

Code of Practice for Water Recycling

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Disclaimer

The information provided in the Code of practice for water recycling (the Code) is general only and is based upon requirements for the risk management of recycled water schemes in the Northern Territory.

The Code and the information herein does not in any part act as an approval to install a recycled water scheme in the Northern Territory.

The Northern Territory Government accepts no liability for costs or damages to any person or property resulting from the application of the Code.

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Definitions and acronyms

Definition	Full form
ABS	Australian Bureau of Statistics
AGWR	Australian Guidelines for Water Recycling is the primary guidance for recycled water quality and management within Australia.
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.
DEPWS	Department of Environment, Parks and Water Security*
DoH	Department of Health*
DPIR	Department of Primary Industry and Resources*
Dual reticulation	The pipework used to supply recycled water to residences or commercial properties
EC	Electrical Conductivity
EPL	Environment Protection Licence
Framework	Framework for Management of Recycled Water Quality and Use: Recycled water-specific quality assurance framework.
GIS	Geographic Information System
High exposure recycled water scheme	<ul style="list-style-type: none"> • Critical infrastructure scheme for irrigation of public open space • The recycled water is supplied to augment a supply of drinking water via a source supply (e.g. a dam) • The recycled water is supplied to premises by way of a dual reticulation system • the recycled water is supplied for use in irrigating minimally processed food crops
Hydraulic consultant	For wastewater management systems installed outside a building control area: Certifying Engineer (Hydraulic) or Certifying Plumber and Drainer (Design) with experience in wastewater management.
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.
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}).
NWI	National Water Initiative
N	Nitrogen
NTEPA	Northern Territory Environment Protection Authority*
P	Phosphorus

Definition	Full form
PCA	Plumbing Code of Australia
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 referred to in the AGWR
Recycled water supplier	Any supplier of recycled water that requires notification to DoH under the Public and Environmental Health Regulations
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 Recycled Water Management System
RWMS leader	The person responsible for the preparation and oversight of the RWMS
SCADA	Supervisory Control and Data Acquisition
STP	Sewage treatment plant
Water utility	A water utility exercising sewerage supply functions under the <i>Water Supply and Sewerage Services Act</i> . A utility may be a recycled water supplier.
UV	Ultra violet

* These titles may change from time to time

1. Introduction

1.1. Background

Historically, sewage effluent was disposed either via land or water. Interest in the recycling of sewage effluent (i.e. water recycling) 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. Public health risks arising from residential use of recycled water were managed through prescriptive treatment processes which 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.

1.2. What is recycled water?

The term recycled water is commonly taken to mean any sort of wastewater that has been treated for the purpose of beneficial reuse. For the purpose of this part, recycled water applies to sewage or effluent, sourced from a service provider's infrastructure that is intended to be reused. A common example is treated effluent sourced from a water utility's sewage treatment plant that is intended to be reused for municipal irrigation.

1.3. Who is a recycled water provider?

A recycled water provider is an entity that owns infrastructure for the production and supply of recycled water. A recycled water scheme is a scheme involving the production and supply of recycled water and includes the infrastructure, owned by the provider, for the production and supply of recycled water. All recycled water schemes must be registered with DoH in accordance with the Public and Environmental Health Regulations.

The most common examples of recycled water providers are private proponents or water utilities that treat sewage to a level such that it can then be supplied as recycled water for beneficial reuse.

1.4. Health risks posed by the use of recycled water

The health risks posed by the use of recycled water are largely dependent on two key factors: the quality of the recycled water being supplied and the extent to which someone might be exposed to the recycled water.

When recycled water is produced from sewage, there is potential for it to contain a range of disease-causing microorganisms. Many of these microorganisms are enteric pathogens that is pathogens associated with the human gastroenteric system, which can cause serious illness in some people. For this reason, the main exposure of concern for public health is via incidental or accidental swallowing of the recycled water, although some pathogens may also affect the respiratory system, or the ears, eyes or skin.

Potential exposure to recycled water is dependent on the likelihood that a person will come into contact with the water as well as the quantity of recycled water they may unintentionally swallow when they do. These two factors are, in turn, influenced by the use of recycled water and the nature of the on-site exposure controls employed.

Some uses of recycled water are associated with greater potential for exposure than others. For example, people are more likely to come into contact with recycled water when it is used to irrigate public open spaces compared to when it is used to irrigate non-food crops on a farm.

On-site controls are controls employed by the user to reduce potential exposure. They are sometimes referred to as 'non-treatment barriers' and include measures aimed at reducing human exposure. Examples include restricting public access to irrigated areas, employing buffer zones between the area where the recycled water is used and where people may pass by or live, displaying signage that advises the public that recycled water is used in the area, and plumbing controls to prevent cross-connections with potable water supplies (e.g. colour-coded pipes and 'non-potable water' or 'do not drink' labels on taps).

Recycled water schemes typically consist of a recycled water provider and a user or a number of users. The responsibility for ensuring the recycled water is of an appropriate quality falls to the recycled water provider and, operationally, it is the responsibility of the user to ensure the recycled water is only used for appropriate uses and that the necessary on-site controls are implemented and maintained. These responsibilities are discussed in further detail below in the context of the Northern Territory's regulatory requirements.

The risk to human health from chemicals in recycled water provided for low-exposure uses is low. Provided appropriate trade waste arrangements are in place for industrial and commercial customers, controls implemented to address the risks associated with pathogens will ensure that chemicals in recycled water will not present a risk to public health.

1.5. Scope

The Code of Practice for Water Recycling (the Code) is a process document and provides proponents of recycled water schemes with advice on how to demonstrate compliance with the Australian Guidelines for Water Recycling 2006 (AGWR) for low exposure and high exposure recycled water schemes.

The Code does not apply to domestic greywater reuse which is addressed in the Code of Practice for Wastewater Management Guidance notes for wastewater management.

2. Low exposure and high exposure recycled water schemes

DoH recognises that water recycling in the Northern Territory may comprise low exposure or high exposure recycled water schemes. The regulation of recycled water differs depending on how much recycled water a member of the public might be exposed to.

Exposure can be thought of as the quantity of recycled water a person might ingest, incidentally or accidentally, as a result of recycled water being used nearby. The higher the exposure, the greater the risk of adverse health effects.

2.1. Low exposure recycled water scheme

The term 'low exposure' has been used in this part as this covers the uses of recycled water that are generally associated with a low level of exposure.

