Department of Health

health

Rainwater use in urban communities

Guidelines for non-drinking applications in multi-residential, commercial and community facilities

State Government Victoria

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Guidelines for non-drinking applications in multi-residential, commercial and community facilities

Accessibility

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Introduction

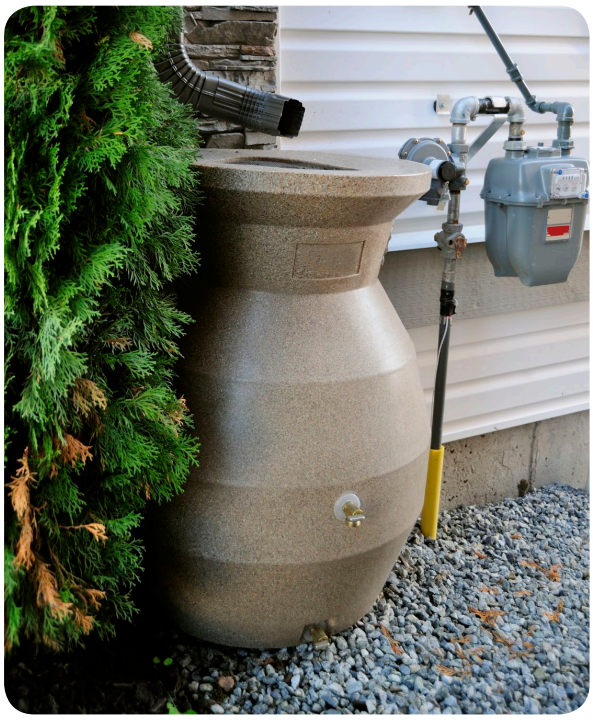
Roof-collected rainwater is widely recognised as a valuable and sustainable water resource. In many areas it can provide a readily accessible water supply that is a low-risk alternative to the use of reticulated (mains) drinking water.

Businesses, community groups, sporting clubs and residential developments can reduce their reliance on reticulated drinking water by using rainwater.

In urban communities, rainwater can be used for a range of purposes, including personal washing, toilet flushing, laundry use, surface and equipment washing, topping up spas and pools, garden irrigation, cooling and heating, and many industrial processes.

The department recommends that reticulated drinking water is used for drinking and food preparation in areas where it is provided. This is because the quality of rainwater is not as reliable as reticulated drinking water, which has been treated to a level that is safe for human consumption.

Irrespective of how rainwater is used, you should develop and implement a water supply management plan to make sure the rainwater is safe for use.



Objective and scope

These guidelines are designed to help people responsible for establishing and managing rainwater schemes in urban communities. The guidelines explain how to develop a risk assessment and water supply management plan to provide rainwater that is safe to use.

The guidelines apply to multi-residential (comprising two or more households with a common rainwater collection and use system), commercial and community sites in areas with a reticulated drinking water supply, and which collect rainwater from roofs as a non-drinking water supply.

Examples of sites that would benefit from this guideline include:

- shopping centres or retail businesses
- commercial sites such as office blocks and conference centres
- accommodation establishments such as hotels, motels, guest houses and camping grounds
- residential complexes, such as apartment blocks or clusters of residences that have shared rainwater facilities
- community facilities such as halls, sports and recreation facilities, public amenities and community gardens
- education centres such schools, higher education centres and preschools
- industrial premises
- construction and building sites.

These guidelines do not apply to the use of rainwater as a private drinking water supply. Guidelines for rainwater used as private drinking water supplies are listed in Appendix 1. These guidelines also do not apply to the collection and use of stormwater. Stormwater is a combination of water that runs off all urban surfaces such as roofs, pavements, car parks, roads, gardens and vegetated open spaces which is captured in constructed storages and drainage systems.

Regulatory framework

The quality and acceptable uses of rainwater are not subject to specific regulation in Victoria. Despite this, individuals or organisations responsible for rainwater systems should demonstrate due diligence by ensuring that rainwater is safe for its intended use. The quality of rainwater and the associated management controls need to be proportional to the level of exposure to rainwater – the more likely it is that rainwater will be ingested, the higher the water quality and more stringent the management controls should be.

The department recommends that reticulated drinking water is used for drinking and food preparation in areas where it is provided. This is because the quality of rainwater is generally not as reliable as mains supplies, which have been treated to a level that is safe for human consumption.

The installation and use of rainwater systems may be subject to specific regulation in Victoria, as described in this section. There are also a number of guidelines and standards that have been developed for the use of rainwater. Contact details for the organisations mentioned in this section are provided in Appendix 2.

Legislation

Acts

Acts of relevance to rainwater systems include:

Public Health and Wellbeing Act 2008

The Public Health and Wellbeing Act makes provision for the prevention and abatement of conditions and activities, which are, or may be, offensive or dangerous to public health.

Building Act 1993

The regulatory requirements for onsite plumbing work in Victoria are stated under Part 12A of the Building Act. This Act establishes the Plumbing Industry Commission's function to determine relevant plumbing regulations.

Planning and Environment Act 1987

Some aspects of rainwater schemes may require approval or a permit from the local council under the Planning and Environment Act and the Building Act. Contact the local council for further information on this.

Occupational Health and Safety Act 2004

The Occupational Health and Safety Act sets out the legal responsibilities for employers to provide and maintain so far as is practicable a working environment that is safe and without risk to health. This means that the installation and use of rainwater systems in workplaces must not place employee health at risk.

Food Act 1984

The Food Act requires food businesses to use drinking (or potable) water for all food preparation activities. Therefore the use of rainwater for food preparation at these sites may not be appropriate, unless it is treated to drinking water standards.

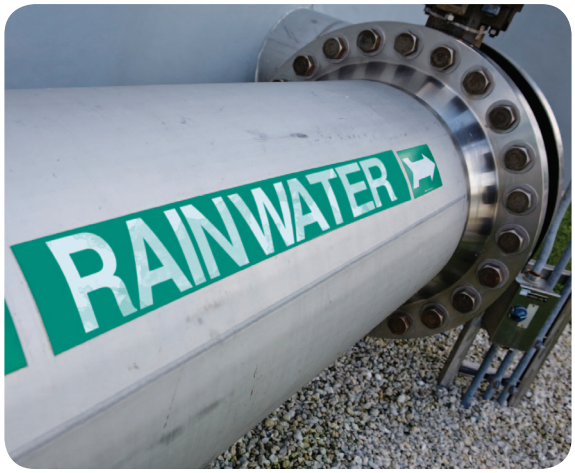
Regulations

The Plumbing Regulations 2008 set the requirements and competencies for licensing and registering plumbers and specify the minimum technical standards for all onsite plumbing work.

