

# Rain Harvesting & Greywater Irrigation

Rain harvesting is an ancient technology used by many cultures to capture rainfall and use the water for irrigation and drinking. Today, rain harvesting is a popular residential water conservation method for supplementing landscape irrigation. Most commonly, rainwater is collected from the runoff from roofs into gutters and then directed into a storage vessel such as a barrel or cistern. The water is stored until needed for hand watering or drip irrigation. Harvested rain water should only be used for irrigation unless it is treated to potable standards.

Systems range in complexity from a barrel at the bottom of a roof downspout to extensive systems with covered storage tanks, pumps, and water treatment. Rain barrels may be purchased starting at about \$100. Some utilities and local governments offer rain barrel give-aways or other incentive programs.

Don't expect rain harvesting to save you as much water as tuning-up your sprinkler system or properly scheduling irrigation. But rain harvesting offers other important benefits including:

- 💧 Good quality water for plant irrigation.
- 💧 Reduced storm water runoff from your property which cuts down on the erosion and pollution of local creeks and waterways.
- 💧 Potential water savings and an alternative water source during drought times.
- 💧 There are limitations and drawbacks to rain harvesting.
- 💧 May only be practical in locations where rainwater can be collected in sufficient quantities during the time that it is needed.
- 💧 Systems must be maintained.

## Components of Rain Harvesting Systems

There are six basic components of all rainwater harvesting systems:

- 💧 **Catchment area/roof** - the surface on which the rain falls
- 💧 **Gutters and downspouts** - for transport from catchment to storage
- 💧 **Leaf screens and roofwashers** - used to remove debris and contaminants
- 💧 **Cisterns or storage tanks** - for storing collected rainwater
- 💧 **Conveyance** - the delivery system (gravity or pump)
- 💧 **Treatment** - filters, additives, etc. to settle, filter, and disinfect

## *Water Savings Potential*

Several factors determine water savings potential of rain harvesting including catchment area, *storage capacity*, annual rainfall and the *seasonality of rainfall*. A 1,500 square foot roof will collect 934 gallons of water from a 1 inch rainfall. If your region has 20 inches of rain annually you could potentially capture 18,680 gallons of water. However, your yield will be considerably less and will depend on the storage capacity of your system and seasonality of rainfall.

Rain harvesting may be impractical where rainfall is highly seasonal (unless you have very large storage capacity) because your storage containers will be quickly filled in the rainy season and quickly depleted in the dry season.

*The Texas Guide on Rainwater Harvesting* is an excellent source of information on designing and building rain harvest system. ([http://www.ecy.wa.gov/programs/wr/hq/pdf/texas\\_rw\\_harvestmanual\\_3rdedition.pdf](http://www.ecy.wa.gov/programs/wr/hq/pdf/texas_rw_harvestmanual_3rdedition.pdf))

### **Irrigation Options for Rain Harvesting**

Water can be delivered to the plants by gravity-feed or by pump. Both manual and automatic irrigation can be used with rainwater harvesting systems.

#### ***Manual Irrigation***

Manual irrigation is the preferred method for small systems. Often a hose bib is incorporated into the bottom of the rain barrel, which makes it easy to distribute the collected rainwater across the landscape. Larger and more elaborate rainwater harvesting systems often use manual irrigation because it is much less expensive and easier to maintain.

#### ***Drip Irrigation***

Subsurface drip irrigation is an excellent application method in dryer regions. The rainwater storage tank or cistern can be connected to a gravity fed drip system that provides water to a wide variety of plants and trees across the landscape. Such a system will require filtration to ensure that the drip emitters don't get clogged, but is generally easy to operate and maintain. This type of system typically does not operate on a timer and requires the user to operate a valve to start or stop irrigation.

#### ***Automatic Irrigation***

Some complex rainwater harvesting systems have pumps capable of providing enough pressure to run spray irrigation emitters or even sprinkler heads. These systems are more expensive and more complex to install and require filters to keep the pump from getting damaged and sprinkler heads from getting clogged. Automatic irrigation tends to use a lot of water very quickly, so it can only be used as part of very large rainwater harvesting systems that feature large storage tanks. These systems are typically designed and installed by professionals. See Resources at bottom for more information.

### **Tips and Maintenance for Rain Harvesting Systems**

The following tips will help you design and maintain a successful rain harvesting system:

- 💧 Metal roofs are the best catchment surfaces.
- 💧 All catchment surfaces should be made of nontoxic material. Painted surfaces should be avoided, or, if the use of paint is unavoidable, only nontoxic paint should be used (e.g., no lead-, chromium-, or zinc-based paints).
- 💧 Roofs with lots of overhanging vegetation should also be avoided because leaves and other debris may clog the catchment system.
- 💧 Storage tanks should have screens and a tight-fitting lid to prevent mosquito breeding, and to keep debris and critters from fouling the tank. Screens and filters should be cleaned regularly.
- 💧 Storage tanks should be opaque to inhibit algae growth.
- 💧 Use gravity rather than a pump whenever possible to convey the rainwater.

