NSW GOVERNMENT | Planning & Environment

BASIX®

Building Sustainability Index

Interim Rainwater Harvesting System Guidelines

May 2015

Contents

Rainwater Harvesting Systems

A rainwater harvesting system involves the collection and storage of rainwater from hard surfaces for a variety of uses. The objectives for rainwater harvesting system design are to ensure water quality is fit for purpose and to provide sufficient yield to meet demand.

Rainwater is water that drains from non-trafficable roof areas of a building or structure. Stormwater is water that drains from trafficable surfaces which can include roof structures such as roof terraces and other non-roof surfaces e.g. paved areas, driveways (based on Australian Standards HB50-2004 Glossary of building terms).

Whilst rainwater tanks are often considered in isolation, they actually form one element in a complex rainwater harvesting system comprising:

- A rainwater catchment and drainage system (i.e. roof, roof gutters, downpipes, rainheads and drainage lines).
- A rainwater tank (i.e. storage, inlets, outlets).
- A rainwater treatment system (i.e. screens, first flush device, filters).
- A rainwater distribution system (i.e. pumps, pressure tanks, mains supply control switches and valves, mains top-up, backflow prevention).
- Rainwater supplied fixtures (e.g. toilets, outdoor taps, washing machines).

NSW Health supports the use of rainwater for toilet flushing, washing clothes, hot water systems, garden watering, car washing, filling swimming pools, outdoor spas and ornamental ponds. NSW Health does not recommend the use of rainwater for drinking purposes where a reticulated potable water supply is available. NSW Health guidelines (http://www.health.nsw.gov.au/environment/water - NSW Health website) should be referred to when harvested water is being considered for all uses.

Rainwater Catchment and Drainage System

What do you need to consider when selecting an appropriate location for rainwater tanks?

Considerations	Appropriate action
Roof area	• Most roof materials are suitable for rainwater harvesting when the water is not used for drinking water supply. • The larger the connected roof area, the greater the potential for capturing rainwater. • Roof areas should be kept clear of overhanging vegetation and tree branches to minimise the quantity of leaves falling on the roof and restrict access by animals including rodents, cats and possums.
Location on site	• The constraints of a particular site should be identified and considered well

Considerations	Appropriate action
	in advance of the installation. Examples of constraints include boundary setbacks, adjacent neighbours, window views and easements. • Rainwater tanks should be located where the connected roof area and connections to fixtures can be maximised. • The downpipe locations will assist with confirming where the best location for a tank would be and how much roof area can be connected. • Below ground tanks can be considered to mediate against site constraints or for preserving view lines from windows