The most common low exposure uses of recycled water include:

- Irrigation of public open spaces (such as playing fields and parks).
- Irrigation of pasture and fodder crops.
- Irrigation of heavily processed food crops.
- Irrigation of non-food crops.
- Dust suppression on mining or construction sites.

Although there is no regulatory requirement for proponents of low exposure recycled water schemes to have a recycled water management system (RWMS), having an appropriate RWMS can be a useful way of demonstrating compliance with this section.

Proponents of low exposure recycled water schemes must meet with DoH prior to lodgement of a notification of intention to supply recycled water for low exposure use.

2.2. High exposure recycled water scheme

DoH requires that the proponent develop, submit and implement a Recycled Water Management System (RWMS) addressing the 12 elements of the AGWR.

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 DoH as evidence of implementation.

This guidance should be read in conjunction with Chapters 2 to 6, and Appendices 3 to 5 of the AGWR.

High exposure recycled water schemes include supplying recycled water to:

- Augment a supply of drinking water via a source supply (e.g. a dam).
- A development by way of a dual reticulation system.
- Irrigate minimally processed food crops.

3. Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1) (2006)

The introduction of the *Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1) (2006)* 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.

3.1. 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. See section 7.2.4. - Element 4.
- That is unfit for purpose is not supplied to consumers. See section 7.2.6. – Element 6.

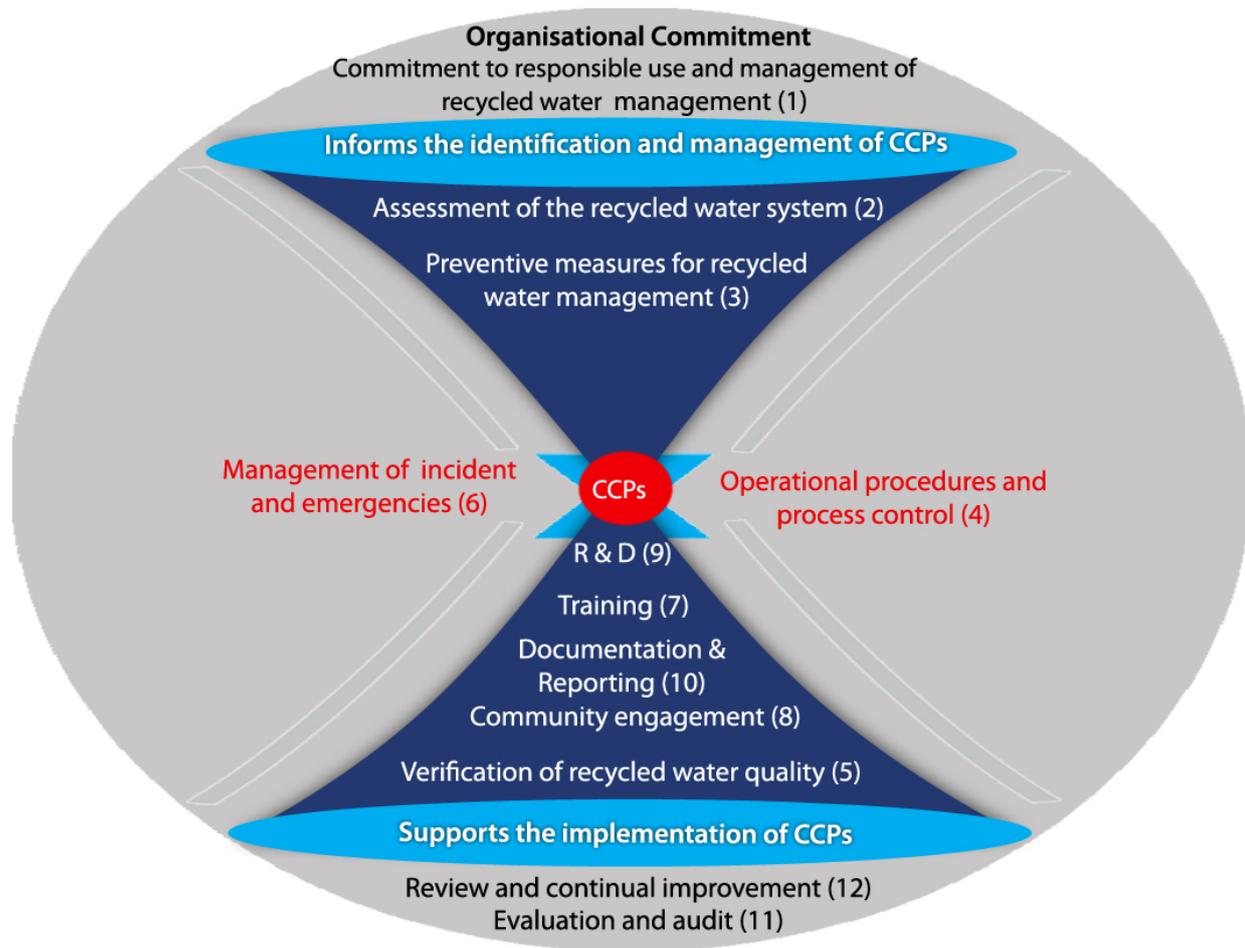
This is managed through critical control points (CCPs). See section 7.2.3. – Element 3 and 'Information sheet – Critical control points' for information in the development and monitoring of CCPs.

The identification and management of CCPs is informed by the assessment of the recycled water supply system. See section 7.2.2. - Element 2 and section 7.2.3– Element 3.

Overarching is the organisational commitment to the responsible use and management of recycled water management. See section 7.2.1. – Element 1.

The Framework, like all management systems is underpinned by evaluation, audit review and continual improvement. See section 7.2.11. – Element 11 and section 7.2.12 – Element 12.

Figure 1: Diagram showing relationship of the Framework Elements



4. Regulatory requirements

4.1.1. Public and Environmental Health Act and Regulations

Under the *Public and Environmental Health Act*, the main regulatory obligation relevant to recycled water providers is that the supply of recycled water does not create a risk to public health.

In cases where an authorised person under the *Public and Environmental Health Act* has determined that the supply of recycled water is causing a public health risk, he or she may issue a 'public health notice' or 'public health order' requiring the recycled water provider to take certain actions to eliminate, or reduce, the risk to public health.

The Public and Environmental Regulations require:

- Providers of low exposure use of recycled water from a wastewater management system need to submit a notification to DoH in the approved form at least 7 days before supplying the recycled water.
- Providers of high exposure use of recycled water from a wastewater management system need to apply to DoH for a high exposure use approval in the approved form.

