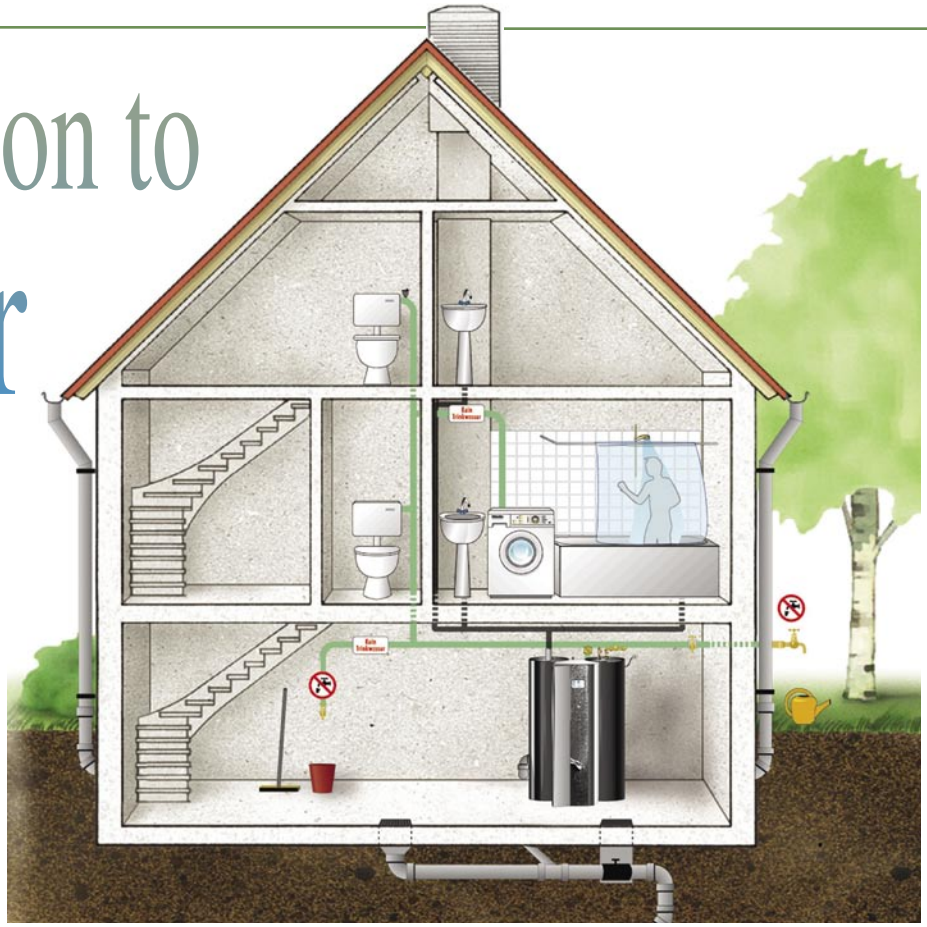
An Introduction to Greywater Part II

A look at some plumbing modifications and mulch basin options that will put household greywater to good use. By Art Ludwig



In the last issue of BackHome, I discussed the everyday waste of a precious resource—water—and how you can recover most of it in a responsible and productive manner (see issue No. 86). In this second installment of that article, I will address some of the plumbing adaptations used to make that happen, along with the use of mulch and swales to help purify the water once it exits the household greywater drain system.

Collection plumbing takes the greywater from various generation points in the house to a point or points just outside. From there, distribution plumbing takes the greywater to plants. For gravity collection plumbing, codes provide useful guidance, and the services of a plumber are helpful.

Greywater collection plumbing is largely independent of the type of system used to distribute greywater. However, you should select and design your distribution system before you start sawing under your house. Collection plumbing does vary a great deal depending on whether it is for gravity sources, appliances with their own pumps (such as a washer or dishwasher), or a greywater-only, radical plumbing system, which replaces the septic/sewer altogether and uses a composting toilet.

Greywater Plumbing Principles

For all greywater users, it is helpful to understand some plumbing principles, 1) so you understand how greywater seemingly violates the laws of physics that govern freshwater flow, and 2) so you can communicate unique greywater considerations to your plumber. There isn't a well-developed code for some of the strange things greywater plumbers have to do, so understanding general principles will help navigate this terra incognita.