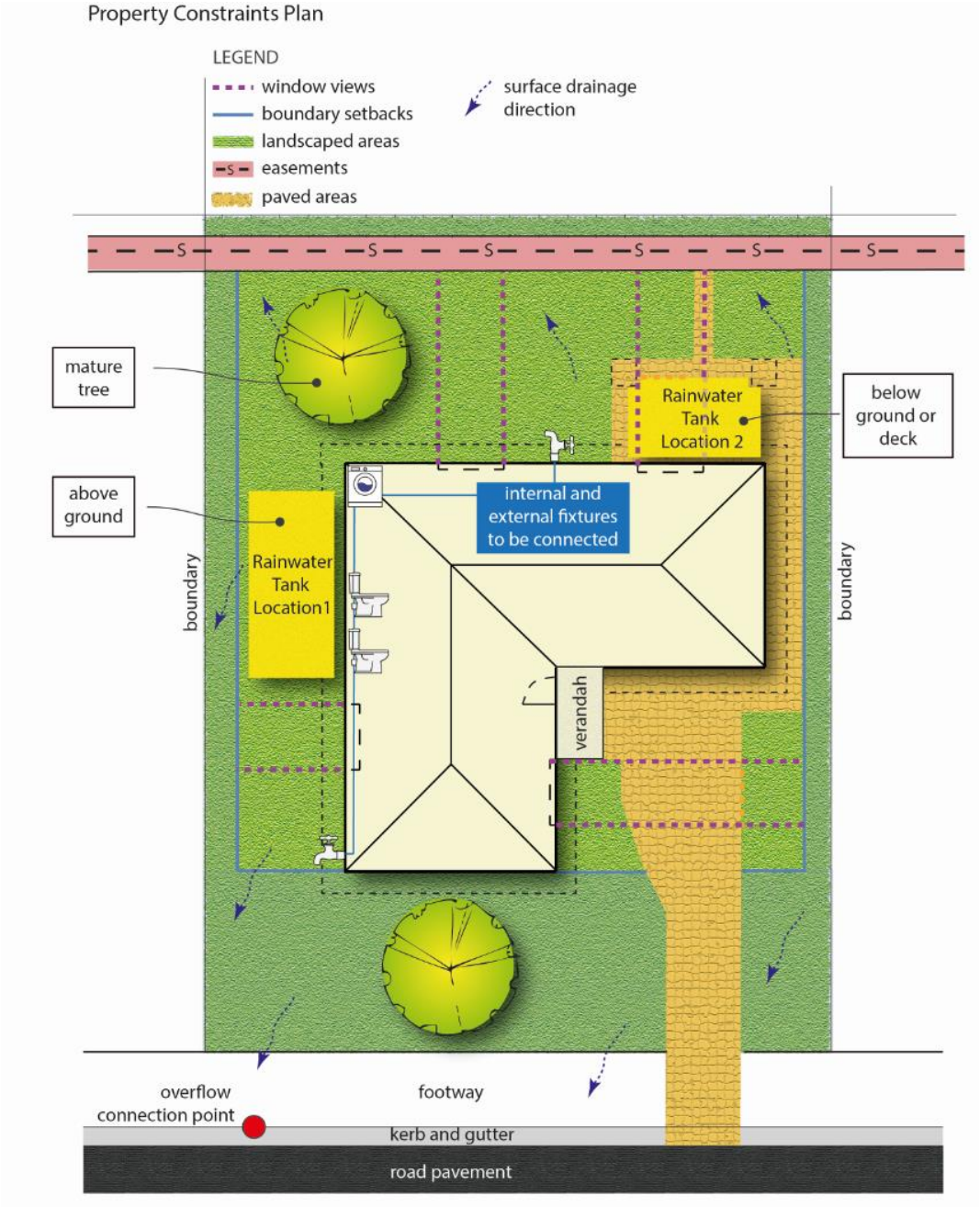


Figure 1: Example Property Constraints Plan

Potential rainwater tank locations and site constraints can typically be identified on a property constraints plan.

Roof drainage systems to the Rainwater Tank

Rainwater flowing off a roof is directed to downpipes distributed along the roof guttering. Downpipes are either gravity fed directly into the rainwater tank or connected below ground via a charged drainage system.

Below is a table explaining the three options:

Roof Drainage System	Description
Gravity systems	• Comprises one or more tanks distributed around a building fed directly by downpipes. • The tanks are typically located under or near downpipes. • Multiple gravity fed tanks on a site can be connected by below ground pipes to regulate the storage in each tank to the same level.
Charged Systems	• Commonly installed to maximise the roof catchment draining to a single central rainwater tank. • The pipes typically remain full of water between storm events unless manually drained via a dewatering pit. Drainage of charged pipes is essential for prevention of stagnant water and build-up or organic material. • It is important that the arrangement and flow capacity of charged drainage systems is confirmed by an experienced plumber or hydraulic engineer to avoid gutters overflowing in large storm events when system is full.
Below ground rainwater tanks	• Must be fully sealed to prevent inflow of ground water. • Must be sited to enable free draining of the down pipes to the tank. • To do this, ensure that the overflow from the tank is a minimum of 50mm below the inlet from the roof of the tank. Refer to AS3500 for guidelines regarding pipe sizing.

