 provides details for calculating LRV for specific exposures.

Recycled water and livestock

Use of recycled water with livestock presents some risks to their health. While most risks to livestock are small by virtue of the 'species barrier', some risks of human pathogens, such as human enteric viruses, protozoan pathogens and eggs of helminthic parasites, remain significant as they may be present in sewage.

The AGWR however provide for the use of recycled water for livestock with appropriate treatment, water quality objectives, management controls and certain livestock exclusions including:

- Not to be used for drinking or fodder for pigs
- Not to be used in dairy operations
- Not to be used on areas where recycled water is irrigated, until the pasture is dry, for lactating dairy cattle.
- Not to be used for wash down of dairy milking machinery.

Despite these risks and exclusions, the AGWR provides for use of recycled water for some livestock drinking water, with appropriate treatment controls, where the recycled water has been secondary treated with disinfection and helminth reduction. DPI has a risk-based program of auditing STPs supplying treated sewage effluent for use with livestock (weblink).

Cattle exposed to ova (eggs) of *Taenia saginata*, the human tapeworm, may develop the parasitic cysts of 'beef measles', or *Cysticercus bovis*. The control of *T. saginata* in treated sewage that is to be used in contact with cattle can be achieved through either 25 days of detention in waste stabilisation ponds or 4-log removal of helminth ova by an alternative treatment.

There are further restrictions in circumstances where animal wastes have entered the sewer as trade wastes, for example saleyard wastes, dairy wash down water or abattoir wastes containing animal faeces, as further risks that Bovine Johne's disease and others may be present.

If the scheme is unable to demonstrate that the risk of Johne's transmission is low to negligible, stock 12 months of age or younger should be isolated from coming in contact with recycled water (this includes grazing pasture irrigated with recycled water and drinking recycled water). For further information relating to Johne's disease in cattle or sheep, refer to the DPI website (weblink)

In developing an application for recycled water use with livestock, utilities should include a specialist officer from the NSW Department of Primary Industries in the risk assessment workshop to give advice on matters of relevance regarding risks to livestock.

More information on use of recycled water for livestock is found in section 3.6 of the AGWR.

3.2.2 Assemble a team

The following roles should be represented on the RWMS team:

- **Coordination role** – the person responsible for developing and maintaining the RWMS. This may be the water quality officer, water engineer or risk manager.
- **Leadership role** – the person who is championing the development of the RWMS. This may be the water manager, technical director or general manager depending on the size of the organisation.
- **Operators** – system operators covering all components of the recycled water supply system/scheme (source, treatment and end use).
- **Environmental Health Officer** - the person who is responsible for local health issues, water sampling and/or reviewing results.
- **NSW Officer of Water** representative/s – the person/s who will provide advice on process suitability and advice relating to the s60 submission e.g. recycled water specialist and regional representative. The NOW inspector for the region should also be invited to the workshop.
- **NSW Health representative** – the officer/s who will assist with the identification of health risks associated with recycled water supply and the management of those risks. A

representative of the local Public Health Unit should be invited to the risk assessment workshop.

- **Recycled water quality and treatment process expert** – the person who will assist with the identification and operation of the process controls.
- **EPA officer** – the person who will assist with the identification and management of the environmental impacts and regulatory requirements.
- **Specialist DPI animal health or livestock officer** – if applicable.

One person may cover several roles.

3.2.3 Draw the system flow diagram

Prepare a system flow diagram that is representative of the whole recycled water system from source to end use, using the information sources in Table 5 as a guide. Example process flow diagrams are included in Figure 8 and Figure 9. Consider source material (e.g. domestic sewage, industrial waste, radiological source (hospitals) and other forms of trade waste) and the temporal nature of the source stream. Consider the integrity of the collection system including illegal connections and infiltration (e.g. salinity). Include details of treatment process units (for both sewage treatment and recycled water production), recycled water distribution system, the numbers and distribution of consumers and variations in recycled water demand.

Figure 7. Recycled water system description

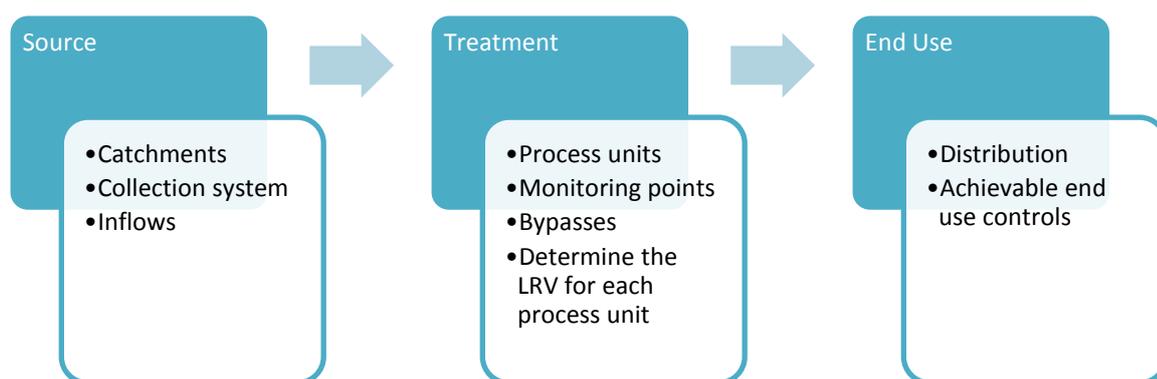


Table 5. Sources of information to develop a source to end use flow diagram

Source	Information	Reference
AGWR	Requirements for flow diagram	Section 2.2.2 - Construct a flow diagram of the recycled water system from the source to the application or receiving environments.
IWCM: Office of Water (2014) IWCM Strategy Check List (weblink)	4. Description of Existing Urban Water Services Systems	4F. A summary outline of your Category 3 trade waste discharges. 4G. A schematic plan of each sewerage system showing the hierarchy of the sewerage pumping facilities, gravity catchments, treatment facilities, water recycling systems and their capacities. 4J. A schematic and a brief description of each water recycling system, the types of end use of water within the enterprises and the associated management practices and agreements.
	6. 30-Year Water Cycle Analysis and Projection	Various relevant contextual information required for flows, loads and projections etc. for sewer catchments and sewage treatment systems. In particular, criterion 6AE contains information on discharge and reuse pathways:

Source	Information	Reference
		"The estimated 30-year daily and annual projection for each of the discharge and/or reuse pathway as a time series."
SBP	Key assets	Section 10 - Total Asset Management Plan
Operation staff and site visits	System performance, equipment sizing/capacity, flow direction, bypasses	Procedures and plant diaries
Other Sources	Process train, equipment sizing/capacity, flow direction, bypasses	Operation and Maintenance Manual / Design Specifications
		Commissioning Reports
		Process and Instrumentation Diagrams (P&IDs)
	System layout	Geographical Information System (GIS) Data
	Potential hazards in source material	Trade waste policy and register

Figure 8. Example simple process flow diagram

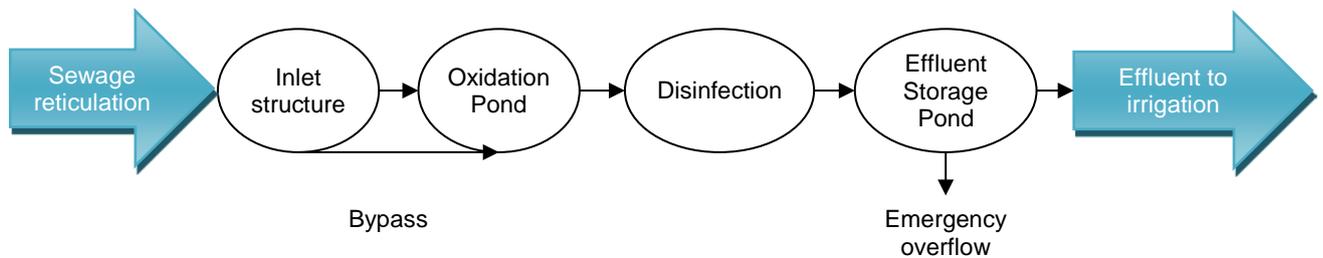
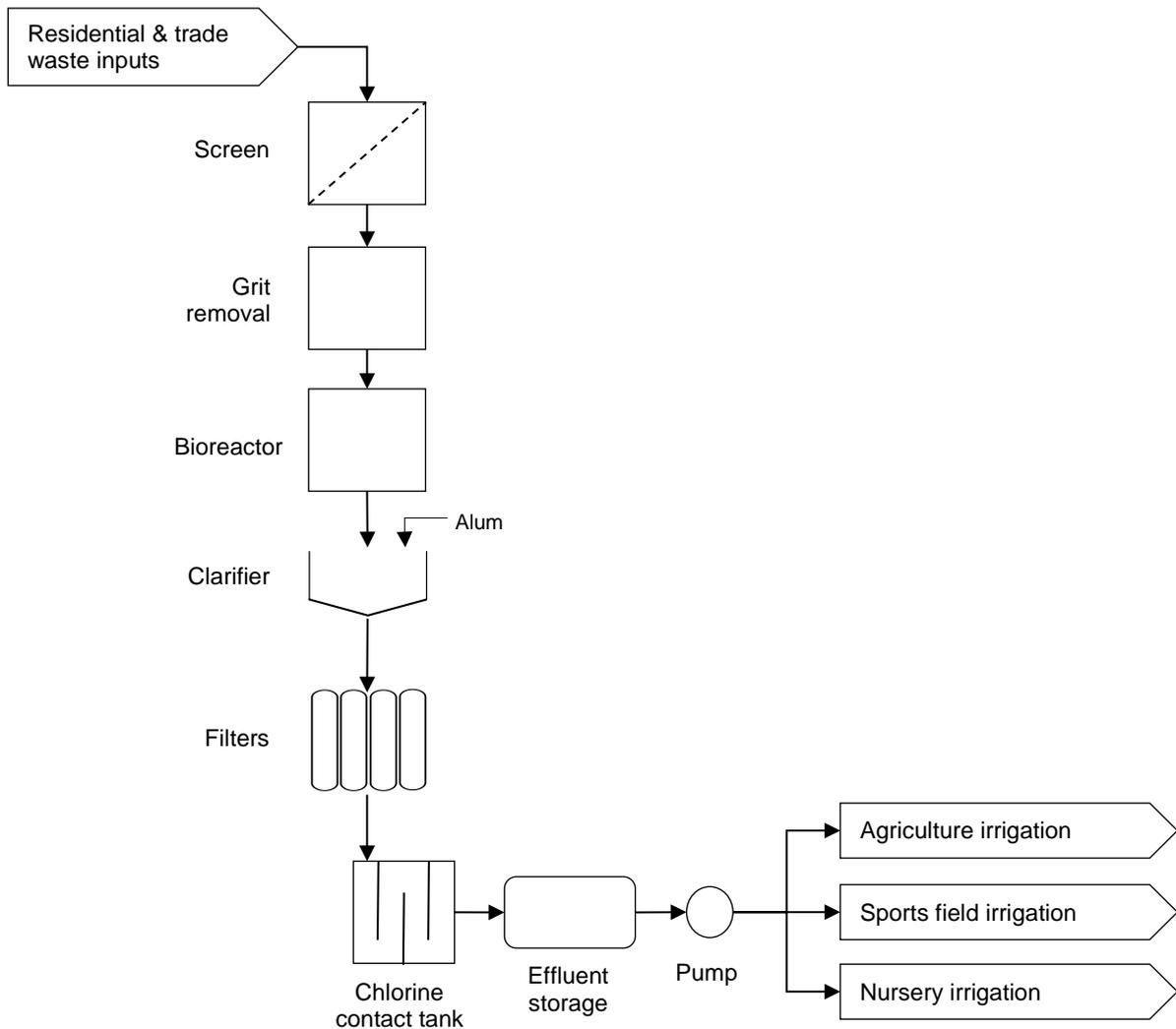


Figure 9. Example process flow diagram



3.2.4 Review and analyse water quality data

Review the water quality data sources listed in Table 6, statistically analyse and trend the data as described in section 3.10 of this document and the *Australian Guidelines for Water Quality Monitoring and Reporting* (2000). Consider rainfall impacts on source water quality. Include the water quality analysis in the risk assessment report (and briefing paper if a workshop is required). Twelve months of data should be reviewed as a minimum. Analysis of longer periods (3-5 years) is preferable.

Table 6. Sources of water quality data

Source	Information	Type
Operator physical testing	Influent, process, recycle and distribution water quality	Operational
SCADA data	Real time influent, process, recycled and distribution water quality and flow	Operational
Laboratory physical testing	Influent, process, recycle and distribution water	Verification and investigative monitoring

Source	Information	Type
	quality	
State of Environment reporting	Recycled water volume	Operational
Bureau of Meteorology	Rainfall	Operational, investigative
IWCM: Office of Water (2014) IWCM Strategy Check List (weblink)	6. 30-Year Water Cycle Analysis and Projection	Various relevant contextual information required for flows, loads and projections etc for sewer catchments and sewage treatment systems. In particular, criterion 6AE contains information on discharge and reuse pathways: "The estimated 30-year daily and annual projection for each of the discharge and/or reuse pathway as a time series."
	IWCM Issues Paper	The IWCM Issues Paper requires all identified issues to be detailed including those relating to current water recycling schemes and future opportunities. 9. Feasibility Review of Options requires the following: For issues relating to sewage treatment and effluent quality improvement including recycled water systems the following is demonstrated: <ul style="list-style-type: none"> N. Since the level of sewage treatment is dependent on the end use of the effluent and the receiving environment, all options (i.e., previously dismissed and potential new) such as urban open space watering, industrial recycling, non-potable reuse, indirect potable recycling (IPR), direct potable recycling (DPR), agricultural recycling, environmental substitution, waterways discharge, etc are to be identified and reviewed along with indicative cost estimates and urban water cycle benefits such as secure yield, potable water demand reduction, etc. O. Includes consideration of sewer mining (new and previously dismissed) with recycling within existing developed areas and new release areas.

