

Roger Babcock & Stuart Shoji  
Water Resources Research Center  
Civil & Environmental Engineering  
UH Manoa  
DOH Wastewater Branch

# DESIGN FOR GRAYWATER REUSE: THE NEW DOH GUIDELINES

# House Resolution No. 290 H.D. 2

House Resolution No. 290 H.D. 2 was passed during 2009 Legislature "Urging the Counties to Adopt and Implement Graywater Recycling Programs for Residential Irrigation purposes as provided under the Uniform Plumbing Code Standards"

# House Resolution No. 290 H.D. 2

- Counties have jurisdiction over residential wastewater treatment in areas served by county sewer systems.
- Under section 342-70, Hawaii Revised Statutes (HRS), counties, with the approval of the Department of Health may implement a graywater recycling program within their jurisdictions.
- The counties have not implemented graywater recycling programs under section 342D-70, HRS, and, in adopting national plumbing standards, have deleted graywater reuse provisions.

# Graywater Reuse

- ❖ Reuse of graywater for landscape irrigation
  - ❖ Reduces wastewater to sewers or IWS
  - ❖ Reduces potable water demand for non-potable use
  - ❖ Extends potable water supply

# States that have developed Graywater Guidelines or Regulations

- California
- Arizona
- Idaho
- Nevada
- New Mexico
- South Dakota
- Utah
- Texas
- Washington

# GUIDELINES FOR THE REUSE OF GRAY WATER



Prepared by  
Hawaii State Department of Health  
Wastewater Branch  
June 22, 2009

(available at: <http://hawaii.gov/health/environmental/water/wastewater/forms.html>)

# Gray water guidelines Committee

- Roger Babcock – UH CEE
- Carl Evensen – UH NREM
- Neal Fujii – DLNR
- Elson Gushiken – ITC
- Douglas Haigh – Kauai DPW
- Timothy Hiu – CCH DPP
- Brian Kajiwara – Hawaii DPW
- Jeremy Kimura – DLNR water commission
- Donald McDonald – Agtech Pacific
- June Nakamura – Engineering Solutions
- Dennis Nishimura – CCH DPP
- Lenore Ohye – DLNR water commission
- Sina Pruder – DOH WW
- Carolyn Sawai – BWS
- Tomas See – DOH WW
- Stuart Shoji – DOH WW
- Barry Usagawa - BWS

# Gray water reuse

- ◎ Uses
  - Irrigation – subsurface only
  - Plant lists
- ◎ Treatment – none
- ◎ System requirements, design considerations, and maintenance
- ◎ Example calculations

# Graywater definition

- ◎ Blackwater: toilets, kitchen sinks
- ◎ Graywater: showers/tubs, lavatories, clotheswashing machines
  - 50-80% of generated residential wastewater

# Characterizing Graywater

Graywater composition depends on:

- ❖ Personal habits of the residents;
- ❖ Type and quantity of soaps, detergents, and cleaners used;
- ❖ Age and number of residents; and
- ❖ Length of time the graywater is stored before being used.

# Health and Safety Considerations

- ⦿ Never use spray irrigation to apply graywater.
- ⦿ Application of graywater must be done by utilizing a subsurface system.
- ⦿ Apply the graywater to areas that receive little or no traffic.
- ⦿ Avoid irrigating edible fruit and vegetable gardens with graywater.
- ⦿ Discourage children from playing in areas where graywater is regularly applied.

# Health and Safety Considerations

- ◉ Wear latex or surgical gloves when handling components of the system to perform maintenance activities, such as cleaning filters.
- ◉ In event of a contagious sickness, divert graywater until that individual has recuperated.
- ◉ Water used to launder clothing soiled by pesticides or other toxic substances should not be discharged into a graywater system.
- ◉ Regular operational and maintenance checks must be performed.
- ◉ If anyone becomes ill after exposure to graywater disposal areas, discontinue using the graywater system until the source of the illness is determined.