4.1.2. Building Act and Regulations

Plumbing and drainage works undertaken inside building control areas must comply with the codes adopted under Building Regulation 4. The requirements in the *Building Act 1993* and Regulations apply inside declared building control areas.

The codes referred to in Building Regulation 4 include the Building Code, the Plumbing Code (PCA) and the Code of Practice for Wastewater Management. These codes also refer to Australian Standards which are therefore also technical requirements

For all drainage works being undertaken, the plumber or drainer carrying out drainage works must notify the Director of Building Control (by contacting BAS) of the completion of drainage work prior to covering up those works; and stop carrying out those works if required by the Director of Building Control.

Where plumbing and drainage works are undertaken without other building work (e.g. replacement or upgrades to an existing disposal area) a building permit may not be required. For all drainage works being undertaken, the plumber or drainer carrying out drainage works must notify the Director of Building Control (by contacting Building Advisory Services) of the completion of drainage work prior to covering up those works; and stop carrying out those works if required by the Director of Building Control. This notification will facilitate the creation of a 'Plumbing only permit' associated with the building record. In these circumstances the plumbing and drainage works must be certified by a certifying plumber and drainer, a certifying plumber or drainer (design) or a certifying engineer (hydraulic) and a section 40 certificate of compliance must be submitted to BAS within 7 days after completion of the works to be included on the building record.

If a building permit applies then the recycled water scheme must form part of the approval by a building certifier. Generally, the building certifier will require the installation to be certified by a certifying plumber and drainer or a certifying engineer (hydraulic) and a section 40 certificate of compliance submitted.

4.1.3. Deemed to satisfy solutions

Plumbing and drainage works installed inside building control areas that comply with PCA 'Deemed-to-Satisfy' solutions can be designed and certified by the following building practitioner categories:

- Certifying plumber and drainer.
- Certifying plumber and drainer (design).
- Certifying engineer (hydraulic).

These works can be installed by plumbers and drainers licenced under *the Plumbers and Drainers Licensing Act 1983*.

4.1.4. Performance solutions

All plumbing and drainage works installed Territory-wide (inside and outside Building Control Areas) that do not comply with the PCA 'Deemed-to-Satisfy' solutions must be installed as a performance solution.

Inside building control areas performance solutions must be designed and certified by a certifying engineer (hydraulic).

Outside building control areas performance solutions must be designed and certified by a hydraulic consultant.

Examples of systems requiring performance solutions include:

- Systems to service flow capacity greater than the flow capacity covered by AS/NZS 1547:2012.
- Systems that do not comply with the PCA or Australian Standards.
- Systems that require a number of product approved systems to be used in the design.
- Community wastewater management systems.

Definition: Performance Solution: as per the definition in the PCA and includes Alternative Solution as referred to in the *Building Act 1993* and Regulations.

4.1.5. Waste Management and Pollution Control Act

The *Waste Management and Pollution Control Act 1998* (WMPC Act) provides for the protection of the environment through encouragement of effective waste management and pollution prevention and control practices for related purposes. The legislation establishes the duties of end users of wastewater.

The WMPC Act requires all users of wastewater to comply with the general environmental duty, meaning that they have a responsibility for the actions taken that affect the environment. Activities must not be carried out where they may cause or likely to cause environmental harm, unless all reasonable and practicable measures are taken to prevent or minimise the harm.

For example, a person must take all reasonable measures to ensure that odours from a WMS offensive to the sense of human beings are not being discharged beyond the boundaries of the premises. A person must also take all reasonable measures to ensure that contaminants from a WMS, including nutrients and sediment-laden runoff from a land application system, are not discharged directly or indirectly into drains or watercourses.

4.1.5.1. Duty to notify of environmental incidents

In addition to the general environmental duty, the WMPC Act also imposes the obligation to notify the administering authority and other relevant person where incidents occur that may have caused or threaten to cause serious or material environmental harm.

A person must notify the Northern Territory Environment Protection Authority (NT EPA) if they are undertaking an activity and an incident occurs which causes, or threatens to cause, pollution resulting in material or serious environmental harm.

4.1.5.2. Environment protection licences and approvals

The NT EPA grants environment protection approvals and licences for activities listed in Schedule 2 of the WMPC Act. These activities are associated with the:

- Disposal of waste by burial.
- Listed Waste collecting, transporting, storing, re-cycling, treating or disposing.
- Processing hydrocarbons so as to produce, store and/or despatch liquefied natural gas or methanol.

Environment protection approvals are granted for works associated with the construction phase of these activities and environment protection licenses are granted for the operational phase of the activity.

4.1.6. Water Act

The *Water Act 1992* requires a person conducting an activity which has the potential to prejudice a declared beneficial use, or which may cause waste to come into contact with water, or water to become polluted, to have a waste discharge licence. The Controller of Water Resources has the statutory power to grant waste discharge licenses under section 74 of the *Water Act 1992*.

Waste discharge licences are regulatory instruments used to regulate the quality and quantity of waste discharged to water in the Northern Territory.

With respect to wastewater management, waste discharge licences are most commonly granted for waste discharges associated with sewage treatment or large WMS.

5. Recycled water end-user agreements

A recycled water end-user agreement is a formal agreement between a recycled water provider and an end-user of low-exposure or high-exposure recycled water. An agreement will typically cover a range of matters associated with the supply and use of recycled water but must be prepared in such a way that it helps ensure the public health risks associated with recycled water schemes are managed appropriately.

To assist recycled water providers and users of recycled water, DoH has developed a model recycled water user agreement. The model agreement, and associated guidance material are available on the [Northern Territory Government website](#).

It is mandatory that recycled water providers have recycled water end-user agreements in place with each of their end-users.

5.1. Public health requirements

From a public health perspective, the end-user agreement must set out:

- The class of the recycled water to be supplied.
- The appropriate use(s) of recycled water.
- The on-site controls the end-user must employ to ensure exposure is appropriately managed.

5.2. Environmental requirements

From an environmental perspective, the end-user agreement must set out how the end-user will comply with the general environmental duty and the duty to report pollution incidents, as set out in the WMPC Act.

6. Low exposure recycled water scheme

End-users of low exposure recycled water can minimise any public health and environmental risks associated with recycled water by using it safely. End-users of low exposure recycled water must ensure that they comply with any restrictions on use, as well as any on-site control requirements, set out in a recycled water user agreement. End-users should also notify the recycled water provider when, for whatever reason, they are unable to comply with these requirements.