Squander No Fall. Fall is the vertical distance between greywater source and destination. Every trap, pipe run, joint, valve, etc., uses up some fall in order to keep the water flowing downhill. Proper slope is the No. 1 driving factor behind collection plumbing design and installation (and branched-drain distribution plumbing as well, described on page 30). Make every connection and pipe run as high as possible.

Build for Future Flexibility. This is important for all systems. At every opportunity, allow flexibility to reconfigure the system in the future. Where possible, leave enough pipe between fittings so they can be sawn apart and reconfigured without throwing the whole assembly away. This may conflict with conserving fall at times, but do it whenever you can afford the fall.

Divert Greywater Downstream from Traps and Vents. This issue is specific to greywater collection plumbing. Once in the yard, traps are not needed, and venting is usually not an issue (any necessary venting is usually accomplished back through the house plumbing). Vents and traps are unlikely to be a point of contention with a plumber. Running greywater separately from toilet water is unusual, but plumbers can do a great job on traps and vents with their existing knowledge base. Venting for greywater collection can be totally separate from the toilet vent, or code allows you to tie into the toilet

vent 12 inches above the spill point of the highest fixture served by the vent.

Provide Cleanouts and Inspection Access. This is important for all systems. Keep ease of service in mind. You don't want to build anything that cannot be inspected or serviced—especially plumbing that could last the life of your house.

Design for Easy Maintenance and Troubleshooting. A well-designed system provides auditory and visual signs of its distress. Slow drains or water running loose in the yard are not catastrophic failures. Water overflowing into the house, greywater siphoning into the potable water supply, or a $500 pump burnout are disasters.

A system that overflows silently and cleanly into the sewer when the filter clogs is not the most efficient. Weeks' worth of greywater may be wasted each time the filter clogs, before it occurs to anyone to check it. In addition to a manual bypass, you want an overflow that splashes conspicuously but harmlessly outside if the system is nonoperational.

When to Get Professional Help

Help from a plumber is recommended for collection plumbing. It is said that "plumbers safeguard the health of the nation." This is not an exaggeration. Don't let the senselessness of some greywater laws delude you into thinking that all plumbing codes are for weenies. The place where codes lose credibility is in the garden, where greywater can be treated better and more ecologically than anywhere else. Under the house, use a plumber and deviate from code only when you know what you're doing, or you may be sorry.

Use a skilled plumber for the house plumbing when the system is to be inspected. The eyes of typical inspectors glaze over in the yard and they don't say much, perhaps not wishing to reveal ignorance. Then, they hold your feet to the fire on the inside plumbing where they really know how to apply the code, zapping you on the slightest deviation. Warn your plumber and use this phenomenon to your advantage. Time and again it has been noted that if the standard plumbing is impeccable, inspectors assume the novel part is done to the same high standard and wave it through. Conversely, if the collection plumbing is flaky, they'll assume you did the distribution plumbing wrong, too.

Greywater in the Landscape

Once you've figured out how to get the greywater out of your house, it's time to consider how to handle it in the landscape. A primary consideration is whether you are designing a system only to treat and dispose of greywater or whether you hope to reduce your freshwater consumption by using greywater for irrigation.

Figuring how much area is needed for treatment and disposal is easy. Check the perc rate of your soil, and look up the needed area in the "Disposal Loading Rates" table in "An Introduction to Greywater, Part I" in issue No. 86. Unless your greywater flow is huge, your perc terribly low, or your area really tiny, space shouldn't be a problem. It only remains to figure out how to distribute greywater over this area, using the greywater distribution system of your choice.