Guidance documents

Relevant guidelines and standards include:

- Plumbing Industry Commission technical information on the plumbing of rainwater systems
- *HB 230-2008: Rainwater tank design and installation handbook* published by the Australian Rainwater Industry Development Group, which can be purchased at <www.arid.asn.au> or through Standards Australia.
- Australian Standards and Australian Technical Specifications, including (but not limited to):
  - AS/NZS 3500 *National plumbing and drainage code*
  - ATS 5200 *Technical specification for plumbing and drainage products*
  - AS/NZS 2179 *Specifications for rainwater goods, accessories and fasteners*
  - AS 1273 *Unplasticized PVC (UPVC) downpipe and fittings for rainwater*
  - AS/NZS 4130 *Polyethylene (PE) pipes for pressure applications*
  - AS/NZS 4766 *Polyethylene storage tanks for water and chemicals.*



Developing a rainwater supply management plan

Rainwater that is clear, has little smell, is free from suspended material, and comes from a well-maintained roof catchment system is likely to be suitable for most uses. However, it is important to understand that this is not a guarantee of safety as contamination is not always visible.

Rainwater systems should be designed, installed and maintained to protect rainwater from contamination. A rainwater supply management plan that is underpinned by preventive risk management principles is the most effective way of achieving this.

The complexity of the management plan should be proportional to the potential level of risk: schemes where there is a higher risk of ingesting rainwater (such as those involving personal washing) will generally require a more detailed assessment and more stringent controls than schemes where there is a low risk of ingestion (such as those involving garden watering). Refer to Appendix 3 for an overview of the key steps for developing a rainwater supply management plan.

Organisational commitment

The organisation that owns or maintains the roof catchment and the rainwater scheme must be committed to developing and implementing a rainwater management plan. Management should have a clear understanding of the principles of preventive risk management and allocate adequate funding for development and maintenance of the scheme.

System analysis and management

A systematic assessment to identify hazards to water quality and appropriate controls for these will underpin the rainwater management plan. Where possible, specific controls for the management of potential health risks associated with rainwater use are provided in this section. However, not all rainwater systems are identical and a one-size-fits-all approach is not appropriate. Therefore, site-specific risks will need to be identified for each scheme, along with measures to control these risks.

System description

An essential prerequisite for hazard identification and risk assessment is to detail each component of the rainwater system. This system description provides the basis for hazard identification, risk assessment and control.

The rainwater system is defined as everything from the collection or catchment of rainwater through to the end-user or receiving environment.

This system description should cover:

- the roof catchment and storage, including roof, guttering, downpipes and rainwater storage tanks
- the supply system (distribution and plumbing) including the pipe specifications and plumbing installation controls
- treatment processes (if applicable)
- intended uses of the rainwater.

A flow chart can help to schematically illustrate the system.

Hazard identification and risk assessment

Hazards and hazardous events should be identified for each component of the rainwater system.

Hazards and hazardous events that are considered relevant to most rainwater systems are included in the template in Appendix 4. Any additional hazards and hazardous events that are considered to be of significant risk should be identified on a case-by-case basis.

Microbial hazards and hazardous events

While the quality of rainwater collected from rooftops is generally good, it may contain a range of disease-causing (pathogenic) microorganisms including bacteria and parasites. These may arise from the faeces of birds, reptiles, amphibians and mammals that have access to the roof or tank, or be free-living environmental organisms.

Animal faeces can carry pathogenic bacteria including *Campylobacter* and *Salmonella* species and parasites such as *Cryptosporidium* and *Giardia* that are infectious to humans. These microorganisms have been associated with disease outbreaks from rainwater tanks and are considered the most significant risk to human health.

Consideration also needs to be given to the potential for some microorganisms to grow within rainwater tanks, or in pools of stagnant water within the rainwater system. While most human pathogens are unlikely, or unable to grow in rainwater tanks, there are some bacterial pathogens such as *Legionella* and *Pseudomonas*, which can grow in water under the right conditions. This growth is generally dependant on the availability of nutrients and the water temperature. Treatment of rainwater to address potential microbial risks is recommended for uses with a moderate risk of ingestion such as personal washing. Treatment is not likely to be necessary for lower exposure uses. Refer to Appendix 5 for advice for rainwater treatment in response to microbial contamination.

Algae and cyanobacteria (also called blue-green algae) may also grow in rainwater tanks if they allow sufficient light in and the rainwater contains sufficient nutrients. Many algae species can affect the taste, appearance and odour of the water and some species of blue-green algae can produce toxins that may cause skin irritation and illness.

Chemical hazards and hazardous events

Chemical hazards may contaminate rainwater via the following:

- dust, atmospheric deposits and leaf litter on roof surfaces
- leaching from roofing, guttering and plumbing materials, or materials used to manufacture the storage tank
- discharges from roof-mounted appliances (such as air conditioners, hot water services and flues)
- air pollutants from industrial or domestic discharges, motor vehicle exhaust fumes and horticultural chemicals used at farms or in home gardens.

The risk of chemical contaminants in rainwater causing harm, when the rainwater is used for purposes other than drinking and food preparation, is likely to be low in most circumstances. Basic controls will further reduce these risks.

An individual assessment of chemical risks is recommended for all schemes where rainwater is used for purposes with a moderate risk of ingestion (refer to Table 1).

To determine whether concentrations of chemical contaminants are of concern, the *Australian drinking water guidelines* (2011), available from the National Health and Medical Research Council, can be referred to as a starting point. These guidelines are conservative if rainwater is not used for drinking or food preparation, so if the concentration of a chemical contaminant exceeded the guidelines it is not necessarily a cause for concern, but may warrant a more detailed risk assessment.