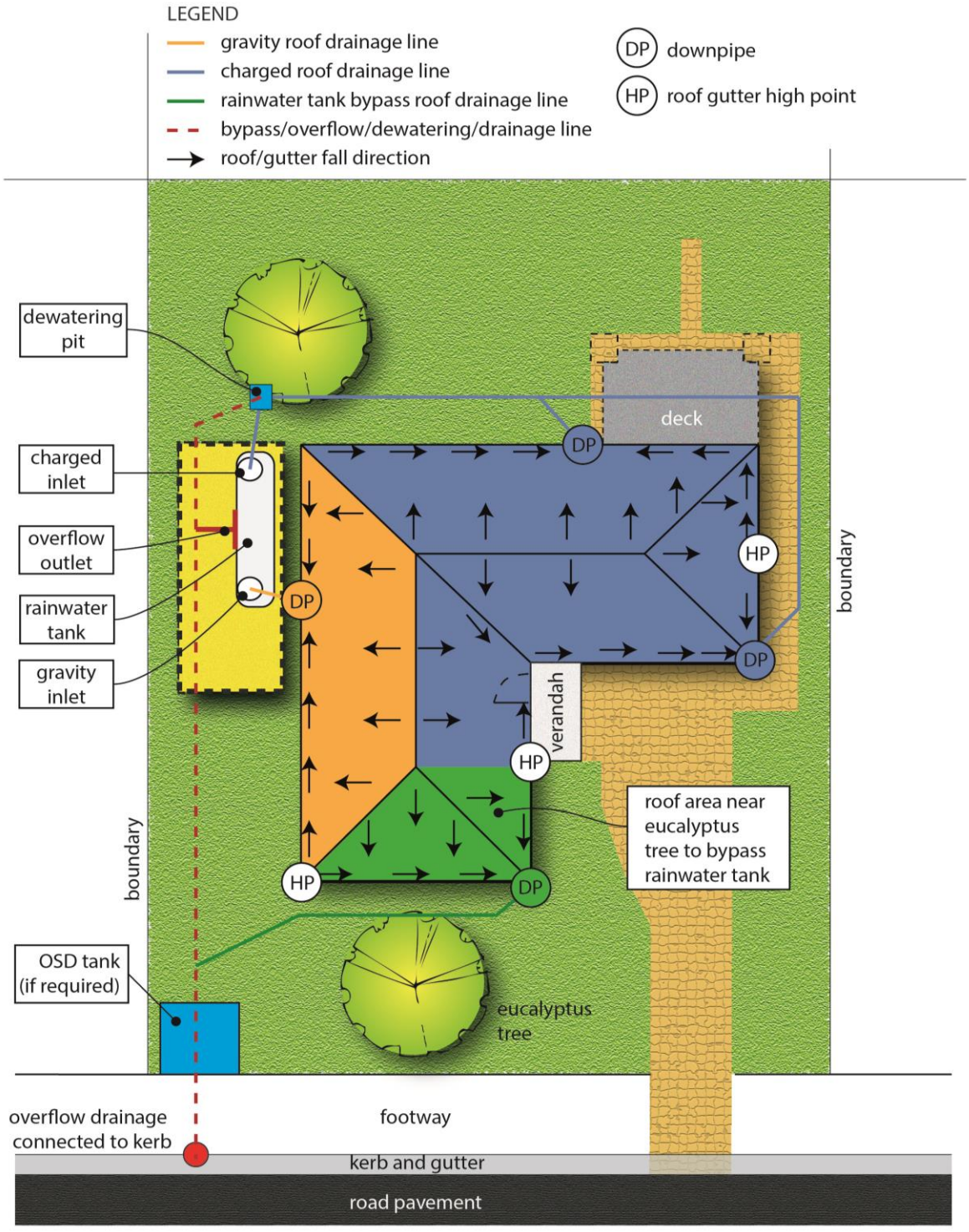


Figure 2: Example Roof Drainage Concept Plan

Before selecting a rainwater tank it is important to work out how much roof area can realistically be connected to the tank. A conceptual roof drainage plan should be prepared to guide decision making.

Rainwater tanks are available in a range of materials and shapes. An experienced rainwater tank supplier can provide advice on the most appropriate tank materials and shapes for a site based on a property constraints plan.