3.2.5 Prepare for the risk assessment

The information in Table 7 is required for the s60 submission and should be gathered prior to undertaking the risk assessment. These requirements have been noted as essential or desired prior to the risk assessment.

Table 7 Information to support the risk assessment

Information	Essential / Desired
Description of the proposed treatment process to deliver the recycled water quantity and quality required.	Essential
Indicative and/or validated log removal values for each treatment unit in the process (see Calculating Log Reduction Values information sheet)	Essential
In the case of an existing system being upgraded to produce recycled water, provide: <ul style="list-style-type: none"> the existing system process, design and performance specifications a proposal for decommissioning any discarded components of the existing system to allow for the proposed system the existing process and environmental monitoring results and assessments historical inflow data where possible, including storm events and periods of water restrictions contingency arrangements for recycled water management or disposal if supply ceases (e.g. due to contamination or off-spec quality) or recipient cannot take it. 	Essential Desired Essential Essential Desired
A water balance analysis to determine the surplus/deficit of recycled water available for the end uses.	Essential
A salt and nutrient balance analysis of the water recycling scheme.	Desired (scheme dependent)

Information	Essential / Desired
Identification of non-treatment barriers and associated indicative log removal values for each (see <i>Non treatment barriers: End use and onsite controls</i>).	Essential
Assessment of the potential public exposure to the recycled water and identification of controls to reduce the exposure, including irrigation timing, signage and fencing.	Essential
Assessment of the potential environmental exposure to the recycled water and identification of controls to reduce the exposure, including: <ul style="list-style-type: none"> identification of the scheme's potential environmental impacts, including quality or quantity requirements for receiving water or groundwater identification of any sensitive environmental factors at the end use locations acceptable and unacceptable climate conditions for recycled water application at the end use location and alternative disposal arrangements. 	Essential
Verification results for existing schemes	Essential

For an assessment conducted as a workshop, this information should be compiled into a briefing paper for distribution to workshop participants ahead of the workshop itself.

Determining treatment and non-treatment LRV

Reduction in pathogen concentrations in recycled water are calculated using LRVs. The LRV required for each end use of recycled water is based on the likely exposure volumes ingested from the use of the water. For more details refer to the information sheets [Indicators, Reference Pathogens & Log₁₀ Reductions: What does it all mean?](#) and [Calculating Log Reduction Values](#).

Indicative LRVs for treatment processes are summarised in Table 8, the minimum value should be used unless supported by validation or verification data, in which case the actual values should be used. For further information refer to the [Validation and Verification](#) and the [Indicators, Reference Pathogens & Log₁₀ Reductions: What does it all mean?](#) information sheets.

Suitable operational monitoring parameters must be available to confirm, in a timely manner, that the treatment steps are achieving the required LRV. Currently it is difficult to demonstrate this for reverse osmosis units so the full LRV is rarely claimed. There is significant research in operational monitoring of reverse osmosis units to demonstrate they are achieving the required LRV.

Table 8. Indicative LRV for treatment processes

Treatment	Indicative Log Reduction Values		
	Protozoa	Virus	Bacteria
Primary treatment	0–0.5	0–0.1	0–0.5
Secondary treatment (well aerated secondary systems)	0.5–2.0	0.5–2.0	1.0–3.0
Dual media filtration with coagulation	1.4–4.0	1.2–4.0	1.0–3.4
Membrane filtration	4.0	2.5–4.0	3.5–4.0
Reverse osmosis	1–4.0	1–4.0	1–4.0
Lagoon storage	1.0–3.5	1.0–4.0	1.0–5.0
Chlorination	0–0.5	1.0–4.0	2.0–4.0
Ozonation	n/a	3.0–4.0	2.0–4.0
UV light	3.0–4.0	adenovirus 1.0–4.0 other 3.0–4.0	2.0–4.0
Wetlands – surface flow	0.5–1.0	n/a	1.0
Wetlands – subsurface flow	0.5–1.0	n/a	1.0–3.0

Source: adapted from AGWR Table 3.4, Smeets et al (2006), Black et al. (2009); Smartwater Fund (2012)

Note: If a process is not included in the above tables then it will need to be verified to determine the achieved LRV

To calculate the LRV for the chlorination treatment process for viruses, the design C.t must be calculated to ensure effective disinfection is occurring. Refer to [Getting Chlorination Right information sheet](#) for further information.

Indicative LRVs for non-treatment barriers are summarised in Table 9. When considering non-treatment barriers it is important to consider who is being protected by each barrier. Sufficient LRVs need to be achieved for all relevant groups. Due to the lack of scientific data surrounding LRVs for non-agricultural irrigation a maximum of 3 LRVs attributed to non-treatment barriers can be claimed.

For more information see [Non treatment barriers: End use and onsite controls information sheet](#).

The RWMS is for the protection of public health and the environment. As with other health and safety risks associated with working at the recycled water plant, the utility's WHS system should be used to manage health risks to employees.

Table 9. Non-treatment barrier LRVs

Non-treatment barrier	LRV	Group protected
Cooking or processing of produce (e.g. cereal, wine grapes)	4 log	Produce consumers
Subsurface irrigation of above ground crops	4 log	Produce consumers
Drip irrigation of raised crops with no ground contact (e.g. apples, apricots, grapes)	4 log	Produce consumers
Drip irrigation of crops with limited to no ground contact (e.g. tomatoes, capsicums)	3 log	Produce consumers
Drip irrigation of crops	2 log	Produce consumers
Removal of skins from produce before consumption	2 log	Produce consumers
Withholding periods — produce (decay rate)	0.5 log/day ¹	Produce consumers
No public access during irrigation and limited contact after (non-grassed areas e.g. food crop irrigation)	3 log	Facility users
No public access during irrigation	2 log	Facility users
Withholding periods for irrigation of parks/sports grounds (1–4 hours)	1 log	Facility users
Drip irrigation of produce/plants/shrubs	4 log	Produce consumers, neighbors, passing public
Subsurface irrigation of plants/shrubs or grassed areas	4 log	Neighbors, passing public
Spray drift control (microsprinklers, anemometer systems, inward-throwing sprinklers, etc.)	1 log	Neighbors, passing public
Buffer zones (25–30 m)	1 log	Neighbors, passing public

Source: adapted from AGWR Table 3.5

Note 1: Based on virus inactivation. Enteric bacteria are probably inactivated at a similar rate. Protozoa will be inactivated if withholding periods involve desiccation.

3.2.6 Hazard identification and risk assessment

The hazard identification and risk assessment (AGWR Section 2.2.4), and the identification of preventive measures for recycled water quality management (Element 3) are normally undertaken in a single risk assessment. For a system where the risk to public and environmental health is minimal a desktop study may be undertaken. For a system with multiple sites or multiple recipients the risk assessment must be undertaken in a workshop format. NOW recommends that an independent (preferably external) facilitator be engaged for the risk assessment workshop.

The identification and planning of preventive measures should always be based on system specific hazard identification and risk assessment, to ensure that the level of protection to control a hazard is proportional to the associated risk. When identifying existing preventive measures, or developing new measures, the following aspects must be considered:

- the entire recycled water system, including the water source, its characteristics and proposed end uses
- existing preventive measures, from source(s) to the user of recycled water, for each significant hazard or hazardous event
- increased risk due to inadvertent or unauthorised actions
- spatial aspects (these need to be considered when identifying preventive measures for environmental risks, because the sensitivity of receiving environments can vary over space)
- areas where the use or discharge of recycled water is not appropriate due to, for example, environmental sensitivity or soil type or topography.

Maximum risk (the risk with no preventive measures in place) and residual risk (the risk with the preventive measures in place) should be assessed for public health and environmental impacts e.g. assessment of harmful nutrient, salinity or sodicity build-up in any resource impacted by recycled water use and how this will be prevented, monitored and/or rectified.

The risk assessment should identify actions for improvement such as introducing or enhancing preventive measures, as well as investigations to reduce uncertainties and further characterise risks. Actions identified in the risk assessment should be transferred to the Improvement Plan (Element 12), prioritised and followed up. An extract from a risk assessment is shown in Table 10 as an example.

Record the outcomes of the Risk Assessment in a report including the information assembled as part of the preparation. The risk assessment report must include:

- a list of the team involved in the risk assessment
- a process flow diagram and description of the recycled water scheme (from source to end use) identifying the critical control points and monitoring points
- the risk register.

The Risk Assessment Report should be referenced in the RWMS document.

Table 10. Risk assessment extract

Process Step	Hazardous event	Hazard	Current Control Measure	Maximum risk			Residual Risk			Follow-up Actions
				Likelihood	Impact	Risk	Likelihood	Impact	Risk	
Residential and trade waste inputs	Metals from reticulation system	Cu, Pb, Fe	-Trade waste agreements	C	1	Low	A	1	Low	-Education of trade waste users -Ensure enforcement of trade waste policy
Sewerage network	Wet weather infiltration	Salinity	-Inflow and infiltration program	Uncertain						-Consider monitoring TDS in effluent

Secondary treatment	Aeration system failure	Nutrients Organic load	-Two reactor tanks -Duty standby blowers, pumps -DO probes -SCADA monitoring -Generator	C	5	Very High	A	5	High	-Check if aeration system failure is in emergency response plan, add if not included
Tertiary treatment	Failure of backwash cycle (e.g. valve failure) leading to higher load on working filters	High turbidity Protozoa Bacteria Organic load	-Redundancy -Automated backwash triggered by pressure or turbidity -Operator monitoring -Flow diversion -Outlet turbidity will be a critical control point	D	4	Very High	D	2	Moderate	-Ensure supply of recycled water is ceased under this condition
UV	Lamp failure / fouling	Protozoa Viruses Bacteria	-SCADA alarm -Regular maintenance by qualified contractors -Lamp redundancy	D	5	Very High	A	5	High	-Ensure signal from SCADA on UV lamp failure closes actuated valve to chlorination

Where risk assessments are conducted at the design stage, the risk assessment should be reviewed prior to commissioning to confirm that all previously identified actions have been undertaken and have assessed for any newly emerged risks. Particular consideration should be given to changes in design for the previous risk assessment.

3.3 Element 3: Preventive measures for recycled water management

Recycled water comes from an inherently unsafe source, sewage, therefore prevention is an essential feature of effective recycled water quality management. Preventive measures, in the context of managing recycled water schemes, are the actions, activities and processes used to prevent significant hazards from being present in recycled water schemes or to reduce any hazards to acceptable levels. Element 3 covers the identification of the preventive measures in place within the recycled water supply system, paying particular attention to the concept of multiple barriers i.e. that a failure of one barrier may be compensated by effective operation of the remaining barriers.

What needs to be done:

- CCPs must be identified based on the risk assessment findings.
- Monitoring requirements for critical control points must be established.
- Critical limits must be set.
- Record the details in the RWMS document and ensure that the information is in place and easy to see, at the CCP location or control room.

The Framework recommends that hazard identification should be completed along with the assessment of maximum risk. The influence of preventive measures on risk should be identified next. In practice the two are typically combined into one Risk Assessment, as described in section 3.2.

Preventive measures should be comprehensive from source through to the recipient. Many preventive measures may control more than one hazard, while, as prescribed by the multiple barrier approach, some hazards require more than one preventive measure for effective control. Preventive measures by their nature should be applied as close to the source as possible, with a focus on prevention at the source rather than sole reliance on downstream control.

The documents listed in Table 11 should be reviewed when evaluating the adequacy of the preventive measures in the system being assessed.

Table 11. Items to consider when assessing the adequacy of preventive measures

Source	Information
Design reports for the Sewage Treatment Plant and Recycled Water Scheme	Functional descriptions, design criteria and performance requirements for each treatment process
Equipment specifications e.g. manufacturers pre-validation certificates	Performance capabilities and log reductions claimable for unit process
Previous reports (including Best Practice Management auditing and investigative reports)	Identified gaps
Relevant international guidance and scientific papers e.g. US EPA Disinfection Profiling and Benchmarking Guidance Manual (1999), US EPA Ultraviolet Disinfection Guidance Manual For The Final Long Term 2 Enhanced Surface Water Treatment Rule (2006)	Chlorination disinfection profiles, UV design and validation, alternative disinfectants

If improvement is required, alternative and additional preventive measures that could be applied need to be evaluated.

3.3.1 Critical control points

A critical control point is defined as an activity, procedure or process where control can be applied, and that is essential for preventing hazards that represent high risks or reducing them to acceptable levels.

Identification of critical control points is system specific, being based on knowledge of potential hazards and associated risks, and preventive measures. Critical control points should be selected appropriately, because they will be the focus of operational control.

Typical critical controls points, depending on end use, may include:

- secondary treatment processes
- filtration process
- disinfection process (e.g. chlorination and/or UV)
- preservation e.g. chlorine dosing for residual

Setting SMART CCPs

The acronym “SMART” can be used to help decide if a process can be classified as a CCP:

- S** Significant - Is there a significant risk managed by the process?
- M** Measurable - Can the process be measured and limits established where action needs to be taken?
- A** Action – Are there timely actions that can be implemented if the process is measured to be outside acceptable limits?
- R** Reduce - Will these actions reduce the risk?
- T** Timely - Can the measurements and response actions be carried out in a timely manner?

If the answer to all these questions is yes then it is a critical control point

Each CCP has an associated monitoring point for which limits need to be set:

- A critical limit at which, if exceeded, control of the process is lost and water quality is not guaranteed. This **must** be set for each CCP.
- A target criterion, which represents a well-controlled process, **should** be set for each CCP, and corrective action undertaken when required target is exceeded.
- An adjustment limit **can** be set which indicates the point at which adjustment needs to be made to restore control and to avoid the critical limit being exceeded.

This information may be developed as part of the risk assessment or be available as part of the plant design specifications. Typical CCPs and their potential monitoring parameters are shown in Table 12.

