Reusing Graywater in Your Landscape

A Guide for Oregon Homeowners

State of Oregon
Department of Environmental Quality

Graywater/Reuse Program
811 SW 6th Avenue
Portland, OR 97204
Phone: (503) 229-5472
(800) 452-4011
Fax: (503) 229-6037
Contact: Ron Doughten
www.oregon.gov/DEQ

DEQ is a leader in restoring, maintaining and enhancing the quality of Oregon's air, land and water.

How to use this document

This publication is a resource for Oregon homeowners who would like to install a graywater reuse system. In this guide you'll find information on:

- what graywater is and how it can be used;
- the benefits of reusing graywater; and
- simple steps to designing, installing and permitting a graywater reuse and disposal system.

Supplemental information on how to evaluate soils for graywater reuse as well as examples of a subsurface graywater irrigation system and a surface drip irrigation system following graywater treatment are included in appendices. Every graywater reuse system will be slightly different because no two graywater projects are exactly alike. As a homeowner, it's your responsibility to ensure your system complies with state and local codes and doesn't cause harm or damage to yourself, your neighbors, or the environment.

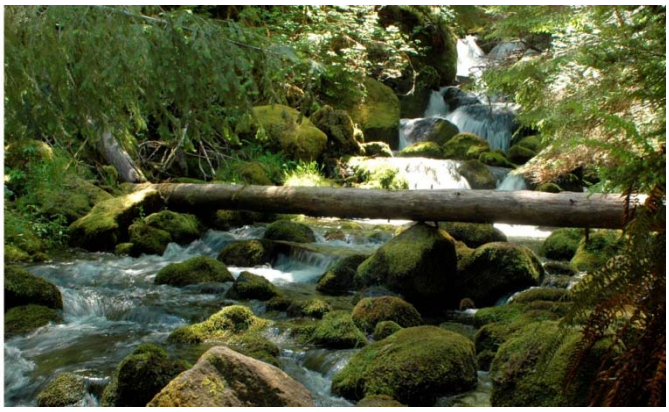
This guide has been written to help Oregon homeowners obtain and comply with a DEQ-permit for a graywater reuse and disposal system installed at single-family residences or residential duplexes with no more than four bedrooms. Technical details on the design, installation, operation or maintenance of a graywater reuse and disposal system should be directed to a professional installer, plumber or landscape professional. More information on Oregon's graywater program and permit applications can be found on the DEQ website at http://www.deq.state.or.us/wq/reuse/graywater.htm.

❒ A checkbox marks something you **must** do to obtain a DEQ permit.

! Pay attention to items with an exclamation point: these are critical concepts or requirements that will help you remain in compliance with your DEQ permit.

What exactly is graywater?

Graywater is "used" water originating from kitchen sinks, bathroom sinks, showers, bathtubs, and washing machines. Graywater specifically does not include wastewater from dishwashers, garbage disposals, toilets, wastewater from the washing of cloth diapers or wastewater that contains hazardous chemicals[1] (for example, rinse water from washing oily rags or paint brushes, pesticides/herbicides, and photo-lab chemicals). Although graywater is generally of higher quality than combined household wastewater discharged to a sewer or septic system, it can contain elevated concentrations of solids (e.g., hair, lint, food scraps), chemicals (e.g.,



[1] For guidance on the safe disposal of hazardous household chemicals, contact your local waste hauler.

Last Updated: 6/24/13
By: Ron Doughten

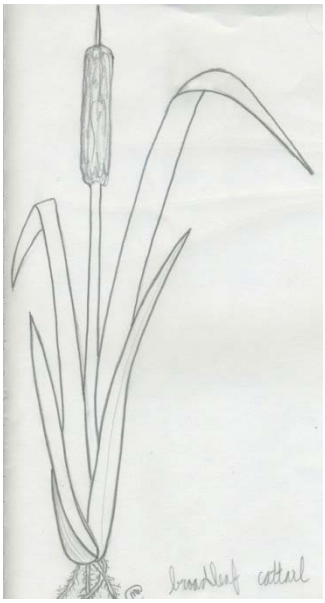
soap, shampoo, detergents, cleaning agents) as well as microorganisms (e.g., bacteria, viruses), including human pathogens.

Oregon recognizes three categories of graywater: Types 1, 2 and 3. Differences in quality, treatment and use of Type 1 and Type 2 graywater are discussed in this guide; the use of Type 3 graywater[2] is beyond the scope of this guide. See Table 2 for more information on graywater characteristics.

Graywater should not be confused with *recycled water*, which is highly treated wastewater from municipal or decentralized wastewater treatment facilities. Recycled water is permitted and managed differently than graywater.

Why reuse graywater?

As environmental awareness has grown and the price of drinking water has risen, the interest and need for water conservation and reuse has grown. It's not necessary to use high-quality potable (drinkable) water for activities such as irrigating lawns or landscape plants. Using graywater for landscape irrigation is a smart way for homeowners to adopt sustainable water practices and conserve our limited drinking water supplies for activities requiring high-quality water. Homeowners that reuse graywater for lawn or garden irrigation may also see a modest cost savings on their water bill. Finally, when Oregonians reuse graywater, less water is withdrawn from rivers and streams, which helps keep our waterways healthy for fish and people.



Steps for developing a graywater system

State law requires all graywater reuse and disposal systems in Oregon to be designed and permitted. Designing, permitting, operating and maintaining a system to use graywater in the landscape is a relatively simple process accessible to the average homeowner.

1. **Determine use** – Decide how you want to use graywater.

2. **Pick a location** – Using guidelines in this document, verify your graywater reuse site is appropriate.

3. **Estimate your water needs** – Determine how much graywater you need for your chosen use.