Most rainwater tanks require a slab or footing for support. An experienced supplier can provide guidance on any stand or slab requirements to support the weight of a full rainwater tank. Specialist engineering advice may be required for tanks installed on slopes or close to building footings.

If a rainwater tank will be located in a bushfire prone area, the tank should be fabricated from steel, concrete or other suitably protected material in accordance with NSW Rural Fire Service guidelines (http://www.rfs.nsw.gov.au/plan-and-prepare/building-in-a-bush-fire-area -NSW Rural Fire Service website). Durability of other components should be confirmed with suppliers and appropriate warranties obtained for tanks and other system components.

Storage Configuration

Rainwater tanks can be configured to achieve multiple functions including rainwater supply, stormwater detention and sediment trapping. A typical rainwater tank storage configuration is shown below.

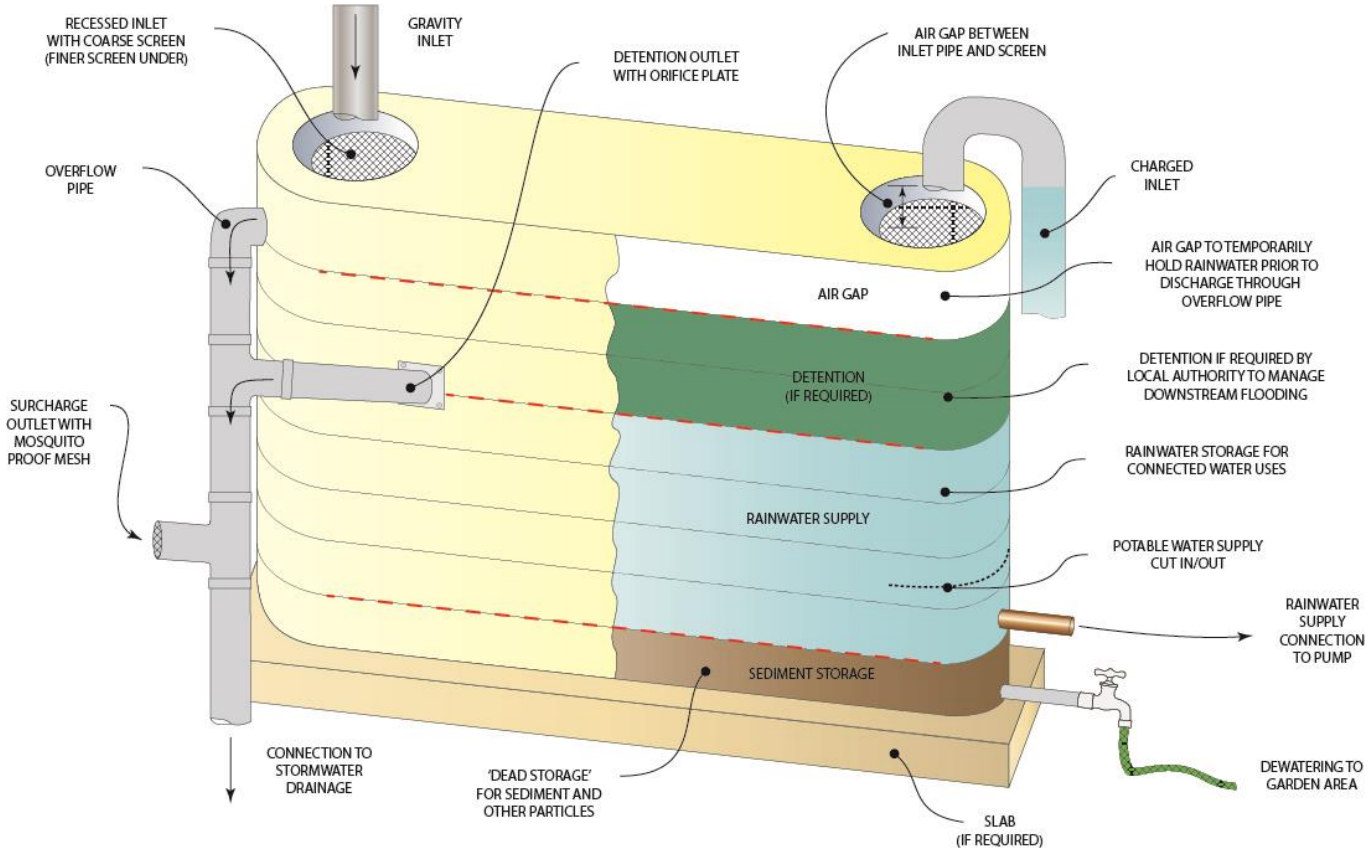


Figure 3: Example Rainwater Tank Storage Configuration

Inlet and Outlet Configuration

Outlet pipes are connected to a stormwater pit, kerb and gutter, absorption trench, or other system acceptable to the local council e.g. infiltration systems or raingardens. At all times, overflow from the

rainwater tank should not be directed over the ground surface into adjacent private properties or towards buildings.