Table 12. Common CCPs and potential monitoring parameters

CCP	Potential monitoring parameters
Chlorination	Free chlorine C.t
UV disinfection	UV intensity/dose UV transmissivity
Membrane filtration	Turbidity Transmembrane pressure
Secondary treatment processes	Dissolved oxygen Ammonia Turbidity
Lagoon retention time	Retention time in days Flowrate Turbidity
Reservoirs (dual reticulation systems)	Reservoir integrity Residual free chlorine

Frequency of monitoring at CCPs needs to be in line with the speed with which the barrier can fail.

Sample information that represents a typical chlorine CCP table is shown in Table 13.

Table 13. Chlorination CCP table

Item	Description
What is being measured?	pH, free chlorine residual
Where/how is it measured?	Online at outlet of contact tank
How is it controlled?	Sodium hypochlorite dosing system
What are the hazards?	Bacteria, virus
Target Criterion	≥ 2.5 mg/L free chlorine
Adjustment Limit	< 2.2 mg/L free chlorine
Critical Limits	< 2.0 mg/L free chlorine, pH > 8.5

Once CCP procedures have been documented, their accuracy should be verified on-site with the operators. This check should confirm that all the steps are included and match what the operators would do for each limit.

3.4 Element 4: Operational procedures and process control

Effective control of multiple barriers within the recycled water system is fundamental to the consistent production of safe, quality recycled water. Even short periods of sudden change and suboptimal performance in a recycled water supply system can represent a risk to public health or the environment. Therefore, it is vital to ensure that all operations are optimised and continuously controlled and that preventive measures are functional at all times.

This element of the Framework requires a description of all preventive measures and their functions, including the wider processes such as control of materials and chemicals, equipment capability and maintenance. Equipment capability, including monitoring equipment, is a key component of the recycled water system and therefore, a program is specifically included in the Framework to ensure that equipment is appropriately maintained and calibrated to ensure accuracy and efficacy of application. Similarly, materials and chemicals are also singled out for specific mention in the Framework as they can provide a source of hazards to the recycled water quality and hence affect the suitability of the end use.

What needs to be done:

- Record procedures for:
 - Managing CCPs and the communication protocol for a CCP exceedance.
 - Operational monitoring and corrections.
 - Chemical and equipment procurement, delivery and testing.
 - Calibration, operation and maintenance of critical treatment equipment.
- Include references to the above procedures in the RWMS document.

3.4.1 Operational procedures

Procedures should be developed for important preventive measures to cover the operation of processes and activities (both ongoing and periodic) from source through to the user of recycled water. These procedures should cover the operation, monitoring, maintenance and calibration associated with these preventive measures.

Procedures should be developed for immediate corrections to re-establish process control following failure to meet target criteria or critical limits. The procedures should include instructions on required adjustments, process control changes and additional monitoring. Responsibilities and authorities, including communication and notification requirements, should be clearly defined. Procedures for CCPs should be recorded in a format similar to Table 14. A template for developing CCPs and their procedures is provided in 4Appendix C.

Table 14. CCP Table with associated procedures

Item	Description	
What is being measured?	pH, free chlorine residual	
Where/how is it measured?	Online after treated water tank	
What is the control point?	Sodium hypochlorite dosing system	
What are the hazards?	Bacteria, virus	
Target Criterion ≥ 2.5 mg/L free	Adjustment Limit < 2.2 mg/L free	Critical Limit < 2.0 mg/L free chlorine pH > 8.5
<ul style="list-style-type: none"> Check sodium hypochlorite strength on delivery and enter into SCADA Daily SCADA trend monitoring and reports page Routine contractor maintenance of online probes 	<ul style="list-style-type: none"> Check analyser and cross-check residual Check chlorine dosing system Check temperature (>15°C) and pH Check sodium hypochlorite strength and review SCADA settings Review water chemistry Contact STP operator for ammonia check and upstream equipment check 	<ul style="list-style-type: none"> Automatic shutdown Report to manager Slug dose of treated water tank by manual operation of chlorine dosing pump Complete incident report

Detailed procedures should be developed for complex or non-routine activities and include details such as the following, where applicable:

- Document identification (version, responsibility, revision date, title).
- Aim and objectives.
- Roles and responsibilities.
- General background.
- Description of the procedure.
- Measurable criteria to be met.
- Flow diagram and/or summary table capturing the essence of the procedure.
- References to supporting information.

For routine activities, daily, weekly and monthly task schedules should be developed to document all required activities. Supporting records can be maintained through log sheets, plant diaries or in electronic format. Routine tasks can be supported through job aids located at the site where the task is undertaken, for example, a calibration procedure located above a pH probe.

Procedures are most effective when operations staff and recycled water recipients are involved in their development, documentation and verification. Participation helps to ensure that all relevant activities are included, improves operator and recycled water recipients training and awareness, and fosters commitment to operational and process control.

Both the detailed procedures, schedules and their supporting records should be referenced in the RWMS document.

3.4.2 Operational monitoring

An operational monitoring plan should be referenced in the RWMS document. The operational monitoring plan must include operational monitoring of critical control points, including the analytical parameters, critical control limits, monitoring frequency and responsible party.

Typical operational monitoring parameters may include:

- pH
- nitrogen and phosphorus
- monitoring specific to secondary processes e.g. MLSS, sludge blanket depth
- recycled water turbidity
- delivered UV dose
- electrical conductivity / TDS
- free chlorine residual after contact tank and in distribution system.

Chapter 5 (Tables 5.4 and 5.6) of the AGWR provide information on how to develop a routine monitoring program (for both operational and verification monitoring). Table 15 below provides a typical operational monitoring program for high, intermediate and low exposure schemes. A high exposure scheme would be a dual reticulation scheme, and intermediate scheme would be one with potential for public contact and low exposure scheme has limited public exposure (e.g. single agricultural user).

Table 15. Typical operational monitoring program

Process step	Frequency			Operational Monitoring
	Low-exposure scheme	Intermediate-exposure scheme	High-exposure scheme	
Primary settling system	Weekly	Daily	Continuous	Flowrate through the system Solids depth
Secondary treatment system	Weekly	Daily	Continuous	Flow rate through the system Sludge blanket depth Turbidity or suspended solids BOD ₅ Ammonia Nitrate DO
Media filtration plant	Daily	Continuous	Continuous	Turbidity of filtrate Head loss across system pH and temperature
Membrane plant	Daily	Continuous	Continuous	Turbidity of permeate Head loss across system Particle counts on outlet
Ultraviolet (UV) plant	Daily	Continuous	Continuous	Turbidity upstream UV transmissivity UV intensity and/or calculated dose Flow rate Ballast functionality Lamp power Lamp status Cleaning frequency
Chlorination plant	Daily	Continuous	Continuous	Turbidity upstream Free chlorine, temperature and pH at downstream monitoring point Flow rate to enable calculation of Ct
Trade Waste Agreement	Annually	Annually	Annually	Presence, currency and comprehension of trade waste agreements

Process step	Frequency			Operational Monitoring
	Low-exposure scheme	Intermediate-exposure scheme	High-exposure scheme	
Over-irrigation control	Biannually	Monthly	Weekly	Soil moisture content Irrigation time
Accidental ingestion control	Daily	Continuous	Continuous	Timing of irrigation Direction of sprinkler throw before application Wind direction before application
	Annually	Annually	Annually	Presence, currency and comprehension of user agreements Presence, integrity and clarity of fittings, signage and other end-user controls

Source: Adapted from AGWR Tables 5.4 and 5.6

3.4.3 Equipment maintenance

A regular inspection and maintenance program should be developed for the recycled water scheme detailing:

- operational procedures and records for the maintenance of equipment, including the calibration of monitoring equipment
- schedules and timelines
- who is responsible
- equipment and personnel required.

Priority should be given to equipment (including monitoring equipment) associated with the CCPs.

Major maintenance and equipment replacement should be carried into the Asset Management Plan within the SBP.

3.4.4 Materials and chemicals

The RWMS document must record the procedures and systems used for the procurement of materials and chemicals. Depending upon the end use, consideration should be given to the following:

- Plumbing Code of Australia and AS/NZS 3500 (use current versions)
- ATS 5200.026:2004 Technical Specification for Plumbing and Drainage Products, Cold Water Storage Products
- AS/ZS 4766:2006 Polyethylene storage tanks for water and chemicals
- AS 2070:1999 Plastics materials for food contact use
- AS (various) Appropriate storage and handling of chemicals, bunding and spill management

Recycled water suppliers must ensure they have suitable procedures for the purchase and use of all chemicals, including those that are not purchased through tendering.

The recycled water supplier must have documented procedures for the delivery and storage of chemicals. These procedures must state that:

- Chemical deliveries are attended by trained treatment plant operators.

- A certificate of analysis is provided by the supplier at the time of delivery for each batch of chemical supplied.
- The correct chemical is being delivered into the appropriate storage.
- How the recycled water supplier ensures that the correct concentration has been supplied. This may be achieved through a simple density calculation for some chemicals. NOW can provide advice regarding testing chemicals upon receipt.

Recycled water suppliers should maintain an Approved Chemical/Material Register and:

- check against the register before purchasing new chemicals
- make sure the register becomes a controlled document
- include the following information for each chemical or material:
 - name (for chemicals, common name and scientific name)
 - use
 - quantity stored
 - purchased by
 - purchase method (e.g. Supply Agreement)
 - approved supplier
 - specification reference
 - delivery, verification and receipt procedure
 - storage method
 - storage life.

MSDSs should be checked for compatibility with use and WH&S provisions and a copy kept local to chemical facilities.

3.5 Element 5: Verification of recycled water quality and environmental performance

Verification of recycled water quality assesses the overall performance of the treatment system, the ultimate quality of recycled water being supplied or discharged to the receiving environment (see [Validation & Verification: What's the difference? information sheet](#)). Verification provides:

- confidence for all stakeholders of recycled water, including users and regulators, in the quality of the water supplied and the functionality of the system as a whole
- confidence that environmental targets are being achieved
- an indication of problems and a trigger for any immediate short-term corrective actions, or incident and emergency responses.

Verification assesses whether a scheme is performing and should be regarded as the final overall check that preventive measures are working effectively and that the target criteria and critical limits set from relevant guidelines are appropriate.

What needs to be done:

- The RWMS document must reference an implemented comprehensive monitoring program for the system and end use points including data review.
- The RWMS document must note how the recycled water supplier ensures recipients comply with their user agreements

3.5.1 Verification monitoring

Verification includes regular sampling and testing to assess whether recycled water quality and application sites and other receiving environments (e.g. soil, groundwater, surface water) are meeting guideline values, regulatory requirements or agreed levels of service. Assessment of public health requirements is generally undertaken at the point of entry to distribution systems. However, in the case of recycled water supplied for domestic non-drinking uses, some monitoring at point of supply to consumers may be required, particularly for indicators of microbiological quality (e.g. free chlorine residual).

Key characteristics that should be considered for verification (based on the risk assessment and end uses) include:

- microbial indicator organisms
- salinity, sodicity, sodium, chloride, boron, chlorine disinfection residuals, nitrogen and phosphorus
- any health or environment-related characteristic that can be reasonably expected to exceed relevant guideline values, even if occasionally
- any characteristic of relevance to end use or discharge of the recycled water that can be reasonably expected to exceed the guideline values, even if occasionally.

Once characteristics have been confirmed, sampling locations should be identified and both should be documented in a consolidated monitoring plan. Monitoring data should be representative, reliable and fully validated. Procedures for sampling and testing should also be documented.

Chapter 5 (Table 5.6) of the AGWR provide information on how to develop a routine monitoring program (covering both operational and verification aspects). Recycled water suppliers should consult this information in developing and implementing their monitoring program.

Table 16 below provides a typical sampling schedule within a verification monitoring program for public health for low, intermediate and high exposure schemes. A high exposure scheme would be a dual reticulation scheme, and intermediate scheme would be one with potential for public contact and low exposure scheme has limited public exposure (e.g. single agricultural user).

Table 16. Typical public health verification monitoring sampling program

Typical parameter	Sampling frequency		
	Low-exposure scheme	Intermediate-exposure scheme	High-exposure scheme
<i>E. coli</i>	Monthly	Weekly	Weekly
Clostridial spores	-	-	Weekly
Audit of calibration activities	Monthly	Monthly	Monthly
Audit of preventive maintenance activities	Annually	Annually	Annually
Audit of operational monitoring activities	Monthly	Monthly	Monthly

Source: Adapted from AGWR Table 5.6

The EPA provides guidance on the monitoring of irrigation environmental endpoints in their [Environmental Guidelines: Use of Effluent by Irrigation](#). Planned responses to recycled water quality non-conformances should be identified in the RWMS document under Element 4 and 6. The RWMS document must also state who is responsible for reviewing the verification monitoring results.

Where recycled water is supplied in proximity to a drinking water network, review of drinking water quality data in relation to those parameters which may signal a cross connection (e.g. salinity) should be undertaken.

3.5.2 Satisfaction of recipients of recycled water

Comments and complaints from recycled water recipients can provide valuable information on problems that may not have been identified by performance monitoring of the water supply system. A complaint and response program should be established and operated by appropriately trained personnel as part of the RWMS. Recipient satisfaction is a major component of the success of recycled water schemes. In the long term, complaints and responses should be evaluated according to type, pattern and change in the number of complaints received.

The procedures for recording and responding to consumer recycled water quality complaints and enquiries should be documented. Most recycled water suppliers will use a customer request management system.

Where recycled water is supplied in proximity to a drinking water network, drinking water quality complaints in these locations should be assessed with a focus on ensuring there are no cross connections.

3.6 Element 6: Management of incidents and emergencies

The recycled water supplier needs to develop considered and controlled responses to recycled water quality incidents or emergencies to protect public health and environmental health, maintain consumer confidence and protect the reputation of the organisation. Some events cannot be anticipated or controlled, or are so unlikely to occur that providing preventive measures would be too costly. For such incidents, there must be an adaptive capability to respond constructively and efficiently - this is the focus of this incident and emergency element of the Framework.