4. **Estimate available graywater** - Decide which fixtures from which graywater will be collected. It may not be feasible to capture graywater from every fixture in your house.

5. **Design your graywater system**- Design your graywater system, including collection, distribution and reuse. Depending on the sources of graywater in your home and how you plan to use graywater, your system design may include graywater treatment and storage.

6. **Document your system** - Create a system design plan and operation and maintenance manual for your system

7. **Apply for a permit** - Obtain a permit application from DEQ and apply for a permit. Permit applications and information are available on the DEQ website[3] at http://www.deq.state.or.us/wq/reuse/graywater.htm.

[2] Type 3 graywater can be used for a wider variety of beneficial purposes but it must be disinfected. Permits and fees will vary based on the situation. Contact DEQ for more information.
[3] For a complete list of websites mentioned in this document, see additional resources at the end of this guide.

8. **Install your system** - Almost all graywater systems will require a plumbing permit and must comply with the Oregon Specialty Plumbing Code (http://www.bcd.oregon.gov/programs/online_codes.html). Anyone you hire to install a graywater irrigation system in the landscape must be licensed with the Landscape Contractors Board (http://www.lcb.state.or.us).

9. **Operate, maintain and report** - Use your graywater only when you need it. Monitor and maintain your system. And finally, submit an annual report to DEQ. It could save you some money.

According to the U.S. Environmental Protection Agency, a typical US residence produces approximately 90 to 100 gallons of graywater each day.

1. Determine use

Oregon law allows graywater to be used for specific beneficial purposes, such as irrigating lawns and gardens. Since some uses of graywater require a higher quality[4] of graywater than others, identifying how you want to use graywater is the first step in designing a graywater reuse and disposal system. Review the following list of graywater uses and note the "type" or quality of graywater required for your specific use or uses of graywater. (You can reuse your graywater for more than one purpose.) Note the special conditions and permit information for each graywater use. This information will help you decide which graywater use is best for your situation. If you are interested in using graywater for toilet or urinal flushing, you are required to purchase an "off-the-shelf" system and get a local plumbing permit.[5] Contact your local building officials for information on using graywater for toilet and urinal flushing.

If you want to use graywater for <u>subsurface irrigation</u> of...

- Gardens, lawns and/or landscape plants
- Food crops - excluding root vegetables or any crops where the edible portion would come into direct contact with the graywater
- Vegetated roofs that do not drain to a rain garden, swale or other structure designed to infiltrate stormwater into the ground
- Wetting compost

...then you need **Type 1 graywater**, which is untreated, or has only passed through a physical process (primary filtration) to remove floatable and settleable solids. Examples of primary filtration include grease traps and filters. For an example of a Type 1 system, please see Appendix B. Consider the following to help you determine whether or not you want to use Type 1 graywater.

Special Conditions of Use

- Graywater system must meet setback distances outlined in Table 1
- Graywater can't be stored for more than 24 hours
- The point of graywater discharge must be at least two inches below soil, mulch, etc.
- Graywater must not travel up to the ground's surface, pond or move off-site

Permitting

- No documentation other than a permit application needs to be submitted to DEQ
- Straight-forward registration process
- Minimal fees (Fees waived in non-renewal years with the submission of an annual report) see Table 3

If you want to use graywater for <u>surface drip irrigation</u> or **<u>landscape ponds</u>** not

[4] Quality here refers to the level of treatment your graywater has received, such as passing through a filter. Different levels of treatment lead to different "types" of graywater, see Table 4.
[5] www.permitsprotect.info

intended for human contact…

...then you need **Type 2 graywater**, which in addition to passing through primary treatment, has been further treated by a chemical or biological process to clean the water. Fruits and nuts that fall to the ground where drip graywater irrigation is used cannot be harvested for human consumption. Consider the following to help you decide if you want to use Type 2 graywater.

Special Conditions of Use

- Graywater must meet setback distances outlined in Table 1
- Signs must be posted at the point of reuse identifying the water as graywater and stating that the water isn't safe for drinking or swimming (if applicable)
- Ponds must be lined to prevent graywater from seeping into groundwater
- Graywater must be treated to meet the following performance standard: A five-day biochemical oxygen demand of 10mg/L or less and a total suspended solids concentration of 10mg/L or less

Permitting

- Requires documents to be reviewed and approved by DEQ
- More time consuming and expensive than Type 1
- Higher initial cost and annual fees (see Table 3)

2. Pick a location

Your graywater reuse system will be located where you need the water, but keep in mind that graywater must not negatively impact the environment or your neighbors. Consider the following five criteria when evaluating your graywater reuse site:

1. Irrigation sites must not be in places that regularly flood or receive large amounts of runoff at the time of irrigation.
2. The site must not have a slope greater than 45 degrees.
3. During the irrigation season, there needs to be at least four feet of distance between the groundwater and where your graywater is discharged. Dig a hole with a shovel to check or ask a local landscape professional or your local Soil and Water Conservation District for help with determining groundwater levels.
4. Consider the ability of the soil and vegetation in your reuse area to use the graywater (see sections on soil and vegetation below).
5. Types 1 and 2 graywater have different horizontal setback distances that must be observed (Table 1).

Table 1. Setback distance requirements for Type 1 and 2 graywater systems.