# Effects of graywater on plants

- ◎ North Carolina State University performed a study in 2004 using graywater on ornamental plants.
  - The source of graywater had a significant effect on the plant health
  - All plant species irrigated with water from kitchen sinks, which is not an approved source of graywater, died
  - All plants irrigated with laundry graywater survived
  - Some plant species grew differently than control group (tap water)
  - Graywater makes the soil more alkaline, so plants that grow best in acidic soils should not be irrigated with gray water
  - With the proper graywater distribution methods and plant selection, a lush landscape can be achieved
- ◎ Guidelines contain recommended plant lists

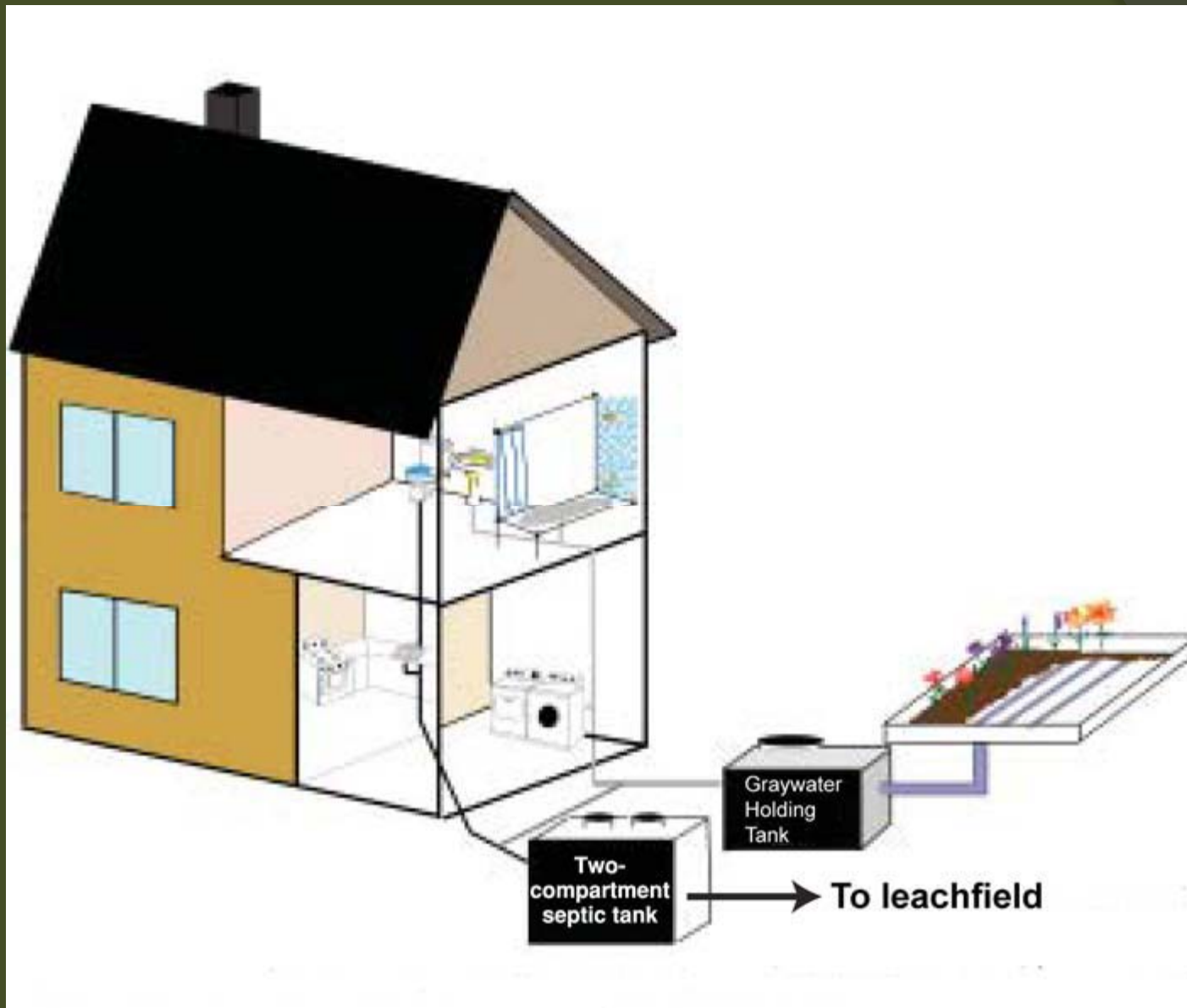
# Soaps, Detergents and Cleaners

Graywater users should avoid soaps, detergents, and cleaners containing:

- ✓ Bleaches
- ✓ Softeners
- ✓ Whitening ingredients
- ✓ Enzymatic powers
- ✓ Borax
- ✓ Peroxygen
- ✓ Sodium perborate
- ✓ Petroleum distillate
- ✓ Alkylbenzene sodium tryochlorite

# Graywater System General Requirements

- ⦿ Blackwater and graywater streams must be separated
- ⦿ Two separate plumbing systems
  - Blackwater to sewer system or IWS
  - Graywater to collection tank



**Figure 1. House diagram of separate blackwater and gray water plumbing systems.**

# Plumbing Systems

- ◎ Because graywater systems may be used seasonally, will need periodic maintenance, or may be abandoned in the future, a diversion valve is necessary.

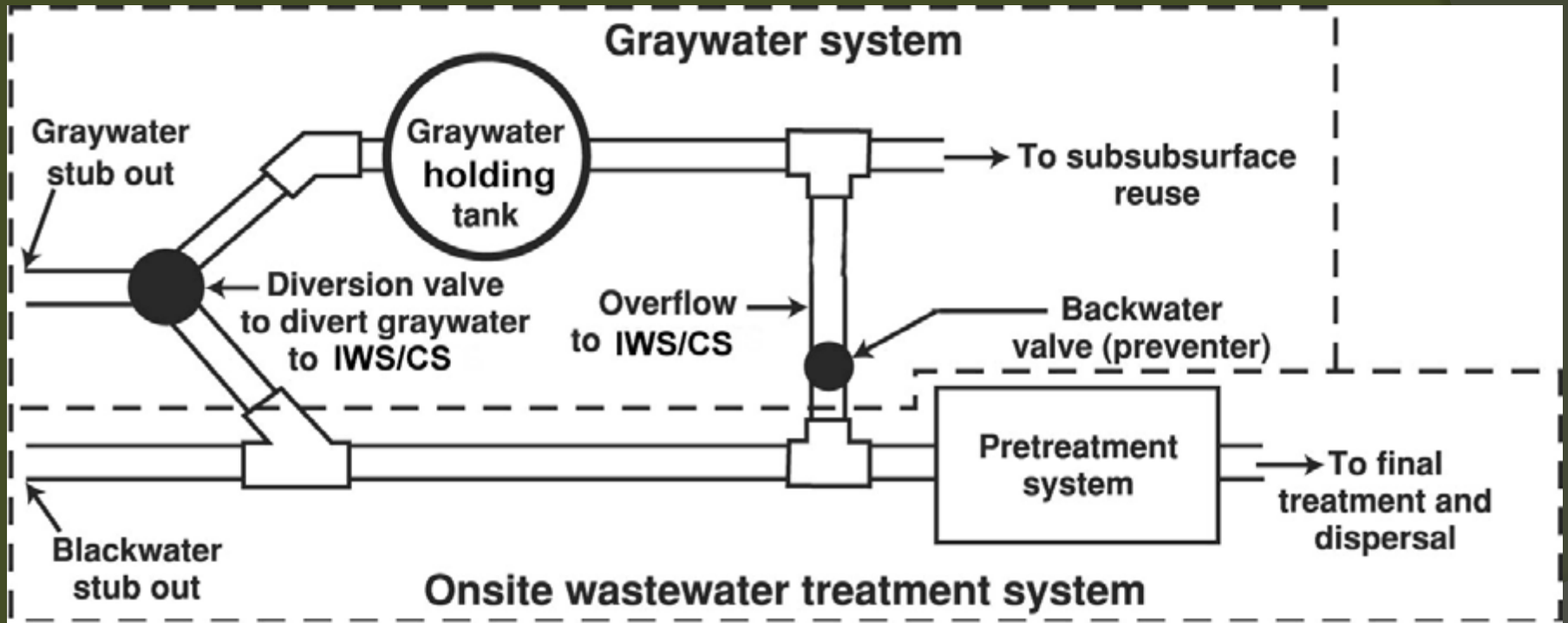
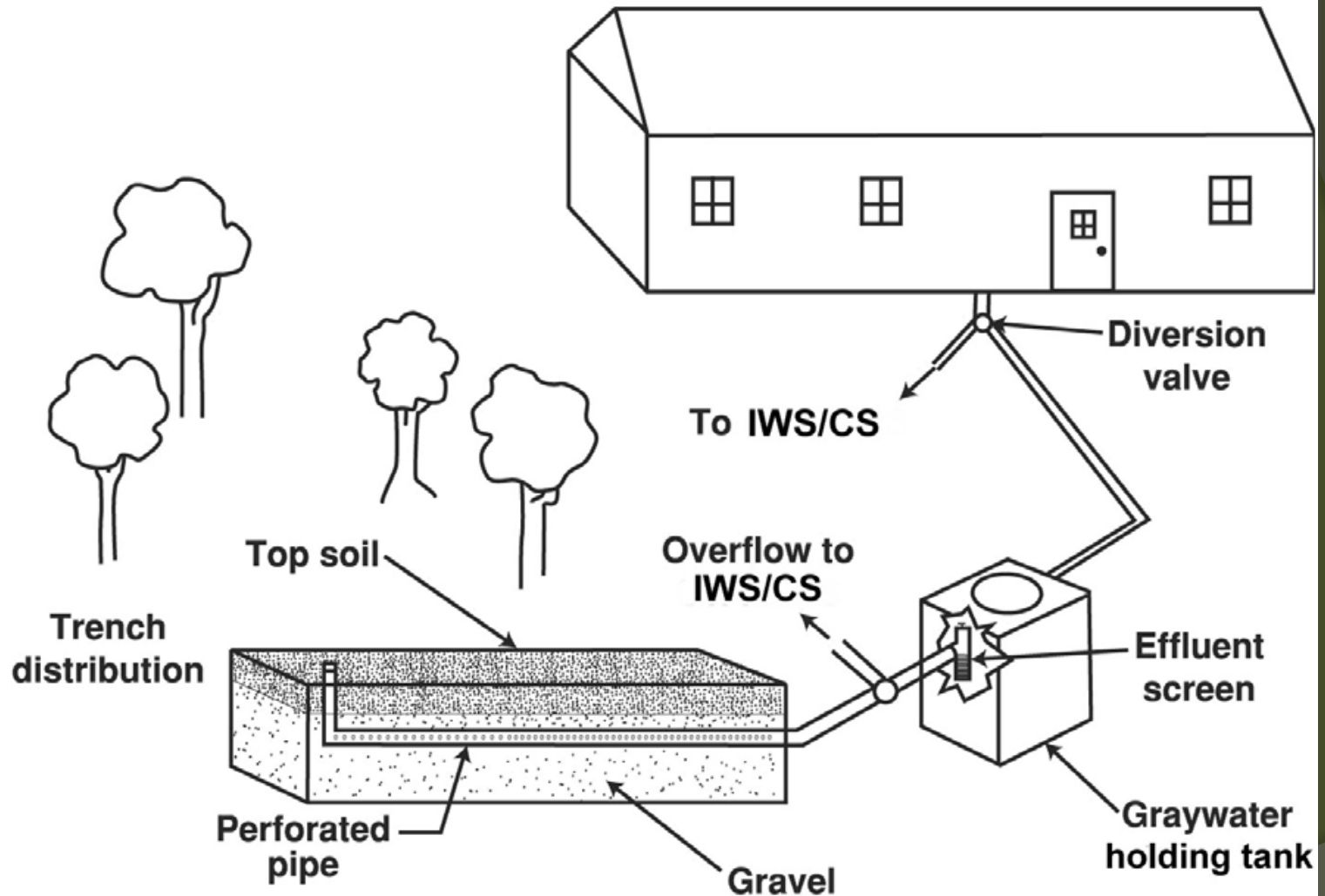


Figure 2. Diverted gray water plumbing system



**Figure 3 –Gray water system with gravity distribution through a gravel media trench.**

# Graywater Holding Tank

The graywater shall be collected in an approved tank that meets the following criteria:

- ❖ Is labeled clearly as “non-potable water”;
- ❖ Restricts access, especially to children;
- ❖ Eliminates habitat for mosquitoes and other vectors;
- ❖ Can be cleaned; and
- ❖ Meets construction requirements of UPC 2006

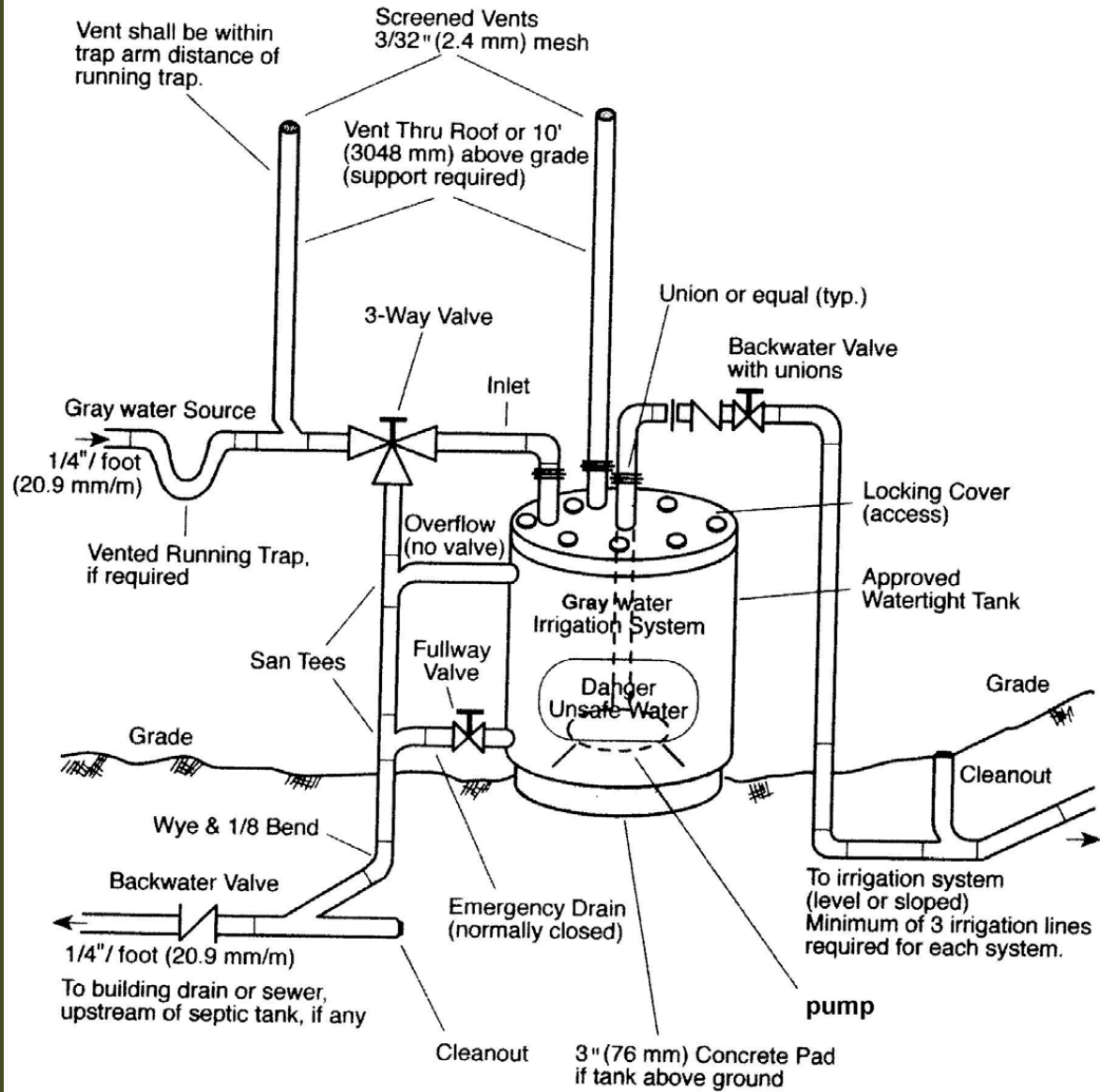
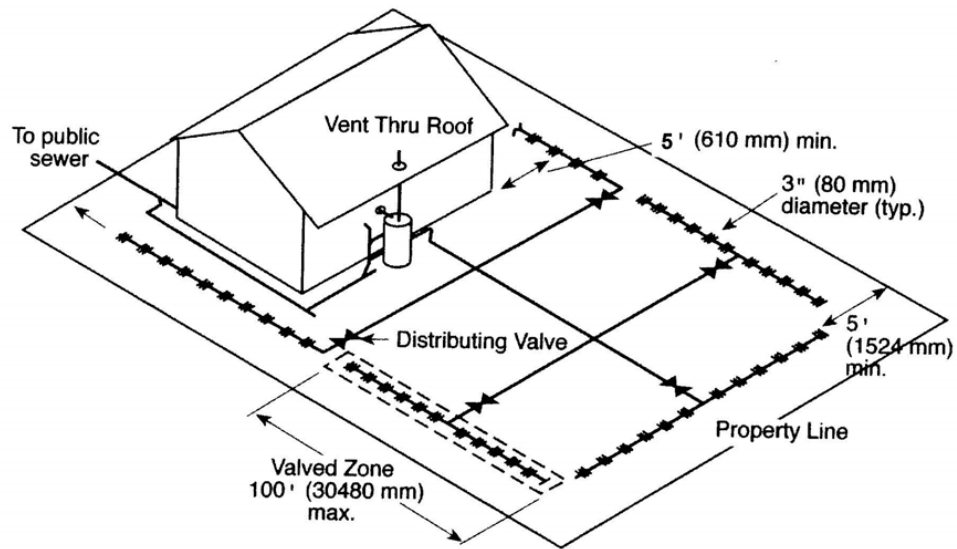


