Rainwater Collection - Basic Components of a Rainwater Storage System

University of Arizona Cochise County Cooperative Extension Water Wise Program
waterwise.arizona.edu

Basic components described are for a non-potable storage system*. A potable system would need to consist of all food grade materials, and water would need to be properly treated to meet drinking water quality standards.*

Storing and using rainwater for landscape plants is a great alternative to using treated drinking water for irrigation. Collecting rooftop rainwater for later use is described as "active" rainwater collection.

Before you set up a water catchment system, ask yourself a few questions:

- What will the water be used for?
- Will I want the option to expand the system?
- How much rain can be collected?
- Where will the tank overflow go?
- Where can the containers be located? Above or below ground?
- Can the containers serve several purposes where they are located such as shading a garden, providing a windbreak or as the edge of a structure?
- Do I need to hide the containers for aesthetic purposes or neighborhood restrictions?
- How will the water get from the roof to the container and to the end use area? Will the system be gravity fed, or will it need a pump?

The Basics

A storage system is comprised of three main components:

1. Collection Area – roof surfaces provide an opportunity for rainwater capture
2. Conveyance System – used to transfer water and is comprised of gutters or flat roof drainage holes, and downspouts and piping
3. Water Storage – may be above or below ground and can be comprised of a single container or multiple containers

Key Components

Collection area

- The smoother, more impermeable the collection surface, the less debris accumulates, keeping the stored water cleaner

Conveyance systems

- Dry –Do not have water in them until it rains
- Wet –Water sits in the low sections until replaced by new water entering the system. This type of system allows for more flexibility in storage tank location. Proper pipe sizing is important to prevent flow backup, and pipes are susceptible to freezing. Connections between downspouts and piping must be watertight to prevent leaking

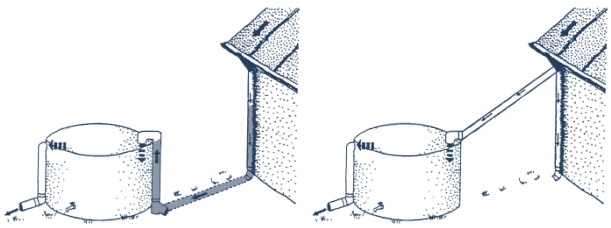


Figure 1 Examples of wet (left) and dry (right) conveyance systems

Storage tank(s) should have an

- Inlet for rainwater
- Outlet for the water such as a hose bib
- Overflow pipe (direct to plants). The overflow pipe should be as large as the inlet pipe
- Air vent for air to escape while the tank is filling. If open to the air, the overflow pipe can serve as the vent

Multiple tanks can be connected together to increase storage capacity. They can be linked at the top or the bottom.

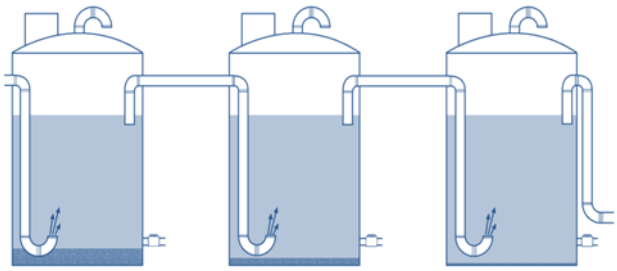


Figure 2 Multiple tanks connected in series

Filtration

To prevent clogging of the conveyance system and prevent sediment build-up in the storage tank, basic filtration is needed. The type and number of filtering components on a system depend on the amount of roof debris. If possible, use a floating pickup to draw water from the middle of the tank.

Filtration may include:

- Gutter and downspout filters prevent leaf litter from entering the system

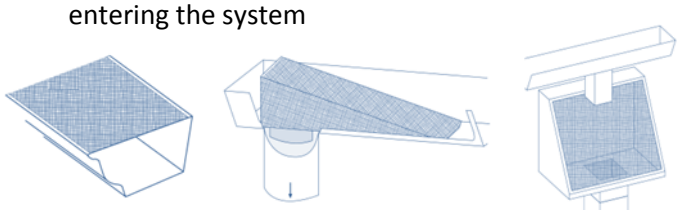


Figure 3 Common gutter and downspout screens

- First flush diverters or "roof washers" keep the first flush of poor quality roof runoff from entering the tank. The system should have a drainage outlet for emptying standing water, and be emptied as needed. This system is usually not needed unless water quality is especially poor (i.e. significant bird droppings)

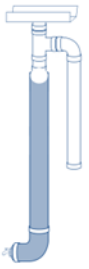


Figure 4 Example of a downspout first flush diverter

- A strainer basket or screen at the tank water inlet serves as further protection from debris or small animals. Do not allow the basket to sit below the water line

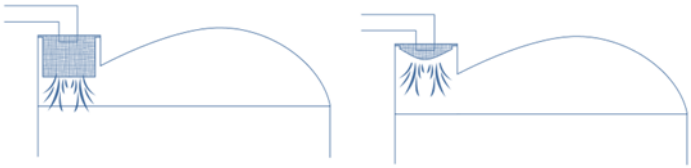


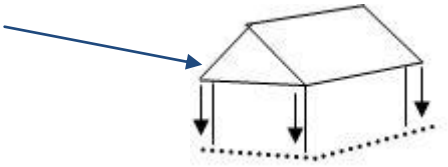
Figure 5 Examples of a strainer basket (left) and screen (right)

How Much Rain Can I Collect?