Sensitive Feature	Distance from Graywater Irrigation Discharge Point (feet) Type 1	Distance from Graywater Irrigation Discharge Point (feet) Type 2
Groundwater Well	100	50
Springs	100	50
Rivers, Streams, Lakes, Ocean	50	25
Stormwater Management Structures such as Raingardens, Bioswales, and Catch Basins	10	10
Underground Injection Control Systems	10	10
Property Lines	2	2

Create a site diagram

Create a diagram or map of your property that includes the following information (a simple hand-drawn diagram with clear writing is acceptable):

- Total size of your property (not just the area receiving graywater)
- Area measurements and slope of reuse site
- Location of surface streams, springs or other bodies of water
- Location of septic tank or other onsite wastewater treatment system (if any)
- Location of raingardens, bioswales, infiltration basins, dry wells or any other structure intended to capture stormwater and infiltrate it into the soil
- Location of existing or planned wells
- Any escarpments, cuts or fills in the landscape
- Location of any unstable landforms, such as landslides and slumps

Crossing Property Lines

It's fine for you to share your graywater with a willing neighbor. If your graywater reuse system crosses a property line:

1. *Both parties agree to reuse graywater in a way that complies with Oregon's graywater rules.*
2. *Both parties sign and honor a written agreement regarding their graywater reuse arrangement.*
3. *The state's officers, agents, employees and representatives are allowed access to enter and inspect all portions of the graywater reuse and disposal system, on both properties.*

Also note on your diagram the uses of adjacent properties (for example, residential housing, commercial, agriculture, etc.). If the neighboring properties have any of the above-listed features (such as a well or raingarden) that are near your graywater reuse area, note it on your diagram.

❒ Keep a written record of your site evaluation!

Evaluate your soil

Having a basic understanding of your soil type (sand, loam, clay) will help you predict how quickly graywater will absorb and infiltrate into the root zone. Water typically infiltrates sandy soils quickly and clay soils slowly. If you plan to irrigate a sandy soil, you may need to use a surge tank to slow down water delivery so plants have time to use the water. Likewise, irrigating a heavy clay soil may require graywater to be delivered at a slower rate or over a larger area to prevent ponding and runoff. Please see Appendix A for easy ways to evaluate your soil profile and infiltration rate. Local landscape professionals or your Soil and Water Conservation District may also provide valuable assistance when evaluating your soils.

Describe the vegetation in the reuse area

Different plants have different water needs, so it's important to consider the type of vegetation you'll be irrigating. Delivering too much or too little water to your plants can damage or kill your landscape vegetation. The rate at which water moves from the soil and to the atmosphere by evaporation from the soil surface and through leaves is known as the **evapotranspiration rate**. Different plants have different evapotranspiration rates. Baseline evapotranspiration rates for plants can be found online or in published landscape references. You can also check with your Soil and Water Conservation District or a professional landscaper or local plant nursery to get more region-specific information. In many cases, it may be enough to know if your vegetation has a very-low, low, medium, or high water needs.

3. Estimate your water needs

The amount of water needed for irrigation will depend on the size of the area you want watered, the vegetation, the climate and the season. For example, how much water do you need to irrigate a 200 square foot lawn in August? The maximum amount of graywater needed for

your identified use(s) is the **system design flow**.

You can easily estimate your water needs for irrigation. If you plan to irrigate an established landscape or garden, you can estimate your water usage from your past water bill or based on the area and type of vegetation. If you're planning a new garden bed, you'll want to estimate water need by following the area and vegetation calculation.

❒ You'll need to know your estimated graywater needs when filling out a permit application.

Method 1: Water bill calculation. If you've irrigated your lawn or garden in the past, look at previous water bills. (Some utilities in Oregon provide this information online as well.) Compare your water usage from your summer bill (when irrigation is most needed) to water usage on your winter bill. If you subtract winter water usage from summer water usage, the difference is typically the amount of water you historically use for irrigation.[6] Convert that number with the following equation to calculate approximately how many gallons per week you'll need.

$$Weekly\ irrigation\ (gal/wk) = \frac{(Summer\ water\ use - Winter\ water\ use) \times 748 \times 7}{Days\ of\ service\ for\ water\ bill}$$

This calculation estimates your total summer irrigation. If you plan to irrigate more or less of your existing landscape with graywater, you may need to apply a factor to this calculation to get a better estimate on your water needs.

Example water use calculation (water bill method):

Summer water use: 22 ccf
Winter water use: 12 ccf
Days of service: 92

$$Weekly\ irrigation = \frac{(22 - 12) \times 748 \times 7}{92} = 569\ gallons\ per\ week$$

Method 2: Area and vegetation calculation. Water needs can also be determined by multiplying the area of irrigation by the water usage (or evapotranspiration rate) in your area. Plant water use is often described as inches of water needed per week. Plant-specific irrigation requirements may be available from local nurseries or landscape professionals. If plant-specific information is unavailable, the irrigation requirements for other landscape plants can be estimated based on the irrigation requirements for a lawn. In Oregon, maximum irrigation need occurs in July and August; as a rule of thumb, lawns require one inch of water per week in mid-summer. The Regional Water Providers Consortium for the Portland area provides the following recommendation for determining vegetation water needs:

- Shrubs: 50% of lawn requirement
- Perennials: 50% of lawn requirement
- Vegetables: 75% of lawn requirement
- Trees: Newly planted trees need regular water for up to the first couple of years, while established trees may need a deep soak or two in summer.

Use the following equation to calculate weekly water needs by the area-vegetation method if you have the weekly irrigation requirement for a lawn:

[6] Most water suppliers express usage in ccf or 100 cubic feet, which is equal to 748 gallons.

$$Weekly\ irrigation\ (gal/wk) = A\ (sq.ft) \times ET_{lawn}\ (in.) \times k_s \times 0.62$$

where

A is the area needing irrigation
ET_{lawn} is the weekly evapotranspiration rate
K_s is the species factor (ex: percentage of the ET_{lawn}) and
0.62 is the conversion from inches of water to gallons.

