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Technical Overview

GREYWATER SYSTEMS

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Cover Photo by Val Little of Water CASA (Water Conservation Alliance of Southern Arizona).

TECHNICAL OVERVIEW
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INTRODUCTION

Most people think sewage is a stinking, awful mess and want no part of it. For others, however, there are different kinds of sewage, different methods of treating it, and different beneficial uses to which it can be put. The most basic separation of sewage is between blackwater, or toilet wastes, and greywater, which is everything else. Not that simple really, and the reader is cautioned to check local guidelines before attempting any greywater project, because different states define greywater differently. Some states include kitchen sinks as blackwater produces, and others may include shower or bathing facilities.

Further, there is a common misconception that greywater is less polluted and less of a threat to public health than blackwater or sewage. This leads to the belief that greywater can be reused directly without treatment. While it is true that a significant portion of the waste strength is in blackwater, greywater still contains solids, bacterial contamination, and harmful pathogens and must be sufficiently treated before reuse. In fact, greywater and blackwater treatment require the same minimum processes of settling and filtration.

What then, is the advantage of greywater systems? They are primarily used to supplement alternative toilets that treat blackwater sources independently. That is, on restricted sites where area or soils are a problem, blackwater can be treated using composting or incinerating toilets (see our Technical Overview on Alternative Toilets). Another major use is in areas with limited water supply. Reusing greywater to flush toilets or irrigate grass can alleviate a strain on limited potable water supplies.

Table 1

Water-quality characteristics of selected domestic wastewater

Water Source	*Characteristics*
Automatic Clothes Washer	Bacteria, bleach, foam, high pH, hot water, nitrate, oil and grease, oxygen demand, phosphate, salinity, soaps, sodium, suspended solids, and turbidity
Automatic Dishwasher	Bacteria, foam, food particles, high pH, hot water, odor, oil and grease, organic matter, oxygen demand, salinity, soaps, suspended solids, and turbidity
Bath tub and shower	Bacteria, hair, hot water, odor, oil and grease, oxygen demand, soaps, suspended solids, and turbidity
Sinks, including kitchen	Bacteria, food particles, hot water, odor, oil and grease, organic matter, oxygen demand, soaps, suspended solids, and turbidity
Evaporative Cooler	Salinity

Adapted from Water Quality Characteristics of Selected Domestic Wastewater, 1996, New Mexico State University Agricultural Communications.

DESIGN

Design of onsite treatment systems for greywater is the same as onsite treatment systems for sewage. There are a few additional uses greywater can be put to, however, which do require some design.

The most obvious design requirement would be a dual plumbing system for recycling greywater. Water savings can be achieved by recycling greywater back into the house for non-potable uses such as toilet flushing. This requires two plumbing loops for the house. The first would be potable water directed to all taps with human contact: sinks, showers, and laundry. Most of these drains would lead to the greywater treatment system, but some states direct that the kitchen sink should be considered blackwater. The second plumbing loop would take water from the greywater treatment system to the toilets for flushing. Toilet waste is routed to the blackwater treatment system.

Design of the treatment system can be as complex as needed. A typical reuse scheme would be to use the effluent as irrigation. The treatment would consist of a tank for solids storage and settling, a pump and control section, and drip irrigation tubing around the area to be irrigated. Some disk filters would need to be included to keep solid particles out of the small drip lines and emitters.

Treatment for household reuse, such as flushing, would also need a tank for settling, pumps and controls, and perhaps a filter unit. These filter units can be in-line disk filters to remove small particles or larger sand filters that provide biological treatment.