6.1. When is low exposure recycled water considered a public health risk or 'not fit for use'?

Recycled water is most likely to be categorised as a public health risk or not 'fit for use' when the quality of the recycled water, from a public health perspective, is below that which is required to protect public health. For example, if it is specified in these guidelines that Class A low exposure recycled water is required for a particular use, and the recycled water provider is supplying recycled water that only meets the requirements for Class C low exposure recycled water, this could be considered an offence.

6.2. Managing risks posed by users of low exposure recycled water

Low exposure recycled water schemes are typically comprised of a recycled water provider and a user, or a number of users. This often means that a recycled water provider will not have day to day control over how the recycled water that they supply is used. This could give rise to situations where recycled water is used inappropriately, resulting in a risk to public health. In such cases, the recycled water provider may be held responsible for allowing such a situation to occur, resulting in significant reputational damage.

Furthermore, if the provider is aware that the recycled water is being used inappropriately and they continue to supply recycled water to that user, they may be subject to enforcement action under the *Public and Environmental Health Act*. To reduce the likelihood of this occurring, recycled water providers are strongly encouraged to:

- Restrict how their customers use recycled water via a 'recycled water user agreement' developed in accordance with these guidelines (user agreements are discussed below).
- Cease supply when they become aware of a user using the recycled water for inappropriate uses.

- Undertake periodic inspections, having regard to the conditions set out in the relevant user agreement, to ensure the recycled water is only being used for the agreed uses and with the necessary on-site controls.

With respect to periodic inspections, it is recommended that these inspections be undertaken annually and need only involve inspecting the area(s) where a customer is, or has been, using recycled water to ensure that they are using the recycled water for agreed purposes only and that they are maintaining the necessary on-site controls.

The frequency for these checks could be reduced if the customer has a history of conformity with the agreement or increased where problems have been identified in the past. Recycled water providers should also investigate legitimate reports or complaints of a customer not using the recycled water appropriately. Finally, users should be aware that, no matter what agreements are in place, they are still obliged to meet their requirements under the *Work Health and Safety Act*. This includes ensuring that the health and safety of workers and other people (e.g. members of the public) is not put at risk as a result of any work activities involving the use of recycled water.

6.3. Monitoring

6.3.1. Public health parameters

Recycled water providers must monitor for a range of parameters to operate a wastewater management system in accordance with the Code and the Public and Environmental Health Regulations. From a public health perspective, the key water quality parameter to be monitored is *Escherichia coli* (*E. coli*). This is because *E. coli* provides an indication of the level of disease-causing microorganisms that may be present in the recycled water and the results of analysis can be used to determine compliance with the different classes of recycled water.

It is recommended that samples for *E. coli* be taken weekly by the recycled water provider and submitted for laboratory analysis. The frequency of this 'verification' monitoring may be reduced provided there is sufficient 'operational' monitoring in place to identify deficiencies in treatment in a timely manner (see Table 1 for definitions of operational and verification monitoring). For example, where disinfection is employed, online monitoring of chlorine dosing could form the basis of a decision to reduce the frequency of monitoring for *E. coli*, although this should not be less than monthly.

The frequency of verification monitoring may also be decreased when the recycled water provider has monitoring data showing the required water quality criteria are met reliably under stable operating conditions, and stable operating conditions exist. That is, the monitoring frequency may be reduced during extended periods of dry weather and ordinary flows when a recycled water provider has data showing the relevant standard will be met reliably under these conditions. Again, the monitoring frequency should not be less than monthly and more frequent monitoring should be undertaken at times when recycled water quality may be affected (e.g. during and after significant wet weather events when wastewater treatment efficacy may be reduced).

Table 1: Types of monitoring

Operational monitoring	Verification monitoring
Operational monitoring typically takes place on-site and is undertaken to check whether the recycled water treatment process is working as expected. Operational monitoring provides operators with an opportunity to address recycled water quality in a timely fashion. Examples include monitoring of turbidity immediately post filtration and monitoring of chlorine residual post chlorine dosing.	Verification monitoring typically involves taking a water sample and sending that sample to a laboratory to check that certain recycled water quality criteria have been met. The most common example of verification monitoring is taking a sample of the treated effluent and submitting the sample to a laboratory for <i>E. coli</i> analysis.

E. coli analysis should be undertaken using a methodology that is recognised as valid (such as the membrane filtration method or the most probable number method, which is often abbreviated to the MPN method) and conducted by a laboratory with National Association of Testing Authorities (NATA) accreditation for the analytical method. *E. coli* analysis may be undertaken 'in-house' provided that duplicate or split samples are taken periodically, with the additional sample submitted to a laboratory with NATA accreditation for the analysis.

The results of the NATA accredited laboratory samples should be compared against the results obtained through the in-house test, to ensure the in-house testing methodology is producing accurate results. Regular monitoring of *E. coli* is a very important part of ensuring, and being able to demonstrate, that the recycled water supplied is 'fit for use'.

Table 2: Guideline values for recycled water (for low-exposure uses)

Class of recycled water	Guideline values
Class A+	Less than 1 <i>E. coli</i> cfu / 100mL or less than 1 <i>E. coli</i> MPN / 100mL in at least 95% of samples taken in the previous 12 months
Class A	Less than 10 <i>E. coli</i> cfu / 100mL or less than 10 <i>E. coli</i> MPN / 100mL in at least 95% of samples taken in the previous 12 months
Class B	Less than 100 <i>E. coli</i> cfu / 100mL or less than 100 <i>E. coli</i> MPN / 100mL in at least 95% of samples taken in the previous 12 months
Class C	Less than 1,000 <i>E. coli</i> cfu / 100mL or less than 1,000 <i>E. coli</i> MPN / 100mL in at least 95% of samples taken in the previous 12 months
Class D	Less than 10,000 <i>E. coli</i> cfu / 100mL or less than 10,000 <i>E. coli</i> MPN / 100mL in at least 95% of samples taken in the previous 12 months

A recycled water provider's compliance with the guideline values should be assessed on a monthly basis, having regard to the previous 12 months' results. To assist recycled water providers to undertake these assessments, DoH has prepared a number of Excel spreadsheets – one for each class of recycled water – that can be used to record the details of monitoring and calculate compliance over the preceding 12-month period.

The relevant spreadsheets are available on the [Northern Territory Government website](#).

If a single sample of recycled water fails to meet the guideline values, an investigation should be undertaken to determine the cause of the non-compliance. This should be followed by undertaking any necessary actions to remedy treatment deficiencies and taking a follow-up sample. If, after undertaking an investigation and correcting the treatment process, the follow-up sample is also non-compliant, the

recycled water provider should contact DoH for advice on any measures that may need to be implemented to ensure public health is not jeopardised.