Example water use calculation (area-vegetation method):

Time: July-August
Area: 4 – 4'x10' raised beds
Vegetation: vegetables

$$Weekly\ irrigation = 160\ sq.ft. \times 1\ in. \times 0.75 \times 0.62$$
$$= 74.4\ gallons\ per\ week$$

If you need assistance estimating the amount of water you need for irrigation, your local Soil and Water Conservation District and/or water department is a place to start.

! Include your usage assumptions in the system documentation so that future residents will know how much water your system was designed to handle.

4. Estimate available graywater

It's unlikely that a graywater system installed in a new or existing home will capture all sources of graywater produced by the household--some pipes are extremely hard to get to and some wastewater must go to a sewer or septic system. The quality of graywater will likely vary between fixtures and you may choose not to use it in your system. Each fixture in your house will produce a different amount of graywater, with different characteristics (Table 2).

Table 2. General graywater characteristics by source

Showers and Baths	Bathroom Sinks	Kitchen Sinks	Washing Machine
• Relatively Clean • Predictable volume and frequency	• Higher concentrations of personal care products (toothpaste, shaving cream, etc.) • Low volume	• "Dirtiest" source of graywater • May contain fats, oils, grease and other solids • May contain bacteria, viruses and other microorganisms	• Predictable volume and frequency • High concentration of lint/fiber • Detergents can be hard on plants

Deciding which sources to include in your graywater reuse system will depend on a combination of how much water you need, how much water you have, and the degree of difficulty in accessing the fixture's pipes. All of your interior plumbing must comply with the Oregon Specialty Plumbing Code. The following guidelines will help you determine how much graywater is available from washing machines, sinks and showers.

Washing Machines

If you're building a system that diverts water from the washing machine you'll need to do the following equation:

$$Washing\ machine\ flow\ (gal/wk) = gallons\ per\ load \times loads\ per\ week$$

Example: *Your household washes four full loads of laundry per week, typically on Sunday. Your machine is older and uses 30 gallons of water per load. You can generally find the gallons per load listed under the lid of the machine. If not, call the manufacturer or find information on your model from the manufacturer's website.*

$$Washing\ machine\ flow = 30\ gal/load \times 4 loads/wk$$
$$= 120\ gal/wk$$

Even though you aren't producing this amount of graywater every day, your system needs to be able to handle that volume to accommodate laundry day. If there is an unexpected fifth load of laundry and your graywater reuse area cannot accommodate the excess flow, that water must be sent to the sewer or septic system by switching the 3-way valve (see Installation section). Alternately, if you only need 90 gallons to irrigate your lawn, you can plan to send only three loads worth of water to the reuse system. It's important that these calculations be included in your system documentation so that any future residents in your home know what your system is designed to handle.

Showers

Depending on the location of the pipes, some showers and tubs can easily be re-plumbed for graywater reuse. The flow rate of your shower head is generally found on the side of the fixture. If not, you can still determine the flow by seeing how long it takes to fill up a 1 gallon bucket. Using either method, multiply the gallons per minute by the average time spent showering per day. This will give you a good estimate of the graywater produced by that fixture.

Example: *Each person in a three-person household showers five minutes every day. The showerhead is rated at 2.2 gallons per minute.*

$$Shower\ flow\ (gal/wk) = 2.2\ gal/min\ \times 5\ min/per \times 3\ per/day \times 7 days/wk$$
$$= 231 gal/wk$$

Sinks

Estimating the amount of graywater generated from sinks is more challenging than for showers and washing machines. Sink flow rates are variable, depending on the fixture, person and the activity. In the U.S., faucets made before 1992 typically have maximum flow rates of 5 gallons/minute (gpm). Faucets made after 1992 are limited to a maximum flow rate of 2.5 gpm, with some high efficiency models as low as 1.5 gpm. Online calculators[7] can estimate your water use, but the most accurate way is to observe and record your water use habits over several days. It's time consuming, but this step will save you time and energy as you design your graywater system.

❒ Keep a record of your estimated available graywater. You'll need this information on the permit application.

Create a water balance

At this point, you know how much water you need for your chosen use, and how much graywater you can capture from your house. A water balance is simply the difference between the amount of graywater you have and the quantity of water you need.

The water balance is a tool to help you design your system. For example, if your water need exceeds the quantity of graywater available, you will need to reduce your water needs or supplement your graywater supply with other sources of water. Since your water needs will vary throughout the year, as the weather changes, you'll have to plan how to manage excess graywater. For example when rainfall provides enough water to meet your needs, you can send

[7] See 'Additional Resources' for a list of online water calculators.

excess graywater to the septic or sewer system. Although Type 1 graywater can't be stored for more than 24 hours, Type 2 graywater can.

! If you'd like to store excess graywater, your system design must include graywater treatment and storage (see the following section: Design your graywater system).

Example water balances:

	Example A	***Example B***
Graywater supply	*274 gal/wk*	*410 gal/wk*
Water need (subtract)	*110 gall/wk*	*569 gal/wk*
Difference	*164 gal/wk* ***surplus***	*-159 gal/wk* ***deficit***
Design options	*Reduce the number of fixtures*	*Plan for supplemental irrigation*

5. Design your graywater system

Treatment refers to processes that "clean up" your graywater before use. There are two kinds of graywater treatment for Type 1 and 2 graywater systems: primary treatment and secondary treatment. **Primary treatment** refers to the physical removal of grease, floatable and settleable solids from graywater through use of a grease trap or filters or both. **Secondary treatment** means the removal of organic matter and suspended solids by a chemical or biological process so treated graywater meets the following water quality standard: five-day biochemical oxygen demand (BOD-5) of 10mg/L or less and a total suspended solids (TSS) concentration of 10mg/L or less. A Type 1 graywater system collecting graywater from a kitchen sink must have primary treatment. All Type 2 graywater systems require both primary and secondary treatment.

