

EARTHRIGHTS DESIGNS

Technology and Nature

Greywater Recycling: matching water quality and water usage

What is Greywater?

Greywater is slightly used drinking water. The best sources of Greywater are your washing machine, bathroom sink and bathtubs. Reverse Osmosis water filters have a high mineral content but are generally okay. Do not use dishwashers because of the caustic cleaners, kitchen sinks because the law prohibits it, and toilets for obvious reasons.

When using Greywater, the types of soaps and cleaners that you use become important. Greywater will contain organic compounds from skin and hair for example. These are food for the organisms that live in the soil. The same NPK that is sold in fertilizer is also available to limited degrees in Greywater and it is beneficial. Not desirable are sodium, chlorine, and boron. These are frequently used in laundry detergents, and they will harm soil and plants over time at the concentrations in commercial products. In addition, many commercial products contain dyes, perfumes and other industrial toxins which are best avoided. All of the natural food stores and many of the local grocers sell alternative cleaning products that are non toxic to your soils and plants. Some examples are Oasis, Ecover, and Lifetree. Some people have success with laundry balls that are used with just a few drops of a cleaner in the washing machine*.

Biologically, Greywater contains microorganisms, both beneficial and potentially harmful. The soil around your plants will deal with all of these. Because Greywater contains both food and bugs, it will start to change immediately after it is produced. The "bugs" will consume the organic materials in the Greywater, and they will use the dissolved oxygen to do this. Soon the Greywater will become anaerobic just like a septic tank, and with the same types of odors. This is the reason to not store Greywater for more than 24 hours without treatment. It begins to stink and becomes a health hazard. Good system design does not leave Greywater sitting in tanks or pipes unless an aeration and possibly a sterilization system are used. At that point, it might be more economical to buy a complete blackwater treatment system.

Delivery

Greywater needs to be removed from the house and delivered to your plants. Most sewage systems were designed to remove Greywater and blackwater from the building by gravity. Until very recently, no thought was given to separating the two. It was all just sewage and it was supposed to go "away". The first step is to locate each of your potential sources of Greywater and see how they can be isolated from the sewer system. The easiest is frequently the washing machine because it has a pump that can raise the Greywater from three to four feet. When near an exterior wall this is an easy matter to run through a wall to a surge tank for distribution. Bathtubs and sinks drain to the same sewer as the toilet. Where there is a crawl space under the house it is possible to separate the two. Where the home is on a concrete slab, it is generally too expensive to do this. Then it is a decision to bale and carry the Greywater each time, or to buy a small pump and to pump the Greywater out of the house.

Systems that use a pump may or may not need a filter. Other systems are generally better off using the natural filtration of soil. The reason for this is that the things that get filtered out are part of the nutrition when they are delivered to the soil. When they are caught in a filter, they become a gross and stinky pollutant. Many people find the cleaning of filters to be unpleasant and so they avoid the job and the system backs up. Thus it is more sanitary and pleasant to avoid filters in most cases.

Dosing is the best way to deal with Greywater.

Dosing means loading a specific amount of effluent onto a specific area of land at a specified frequency. This is how septic leach fields are designed. The goal is to apply the ef-

fluent aka Greywater in a way that the soil absorbs it without puddling and without becoming waterlogged. It also implies that Greywater is stored for very short times (like in a surge tank) if at all. A healthy soil requires air as much as it does water. Dosing ensures that air is drawn in between doses and that no saturated links to groundwater are created. Constantly running Greywater to one spot is not good for soil or plants. The grey water needs to be distributed over space and over time. Most gardeners do this intuitively by watering different planting areas. If the system is automated, dosing needs to be designed into the project.

Distribution

When using Greywater for shrubs and trees it should be applied in amounts and with timing to imitate an irrigation system. The objectives are: even distribution, rapid infiltration, and establishment of moisture banks in the soil at levels appropriate to the plants in that area. Above all the objective is to use the Greywater to create and maintain areas of living soil with moisture, food, and air in balance for the web of life to function.

Distribution, like water harvesting can be active or passive, in both it's distribution and management. Here you have decide how involved you want to be with the Greywater and your garden

Passive distribution depends on gravity and landforming to get the Greywater spread out and absorbed by the ground. Some structures that will accomplish this are: p u m i c e trenches, pumice wicks, and mulch basins.

Active systems use surge tanks to catch the Greywater, pumps and/or gravity to move it, and various systems of valves and pipes to divide and distribute each dose. This can be as simple as a tank and a hose that is moved each time a dose of Greywater is received. On the other end are fully automated system with backwash filters, pumps, and timers. The choices are based on time, money, and interest in active participation.