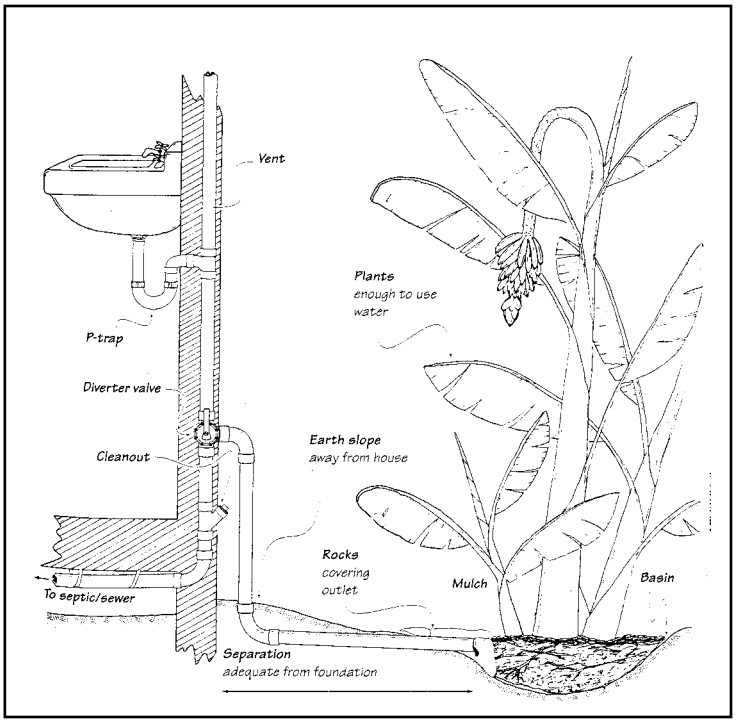
In arid lands, freshwater irrigation raises the salinity and pH of the already too salty and alkaline soil.Unfortunately, greywater tends to do the same to an even greater degree.

This is a case where an ounce of prevention is worth hundreds of pounds of cure. To minimize the damage, don't soften water using sodium chloride, choose cleaners carefully, and direct urine appropriately for the soil and climate (i.e., septic or disposal field). In addition, use concentrated rainfall and/or runoff to flush salts from irrigated areas.

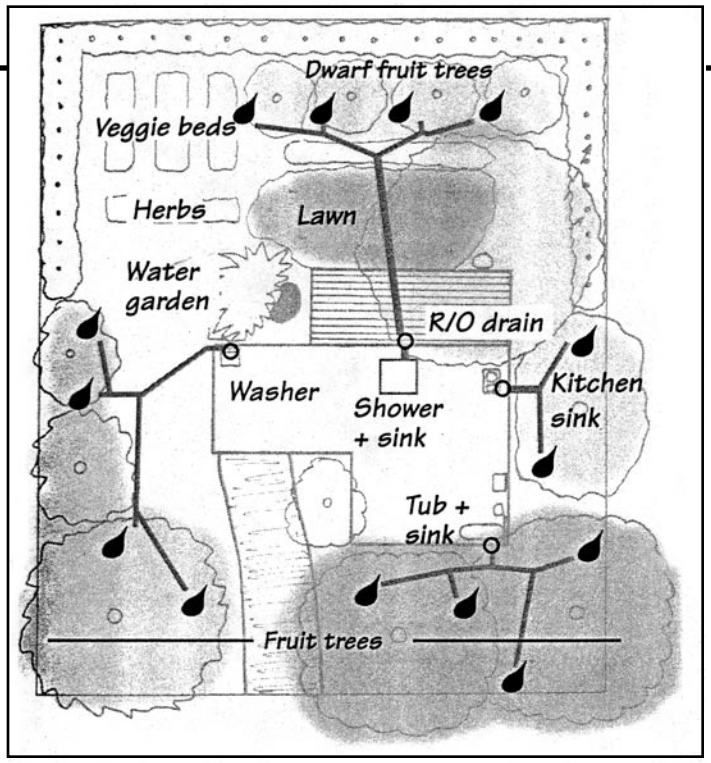
Rain (which has virtually no dissolved solids) is highly effective for flushing excess salts from the root zone. In rainy climates with free-draining soil, flushing is automatic. Otherwise, run rainwater from the roof downspouts or hardscapes into the mulch-filled basins that receive greywater. Give each basin several inches in a short period of time, then divert the rainwater to the next basin.

Mulch Basin Design

If I had to improve the world's handling of greywater in just two words, they would be *mulch basin.* Even



The *Drain-To-Mulch Basin* option is a simple system that's built off existing plumbing and ensures a high level of treatment.