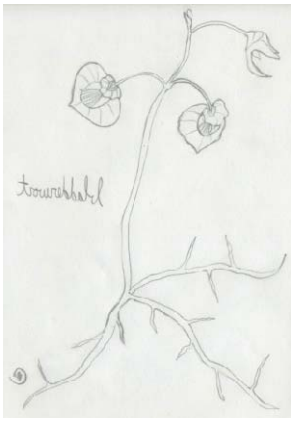
Table 3. Treatment requirements for Type 1 and Type 2 graywater

Type 1 Graywater	Type 2 Graywater
Type 1 graywater has not gone through secondary treatment. Graywater coming from a kitchen sink must go through primary treatment. Primary treatment is the physical separation of settleable solids, such as lint, grease, hair, etc. from the graywater. For safety reasons, untreated graywater cannot be stored for more than 24 hours. This precaution greatly reduces the chance for pathogens and bad odors to become problems.	Type 2 graywater goes through both primary and secondary treatment. Secondary treatment means a chemical or biological process to remove a portion of the organic matter and other solids in the graywater. Secondary treatment is defined by the following performance standard: • A five-day biochemical oxygen demand of 10mg/L or less. Biochemical oxygen demand means the amount of oxygen needed by organisms in water in order to break down organic matter present. • A total suspended solids concentration of 10mg/L or less. Total suspended solids means the weight of particles floating in water.

Treatment options for Type 2 graywater reuse and disposal systems

There are two basic treatment approaches for Type 2 graywater treatment systems: technology-based treatment and performance-based treatment. Technology-based treatment systems are products that have been certified by a third party to successfully treat graywater to the performance standards. Performance-based treatment refers to any system, purchased or constructed, that can also meet the water quality standards, but hasn't been certified by a third party.

Technology-based treatment. Any technology-based treatment system used in Oregon must have a seal of approval from the American Standards Institute, the International Association of Plumbing and Mechanical Officials, the Canadian Standards Association or from another body recognized by both DEQ and the Oregon Department of Business Services Building Code Division. Along with the purchase price, you should consider any electricity costs for system operation, such as for pumps.



Performance-based Treatment. Performance-based treatment systems can be any design in which treated graywater meets required water quality standards. One common type of treatment is a slow sand filter. Sand filters work by passing graywater through a bed of sand, which traps particles and provides space for bacteria to decompose organic material. Eventually the sand clogs and must be replaced. Slow sand filters don't require adding chemicals, but may need a pump. Another performance-based treatment option is a small outdoor plant treatment system. Plants and the community of microscopic organisms that live in the soil and water around their roots naturally filter water. Plants are a proven method for water treatment. Wetlands are an example of plant communities that slow the flow of water, allow particles to settle, and remove excess nutrients from the water. For an example plant treatment system, see Appendix C.

If you want to treat your graywater to Type 2 standards using a "performance-based" natural treatment system, such as a plant-based wetland system, consider working with a designer familiar with wastewater treatment. At least once per year, a sample of your Type 2 graywater must be collected and analyzed by a private lab to demonstrate the treatment system is working. See Additional Resources, for a link to accredited water testing labs.

! Send the results of graywater testing (when required) to DEQ with your annual report. If you treat graywater using a technology-based system, annual graywater monitoring is not required.

6. Document your system

All graywater reuse and disposal systems must be documented in a **system design plan** and an **operation and maintenance manual**. For Type 2 systems, you must send this documentation to DEQ with your permit application. The documentation for your system stays with the house if the property is sold, which is one reason it's important to document how your system is designed to work.

❒ **System design plan.** The system design plan must include the following information:

- Beneficial uses of graywater
- Location of the system
- Design flow of the graywater reuse and disposal system
- Fixtures that are the source of graywater
- Design of the distribution and reuse system
- Description of any graywater treatment system used
- Name and contact information for the person responsible for the system design

❒ **Operation and maintenance manual.** This manual is a short guide on how to operate and maintain your system. It's meant to be a flexible document that you can change and add information to as needed. At a minimum, the operation and maintenance manual must include:

- A detailed description of the graywater system, including any graywater treatment. Consider including the following information in the description of your graywater system:
    - A simple diagram of the system identifying the locations of diversion device (3-way valve, etc.) and the location of any filters or system components

requiring regular maintenance

- A detailed description of any activities required to operate the system:
  - Describe how and when to send graywater to the reuse system vs. the sanitary sewer
  - Include your assumptions and calculations of how much graywater the system is designed to handle
  - Briefly discuss what types of products are and aren't safe to put in your graywater system
- For Type 2 graywater systems, graywater monitoring procedures:
  - Include steps for monitoring and reporting
- Describe how to maintain the system, such as:
  - Turning on the system in the spring
  - Routine maintenance tasks, such as changing filters or inspecting the system, and approximately how often to perform them
  - Flushing the surge tank and distribution lines
  - Draining the irrigation lines before winter

If your graywater crosses a property line, include your neighbor agreement document in the manual.

7. Apply for a permit

Information on graywater permitting is available on the Oregon DEQ website. See Table 4 for the type of permit, documentation requirements, and fees for your graywater system.

❒ **Plumbing permits** are separate and you should check with your installer or with the local building code department to determine what may be required. You'll need to note on the graywater permit application any other permits issued or applied for with this project.

