
Special greywater design considerations for the State of Wyoming

Overview

It would be impractical for the State of Wyoming to create a complete design manual for the greywater rule when there is so much good information already available on the free market. In fact almost anything we could assemble would only be a duplication of somebody else's work.

What we present here is some material to address some of the problems you may encounter depending upon the scope of your system, and that are specific to greywater use in Wyoming. Some of the solutions will add to the complexity of your greywater system. As a general rule, this means it will be more of a hassle and less reliable. *Whenever possible, consider the simplest solution to your problems.*

Wyoming's greywater policy has been written to allow the greywater user reasonable flexibility, while providing maximum protection to surrounding property and environmental resources. The specific text is located on the DEQ website (<http://deq.state.wy.us/wqd/www/greywater.htm>), and it states in more specific terms "do no harm." If your greywater system is not harming anybody, degrading environmental quality or causing a nuisance, it is probably covered under "permit by rule" as defined in Chapter 16 of the DEQ Water Quality Rules and Regulations.

Chapter 16 (2)(u) "Permit by rule" means an authorization included in these rules which does not require either an individual permit or a general permit. A facility which is permitted by rule must meet the requirements ..., but is not required to apply for and obtain a permit to construct and operate the facility.

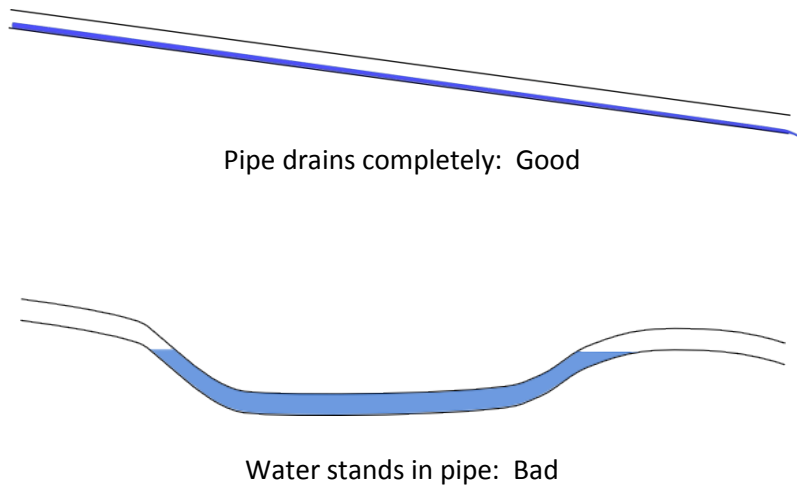
So feel free to experiment and innovate. If you feel that you have a better solution to the issues below and would not mind sharing, we would love to hear from you so we can add your experience to this guide. Call Hannes Stueckler at 307-335-6964 or email hstuec@wyo.gov

If you hire a professional contractor to install your greywater system, please encourage them to contact the DEQ district engineer in your area for the most up-to-date information on greywater system installation in the State of Wyoming.

Circumstances which require special attention

Freezing

Probably the most important aspect of designing and building your greywater system for Wyoming's intermittent freezing weather is to make sure the pipes drain completely:



During Wyoming's cold winters, keeping your greywater system in compliance may be difficult. The ground freezes to a depth of 6 feet in many places. Please consider the following options for winter:

Re-route your greywater to your blackwater system during the winter.

Your greywater system should already be designed to use this method, so this is by far the simplest and most convenient solution. Don't forget to drain your greywater system before the first big freeze.

Re-route your greywater to an underground disposal area, such as a leachfield or mulch basin.

A mulch basin is a simple solution for early and late season irrigation, but will likely freeze in midwinter. The installation of a mulch basin is a very common use of greywater, and details of its construction can be found on the internet and in books.

A disposal leachfield, designed to similar standards as a normal septic system leachfield will add to the cost of the project, but will make winter greywater disposal relatively trouble free. If considering this option, there are a few important items to consider:

- Solids need to be removed from the greywater or they will plug your leachfield. There are several ways to accomplish this including commercially available filters, the installation of a septic tank, or a homemade filter if you can keep it warm enough to avoid freezing in winter months.
- A septic tank is the most costly option, but will give you years of maintenance free operation. It is the best choice if the leachfield will be used continuously or for extended periods of times (such as all winter).
- Septic tanks that are left unused during the winter can freeze.

- If the system will be only used periodically in a hunting cabin or vacation home, a filter system would be preferable due to lower costs and the ability to drain it. (See “filtration” at the end of this document for some ideas on homemade filters.)