The risk from asbestos is one that is commonly raised in relation to rainwater systems. Asbestos is no longer used in new houses, but may be present in some older roofs. Asbestos fibres are dangerous to health when inhaled in sufficient quantities, but are not believed to pose a risk via rainwater harvesting systems. Where possible, asbestos roofing should be left undisturbed, as fibres can be released into the air by actions such as cutting, grinding or drilling. High-pressure roof cleaning methods should also be avoided. Where the roof catchment area has deteriorated badly, it should be replaced with asbestos-free substitutes.

Certain characteristics of rainwater may also cause aesthetic or other physiochemical issues, such as staining of laundry or corrosion of plumbing fittings.

Mosquitoes

In addition to direct health risks associated with the ingestion of rainwater, rainwater tanks may pose indirect health risks by providing breeding sites for mosquitoes, which can transmit disease.

Although rainwater tanks have not been associated with outbreaks of mosquito-borne disease in Victorian urban areas to date, increasing numbers of rainwater tanks in urban areas may provide additional breeding sites for mosquitoes and increase the likelihood of disease transmission.

Control measures

Control measures should be identified for all significant risks. When identifying control measures, you should consider the multiple barrier approach. The strength of this approach is that if one control measure (or barrier) fails, the remaining control measures will minimise the likelihood of contaminants passing through the entire system and being present in sufficient amounts to cause harm to rainwater users.

Control measures for rainwater systems would typically include:

- roof catchment protection and maintenance
- correct material selection and installation of the rainwater storage, distribution and plumbing
- treatment, such as filtration and disinfection, where deemed necessary
- regular inspection and maintenance of the supply system (pipes, tanks, pumps and other elements).

Control measures that are generic to most rainwater systems are discussed in this document, and summarised in the template in Appendix 4. However, the individual system assessment may identify that additional control measures are required.

Roof catchment protection and maintenance

Using correctly designed and maintained roof catchments is a key step to protecting rainwater from contamination. For all systems, the following should be implemented.

- Overhanging vegetation should be cut back.
- Gutter shielding devices ('gutter guard') should be installed where roof catchments are adjacent to trees and vegetation, to reduce the amount of debris entering gutters and storage tanks.
- Gutters should have sufficient and continuous fall to downpipes to prevent pooling of water, which could accumulate debris, lead to algal growth and possibly provide a site for mosquito breeding. A fall of 1:500, or 1:200 for box gutters and internal guttering should be sufficient (consistent with AS/NZS 3500 *National plumbing and drainage code*).
- Overflows and bleed-off pipes from roof-mounted appliances, such as cooling systems and hot water services should not discharge onto the rainwater catchment.
- Chemicals used for any roof cleaning should be carefully selected to ensure they do not pose a risk to human health or the environment.
- Sections of roof affected by emissions from any industrial processes within the building should be excluded from the rainwater catchment.

The following measures are generally considered good practice, but are most important where rainwater is used for purposes with a moderate risk of ingestion.

- First-flush diverters or by-pass devices should be installed to reduce the entry of contaminants, which build up on roofs and in gutters during dry spells, to the storage tank.
- Flues from slow combustion heaters should be installed in accordance with the relevant Australian Standards.
- Lead flashing should be removed.
- Rainwater should not be harvested from roofs coated in bitumen products or lead-based paints.
- Exposed preserved or treated timber should be sealed, or the section of roof containing the timber should not be used for collection of rainwater.
- Roof access should be restricted to maintenance activities only.
- Structures that provide a perching place for birds should be removed or modified.

Rainwater storage

Rainwater tanks are available in a range of materials including galvanised steel, fibreglass, polyethylene, concrete and a number of proprietary products. All can be suitable, providing the materials used will not contaminate the rainwater, and they comply with the relevant Australian Standards.

Tanks should be assembled and installed in accordance with the manufacturer's requirements and be structurally sound. Tanks should also be installed in accordance with any local council requirements (contact the relevant local council for further information).

Tanks should have impervious covers and all access points, except for the inlet and overflow, should be provided with close-fitting lids which should be kept shut unless in use. The inlet to the tank should incorporate a screen to prevent material being washed into the tank, and a mesh covering to prevent access of mosquitoes and other insects. Overflows should also be covered with insect-proof mesh.

Tanks should be lightproof to minimise algal growth.

In-ground tanks need to be properly sealed and access points need to be protected against surface run-off, groundwater and soils. Tanks should not be buried in contaminated ground, near underground chemical or petroleum storage tanks, or near septic tanks.

All products and materials used for connections to and from the rainwater tank should comply with current Australian Standards and plumbing regulations. Wherever possible, all sections of inlet pipes should be directed down and rainwater should flow into the top of the tank. The inclusion of rising sections of pipework or charged downpipes should be avoided, where possible, as they provide potential traps for sediments and stagnant water.

Run-off that is not collected in the tank and tank overflows must be diverted into the stormwater drain. It must not be allowed to pool or to cause a nuisance to neighbouring properties or to areas of public access. The overflow should be designed to prevent stormwater from flowing back into the tank.

Rainwater distribution and plumbing

A licensed plumber should install the rainwater distribution system in accordance with AS/NZS *3500 National drainage and plumbing code*, and any relevant Plumbing Industry Commission guidance (contact details in Appendix 2).

To prevent cross-connections between the rainwater and mains water supplies, rainwater distribution pipes should be clearly labelled 'RAINWATER' in a contrasting colour, in accordance with AS/NZS 3500 *National plumbing and drainage code*. In addition, as-built drawings of the distribution system should be available and protocols developed to ensure modifications and maintenance on the distribution system do not result in a cross-connection.

Rainwater systems in urban areas will often have a mains water supply incorporated to provide the system with water in periods of no rainfall. This is particularly important where rainwater is used to supply essential services such as toilets. Water businesses do not usually allow the direct connection of the reticulated drinking water supply to rainwater systems, and require the use of backflow prevention devices to prevent the risk of rainwater siphoning back into and contaminating the drinking water supply. Information on this should be sought from the local water business or the Plumbing Industry Commission. Backflow prevention devices must comply with Australian Standards.