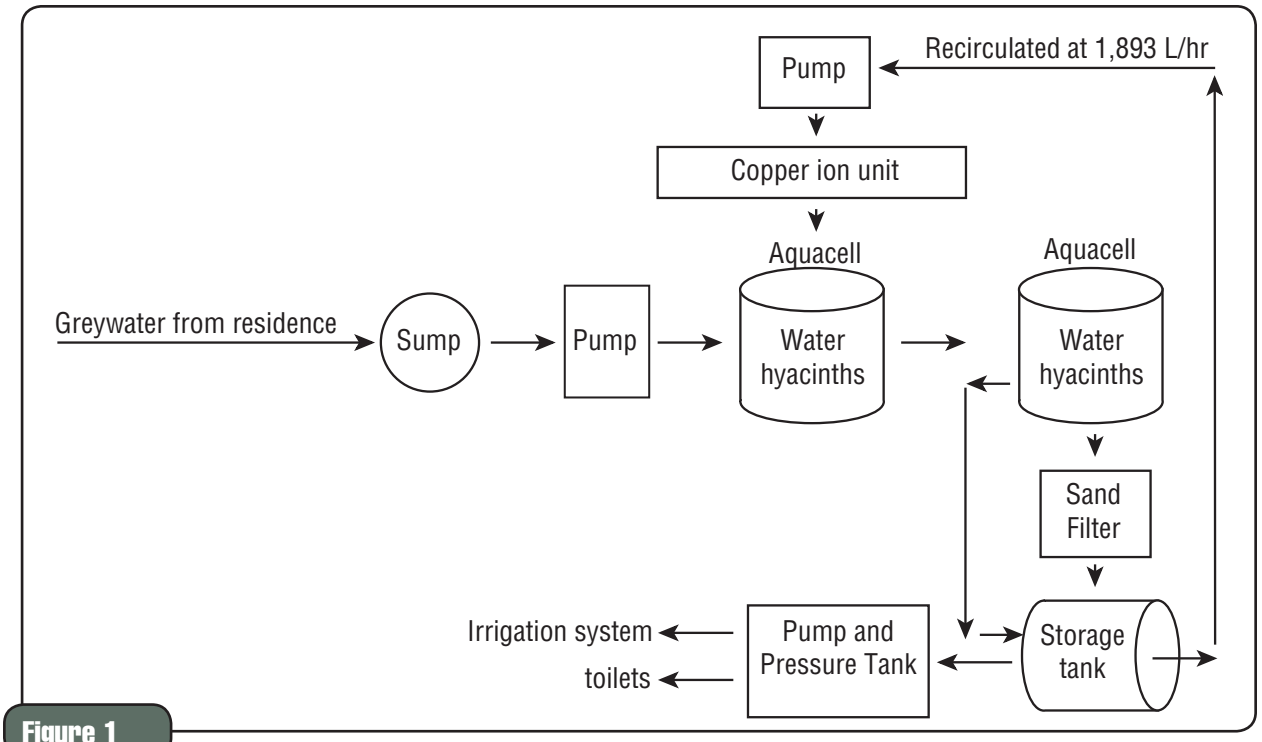

Figure 1

Schematic of a possible greywater treatment system.