Your participation is the final element of distribution. The simplest system is to hook a hose to the outlet of the surge tank and to move it before or after each dose from a washing machine or shower. By making it a habit to move the hose you can have a sophisticated distribution system that applies water where it is most needed each time for very little expense. For someone that wants the benefits without having to participate, there many ways to automate the system. In between is a system of valves and pipes that where the user manually selects different zones by valves or weirs. The pipes then distribute throughout the zone.

Whichever system you choose, consider all of the elements before you start: delivery, dosing, and distribution.

Safety and Sanitation

This is largely a matter of common sense. Greywater is generally benign when it comes out of your home, but it can have pathogens and it can make you sick. Get it into living soil in correct doses and you will never have standing water for more than a few minutes in any area. Don't let the kids and the pets play in it. Never make a connection of a Greywater line to your potable system. Any pipes or valves that have pumped Greywater, or that have an exit that could be mistaken for drinking water need to properly labeled. Purple is the color that is associated with Greywater and you can either buy precolored parts or paint them yourself.

The use of Greywater is a time tested way to better match the quality of your water to its use. It is not going to solve the problems of badly designed and thirsty landscapes but it will go a long way towards creating and maintaining beautiful landscapes that are appropriate to this area.

Resources

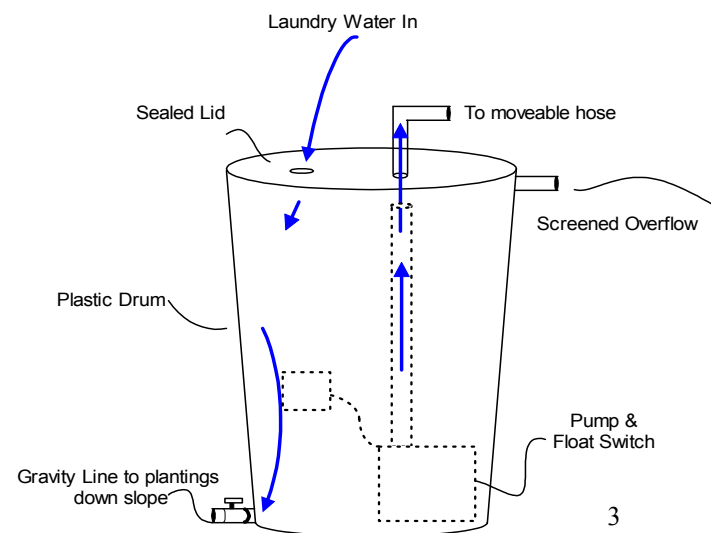
The best source of Greywater information for the do-it-yourselfer is from Art Ludwig. See the links page



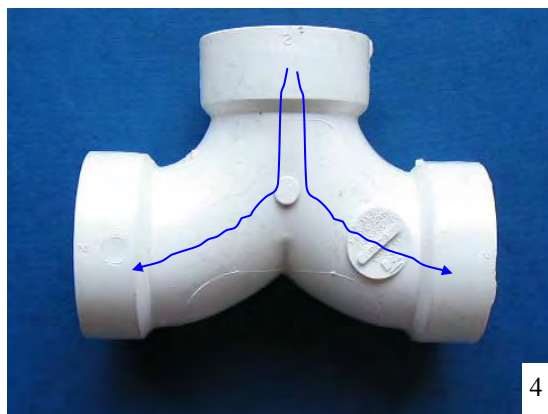
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1. Laundry piped to greywater line. Center section of the line is a tee so that a backed up line will dump to the sewer automatically.
2. Laundry line to filter pipe. Cap can be slid up the pipe to clean or replace the filter which is a used nylon stocking. The washwater is dosed to a pumice wick.
3. Schematic of surge tank with gravity outlet for plants down slope and pump for plants up slope.
4. Double El plumbing fixture. Basis of the branched drain gravity distribution system developed by Art Ludwig of Oasis Designs. State of the art info source.
5. Twisted Tee System. Tee outlet to each mulch basin. Tees are twisted progressively downward away from source. Flow is tested before tees are glued



5

Greywater Systems: Dosing and Distribution

Greywater dosing delivers water to plants intermittently. This allows the soil to dry out between doses and to draw in oxygen. A constant flow of greywater will produce anoxic, stinky soils and dead plants. Distribution is the division of the greywater so that each plant receives a measured amount of the flow. Accuracy of dosing and distribution is the key to low maintenance systems with healthy plants. A simple test is whether you can see or smell effluent. Neither is desirable.