To calculate collection potential, multiply:
square footage of collection area * rainfall (in inches) *.623 * efficiency factor for collection type

The efficiency factor is approximately 90% for most roof types

Measure the footprint of the collection area:



Example:
Roof area = 1,000 sq ft
Annual Rainfall = 15 inches
Roof area x annual rainfall = 1, 000 sq ft x 15 inches x 0.623 x 0.90 = 8,140 gallons/year

Rules of thumb:

- 1000 square feet of roof = 623 gallons/1" rain
- One foot of elevation = 0.43 psi
- 2.31 feet in elevation = 1 psi, , no matter the size of the storage tank
- Water weighs 8.34 pounds per gallon
- There are 7.48 gallons of water in one cubic foot
- Roof washers: Depending on your water quality needs, divert 1 -10 gallons of runoff water per 1000 square foot of roof area

Optional Components

Pump: If water will be used with a drip irrigation system, moved long distances, or uphill, a pump may be needed to pressurize the system. Without a pump the water will be gravity fed. There are many different types of pumps, either external or submersible.

Pumps should be selected based on end use. It is best to consult a pump technician and provide him/her with the system requirements for correct pump sizing. Plumbing from the tank to the pump should be

Schedule 40 PVC pipe, not copper, ABS or galvanized metal.

For drip irrigation systems, the pump should be sized to prevent cycling on and off from pressure feedback. Drip irrigation systems and soaker hoses typically operate at 15-25 psi and release water to emitters rated at *gallons per hour* while pumps are rated at *gallons per minute*.

Irrigation:

- An irrigation controller can be used to automate landscape watering. If the system will be pressurized and does not use an on-demand pump, the controller should be able to control a pump start relay
- A pressurized drip irrigation system should include a pressure regulator and filter
- Gravity fed systems can use low flow/low pressure valve(s)

Automatic Fill Valve: A fill valve is connected to the house water supply and will automatically refill the tank to a specified level if rain amounts are insufficient. This system is used when the raintank is the sole source for the non-potable water. This is especially important if the system uses a pump.

When connecting a potable water supply to any rainwater system component that conveys water, a backflow check valve or air gap between the potable water inlet and the tank water will prevent cross contamination of waters.

Things to Know

Conveyance System

- Gutters should be sized and sloped adequately to move the water. The rule of thumb is ¼" per 10" of seamless gutter
- Connections such as elbows will slow the water flow and should be large to not significantly restrict flow

Storage Tanks

Tank considerations depend on cost, size, aesthetics, and/or the water use. To determine an appropriate tank size, consider using a water supply and demand water budget calculator. *(See Rainwater Collection – Calculating Water Supply and Demand to Estimate Storage Needs in Resources).*

- Cover tank openings to prevent evaporation and keep light out. Light promotes algae growth
- Dark colored tanks are preferable to light color tanks as they do a better job of keeping light out
- Above ground tanks should be UV resistant to prevent damage from the sun. Tanks can be painted with rubberized paint (no tank prep or primer needed for poly tanks) to provide sun protection, help prevent light from entering and/or make them blend with surroundings, or be fun and interesting
- On multiple tank systems, install shutoff valves between tanks for easy maintenance
- Identify water supply outlets as a "non-potable"
- Water reaches its own level, so interconnected multiple tank systems will only fill to the highest point on the lowest tank
- Be sure tanks are level
- Tanks located in windy areas should be tied down or store a reserve of water to as ballast
- Large tanks should be situated 5-10 feet from foundations and be placed on a surface such as a cement pad, pea gravel base, or compacted earth
- Tanks can be raised to increase water pressure and to easily access the water outlet
- Methods of irrigation such as basin flooding or "T-Tape" (a drip system that functions on 2-10 psi) can be used for gravity fed systems. For more information on "T-Tape", search the web
- Mosquito and animal-proof tank access points. A microbial insecticide specific to mosquito larvae containing *Bacillus thuringiensis israelensis (Bti)* can be used and is easy to find in gardening catalogues and in garden departments, often called "Mosquito Dunks"
- Direct the overflow to a useful area, away from tank foundation, buildings, and toward plants

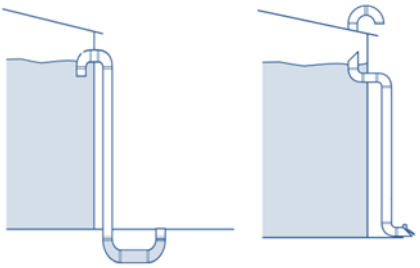


Figure 6 Examples of tank overflow outlets

- Weatherize water pipes and outlets to protect from freezing and UV degradation
- Small tanks are available at feed stores, car washes, web sites, rain harvesting suppliers, etc. Larger containers can be plastic, metal, fiberglass, ferrocement, septic tanks, corrugated metal pipes (culverts), or ? They are available at feed stores, septic system suppliers, building suppliers, tank

supply companies, and rainwater suppliers (look in phone books or on the web)