A surcharge vent is required on any outlets to ensure stormwater from the street or property drainage system is unable to back up into the tank. The surcharge vent will typically comprise a three way pipe connection fitting installed along a vertical section of the outlet drainage pipe. The open part of the fitting should be covered with a mosquito proof mesh screen.

Additional Detention Requirements

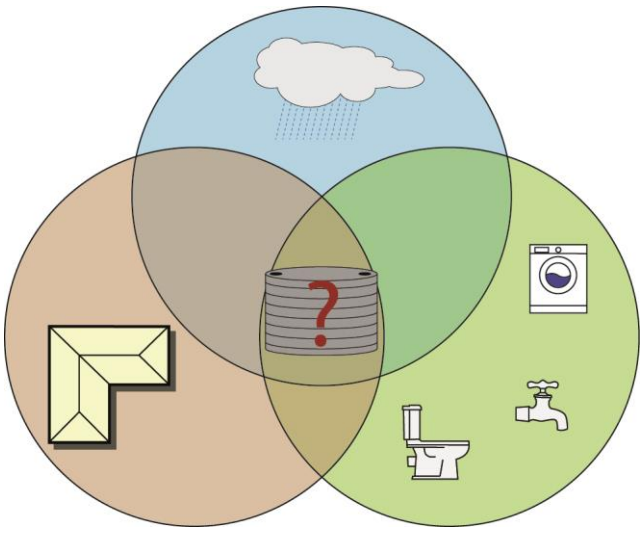
Allocating stormwater detention capacity within a rainwater tank may remove the need to construct a separate detention tank to manage stormwater flows. The detention volume must be in addition to the rainwater tank size required to meet BASIX certificate commitments. As in Figure 3 the tank configuration must be designed to leave the detention capacity free.

If a property is located in a bushfire prone area (confirm with the relevant local council), rainwater tanks can also be configured to incorporate additional storage required for fire-fighting supply, seek approval from your local council and the NSW Rural Fire Service. The NSW Rural Fire Service provides guidance on the additional fire-fighting storage requirements for residential development. (http://www.rfs.nsw.gov.au/plan-and-prepare/building-in-a-bush-fire-area -NSW Rural Fire Service website).

Sizing

Selecting the most appropriate rainwater tank size requires consideration of local rainfall, connected roof area and the fixtures/uses being supplied. Rainwater tanks are unlikely to meet all water demands at all times of the year. A connection to the potable water supply system will still be required to ensure water is available when the tank storage is low.