Emergency protocols must remain in place until the system can be returned to normal operating conditions.

What needs to be done:

- Develop a contact list for incidents and emergencies.
- Record in the RWMS document where controlled copies of the contact list are kept.
- Reference the protocols to be followed in case of incident or emergency.
- Record in the RWMS

3.6.1 Communication

Effective communication is vital in managing incidents and emergencies. See [Recycled Water Incident Notification and Response information sheet](#). Clearly defined protocols for both internal and external communications should be established with the involvement of relevant agencies including health, environment and other regulatory agencies:

- ensuring that all possible threats are identified as potential causes of an incident
- defining what an incident is
- documenting who makes the notification and to whom
- documenting when notifications occur.

Recycled water suppliers should have a contact lists for incidents and emergencies which is available to all operational staff. The contact list should include contact information including name, work number, after-hours number, mobile number and pager number for the organisations listed in Table 17 as a minimum.

Table 17. Emergency Contacts.

Emergency Services	Other organisations	Other
Police, Fire and Rescue, Ambulance Rural Fire Service (local brigade) SES (local unit or 132500)	NSW Health local Public Health Unit Water testing laboratory NSW Office of Water, Water and Sewerage Inspectors NSW Office of Environment and Heritage and EPA Electricity utility control centre WorkCover Local Land Service NSW Trade and Investment	Media (each local newspaper, TV radio station) Telecoms service provider control room (<i>Telstra, Optus, Vodafone etc</i>) Staff internal to the water supplier (media, executive, managers etc.)

The contact list must be controlled and its currency maintained. It must have a review date and responsibility for review assigned on the document or file. Contact lists should be updated regularly (e.g. three-monthly) to ensure they remain accurate.

User confidence and trust during and after an incident or emergency are essential and are largely affected by how incidents and emergencies are handled. A public and media communication strategy should be developed before any incident or emergency situation occurs. Draft public and media notifications should be prepared in advance of any incident and should be designed for the target audience. An appropriately trained and authoritative contact should be designated to handle all communications in the event of an incident or emergency. All employees should be kept informed during any incident for their own needs and because they provide informal points of contact for the community.

Recipients of recycled water should be told when an incident has ended and should be provided with information on the cause and actions taken to minimise future occurrences.

3.6.2 Incident and emergency protocols

Incidents may arise through many circumstances. Table 19 provides guidance on sources of information for managing incidents in NSW. Recycled water suppliers should review the information available and tailor it to their needs in consultation with their local Public Health Unit.

When tailoring incident and emergency protocols, the recycled water supplier should discuss with key agencies under what circumstances notifications should take place and which personnel from the recycled water supplier are authorised to communicate with these agencies.

A single Incident and Emergency Response Plan (IERP) could be prepared where the Plan incorporates all the relevant obligations of the Pollution Incident Response Management Plan (PIRMP) required by the *Protection of the Environment Operations Act (1997)*.

Table 18. Information sources for managing incidents in NSW

Incident Type	Document Reference
Business interruption	NSW Water Directorate Business Continuity Management Guidelines
Business continuity standard	ISO 22301 Business Continuity Management
PIMRP	Environmental Guidelines: Preparation of Pollution Incident Response Management Plans
CCP exceedance	Framework Element 3, 4 and 10
Public Health Incidents	NSW Benchmarking Reports and Utility TBL Performance Reports

All relevant staff and contractors should be trained in the application of the IERP and procedures. This training should be recorded in the recycled water supplier's training register (Element 7). Training should focus on those incidents most likely to occur e.g. under dosing of chlorine or discovery of a cross connection. Training on the IERP will help familiarise staff with procedures and determine what works and what does not so that revisions can be made accordingly.

After an incident or emergency has been resolved all the staff involved should be debriefed and this information used to improve the recycled water supplier's IERP. The Framework provides advice on this (Chapter 2.6.2).

3.7 Element 7: Operator, contractor and end user awareness and training

The successful operation of a recycled water supply system rests not just on the engineered components but also on the knowledge, skills, motivation and commitment of all involved in the operation of the recycled water supply system from source through to end use.

The knowledge, skills, motivation and commitment of operators, contractors and recipients ultimately determine:

- *a recycled water supplier's ability to successfully operate a recycled water supply system and maintain the treatment barriers used for preventive measures*
- *the effectiveness of non-treatment barriers used as preventive measures.*

This element therefore involves both recycled water quality awareness and training requirements.

What needs to be done:

- In the RWMS document, record the management, review and record keeping processes for operator, contractor and recipient training.
- Reference to the management of training, including records kept and the review processes in place, should be made in the RWMS document.
- The RWMS document must include information on how the recycled water supplier improves and maintains employees' and contractors' awareness of recycled water quality and environmental issues.

The Human Resources section of the recycled water supplier usually manages training requirements and records, including:

- Organisational structure.
- Position descriptions (including reporting responsibilities – see Element 10, Section 3.10 of this document).
- Skills matrix.
- Training records (e.g. certificates and records of attendance).
- Skill currency and requirement for retraining.

Reference to these systems, including the records kept and the review processes, should be made in the RWMS document.

The recycled water supplier must ensure that contractors meet the requirements of this element. Induction is one of the initial steps a recycled water supplier can take in informing staff and contractors of recycled water quality awareness. A good induction package should include a simple assessment to ensure that the reader of the materials has not only read the information, but also understands the content and the implications.

The recycled water supplier must also ensure the recipients are meeting the training obligations in their user agreement as discussed in Element 1.

3.7.1 Employee awareness

The RWMS must record how the recycled water supplier improves and maintains employees' awareness of recycled water quality issues. Mechanisms for raising awareness include:

- 'Toolbox' meeting plan and minutes
- Regional Organisations of Councils and Alliance workshops and training
- NSW Health workshops
- NOW training courses and update seminars
- Conferences and publications by industry bodies for example NSW Water Directorate, Australian Water Association and Water Industry Operators Association
- Contractor management policies.

3.8 Element 8: Community involvement and awareness

It is important that the recycled water supplier consults with its consumers/community, to ensure that recycled water quality decisions are aligned, wherever possible, with the community's desired outcomes.

Consultation with recipients of recycled water, stakeholders (e.g. buyers of irrigated produce) and the general community is an essential component of the development of recycled water schemes, and needs to be started as early as possible. Public and stakeholder concerns can be very powerful, and can mean the difference between acceptance and rejection of recycled water schemes. Any issues raised during the consultation process must be addressed.

What needs to be done:

- The water supplier must record in the RWMS document how it engages with the community on recycled water quality issues. The level of engagement will be system specific.

3.8.1 Community consultation

Chapter 6 of the AGWR provides advice on engaging with the community regarding recycled water.

For NSW utilities some examples of where community engagement for prospective recycled water projects may be required include:

- Strategic Business Planning, which requires regular consultation with the community in the preparation of the plan and the proposed levels of service.
- Integrated Water Cycle Management (IWCM) Strategy development which requires the community to be involved from the inception of an IWCM study.

Strategic Business Planning and an Integrated Water Cycle Management (IWCM) Strategy are requirements of the *Best Practice Management of Water and Sewerage Guidelines 2007*. At the time of writing, the *NSW Water and Sewerage Community Involvement Guidelines* were being finalised by the NSW Office of Water. The finalised Guidelines should be consulted.

The International Association for Public Participation (IAP2) provides information and tools for community engagement including a spectrum of engagement and a toolbox outlining different engagement tools (weblink).

3.8.2 Recipient consultation

Where recycled water is supplied to major customers, a recipient engagement program should be developed. This engagement program should consider:

- recipient implementation and on-going costs (e.g. compliance with plumbing and signage requirements of AS/NZS 3500)
- the establishment of levels of service and performance
- on-site controls
- restrictions
- safeguards.

Recipients of recycled water should also be consulted on monitoring requirements and mechanisms for reporting system performance.

Community consultation, including end use identification and assessment, is a fundamental component of the IWCM process and is included through:

- **Evaluation of Integrated Water Cycle Management Scenarios:** Information on social considerations is taken into account in the scenario assessments (NSW Office of Water, undated).
- **Project Reference Group (PRG):** comprises key stakeholders that assist the IWCM process in developing a workable long-term urban water service strategy. The PRG facilitates community involvement in identifying problems and evaluating solutions (NSW Office of Water, 2010).

3.8.3 Community education

The level of community education required when implementing a RWMS will depend upon the end uses for the recycled water and the locations where it is used. Chapter 6 of the AGWR provides methods for coordinating and disseminating information for community education. Social media is also increasingly being used as a communication and engagement tool by recycled water suppliers. The RWMS document should state the water supplier's community engagement program.

In dual reticulation areas supplying recycled water an active education program should be developed for specific groups e.g. plumbers, doctors & pharmacists. A consumers' education program to explain the quality difference between the two systems and encouraging consumers to check for cross connections on their property is essential.

3.8.4 Community communication protocols

Where recycled water use may have a public health or environmental impact, the recycled water supplier should consider various situations that may impact on the community. Protocols should be developed for communicating with all sectors of the community during these situations. Plan the practicality of ensuring that the community is effectively informed, for example contingencies for door knocking, signage and preworded advice notices.

3.8.5 Consumer feedback and water quality complaints

A call centre provides the opportunity for the community to provide feedback. Informal feedback regarding recycled water quality also occurs, particularly in smaller communities. It is important that employees are trained to document this information. For any system where recycled water is transported in proximity to town water complaints regarding water quality must be taken very seriously and the potential for cross connection must be considered when prioritising calls.

A recycled water quality complaint refers to an 'expression of dissatisfaction' made to the organisation (AS ISO 10002-2006). Utilities need to carefully report complaints on this basis. Customer queries or any 'other customer feedback' where the customer 'is not dissatisfied' must be documented separately as 'other consumer feedback' and excluded from the record of 'water quality complaints'.

Social media comments should also be tracked as a source of feedback.

Table 19. Areas of community engagement and education

Topics	Program / Information Source
Conservation	Water week 'We all use water' School programs
Source (influent) Protection	drumMUSTER / ChemCollect IWCM Local paper Council news
Water Quality / Levels of Service	Water bill notice IWCM SBP School programs
Compliance	Trade waste program / backflow prevention
End use identification and assessment	IWCM Information Sheets 4 and 6

3.9 Element 9: Research and development

The purpose of this element is to understand the recycled water quality issues or factors associated with continual improvement in the delivery of a safe, quality water supply. Validation of processes and design of equipment, investigative studies and research monitoring can all contribute to the requirement of this element.

Validation involves evaluating available scientific and technical information (including historical data and operational experience) and, where necessary, undertaking investigations to validate system-specific operational procedures, critical limits and target criteria (See the [Validation & Verification information sheet](#)).

The aim of process validation is to ensure effective operation and control of the recycled water system. Validation is particularly important for innovative hazard-control processes and for schemes involving relatively high exposures (e.g. residential use). In these cases, validation may be divided into stages, starting with evaluation of existing information, followed by pilot trials and pre-commissioning testing of full-scale plants.

Pilot trials and pre-commissioning normally incorporate water quality monitoring. In some cases, validation may include evaluation of specific end-use restrictions for human health or environmental protection. Seasonal variations should be considered in designing validation programs.

What needs to be done:

- Review Risk Assessment outcomes for actions to investigate recycled water quality or improve knowledge of the system.
- A program to validate / verify the initial operation of the recycled water plant must be developed, submitted to NOW and implemented.
- In the RWMS document, record all water quality investigations in which the recycled water supplier is involved.
- In the RWMS document, record the processes for equipment and plant validation.
- Confirm the disinfection C.t where chlorine / chloramine is used as the primary disinfectant.

3.9.1 Validation of processes

To ensure that STPs and the recycled water scheme are fit for purpose, robust and cost-effective, a local water utility requires NSW Office of Water's approval under s60 of the *Local Government Act 1993* (NSW) to treat the sewage or supply to any person (including recycled water). The Office of Water inspector may also direct corrective actions to be undertaken under Section 61 of the *Local Government Act*. These actions should be carried out after consultation with the local Public Health Unit and NSW Office of Water.

See the [Validation & Verification information sheet](#) and Section 2.9 and 5.2.3 of the AGWR provide advice on validation monitoring.

3.9.2 Design of equipment

Research and development should be undertaken when designing new equipment and infrastructure, or when implementing design changes to improve plant performance and control systems. New technologies require pilot-scale research and evaluation before full-scale

implementation. Design specifications should be established to ensure that new equipment is able to meet the intended requirements and provide necessary process flexibility and controllability.

Other considerations for ensuring the reliability of recycled water treatment systems include designing equipment and facilities to withstand natural disasters (e.g. earthquakes and flooding), and providing backup systems for emergency use (e.g. alternative power generation).

Appropriate consideration of these factors during the design phase will reduce the risk that equipment failures will cause major disruptions in service, or pose risks to the health of humans or the environment. HAZOP (Hazard and Operability) and CHAIR workshops should be undertaken during the design stages to ensure designers, builders, asset owners and operators have considered plant safety, operability, maintainability and constructability in the design stages. Some of these reliability and operability considerations are taken into account when NOW assesses sewerage design for s60 approval.

A separate s60 approval is required for any significant modification to the STP. The specific approval process (weblink) depends on whether the modification will be undertaken as a design and construct or as a detailed design.

3.9.3 Investigative programs

Recycled water suppliers may conduct investigative programs to better understand and characterise their system. Programs may include treated or finished water investigative monitoring or targeted reticulation monitoring programs or receiving environment studies. NOW may provide advice (or directly via a *Local Government Act 1993* (NSW) Section 61 Corrective Action) on monitoring programs.

3.10 Element 10: Documentation and reporting

Managing documents and records is essential to ensure that all information relevant to the recycled water supply system can be stored effectively and retrieved as required as well as ensuring that all participants in the recycled water system are operating from the most current of procedures, rules and standards.