Rainwater treatment

As rainwater collected from well-maintained rooftops is generally of a quality that is safe for many uses, the need for treatment is unlikely. However, in some circumstances there may be a need to treat rainwater.

Rainwater systems that serve multi-residential, commercial and community sites should incorporate treatment to reduce microbial hazards when rainwater uses have a moderate risk of ingestion (for example bathing, showering and hand basins). This is particularly important when elderly, very young or people with suppressed immune systems are likely to be using rainwater.

There is a moderate risk of ingesting rainwater when it is used in swimming pools and spas. Most swimming pools and spas incorporate some form of treatment (for example chlorination), which should effectively manage potential health risks in rainwater in most scenarios.

Other issues relating to hardness and aesthetic qualities of water such as colour should also be considered as part of the risk assessment when rainwater is used for laundry or swimming pools.

All public swimming pools and spas (regardless of whether rainwater is used) must comply with the Public Health and Wellbeing Regulations 2008, and the Pool operators' handbook should be consulted for information on managing health risks. This handbook is available from the Department of Health website – refer to Appendix 1 for details.

Treatment options for rainwater systems most commonly include:

- filtration
- disinfection (usually chlorine or ultraviolet light).

The type and level of treatment required depends on the hazards that require control. In most cases, treatment by disinfection should be sufficient if the contaminants of concern are microbial, and the rainwater has little suspended material and is of low turbidity (indicatively < 1 nephelometric turbidity unit).

If the rainwater is susceptible to significant chemical contamination, or is likely to be turbid or contain suspended particles or organic matter, then filtration may be required, followed by disinfection.

Water treatment systems should always be designed or installed with the oversight of a water treatment professional to ensure the treatment system can remove the contaminants of concern and that an appropriate maintenance schedule is established.

Hot water services

However, hot water services are currently designed to address *Legionella* risks from water (consistent with the requirements in AS/NZS 3500 *National plumbing and drainage code*). Hot water services should not be relied on to inactivate enteric pathogens (pathogens found in the gut) as they may not heat water to a high enough temperature for long enough to act as appropriate treatment (Deere et al 2012).

End-use controls

Rainwater users should be aware of the appropriate uses of rainwater. teps should be taken to ensure that rainwater is only used for its intended use.

External taps supplying rainwater should be identified with a safety sign labelled 'RAINWATER'. Signs should comply with AS1319 *Safety signs for the occupational environment*, with black writing on a yellow background. Where signs could be encountered by sensitive groups who may not be able to read (for example childcare centres), additional controls should be considered such as using taps with removable handles or locating taps 1.5 metres or more above the ground.

Internal rainwater outlets should be identified, for example via a 'RAINWATER' label on tap buttons.

Monitoring and corrective actions

Monitoring the rainwater system is an essential part of the multiple barrier approach. The results of monitoring show whether the risk control measures are working properly. Employ corrective actions when monitoring indicates that a control measure or barrier has not been operating effectively.

Whether the water is treated or not, a full rainwater system inspection should be undertaken at least quarterly. Things to look for include:

- checking the roof and gutters to ensure they are in good condition, clean, that any appliances are not discharging contaminants onto the roof catchment, and that barriers such as leaf guards and first-flush diverters are clear and working properly
- checking rainwater storage tanks to ensure they are in good structural condition, there is no evidence of contaminating matter leaching into tanks, any protective mesh is intact, and that there are no signs of contaminating matter (including dead animals) or build up of sediment in tanks
- checking for cross-connections by turning off the mains water supply at the water meter and checking drinking water taps – if water continues to flow through drinking water taps when the mains water is switched off then a cross-connection has occurred. Note that this is only necessary when pipes carrying rainwater are in close proximity to those carrying drinking water, for example when rainwater is used indoors for toilet flushing, laundry or personal washing
- maintaining any pumps and plumbing
- checking and maintaining any backflow prevention devices, in accordance with Australian Standards
- checking any signage is in place and in good condition
- periodically monitoring for chemicals of concern, if applicable.

Other monitoring requirements should be identified during the hazard identification and risk assessment process. For example, if the risk of chemical contamination causing harm to rainwater users is deemed to be a significant risk, then the chemical quality of the rainwater should be tested.

Monitoring treatment processes

Regular checking and maintenance of water treatment systems is important to ensure that the water supply continues to be safe. The following monitoring is recommended, at a minimum, for treatment processes.

Filtration

All monitoring, maintenance and corrective actions for filtrations systems should be undertaken in accordance with the manufacturer's advice.

Water quality should be regularly checked after filtration. If the flow decreases or the water becomes turbid (dirty or cloudy) the filter needs to be checked and may need servicing.

Chlorination disinfection systems

Chlorine injection units should be checked to ensure they are fully operational and have an adequate supply of chlorine at least weekly.

Where chlorine is used, it is desirable to have a free chlorine residual of at least 0.5 mg/L after 30 minutes. This should be checked weekly, using a suitable chlorine test kit (available from swimming pool equipment suppliers).

If the chlorine residual is found to be too low, then modifications to the dosing system should be made as soon as possible.

UV disinfection systems

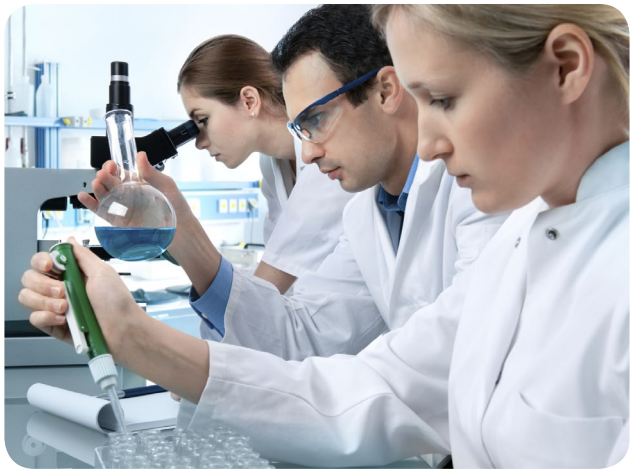
The effectiveness of a UV disinfection system depends on the water quality, flow rate and hydraulics, intensity of UV radiation, amount of time the microorganisms are exposed to the radiation, and the reactor type and configuration.

