water SMART

PRACTICE NOTE 4

Rainwater tanks

WaterSmart development involves simple design and management practices that take advantage of natural site features and minimise impacts on the water cycle. It is part of the contemporary trend towards more 'sustainable' solutions that protect the environment and cost less.

This WaterSmart Practice Note explains how to design and configure domestic rainwater tanks.

- **Gravity & pressure systems**
- **Dual supply systems**
- **How to configure tanks**

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Rainwater tanks

Introduction

This Practice Note describes how to design and configure various types of domestic rainwater tank systems, including gravity systems, pressure systems and dual supply systems. There is currently an enormous resurgence of interest in using rainwater tanks due to their many economic and environmental benefits.

In urban areas, domestic water supply is typically met by importing large volumes of treated water from neighbouring catchments, often at considerable cost. At the same time, similar volumes of roofwater are discarded unused via stormwater drainage systems that have significant erosion, sedimentation and flooding impacts.

Whilst all mains water is treated to drinking water standards, as little as 1% of domestic water consumption is actually used for drinking. Hot water, toilet flushing, laundry and outdoor uses represent the bulk of domestic water consumption (about 90%), but these uses do not require water to be treated to such a high standard. Such uses can be satisfactorily supplied using rainwater collected from roofs and stored in tanks. Benefits include significant water supply cost savings and substantial reductions in stormwater discharges.

It is often mistakenly assumed that using rainwater solely for outdoor uses (such as garden watering) will produce substantial mains water savings. Mismatches between seasonal rainfall and outdoor water use patterns can result in poor utilisation of rainwater, resulting in long periods during which tanks are either empty or full. This problem can be remedied by using rainwater to supply interior uses such as toilet flushing. Not only does this ensure that stored rainwater is utilised at a relatively constant rate, but it allows rainwater to refill the storage more often. Using rainwater for various uses (such as toilet flushing and garden watering), each with different usage patterns, can result in optimum mains water savings and large reductions in stormwater discharges.

System overview

A rainwater harvesting system consists of the following key elements (see Figure 1):

- house roof
- roof gutters
- first flush device
- rainwater tank
- pump
- overflow to garden areas, infiltration trenches and street drainage system.

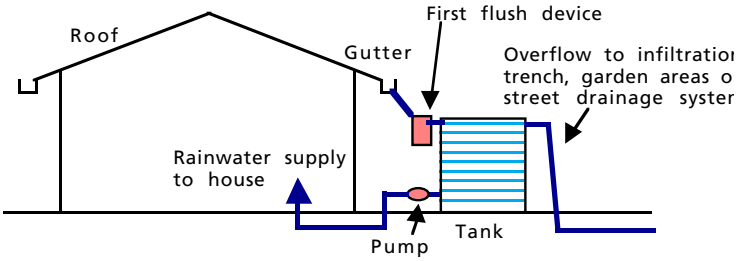

Fig 1: Key elements of a domestic rainwater system

Depending on site conditions, user requirements and budget, rainwater tank systems can be installed using a variety different configurations, including:

- installing tanks above- or below-ground
- using gravity or pressure systems
- using dual supply systems
- including a detention volume inside the tank for additional stormwater management.

Gravity systems

Gravity systems involve placing the tank on a stand (see Figure 2). Such systems are widely used in rural areas for household supply, and are also increasingly being installed in urban areas for supplying water for drinking and garden watering purposes.

Rainwater tanks

In gravity systems, rainwater is collected from the roof and directed to the tank via a first flush device. All connections to outdoor and household fixtures depend on gravity alone. Water pressure at each fixture is governed by the difference in height between the tank and the fixture.

To achieve a water pressure similar to that of normal mains water, the tank needs to be positioned 20 metres vertically above fixtures. This is generally not practicable. However, many household water uses such as toilets, laundry tubs and garden hoses do not require such high water pressures. Gravity systems are often quite adequate for these purposes.

