

Welcome - Graywater Demonstration Project
Mitchell Lake Audubon Center, San Antonio Texas



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Graywater Irrigation Primer

Some Background

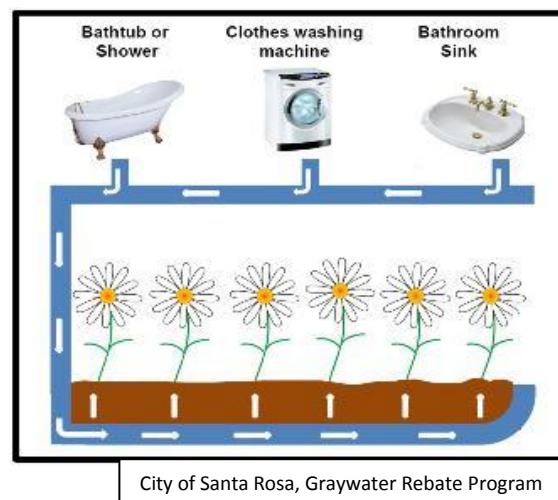
In Texas, *graywater* is defined as untreated, non-toilet, household water including water from bathroom sinks, showers and baths. Implied in this definition is water produced from clothes washing in the home. Exception: It does not include water from clothes washing if diapers are laundered routinely.

A primary use for water in many households is irrigation of lawns and gardens. Many homeowners have considerable time and money invested in their landscape and most people enjoy some “greenery” in and around their homes. For some people the idea of water recycling in the home is consistent with their ideas of environmental sustainability, and for that reason graywater use is a viable option. However, for most people, the decision to use graywater for irrigation will be purely financial. What’s the cost and how much money will I save?

The answer to these questions is “it depends”. Things to consider are how large is your family (larger families consume more water); what do I plan to do with the water once I have it; what is the initial expense of installation; how easy is it to maintain; are there any health risks associated with graywater use. These are some of the questions you might consider when planning a graywater harvesting project at your house.

Harvesting of graywater in your house can lower the amount of potable water used for irrigation and reduce your monthly water bills. Lowered potable water use in the home can also result in lowered sewage charges as well, since these are often linked in the utilities billing system. This water conservation effort can also lower the utilities cost to provide water to customers since energy is required to pump potable water supplying each end user. Lower water use results in less energy consumed in the utilities distribution network.

Droughts, rising energy costs for water transport and treatment and increased population are driving an interest in innovative alternatives to traditional water sources. Many areas are already under severe water use restrictions, and current predictions indicate this drought will persist; all the more reason to install simple conservation measures to reduce potable water use in the home.

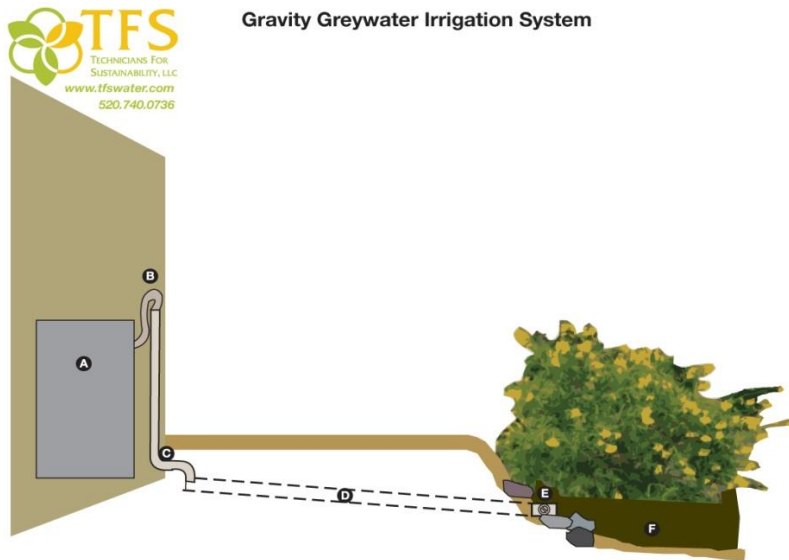


Looking at the picture above, we all have sources of graywater in our homes, and we would like to get it where it can do us some good and save us money in the process. It’s the “in-between”, from source to end use that may vary from one home to another. The *general principle* in graywater system design is that there are *no general principles*. The type and number of Installed components vary depending on several factors and may be divided into low technology, medium technology, and high technology systems. These differences will be discussed in a later section.