- 💧 Keep your roof, gutters, and downspouts clear of leafs, branches, and debris.
- 💧 Trim tree branches that overhang the roof. Branches are perches for birds that can produce waste.
- 💧 Storage tanks may require cleaning at infrequent intervals. Tanks should be checked annually for leaks and in cold climates and may need to be drained for the winter to prevent freezing and expansion cracks.
- 💧 Frequently monitor your irrigation system, checking for leaks, blocked emitters, and other problems.

## Resources for Rain Harvesting

One of the best references on the subject is *the Texas Guide to Rainwater Harvesting*.

If you live in a region where rainwater harvesting is fairly common (U.S. Virgin Islands, parts of Texas, Oregon, & Arizona, etc.) you should be able to find system installers in the yellow pages. In areas where rainwater harvesting is not practiced frequently it may be more challenging to locate equipment and installers. Roofing and gutter installation companies may be able to help you locate rainwater harvest system installers.

A substantial amount of information is available on the internet including sample designs and a list of suppliers. Rain barrels are available from a wide variety of supplies on the internet or at builders hardware and gardening stores. The following web sites should be useful in locating sources for rainwater harvesting systems and design information:

[www.oas.org](http://www.oas.org)

[www.ag.arizona.edu](http://www.ag.arizona.edu)

[www.twri.tamu.edu](http://www.twri.tamu.edu)

[www.jademountain.com](http://www.jademountain.com)

[www.waterwiser.org](http://www.waterwiser.org)

[www.cityfarmer.org](http://www.cityfarmer.org)

[www.twdb.state.tx.us](http://www.twdb.state.tx.us)

[www.nahbrc.org](http://www.nahbrc.org)

[www.kingcounty.gov](http://www.kingcounty.gov)

## Greywater (a.k.a Graywater)

The definition of greywater may differ from state to state, but greywater is usually defined as "untreated used household water that does not contain human wastes." Examples of greywater include: wash or rinse water from a sink, shower, bathtub, or other household fixture, excluding a toilet. On average up to 40 gallons per person of greywater is available to be recycled on a daily basis. In areas where greywater systems are permitted, water that does not contain human wastes may be reused for toilet flushing and outdoor irrigation of non-food plants.

Because greywater systems require separate "dual" plumbing to collect these wastewaters, they can be quite expensive. Greywater systems may be cost effective if they are incorporated into the construction of a new home but probably not for modifying an existing home. You should maximize other efficiency measures such as water-wise landscaping, Smart Irrigation controllers and high efficiency toilets before pursuing greywater. After that, it can offer a way to reuse a substantial portion of indoor household water use.

## Components of Greywater Systems

Greywater systems vary in complexity but generally consist of the following components:

- 💧 Dual plumbing to collect wastewater from sinks, showers, tubs, etc.
- 💧 Three-way valve to divert contaminated or excess water to the sewer or septic system;
- 💧 Treatment assembly such as a sand filter,
- 💧 Holding tank to store the water until needed
- 💧 Bilge pump to pump water from the holding tank to the irrigation system (unless gravity fed).
- 💧 Irrigation or leaching system to use the water (or plumbing to refill toilet tanks)

## Types of Greywater Systems

There are three levels of greywater system currently available. The table below, courtesy of Home Energy Magazine, briefly describes the features and cost of these systems.

Types of Systems Currently Available			
System Type	Source of Greywater	Features	Cost
Low-tech owner or professional installation	Washing machine only	200 micron mesh filter 55 gal garbage can w/locking lid	\$400 \$800
Medium-tech	Uses all greywater sources	Sump pump to pvc tubing Subsurface drip irrigation 200-micron mesh filter (2) 55 gal. storage tanks	\$1,000 \$1,500
Fully automated Professional installation	Uses all greywater sources	Automatically back-washed sand filter 250 gallon storage tanks Pumps at both source and tank/filter 3-way valve, backflow preventers Microprocessor controls all flows Backed by potable water	\$2,500 \$5,000

Source: Bennett, Dick. "Graywater An Option For Household Water Reuse", Home Energy Magazine. July/August 1995.

## Irrigation Options for Greywater Systems

Most greywater systems are designed so that the reuse system links directly with a subsurface drip irrigation system feeding a select group of landscape beds.

Very few greywater systems feed into automatic clock driven irrigation systems. There simply isn't a large or reliable enough supply of greywater for that type of system. Instead, many greywater systems

use gravity to irrigate plants that are downhill from the greywater storage tank. In these systems, subsurface drip irrigation is often utilized.