A monitoring, cleaning and maintenance schedule for UV disinfection systems needs to be established based on the advice of the manufacturer and a water treatment specialist for the system to remain effective.

All disinfected systems

Generally rainwater supplies shouldn't need to be tested if the system is well managed and maintained. However, if the water needs to be tested *Escherichia coli (E. coli)* can be used as an indicator for faecal contamination. The presence of *E. coli* indicates that people using rainwater could be exposed to disease-causing microorganisms. Samples should be taken from the tank outlet or from taps within the distribution system. *E. coli* should not be detected in 100 mL of water. If detected, corrective actions should be taken as soon as possible (for example through batch dosing the storage with chlorine and resampling).

To ensure the highest level of accuracy, water samples should be tested at a laboratory that is certified as having appropriate quality assurance programs for the analysis required, for example accredited by the National Association of Testing Authorities. Refer to Appendix 2 for contact details.



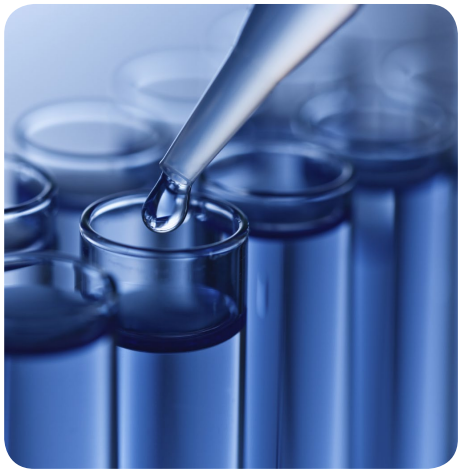


Table 1: Treatment and monitoring recommendations for rainwater in urban communities

Use	Risk of ingestion	Treatment	Recommended minimum monitoring			
			System Inspection	Treatment process	E.coli	Chemicals
Personal washing (showers, baths and hand basins)	Moderate	Recommended	Quarterly	Consult	N/A[1]	Every three years[2]
Swimming pool/ spa	Moderate	See note[3] (below)	Quarterly	N/A	N/A[4]	Every three years[2]
Laundry (trough and washing machine) Toilet flushing Garden watering and general outdoor use[5] Fire protection systems Open industrial systems	Low	Unlikely to be necessary[6] (Unless hazard identification and risk assessment indicates that significant risks require management)	Quarterly	N/A	N/A[4]	N/A[7]
Garden watering (subsurface or drip irrigation) Heating and cooling systems (including cooling towers[8]) Closed industrial systems	Extremely low	Unnecessary[6]	Quarterly	N/A	N/A[4]	N/A[7]

Notes:

1. It may be appropriate to increase the frequency of *E. coli* monitoring if rainwater is used for susceptible groups, such as elderly, immune-suppressed or very young.
2. More frequent monitoring of chemicals may be appropriate if the initial sampling and risk assessment indicates that chemical concentrations are close to levels of health concern, or if treatment processes are being used to remove chemicals of health concern.
3. Swimming pool and spa water treatment processes, such as chlorination, should meet treatment needs in most cases (unless chemicals are assessed as being of concern. Public pool operators should refer to the *Pool operators' handbook*, available from the department's website, for further information.
4. *E. coli* monitoring is usually unnecessary. However, if contamination is suspected, *E. coli* monitoring may be an appropriate indicator of treatment effectiveness.
5. Garden watering includes vegetable gardens. General outdoor use includes car washing, dust suppression, construction, wash down, and filling water features and ponds.
6. Treatment is generally considered unnecessary from a human health risk perspective. In some circumstances it may be necessary to treat rainwater to remove chemical contaminants that may damage appliances or industrial systems.
7. Monitoring may be appropriate for chemicals of aesthetic or physiochemical concern.
8. Under the *Building Act 1993* a specific risk management plan is required to control the risk of Legionnaires disease from cooling tower systems. Contact the Department of Health for further information – refer to Appendix 2 for contact details.

Incident management

The risk management plan should include the development of responses to incidents that may affect the supply or quality of rainwater.

Incidents can be identified using the system assessment, and may include:

- contamination of water with pathogens as a result of animal faeces or dead animals in the roof catchment or storage tank (note that a protocol for disinfection of the rainwater storage is provided in Appendix 5)
- blue-green algae bloom in the storage tank
- incidents that increase the risk of potentially harmful contaminants (such as treatment failure, incorrect dosing of chemicals)
- damage to the rainwater system (roof catchment, storage or distribution) as a result of storms, floods or a natural or human-made disaster
- chemical contamination of the roof catchment, for example through aerial spraying with pesticides
- events such as flood of bushfire
- sabotage or vandalism.

Where an incident has a reasonable likelihood of occurring, response protocols should be developed to ensure human health and safety risks are managed efficiently and effectively.

Key areas to be addressed in any incident response protocol include:

- response actions
- responsibilities of individuals and agencies, both internal and external
- communicating risks to customers and staff
- plans for alternative water supplies
- increasing water quality monitoring and health surveillance.

It is important that people responsible for operating the rainwater system have the skills and knowledge to manage incidents effectively..

Putting the plan together

The outcomes of the system assessment need to be documented in the risk management plan, along with the elements that support the effectiveness of the plan:

- roles and responsibilities
- communication
- training
- review and improvement.

These areas are discussed in further detail in this section.

Roles and responsibilities

Scheme manager

The scheme manager is the person or organisation responsible for overseeing the installation and operation of the rainwater system. A scheme manager could be a property owner, body corporate, property manager, business owner, community group or sporting club.

The scheme manager should demonstrate due diligence and ensure that the legal risks associated with the use of rainwater are appropriately addressed. To fulfil this responsibility scheme managers should ensure that their rainwater system is managed in accordance with these guidelines, including the development, implementation and review of the rainwater management plan, and ensuring communication and training needs are adequately met.

The scheme manager should be familiar with any legislation, Australian Standards and guidelines relevant to the use of rainwater.

In many cases the scheme manager will be the same entity as the scheme operator.

Scheme operator

The scheme operator is the person or persons who operate and maintain the rainwater system on behalf of the scheme manager. The scheme operator is responsible for ensuring all the activities described in the rainwater scheme's risk management plan are followed correctly.