The *Branched-Drain System* is more complicated to build and slope must be carefully considered. This version has separate fixture feeds, then the flow is split.

wastewater flowing over the surface of the soil is purified to a surprisingly high level. However, the simple measure of covering and containing the greywater in mulch basins assures a spectacularly high level of treatment. Contouring the ground helps contain runoff and concentrate irrigation water where needed, especially on slopes. Mulch basins and swales (long thin basins on contours across a slope, like terraces) are also perfect for capturing rainwater and storing it in the soil. Put swales on slopes and basins by downspouts.

Mulch (ideally wood chips) covers the greywater so kids and dogs can't play in it. Greywater coming from a free-flow outlet or hose quickly vanishes under mulch and is contained by the basin. Mulching softens the soil's surface and slows the flow of greywater over it, allowing greywater to infiltrate much more quickly. Mulch basins are a good way to reuse organic waste such as leaves, straw, prunings, weeds, and tree chips that might otherwise be landfilled.

Build your soil by tossing these reclaimed materials into mulch basins. Place the unchipped prunings at the bottom and the most attractive material on top. It will all biodegrade over time.

Mulch soaks up greywater, then time-releases it, which smoothes irrigation peaks and reduces erosion. Mulch slows the movement of runoff, retards evaporation (reducing salt buildup), helps lower pH, and provides habitat for beneficial organisms. Mulch reduces loss of water through gopher holes. Mulch adds beneficial organic matter and, eventually, nutrients to the soil. If you spread fertilizer on top, mulch binds it and then time-releases it. Mulch is basically gold. Spread mulch over all exposed soil in your yard and fill basins to the level of the surrounding soil.

A basin is formed by scooping a doughnut-shaped hole in the earth and piling the tailings from the hole in a ring around the basin. Tailings can be piled downhill to make a basin on a slope. The walls of basins tend to get worn down, so they should be dug deep initially—ten inches at least—then filled with mulch. Size them to accommodate the surge volume they will receive: a bathtub and washer cycle's worth, for example. The basin should be at least as wide as the drip line of the tree (the diameter of the canopy) and can be much wider. Most tree roots extend farther than their branches. Making the basins bigger than the tree makes it easier to expand them without hurting the roots as the tree grows.

Swales are long, thin basins (or blind-ended ditches) that run on contour; that is, on the same level across a slope. Their downhill tailings are an ideal place to plant fruit trees. Roots can seek water in the bottom of the swale during drought and seek air in the top of the tailings during flood. As with basins, swales should be filled with mulch.

Two Simple Greywater Systems

These proven systems are the easiest and simplest. Each has its pros and cons. The first is complete, incorporating collection with distribution and receiving. The second is a subsystem that needs to be combined with a collection system to make a complete greywater system.

The *Drain-To-Mulch Basin* is an improved version of what I call the "drain-out-back," the simplest system for just getting rid of greywater. Probably 90 percent of the greywater systems in the world are no more than drains that point out the back of the house. Some are gross, and most don't reuse the water for irrigation. The simple refinement of adding a mulch-filled basin or sloping channel where the pipe dumps eliminates most grossness. Cultivating plants there whose irrigation needs match the water source can efficiently reuse the water. Cover the greywater outlet with rocks and mulch, and install a screen over the drain (or a vent and trap), unless you want the true backwoods feel, complete with vermin entering the house via the drainpipe. The lines are installed the same way as branched-drain distribution lines (described below). Lines can run any distance with continuous downhill slope.

The *Branched-Drain System* is the one I recommend most frequently if the area to be irrigated is downslope from the greywater source and the volume is residential scale. It is not particularly simple to build—with lots of greywater and little slope, it is quite challenging—but it is easy to use and maintain.

Branched-drain systems improve on the drain-out-back by splitting, containing, and covering the flow. The flow is split by double ells or other flow-splitting fittings in a branching network. The output is contained in basins or subsoil infiltration galleys,

covered by mulch or soil.

For sites with continuous downhill slope from greywater source to irrigated areas, Branched-drain systems provide inexpensive, reliable, automated distribution with almost no maintenance. Branched drains have no filter, pump, surge tank, or openings smaller than one inch in diameter. All variations of this system meet legal requirements in Arizona, New Mexico, and Texas. A friendly inspector can issue a permit for this system under the Universal Plumbing Code.