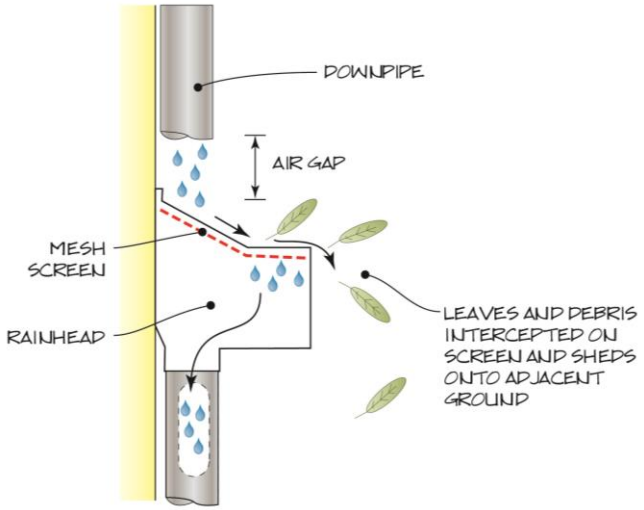
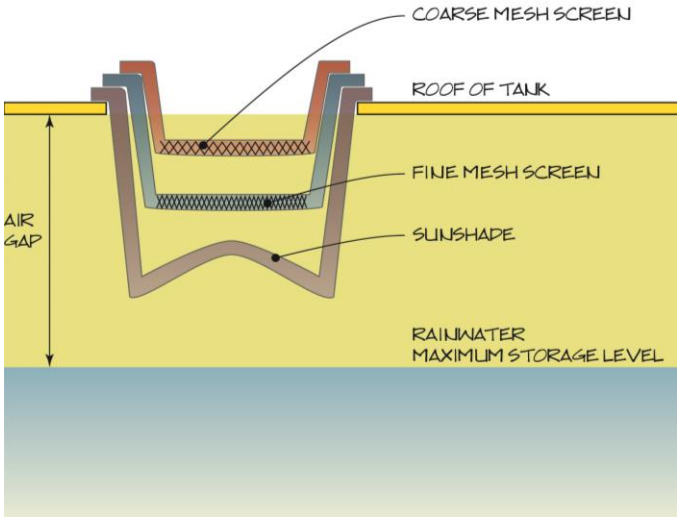
Large tanks provide additional storage capacity to collect rainwater and can maximize supply substitution, but are more expensive and require more space to install. Small tanks use less space, but will overflow and will need to be topped up by mains water more regularly. In addition to increasing tank size, connecting a rainwater tank to more roof area as well as connecting to as many appropriate fixtures/uses as possible will provide the most effective rainwater use.

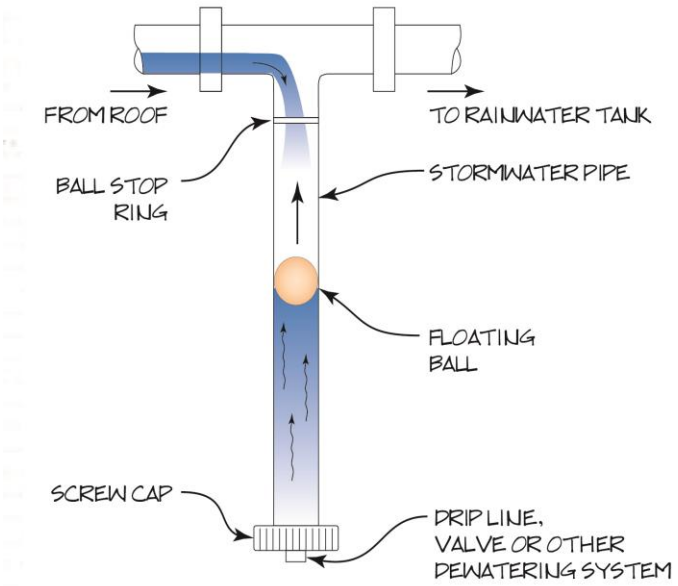


Professional stormwater engineers and tank installers can all assist with identifying the optimum tank size for a particular site. There are a range of resources, calculators and numerical models to assist.

Discoloured rainwater can be of concern to some for washing clothes and toilet flushing. Also odours from poor quality rainwater due to breakdown of leaves and other organic matter in the tank are undesirable. To minimise detrimental impacts on rainwater quality, potential water pollutants should be intercepted prior to draining into the tank. The use of multiple safeguards is recommended rather than relying on a single element. Ongoing treatment will ensure water quality is maintained.

