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)

IAPMO 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 widely, 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 "greywater") 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 drinking water is 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 G) 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* gave this reason: Moving the appendi[ces] 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 surfacing 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 multiple-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.

Table 16-1, shown below without footnotes, contains requirements on the location of graywater systems. It specifies how far the holding tank and irrigation/disposal field must be located from buildings, adjacent property, septic tanks and sewage pits, wells, lakes and streams, etc. The intent is that the graywater should soak into the ground before it reaches those sites.

TABLE 16-1
Location of Gray Water System

Minimum Horizontal Distance in Clear Required From:	Holding Tank	Irrigation/ Disposal Field
Building structures	5'	2'
Property line adjoining private property	5'	5'
Water supply wells	50'	100'
Streams and lakes	50'	50'
Sewage pits or cesspools	5'	5'
Disposal field and 100% expansion area	5'	4'
Septic tank	0'	5'
On-site domestic water service line	5'	5'
Pressurized public water main	10'	10'

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 bedroom. Estimate 25 gallons of water per day (GPD) for showers, bathtubs, and washbasins and 15 GPD for laundry facilities discharging into the graywater system.

Example of estimating graywater discharge: 3 bedrooms with showers, bathtubs, washbasins, and a clotheswasher. 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 area 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. ▶

Graywater System Tank - Gravity

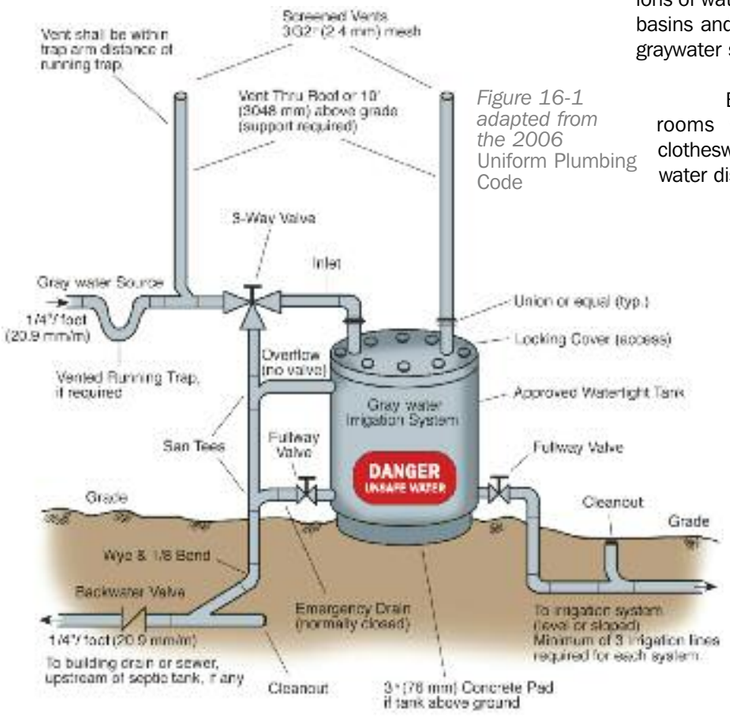


Figure 16-1 adapted from the 2006 Uniform Plumbing Code

TABLE 16-2
Design Criteria of Six Typical Soils

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

For construction of the irrigation/disposal field, Section 1607.0 describes the three or more valved zones that are required and Figure 16-5 shows a typical graywater system irrigation layout. The chart on *UPC* 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

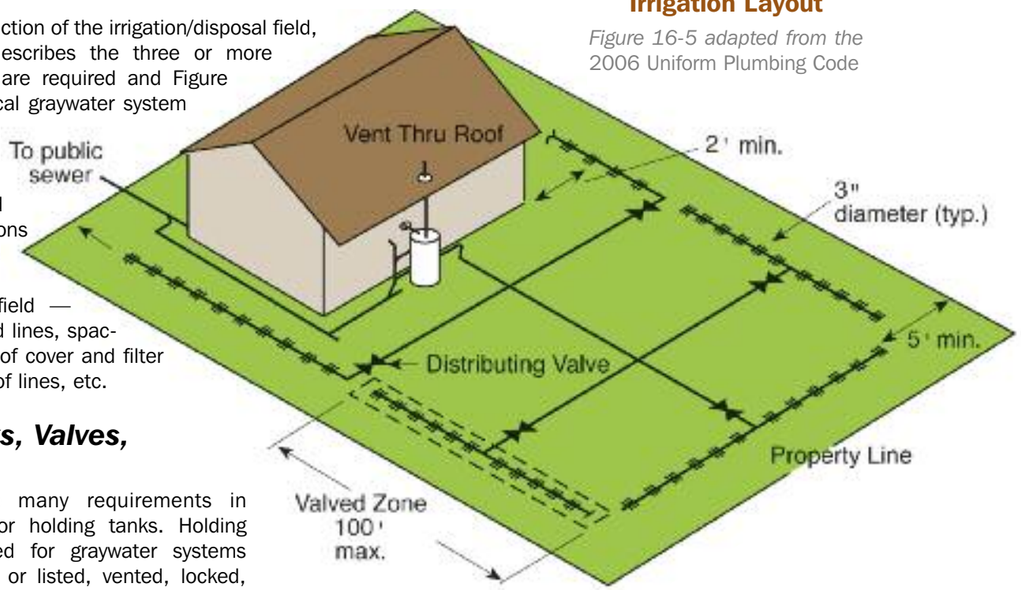
There are many requirements in Section 1609.0 for holding tanks. Holding tanks manufactured for graywater systems must be approved or listed, vented, locked, and watertight, have an emergency drain and minimum capacity of 50 gallons, and underground tanks must be able to withstand anticipated earth loads. Holding tanks must be made of steel with corrosion protection. They must be labeled "Graywater Irrigation System, Danger – Unsafe Water." Per Section 1610.0, all graywater piping must also be labeled "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.