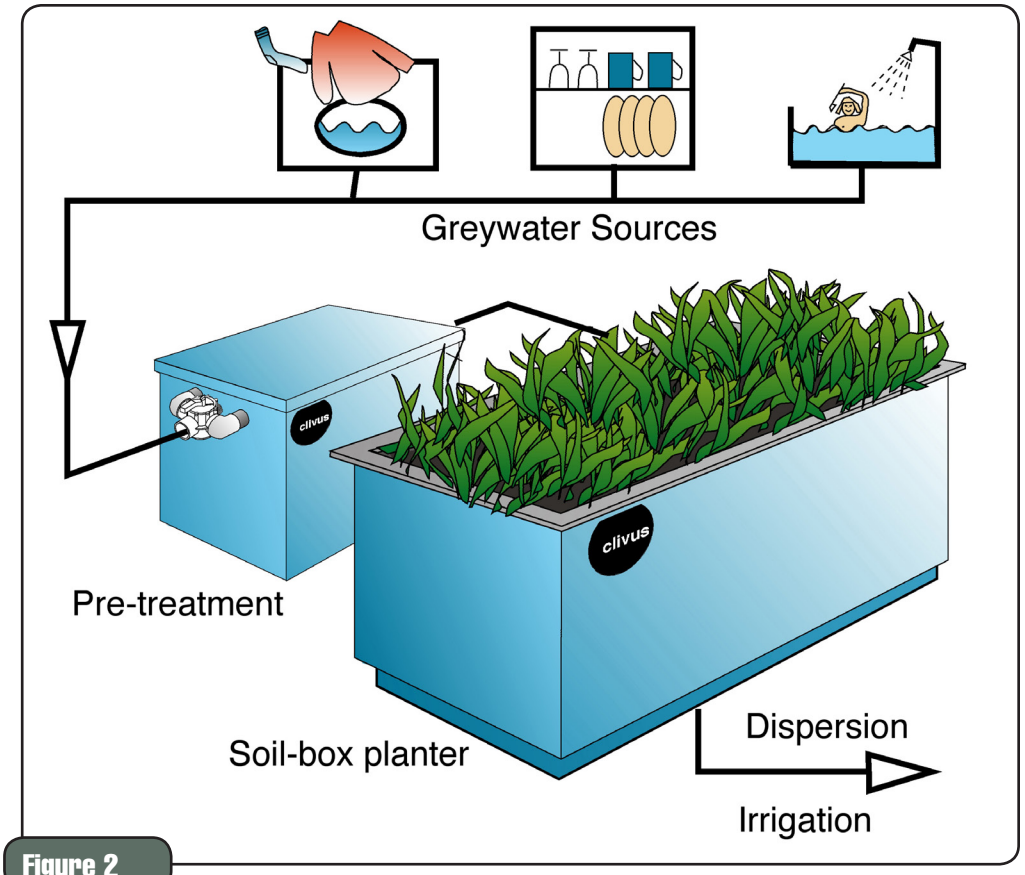

Figure 2

Image courtesy of Carl Lindstrom, http://greywater.com

ADVANTAGES AND DISADVANTAGES

The most common use for a greywater system, and its biggest advantage, is to save water. Usually used in situations where water supply is problematic, an alternative toilet is installed to save water. With the toilet waste dealt with by the toilets directly, a greywater system needs to be installed to handle sinks, tubs, and laundry facilities. Such a greywater system would be designed similar to a conventional onsite system. Some states will allow reductions in the size of the system, though, because the design flow is lower than normal. Check with your local health department or permitting agency for their regulations on sizing greywater onsite systems.

The disadvantage to this system is that alternative toilets can be expensive, and usually require more user operation than a simple flush toilet. For instance, composting toilets require the addition of a bulking material (newspaper, sawdust, etc.), warmth, ventilation, and periodic turning of the pile. This may be more of an investment than the casual homeowner wants to provide.

For greywater systems intended for water reuse, complexity is the main disadvantage. The extra in-house plumbing and dual treatment systems add expense to the construction and maintenance of such a project. This needs to be weighed against the advantages of more efficient water use and the benefits of recycling, such as lower water bills. In areas of the country with water supply problems, these advantages can be considerable.