Documentation should:

- *demonstrate that a systematic approach is established and is implemented effectively*
- *develop and protect the organisation's knowledge base*
- *provide an accountability mechanism and tool*
- *satisfy regulatory requirements*
- *facilitate reviews and audits by providing written evidence of the system*
- *establish due diligence and credibility.*

Documentation provides a basis for effective communication within the organisation, as well as with the community and various stakeholders. A system of regular reporting, both internal and external, is important for ensuring that the relevant people receive the information needed to make informed decisions about the management or regulation of recycled water quality and the system (from source to recipient).

What needs to be done:

- Record in the RWMS document the record keeping procedures and systems to be used by the recycled water supplier.
- Record how monitoring results (operational monitoring, incidents and emergencies and recycled water quality review) and responses are to be reported to management and external parties.

3.10.1 Documentation

Documentation in this context refers to the formalisation of the information required by this guidance. Documentation should be visible and readily available to operators and recycled water recipients, where required. Mechanisms should be established to ensure that operators and recycled water recipients read, understand and adhere to the appropriate documents.

A document-control system should be developed to ensure that only the most recent version of an appropriately approved document is in use. Operational documents should have a formal schedule for review. Documents should have version control to make sure everyone using the documents has the latest version. The most important areas for documentation review are:

- Emergency contact lists. These should be reviewed every three months.
- CCP procedures for operation and monitoring. These should be regularly updated to reflect what the operators are doing (if the changes are appropriate).

Regular review of documentation ensures the retention of corporate memory. This is especially important for those recycled water suppliers that have difficulty retaining staff and those with an aging workforce.

Procedures should define the activities for which records need to be kept. Records provide evidence that activities have been performed or that results have been achieved. They may document traceability, provide evidence of verification or that preventive or corrective actions

have been undertaken. Recycled water suppliers have a range of obligations for record keeping. Examples are provided in Table 20.

Table 20. Data management obligations.

Obligation	Information
State Records Act 1998 (NSW)	Councils, County Councils and bodies classified as a public office have record keeping obligations. See: Part 2-records management responsibilities of public offices.
NSW Performance Monitoring System	Annual reporting of water supply and sewerage system performance, including recycled water volumes produced, required under the <i>NSW Best-Practice Management Framework</i> and the National Water Initiative. Independent auditing of reported data is required for the larger local water utilities which are reported in the annual National Performance Report for Urban Water Utilities (weblink)
Organisation's governance policy	As documented in the policy.

Recycled water suppliers manage their records through a range of systems (Table 21). Data collection or testing records should include, either by signature or if electronic by name, who took the reading or measurement.

Operational data should be stored in a format where it can be reviewed and accessed. Physical testing and operational monitoring information should be stored electronically in a spreadsheet or water quality database (even if it is collected in log sheets and log books). Electronic storage allows the information to be backed up and reviewed by others.

Table 21. Types of recycled water supplier records.

Source	Information Held
Council/recycled water supplier record management system / quality management system	Correspondence, reports
Laboratory Information Management System	Recycled water quality data
Recycled water supplier water quality database	Recycled water quality data
Asset Management System	Asset condition and replacement schedule
Geographic Information System (GIS)	Asset types, characteristics including locations
Accident and incident register	Environmental spills and water quality incidents
Consumer request management system	Consumer/ recipient issues
Operator log books	Daily operational data and activities
Contractor reports	Specialist contractor reports e.g. reservoir inspections
Recipient register	Recipient agreements including contact details of recipient, end use, agreed supply volume, audit records.
Training register	Training records

All staff must be trained in keeping records and ensure record keeping is undertaken. This should be documented as part of Element 7.

Suppliers must ensure that information is recorded and maintained in a way that provides easy access for reporting requirements, for example NSW Performance Monitoring System, see *NSW Benchmarking Reports* (weblink).

The RWMS document should reference the document control and record keeping systems.

3.10.2 Reporting

Clear reporting is an essential component of communication. Reporting responsibilities should be included in job descriptions and procedures. Types of reporting include:

- Line management reporting of monitoring results (Element 3, 4, 5 and 9) and documented responses to noted issues (Element 12).

Reporting of incidents and emergency response (Element 6, see A single Incident and Emergency Response Plan (IERP) could be prepared where the Plan incorporates all the relevant obligations of the Pollution Incident Response Management Plan (PIRMP) required by the *Protection of the Environment Operations Act (1997)*.

- Table 18 Recycled water quality reviews (Element 2, 11) and documented responses to noted issues (Element 12).

Annual reporting to NOW is a standard condition of approval. In general, annual returns should contain a statement of compliance and a monitoring summary. Any anomalies, exceedances or gaps in monitoring should be accompanied with appropriate explanation. The returns should also identify any amendments to documents listed in the approval.

An annual report should be prepared for the LWU and provided to the regulatory authorities, considering the following outline of content:

1. Scheme summary
2. Water quality review
3. Critical control points and critical limits
4. Critical limit exceedances
5. Incident log and follow up
6. Site audit summary
7. Water volumes
8. Site monitoring
9. Review of improvement plan
10. Review of RWMS implementation

Appendix A – Water quality tables and graphs

Appendix B - Internal audit report

Examples of external reporting required in NSW are shown in Table 22.

Table 22. External reporting of recycled water performance in NSW

Item	Aspect
EPA licence	EPL monitoring points and results to be published on recycled water suppliers' websites.
NSW Water Supply and Sewerage Performance Monitoring Report	Recycled water quality management aspects. Recycled water quality compliance. NSW Best-Practice Framework: IWCM implementation – specifically in relation to recycled water supply.
NSW Water Supply and Sewerage Benchmarking Reports	Categorisation of water supply public health incidents.
NSW Water Supply and Sewerage Strategic Business Planning Guidelines	Utilities are required to report on the implementation of recommendations by NSW Office of Water with regard to section 61 of the <i>Local Government Act 1993 (NSW)</i> .
State of Environment Report	Recycled water volumes

The recycled water supplier may consider providing relevant water quality information to the community, which can be evaluated through the community consultation program (Element 8). This could be in the form of a publically available, annual water quality report (NSW Water Supply and Sewerage Benchmarking Reports).

Annual reporting can be aligned with other regulatory reporting obligations.

3.11 Element 11: Evaluation and audit

Systematic assessment of a recycled water supply's water quality results, including auditing how recycled water quality is being managed, is important in determining how effective current management practices are and whether new strategies and measures need to be considered. Fundamental to this overall process is an understanding of how a recycled water supply rates in terms of identified standards and guidelines, and facilitates the setting of benchmarks in relation to similar supplies and circumstances.

Long-term evaluation of recycled water quality results and audit of recycled water quality management are required to determine whether preventive strategies are effective and whether they are being implemented appropriately.

This long-term evaluation allows performance to be measured against objectives and helps to identify opportunities for improvement.

What needs to be done:

- Record the processes by which the recycled water supplier undertakes long-term evaluation of its recycled water quality data and records actions for whether improvements are required in the RWMS document.
- The recycled water supplier should record how it satisfies the internal and external auditing requirements of this element including a schedule for internal and external audits.

3.11.1 Long term evaluation of results

The recycled water supplier should review data on how well its system is performing. This evaluation should be undertaken prior to the annual review of the improvement plan (see Element 12), annual budgeting process and the strategic planning process. As a minimum review the following areas:

- Performance of critical control points.
- Water quality data (influent, treated and distribution recycled water quality including both operational and laboratory data).
- Levels of service (including user requests).

Reviews should be against the identified log reduction requirements, critical limits, design requirements, levels of service, NSW Water Supply and Sewerage Performance Monitoring reports and other regulatory requirements (Element 1). Shortcomings should be captured in the Improvement Plan (Element 12) and financial planning process.

3.11.2 Audit of the recycled water management system

Recycled water suppliers should establish a system of internal and external audits. Table 23 is a recommended schedule for internal audits.

Table 23. Internal audit frequency requirements

Item	Minimum Audit Frequency
Audit of equipment and instrumentation calibration	3 monthly
Audit of preventative maintenance	Annual
Audit of operational monitoring This should include a review of the water quality results and an audit of CCP limits and any excursions. Audit that the appropriate action was undertaken to prevent future excursions of this nature.	Monthly
Recipient complying with agreements (desktop and on-site) particularly in relation to the application of on-site control measures and in assessment of on-site impacts.	Annually
Improvement Plan	Annually
Review of investigative programs	Annually
Backflow prevention (where recycled water is supplied to sites that are also supplied with town water)	Annually

Internal audits should initially focus on:

- Implementation of CCPs and documented responses including investigative follow-ups to any exceedances and near hits.
- Progress of implementation of improvements and actions (Element 12).
- Record keeping of day-to-day monitoring.
- Data required for the NSW Performance Monitoring System.

3.11.3 External audits

The frequency of external audit of the RWMS should be determined in consultation with NOW and local Public Health Unit. Audits must be carried out by an independent auditor approved by NOW. The auditor must consider all relevant records including NOW and Public Health Unit inspections or reports.

NOW inspectors and local Public Health Unit Environmental Health Officers may undertake external checks of aspects of the RWMS and keep records of these checks, for example whether Critical Control Points are implemented correctly. Corrective actions may need to be carried out under section 61(1)(b) of the *Local Government Act 1993*.

Local water utilities with over 10,000 connected properties must arrange auditing of their core performance indicators in accordance with the auditing requirements of the National Performance Framework.

3.12 Element 12: Review and continual improvement

Review by the senior executive is fundamental to continually improving recycled water quality and consistently delivering a safe, quality recycled water supply. Essential to this commitment is the need to assign resources to ensure the delivery and continual improvement of recycled water supply services from a quality and safety perspective. Senior managers should regularly review their approach to recycled water quality management, develop action plans and commit the resources necessary to improve operational processes and overall recycled water quality.

An improvement plan should be developed to address identified needs. Improvement plans can be short term (e.g. one year) or long term. Short-term improvements might include actions such as improving on-site audit programs, increasing staffing and developing community awareness programs. Long-term capital works projects could include increasing storage capacity, extending distribution systems, or improving treatment processes for higher exposure users.

What needs to be done:

- Recycled water suppliers should review the effectiveness of the management system and its implementation, at least annually, to ensure that it maintains currency with the recycled water system. A record of this review and actions arising from the review should be kept.
- A complete review of all management systems should occur every four years in line with the review of the Strategic Business Plan.
- The scheduled dates for these reviews should be included in the RWMS document.

3.12.1 Keeping the RWMS current and senior executive review

Recycled water suppliers should review the effectiveness of the management system and its implementation, at least annually, to ensure that it maintains currency with the recycled water system. A record of this review and actions arising from the review should be kept.

Where significant changes to the recycled water scheme are proposed, a review of the relevant areas of the management system should occur, for example for an additional use, undertake a risk assessment and review CCPs.

Reviews of the effectiveness of the recycled water management systems can be undertaken through the mechanisms shown in Table 24. It is important that records are kept to show that a senior executive review has been undertaken and that recycled water quality issues have been communicated and followed up for action.

Table 24. Information that can be used to help fulfil senior executive review requirements.

Source	Information Reviewed	Documentation
Recycled Water Quality Reports to Council	Sewage / recycled water quality exceedances (where there is a dual reticulation supply, drinking water quality should also be reviewed to check for cross connections). Recycled water quality incidents CCP exceedances and near hits. Consumer Information	Minutes of Council meeting and Senior Executive Team Meetings.

Source	Information Reviewed	Documentation
	Requests and recycled water quality complaints.	
Review of effectiveness of Recycled Water Management System	Report on the review and whether improvements are warranted.	Report on findings and recommendations of the review
Strategic Business Plan	Capital Improvement Program. Operational Expenditure. Asset Management Plan.	Adopted SBP, evidence of progress in implementing the adopted SBP. Best practice audits.
Investigative Studies	Options for recycled water quality improvements.	Reports of the investigation and documentation that they had been communicated to senior management.

3.12.2 Continuous improvement plan

A recycled water quality management Improvement Plan documents any actions required to improve water quality. Improvement plans should include objectives, actions to be taken, accountability, timelines and reporting.

Details for each action should include:

- who is responsible
- date for completion
- progress reporting.

Improvement plans should be communicated throughout the organisation and to the community, regulators and other agencies.

Progress against the Improvement Plan should be reviewed on a monthly basis. The actions within the plan should be reviewed as part of the budgeting and strategic planning process. Progress against the Improvement Plan will be a key area of auditing focus.

3.12.3 Developing an improvement plan

Actions can be identified from a range of sources including:

- Areas of improvement identified when developing or reviewing the recycled water management system, including:
 - Actions from the Risk Assessment (Element 2 and 3).
 - The recycled water supplier's Continuous Improvement System.
- *Local Government Act 1993* (NSW) section 61(1)(b) Corrective Actions.