Getting Started

Choosing the right graywater system (low, medium, high technology) to install is based on key factors that should be considered early in the design process. For the homeowner, even before you start thinking about installing a system, regardless of complexity, you should consider how much you are willing to spend and who will do the installation.

If you are fairly good with basic hand tools, then a low tech system is well within your capabilities. If you are a DIY plumber, then a more complex system might be easy, based on your experience and the tools available to you. Depending on your particular home construction, some graywater retrofits are just not worth the cost. These will be evident as we explain the simple factors needed to consider a graywater irrigation system.



The picture above shows an application of a gravity irrigation system from a washer. Even this simple system requires consideration of several aspects of your home and landscape before deciding what to install.

Some Factors to Consider

At times even the obvious questions need to be asked so we should start with some basics. Thinking about these questions, you will begin to see how a graywater irrigation system might be properly used in your home.

1) Where do you want to use the graywater that you collect from your home? If the area to be irrigated is large, far away from your house, and at a higher elevation than your home, then these factors will affect the design of your graywater system. A simple gravity design will not be suited to this application. This generally means more parts, labor, and design to accomplish the task.

2) What is the nature of the landscape to be irrigated? Plants which require lots of water to survive may need additional watering in addition to the graywater; that defeats the purpose of installing a graywater system in the first place. Native and other well-adapted plants, adapted to dry conditions in Texas, will likely thrive using the additional moisture provided by a graywater irrigation system. Also, graywater systems are best suited to watering distinct plants rather than smaller plants spread over a large area.

3) Assuming we are talking about an existing house, is the construction of your home a factor to consider as well? If you want to capture every ounce of produced graywater, and your home is “slab on grade” construction, meaning your plumbing goes through a concrete floor which is directly on the ground, then this becomes a very costly project. This is in contrast to a house which has a crawlspace or pier and beam construction where plumbing pipes are accessible in the area between the floor and the ground. The exception to the difficulty of a slab on grade house would be if the home is a two story design and the second floor shower, bath, and sink plumbing are accessible. Even if your house is slab on grade, the washing machine is often still accessible and requires minimum effort to capture the wash/rinse water before it goes down the drain.

Factors (continued)

4) Can I use water from a dishwasher? Dishwashers are not a good source of graywater because the detergents used are higher in salts which over time will destroy the structure of your soil. The exception would be to purchase detergents low in salts and other detrimental chemicals. These detergents generally cost more and therefore would reduce expected savings from your graywater reuse effort.

5) Can I use produced graywater if I have a water softener installed in my home? Most water softeners use brine which is salt slurry to make the water soft. This type of water is not suitable to be used for outdoor irrigation since it can harm plants and soil. There are alternative water softeners that use potassium rather than sodium that are acceptable. Also, depending on the water hardness in a given locality, many washing machines are plumbed to bypass the water softener. This wash water can be used in your graywater irrigation system.

6) Can I use graywater for my pond? Graywater is not suitable to be used for any type of water feature, i.e., water fountain, waterfalls, pond, creek, etc. A graywater pond may begin to smell, and may present a health hazard if someone played in it and accidentally drank it. Graywater used for irrigation is acceptable since it is applied directly to the soil and the most effective graywater “filter” is biologically active soil covered in mulch.

7) Can I store my graywater for future use? The simple answer is “No”. The general rule of thumb is to use your graywater within 24 hours, but is better if it is used immediately as it is produced. Unlike fresh water and rain water, graywater contains nutrients and organic material from soaps and dirt. As these begin to decompose they use up oxygen in the water which then begins to smell.

8) Is graywater use legal? Policies on graywater use differ from state to state and within municipalities. Check local building codes for specifics.

Selecting Your System

We will now begin the discussion of some graywater specifics so that you can begin to formulate which system, low tech, medium tech, or high tech best suits your needs.

Remember that the goals are to conserve potable water use in the home, lower monthly billing for water and sewage fees, and irrigate some of our landscape in the process. Any savings is good savings, but spending too much money to accomplish the task might not make economic sense. A good rule of thumb is that expected savings will be between \$5 -\$25 per month and a 2 year payback on your investment is a reasonable expectation.

Which areas of the home you select for graywater collection and redistribution will affect the cost of the system, the complexity of the system, the savings benefit from the system, and the amount of area to be irrigated. Remember that a portion of the cost to install any system is derived from the work (materials and labor) done in the house as well as getting the graywater to your landscape. Any work done DIY will lower the cost of the system and payback your investment quicker.