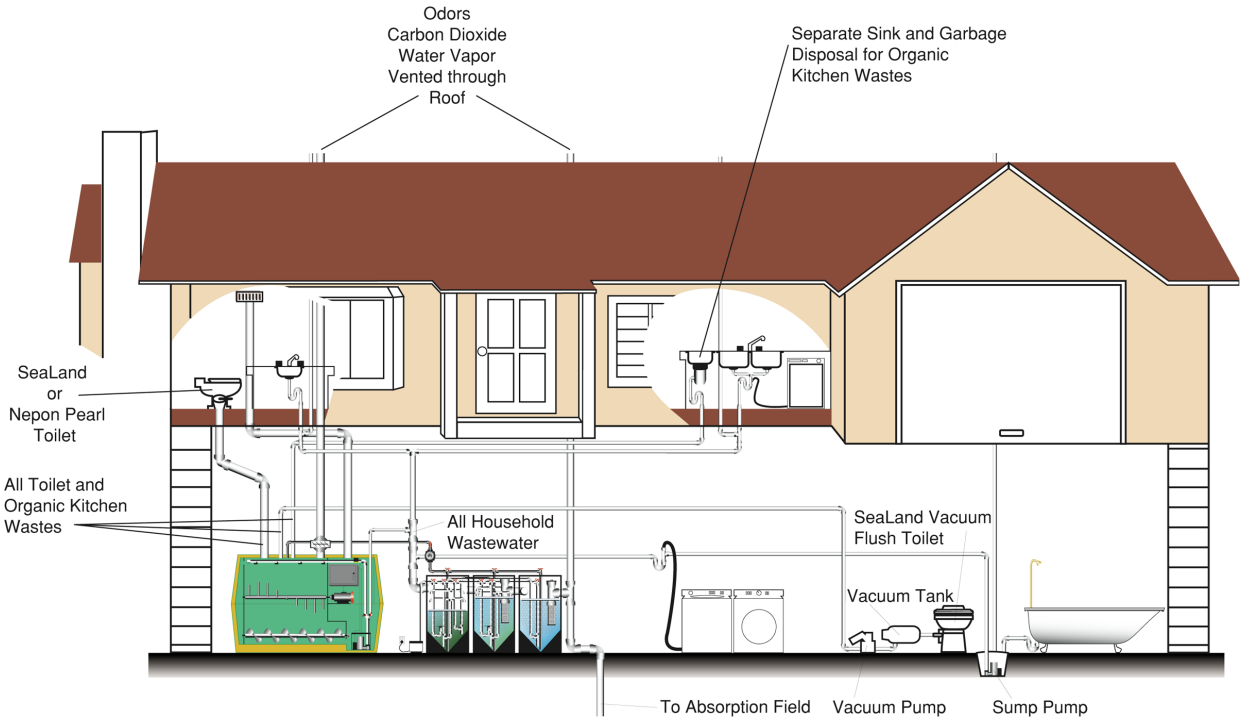

Figure 3 *Possible greywater system layout from Equaris. Image courtesy of Equaris, www.equaris.com*

OPERATION AND MAINTENANCE

For greywater systems, the operation and maintenance (O&M) is not any more complicated or involved than a normal onsite wastewater treatment system. Septic tanks need to be inspected and pumped periodically, depending on usage and size, and soil absorption areas need to be inspected for saturation or lush vegetation.

The real O&M difference comes in the alternative toilet selected. Non-flush toilets, such as incinerating or composting toilets, require a lot of maintenance for proper operation. Please refer to the related technical overview on Alternative Toilets for a more detailed description of the O&M requirements of these types of toilets.

COSTS

The cost of greywater treatment will vary with the type of system selected. The costs should be in the same range as those for similar onsite system technologies, however. Again, as with the O&M needs, the costs of a greywater system will also depend on the type of non-flush toilet selected.

Chemical toilets, depending on size, can be as low as $60 or as much as $400. The chemical additive is relatively inexpensive, around $5 for 100 “flushes.” Incinerating toilets represent a substantial investment, averaging around $1500 per unit. Power or gas costs are not excessive but they are a factor. Composting toilets can also be expensive, with large compost containers, heating, and ventilation, and can cost as much as $2000. There are some electric costs, but the major maintenance expense is the labor involved in turning and removing the compost pile. These costs must be weighed against the money

Greywater used to irrigate flower beds for an Arizona home. Photo by Val Little of Water CASA (Water Conservation Alliance of Southern Arizona).

saved in reduced water use. For a family of four, this could mean saving 10,000 gallons per year.

For water reuse systems, costs will be higher depending on the complexity of the system chosen. Dual plumbing for the house and a second treatment scheme make reuse systems a serious investment. Again, though, those costs must be evaluated against the potential water savings or reduced environmental impact. Not every cost or benefit can be placed in monetary terms.

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