Below are a few options:

Options	Description	
Gutter and downpipe screening	Screening devices positioned between the roof surfaces and the rainwater tank assist to separate this debris from the rainwater. Combinations of coarse and fine mesh screens can be provided to remove different size debris and prevent tank access by mosquitoes, frogs, rodents and other animals. Screens are typically provided at breaks in downpipes.	
Tank and inlet screening	Coarse and fine mesh screens are usually provided in the roof of the rainwater tank to filter rainwater at inlets. Finer screens are provided over outlets from the tank to prevent mosquito access. Sun-shades or screens should be installed to cover all tank inlets to minimise light penetration into the rainwater tank and restrict the growth of algae and other unwanted biological activity in the tank that can lower the rainwater quality.	

Options	Description
First Flush Diverters	A first flush diverter for downpipes should be installed prior to a rainwater tank inlet and after a screening device on all downpipes that feed in to the tank. First Flush diverters are one of the few safeguards for fine suspended particles and dissolved contaminants. In ground first flush diverters are another option which are ideal for sloping sites and can support the drainage of charged pipes. First flush devices should be sized appropriately, 20L should be sufficient for 100sqm of connected roof area for urban tanks not used for drinking water. This initial capture of rainwater typically contains the highest concentration of pollutants. Larger first flush devices may not produce proportional improvements in water quality. 
Passive Treatment	Passive water treatment occurs within the tank due to settling of sediments and formation of biofilms on the internal walls of the tank. To prevent excessive build-up of sediment, dewatering of the rainwater tank should occur every few years depending on location. A valve located at the base of the tank assists with completing this efficiently.
Filters	In most circumstances, screens and first flush diverters will be sufficient for providing rainwater of an appropriate quality for all non-potable rainwater uses. The use of filters is recommended in circumstances where finer pollutants or discolouration of water is of concern. Filters may require increased maintenance and energy input to pump water as they can regularly become blocked by fine sediments. If intending to connect rainwater tanks to all household uses, refer to the NSW Health guidelines for further information on filters and other advanced water quality treatment considerations (http://www.health.nsw.gov.au/environment/water -NSW Health website).
Outlet Height	A minimum tank outlet height of 100mm will reduce the re-suspension of sediments which capture at the bottom of the tank and reduce the opportunity for suction of sediments into the water supply.

Pump selection

In order to maintain appropriate flow rates, the majority of rainwater supply systems will require a pump to distribute water to internal and external plumbing fixtures. A pump should be sized to balance the required flow and pressure for the intended uses of the rainwater from the tank.

Recent monitoring of 52 rainwater tanks connected to new primarily four bedroom dwellings over a 12 month period identified that nearly all rainwater supplied was delivered at flow rates less than 15L/minute. These monitoring results suggest that pumps with capacities less than 30L/minute are sufficient for most residential applications.

The selection of an appropriate pump requires decisions on a number of elements by a number of individuals to ensure that it is appropriate for the intended use. Some key considerations are outlined in the following table.

Rainwater Supply System Element	Responsibility				
	Owner	Designer/ Builder	Supplier	Electrician	Plumber
Fixtures to be connected	●	●			○
Fixture location, height and specifications	○	○	○		●
Fixture water pressure requirements	○		○		●
Identify appropriate pump sizes and types			○	○	●
Energy efficiency of pump			○	●	○
Submersible or external pump?	○			○	●
Select pump	○		○	○	●
Pump location	●	●	○	○	○
Pressure control switch and uses			○	●	○
Mains supply control switch	○		○	●	○
Weather protection requirements			○	●	○
Sound proofing requirements	○	●	○	○	
Electricity supply requirements				●	
Accessibility for maintenance	○	○	○	●	●
● Key person/s ultimately responsible for the decision ○ Person/s who should be consulted /can assist with making the decision					

To mitigate against potential power failure resulting in loss of power to the rainwater tank pump there are systems that should be installed to ensure there is water available. A cost effective and simple option is a manual switching device, which relies on manually switching the home's water supply over to mains when the pump fails. Otherwise a more convenient option is an automated switching device which can be retrofitted to an existing tank or fitted upon installation. Automatic switching devices, otherwise known as mains backup systems, change from rainwater to mains when needed (power failure or no rainwater in the tank) and then switch back to rainwater when it is available. It is strongly recommended that you investigate the available technologies and select the most appropriate design for your situation.