If a recycled water provider fails to meet the 'annual value' (i.e. less than 95% of samples taken in the preceding 12 months meet the relevant standard), the recycled water provider should contact DoH to discuss any measures that may need to be implemented to ensure public health is not jeopardised. This may include improving treatment processes, implementing more rigorous on-site controls, or ceasing the supply of recycled water until appropriate improvement measures can be implemented.

6.3.2. Environmental parameters

Recycled water providers must also consider conducting environmental monitoring to ensure that recycled water quality does not adversely impact the environment or cause environmental harm. For further information, please contact the Northern Territory Environmental Protection Authority (NT EPA).

6.4. Operational reporting and audit

Planning stages, commissioning and ongoing management including methods, data sources, and reasons for decisions should all be recorded. In order to create a history of the recycled water supply and reference material for periodic reviews and audits, certain data must be kept readily accessible. Records are an important aspect of good corporate governance and decisions concerning the making and control of records should take into account:

- Any regulatory requirements.
- The cost of creating and maintaining records.
- The benefits of reusing information.

6.4.1. Record keeping

Document control procedures shall be implemented to ensure that all copies are current and controlled. The types of records that should be kept include:

Table 3: Documentation and recording

Record	Description
Volumes of wastewater	Total water flows to the plant influent
Volumes of recycled water produced	Total recycled water flows shall be recorded for all recycled water delivered to end users (if applicable)
Percentage of recycled water used by end use	Volumes of recycled water used per year for each one of the approved end-uses (if applicable)
Water quality testing	Details of results of analytical testing should be maintained
Online monitoring data	Details of results of operational parameters should be maintained
Operational & maintenance plan	Any check list and maintenance of on system components should be recorded and these records maintained
Complaints	Any complaints should be recorded and these records maintained and reported in DoH annual report
Training	All training activities and list of attendances with the corresponding signatures should be recorded and these records maintained

6.4.2. Annual report

The reporting of monitoring programs, monitoring results, incidents, compliance and maintenance programs is paramount and is required to be submitted to DoH as part of the annual report.

Annual reports shall be submitted to DoH by 30 September each year.

6.4.3. Audit reporting

The scheme manager is responsible for ensuring auditing of the scheme is conducted. The frequency of internal and external audit will depend on the risk level exposure and the conditions of approval to operate the recycling scheme. Internal audit shall occur at least every three years and external audit should occur every five years, when major changes of the scheme are proposed or at the discretion of DoH. Audits will confirm that the management and operational strategies are being adhered to and that any non-compliance or incident has been dealt with in an effective and efficient manner.

6.4.4. Non-compliance reporting

From time to time it may be necessary for the recycling scheme manager to notify DOH of events that may affect recycled water quality.

Events that require notification within 24 hours of occurrence included:

- Sewage spills (Please refer to the Wastewater Overflow Response Procedure)
- Algae bloom events
- Any microbial sample (E Coli, coliphage, clostridia sample result showing a value that is 10 times higher than the water quality criteria for the corresponding risk exposure level).
- Any operational parameter that is outside the compliance value specified in Table 2.

The notification shall be by phone 1800 095 646 within 24 hours of becoming aware of the event. Confirmation shall be by e-mail to wastewater@nt.gov.au within one working day.

When the agreed actions in response to the event have been successfully implemented, the event will be closed out. The event, the actions implemented and the event close-out shall all be reported in the annual report.

6.5. Point at which water quality should be assured

The supply of recycled water generally necessitates the use of storages such as lagoons, dams or reservoirs to ensure continuity of supply or to store surplus recycled water during periods of lower demand by users. This means that the recycled water might first be directed to a lagoon, managed by the recycled water provider or another entity, before being supplied to customers via a pipeline. Alternatively, recycled water may be supplied to a user's dam via a pipeline before being used on-site. As these storages can be subject to faecal contamination from the environment, some recycled water providers have been unsure of where to monitor for *E. coli*.

DoH's position is that the *E. coli* should be sampled at the last point where treatment of the water is undertaken by the recycled water provider. For example, where chlorine disinfection is the last treatment step, samples for *E. coli* should be monitored at the point where the recycled water is discharged from the chlorine contact tanks or before it enters a storage lagoon or pipework for distribution to customers.

7. High exposure recycled water scheme

End-users of high exposure recycled water can minimise any public health or environmental risks associated with recycled water by using it safely. End-users of high exposure recycled water must ensure that they comply with any restrictions on use, as well as any on-site control requirements, set out in a recycled water end-user agreement. End-users should also notify the recycled water provider when, for whatever reason, they are unable to comply with these requirements.

7.1. Overview

This section provides proponents with guidance on the development and implementation of a RWMS for high exposure recycled water schemes in the NT.

A RWMS 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 to DoH for 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).

A RWMS document template is available to assist proponents 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 4 summarises *what* needs to be included in the RWMS. The requirements for each element are explained in further detail in section 7.2. The remainder of the chapter focuses on *how* to develop a RWMS.

Table 4: Requirements for developing a RWMS document

Element	What needs to be complete prior to submission to DOH
Element 1: Commitment to responsible use and management of recycled water quality	Review your organisation's planning documents 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).
Element 2: Assessment of the recycled water system	A risk assessment of the recycled water system must be undertaken: <ul style="list-style-type: none"> • Identify the source including the 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 a risk assessment. • 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.

Element	What needs to be complete prior to submission to DOH
Element 3: Preventive measures for recycled water management	Critical control points (CCP) must be identified based on the risk assessment findings. Critical limits must be set. 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.
Element 4: Operational procedures and process control	Record procedures for: <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. Include references to the above procedures in the RWMS document.
Element 5: Verification of recycled water quality and environmental performance	The RWMS document must reference an implemented comprehensive monitoring program of the system and environmental end points including data review. The RWMS document must note how the recycled water supplier ensures recipients comply with their user agreements.
Element 6: Management of incidents and emergencies	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 an incident or emergency. Document contingency arrangements for recycled water management or disposal (e.g. due to contamination or other off-spec quality). Record in the RWMS.
Element 7: Operator, contractor and end user awareness and training	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 how the recycled water supplier improves and maintains employees' and contractors' awareness of recycled water quality and environmental issues.
Element 8: Community involvement and awareness	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.
Element 9: Validation, research and development	A program to validate / verify the initial operation of the recycled water plant must be developed, submitted to DoH and then undertaken. Review the Risk Assessment outcomes for actions to investigate recycled water quality or improve knowledge of the system. In the RWMS document, record all water quality investigations in which the recycled water supplier is involved. In the RWMS document, record processes for equipment and plant validation. Confirm the disinfection Ct where chlorine / chloramine is used as the primary disinfectant.
Element 10: Documentation and reporting	Record in the RWMS document record keeping procedures and systems to be used by the recycled water supplier. Record how monitoring results (operational monitoring, incidents, emergencies and recycled water quality reviews) and responses are to be reported to management and external parties.
Element 11: Evaluation and audit	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 internal and external auditing requirements of this element including a schedule for internal and external audits.
Element 12: Review and continuous improvement	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. The scheduled dates for these reviews should be included in the RWMS document.