Some greywater systems do feature pumps capable of providing enough pressure to run spray irrigation emitters or even dirty water sprinkler heads. These systems are more expensive and more complex to install.

### **Benefits and Drawbacks of Greywater Systems**

The average family of four can save about 30,000-40,000 gallons of water per year. Water saved from your greywater system can be put to use in landscaping either at the time of its original use, or saved for later as a resource for dryer times. Depending on your storage tank capacity, greywater can be a cushion of water during drought. The water you save with graywater system will also reduce your water bill, if you live in an area with metered water.

Greywater reuse also has environmental benefits. Less wastewater is generated that would otherwise have to be treated and disposed of, and lower water use allows for greater amounts of water to remain in local watersheds and groundwater, benefiting wildlife and humans alike.

While you will save water, there are drawbacks. Retrofitting your home with a greywater system can be quite expensive and intrusive to install dual plumbing for wastewater collection. Greywater systems are more cost effective if they are incorporated into new construction (or if you have to rework your plumbing system for other reasons), or if they are very simple systems. Families with large indoor water usage will benefit more than those with less indoor water use.

Also be aware that as the efficiency of indoor fixtures and appliances improves, there will be less water available for reuse. New high efficiency clothes washers, for example, can cut your water and energy use by 50% and are probably more cost-effective than installing a greywater system.

Greywater is limited to only a few uses, as it can pose health risks if used on food plants or for indoor uses other than toilet flushing. If you don't have a landscape to irrigate, there may be no reason to do it. Soaps and other chemicals in greywater may also adversely affect some plants.

Finally, depending on where you live, it can be difficult to obtain a greywater permit. In some areas greywater systems are illegal and in other areas many restrictions are placed on building and maintaining them. Check the local regulations in your area before pursuing greywater.

### **Tips and Maintenance for Greywater System**

Systems can either be custom designed and built, or purchased as a package. Some system components can retrofit existing irrigation systems. If you intend to purchase a ready-made greywater kit, "buyer beware" is the message according to Oasis Design. Claims by greywater manufacturers are often overstated. According to Oasis Design:

- 💧 The majority of successful greywater systems are very simple (e.g. a garden hose hooked up to the bathtub or clothes washer drain).
- 💧 The economic payback time for the majority of *complex* greywater systems is often longer than the system life.
- 💧 Most new greywater reuse systems are abandoned or achieve less than 10% reuse efficiency within five years.

The bottom line is research any system carefully before taking the leap into any type of complex greywater system. Carefully consider what you will irrigate with the greywater. The homeowner or designer must decide which plants can be irrigated with greywater. The soil type, the volume of greywater produced, and the summer water requirements of the plants determine the irrigated area.

### **Maintenance**

Regular maintenance of a greywater system typically involves cleaning and replacing filters and making sure the system continues to function as designed. Below are a list of greywater do's and don'ts courtesy of the Water Conservation Alliance of Southern Arizona [www.watercasa.org](http://www.watercasa.org).

#### Greywater Do's...

- 💧 Regularly check your greywater system to be sure it is functioning properly.
- 💧 Storage tank should have a secure cover for safety and mosquito control.
- 💧 Keep an eye (and a nose) out for leaks.
- 💧 Operate your greywater irrigation system efficiently to provide sufficient water to your plants while minimizing loss from deep percolation beyond the root zone.
- 💧 Clean and/or replace your greywater filter regularly.
- 💧 Frequently check your plants that are greywater irrigated for signs of over watering or stress from high organic content in the water.
- 💧 Check for information about ingredients in laundry products that may affect the plants you are irrigating.
- 💧 Divert your greywater to your sewer or septic system when laundering diapers or dyeing clothes.

#### Greywater Don'ts...

- 💧 Do not use greywater to irrigate food crops or any other use except toilet flushing.
- 💧 Never allow greywater to leave your property.
- 💧 Don't use water that contains hazardous chemicals such as those used for cleaning car parts, washing of greasy or oily rags, disposal of solutions from home photo labs or similar hobby activities.
- 💧 Don't over irrigate with greywater.
- 💧 Don't reuse your greywater if any family member has an infectious disease or from laundering diapers.

### **Resources**

The following web sites offer information and links to retailers and manufacturers of greywater reuse systems for single-family homes.

Oasis Design (<http://oasisdesign.net/greywater/>)

National Assoc. of Homebuilders Research Center (<http://www.homeinnovation.com/>)

Planning A New Greywater System (<http://www.greywater.com/planning.htm>)

[www.greywater.com](http://www.greywater.com)

Greywater Future Trends (<http://www.h2ouse.org/tour/rain-harvesting.cfm>)