Irrigate and/or dispose of your greywater in a greenhouse.

There are many excellent greenhouse designs available that will give you options to deal with winter greywater.

Use insulated pipe and heat tape to distribute your greywater. Remember that ice will form at your outlet point(s). Try this link for some heat tape tips (or search the internet for “how to install heat tape”):

http://www.mygreathome.com/fix-it_guide/heat_tape.htm

Here are some examples of freezing climate solutions:

<http://www.greywateraction.org/content/systems-cold-climates-including-wetlands>

Clay soil

Many areas of our state have clay soil. Water poured onto clay does not soak into the ground very well. Poor percolation (“perc”) rates can result in standing water on the ground surface, and the drowning of plants by keeping their roots flooded with water.

It is important to consider the quantity of greywater you will be using every day when planning your greywater system. There are several ways to determine how much water you will produce. Most methods estimate your total water determined on how many people are in your household. These methods are fairly rough. It would be best to measure how much water you actually use. This can be determined with a bucket and watch in most cases (measure how many gallons in one minute for your shower, for example.)

Having multiple places to send your water will allow one place to drain while the other is filled. When the water drains completely into the ground, it pulls oxygen with it, which is good for your plants and for the microbes that treat your greywater. If the ground is continuously wet, your plants will most likely die, and the water will smell bad. The system can be as simple as a hose that you move from tree to tree, or as complex as an electronically zoned irrigation system. *Keep in mind that simpler is almost always better.*

For the more technically minded greywater user, it may be beneficial to perform a “perc test” near the ground surface to determine how much water the ground can absorb. A very low perc rate (less than 1 inch per hour) will mean that you should plan on sending your water to several plants, so that they can draw up the excess water and release it into the air. (This is what plants do well. It is called “evapotranspiration” in case you want to search the internet for more info.) Instructions on how to perform a perc test can be found here:

<http://deg.state.wy.us/wqd/www/Permitting/Downloads/PercProcedures.pdf>

Kitchen greywater

The Wyoming greywater policy deviates from most other states, as it allows the re-use of kitchen water as part of a greywater system. This includes water from your kitchen sink (and garbage disposal) and dishwasher.

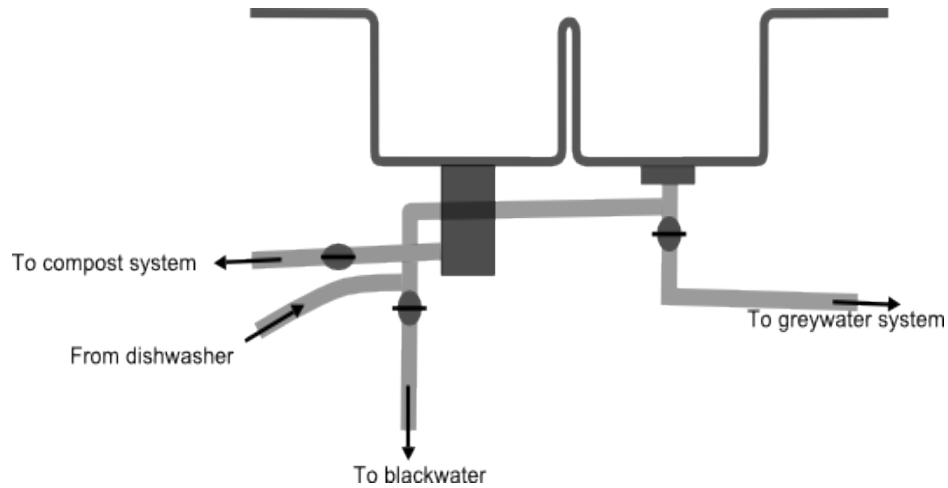
This does not mean that your kitchen water should be considered the same as all of your other greywater. It will most likely contain much higher levels of nutrients and solids, and its re-use should be planned carefully in order to prevent a plugged, smelly greywater system. In fact we recommend careful consideration about using it at all. It is not going to be the best idea for everyone. Please consider the following points and suggestions before re-using your kitchen water:

- There should be little or no storage of this nutrient rich water. Immediate, direct application is by far the best method of use. Pipes should drain completely when no water is flowing.
- Pipe sizing is very important. A pipe that is too small may plug directly, whereas a pipe that is too large won't wash everything through, and will eventually "dam" up. It is best to follow the uniform plumbing code for kitchen drain piping for this application. If you are not sure what that means, the money spent on a professional plumber might save you quite a bit of hassle.
- Maintenance will be ongoing. The discharge point will build up solids and most likely need to be cleared, or moved. Don't expect to install and forget.
- End use is very important. An ideal use of your kitchen water will be to put it on your compost pile. You will be adding more compost with every use. Consider a flexible hose at the end of the water system so that you can move it around. Be sure to study up on composting to make sure that you don't create a nuisance smell for your neighbors (or yourself). Try starting here and searching around for more info:

<http://www.howtocompost.org/>

- Make it easy to divert back to your blackwater. There is a good chance you will make more greywater than you need for your compost. A single diverter valve under the sink would be an ideal way to send it to the garden or the sewer.

