Graywater Application for Army Installations – Introducing a New Guidance Document

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Report Documentation Page

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Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18
What Are PWTBs?

- Public Works Technical Bulletins
- Sponsored by USACE HQ
- Variety of Subjects
- Available through Whole Building Design Guide
- Accessible at:
- May have to use Alternate Path – CCB, Army/COE, then PWTB
PWTB Contents

- Definitions
- Regulatory Review
- Overview of Graywater
- Types of Systems
- Potential Military Installation Applications
- Summary
Military Installation Water Drivers

**Water Resources**
- Increasing Water Quantity and Quality Concerns
- Drought
- Climate Change

**Legislative and Executive Drivers**
- Clean Water Act
- Energy Policy Acts
- Executive Order 13423 - All Installations Must Reduce Consumption 2% Annually

**Defense/Army Strategies and Policies**
- Strategic Plan for Army Sustainability
- Army Strategy for the Environment
- 2005 Army Energy and Campaign Plan for Installations
- Installation Sustainability Plans - Water Conservation Goals
- LEED (Leadership in Energy and Environmental Design) USGBC
- Federal Best Management Practices
Decreasing Supply

- Over Withdrawal
- Climate Change
- Cost and Financing
- Quality Degradation

"I wish to make it clear to you, there is not sufficient water to irrigate all the lands which could be irrigated, and only a small portion can be irrigated. I tell you, gentlemen, you are piling up a heritage of conflict."

-- Maj. John Wesley Powell, 1893

Rocky Mount Reservoir, NC (2007)

Lake Mead, 2003
(Las Vegas Valley Water District)
FEMP Best Management Practices

1. Water Management Planning
2. Information and Education Programs
3. Distribution System Audits, Leak Detection and Repair
4. Water Efficient Landscaping
5. Water Efficient Irrigation
6. Toilets and Urinals
7. Faucets and Showerheads
8. Boiler/Steam Systems
10. Cooling Tower Management
11. Commercial Kitchen Management
12. Laboratory/Medical equipment
13. Other Water Use
14. Alternate Water Sources
Other Water Use/Alternate Water Sources Options

What can be done to increase available supply? How can we efficiently use what’s available?

- Water Reuse
- Desalination
- Produced Water
- Rainwater Harvesting
- Ground Water Recharge
- GRAYWATER REUSE
- Sewer Mining
Army Policy

• Where LCC effective, reclaimed or treated recycled water will be used for irrigation and other non-potable uses.

• Gray-water or untreated effluent from laundry, dishwashing, and personal hygiene/bathing will not be recycled or reused as part of a United States Green Building Council (USGBC) sanctioned program for a LEED (Leadership in Energy and Environmental Design) credit without approval from IMCOM.
Definitions

Graywater = Greywater = Gray Water = Grey Water

Blackwater
Toilet, Kitchen Wastewater

Reclaimed Water
Wastewater Treated to High Standards at Municipal Treatment Facilities, Delivered to Customers via “Purple Pipe” System
History

• Long History in Arid Parts of the U.S.
  - Common in Rural Areas
  - Technically Still Illegal in Many Places
  - May Get 40 Gallons per day per Person
  - Technology to Use – Highly Variable
    ▪ Rinse Water from Washer for Next Load
    ▪ Direct Discharge to Irrigation
    ▪ Or Complex Treatment
    ▪ Living Systems – Water Plants and Sand Filtration
    ▪ Often Minimal Treatment then Underground Irrigation System

• Many Commercial Package Plants
  - Filtered, Disinfected Product – Fairly Expensive
# Graywater Sources and Percent of Household Flow

<table>
<thead>
<tr>
<th>Source</th>
<th>Percent</th>
<th>Category</th>
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</thead>
<tbody>
<tr>
<td>Toilet</td>
<td>40</td>
<td>Blackwater</td>
</tr>
<tr>
<td>Kitchen waste</td>
<td>10</td>
<td>Blackwater</td>
</tr>
<tr>
<td>Misc</td>
<td>5</td>
<td>Graywater</td>
</tr>
<tr>
<td>Laundry</td>
<td>15</td>
<td>Graywater</td>
</tr>
<tr>
<td>Bath/Shower</td>
<td>30</td>
<td>Graywater</td>
</tr>
</tbody>
</table>
Quality of Graywater

- Biological
  - Microorganisms
- Chemical
  - Dissolved Salts – sodium, nitrogen, phosphates, chloride
  - Others – oils, fats, soap, detergents
- Physical
  - Soil
  - Lint
Compared to Combined Wastewater

- Lower in BOD
- Lower in Suspended Solids
- Lower in Nitrogen
- Lower in Phosphorous
- More Alkaline
- Higher in Salts
Controversy?