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This project shows the reuse of greywater in an urban landscape. Because of the existing slab, the bathtub was too low for a gravity diversion from the drain (#1), a pumped system was chosen. A good unit for a home system of this type is the Flotec IntelliPump. This unit senses absence or presence of water. It can be set in the bathtub after the bather exits. It will pump down to about 1/4 inch and then shut off. This allows the bather to ignore the pump until it has finished. Some other pumps are damaged when run dry. The owner had a compartment built (#3) to store the pump in the wall above the tub. When the pump is used it is removed from the wall, turned on and run. Greywater exits at a quick disconnect fitting (#4). The greywater hose is moved around the landscape where the water discharges into mulched areas so that there is never standing water.

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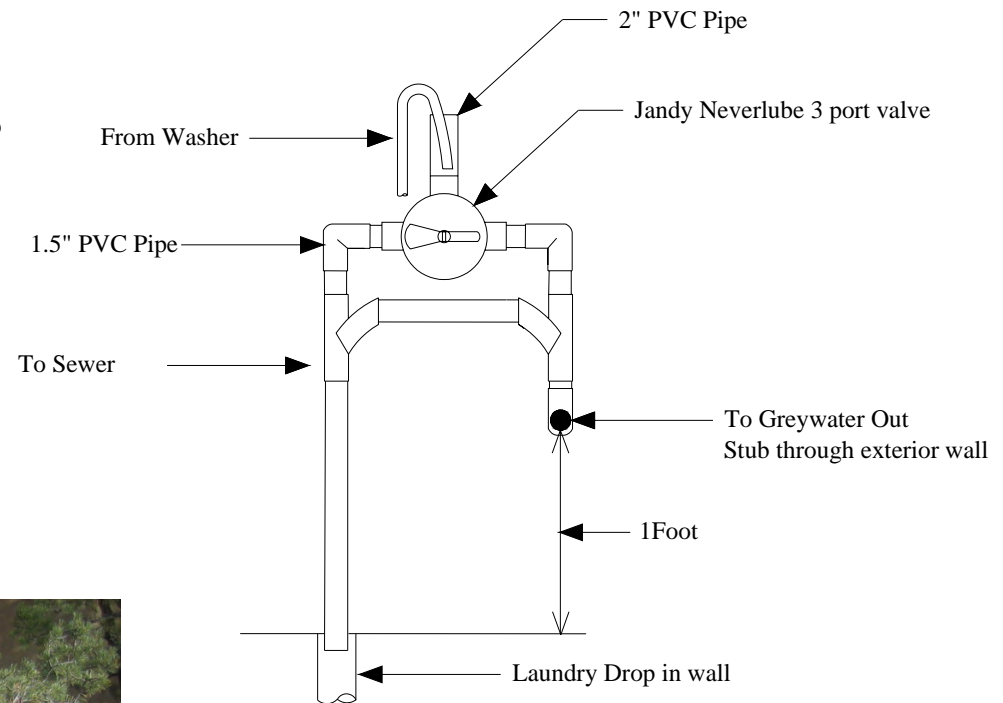
Greywater Recycling with Split Diversions

Installed by Sam's Landscapes Santa Fe, New Mexico

Greywater Recycling with Split Diversions

Installed by Sam's Landscapes Santa Fe, New Mexico

This project has a low water use, horizontal axis washing machine similar to that used in most European homes. The washer was on the opposite side of the home from the bathtub. There was little point in developing a large distributed network since the flows are minimal. In this case the water was diverted passively to one nearby favorite tree. The outlet is shown above the stone lined swale. An air gap prevents any plugging. Every couple of years there will be enough lint accumulated to warrant cleaning it up. There is no other maintenance.



The drawing shows a typical washing machine connection for greywater diversion. The two key pieces are:

1. The valve which allows a dump to sewer during weather that is too cold or too wet for greywater reuse.
2. The crossover that creates an overflow to sewer if the line out should ever plug.

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This project shows the reuse of greywater in an urban landscape. Because the greywater is produced on a daily basis, a supply driven system was chosen. A float switch starts a pump and the greywater is dosed virtually every day in about 40 gallon increments. Greywater is not useful for drip irrigation. It would either require more filtration and equipment than it is worth, or it will rapidly clog drip emitters. The benefit of drip is the dispersal of small amounts of liquid to precise areas. A method was designed to get the benefits of drip without the problems; a low pressure manifold with 1/2 inch emitters. The greywater is collected in and dosed from a buried sump(#1). It is dosed with a submersible pump to a sequencer valve (#2). Each port of the valve has a manifold connected. The manifold consists of a length of 1 inch poly tubing. At each plant that is to be watered a 1" x 1" x 1/2" barbed tee is inserted in the line. This distributes the greywater. Because the line is pressurized, a relatively even distribution from each of the tees is achieved. By using more than one port for a single zone, greywater can be proportioned in different ways.