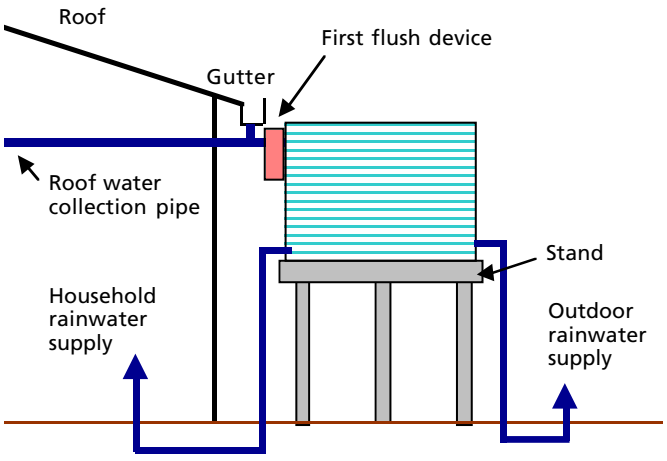

Fig 2: Configuration for a gravity system

Pressure systems

A pressure system involves using a pump to deliver rainwater to household or garden fixtures. Pressure systems are required where the tank cannot be installed at a sufficient height to provide acceptable pressure (see Figure 1), or if the tank is installed underground (see Figure 3).

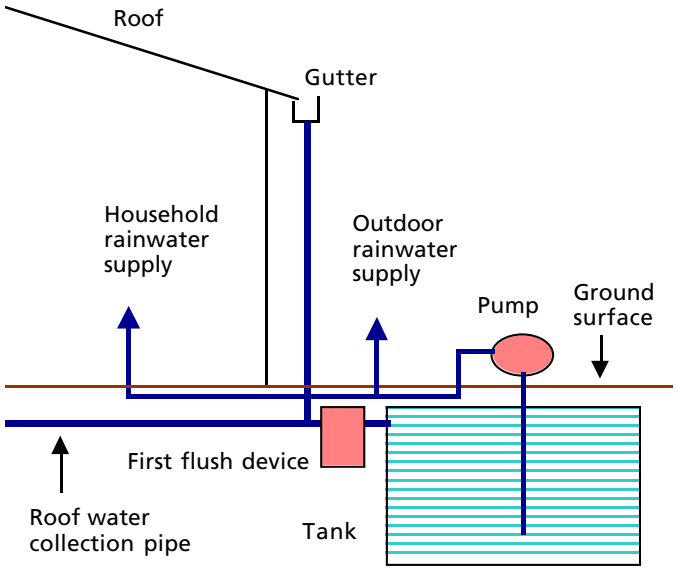

Fig 3: Configuration for a pressure system

Dual supply systems

Dual supply systems utilise both rainwater & mains water. Under this system, a rainwater tank is topped up with mains water when the tank level is low (due to dry weather or high usage). This ensures an extremely reliable water supply, whilst also providing significant cost savings and stormwater management benefits.

Required tank capacity will depend on the number of persons in the household, water use, rainfall and roof area, but 5,000–15,000 litres is generally sufficient. Smaller tank sizes can also provide considerable benefits. When designing the tank system, provision should be made for each of the following storage components (see Figure 4):

- minimum storage (or mains water top up zone) to ensure that water supply is always available
- rainwater storage zone
- air gap for additional stormwater management
- anaerobic zone (water is drawn from above this zone to ensure that sediment is not entrained).

Rainwater tanks

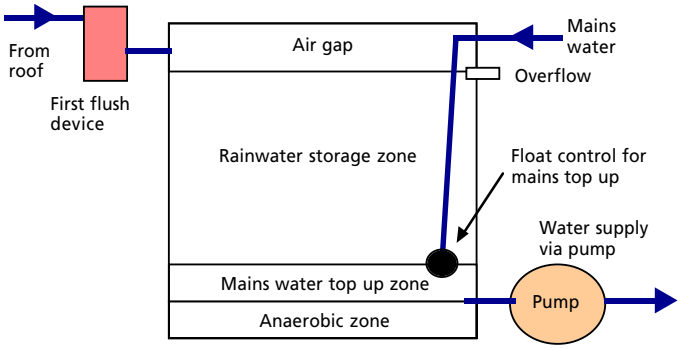

Fig 4: Storage components for a dual supply system

The minimum storage volume (mains water top up zone) is the maximum daily water use that is expected from the tank, less the potential daily volume of mains water (about 250–750 litres). If the volume of stored water falls below the minimum storage volume, the shortfall can be overcome by topping up the tank with mains water to the required level. A simple float valve system can be installed to do this automatically.