4 References and further reading

- AGWQMR (2000) *Australian Guidelines for Water Quality Monitoring and Reporting*, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (website). ISBN 0 642 19562 5
- AS/NZS 3500 Plumbing and Drainage (current edition).
- Australian Water Association (website)
- Shamarie Black , Jeanette A. Thurston & Charles P. Gerba (2009) *Determination of Ct values for chlorine of resistant enteroviruses*, Journal of Environmental Science and Health, Part A: Toxic/Hazardous Substances and Environmental Engineering, 44:4, 336-339.
- Department of Energy, Utilities and Sustainability (2004) *Integrated Water Cycle Management Guidelines for NSW Local Water Utilities* (website) ISBN 0 7347 5205 9
- Department of Environment and Conservation (2004), *Environmental Guidelines: Use of effluent by irrigation* (weblink), NSW Department of Environment and Conservation.
- Department of Primary Industries Office of Water (2014) *IWCM Strategy Check List* (website)
- Department of Premier and Cabinet (2010) *Planning and Reporting Guidelines for local government in NSW* (website) (2010), Version 1, NSW Division of Local Government ISBN 1 920766 84 7
- International Association for Public Participation (IAP2) *information and tools for community engagement* (website)
- Smart Water Fund. Alexandra Keegan, Satiya Wati & Bret Robinson. (2012). *Chlor(am)ine disinfection of human pathogenic viruses in recycled waters*.
- Local Government Act 1993* (website) (NSW)
- National Water Commission 2011-12 National Performance Framework: urban performance reporting indicators and definitions handbook, and auditing requirements (website)
- NSW Department of Primary Industries (2004) *Landform and soil requirements for biosolids and effluent reuse* (weblink)
- NSW Office of Water (2011) *Best-Practice Management of Water Supply and Sewerage Framework* (weblink)
- NSW Office of Water (2007) *Best-Practice Management of Water Supply and Sewerage Guidelines* (weblink)
- NSW Office of Water (2011) *NSW Water and Sewerage Strategic Business Planning Guidelines* (weblink)
- NSW Office of Water Performance Reporting Form (via the Performance Monitoring Database) (weblink)

NSW Office of Water – Wastewater Treatment Operator Training Courses (weblink).
NSW Office of Water (undated) Evaluation of Integrated Water Cycle Management Scenarios. Information Sheet 6 (weblink).

NSW Office of Water (undated) The role and purpose of the Project Reference Group. Information Sheet 4 (weblink).

NSW Water Directorate Business Continuity Management Guidelines (weblink).

NSW Water Supply and Sewerage Benchmarking Reports (weblink)

NSW Water Supply and Sewerage Performance Monitoring Reports (weblink) (includes TBL reporting)

NWP07 National Water Training Package (weblink) Version 2

Protection of the Environment Administration Act 1991 (weblink) (NSW)

Protection of the Environment Operations Act 1997 (weblink) (NSW)

Public Health Act 2010 (weblink) (NSW)

State Records Act 1998 (weblink) (NSW)

Smeets P, Rietveld L, Hijnen W, Medema G, Strenstrom T, (2006) *Efficacy of water treatment processes*

Water Industry Operators Association (weblink)

Water Management Act 2000 (NSW) (weblink)

Appendix A Preliminary Section 60 Checklist

This checklist is the preliminary checklist to be used in the early engagement stage of developing a RWMS. To submit a full application please use checklist in Appendix B.

General	
Utility name & contact person/s	<input type="checkbox"/>
Recycled water scheme name & contact person/s	<input type="checkbox"/>
Treatment	
Description of treatment works and all process units (see table below)	<input type="checkbox"/>
Description of monitoring regime (parameters, frequency, limits, responsibility, critical control points)	
Monitoring data (summarised; up to 1 year if available. N/A for new sewage treatment systems)	<input type="checkbox"/>
Scheme flow diagram – attach diagram and show monitoring points	<input type="checkbox"/>
Map - showing STP, any storage facilities, end use(s) & surrounding land use(s)	<input type="checkbox"/>
Management of off-specification water	<input type="checkbox"/>
End Use	
Description of recycled water end uses (number & type of uses and recipients; indicate if any 3rd party)	<input type="checkbox"/>
Any storage or mixing with other water sources prior to reuse	<input type="checkbox"/>
Type of irrigation system (where applicable)	<input type="checkbox"/>
Crops irrigated (where applicable)	<input type="checkbox"/>
Contingency for non-supply or demand (eg. off spec water, wet weather or storage full)	<input type="checkbox"/>
Description of any non-treatment barriers or controls at end use site (see table below)	<input type="checkbox"/>
Treatment barriers	
Primary treatment	<input type="checkbox"/>
Secondary treatment	<input type="checkbox"/>
Dual media filtration with coagulation	<input type="checkbox"/>
Membrane filtration	<input type="checkbox"/>
Reverse osmosis	<input type="checkbox"/>
Lagoon storage (include detention time)	<input type="checkbox"/>
Chlorination	<input type="checkbox"/>
Ozonation	<input type="checkbox"/>
UV light	<input type="checkbox"/>
Wetlands – surface flow	<input type="checkbox"/>
Wetlands – subsurface flow	<input type="checkbox"/>
Other (describe)	<input type="checkbox"/>
Non-treatment barriers	
Cooking or processing of produce (identify crop)	<input type="checkbox"/>
Subsurface irrigation of plants/shrubs or grassed areas	<input type="checkbox"/>
Drip irrigation of raised crops with no ground contact (identify crop)	<input type="checkbox"/>
Subsurface irrigation of above ground crops (identify crop)	<input type="checkbox"/>
Drip irrigation of plants/shrubs	<input type="checkbox"/>
Drip irrigation of crops with limited to no ground contact (identify crop)	<input type="checkbox"/>
No public access during irrigation & limited contact after (identify vegetation or crop)	<input type="checkbox"/>
Removal of skin from produce before consumption (identify crop)	<input type="checkbox"/>
Drip irrigation of crops	<input type="checkbox"/>
No public access during irrigation (indicate method & whether passive or active exclusion)	<input type="checkbox"/>
Withholding periods for irrigation of parks/sports grounds (identify number of hours)	<input type="checkbox"/>
Spray drift control (identify method eg. anemometer systems, inward-throwing sprinklers, etc)	<input type="checkbox"/>
Buffer zones (identify distance in m)	<input type="checkbox"/>
Withholding periods — produce (indicate period of time between irrigation & harvest)	<input type="checkbox"/>
Other (describe)	<input type="checkbox"/>

Appendix B Section 60 Checklist

RWMS	CHECKLIST	
SUMMARY	Background/Purpose	<input type="checkbox"/>
	Proposal (treatment, end use and recipients)	<input type="checkbox"/>
	CCPs/Monitoring/Improvements/Protocols	<input type="checkbox"/>
INTRODUCTION AND BACKGROUND	Scope	<input type="checkbox"/>
	Scheme Name	<input type="checkbox"/>
	Applicant	<input type="checkbox"/>
	STP name and address	<input type="checkbox"/>
	STP treatment process/es	<input type="checkbox"/>
	STP EPL details	<input type="checkbox"/>
	Volumes of RW involved	<input type="checkbox"/>
	Number and type of end uses and recipients	<input type="checkbox"/>
	Scheme LRV requirements	<input type="checkbox"/>
	Responsibilities of all parties	<input type="checkbox"/>
	Historical compliance	<input type="checkbox"/>
	AGWR framework	<input type="checkbox"/>
	Document Control	<input type="checkbox"/>
1	ELEMENT 1 COMMITMENT TO RESPONSIBLE USE AND MANAGEMENT OF RECYCLED WATER QUALITY	
1.1 RESPONSIBLE USE OF RECYCLED WATER	Are arrangements with recipients in place including obligations and responsibilities of each party?	<input type="checkbox"/>
	Are scheme management responsibilities identified?	<input type="checkbox"/>
1.2 REGULATORY AND FORMAL REQUIREMENTS	Governance, regulatory and formal requirements identified?	<input type="checkbox"/>
	Responsibilities of agencies, designers, installers, maintainers, operations staff, contractors and recipients identified?	<input type="checkbox"/>
	Planning documents reviewed and recorded?	<input type="checkbox"/>
	Best practice documents in place? (IWCM, SBP)	<input type="checkbox"/>
1.3 PARTNERSHIPS AND ENGAGEMENT OF STAKEHOLDERS (INCLUDING THE PUBLIC)	Has engagement with regulatory agencies, operators and relevant stakeholders (involved in scheme development design, management and risk assessment) identified and undertaken?	<input type="checkbox"/>
1.4 RECYCLED WATER POLICY	Is a recycled water policy included?	<input type="checkbox"/>
2	ELEMENT 2: ASSESSMENT OF THE RECYCLED WATER SYSTEM	
2.1 SOURCE OF RECYCLED WATER, INTENDED USES, RECEIVING ENVIRONMENTS AND ROUTES OF EXPOSURE	Sources	
	All wastewater sources clearly identified?	<input type="checkbox"/>
	Location and current use/s identified?	<input type="checkbox"/>
	Source water quality assessed?	<input type="checkbox"/>
	Any potential hazards or contamination in sewage catchment?	<input type="checkbox"/>
	Trade waste agreements in place?	<input type="checkbox"/>
	Chemical roundups or similar programs?	<input type="checkbox"/>
Quantity of wastewater available from each of the sources identified?	<input type="checkbox"/>	

	Total daily volumetric flow rate indicated?	<input type="checkbox"/>
	Average and peak demand flow rates indicated?	<input type="checkbox"/>
	Uses, Recipients and Receiving Environments	<input type="checkbox"/>
	Number & type of recipients identified (utility & 3rd party recipients)?	<input type="checkbox"/>
	Number and type of end uses identified?	<input type="checkbox"/>
	Are intended end uses covered by AGWR?	<input type="checkbox"/>
	If not, is a separate exposure assessment considering volume and exposure frequency included?	<input type="checkbox"/>
	Site suitability for land-based recycling included?	<input type="checkbox"/>
	LRV targets for proposed uses and LRV estimates included?	<input type="checkbox"/>
2.2 RECYCLED WATER SUPPLY SYSTEM ANALYSIS	Treatment process	
	Trained operators?	<input type="checkbox"/>
	Any process/performance specification or upgrade required?	<input type="checkbox"/>
	If so, any compromise of existing system's capacity to treat?	<input type="checkbox"/>
	Has a separate s60 approval for works been obtained?	<input type="checkbox"/>
	Assessment of total and fluctuations in availability of effluent including bypassing issues and storage capacities	<input type="checkbox"/>
	Any decommissioning or replacing of old components of the system?	<input type="checkbox"/>
	If so, appropriate methodology for removal and disposal?	<input type="checkbox"/>
	Treatment system	
	Verified system flow diagram from source to end use with:	<input type="checkbox"/>
	All treatment steps	<input type="checkbox"/>
	Transfer points	<input type="checkbox"/>
	Discharges	<input type="checkbox"/>
	Recipients	<input type="checkbox"/>
Operational monitoring points identified for CCPs, end use sites & EPL	<input type="checkbox"/>	
Historical compliance?	<input type="checkbox"/>	
2.3 ASSESSMENT OF WATER QUALITY DATA AND CHARACTERISATION	1 year or more water quality data summarised (existing plants)?	<input type="checkbox"/>
	Analysis and review of water quality data included?	<input type="checkbox"/>
	LRV estimates from treatment barriers identified?	<input type="checkbox"/>
	Is the highest public exposure identified?	<input type="checkbox"/>
	Does the LRV match?	<input type="checkbox"/>
	Are AGWR water quality objectives achieved?	<input type="checkbox"/>
2.4 HAZARD IDENTIFICATION AND RISK ASSESSMENT	Risk assessment undertaken?	<input type="checkbox"/>
	Did risk assessment include:	
	Identification of team with diversity of background and expertise	<input type="checkbox"/>
	Identification of hazardous events	<input type="checkbox"/>
	Identification of treatment and non-treatment barriers to reduce exposure	<input type="checkbox"/>
	Assessment of public health, environmental and operational risks?	<input type="checkbox"/>
	Assessment of animal health /livestock risks (as appropriate)	<input type="checkbox"/>
Risk assessment outcomes report included?	<input type="checkbox"/>	

	In the RWMS document, record the details of the risk assessment process and append the Risk Assessment Report	<input type="checkbox"/>
3	ELEMENT 3 PREVENTIVE MEASURES FOR RECYCLED WATER QUALITY MANAGEMENT	
3.1 PREVENTIVE MEASURES AND MULTIPLE BARRIERS	Are preventive measures and non-treatment barriers identified to reduce exposure?	<input type="checkbox"/>
	Are they required to achieve LRV?	<input type="checkbox"/>
	Are responsibilities and protocols in place for them?	<input type="checkbox"/>
	Does monitoring frequency of the measures and barriers match the speed with which they can fail?	<input type="checkbox"/>
3.2 CRITICAL CONTROL POINTS	Are CCPs based on risk assessment findings?	<input type="checkbox"/>
	Can CCPs be measured and actioned in a timely manner?	<input type="checkbox"/>
	Do CCPs include monitoring requirements?	<input type="checkbox"/>
	Do CCPs have critical limits set and associated actions?	<input type="checkbox"/>
	Will supply to recipient be stopped if critical limits are exceeded?	<input type="checkbox"/>
	Is monitoring frequency in line with the speed of barrier failure?	<input type="checkbox"/>
	Are Ct calculations included (if chlorination is a CCP)?	<input type="checkbox"/>
	Have CCP procedures been documented and verified for accuracy on-site with the operators?	<input type="checkbox"/>
	Is CCP information visibly in place at CCP location &/or control room?	<input type="checkbox"/>
4	ELEMENT 4: OPERATIONAL PROCEDURES AND PROCESS CONTROL	
4.1 OPERATIONAL PROCEDURES	Are procedures referenced and available for:	<input type="checkbox"/>
	Managing CCPs?	<input type="checkbox"/>
	Communication protocols for CCP exceedance?	<input type="checkbox"/>
	Operational monitoring and corrections?	<input type="checkbox"/>
	Chemical and equipment procurement, delivery and testing?	<input type="checkbox"/>
	Calibration, operation and maintenance of critical treatment equipment?	<input type="checkbox"/>
	Managing or disposing of off-spec water?	<input type="checkbox"/>
	Communication protocols for supply or demand fluctuations or seasonality?	<input type="checkbox"/>
	Routine (daily/weekly/monthly/yearly) task schedules (at STP and for non-treatment barriers)?	<input type="checkbox"/>
	Do procedures contain responsibilities and authorities and clearly defined communication and notification requirements?	<input type="checkbox"/>
4.2 OPERATIONAL MONITORING	Is an operational monitoring plan referenced or included?	<input type="checkbox"/>
	Does it include monitoring points, analytical parameters, critical limits, frequency and responsible parties for both treatment and non-treatment barriers?	<input type="checkbox"/>
	Does monitoring include water quality and environmental parameters of relevance (eg. soils, groundwater, surface water)?	<input type="checkbox"/>
4.3 OPERATIONAL CORRECTIONS	Are corrective action procedures in place for off-spec operational parameters?	<input type="checkbox"/>
	Are rapid communication systems in place for unexpected events?	<input type="checkbox"/>
4.4 EQUIPMENT CAPABILITY AND MAINTENANCE	Is there a regular equipment inspection, testing, calibration and maintenance program?	<input type="checkbox"/>
4.5 MATERIALS AND CHEMICALS	Are procedures in place for materials and chemical purchase, QA, use, delivery, storage and handling?	<input type="checkbox"/>

