What’s Your Question?  
An Apprentice Series on the Codes

By Anne V. Sonner

This series is for apprentices learning the plumbing and mechanical professions and for experienced tradespeople who want to revisit certain code issues. In this article we reference the 2006 Uniform Plumbing Code. Let us know if there is a subject you would like to see covered in future editions of this magazine.

Graywater Systems for Single-Family Dwellings  
(UPC Chapter 16)

APMCO has joined the current movement in the construction industry toward “green” environmentally responsible building. Part of this environmental responsibility is water conservation. Using graywater to irrigate your yard is one way to conserve drinking water. If used wisely, graywater systems could even reduce the needed capacity for, and therefore the costs of, sewage treatment and private sewage systems.

What is Graywater?

Graywater (also spelled “gray water” or “graywater”) is untreated waste water from bathroom sinks, showers, tubs, clothes washers, and laundry tubs. Graywater does not include waste from toilets (because of bacteria and odor) or waste from kitchen sinks and dishwashers (because of grease).

Graywater is different from “reclaimed” or “recycled” water, which is waste water that has gone through treatment to clean it, though not to the level that it must be cleaned. Reclaimed water systems are covered in Part II of UPC Chapter 16. See the next article in this series for more on reclaimed water.

Why Graywater is in the Code

In the 1994 UPC, IAPMO introduced Appendix W (later changed to Q) on graywater systems. The code change was proposed by Los Angeles County because six counties in California, where more than ten million people live, were using graywater systems, but there were no code requirements for those systems.

In 1991, prompted by public interest in the use of graywater as a water conservation measure during a long drought, the California Ad-Hoc Graywater Committee was formed to investigate whether graywater could be safely used. Committee members included representatives of the California Conference of Directors of Environment Health, the California Mosquito & Vector Control Association, the California Association of Building Officials, the Building Standards Commission, IAPMO, the Los Angeles County Building & Safety Agencies, the City of Los Angeles Office of Water Reclamation, the Water Reuse Association of California, the Sierra Club, the Department of Health Services, the State Water Resources Control Board, and the Department of Water Resources. The committee developed the graywater appendix “to provide guidance (and maximum safety) to any jurisdiction considering the legalization of graywater installations.”

In 2006, Appendix G and Appendix J on Reclaimed Water were moved into the body of the code in Chapter 16. The Report on Proposals gives this reason: Moving the appendix [d]es into the body of the code will give [them] needed exposure and input from the industry to address the next big issue[s] in water conservation.

When to Use Graywater

Of course, graywater systems may only be used if allowed by law in your jurisdiction. Also, they should be economical. Installing them in new construction is more cost-efficient than installing them in existing construction. Before installing a graywater system, you would want to estimate your water usage and potential savings versus the cost to install and maintain the system. Location is another consideration. It may make sense to install graywater systems in dry areas with little rainfall and high water prices, but not in parts of the country that receive a lot of rain and need little or no landscape irrigation. Currently, graywater systems are used in states including California, Arizona, and New Mexico. Texas is proposing laws and regulations for graywater systems.

Restrictions on Graywater Systems

Per UPC Chapter 16, graywater systems may only be used for single-family residences. They are not allowed for multi-family dwellings like apartments, condos, and townhouses, or for commercial buildings.

A graywater system may not have any connection to the potable water system. Graywater is not safe to drink. Graywater landscape irrigation piping must be underground — no sprinklers — and must not result in any surface run-off of the graywater. All the graywater should be absorbed by the ground (“irrigation/disposal field”) and not run off.

Graywater systems may not be installed in “geologically sensitive” areas.

See UPC Section 1601.0 for several other restrictions on graywater systems.

Requirements for Graywater Systems

A graywater system contains a holding tank that receives graywater from the house, and then discharges it to the irrigation system of underground perforated pipes and also discharges to the building drain or sewer. UPC Figures 16-1 and 16-2 show graywater systems: gravity-type and pumped. Figure 16-3 shows a multi-tank installation and Figure 16-4 shows a graywater system with an underground tank.

As with other plumbing installations, graywater systems require the proper permits, plans, and approvals. The systems must be designed based on location, soil type, and groundwater level, and therefore commonly require plot plans and soil testing. Graywater systems must be inspected and tested per UPC Section 1605.0.