A branched-drain system solves most of the drawbacks of the drain-out-back while retaining most of its advantages. Unlike the drain-out-back, it can automatically disperse greywater to several trees with satisfactory efficiency, it is much more sanitary, and it is possible that you could get a permit for it. The difference is that it splits the greywater in a branching network of pipes, then contains and covers the greywater in the landscape by means of mulch-filled basins.

After you've figured out what plants you want to irrigate with a Branched-Drain distribution system, you'll have to determine how to split the flow, which can be accomplished with tee fittings, with a distribution box, with a movable drain, or by keeping flows separate from the outset.

Some Common Greywater Errors

You should at least scan this part for applicable pearls of wisdom. Don't, however, let it scare you. Fortunately, even the most pathetically misguided greywater systems rarely cause actual harm, and for the few that do, it's not much. The following pitfalls are easy to avoid, and even if you fall into one, odds are your system will still show a net benefit relative to the alternatives.

Error: Assuming It's Simple. Most of the errors that follow stem from this fundamental error, which in turn stems from the following:

1. Recognition that in most cases the resource potential of the greywater (water, nutrients, embodied heat) is not worth very much in the scheme of things, and that the costs of poor management (minor health threat, smells, etc.) are not very high either.

2. Failure to realize that a greywater system that achieves common goals (e.g., saving water) is a more site-specific and user-specific design issue than almost any other green-home technology.

Error: Out-of-Context Design. Constructed wetlands in the desert. Irrigation of a swamp. Sand filtration, ozonation, and pumping uphill for flushing toilets in a residence. These are valid designs but applied in the wrong contexts. In a culture where standardized solutions are the norm, we must remind ourselves constantly to pay primary attention to the context.

Error: Overly Complex, Delicate, and/or Expensive System. These systems miss the big picture and result in negative net benefit. A typical residential greywater system saves $5 to $20 worth of freshwater a month. If the system costs more than several thousand dollars it is probably overbuilt.

In a residential context, any system that uses a pump and/or filter, or costs more than you spend on water in several years, is suspect. Disinfection is extremely suspect. Systems that entail massive, permanent disturbance to the planted area are also missing the point.

Error: Mansion with a Greywater System. This is a specific case of the previous error. A greywater system for a large house with acres of irrigated area and just a handful of inhabitants is more likely to have negative net benefit. In this situation, the value of the greywater is literally a drop in the bucket compared to all the other waste going on—and attempting to capture it just adds more waste.

Error: Storage of Greywater. The word "storage" should immediately sound an alarm, as should any residential system that includes a tank bigger than 55 gallons. Storage rapidly turns greywater into blackwater. If you doubt this, fill a bucket with greywater and observe as it progressively darkens and reeks. Bacteria (at least indicator bacteria) multiply to blackwater levels as well.

Error: Cavalier Disregard for Legitimate Public Health Concerns and/or Excessive Paranoia about Negligible Health Concerns. Some people advocate irrigating lettuce and carrots with untreated greywater. Others fret about distributing greywater under nine inches of soil without disinfection. Some worry about eating fruit that contains molecules from biodegraded dish soap, forgetting that they imbibe traces of dish soap directly with every glass of water and plate of food.

Error: Surface Greywatering of Lawns. Applying greywater to the surface of a lawn short-circuits the all-important purification step. If the lawn receives traffic, it invites direct contact with untreated greywater. The likelihood of transmitting pathogens is small, but it exists.

Error: Irrigating Vegetables. The primary reason not to use greywater on vegetables is concern about transmitting disease. Some people greywater veggies anyway. If your goals are both to grow food and lower overall water consumption, chances are you'll have more irrigation demand than greywater. In this case, use greywater first on ornamentals, then on fruit trees, and use the freshwater you saved to water your veggies.

Of the greywater systems in the United States, probably 15 percent are achieving most of the benefit they should, 80 percent or more could easily do better, and a few have overall negative net benefit. Pondering the failings led our design path further and further from mainstream greywater thought. The more realistic we get, the lower we aim—and the more often we hit the target.

For more information on designing, building, and maintaining greywater systems, see the books Create an Oasis with Greywater *and* Builder's Greywater Guide, *both available from the author at www.oasisdesign.net/greywater.*