The rainwater storage zone comprises the total volume available in the tank to store rainwater below the overflow pipe. The air gap between the overflow pipe and the top of the tank can be used to provide 'stormwater detention', thereby delaying the delivery of excess roof water to the drainage system. The rainwater storage zone and the overlying air gap provide both stormwater retention and detention.

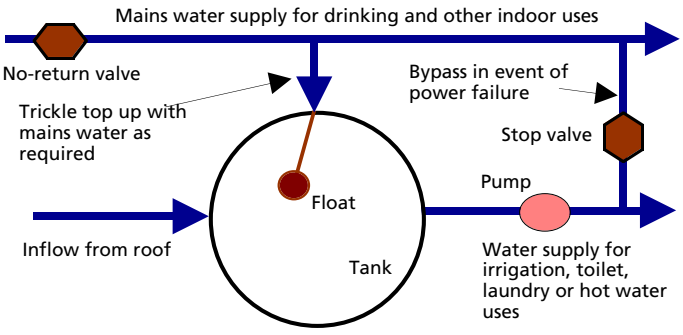

Fig 5: Configuration for a dual supply system

The plumbing configuration for a dual supply system is shown in Figure 5. Tank water is directed to fixtures via a small pump. When tank levels are low (such as during prolonged dry weather), the tank is topped up with mains water via a trickle system. This reduces peak demand on the mains water distribution network. The tank can be bypassed in the event of a pump or power failure.

When designing an above-ground tank, it is important to take into account the amount of site area required for the tank. A 5,000 litre tank will occupy an area of about 2 square metres, whilst a 15,000 litre tank will occupy 6 square metres.

First-flush devices

A first-flush device separates the first part of rainfall from entry to the rainwater tank (see Figure 6). This is required to prevent dust or other material on roof or gutters surfaces from contaminating tank water. The device operates by filtering roof runoff through a mesh screen to capture leaves and debris. The first part of runoff is stored in the chamber to slowly trickle through a small hole whilst cleaner water at the top of the chamber passes into the rainwater tank.

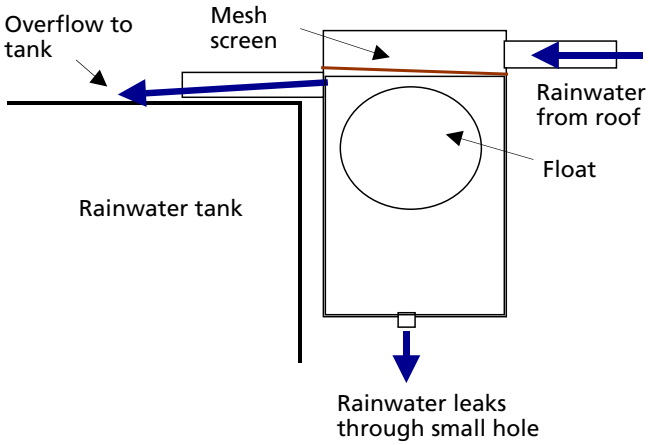

Fig 6: Basic design features of a first flush device

Rainwater tanks

Roofs & gutters

Rainwater should not be collected from roofs painted with lead-based or tar-based paints, or from asbestos roofs. Galvanised iron, Colorbond™, Zincalume™, slate or ceramic tiles provide acceptable water quality. Special roof guttering is not required. Normal guttering is sufficient provided that it is kept clear of leaves and debris.

Water quality

There is growing scientific evidence to confirm traditional knowledge and practice that water sourced from rainwater tanks is acceptable for most household uses. For example, research undertaken by the University of Newcastle has shown that domestic roofwater is of acceptable quality for toilet, hot water and outdoor uses. This research also showed such water, when used in hot water systems, complied with the *Australian Drinking Water Guidelines* provided that temperature settings greater than 50°C were maintained. (Relevant Australian Standards require domestic hot water systems to be set at 60°C, and hot water to be delivered to the house at 50°C).