It is important that the risk management plan clearly documents responsibilities of the person or people acting as the scheme operator

Communication

A communication program is an important component of a rainwater scheme, and should be documented in the risk management plan. Key messages to be communicated to users of the system should address:

- Appropriate uses of rainwater.
- Inappropriate or potentially unsafe uses of rainwater.
- How to identify rainwater pipes and outlets.
- Where to get further information and advice.
- How to report rainwater supply or quality issues.

For residential developments, you should give residents written information when the scheme is established, and on change of ownership or tenancy. Yearly reminders of the key messages should be provided to each household.

For other facilities, written communication packages may not always be appropriate. In these cases the best tools to communicate the key messages about the rainwater systems should be identified and documented in the rainwater plan. These tools may include, but are certainly not limited to, site induction programs, school education programs and additional signage.

Training

The scheme operator should have the skills and knowledge to competently manage a rainwater system, including knowledge about assessing and managing risks.

Where a rainwater system is used within a workplace or commercial environment, employee training may be required that covers (depending on the role of the employee):

- the principles of risk management
- knowledge and awareness of the rainwater management plan, including roles and responsibilities of individuals and agencies, both internal and external
- the rainwater system, including its operation and the control measures that are in place to protect human health (for example system maintenance, monitoring, testing and sampling).

Training can take place in a number of forms.It may include formal induction and training sessions with manuals, or the use of newsletters, briefings and meetings. Regardless of which method is used, employees should be encouraged to communicate and think critically about the aspects of their work that relate to, or may affect, the rainwater system and use of rainwater.

All training activities should be documented in the rainwater management plan.

Documentation

Records of all rainwater system management and monitoring activities should be kept, including:

- system inspection results
- equipment checks and maintenance, including any filter change or refurbishment
- treatment monitoring results
- rainwater quality monitoring results
- any adverse events, such as broken pipe work, dead animals in the water source, cross connections and repairs to the system
- corrective actions taken to fix faults or prevent contamination.

Documentation requirements, the location of records, and the individuals responsible for keeping and maintaining records should be identified in the risk management plan.

Review and improvement

The rainwater management plan should be reviewed and updated to ensure that it remains effective. The review should aim to:

- address emerging problems and trends identified through monitoring activities, incidents and emergencies
- identify priorities for improving the rainwater system
- assess overall performance against guidelines and regulatory requirements.

Reviews should be conducted annually.

Appendix 1: References

Department of Health 2009, *Guidelines for water reuse and recycling in Victorian health care facilities: Non-drinking applications*, State Government of Victoria, Melbourne, available from <http://health.vic.gov.au/water/>.

Department of Health 2011, *A guide to completing a water supply management plan: for schools using private drinking water supplies*, State Government of Victoria, Melbourne, available from <http://health.vic.gov.au/water/>.

Department of Human Services 2009, *Guidelines for private drinking water supplies at commercial and community facilities*, State Government of Victoria, Melbourne, available from <http://health.vic.gov.au/water/>.

Department of Human Services 2008, *Pool operators handbook*, State Government of Victoria, Melbourne, available from <http://health.vic.gov.au/water>.

Department of Human Services 2006, *Your private drinking water supply*, State Government of Victoria, Melbourne, available from <http://health.vic.gov.au/water/>.

enHealth council 2010, *Guidance on the use of rainwater tanks*, Australian Government, Canberra, available from <http://www.health.gov.au/internet/main/publishing.nsf/Content/ohp-enhealth-raintank-cnt.htm>.

National Health and Medical Research Council and Environment Protection and Heritage Council 2006, *Australian guidelines for water recycling: managing health and environmental risks (phase 1)*, Australian Government, Canberra, available from <http://www.ephc.gov.au/>.

National Health and Medical Research Council and National Management Ministerial Council 2011, *Australian drinking water guidelines*, Australian Government, Canberra, available from <http://www.nhmrc.gov.au/guidelines/publications/eh52>.

Deere, D., Billington, K., O'Toole, M. and Sinclair, M. 2012, *Supply of roof-harvested rainwater to residential hot water services: microbial risk assessment*, Water Quality Research Australia, Adelaide.

Appendix 2: Further information

Department of Health

The Department of Health is responsible for providing guidance for alternative water supplies to ensure that they are protective of public health.

Phone 1300 761 874 | www.health.vic.gov.au/water

Plumbing Industry Commission

The Plumbing Industry Commission (PIC) plays an active role in the development and enforcement of standards and regulatory requirements for all onsite regulated plumbing work. The PIC monitors plumbing works and takes corrective action if required.

Phone 1800 015 129 | www.pic.vic.gov.au

WorkSafe Victoria

The Victorian WorkCover Authority (VWA) is the manager of Victoria's workplace safety system. It is the responsibility of the organisation to help avoid workplace injuries occurring and enforce Victoria's occupational health and safety laws.

Phone 1800 136 089 | www.worksafe.vic.gov.au

Local government

Local councils are responsible for local enforcement of the *Food Act 1984* (which requires that potable water is used for food preparation activities at food businesses), and provide permits and approvals under the *Planning and Environment Act 1987* and *Building Act 1993,* which may apply to some rainwater schemes.

Local council contact details can be found on the Municipal Association of Victoria website: www.mav.asn.au

Standards Australia

Standards Australia has developed and published a number of standards relevant to the installation of rainwater systems.

www.standards.com.au

Australian Rainwater Industry Development Group

The Australian Rainwater Industry Development Group provide technical information on the design of rainwater harvesting and use systems. Their National Rainwater Tank Design and Installation Handbook can be purchased through their website, or from Standards Australia.

www.arid.asn.au

Water Quality Research Australia

Water Quality Research Australia Limited (WQRA) is a not-for-profit company, established and funded by its members, to undertake collaborative research of national application on drinking water quality, recycled water and relevant areas of wastewater management.

http://www.wqra.com.au/

National Association of Testing Authorities (NATA)

NATA provide accreditation for laboratories and similar testing facilities.