- You might want to separate your kitchen greywater. Consider sending the dishwasher and garbage disposal water to one use, and designating the other side of your sink as the “clean” side. Water from the clean side of your sink can go to your regular greywater system. A rough example of this is provided below. Feel free to improve on it.



Here are some examples of well designed kitchen sink greywater systems:

<http://www.greywateraction.org/content/kitchen-sink-system-branched-drain>

<http://www.greywateraction.org/content/woodchip-biofilter-kitchen-sink-wetlands>

<http://www.omick.net/graywater/graywater.htm>

http://www.youtube.com/watch?v=QFqV17wrnvE&feature=player_embedded

Spray irrigation

Before considering spraying greywater into the air, be sure that the spray cannot possibly leave your property regardless of the direction of the wind, or how hard it blows. Also take care that it cannot drift onto livestock, pets, or the edible portion of any food crop.

The use of spray irrigation is not going to be practical for most situations; however it was allowed in the rule for the benefit of users in very sparsely populated areas. If you do not live in an isolated area, and do not own a multi-acre property, the use of spray irrigation is strongly discouraged.

Some factors to consider when designing your spray system:

Is it energy efficient and practical?

Spraying your greywater requires energy, and that usually costs money. In addition, there will be several design considerations adding to the complexity of your greywater system, and complexity usually means added cost and regular maintenance.

If it still appears that spray irrigation may fit your needs, let's look at the practical considerations.

- **Maintenance:** If this facility will only be used during part of the year, such as during growing season, a hunting cabin or vacation home then a system that needs weekly maintenance may be appropriate, as it can be made part of your seasonal routine. If the system will be used on a long term or continuous basis, you will most likely eventually find maintenance to be a hassle, and it is likely that the system will fall into disrepair. Simplicity is probably the most important and overlooked design factor. Ask yourself what you will honestly be willing and able to do.
- **Resale:** If you have a complicated greywater system, it is most likely that the next owner will not want to maintain it, and it could lower the value of your property. On the other hand, a well designed and easy to operate system can be a selling point, especially if you have to haul water in your area.
- **Energy:** You will have to spend money on parts one time, but if you need to pump, there will be a constant energy cost. Will this justify the money you save on water? The answer to this will vary significantly depending on your situation. If you haul water the answer may be yes, while the answer may be no for the same situation on city water.
- **Pressure and flow:** If your property has enough of a slope, and your greywater is generated at a high point, you might have enough natural pressure, also called "head", to run your sprinklers. Every 2.31 feet of drop between the source of the water and the sprinkler produces 1 PSI of pressure in an enclosed pipe. For example if you have 42 feet of drop, you can calculate the pressure at the sprinkler like this:

$$\frac{\text{Feet of drop}}{2.31} = \text{Static Pressure at sprinkler (in PSI)}$$

$$\frac{42}{2.31} = 18.2 \text{ PSI}$$

You will also lose some pressure due to the friction of water in the pipe as it flows to your sprinkler. Calculating friction loss in the pipe is beyond the scope of this document; however there are several online calculators that will make the process simple. Try these links:

<http://www.freecalc.com/fricdia.htm>

http://www.engineeringtoolbox.com/hazen-williams-water-d_797.html

To continue our example from above, let us assume:

- that you wish to place the sprinkler 500 feet from the source of the greywater,
- that your pipe diameter is 1"
- that your pipe is made of HDPE
- that your sprinkler will deliver 5 gallons per minute.

Using one of the above online calculators will reveal a pressure loss of approximately **4.8 PSI**; therefore:

$$18.2 \text{ PSI} - 4.8 \text{ PSI} = 13.4 \text{ PSI}$$

13.4 PSI will be available for the sprinkler. So, if you chose a sprinkler that can operate at 10 PSI (to be safe), then it will work. If you chose a sprinkler that needs 30 PSI to operate, it will dribble and you will be unhappy with your results. If you are uncertain of the minimum operating pressure of the sprinkler, consult the manufacturer or supplier.