- Why? Potential Health Threat
- No Cases Reported
- No National Guidelines
- More States Becoming Proactive in Encouraging Use
- Lobbying at Federal Level for Recognition for Use
- Guidelines Vary Internationally
### California Greywater Policy Data and Calculations

Oasis Design © Feb 24, 2009. Check [http://oasisdesign.net/greywater/law/california/index.htm#references](http://oasisdesign.net/greywater/law/california/index.htm#references) for updates to this spreadsheet. May be reproduced if credit and notice of reproduction are given.

<table>
<thead>
<tr>
<th>Datum</th>
<th>What</th>
<th>Date</th>
<th>Source</th>
<th>URL, comment</th>
</tr>
</thead>
</table>
| **Greywater system exposure in California**

| 13.9% | Households with greywater systems | 1999 | Soap and Detergent Manufacturer's Association Graywater | [http://www.sdascsience.org/docs/Greywater_Habits_&_Usage.pdf](http://www.sdascsience.org/docs/Greywater_Habits_&_Usage.pdf) |
| 5,080,897 | Greywater users | 2009 | US census bureau | [http://quickfacts.census.gov/qfd/states/06000.html](http://quickfacts.census.gov/qfd/states/06000.html) |
| 2.87 | People per household | 2000 | US census bureau | [http://quickfacts.census.gov/qfd/states/06000.html](http://quickfacts.census.gov/qfd/states/06000.html) |

**Greywater system user years—CA**

| 5,080,897 | Greywater users | 2009 | Estimate; in general, older infrastructure has more greywater use, approaching 100% with rural 70+ year old buildings | [http://quickfacts.census.gov/qfd/states/06000.html](http://quickfacts.census.gov/qfd/states/06000.html) |
| 10.0% | Households with greywater systems | 1950 | Estimate; in general, older infrastructure has more greywater use, approaching 100% with rural 70+ year old buildings | [http://quickfacts.census.gov/qfd/states/06000.html](http://quickfacts.census.gov/qfd/states/06000.html) |
| 10,586,223 | Average number of greywater users | 1949-2009 | Average of 2009 and 1950 greywater users | [http://quickfacts.census.gov/qfd/states/06000.html](http://quickfacts.census.gov/qfd/states/06000.html) |
| 184,185,576 | System-user-years of greywater exposure, not counting neighbor calculation; average greywater users * years | 2009 | Extrapolation from 1999 | [http://quickfacts.census.gov/qfd/states/06000.html](http://quickfacts.census.gov/qfd/states/06000.html) |

**System user years—US**

| 21,267,725 | Greywater users | 1999 | Soap and Detergent Manufacturer's Association Graywater | [http://www.sdascsience.org/docs/Greywater_Habits_&_Usage.pdf](http://www.sdascsience.org/docs/Greywater_Habits_&_Usage.pdf) |
| 8,211,477 | Greywater systems | 2009 | Calculation; greywater users / people per household | [http://quickfacts.census.gov/qfd/states/06000.html](http://quickfacts.census.gov/qfd/states/06000.html) |
| 1,094,845,995 | System-user-years of greywater exposure, not counting neighbor calculation; average greywater users * years | 2009 | Extrapolation from 1999 | [http://quickfacts.census.gov/qfd/states/06000.html](http://quickfacts.census.gov/qfd/states/06000.html) |