Table 4. Permit structure for graywater reuse systems

Permit Type	Tier 1 (2401)	Tier 2 (2402)
Graywater Type	Type 1 only	Type 1 or Type 2
Flow	< 300 gallons per day	< 1,200 gallons per day
Uses	Subsurface irrigation	Subsurface irrigation Drip irrigation Landscape ponds
Documentation required	Permit application	Permit application System design plan Operations and maintenance manual
Fees (new; annual)*	$50; $40	$534; $50

**The sum of the new and annual fee is required with every new graywater reuse and disposal system permit. The annual fee for Tier 1 permits will be waived every four out of five years if an annual report is submitted to DEQ.*

8. Install your system

Since every graywater reuse project will be different, this guide cannot give you detailed instructions on how to install your system.
Every system **must** have a diversion device that lets you easily select where to send your graywater—either to your reuse system or a wastewater disposal system.

❒ Your graywater system **must** connect to a sanitary sewer on onsite septic system. On your permit application, you must specify if your graywater system connects to a sewer or an onsite wastewater treatment system (e.g., septic system).

The graywater diversion valve must be constructed and installed to meet the requirements of the Oregon Specialty Plumbing Code.

! If your graywater system connects to a pre-existing irrigation system you **must** install a back-flow valve to protect potable water from contamination. The back-flow valve must be permitted by your local water agency. It's important that all exterior graywater piping be labeled: "Caution - non-potable water. Not safe to drink."

If your system uses a surge tank or a storage tank (Type 2 graywater only), make sure the container is secure (won't tip over), sized to accommodate peak flow, labeled "Caution - non-potable water. Not safe to drink," and is fitted with an overflow drain that's connected to an approved sewage system.

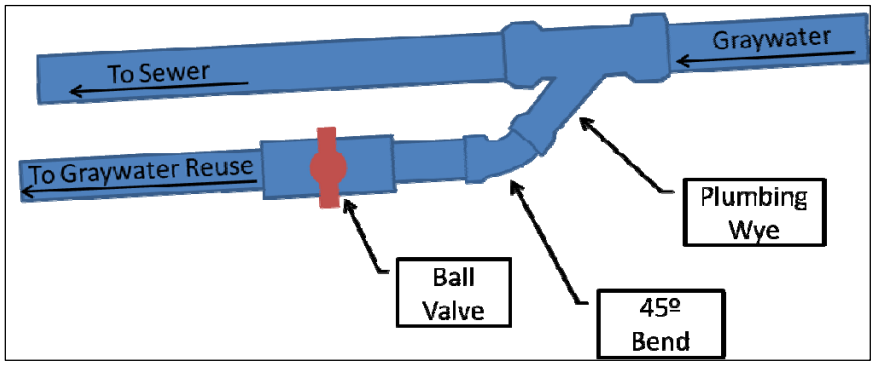


Figure 1. Illustration of a graywater diversion valve. The existing graywater line was cut to install the plumbing wye and the new graywater reuse line. When the ball valve is open, graywater flows by gravity to the reuse system. When valve is closed, graywater flows by gravity to the sewer.

Signage is required for Type 2 graywater systems that involve surface irrigation or landscape ponds. Post easy to see signs that graywater is being used and that the water is not safe for drinking on swimming.

Your graywater irrigation system also needs to be identified as using non-potable water. Purple-colored fixtures, pipes and hoses are commonly used to identify non-potable water. If these materials aren't available from a local hardware or home-improvement store, check with businesses that specialize in rain-water harvesting. It's also acceptable to use some other type of permanent labeling system that alerts someone that graywater is being used for irrigation.

! If you own your property and you are installing a graywater system on your property *yourself*, you may do so. However, anyone you hire to install a graywater irrigation system in the landscape must be licensed with the Landscape Contractors' Board (http://www.lcb.state.or.us).

9. Operate, maintain and report on your system

Use your graywater when you need it and use only as much graywater as you need for your use. For people living in the Portland metro area, the website http://www.ConserveH2O.org has a zip code specific water calculator that will tell you how many inches of water your lawn needs for the current week.

! If you produce excess graywater, you **must** send it to the sewer or septic system, or treat and store it (Type 2 graywater only) for later use.

You cannot discharge graywater into frozen or saturated soil. If you're unsure whether or not your soil is saturated, do the following simple test: Dig six inches below soil surface. Pick up a handful of soil and squeeze it. If water drips out, your soil is saturated.

! Use biodegradable soaps and detergents when you're sending water to your reuse system. If you need to wash diapers or use chlorine bleach, send that water to your wastewater disposal system.

! Perform routine maintenance on and monitor your system. Note maintenance and changes in your operation and maintenance manual.

! Submit an **annual report** to DEQ using the form on the DEQ website. By submitting an annual report, DEQ will waive the annual fee for Tier 1 permit holders, except in permit renewal years.

Additional Resources

Oregon Department of Environmental Quality:
http://www.deq.state.or.us/wq/reuse/graywater.htm

Oregon Building Code Department - Plumbing Codes
http://www.bcd.oregon.gov/programs/online_codes.html

Oregon Landscape Contractors Board
http://www.oregon.gov/LCB/pages/index.aspx

Permits Protect – A public-private program including information about building codes and permits for flushing toilets with graywater;
http://www.permitsprotect.info

Water use calculators:
http://www.h20conserve.org

http://www.swfwmd.state.fl.us/conservation/thepowerof10/

Irrigation calculator for Pacific NW
http://irrigation.wsu.edu/Content/Select-Calculators.php

Water testing labs
http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Documents/acclab.pdf

Oregon Soil and Water Conservation Districts
http://www.oacd.org/

Acknowledgments:

Primary author: Sarah Eastman, Portland State University, Dept. of Environmental Science.
Photographs and illustrations: Sarah Eastman
Botanical illustrations: Morgan Whitney

For more information please contact:

Ron Doughten, DEQ water reuse program coordinator, Portland, (503) 229-5472

Alternative formats

Alternative formats (Braille, large type) of this document can be made available. Contact DEQ's Office of Communications & Outreach, Portland, at (503) 229-5696, or call toll-free in Oregon at 1-800-452-4011, ext. 5696. Hearing-impaired persons may call 711.