5 ELEMENT 5: VERIFICATION OF RECYCLED WATER QUALITY AND ENVIRONMENTAL PERFORMANCE		
5.1 RECYCLED WATER QUALITY MONITORING	Is a verification monitoring schedule or results report included?	<input type="checkbox"/>
	Are contingency arrangements in place for when verification is being conducted?	<input type="checkbox"/>
	Are procedures for sampling and testing documented?	<input type="checkbox"/>
5.2 APPLICATION SITE AND RECEIVING ENVIRONMENT MONITORING	Is a monitoring plan for the receiving environment referenced or included?	<input type="checkbox"/>
	Does it include monitoring points, analytical parameters, critical limits, frequency and responsible parties?	<input type="checkbox"/>
	Are procedures for sampling and testing documented?	<input type="checkbox"/>
5.3 DOCUMENTATION AND RELIABILITY	Has a representative and reliable sampling plan for each characteristic to be monitored, including the location and frequency of sampling, been established or documented?	<input type="checkbox"/>
5.4 SATISFACTION OF USERS OF RECYCLED WATER	Is a complaint & response program for recycled water users referenced?	<input type="checkbox"/>
	Is appropriate training of people responsible for the program included?	<input type="checkbox"/>
	Does the supplier ensure recipients comply with their user agreements?	<input type="checkbox"/>
5.5 SHORT-TERM EVALUATION OF RESULTS	Are procedures in place for the short-term review of monitoring data and satisfaction of recycled water users?	<input type="checkbox"/>
	Have internal and external reporting mechanisms been developed?	<input type="checkbox"/>
5.6 CORRECTIVE RESPONSES	Are procedures for corrective responses to non-conformance or feedback from recycled water users in place?	<input type="checkbox"/>
	Are rapid communication systems in place for unexpected events?	<input type="checkbox"/>
6 ELEMENT 6: MANAGEMENT OF INCIDENTS AND EMERGENCIES		
6.1 COMMUNICATION	Are communication protocols with relevant agencies in place?	<input type="checkbox"/>
	Is a contact list of key people, agencies and businesses included?	<input type="checkbox"/>
	Has a public and media communications strategy been developed?	<input type="checkbox"/>
6.2 INCIDENT AND EMERGENCY RESPONSE PROTOCOLS <i>(Refer to Information Sheet: Public Health Incident Notification and Response)</i>	Public Health	
	Public health incident response protocol, including:	<input type="checkbox"/>
	Contact details of NSW Health EHOs	<input type="checkbox"/>
	Definitions of potential incidents and when to contact EHOs (eg. illness complaints, drinking water cross connections, inadvertent exposure of recycled water to the public)	<input type="checkbox"/>
	Was NSW Health consulted in protocol development?	<input type="checkbox"/>
	Are employees trained and emergency response plans regularly tested?	<input type="checkbox"/>
	Are protocols periodically reviewed?	<input type="checkbox"/>
	Environmental	
	Is an environmental incident response protocol in place?	<input type="checkbox"/>
	Are potential incidents and emergencies defined?	<input type="checkbox"/>
	Are relevant emergency contacts provided?	<input type="checkbox"/>
	Are employees trained and emergency response plans regularly tested?	<input type="checkbox"/>
Are protocols periodically reviewed?	<input type="checkbox"/>	
7 ELEMENT 7: OPERATOR, CONTRACTOR AND END USER AWARENESS AND TRAINING		
7.1 OPERATOR,	Are mechanisms / communication procedures in place to increase	<input type="checkbox"/>

CONTRACTOR AND END USER AWARENESS AND INVOLVEMENT	operator, contractor and end user awareness of recycled water quality management, and environment and health protection?	
7.2 OPERATOR, CONTRACTOR AND END USER TRAINING	Have training needs for operators, contractors and recycled water recipients been identified?	<input type="checkbox"/>
	Are training resources and support available?	<input type="checkbox"/>
	Are training records kept?	<input type="checkbox"/>
8 ELEMENT 8: COMMUNITY INVOLVEMENT AND AWARENESS		
8.1 CONSULTATION WITH USERS OF RECYCLED WATER AND THE COMMUNITY	Have requirements for effective involvement of users of recycled water and the community been assessed?	<input type="checkbox"/>
	Has a comprehensive strategy for community consultation been developed?	<input type="checkbox"/>
8.2 COMMUNICATION AND EDUCATION	Is a two-way communication program in place to inform users of recycled water and promote awareness of recycled water quality issues (including impacts of unauthorised use and the benefits of use)	<input type="checkbox"/>
9 ELEMENT 9: RESEARCH AND DEVELOPMENT		
9.1 VALIDATION OF PROCESSES	Are processes & procedures validated to ensure effective hazard control?	<input type="checkbox"/>
	Have validation and verification schedules been developed (or results reports included)?	<input type="checkbox"/>
	Are contingency arrangements in place for when validation and/or verification is being conducted?	<input type="checkbox"/>
9.2 DESIGN OF EQUIPMENT	Is the design of new equipment and infrastructure validated?	<input type="checkbox"/>
9.3 INVESTIGATION OF STUDIES AND RESEARCH MONITORING	Are programs in place to increase understanding of the recycled water supply system and improve management of the system?	<input type="checkbox"/>
	Has the disinfection Ct been confirmed (if primary disinfectant)?	<input type="checkbox"/>
10 ELEMENT 10: DOCUMENTATION AND REPORTING		
10.1 MANAGEMENT OF DOCUMENTATION AND RECORDS	Is a document-control system in place?	<input type="checkbox"/>
	Is staff trained to keep records?	<input type="checkbox"/>
	Is documentation reviewed and revised periodically?	<input type="checkbox"/>
10.2 REPORTING	Are effective internal and external reporting procedures in place?	<input type="checkbox"/>
	Will an annual report be produced and available to consumers, regulatory authorities and stakeholders?	<input type="checkbox"/>
11 ELEMENT 11: EVALUATION AND AUDIT		
11.1 LONG TERM EVALUATION OF RESULTS	Will long-term data be documented, collected and evaluated for performance and identification of problems?	<input type="checkbox"/>
11.2 AUDIT OF RECYCLED WATER QUALITY MANAGEMENT	Will internal or external audits be conducted?	<input type="checkbox"/>
	Is frequency indicated?	<input type="checkbox"/>
	Will audit results be documented and communicated?	<input type="checkbox"/>
11 ELEMENT 12: REVIEW AND CONTINUOUS IMPROVEMENT		
12.1 REVIEW BY SENIOR MANAGERS	Will senior managers review the effectiveness of the management system and evaluate the need for change?	<input type="checkbox"/>
12.2 RECYCLED WATER QUALITY MANAGEMENT IMPROVEMENT PLAN	Is an improvement plan included?	<input type="checkbox"/>
	Is the plan communicated and improvements monitored for effectiveness?	<input type="checkbox"/>

APPENDICES (AS APPLICABLE)		
RECYCLED WATER POLICY	Is recycled water policy endorsed by senior management?	<input type="checkbox"/>
	Is it well communicated?	<input type="checkbox"/>
WATER QUALITY DATA REPORT	Does it include sample number, max, min, average, 95 th %ile?	<input type="checkbox"/>
RISK ASSESSMENT SUMMARY REPORT	Does the Risk Assessment Summary Report include:	
	Methodology used?	<input type="checkbox"/>
	List of the risk assessment team?	<input type="checkbox"/>
	Description of the recycled water scheme (from source to end use)?	<input type="checkbox"/>
	Process flow diagram?	<input type="checkbox"/>
	Identification of critical control points and monitoring points?	<input type="checkbox"/>
	Risk register (including hazards, risk rankings and preventive measures)?	<input type="checkbox"/>
	Outcomes/actions/improvements?	<input type="checkbox"/>
END USER AGREEMENT SUMMARY <i>(Refer to Information Sheet: User Agreements)</i>	Does the User Agreement include:	
	Identification of all the recipients?	<input type="checkbox"/>
	Permitted uses	<input type="checkbox"/>
	Responsibilities and obligations of both parties (eg. ongoing monitoring, signage, irrigation management, site controls, reporting, notification protocols etc)	<input type="checkbox"/>
	Contingency arrangements for variability (eg. seasonality) or non-supply/demand (eg. off spec water, wet weather or full storage)?	<input type="checkbox"/>
SITE SUITABILITY AND (ENVIRONMENTAL) MANAGEMENT PLANS	Does the Site Suitability / Management Plan include:	
	Soil/landform suitability assessment?	<input type="checkbox"/>
	Water/nutrient/salinity balances?	<input type="checkbox"/>
	Surplus/deficit of recycled water available for recipients?	<input type="checkbox"/>
	Irrigation stop/start triggers?	<input type="checkbox"/>
	All environmental end points?	<input type="checkbox"/>
	Any sensitive end points?	<input type="checkbox"/>
	EPL in place?	<input type="checkbox"/>
	Contingency arrangements identified for variability in supply/demand (eg. seasonality) or absence of supply/demand (eg. off spec water, wet weather or full storage)?	<input type="checkbox"/>
Environmental protection measures?	<input type="checkbox"/>	
TABLES (AS APPLICABLE)		
<i>Refer to RWMS Template, Guidance and applicable Information Sheets</i>		
CCPS AND PROCEDURES	<i>Refer to RWMS Template, Section 3.4 & Info Sheet 4 Critical Control Points</i>	<input type="checkbox"/>
OCPS AND PROCEDURES	<i>Refer to RWMS Template, Section 3.4 & Info Sheet 5 Types of Monitoring</i>	<input type="checkbox"/>
VALIDATION & VERIFICATION SCHEDULES	<i>Refer to RWMS Template, Section 3.4 & Info Sheet 5 Types of Monitoring</i>	<input type="checkbox"/>
OPERATIONAL MONITORING SCHEDULE/S	<i>Refer to RWMS Template, Section 3.4 & Info Sheet 5 Types of Monitoring</i>	<input type="checkbox"/>
PRELIMINARY AUDIT SCHEDULE/S	<i>Refer to RWMS Template</i>	<input type="checkbox"/>
LOG REDUCTION VALUES	<i>Refer to RWMS Template, Section 3.2 & Info Sheets 2&3 Log Reduction Values</i>	<input type="checkbox"/>

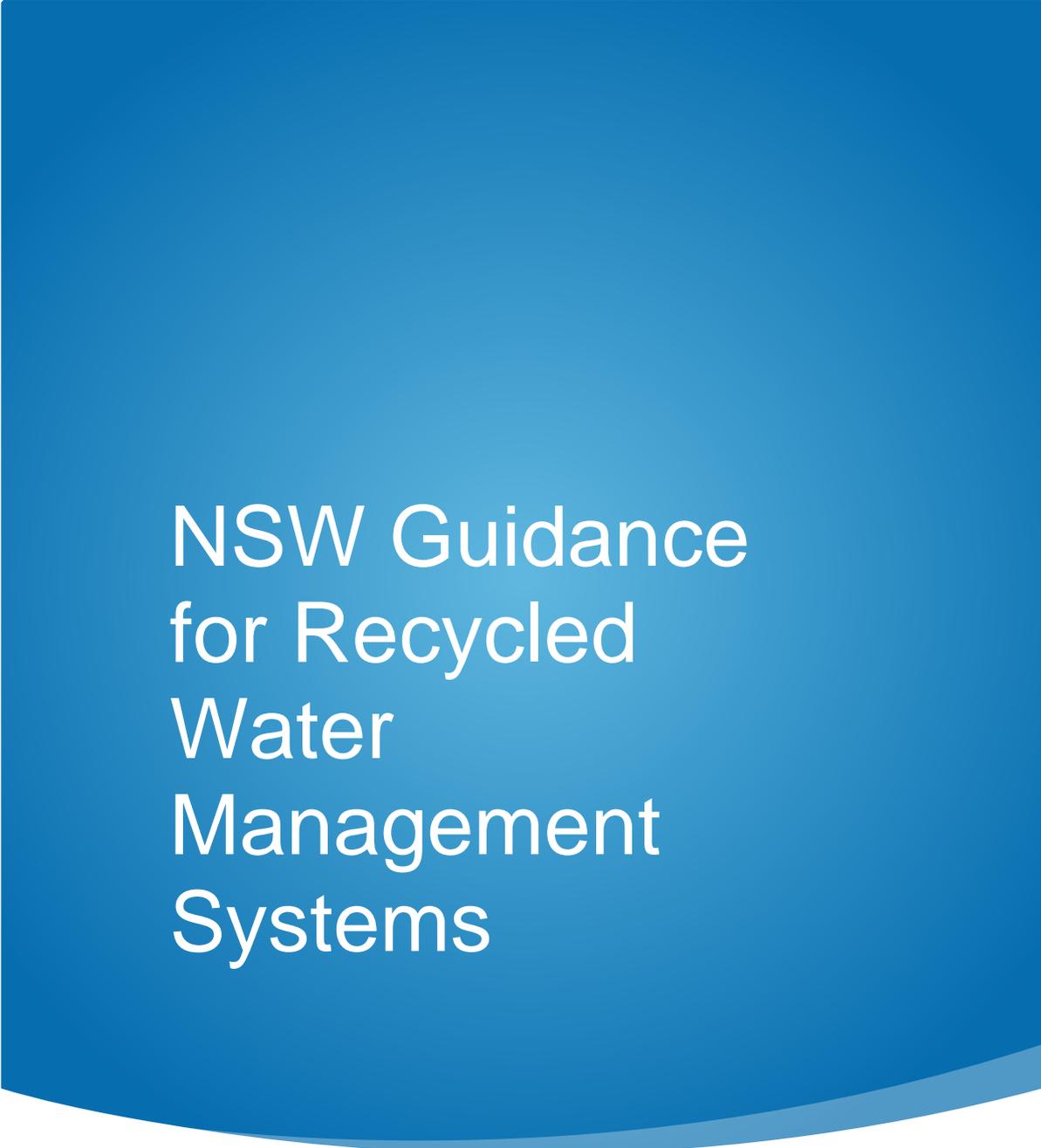
Appendix C Critical Control Point template

CCP – [Enter CCP name]

What is being measured?	
Where/how is it measured?	
What is the control point?	
What are the hazards?	