It is not recommended that rainwater be used for drinking unless it is passed through an approved filtration system. This should be sufficient to remove possible contamination from accumulated soil and leaves in gutters, faecal material (deposited by birds, lizards, rodents and possums) and dead animals in gutters or tanks. Acceptable water quality can be maintained by:

- installing mesh screens over all inlets and outlets to prevent leaves, debris and mosquitoes from entering the tank
- installing a first-flush device to discard the first part of rainfall
- regularly cleaning gutters of leaves and debris.

Regulatory issues

Health departments

State government health departments do not prohibit the use of rainwater for drinking or other purposes. They do however recommend proper use and maintenance of rainwater tanks, and provide guidelines for this (see Cunliffe, 1998). The focus of published guidelines is on drinking water quality. No guidelines exist for outdoor, toilet, laundry and hot water uses.

Water supply authorities

Water supply authorities cannot prohibit the reuse of rainwater or stormwater on private land. However, they do require the installation of an appropriate backflow prevention device to prevent contamination of mains water by rainwater or stormwater (see ‘Design Standards’ below).

Local councils

Rainwater tanks and stormwater retention devices may require development consent. However, a growing number of councils have declared rainwater tanks to be ‘exempt development’ (which does not require consent) provided that certain requirements relating to size, height and siting are satisfied. If a development application is required, details should be provided as to:

- location and relationship to nearby buildings
- the configuration of inlet/outlet pipe and overflow pipe
- storage capacity, dimensions, structural details and proposed materials
- the purposes for which the stored water is intended to be used.

Local councils cannot prohibit the reuse of rainwater or stormwater provided the quality of the water is fit for the proposed purpose. Where a council is a water supply authority, it can require the installation of a backflow prevention device.

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Design standards

Chapter 7 of the *Australian Drinking Water Guidelines* (NHMRC, 1996) contains guidance on the management of small potable water supplies. Cunliffe (1998) provides a complete coverage of the topic. There are no recognised standards for the reuse of stormwater for secondary quality purposes.

Australian Standard *AS/NZ 3500.1.2-1998: National Plumbing and Drainage - Water Supply - Acceptable Solutions* provides guidance on the design of stormwater and rainwater reuse systems. The standard categorises cross connection between mains water supply and a domestic roofwater tank as a low hazard connection. This requires a non-testable backflow prevention device, such as:

- no physical connection between the tank and the mains water system
- an air gap
- a reduced pressure zone device (RPZD)

An air gap refers to a physical separation between the mains water and rainwater supplies within the tank. This is a simple, reliable and maintenance-free solution. A RPZD is a mechanical device that separates mains and other water supplies. It requires regular servicing and replacement. Under AS/NZ 3500.1.2-1998, dual supply systems that utilise an air gap or a RPZD can be configured as shown in Figures 7 and 8 respectively.