### Reports of greywater-transmitted illness in US

<table>
<thead>
<tr>
<th>Disease</th>
<th>Cases in 2007</th>
<th>Est. 60 Years Cumulative Cases</th>
<th>Cases Linked to Graywater</th>
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<tbody>
<tr>
<td>Cholera</td>
<td>7</td>
<td>288</td>
<td>0</td>
</tr>
<tr>
<td>Cryptosporidiosis</td>
<td>11,170</td>
<td>502,650</td>
<td>0</td>
</tr>
<tr>
<td>E. coli, Shigatoxin-producing (STEC)</td>
<td>4,847</td>
<td>218,115</td>
<td>0</td>
</tr>
<tr>
<td>Giardiasis</td>
<td>19,417</td>
<td>873,765</td>
<td>0</td>
</tr>
<tr>
<td>Hepatitis A</td>
<td>2,979</td>
<td>134,055</td>
<td>0</td>
</tr>
<tr>
<td>Legionellosis</td>
<td>2,716</td>
<td>122,220</td>
<td>0</td>
</tr>
<tr>
<td>Salmonellosis</td>
<td>47,965</td>
<td>2,159,775</td>
<td>0</td>
</tr>
<tr>
<td>Shigellosis</td>
<td>19,758</td>
<td>889,110</td>
<td>0</td>
</tr>
<tr>
<td>Vibriosis (non-cholera Vibrio species infections)</td>
<td>447</td>
<td>26,560</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>123,713</strong></td>
<td><strong>4,920,993</strong></td>
<td><strong>0</strong></td>
</tr>
</tbody>
</table>
Using Graywater

- Advantages
  - Saves Water
  - Less Discharge
  - Less Energy and Chemical Use
  - Recovery of Nutrients
  - Reduction of Hydraulic Load to Existing Systems

- Disadvantages
  - More Costly
  - May Decrease Flow to Sewage Plant
  - Potential for Spreading Disease Through Human Contact if not Properly Handled or Treated
  - Damage to Soil Long-term?
  - Potential Odors in Surge or Storage Tanks
When to Use

- Best in New Construction
- Estimate Graywater Production
- Office – Probably Not
- Barracks – Potentially
- Cost-Effective? Water Restrictions?
- Determine Applications – End Use
- Separate Systems
Other Concerns

• Fixture Flushing
• Cooling Towers
• Irrigation

• Regulations – Constantly Evolving
• States Vary
• Plumbing Codes Vary
• Usually Use for Sub-surface or Drip Irrigation
Graywater Reuse Opportunities
Systems

- AZ Regulations for Surface Application
  - Settling Tanks and Sand Filters
  - Sump Surge Tank
  - Filter Lint and Hair
  - Pump to Toilet or Landscape
  - State Review of Design and Construction
  - Settling or Holding Tank, Filtration, Disinfection if Applied to Surface Vegetation
  - Discourages Direct Discharge of Wash Machine to Outside Surface
  - Monitoring
- CA Requires Surge Tank, No Holding or Settling, Then Drip Irrigation
  - Local Control, Can Vary Requirements
- Other States Vary
  - Some Require Use of Separate Septic Tanks Before Use
- Changes Coming – Becoming More Liberal
Example

• Cochise County, AZ – “New residential construction shall have gray water lines plumbed to stub out, and be capped and clearly marked so as to permit the optional use of gray water by residents. The gray water plumbing must connect at least two plumbing fixtures, and preferably those that produce the most gray water without compromising the efficient evacuation of the black water pipes.”

• Applies to both single-family and multi-family and commercial projects.
Graywater Treatment

How Gray Water Reclamation Works

Bath

Laundry

To Sewer

Out to garden or lawn

Surge Tank

Screen

Overflow

Vent

Pump

To Sewer

US Army Corps of Engineers®

Engineer Research and Development Center
Future and Larger Scale Systems

- More Complex Operations
- Collect Large Quantities
- Blocks and Large Buildings have Dual Plumbing and Communal Systems with Treatment
- Combine with Other Sources Such as Rainwater
Engineer Research and Development Center
Summary

- Numerous Drivers Promote Water Efficiency
- Graywater Use - One Option to Using Less Potable Water
- Graywater Quantities Can Be Significant
- Treatment Processes Variable
- Health Considerations Important
- Regulations Changing
- Match Water Quality with End Use
- U.S. Playing Catch-up
- New/Emerging Technologies Should be Demonstrated/Adopted
- PWTB to be Available Final Early FY 2010
Questions, Comments?

Also:
I would like your help!
Any information on graywater applications (planned or existing) at your installations or in your states would be greatly appreciated!
Also Rainwater Harvesting Applications.

Contact information or for additional information or resources

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217-398-5590