Based on the literature there are generally three main ways to use your graywater.

1. Low tech systems for outdoor irrigation: laundry to landscape and branched drain
2. Medium tech systems for outdoor irrigation: drum effluent pump
3. High tech systems for outdoor irrigation: sand filter to drip

As you progress from a low tech to medium tech to high tech system, expect increases in material and labor cost along the way. Low tech typically can be completed by the homeowner, while only portions of the other system may be within the capability of the average DIY homeowner.

Laundry to Landscape

Many people already take advantage of graywater from their washing machine by attaching a garden hose to their washers. Although the intention is good, this arrangement has problems, some of which will be mentioned as we discuss a “better way” to get your wash water to the garden.



The picture above shows an appropriate installation for using wash water to irrigate the landscape. A diverter valve is installed so that the option always exists to allow the water to either be sent to the garden or to the standpipe/sewer as before. An alternative to the standpipe drain is a nearby sink as shown below.



If the diverter valve is set to irrigate, the water can either be sent to a surge tank, or the wash machine pump can be used to distribute graywater to the planted areas. A surge tank is not the same as a holding tank. Remember that graywater should be used as soon as possible, but certainly not kept for longer than 24 hours in any container.

If using a surge tank, you are dependent on gravity flow to irrigate the landscape. If your plants are all downhill from your home then this is not a problem, and is perhaps one of the easiest installations to accomplish. For every foot of elevation drop in your lines, there is an increase of 0.433psi in pressure. You can add to this pressure by gradually adding downward slope to the lines in the trenches as well. If you place a piece of screen on the tank opening, this helps keep lint and other debris out of the distribution pipes and mosquitoes out of your tank. An added benefit would be in allowing the pipe to discharge just above the tank opening creating an “air gap” between the graywater side and the washer. This is beneficial from a health perspective and perhaps a local code standpoint.

Remember that once you get the water beyond the walls of your house, you still need a distribution system to get it to your individual plants. This is where a little “sweat equity” will keep the costs down.



If using your wash machine pump to distribute the water, remember that the washer itself can pump a large distance horizontally or a short distance vertically. Without stressing the pump you can irrigate any distance “downhill” or pump up to an elevation 2’ below the top of the washer up to 100’ away. The distribution pipe should be 1 inch in diameter so that water being pumped does not create excessive resistance on the pump motor. This is a common problem with the washer to garden hose arrangement mentioned earlier. The hose diameter is smaller and pressure is increased in the line which creates resistance that must be overcome by the pump. The variables that affect pump life are pump model/quality, pumping height differential, and pipe flow resistance.

Another problem with the washer to garden hose arrangement is that there is only one outlet and you have to physically move the hose to water different plants; a very labor intensive process. If this single outlet should become accidentally plugged, then the pump will be forcing water against a dead end which will result in either a ruptured pipe somewhere along the line or a damaged pump.

Branched Drain

A branched drain graywater system is a gravity-based system that sends graywater from showers, laundry, and/or sinks to the landscape using standard (1.5” or 2”) drain pipe. As the name implies, the system is made up of multiple branches by continuously splitting the flow in a line much as a “family tree” branching diagram. The final outlet of each branch irrigates the root zone of a plant inside a mulch basin (more on this later). One large flow can be split into as many as 16 smaller flows in this fashion; it was first developed by Art Ludwig of Oasis Design. As with any gravity system, the irrigated area must be lower in elevation than the graywater source. Piping placed in trenches should maintain a gradual downward slope. The recommendation is $\frac{1}{4}$ ” slope per foot of installed pipe. Some advantages to this system are ease of maintenance, low economic cost, no pump, no filtration or surge tank is required, and they have a low failure rate.

For sure the key to installing this type of system in your house would be the ability to get to all the graywater sources in your home. The picture below shows a branched drain installation in progress.



If you plan to install a branched drain system yourself, then some effort will be required to place the irrigation lines outside of the house. Depending on your skill level (and local codes), a plumber may be required to perform piping and connections bringing your graywater sources to a common header. Depending on the layout of your home and the elevation of your surrounding property, you may want to consider more than one graywater outlet from your home.