Figure A-2. Pumped System

# Graywater Subsurface Distribution

- ❖ Edible root crops should not be irrigated with graywater.
- ❖ Use graywater for well-established plants rather than for seedlings;
- ❖ Graywater usually is slightly alkaline, so avoid using it to water plants that thrive in acidic soils;
- ❖ To prevent salt accumulation, distribute graywater over a large surface area and rotate distribution from one area to another;
- ❖ Select reuse applications appropriate for the amount of water to be generated in the system.



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.

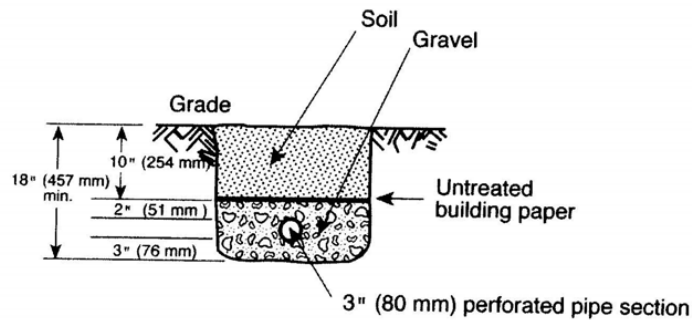


Figure A-5. Typical Irrigation Layout

# Labeling of Graywater Systems

- ⦿ Proposed revisions to the UPC 2009 would require purple background and black upper case lettering for graywater systems to read, “CAUTION: NONPOTABLE WATER, DO NOT DRINK”
- ⦿ The Florida Department of Environmental Protection strongly opposes the adoption of this standard because of use of purple pipe.
  - Purple labeling should only be reserved for reclaimed water that has been treated.
  - Most graywater is not treated
  - Potential cross-connection problem
  - Could adversely impact the high quality of the reclaimed water and create a health hazard.