- Any tanks used for underground storage must be rated for this use
- A tank inlet component that helps calm the entering water will help prevent stirring a sediment layer

Figure 7 Examples of calming inlets

Figures 1-7 courtesy of Texas AgriLife Extension Service

Resources

Rainfall data: www.noaa.gov
"Regional Climate Centers"

UA Publications (http://cals.arizona.edu/pubs):

RainScapes, AZ1539

Rainwater Collection – Calculating Water Supply and Demand to Estimate Storage Needs

Harvesting Rainwater for Landscape Use, AZ1344

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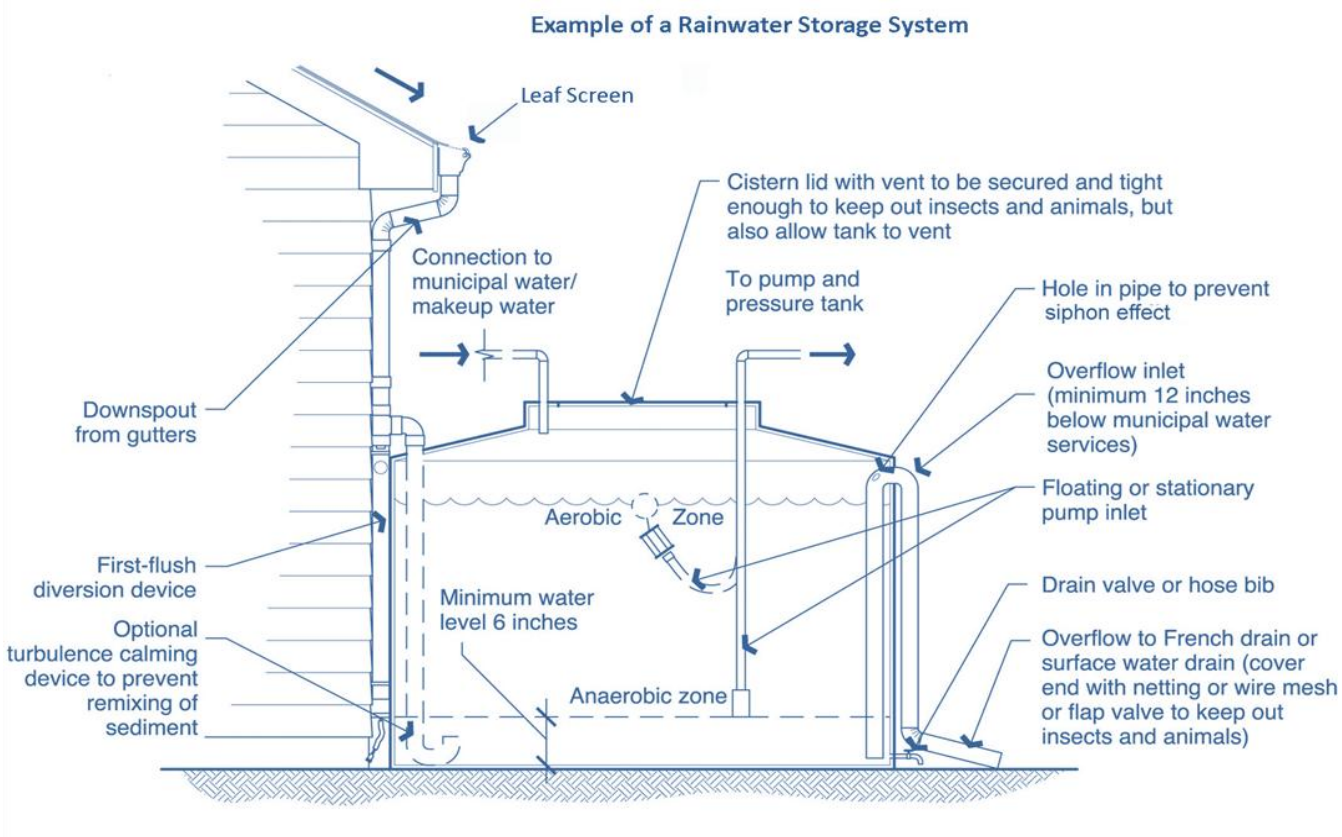
Maintenance

- Adequate filtration will slow sediment buildup and reduce cleaning chores. Filters should be cleaned periodically. This includes:
  - cleaning downspout and gutter screens
  - draining the first flush diverter of debris
  - clearing the strainer basket
  - rinsing or replacing pump filters
  - rinsing or replacing irrigation system filters
- Check the system regularly to identify potential problems
- Pump connections should include shut off valves and unions
- An access hatch or inspection port on a tank eases maintenance. The access hatch should be secured for safety to prevent unauthorized access



Residential Cistern Detail ***Forgotten Rain – Rediscovering Rainwater Harvesting*****, Heather Kinkade Illustration used by permission**