Phone 1800 621 666 | www.nata.asn.au

Appendix 3: Key steps for developing a rainwater supply management plan

Step 1: Organisational commitment to responsible use and management of rainwater

This first step requires organisational commitment to the application of preventative measures to ensure the responsible use and management of the water supply.

Someone should be nominated as responsible for the rainwater supply system. This role will require them to ensure that the water system is adequately maintained, operated and routinely monitored to ensure that the rainwater is of appropriate quality. The following details should be detailed in the management plan:

- person/manager responsible for system monitoring and maintenance
  - name of person responsible for the rainwater supply system
  - role and responsibilities
  - contact details (including after hours)
- other person responsible
  - role and responsibilities
  - contact details (including after-hours).

Step 2: Provide a detailed description of the water supply system

A detailed description and map of the rainwater supply system is important to help understand how the system works. The description and map should include:

- the water source
- storage and distribution
- any treatment applied to the water
- the end uses of the water.

A variety of methods can be used to map out the water supply system. Use a format that best suits your needs. Managers are encouraged to use this checklist to ensure all elements relating to their rainwater supply management plan are implemented.

Step 3: Identify hazards and ways to manage risks to the water supply

A thorough risk assessment of the rainwater supply system should be completed. A good understanding of the water supply system is required in order to identify all potential risks to the water supply and possible sources of contamination. The identified risks need to be managed and adequately addressed by measures such as routine maintenance of the system and if required, appropriate treatment.

Factors to consider when identifying hazards:

- possible sources of contamination and associated control measures
- source water (contamination sources)
- storage and risk of contamination inputs above ground and below ground
- treatment failure
- pipework (cross connection risks and biofilm growth).

Step 4: Document operation, monitoring and maintenance procedures for the water supply system

Document the standard operating procedures for the rainwater supply system, including what procedures to follow for regular operation, monitoring and maintenance.

Tailor the maintenance activities to suit your rainwater supply system and add additional items as necessary.

Treatment of the rainwater supply helps to ensure the health of consumers is not placed at risk. The most common treatment methods include filtration and disinfection (ultraviolet light and chlorine). To select the best method to treat the rainwater, consider consulting a water treatment professional.

For each monitoring activity, the following information should be recorded:

- person responsible (including contact details)
- frequency of monitoring
- procedure used
- outcome of monitoring activity.

Records should be kept for:

- results of system inspections
- results of microbial and chemical testing
- treatment performance (include indicators such as chlorine levels, UV intensity, turbidity)
- details (date and type) of maintenance carried out on the water system, including calibration of any monitoring equipment and equipment manufacturer maintenance and replacement schedules
- incidents and the corrective actions taken
- deliveries of carted water
- the posting of warning signs.

Step 5: Have an incident management plan in place

Plan how to respond if an incident occurs, include contingency plans and who to notify.

Unusual events can contaminate water supplies that are normally clean. These events might include:

- sewage or chemical spills
- dead animals in a storage tank
- bushfires
- equipment failure
- algal blooms.

If you suspect that the rainwater supply has been contaminated, act immediately to ensure everyone with access to the water is notified. Advise users to avoid accessing potentially contaminated water. Put up adequate signage to warn that the water is, or may be, unsafe to use. Ensure that potable water is used as an alternative source.

If the water has been contaminated, the microbiological or chemical levels may have to be tested at a water-testing laboratory. You may wish to consult with your local environmental health officer or a water treatment specialist for advice.

Step 6: Review

To ensure the management plan is effective and up to date, it should be reviewed on an annual basis.

Appendix 4: System assessment – hazard identification and control template

Hazard	Hazardous event	Typical control measures	Monitoring	Corrective actions
Roof catchment and storage				
Microbial *Faecal contamination from birds and animals*	Overhanging branches	Prune tree branches	Check tree growth during system inspection	Prune branches
	Bird and animal faeces on roof	Remove or modify structures that encourage bird perching *(this is particularly important for schemes with moderate risk of ingestion)*	Check during system inspection	Repair or modify, as required
		Treatment, where appropriate (refer to table 1)	As per manufacturer's advice For additional monitoring, refer to table 1	As per manufacturer's advice
	Animal access to tank	Protect or screen all inlets, overflows and other openings to tank	Check access covers, inlets, overflows and openings during system inspection	Repair gaps and secure access cover
		Maintain integrity of tank roof and body	Check structural integrity of tank during system inspection	Repair, as required
Microbial *Faecal contamination from humans (above-ground tanks)*	Human access to tank	Prevent access. Ensure tank is roofed and access hatches are secured	Check access covers during system inspection	Secure access covers
Microbial *Faecal contamination from humans and animals (below-ground tanks)*	Contamination of rainwater from surface water, leaking sewerage pipes or septic tanks	Use above-ground tanks, or protect tank from overground flows and ensure tank walls are intact	Check structural integrity during system inspection Check surface water does not enter tank during storm events	Repair or line inside of tank. Improve barrier to surface water flow

Hazard	Hazardous event	Typical control measures	Monitoring	Corrective actions
Roof catchment and storage				
Microbial *Growth in tank or rainwater system*	Growth of microorganisms in rainwater storage tank	Keep roof catchment and gutters clean Install a first flush diverter to minimise entry of nutrients and sediments to tank *(this is particularly important for schemes with moderate risk of ingestion)* Use 'gutter guard' and tank inlet screening to minimise entry of leaves and debris	Inspect roof, gutters and screens at tank openings during system inspection	Clean gutters Repair or replace any damaged screens
	Growth of microorganisms in rainwater system	Design system to prevent pooling and stagnation of water	Inspect gutters during system inspection, and periodically after rainfall	Clean gutters or make changes to ensure they drain quickly between rain events
	Growth of algae in rainwater storage tank	Ensure tank is light-proof	Check integrity of roof Inspect water for presence of visible algal growth	Repair roof Confirm algal species and risk to health; treat water to remove algae if appropriate
Microbial *Other*	*Other source of microbial contamination, identified on a case-by-case basis*	*As appropriate*	*As appropriate*	*As appropriate*
Mosquitoes	Access to stored water	Protect all tank inlets with insect-proof mesh	Check access covers, inlets, overflows and openings during system inspection Inspect water for presence of larvae.	Repair mesh to prevent access and if larvae are present, to prevent escape of mosquitoes Add small amount of medicinal liquid paraffin to the tank if larvae are persistent (approx 2 tablespoons for a 10 kilolitre tank)