Calculations

To design a graywater system, first estimate the amount of graywater that will discharge from the house, and determine the absorption capacity of the soil.

Section 1601.0 specifies how to estimate graywater discharge. Count two occupants for the first bedroom and one occupant each for additional bedrooms. Estimate 25 gallons of water per day (GPD) for showers, bathtubs, and wash basins and 15 GPD for laundry equipment. As with other plumbing installations, graywater systems require the proper permits, plans, and approvals. The systems must be designed based on location, soil type, and groundwater level, and therefore commonly require plot plans and soil testing. Graywater systems must be inspected and tested per UPC Section 1605.0.

Example of estimating graywater discharge: 3 bedrooms with showers, bathtubs, washbasins, and a clothes washer. Occupants: 2 + 1 + 1 = 4. Estimated graywater discharge: 4 occupants x (25 + 15) = 160 GPD.

Use Table 16-2 to determine the absorption capacity of the soil. The Authority Having Jurisdiction may require percolation tests on the soil. The more absorbent the soil, the less space is needed for the irrigation area. Conversely, the less absorbent the soil, the more space is needed. For example, soil containing a lot of clay needs more area than sandy soil because graywater soaks into the clay soil more slowly and spreads out.

Then determine the area for the irrigation/disposal field for the graywater system. Use the estimated graywater discharge or the size of the holding tank, whichever is larger. Table 16-2 specifies the minimum area that the irrigation/disposal area must be, based on the amount of graywater discharge.
Why should plumbers and inspectors care about graywater systems? The UPC Illustrated Training Manual says: “Plumbing officials have an indirect responsibility for water quality enhancement. Becoming aware of water quality and plumbing issues helps an official review new products and methods of construction. In ensuring that minimum code requirements are met and that approved or listed water conservation products and devices are used, the plumbing official can aid in conservation goals.” The same reasoning applies to new systems that conserve drinking water.

Thanks to Bob Shepherd, Dave Viola, and Johnni Brown for their assistance with this article.

### Graywater System Typical Irrigation Layout

Figure 16-5 adapted from the 2006 Uniform Plumbing Code

![Graywater System Typical Irrigation Layout](image)

**TABLE 16-2** Design Criteria of Six Typical Soils

<table>
<thead>
<tr>
<th>Type of Soil</th>
<th>Minimum square feet of irrigation/leaching area per 100 gallons of estimated gray water discharge per day</th>
<th>Maximum absorption capacity in gallons per square feet of irrigation/leaching area for a 24-hour period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse sand or gravel</td>
<td>20</td>
<td>5.0</td>
</tr>
<tr>
<td>Fine sand</td>
<td>25</td>
<td>4.0</td>
</tr>
<tr>
<td>Sandy loam</td>
<td>40</td>
<td>2.5</td>
</tr>
<tr>
<td>Sandy clay</td>
<td>60</td>
<td>1.7</td>
</tr>
<tr>
<td>Clay with considerable sand or gravel</td>
<td>90</td>
<td>1.1</td>
</tr>
<tr>
<td>Clay with small amounts of sand or gravel</td>
<td>120</td>
<td>0.8</td>
</tr>
</tbody>
</table>

For construction of the irrigation/disposal field, Section 1607.0 describes the three or morevalved zones that are required and Figure 16-5 shows a typical graywater system irrigation layout.

The chart on page 266 gives minimum and maximum dimensions for constructing the plumbing in the irrigation/disposal field – length of perforated lines, spacing of lines, depth of cover and filter materials, grading of lines, etc.

### Holding Tanks, Valves, and Piping

There are many requirements in Section 1609.0 for holding tanks. Holding tanks manufactured for graywater systems must be approved or listed, vented, located, and watertight, have an emergency drain and minimum capacity of 50 gallons, and underground tanks must be able to withstand anticipated earth loads. Holding tanks must be made of steel with corrosion protection. They must be labeled “Graywater Irrigation System, Danger – Unsafe Water.”

There are requirements for traps on graywater piping discharging into the holding tank and for piping connecting to the sanitary drain or sewer piping. The valves must be readily accessible and a backwater valve must be on all holding tank drain connections to the sanitary drain or sewer piping to prevent sewage overflow entering the graywater system. As always, consult the Uniform Plumbing Code for the complete code requirements.

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