Drum Effluent Pump

This system is typically used when the area to be irrigated is uphill from the graywater discharge at your home. It may also be employed when the area is further than 100 feet from your home or the number of plants or area to be irrigated is large. This system can be used when all graywater sources from the home are aggregated into a common pipe as in the case of the branched drain, but also when a single source is available, i.e., laundry to landscape. The source and amount of graywater will affect the size and type of components selected for this system as mentioned below.

The system employs two major components in addition to the outdoor graywater distribution piping which is common to all systems. These components are a drum, or watertight “temporary storage container similar to the surge tank mentioned earlier, and a pump to get the graywater to the area to be irrigated.



The picture above shows the drum which temporarily holds the graywater produced; the pump is located at the bottom of the drum. This drum has been purposely oversized to allow future addition of rainwater harvesting. Notice how close the roof gutter down spout is to the graywater discharge from the building.

Depending on the source(s) of the graywater used in this system and the area to be irrigated, requirements for the pump may vary in type and size. A smaller pump may be sufficient if only water from the washing machine is captured. If all sources of graywater in the home are used, then a slightly larger pump with the ability to move solids may be required. Selection of the pump is site/job specific. The pump in this system requires power which means location is a consideration as well. The pump may need 110VAC power from the home or it may need 12VDC depending on which type of pump you choose. This type of system offers additional flexibility in that distance from the home, increased elevation and larger irrigation area can be overcome by use of the pump.

Sand Filter to Drip

The primary reason for including sand filtration in a graywater irrigation system is to allow the use of drip irrigation in outdoor distribution to the plants. Use of drip irrigation has not yet been mentioned and is discussed in a later section. Due to the higher expense associated with installing a filtration system, this system only makes sense if all graywater from the house is being used for irrigation. This means that all “accessible” household graywater is replumbed and piped into the system which also adds to the overall cost of the system. The graywater is plumbed to a holding tank where it is temporarily stored. From this tank, an effluent pump sends the graywater through a sand filter where any debris and particles are filtered out. The filtered water then passes through the irrigation piping and to the drip tubing and emitters located near the root zone of your plants. Since drip irrigation and drip emitters are being used, this system may be tied to an irrigation controller which allows watering of specific zones or plant groupings on the landscape. It can also be tied into the domestic water system for periods when no graywater is available. Appropriate backflow and cross connection devices would need to be installed per code requirements which will increase overall cost of the system.

Drip Irrigation or Mulch Basin

Application of graywater to the plants has not been discussed in detail, but a brief mention is relevant here since there is some difference of opinion on the use of drip irrigation in many of these applications.

Drip irrigation is the slow application of water directly to the plants root zone. Drip irrigation helps maintain the root zone at ideal moisture level, encouraging the formation of deeper roots and more abundant foliage, as well as saving water with reduced evaporation and runoff. By their nature, drip emitters have small openings through which the irrigation water flows to each individual plant.

Drip irrigation is less tolerant of particles, lint, hair, etc and may become clogged requiring routine cleaning. Newer drip emitters have been designed to make the task of cleaning easier, but still require some time and effort to maintain. The amount of time spent on maintenance depends of course on the source and quality of your graywater. Drip emitters rarely work in a gravity system since many have a minimum flow rating necessary for proper operation. This means that to work properly and efficiently these systems require some auxiliary pump, such as used in the *sand filter to drip* or the *drum effluent pump* systems.

The picture below shows an adjustable drip emitter used at the demonstration site located at Mitchell Lake Audubon Center in San Antonio, Texas. The system has a small pump to create the necessary pressure and a “filter sock” to catch debris and lint before it gets to the emitter. These particular emitters are easy to clean and have been functioning for 2 months without problems.



A mulch basin will get water near the root zone of the plant, but in a much less efficient or controlled manner. Rather than “dumping” the water, the mulch basin targets the root area surrounding the plant. As the pictures below indicate, this type of irrigation system is easy to construct since it is basically a hole drilled directly into the graywater distribution line near the plant. The hole is drilled on the underside of the pipe to direct water downward rather than up into the air. The holes are typically less than 1/4” and the pipe once drilled may be covered with mulch to inhibit evaporation. Using a mulch basin is generally less expensive and easier to maintain than a drip irrigation system. The mulch basin can be improved by running the pipe through a small irrigation valve can or plastic flower pot that is inverted and placed near the root zone. This further reduces evaporation. The second picture below illustrates this concept.



This short paper has been an introduction to graywater irrigation ideas and concepts. Hopefully it will get you thinking about the possibility of using graywater to irrigate around your home. It is not intended as a design document.

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