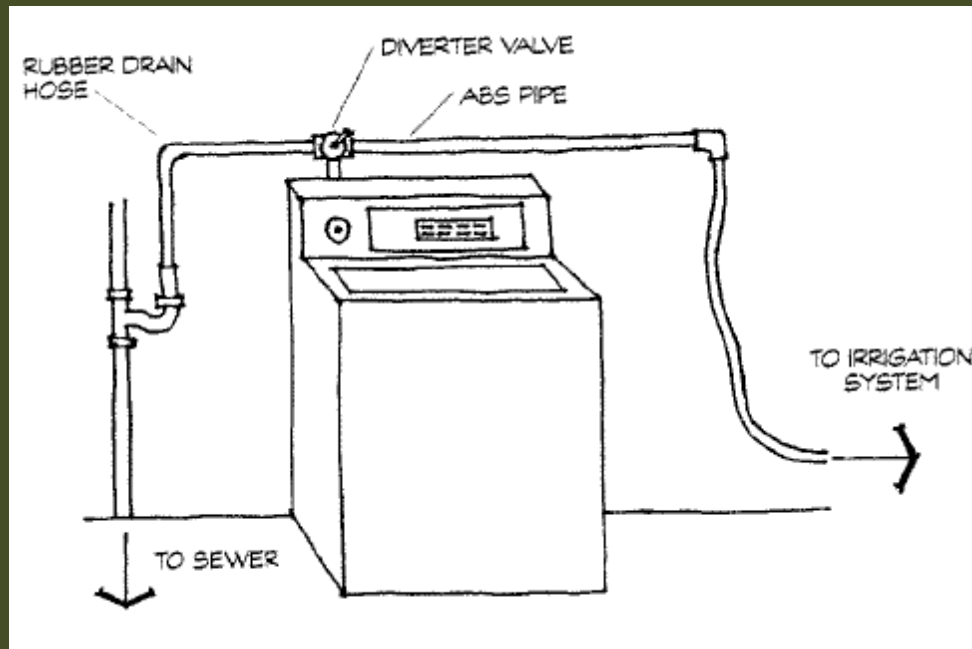


Figure B.1. 3-way valve for washer gray water.

# Calculating gray water volume

- To estimate the volume of gray water generated in a household follow the steps below (based on 2006 UPC):
- First calculate the number of occupants of a home as follows:
  - 2 persons for first bedroom
  - 1 person per additional bedroom
- Next, calculate each person's daily gray water flow allocation as follows:
  - Showers, bathtubs, and washbasins: 25 gallons per day
  - Laundry: 15 gallons per day
- The total number of occupants shall be multiplied by the applicable estimated gray water flow allocation as provided above, and the type of fixtures connected to the gray water system.
- **Example 1:**
- Single-family dwelling; three bedrooms with showers, Bathtubs, washbasins; and laundry facilities all connected to the gray water system:
- Total number of occupants =  $2 + 1 + 1 = 4$
- Estimated gray water flow =  $4 \times (25+15) = 160$  gallons per day

# Sizing a Gray Water Tank

- ◎ Gray water tanks must be designed to provide at least 24 hour combined retention for the daily flow of the gray water
- ◎ **Example 1:**
- ◎ Using the result from Example 1 above, the gray water flow = 160 gallons per day.  
Therefore, the capacity of tank that is required is:
  - 160 gallons per day + 24 hour combined retention (i.e. double the daily flow)
  - = 160 gallons per day x 2
  - = **320 gallons tank capacity**

# Sizing the Irrigation Area

- Gray water irrigation systems are sized on whether they use subsurface mini leachfield or drip irrigation methods. Systems are sized based on the capability of the soil to receive the gray water, water demand based on evapotranspiration (ET) data and the estimated gray water flow.
- **Example 1:**
- Example of calculating irrigation area of a subsurface mini leachfield using soil data in Appendix A, Table A-2
  - Gray water volume = 160 gallons per day
  - Soil type: Sandy clay
  - From Table A-2, the minimum irrigation area required for sandy clay is:
    - Sandy clay = 90 ft<sup>2</sup> per 100 gallons
  - The area required is calculated as follows:
    - Gray water volume (gallons per day) x 90 ft<sup>2</sup>/100 gallons
    - = 160 gallons per day x 90 ft<sup>2</sup>/100 gallons
    - = 160 gallons per day x 0.90 ft<sup>2</sup>/gallon
    - = **144 ft<sup>2</sup>**

# Questions?

rbabcock@hawaii.edu

<http://hawaii.gov/health/environmental/water/wastewater/forms.html>