Target Criterion [enter target here]	Adjustment Limit [enter limit here]	Critical Limit [enter limit here]
<ul style="list-style-type: none">• [Detail procedures here]•	<ul style="list-style-type: none">• [Detail procedures here]•	<ul style="list-style-type: none">• [Details procedures here]•

Appendix D RWMS Template



NSW Guidance for Recycled Water Management Systems

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Element 1 Commitment to responsible use and management of recycled water quality

The AGWR requires the actions listed within the boxes to be addressed to implement its Framework.

Responsible use of recycled water

AGWR Framework Actions:

- Involve agencies (ie stakeholders) with responsibilities and expertise in protection of public and environmental health
- Ensure that design, management and regulation of recycled water schemes is undertaken by agencies and operators with sufficient expertise.

Document the activities that council undertakes that meets the above actions

Regulatory and formal requirements

AGWR Framework Actions:

- Identify and document all relevant regulatory and formal requirements.
- Identify governance of recycled water schemes for individual agencies, designers, installers, operators, maintainers, owners and users of recycled water.
- Ensure that responsibilities are understood and communicated to designers, installers, maintainers, operations employees, contractors and end users.
- Review requirements periodically to reflect any changes.

Document the activities that council undertakes that meets the above actions

Partnerships and engagement of stakeholders (including the public)

AGWR Framework Actions:

- Identify all agencies with responsibilities for water resources and use of recycled water; regularly update the list of relevant agencies.
- Establish partnerships with agencies or organisations as necessary or where this will support the effective management of recycled water schemes.
- Identify all stakeholders (including the public) affecting, or affected by, decisions or activities related to the use of recycled water
- Develop appropriate mechanisms and documentation for stakeholder commitment and involvement

Document the activities that council undertakes that meets the above actions

▪ **Recycled Water Policy**

AGWR Framework Actions:

- Develop a recycled water policy, endorsed by senior managers, to be implemented within an organisation or by participating agencies.
- Ensure that the policy is visible and is communicated, understood and implemented by employees and contractors.

Include the recycled water policy and how this is communicated to staff

Element 2: Assessment of the Recycled Water System

- **Source of recycled water, intended uses, receiving environments and routes of exposure**

AGWR Framework Actions:

- Identify source of water.
- Identify intended uses, routes of exposure, receiving environments, endpoints and effects.
- Consider inadvertent or unauthorised uses

The above points should be addressed in the risk assessment output paper (attached as an appendix) and summarised in this section

- **Recycled water supply system analysis**

AGWR Framework Actions:

- Assemble pertinent information and document key characteristics of the recycled supply system to be considered.
- Assemble a team with appropriate knowledge and expertise.
- Construct a flow diagram of the recycled water supply system from source to the application or receiving environments.
- Periodically review the recycled water system analysis.

The above points should be addressed in the risk assessment output paper. A summary including the flow diagram should be included in this section

▪ **Assessment of water quality data**

AGWR Framework Actions:

- Assemble historical data about sewage, greywater or stormwater quality, as well as data from treatment plants and of recycled water supplied to users; identify gaps and assess reliability of data.
- Assess data (using tools such as control charts and trends analysis), to identify trends and potential problems.

The above points should be addressed in the risk assessment output paper (attached as an appendix) and summarised in this section

▪ **Hazard identification and risk assessment**

AGWR Framework Actions:

- Define the approach and methodology to be used for hazard identification and risk assessment considering both public and ecological health.
- Periodically review & update the hazard identification & risk assessment to incorporate any changes.
- Identify and document hazards, sources and hazardous events for each component of the recycled water system.
- Estimate the level of risk for each identified hazard or hazardous event.
- Consider inadvertent and unauthorised use or discharge.
- Determine significant risks and document priorities for risk management.
- Evaluate the major sources of uncertainty associated with each hazard and hazardous event and consider actions to reduce uncertainty.

The above points should be addressed in the risk assessment output paper (attached as an appendix) and summarised in this section

The log reduction requirements estimates for the scheme should be summarised in the table below

Table 25. Log reduction requirements

	Protozoa (Cryptosporidium)	Virus (Rotavirus / adenovirus)	Bacteria (Campylobacter)
TREATMENT BARRIERS			
Treatment 1			
Treatment 2			
Treatment 3			
Total Treatment LRV			
NON-TREATMENT BARRIERS			
Non-treatment 1			
Non-treatment 2			
Total Non-Treatment LRV			
TOTAL SCHEME LRV			
Required LRV			
Required Water Quality Objective			

Element 3 Preventive Measures for Recycled Water Quality Management

Preventive measures and multiple barriers

AGWR Framework Actions:

- Identify existing preventive measures system wide (including treatment and non-treatment barriers) for each significant hazard or hazardous event, and estimate the residual risk.
- Identify alternative or additional preventive measures that are required to ensure risks are reduced to acceptable levels.
- Document the preventive measures and strategies, addressing each significant risk.

A summary of key preventive measures for the system identified in the risk assessment should be listed in this section.

Critical Control Points

AGWR Framework Actions:

- Assess preventive measures throughout the recycled water system to identify critical control points.
- Establish mechanisms for operational control.
- Document the critical control points, critical limits and target criteria.

The critical control points identified in the risk assessment workshop should be summarised in the table below

Table 26. Critical control points

CCP –

What is being measured?	
Where/how is it measured?	
What is the control point?	
What are the hazards?	

Target Criterion	Adjustment Limit	Critical Limit

Please note: This table can be laminated and used at the CCP location in the STP & included in O&M manual

Element 4: Operational Procedures and Process Control

This section covers the operational procedures and processes that formalise activities essential for ensuring that recycled water of an acceptable quality is consistently provided.

Operational Procedures

AGWR Framework Actions:

- Identify procedures required for all processes and activities applied within the whole recycled water system (source to use).
- Document all procedures and compile into an operations manual

Document the activities that council has undertaken that meets the above actions. Reference may be made to the locations (physical or electronic) where procedures are

Source:

E.g. trade waste

Treatment:

E.g. O&M manual, daily checklist and their location

End Use:

E.g. checks undertaken relating to the recipients and end users

Operational Monitoring

AGWR Framework Actions:

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

Document the activities that council has undertaken that meets the above actions. Reference may be made to the locations (physical or electronic) where information is stored.

Table 27. Operational monitoring schedule for treatment barriers

Parameter	Location	Frequency	Limit / Range	Units	Responsibility

Table 28. Operational monitoring schedule for non-treatment barriers

Non treatment Barrier	What is monitored or observed	Frequency	Responsibility

▪ Operational Corrections

AGWR Framework Actions:

- Establish and document procedures for corrective action where operational parameters are not met.
- Establish rapid communication systems to deal with unexpected events

List documentation relating to corrective actions

▪ Equipment capability and maintenance

AGWR Framework 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.

Document the activities that council undertakes to meet the above actions.

▪ Materials and chemicals

AGWR Framework Actions:

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

Document the activities that council undertakes to meet the above actions

Element 5: Verification of recycled water quality and environmental performance

Recycled water quality monitoring

AGWR Framework Actions:

- Determine the characteristics to be monitored.
- Determine the points at which monitoring will be undertaken.
- Determine the frequency of monitoring

Application site and receiving environment monitoring

AGWR Framework Action:

- Determine the characteristics to be monitored and the points at which monitoring will be undertaken.

Documentation and reliability

AGWR Framework Action:

- Establish and document a sampling plan for each characteristic, including the location and frequency of sampling, ensuring that monitoring data is representative and reliable.

Document the monitoring that council undertakes to meet the above actions. This could be documented in the table below.

Table 29. Recycled water quality monitoring schedule

Parameter	Location	Frequency	Limit / Range	Units	Responsibility

Document the monitoring that council undertakes to meet the above actions. This could be documented in the table below.

Table 30. End user water quality monitoring schedule

Parameter	Location	Frequency	Limit / Range	Units	Responsibility

▪ **Satisfaction of users of recycled water**

AGWR Framework Action:

- Establish an inquiry and response program for users of recycled water, including appropriate training of people responsible for the program.

Document the activities that council undertakes that meets the above actions

▪ **Short-term evaluation of results**

AGWR Framework Actions:

- Establish procedures for the short-term review of monitoring data and satisfaction of users of recycled water.
- Develop reporting mechanisms internally and externally, where required.

Document the activities that council undertakes that meets the above actions

▪ **Corrective responses**

AGWR Framework Actions:

- Establish and document procedures for corrective responses to nonconformance or feedback from users of recycled water.
- Establish rapid communication systems to deal with unexpected events.

Document the activities that council undertakes that meets the above actions

Element 6: Management of incidents and emergencies

The AGWR requires the actions listed within the boxes to implement its Framework.

■ Communication

AGWR Framework Action:

- 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 communications strategy

Document the activities that council undertakes that meets the above actions

■ Incident and emergency response protocols

AGWR Framework Action:

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

Document the activities that council undertakes that meets the above actions

Element 7: Operator, contractor and end user awareness and training

Operator, contractor and end user awareness and involvement

AGWR Framework Action:

- Develop mechanisms and communication procedures to increase operator, contractor and end user awareness of, and participation in, recycled water quality management and environmental protection.

Document the activities that council undertakes that meets the above actions

Operator, contractor and end user training

AGWR Framework Actions:

- Ensure that operators, contractors and end users maintain the appropriate experience and qualifications.
- Identify training needs and ensure resources are available to support training programs
- Document training and maintain records of all training sessions.

Document the activities that council undertakes that meets the above actions

Element 8: Community involvement and awareness

■ Consultation with users of recycled water and the community

AGWR Framework Actions:

- Assess requirements for effective involvement of users of recycled water and the community
- Develop a comprehensive strategy for community consultation

Document the activities that council undertakes that meets the above actions

■ Communication and education

AGWR Framework Actions:

- Develop an active two-way communication program to inform users of recycled water and promote awareness of recycled water quality issues.
- Provide information on the impacts of unauthorised use
- Provide information on the benefits of recycled water use

Document the activities that council undertakes that meets the above actions

Element 9: Research and development

The AGWR requires the actions listed within the boxes to implement its Framework.

■ Validation of processes

AGWR Framework Actions:

- Validate processes and procedures to ensure they control hazards effectively.
- Revalidate processes when variations in conditions occur.

Document the information you have that shows that the process will produce water of appropriate quality. This may include desktop calculations or validation certification

■ Design of equipment

AGWR Framework Actions:

- Validate the design of new equipment and infrastructure to ensure continuing reliability.
- Develop a validation and verification plan

Document the information you have that shows that the equipment will produce water of appropriate quality. This may include desktop calculation for pre-validated equipment. Document the verification plan (and validation plan if required)

■ Investigation of studies and research monitoring

AGWR Framework Action:

- Establish programs to increase understanding of the recycled water supply system, and use this information to improve management of the recycled water supply system.

Document the activities that council will undertake to improve the management of the recycled water system

Element 10: Documentation and reporting

Management of documentation and records

AGWR Framework Actions:

- Document information pertinent to all aspects of recycled water quality management, and develop a document-control system to ensure current versions are in use.
- Establish a records-management system and ensure that employees are trained to complete records.
- Periodically review documentation and revise as necessary

Document the activities that council undertakes that meets the above actions

Reporting

AGWR Framework Actions:

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

• Document the activities that council undertakes that meets the above actions

-

Element 11: Evaluation and audit

The AGWR requires the actions listed within the boxes to implement its Framework.

▪ Long term evaluation of results

AGWR Framework Actions:

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

Document the activities that council undertakes that meets the above actions

▪ Audit of recycled water quality management

AGWR Framework Actions:

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

Document the activities that council undertakes that meets the above actions. A sample audit schedule is shown below.

Table 31. Preliminary internal audit schedule

Item verified	Method	Frequency	Responsibility	Objectives	Reference
Critical control points	Internal audit of operational activities identified in the CCP protocol	Quarterly		Implementation of CCPs and documented responses including investigative follow-ups to any exceedances and near hits	Internal audit findings summary
Critical limit monitoring instruments	Review of calibration testing of critical limit monitoring instruments. Through cross checking	Quarterly ¹		Ensure routine and annual calibration is occurring as scheduled.	Calibration sheets
RWMS	Internal review of all 12 Elements in the RWMS, with a risk based approach to the selection of procedures and processes to be verified.	Annually		Conformity between RWMS and practices	Internal audit findings summary
Improvement Plan	Review progress of improvement actions	Annually		Progress of implementation improvements action plan	Improvements action plan

Element 12: Review and Continuous Improvement

The AGWR requires the actions listed within the boxes to implement its Framework.

▪ Review by senior managers

AGWR Framework Actions:

- Senior managers review the effectiveness of the management system and evaluate the need for change.

Document the activities that council undertakes that meets the above action

▪ Recycled water quality management improvement plan

AGWR Framework Actions:

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

Document the activities that council undertakes that meets the above actions

Appendices

If not included elsewhere in the RWMS, attach the recycled water policy, risk assessment paper, critical control point tables, improvement plan, user agreement summary, site suitability or environmental management plans and any additional supporting information. Use the guidance and the various [information sheets](#) where relevant.