Clogging

- Any particles of food, hair from the shower, etc. will have to pass through your pump (if you are using one) and sprinkler. You will either have to select equipment that can handle this situation or filter your greywater. There are many ways to deal with filtration, including running the flow through an old sock before pumping, homemade sand filter, commercial filter system, or even installing an engineered wetland. Each of these options requires maintenance, so consider your choice carefully. (See "filtration" at the end of this document for some ideas on homemade filters.)

Pump design

Gravity flow is preferable, but if a pump must be used, be sure to choose one that will be able to handle the conditions of the water that you intend to pump. Some pumps have very small internal spaces that the water is forced through. This will result in the pump clogging frequently, and will not be practical.

The best way to find out which pump is right for you is to speak with the manufacturer or a supplier that specializes in pumps. General retail outlets for pumps will most likely not have the knowledge to help you with a non-standard use.

Remember to consider pressure head gain or loss and friction loss in the pipe as part of your pump design!

There is a lot to be said on the subject of pump selection, and it would be impossible to cover much of it in this document. There are many publications that can help the end user get a more thorough understanding of pumps if it is desired. A few guidelines to keep in mind are:

- Excess pumping power is a waste. If you choose a pump that produces much higher pressures or flows than you need, it will waste electricity and wear out much sooner than a properly sized pump. There is no need to “drive a thumbtack with a sledgehammer”. Every pump has a maximum efficiency point, and operating it at that combination of flow and pressure will result in the longest pump life and the least power consumed.
- There are many types of pumps. Centrifugal pumps are the most common for this application.
- Moving more water uses more power, and choking the pump back with a valve decreases the electricity consumed with a centrifugal pump. This seems counterintuitive, as we would think that we are making the pump work harder if we begin to close of the pump outlet, but hook up an amp meter and see for yourself!
- Excessive flow and not enough flow can damage your pump. Once again, operate the pump as close to its maximum efficiency point as possible.

For more information on pump operation, try these links:

<http://www.pumped101.com/>

http://www.engineeringtoolbox.com/pump-system-curves-d_635.html

<http://www.coleparmer.com/techinfo/techinfo.asp?ID=629&htmlfile=ReadPumpCurve.htm>

Freezing

Freezing of a greywater sprinkler is no different from freezing any other sprinkler from a strictly technical point of view. The lines need to be drained before freezing weather sets in and destroys your irrigation system.

This complication becomes a problem because you need to have an alternative way to dispose of your greywater during freezing months, as discussed above in the general freezing weather section.

Wind drift

Under no circumstances should your sprayed greywater contact people, animals or food crops. Sprinklers should be set in a remote location so that the wind does not allow it to violate this rule.

Storage

The opinion of the greywater community on storage can be summed up simply: "Don't do it!"

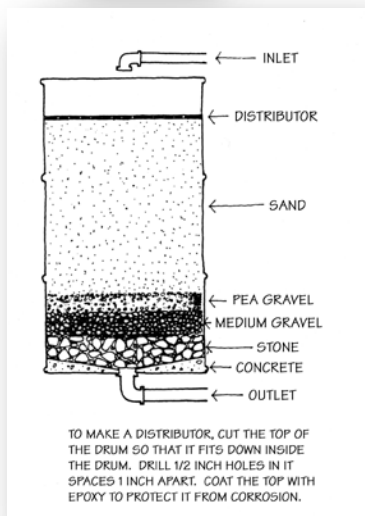
Make every effort to avoid storing your greywater for more than 24 hours. The simple reason is that it rots and stinks. Remember that greywater is full of nutrients and bacteria, and when kept together the bacteria will consume the nutrients and grow. Once it starts to do this, it becomes blackwater. If you are still determined to store your greywater, you will need to treat it to prevent it from going bad. There are several ways to accomplish this:

- The least desirable way is to filter and treat your water with enough chlorine or other chemical to keep it from going bad. Doing this makes it mostly unusable for plants or composting.
- An engineered wetland, as described in the spray irrigation section will remove most of the nutrients and bacteria from the water, preventing it from fouling as severely. This wetland must be carefully designed since it is being used for more than filtration. We strongly suggest getting professional help from an engineer. If this method is followed by a little chlorine addition to maintain a concentration of 5 parts per million (ppm), you should be able to keep the water for a longer period of time.

Filtration



The nylon sock is a simple method to remove large solids prior to letting the water run into a pump chamber. It is far from ideal, as it requires frequent maintenance, and will block greywater flow as it gets full. If not properly maintained, it will rot and stink, making maintenance even harder. This method of filtration is only recommended as a temporary solution.