Pressure Tanks

An effective way to reduce energy consumption is to attach a pressure tank to the rainwater pump. The key advantage of a pressure tank is that the pump is only required to turn on and off once to fill the pressure tank. Pressure tanks can be filled rapidly and efficiently by a high flow pump and then drawn down gradually over time as the water in the pressure tank is used. When the water level and pressure in the pressure tank is low, the pump starts and fills the tank ready for use again.

Pressure tanks are particularly effective where water use is dominated by a large number of smaller 'events' such as toilet flushing. As pumps draw more electricity in the start-up operation, reducing the number of times the pump starts will reduce the power it consumes.

Backflow Prevention

A water supply backflow prevention valve will be required along the potable water service line near the property boundary on the building side of the water meter. A backflow prevention valve ensures that water is unable to flow from the property side back into the water supply main and potentially contaminate the potable water supply. See Section B1.2 and BP1.4 of the NCC Volume Three, Plumbing Code of Australia for a detail of these requirements and confirm any other requirements with the local water authority.

As a rainwater tank will be empty on occasions, a back-up system is required to ensure that water can be sourced from a potable water service. In urban areas, access to potable water is typically available from water mains in the road reserve adjacent to the property. Two main options are used for securing water supply in urban areas when a rainwater tank empties:

- Resident operated manual valves to switch between rainwater and potable water;
- A switch that automatically opens/closes rainwater and potable supply valves in response to monitored water levels in the rainwater tank.

Some key considerations for selecting an appropriate back up option are outlined in the following table.

Planning/Design Consideration	Rainwater Supply Backup Option	
	Manual Valve	Mains Switch
Relative complexity of the back-up option	Low	Moderate
Separate plumbing to supplied fixtures	Possible	No
Potential volume of rainwater captured	Lower	Highest
Extent of resident monitoring required	High	Low
Potential for potable water use when rainwater available in tank	High	Low
Wet weather or night time outdoor access to maintain water supply	Possible	No
Additional plumbing to the tank	No	No
Plumber familiarity	High	High
Electrician required to install	No	Yes
Number of components	Low	High
Cost to modify or replace	Low	High
Maintenance	Low	Moderate

Further Guidance

There are a number of professionals that can provide advice when planning and designing a rainwater supply system as shown in the following table.

Rainwater Supply System Element	Professional Advisor				
	Engineer	Architect/ Designer	Builder	Supplier	Plumber
Property constraints plan	●	●	○		○
Fixtures to be connected		●	●		○
Connected roof area	●		●		●
Drainage system hydraulics	●				●
Pump and bypass system design	●			●	●
Tank size	●	●	○	○	
Tank shape and materials		●	●	●	
Identify suitable tank locations	●	●	●	○	●

6. Inspections and Maintenance

The plumber responsible for installing the tank should certify the installation and register this with the Department of Fair Trading along with the other plumbing elements.

If the tank is being used for firefighting or on-site detention purposes, it needs to be inspected by the local Council compliance officer.

If the tank is only being used for garden irrigation and outdoor uses, no inspection is required.

Maintenance

To ensure a good quality supply of rainwater, tanks systems must be regularly maintained. An effective maintenance program will;

- ✓ Ensure the roof collection area does not contain lead based paints, bitumen/tar coatings, treated timbers etc.
- ✓ Regularly inspect and clean roofs and gutters – overhanging branches should be removed.
- ✓ Regularly check and clean tank inlet and outlet screens to eliminate entry to the tank of vermin and /or mosquitoes.
- ✓ All first flush diverters, guards and screeners should be regularly checked and cleaned.
- ✓ Desludge the tank every 2 to 3 years.
- ✓ Tank structure should be assessed.
- ✓ Rainwater tank pump and mains control switch should be checked to ensure that it is working properly; pump is operating when rainwater in tank, mains water flowing when rainwater tank is empty.
- ✓ Ensure all leaks are repaired to prevent cyclic starting and stopping of a typical pump that may occur in cases where there is a leak or a dripping tap.