Ecoscapes improved on the design by adding a ball valve at the end of each line. This valve can be used as a flush. It is also used to adjust the line pressure to get more even distribution. One area that was given double water was a stand of Ponderosa Pines. The emitters were covered with mulch so that all flows are subsurface. The emitters are easily located by the stands of grass that have already grown around them.

A 3 port valve is available for a sewer dump. A bayonet valve is also plumbed to drain the sump completely.

This system will require removal and cleaning of the pump screen about twice a year. Another maintenance method is the use of a pantyhose leg strapped on the inlet pipe. This system, invented by Art Ludwig, catches most of the hair, lint, etc. It also has the advantage of being somewhat forgiving when maintenance is not done as the fabric stretches.



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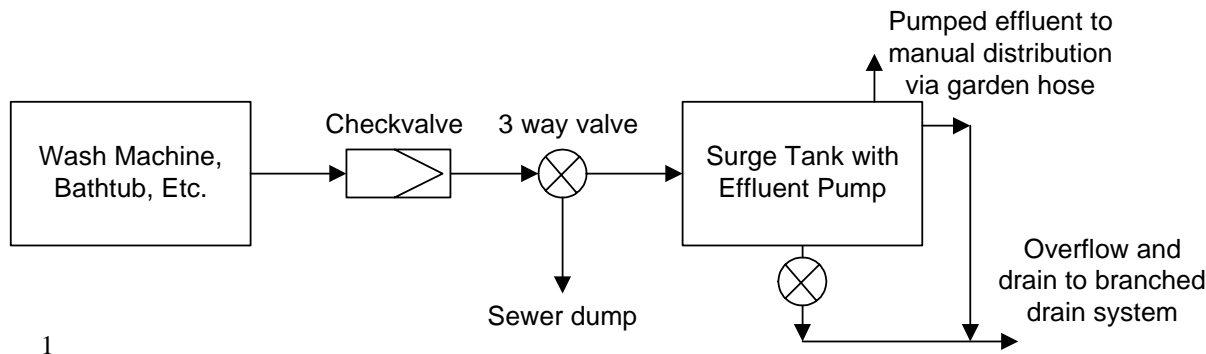
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Greywater Recycling with a Sequencer Valve and Low Pressure Manifolds

Installed by Ecoscapes Landscapes Santa Fe, New Mexico



This series of photos shows a greywater recycling system that was retrofit by changing the plumbing in the crawl space. Drain lines from the washing machine and bathtubs were diverted for greywater use (# 1). A three way valve allows the owner to conveniently redirect these lines back to the sewer if needed. The owners created their own marking and instructions which they wrote on the pipes along with hanging labels (# 3). The surge tank collects the greywater (# 2). From there it can be drained to a branched drain system on the southwest of the property in winter when the soil will not freeze and moisture banking is advantageous (# 4). The branched drain system is laid out to infiltrate the daily maximum generation of effluent (# 5). The branched drain also receives the effluent via an overflow. The drain was covered after the photo to prevent entrance of vermin. During most of the year the owner can pump the effluent to various parts of the property simply by closing the drain and by laying the hose over a mulched planting area. The hose outlet is marked to prevent inappropriate use of the effluent.