There are many variations of the homemade sand filter. Choose a design that will best fit your needs.

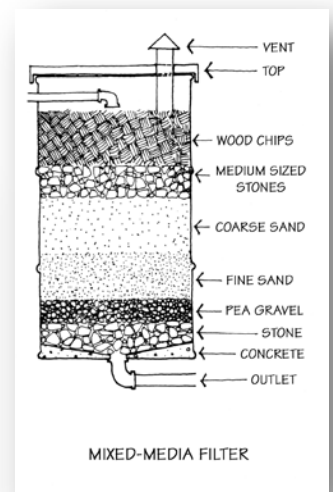
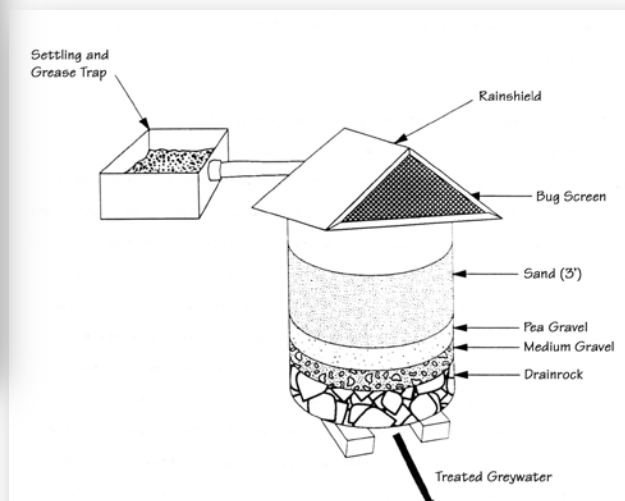
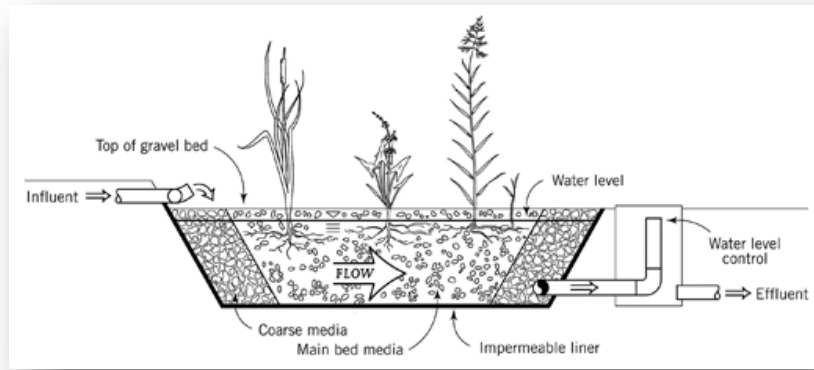
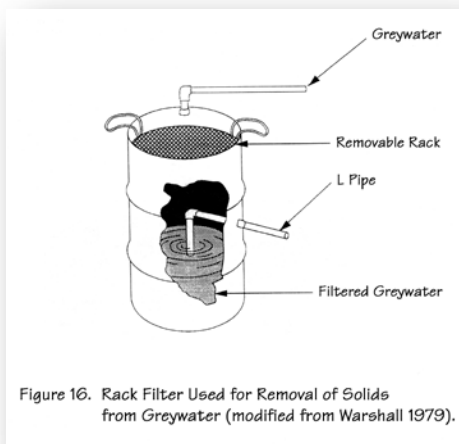


Figure 18. Greywater Sand Filter System (modified from Warshall 1979).



Engineered wetlands provide filtration and nutrient removal, but are more complex to design and construct. Remember that a wetland is a living thing, so it requires “proper care and feeding” like a pet. This means that you will spend some time every month removing accumulated debris from the top of the gravel bed, and some time every year clearing away the dead tops of plants and doing other routine maintenance.

When designing your wetland, care must be taken to size it correctly. If it is too small, you will have less nutrient removal than you may desire. If it is too large, it will cost more money than it should, and the plants will only survive on a portion of the bed. Neither of these conditions will prevent your sprinkler irrigation from working. A little experimentation will yield good results. There is plenty of information available on the subject of greywater wetland design. An internet search for “greywater wetland” will turn up many possible options.



A rack filter on a drum may be a good solution for a pumping chamber. The illustration on the left does not show a pump, but a submersible pump could be used, and the pipe can come out the top. The pipe can also come out of the bottom of the drum by using a “tank adaptor”, which would allow feeding the water directly into an external irrigation pump. Use float switches or other water level sensors to control your pump.