Hazard	Hazardous event	Typical control measures	Monitoring	Corrective actions
Roof catchment and storage				
	Access to pooled water	Design system so that potential for pooling of water (for example in gutters) is minimised Keep gutters clear of debris	Inspect gutters during system inspection, and periodically after rainfall	Clean gutters or make changes to ensure they drain quickly between rain events
Chemical *Roof catchment contamination*	Accumulated sediments on roof catchments	Keep roof catchment and gutters clean and install a first flush diverter to minimise entry of nutrients and sediments to tank *(this is particularly important for schemes with moderate risk of ingestion)* Use 'gutter guard' or tank inlet screening to minimise entry of leaves	Check first flush diverter operation during system inspection Inspect roof and gutters during system inspection Inspect tank sediment levels every 2-3 years	Maintain first flush diverter Clean gutters Clean tank, if required
	Contamination with smoke and emissions from flues	For wood heaters, use fuel that is not painted or treated with preservatives, and ensure flues are installed according to the appropriate Australian Standards *(this is particularly important for schemes with moderate risk of ingestion)* For other flues, exclude affected sections of roof from rainwater catchment	Check choice of fuel Check flue installation Inspect roof before installing tank	Discard inappropriate fuel Address as appropriate
	Overflow and discharges from roof-mounted appliances onto catchment	Eliminate, or exclude affected sections of roof from catchment	Inspect roof before installing tank Check during system inspection	Make alterations, as appropriate
Chemical *Contamination from roof and system materials*	Chemical leaching from roof or system materials	Remove lead flashing and seal any exposed preserved/treated timber, or exclude affected sections of roof from catchment *(this is particularly important for schemes with moderate risk of ingestion)*	Inspect roof before installing tank	Remove, cover or seal, as appropriate

Hazard	Hazardous event	Typical control measures	Monitoring	Corrective actions
Roof catchment and storage				
		Don't collect water from roofs coated or painted with materials that may leach hazardous substances (e.g. lead-based paints or tar-based materials)	Inspect roof before installing tank	Remove, cover or seal, as appropriate
		Use tanks and system components that comply with the relevant Australian Standards	Check suitability of components with supplier or retailer	Remove or replace product
Chemical *Other*	*Other source of chemical contamination, for example from atmospheric pollution (identified on a case-by-case basis)*	*As appropriate*	*As appropriate*	*As appropriate*
Distribution and plumbing				
Microbial and chemical	Cross connections between rainwater and other water supplies	Ensure distribution system complies with PIC guidance and relevant Australian Standards	Inspect system after installation to ensure compliance Inspect after modifications or maintenance to system to ensure compliance	Rectify non-compliant distribution or plumbing work
Chemical	Chemical leaching from system materials			
Microbial and chemical	Cross connections between rainwater and other water supplies	Ensure distribution system complies with PIC guidance and relevant Australian Standards	Inspect system after installation to ensure compliance Inspect after modifications or maintenance to system to ensure compliance	Rectify non-compliant distribution or plumbing work

Hazard	Hazardous event	Typical control measures	Monitoring	Corrective actions
Treatment (where applicable)				
Microbial and chemical	Treatment process failure	Monitoring and maintenance as per manufacturer or water treatment specialist advice	As per manufacturer's advice	As per manufacturer's advice
End use				
Microbial and chemical	Unintended use of rainwater (e.g. drinking) causing illness	Make residents and rainwater users aware of appropriate uses through communication tools	Ensure communication tools or packages are available to rainwater users, and updated when necessary	Address as appropriate
		Provide signage, where appropriate	Inspect signage presence and condition during system inspection	Repair or replace signage
		Ensure distribution and plumbing system complies with PIC guidance and relevant Australian Standards	Inspect system after installation to ensure compliance Inspect after modifications or maintenance to system to ensure compliance	Rectify non-compliant distribution or plumbing work
			Inspect distribution system for cross connections to drinking water supply or connections to inappropriate uses	Rectify any inappropriate connections
		Ensure backflow prevention protects drinking water supply at any drinking water back-up to rainwater system and complies with Australian Standards	Inspect backflow prevention system, as per manufacturer's advice and Australian Standards	Repair or replace as appropriate

Appendix 5: Rainwater Treatment – microbial contamination

If it is suspected that water storages have been contaminated, corrective action should be taken. This normally involves controlling the source of contamination and treating or disposing of contaminated water.

Water storages can be manually treated with chlorine if the contamination is microbial. When treating contaminated rainwater storages it is important not to over-dose the system, and to follow occupational health and safety guidelines and all safety and handling instructions provided on any chemical containers.

To effectively treat rainwater storages, a dose of 5 milligrams per litre (mg/L) of chlorine is needed. This can be achieved by adding:

- 125 millilitres (mL) of liquid bleach (4% available chlorine) to every 1000 litres (kilolitre) of water in storage, or
- 40 millilitres (mL) of liquid sodium hypochlorite (12.5% available chlorine) for every kilolitre of water in storage, or
- 8 grams (g) of granular calcium hypochlorite (65% available chlorine) for every kilolitre of water in storage.

The concentrated chlorine mixture should be spread as widely as possible across the storage surface to promote mixing.

The volume of water (in kilolitres) in a cylindrical tank can be estimated using: V = D x D x H x 0.785, where D is the diameter of the tank in metres and H is the depth of water in the tank in metres.

Liquid bleach, sodium hypochlorite and calcium hypochlorite can be purchased from large supermarkets, hardware stores or swimming pool suppliers.

To ensure effective treatment, check that the free chlorine level is 0.5 mg/L at the rainwater storage outlet 30 minutes after treatment. If the free chlorine is less than 0.5 mg/L retest the water 60 minutes after treatment. If the free chlorine is still less than 0.5 mg/L repeat treatment and testing.

Once the free chlorine level of 0.5 mg/L has been met flush the rainwater distribution pipes with the treated water.

Note that disinfection with chlorine is only effective in controlling microbial contaminants and will not reduce or remove chemical contamination.