7.1. Steps to develop a RWMS

The information summarised in Table 4 is what needs to be included in a RWMS. 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 DoH approval for water recycling.
- A proponent 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.

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.

7.1.1. Developing a RWMS for an existing recycling system

Proponents that have not previously notified DoH 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 Proponents 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' with DoH.
- Identify recycled water end uses, recipients and on-site controls. Determine the pathogen log reduction requirements for those uses. See 'Information Sheet: Calculating Log Reduction Values'. This may require an exposure assessment (see section 7.2.2.1).
- 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' to DoH for feedback.

Stage 2: Assess and confirm system capability

Assess potential treatment log reduction values (See section 7.2.2.5 and the 'Information sheet Calculating Log Reduction Values'). This assessment should consider indicative log reduction values (Table 10), 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 DoH 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 'Information Sheet: Critical Control Points').

If your scheme has verification data consistent with Table 20, and supporting operational data, assemble the data and provide to DoH who will review and comment on adequacy. If the system has not undertaken verification testing then develop and submit a verification plan to DoH. 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 7.2.2.6.)

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.

Stage 4: Develop RWMS

Develop the RWMS including supporting documentation in line with this Code.

Stage 5: DoH approval

Submit the RWMS and supporting documentation to DoH for approval.

7.1.2. Planning for recycling using existing treatment facilities

Proponents 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 DoH 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 7.1.1, with the exception that early engagement with DoH 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.

7.1.3. Developing a RWMS for a new plant or major upgrade

Proponents 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 7.1.4 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 DoH and the information requirements of the 'Preliminary Recycling Checklist'.
- 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 7.2.2.1).
- 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 to DoH 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. 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 7.2.2.6). 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 DoH for approval. Commissioning verification should be undertaken.

Stage 5: DoH approval

Submit the RWMS and supporting documentation to DoH 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 5.

Table 5: Relationship between project phases for a new plant or major upgrade, RWMS stages and the framework elements

Project Phase	RWMS Development Phase	Framework Element
Planning	Stage 1: Early Engagement – Submit 'Preliminary DoH approval checklist for a RWMS'	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 recycle water supply system
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 application to DoH 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 DoH approval prior to start of operations Ensure all components of the RWMS are implemented	All as part of the on-going RWMS implementation

7.1.4. Recycled water supplied through a dual reticulation system

Proponents 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. Proponents 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 7.1.3, 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 & Verification information sheet). 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. DoH 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 DoH. 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.

7.2. Requirements for a recycled water management system

Section 7 provides guidance for preparing a RWMS document for DoH approval.

7.2.1. 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 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).

7.2.1.1. 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. (see 'Information sheet: End-user agreements')

The recycled water end-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.
- The commercial terms under which recycled water is supplied.

7.2.2. 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. DoH 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 DPIR 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.

7.2.2.1. 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).

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 6 summarises the LRV targets for typical end uses.

Table 6: Log reduction targets for typical end uses

End-use	Log Reduction Targets		
	Protozoa	Virus	Bacteria
Firefighting (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.

7.2.2.2. 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.
- Department of Health – Public Health Directorate representative/s – the person/s who will provide advice on process suitability and advice relating to the submission e.g. recycled water specialist and regional 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.
- Department of Environment and Natural Resources (DENR) officer – the person who will assist with the identification and management of the environmental impacts and regulatory requirements.
- Specialist Department of Department and Primary Industry (DPIR) animal health or livestock officer – if applicable.

One person may cover several roles.

7.2.2.3. 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 7 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

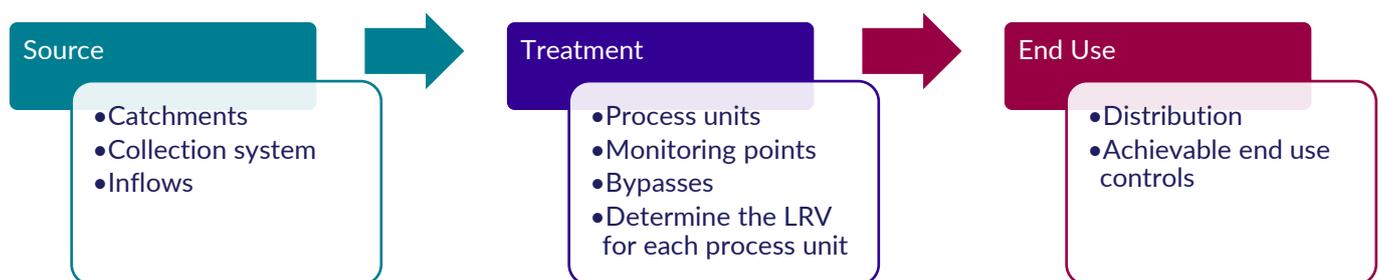


Table 7: Sources of information to develop a source to end use flow diagram

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
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
	System layout	Process and Instrumentation Diagrams (P&IDs)
	Potential hazards in source material	Geographical Information Systems (GIS) Data
		Trade waste policy and register