Appendix A: Infiltration and Soil Type Tests

Easy Infiltration Test

Follow these steps to determine how quickly water can infiltrate your soil. Be sure to do this during the same time of year that you plan to irrigate for the most accurate results.

1. Dig a hole four feet deep. If you hit a layer that is too hard to dig through, stop, record the depth of your hole and proceed with the test. If you find groundwater before four feet, stop. Graywater can't be used in places where the groundwater is closer than four feet to the soil surface.
2. Fill the hole with six inches of water, and record the exact time. Check the water level at regular intervals (every one minute for fast-draining soils to every 10 minutes for slower-draining soils) for a minimum of one hour or until all of the water has infiltrated. Record the distance the water has dropped from the top edge of the hole.
3. Repeat this process two more times, for a total of three rounds of testing. These tests should be performed as close together as possible to accurately portray the soil's ability to infiltrate at different levels of saturation.

Easy Soil-Type Test/Ribbon Test

Use this test to determine what type of soil you have. Soils range from clay to sandy, with loam being the mid-point between the two. Many soils are a combination such as sandy-loam. Clay soils hold water, while sandy soils drain quickly.

1. Put a small handful of soil in your hand and slowly moisten it with water while kneading it.
2. Squeeze the soil and see if you can make an impression of your hand (a cast).
3. Try to form the soil into a ball. Place the ball of soil in the palm of your hand. Squeeze gently between your thumb and fingers, pushing the soil upward into a ribbon.
4. Let the ribbon break from its weight. Use Table 5 below to determine your soil type.

Table 5. Soil types based on sample characteristics.

Soil Sample Characteristics	Soil Type
Soil won't stay in a ball, feels loose and gritty when wet.	Sand
A cast forms, but easily breaks. A ribbon won't form. Soil feels slightly gritty.	Sandy loam
A short ribbon forms but breaks when around 1/2 inch long.	Loam
A ribbon forms but breaks around 3/4 inch. Soil feels slightly sticky.	Clay loam
The ribbon is an inch or more in length. Soil feels very sticky and gritty.	Sandy/silty clay
The ribbon is an inch or more in length. Soil feels very sticky and smooth.	Clay

Appendix B: Type 1 Reuse System Example

No two graywater reuse system are going to be exactly alike. Figure 2 shows a basic example that can be easily adapted to fit your unique situation. Remember, a landscape professional can help you design a system that both meets your needs and complies with regulations.

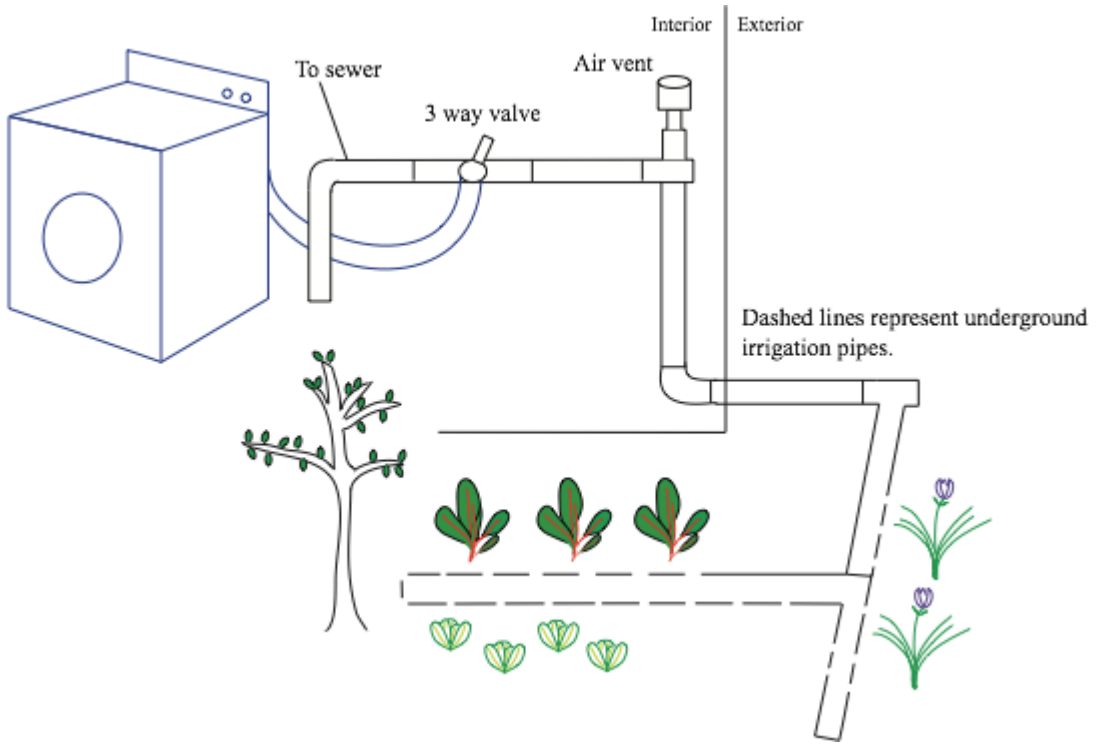


Figure 2. A simplified example of a Type 1 subsurface irrigation system.

Graywater from kitchen sinks must pass through a grease trap. It's recommended that graywater from washing machines pass through a filter. Install your filtration device where the water exits the fixture, before it arrives at the valve. Be sure to empty the filter/grease trap regularly to keep your system running smoothly.