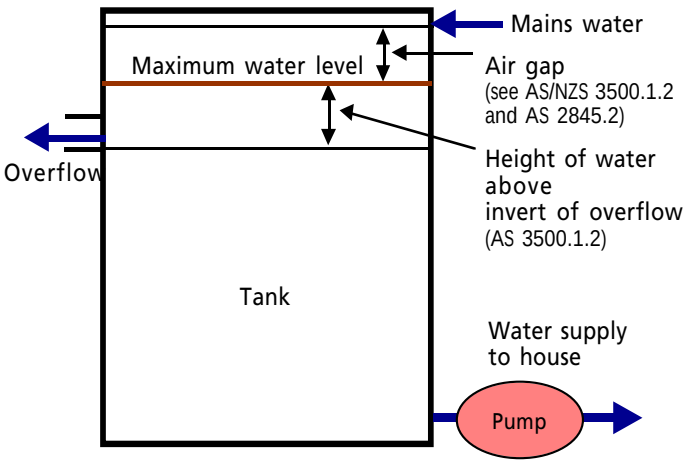

Fig 7: Backflow prevention using an air gap

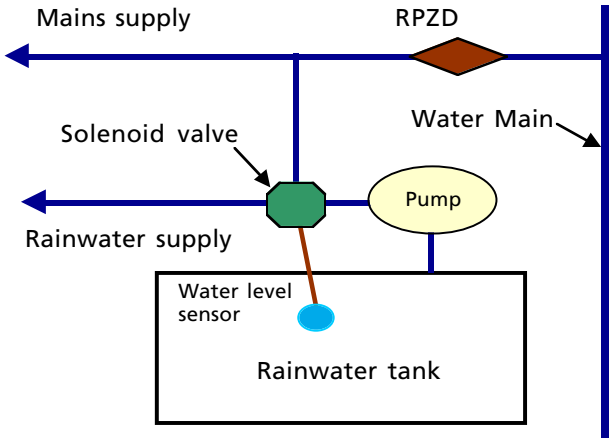

Fig 8: Backflow prevention using a RPZD

Materials & products

Concrete

Concrete tanks can be purchased in a ready-made form or constructed on-site. They can be placed above- or below-ground. Concrete tanks can be subject to cracking although careful construction techniques will minimise the potential.

Fibreglass & plastic

Fibreglass tanks are constructed from similar materials as fibreglass boats and can be used in above-ground installations. Plastic or poly tanks are constructed using food-grade polyethylene that has been UV-stabilised and impact modified. These tanks are strong and durable.

Metal

Galvanised iron tanks are constructed from steel with a zinc coating, and can be used in-above ground installations. This tank is strong and durable, but can be subject to corrosion if copper pipe for the household water service is connected to the tank. The first section of plumbing connected to the tank should be UPVC or other non-metallic material. Zincalume™ tanks are constructed from steel with a zinc/ aluminium coating. They are similar to galvanised iron tanks. Aquaplate™ tanks

Rainwater tanks

are made from Colorbond™ lined with a food-grade polymer. They can be used in above-ground installations. This tank is strong, durable and corrosion resistant. When cleaning the tank, it is important to avoid damaging the polymer lining.

Maintenance

A rainwater tank system requires very little maintenance. Regular maintenance tasks are:

- cleaning the first flush device every three to six months
- removing leaves and debris from the inlet mesh on the tank every three to six months
- removing leaves and debris from the gutters every three to six months
- checking the level of sediment in the tank every two years.

Tanks require occasional cleaning. The frequency of cleaning will depend on the amount of sediment and debris that enters the tank. A first flush device and adequate mesh screens on all tank inlets and outlets will ensure that the majority of sediment and debris does not enter the tank. This will reduce the frequency of cleaning to every 10 years or so.

Costs & savings

Tank costs vary from place to place. Indicative 2002 prices (without installation) are as follows.

Material	Capacity	
	4,500 litres	9,000 litres
Aquaplate™	$540	$860
Galvanised iron	$440	$640
Polymer	$670	$1,150
Concrete	$1300	$1,800

Small household pumps with pressure controllers can be purchased for $300 to $400.

Installation costs are also highly variable. The cost to fully install a 4500 litre above-ground rainwater tank for indoor and outdoor use can range from $1300 to $2100. Underground installation will usually add about $2000 to the cost. This system will provide the home owner with a water saving of about $50 to $110 per year, reduce stormwater discharges to the environment, reduce water demand on rivers and dams, and improve water quality in downstream stormwater catchments.

Useful websites

CSIRO Urban Water Program: www.dbce.csiro.au/urbanwater

CRC for Catchment Hydrology: www.catchment.crc.org.au

Peter Coombes, University of Newcastle: www.eng.newcastle.edu.au/~cegak/Coombes

Environment Australia: www.greenhouse.gov.au/yourhome

Environmental Conservation Planning: www.rain-harvesting.com

Michael Mobbs: www.sustainablehouse.com.au

BDP Environment Design Guide: The Royal Australian Institute of Architects

Product suppliers

Bushman Tanks: 02 6361 8750

Cessnock Tank Works: 02 4991 2558

Jenory Concrete Tanks: 02 4932 4298

National Pumps and Irrigation: 02 4934 8696

Rainwater tanks

References

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