Figure 8: Example simple process flow diagram

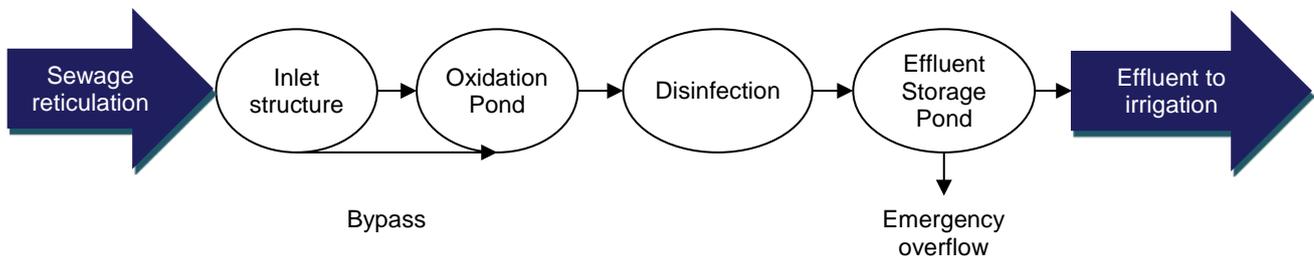
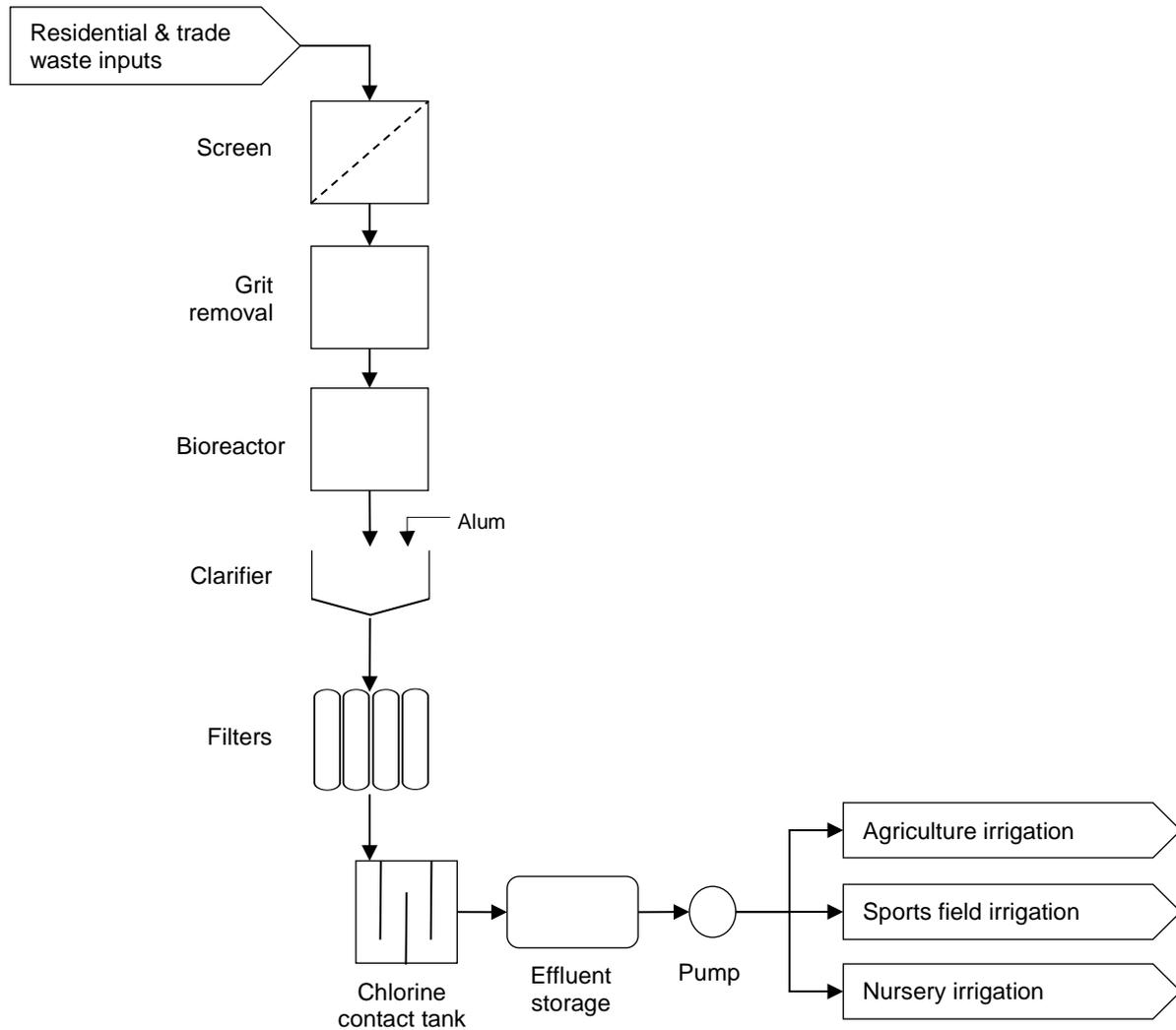


Figure 9: Example process flow diagram



7.2.2.4. Review and analyse water quality data

Review the water quality data sources listed in Table 8, statistically analyse and trend the data as described in section 7.2.1 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 8: 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 quality	Verification and investigative monitoring
Bureau of Meteorology	Rainfall	Operational, investigative

7.2.2.5. Prepare for the risk assessment

The information in Table 9 is required for the DoH 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 9: 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 	Essential
<ul style="list-style-type: none"> a proposal for decommissioning any discarded components of the existing system to allow for the proposed system 	Desired
<ul style="list-style-type: none"> the existing process and environmental monitoring results and assessments 	Essential
<ul style="list-style-type: none"> historical inflow data where possible, including storm events and periods of water restrictions 	Essential
<ul style="list-style-type: none"> contingency arrangements for recycled water management of disposal if supply ceases (e.g. due to contamination or off-spec quality) or recipient cannot take it 	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)
Identification of non-treatment barriers and associated indicative log removal values for each (see <i>Non treatment barriers: End use and on-site 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 	Essential
<ul style="list-style-type: none"> identification of any sensitive environmental factors at the end use locations 	Essential
<ul style="list-style-type: none"> 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 log reduction values (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 see 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 10, 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 see 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 LVR.

Table 10: Indicative LRV for treatment processes

Treatment	Indicative Log Reduction Targets		
	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	1.0-3.4
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. See to 'Getting Chlorination Right' information sheet for further information.

Indicative LRVs for non-treatment barriers are summarised in Table 11. 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 on-site 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 proponent's work health and safety system should be used to manage health risks to employees.

Table 11: 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, neighbours, passing public
Subsurface irrigation of plants/shrubs or grassed area	4 log	Neighbours, passing public
Spray drift control (microsprinklers, anemometer systems, inward-throwing sprinklers, etc.)	1 log	Neighbours, passing public
Buffer zones (25-30m)	1 log	Neighbours, passing public

Source: adapted from AGWR Table 3.5

7.2.2.6. 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. DoH 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).