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.

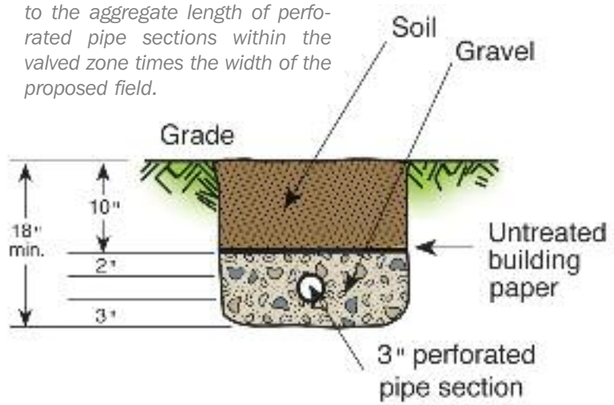
Thanks to Bob Shepherd, Dave Viola, and Johnni Brown for their assistance with this article.

Graywater System Typical Irrigation Layout

Figure 16-5 adapted from the 2006 Uniform Plumbing Code



Note: Each valved zone shall have a minimum effective absorption/irrigation area in square feet predicated on the estimated graywater discharge in gallons per day and on the type of soil found in the area. The area of the field shall be equal to the aggregate length of perforated pipe sections within the valved zone times the width of the proposed field.



Answers & Analysis

***Taken from the 2000/2003/2006 editions of the* UPC & UMC Answers and Analysis**

This section, formerly titled "*UPC/UMC* Interpretations" has a new name, "*UPC/UMC Answers and Analysis*." We will continue extracting published clarification requests from the new *UPC* and *UMC Answers and Analysis* manuals (formerly known as the *Interpretations Manuals*). For ease of use, each question and answer will indicate the applicable code year (i.e., 2000, 2003 and/or 2006). The new *Answers and Analysis* manuals feature a completely new look. This overhaul provides users with clarification to issues based on both the 2000, 2003 and 2006 code editions.

***UPC* Answers & Analysis**
Section 510.0 Location of Water Heaters; see also 510.0 (2000), 508.14 (1) and (3) (2003/2006)

Question: Would a garage wall separation, similar to the one shown in Figure 1, qualify the utility room as part of the residential occupancy and thus not require pilots, burners, or heating elements and switches to be installed at least 18 inches above the floor level? The separation is normally not weatherstripped. Would the interpretation change if it were weatherstripped?

Figure 2 depicts the utility room as part of the residential occupancy. Would the utility room be considered part of the garage and thus require an 18-inch elevation?

Answer: The code requires that the water heater be elevated in the installation shown in Figure #1. The addition of weatherstripping would not waive this requirement.

The installation in Figure #2 is within the interior occupied space of the building, where that requirement is unnecessary.

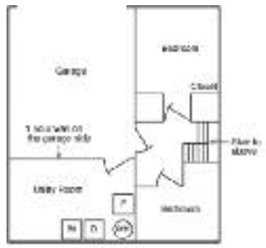


Figure 1
Dwelling Unit

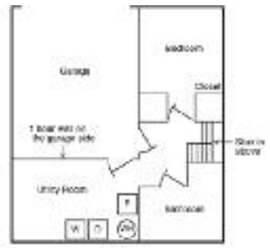


Figure 2
Dwelling Unit

Section 510.7 Approved Connection for Watertight Pans 510.7 (2000), 508.4 (2003/2006)

Question: Could the drain from a watertight pan required under a water heater per the code be discharged to a tailpiece of a lavatory or to an approved accessible inlet on a bathtub overflow as provided in Section 807.2 for condensate waste from air conditioning coils?

Answer: No, the intent of the code is to protect the structure from damage and alert the occupant that a leak has occurred. Terminating the drainpipe into a physical connection defeats this objective. Therefore, it is necessary that the termination be at a point which is readily observable.

***UMC* Answers & Analysis**
Section 309.0 Electrical Connections (2000/2003/2006)

Question: Various HVAC manufacturers have UL equipment with disconnects that come with the unit inside the unit. The *National Electrical Code* specifically allows this. However, does this meet the requirements of the *UMC*?

Answer: No. The requirement for a disconnect is intended to allow the equipment to be replaced without having to isolate the equipment from a remote location. Therefore, a disconnect must be located adjacent to the equipment to allow it to be isolated at its location to make it easily replaceable.

Section 310.2 Condensate Control (2000/2003/2006)

Question: Does the discharge from a relief valve or boiler drain require an airgap or is an airbreak acceptable?

Answer: Section 1008.0 (or 1007.0 in 2006) refers to hot water heating systems only. The discharge from relief valves shall be piped to within 18 inches of the floor or to an open receptacle. An airbreak would be acceptable. However, if this boiler is used for any other purpose than a hot water heating system, then an airgap would be required.

Section 601.0 (2003/2006)

Question: Is it the intent of Section 601.0 to have all duct systems, regardless of fresh air attached, to be sized according to the standard (for which it is listed) or other approved methods?

Answer: Yes. Section 601.0 does not differentiate between systems that do or do not have outside air attached. Therefore, all systems must be sized in accordance with Chapter 17 or by other approved methods.