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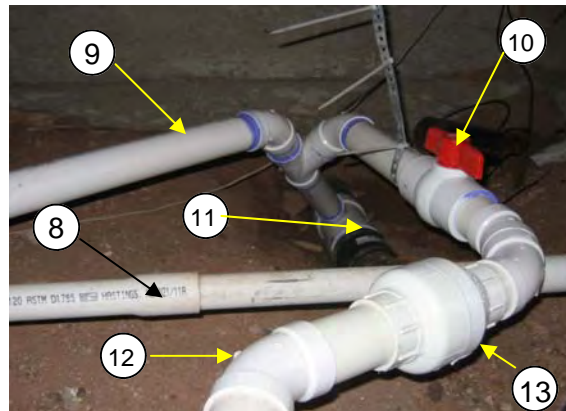
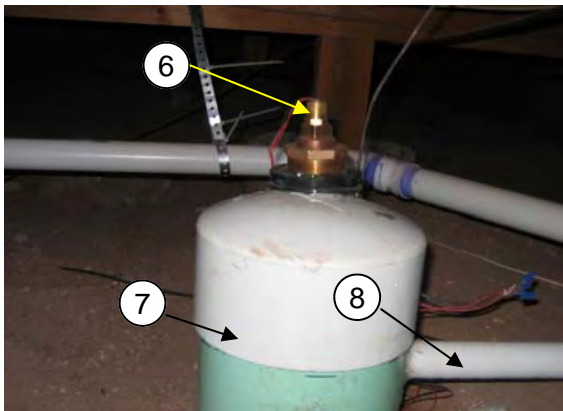
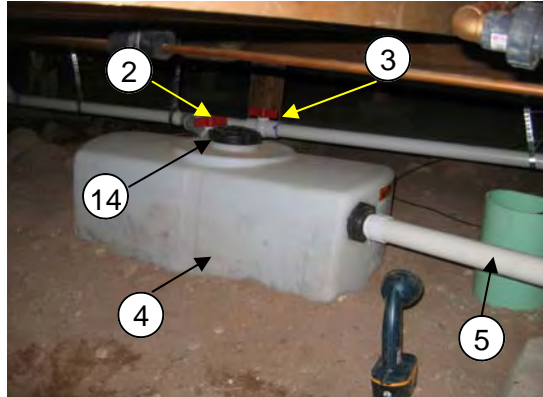
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Greywater Recycling with Crawl Space Plumbing and Branched Drain Overflow
Santa Fe, New Mexico

Greywater Recycling in a 30" Crawlspace

Installed by Ecoscapes Landscapes Santa Fe, New Mexico

This system collects and distributes household greywater on a supply driven basis in a small crawlspace. Pressure distributed effluent is possible with coarse filtration ahead of the pump, and large orifices 1/2" or greater at the distribution end. The relatively small tank assures that greywater is cycled regularly. The surge tank also drains completely to the standpipe so that there is no more than 1 gallon standing. The system can be easily diverted to sewer in cold weather. A subsurface sump allow complete drainage of the standpipe.



1. Greywater conveyance pipes.
2. Greywater Inlet valve (normally open).
3. Greywater Bypass valve (normally closed).
4. Greywater tank 50 gallon max.
5. Greywater System overflow.
6. Level sensor for high level start and low level shut off.
7. Standpipe with submersible pump.
8. Pumped greywater outlet pipe.
9. Greywater system bypass pipe.
10. Greywater service valve (normally open). Closing this valve allows any component in the system to be removed and repaired with no possibility of sewage backing up
11. Building sewer line.
12. Overflow line from greywater system to sewer.
13. Backwater valve. Prevents sewer backup into the greywater system.
14. Service Lid for replacing pantyhose filter

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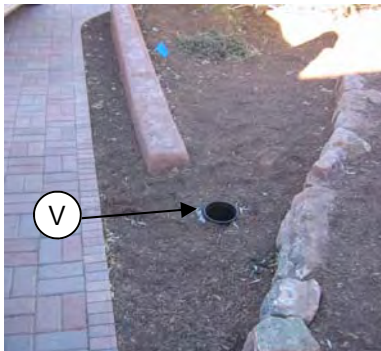
Sequencer Valve and Low Pressure Manifolds



Mechanical Sequencer Valve. Distributes Greywater to three distribution lines



Greywater Zone 1 Emitters at Piñon and others at locust tree.



Flow adjuster valve at Greywater Zone 2. Controls emitters at fir and piñon



Greywater Zone 3 Emitters at fir and others at piñon at bottom of driveway

This system distributes the greywater from the preceding page. A four port sequencer valve was used with a three port cam. This allow for future expansion if desired. A King drain empties the line in between cycles to prevent freezing. This type of system can run during most of the time during a warm dry winter which is becoming common during the current drought cycle. Because large orifice emitters (1/2" tees) are used, there is no pressure compensation and the system must be balanced for relatively equal distribution. This is the function of the flow adjuster valve

Installed by Ecoscapes Landscapes Santa Fe, New Mexico

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Greywater from A Washing Machine to A Pumice Wick

Collaborative project with Ecoscapes, LLC

This project took greywater directly from a washing machine to a pumice wick for landscape irrigation. It has eliminated virtually all of the potable water use for this landscape. (# 1 & 2). The system was designed based on a maximum of 4 wash loads per day with a full size vertical axis washing machine. There are two overflows to mulched areas in the unlikely event that the wick ever temporarily fills or saturates. (# 3) The overflow shown is a “popup” type that prevents the entrance of vermin.

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Produce from Greywater Systems

Santa Fe, New Mexico

Clockwise from upper left: Hopi Turquoise Corn, Golden Current Bush, Golden Currents Harvested, Acoma Tobacco Box Gourds, Hopi Red Squash, Heritage Raspberry Bush, .

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