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

- 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 (see 7.2.12 - Element 12), prioritised and followed up. An extract from a risk assessment is shown in Table 12 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 12: 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	<ul style="list-style-type: none"> Trade waste agreements 	C	1	Low	A	1	Low	<ul style="list-style-type: none"> Education of waste users Ensure enforcement of trade waste policy
Sewage network	Wet weather infiltration	Salinity	<ul style="list-style-type: none"> Inflow and infiltration program 	Uncertain						<ul style="list-style-type: none"> Consider monitoring TDS in effluent
Secondary treatment	Aeration system failure	<ul style="list-style-type: none"> Nutrients Organic load 	<ul style="list-style-type: none"> Two reactor tanks Duty standby blowers, pumps DO probes SCADA monitoring Generator 	C	5	Very High	A	5	High	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> High turbidity Protozoa Bacteria Organic load 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Ensure supply of recycled water is ceased under this condition
UV	Lamp failure/fouling	<ul style="list-style-type: none"> Protozoa Viruses Bacteria 	<ul style="list-style-type: none"> SCADA alarm Regular maintenance by qualified contractors Lamp redundancy 	D	5	Very High	A	5	High	<ul style="list-style-type: none"> 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.

7.2.3. 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 7.2.2.6.

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 13 should be reviewed when evaluating the adequacy of the preventive measures in the system being assessed.

Table 13: 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.

7.2.3.1. 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 14.

Table 14: 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 limit	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 15.

Table 15: 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	≥ 2.25mg/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 steps are included and match what the operators would do for each limit.

7.2.4. 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.

7.2.4.1. 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 16. See to template for developing CCPs.

Table 16: 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 ≥ 2.5mg/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.

7.2.4.2. 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 17 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 17: 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	Flowrate 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 Flowrate 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
Over-irrigation	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, signing and other end-user controls

Source: Adapted from AGWR Tables 5.4 and 5.6

7.2.4.3. 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.

7.2.4.4. 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 Codes of Australia and AS/NZ 3500 (use current version).
- ATS 5200.026:2004 Technical Specification for Plumbing and Draining Products, Cold Water Storage Products.
- AS/NZS 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. DoH 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 and 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 work health and safety provisions and a copy kept local to chemical facilities.

7.2.5. 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 'Information Sheet: Validation & Verification: What's the difference?'). 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.

7.2.5.1. 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 18 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 18: 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 preventative maintenance activities	Annually	Annually	Annually
Audit of operational monitoring activities	Monthly	Monthly	Monthly

Source: Adapted from AGWR Table 5.6

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.

7.2.5.2. 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.

7.2.6. 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.

7.2.6.1. 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 19 as a minimum.

Table 19: Emergency Contacts

Emergency Services	Other organisations	Other
NT Police, Fire & Emergency Services 131 444	Department of Health 1800 095 646 NT Environment Protection Authority 1800 064 567	Media (each local newspaper, TV, radio station) Telecoms service provider control room (Telstra, Optus, Vodafone etc.) 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.

7.2.6.2. Incident and emergency protocols (IERP)

Incidents may arise through many circumstances. Recycled water suppliers should review the information available and tailor it to their needs in consultation with DoH.

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.

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 (see [section 5.2.7](#) - 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.

7.2.7. 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 section 7.2.10 – Element 10)).
- 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 section 7.2.1 - Element 1.

7.2.7.1. 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.
- DoH workshops.
- DOH training courses and update seminars.
- Conferences and publications by industry bodies, e.g. Australian Water Association and Water Industry Operators Association.
- Contractor management policies.

7.2.8. 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

- 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.

7.2.8.1. Community consultation

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

7.2.8.2. 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.

7.2.8.3. 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.

7.2.8.4. 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 pre-worded advice notices.

7.2.8.5. 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 sees to an 'expression of dissatisfaction' made to the organisation (AS ISO 10002-2006). Proponents 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 20: Areas of community engagement and education

Topics	Program / Information Source
Conservation	Water week School programs
Source (influent) Protection	Social media Local paper Council news
Water Quality / Levels of Service	Water bill notice School programs
Compliance	Trade waste program/backflow prevention

7.2.9. 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 Information sheet: Validation & Verification).

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 DoH 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.

7.2.9.1. Validation of processes

To ensure that STPs and the recycled water scheme are fit for purpose, robust and cost-effective, a proponent of a recycled water system requires DoH's assessment under the Public and Environmental Health Regulations.

See to the 'Information Sheet: Validation & Verification' and section 5.2.3 of the AGWR for advice on validation monitoring.

7.2.9.2. 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 DoH assesses sewerage design for approval.

A separate DoH notification is required for any significant modification to the wastewater management system.

7.2.9.3. 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. DoH may provide advice on monitoring programs.

7.2.10. 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

- Records in the RWMS document the record keeping producers 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.

7.2.10.1. Documentation

Documentation in this context sees 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.

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
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 contract 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.

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

7.2.10.2. 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).
- Recycled water quality reviews (Element 2) and documented responses to noted issues (Element 12).

Annual reporting to DoH 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 by the proponent and provided to DoH, 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.

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 publicly available, or annual water quality report.

Annual reporting can be aligned with other regulatory reporting obligations.

7.2.11. 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.

7.2.11.1. 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, and other regulatory requirements (Element 1). Shortcomings should be captured in the Improvement Plan (Element 12) and financial planning process.

7.2.11.2. Audit of the recycled water management system

Recycled water suppliers should establish a system of internal and external audits. Table 22 is a recommended schedule for internal audits.

Table 22: Internal audit frequency requirements

Item	Minimum Audit Frequency
Audit of equipment and instrumentation calibration	3 monthly
Audit of preventative maintenance	Annually
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 (see 7.2.12 - Element 12).
- Record keeping of day-to-day monitoring.

7.2.11.3. External audits

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

DoH 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 as directed under the *Public and Environmental Health Act* or Public and Environmental Health Regulations.

7.2.12. 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.

7.2.12.1. 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 should be undertaken. 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.

7.2.12.2. 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.

7.2.12.3. 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 (see section 7.2.2. - Element 2 and section 7.2.3. - Element 3)
 - The recycled water supplier's Continuous Improvement System.

8. References/Guidelines used in the development of the Code

Environment Protection and Heritage Council, the Natural Resource Management Ministerial Council and the Australian Health Ministers' Conference, 'Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1), Canberra, 2006.

NSW Department of Primary Industries – Office of Water, 'Recycled Water Guidance Document – Recycled Water Management Systems' New South Wales, 2015.

Queensland Health 'Guidelines for low-exposure recycled water schemes', Queensland, 2019.

South Australia Department of Health and Aging, 'Recycled water schemes: Information for applicants', South Australia, 2013.