By switching the valve, you can send your graywater to either the sewer, or to your reuse system. The air vent is a critical part of the plumbing. It prevents graywater from back-flowing. The subsurface irrigation system shown in Figure 1 releases water slowly to plants via perforated piping. The exterior pipes must be covered by at least two inches of soil or mulch.

Appendix C: Type 2 Plant Treatment System Example

Plants and the community of microscopic organisms that live around them have been filtering water long before humans took notice. In science the term phytoremediation describes the ability of plants and their associated microscopic organisms to treat water or soils. Wetlands are a prime example of plant communities that slow the flow of water, allow particles to settle, and remove excess nutrients from water.

It's possible to create a treatment wetland for your household graywater on a much smaller scale. After your graywater has gone through primary treatment, such as a grease trap, it can be sent into a constructed wetland for secondary treatment. Your wetland could be in a lined pond or even an old bathtub. Either way, the combination of slowing the flow of water down, wetland plants and the microbial community can effectively treat your graywater to meet the standards discussed in this guide. From there, water can be used for any of the purposes that are allowed for Type 2 graywater. It's recommended that you consult with an expert when designing a plant-based treatment system.

Above and to the left are small-scale plant treatment systems for graywater. The treatment tanks have 'living walls' - which are irrigated by the graywater. This system was built by Paul Kay for demonstration purposes at the Oregon Garden in Silverton.

Wetland Plants

Many different plants could grow in your wetland. It's important, though, that you not choose plants that are considered noxious weeds by the state. These plants can easily spread from your yard to nearby natural areas and take over, creating what are known as monocultures.[8] Refer to

[8] Monoculture refers to growing just one type of plant in a given area. Plant monocultures also decrease the diversity of animal species that can survive there.

Table 6 and Table 7 for examples of plants to look for and some to avoid. Other books and articles about constructing treatment wetlands recommend using plants that work well but that Oregon considers noxious. However, lesser-known native plants will do just as well at treating your graywater. These lists are by no means complete. Before buying or growing your wetland plants please check Oregon's list of noxious weeds http://www.oregon.gov/ODA/PLANT/WEEDS/lists.shtml.

Table 6. Examples of wetland plants to avoid.

Common Name	Latin Name
Water Hyacinth	*Eichhornia crassipes*
Common Reed Native to Africa	*Phragmites austalias ssp. australis*
Yellow Flag Iris	*Iris pseudacorus*
Reed Canary Grass	*Phalaris arundinacea*

Table 7. Examples of recommended wetland plants.

Common Name	Latin Name
American White Waterlily	*Nymphaea odorata*
Common Reed Native to N. America	*Phragmites australias ssp. americanus*
Common Duckweed	*Lemna Minor*
Water Sedge	*Carex aquatilis*
Slough Sedge	*Carex obnupta*
Broadleaf Cattail	*Typha latifolia*
Bladderwort	*Utricularia macrorhiza*
Creeping Spikerush	*Eleocharis palustris*

Every treatment system will be different. It's critical that your system comply with the rules. Beyond that, the design decisions are up to you. The cost for materials will depend on your design. Constructing a lined pond may be more expensive than using an old bathtub for instance. **Figure *3*** shows an example design for an outdoor treatment wetland that can easily be modified to fit your situation.

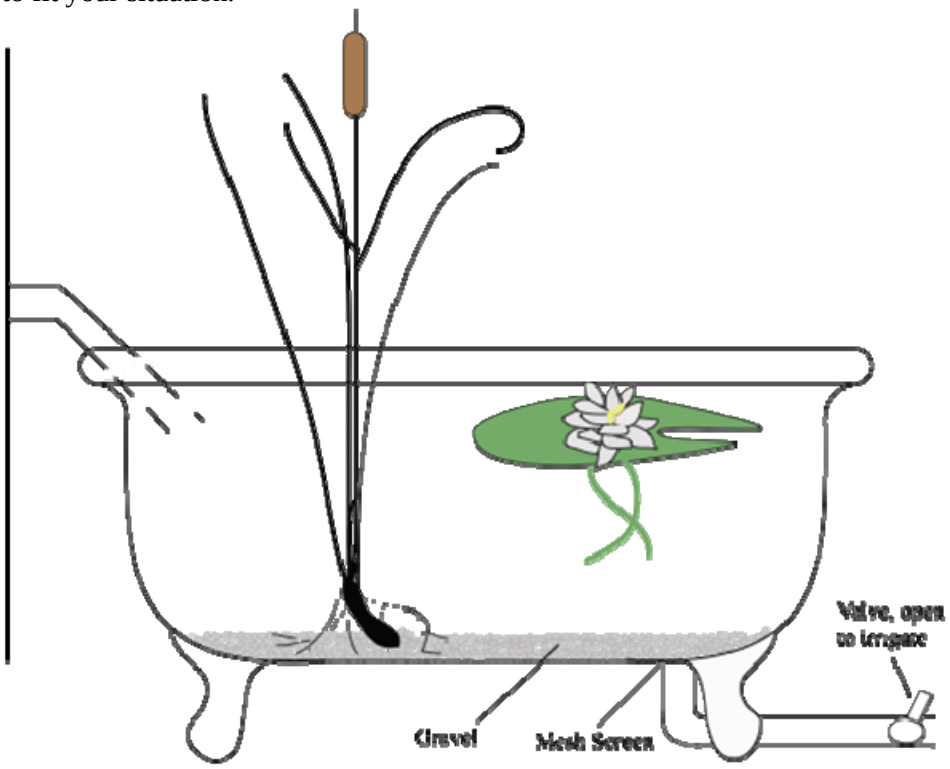


Figure 3. Simplified example of a bathtub treatment wetland for graywater.