City of Long Beach
Working Together to Serve

Memorandum

R-16

Date: March 22, 2011

To: Honorable Mayor and City Council

From: Vice Mayor Lowenthal, Chair, Environmental Committee

Subject: **GREYWATER RECYCLING PILOT PROGRAM**

The Environmental Committee, at its meeting held Tuesday, March 1, 2011, considered communications relative to the above subject.

It is the recommendation of the Environmental Committee to the City Council to approve the Greywater Recycling Pilot Program in the City of Long Beach.

Respectfully submitted,

ENVIRONMENTAL COMMITTEE

Vice Mayor Suja Lowenthal, Chair

Attachment(s)

R-22

James Johnson
City of Long Beach
Councilmember, Seventh District

Date: October 19, 2010

To: Honorable Mayor and Members of the City Council

From: Councilmember James Johnson, Seventh District
Councilmember Suja Lowenthal, Second District
Councilmember Patrick O'Donnell, Fourth District

Subject: Request to Consider a "Tubs to Shrubs" Greywater Recycling Pilot Project

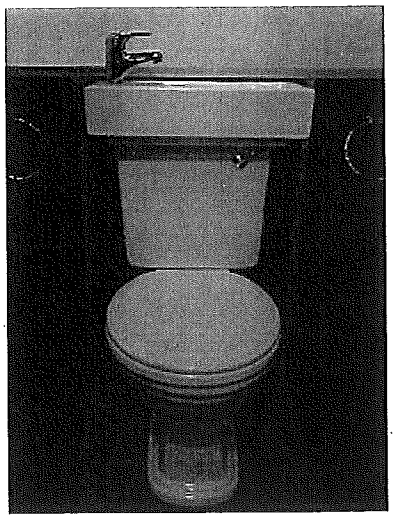
RECOMMENDATION:

Refer exploration of a potential greywater pilot project to the City Council's Environmental Committee for deliberation and consultation with stakeholders and request that they report back to the Council regarding their recommendation.

DISCUSSION:

The history of California has long been defined by water—how we get it, who gets it, and where it goes. How jurisdictions throughout the state manage water use and how we can creatively increase conservation will determine how our economy and quality of life will fare, given the long-term constraints on our water supply.

One solution that has been proposed to reduce the use of potable water is the reuse of "greywater." Greywater is water that is dirtier than potable or "white" water but cleaner than sewage water or "black" water. For example, water discharged from bathtubs and sinks is greywater. Subject to state and local regulations, such water can be reused to water lawns and gardens rather than being discharged along with blackwater through sewage pipes, thus reducing the use of potable water.



It is estimated that by using indoor water for landscapes, overall potable water use could decline by 14-40%. (See "Greywater—A Potential Source of Water," attached.) Such savings would represent a fundamental shift in Long Beach's demand and continue our reputation as a national leader in conservation.

Historically, the use of greywater has been constrained by state law that discouraged its use. However, in August 2009 the State Plumbing Code

was revised to encourage greywater use throughout the state. (Attached) Given this change, the City should work with all interested stakeholders such as the Water Department, Developments Services, the environmental community, the Sustainability Commission, and the Office of Sustainability to explore a greywater pilot project. Such a project would select a small number of households to undertake approved greywater systems to assess the water conservation that results as well as the cost and effort required.

FISCAL IMPACT:

There are no significant costs for the Council's Environmental Committee to explore this item. Any city costs related to a pilot project would be presented to Council for final approval before commencement.

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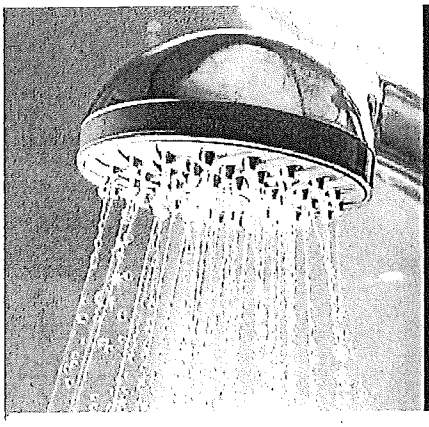
Southern California Environme
Fall 2009



GRADE B+ to B-

Graywater - A Potential Source of Water

by Yoram Cohen, Ph.D.
Professor, UCLA Department of Chemical and Biomolecular Engineering
and the Water Technology Research Center

Yoram Cohen, Ph.D.

California is facing a serious drought that prompted Governor Arnold Schwarzenegger to declare "This drought is having a devastating impact on our people, our communities, our economy and our environment...This is a crisis, just as severe as an earthquake or raging wildfire, and we must treat it with the same urgency by upgrading California's water infrastructure to ensure a clean and reliable water supply for our growing state." After three years of dry weather, and with forecasts of precipitation and snowpack below normal levels, California is preparing for the likelihood that 2010 will be a fourth year of drought [1, 2] with the State's key water reservoirs projected to be at only about 70% of their average storage. Unless precipitation leads to significant restoration of the State water supply and demand is reduced, the situation in California will become unsustainable.

WATER USE IN CALIFORNIA

The California Department of Water Resources has pursued a multifaceted approach to address the severe water

shortage in California, with water conservation as a key element of its plan. Among its various elements, the approach considers reduction in water use efficiency and conservation, as well as the reclamation and reuse of municipal, industrial and agricultural wastewater streams. Various California local governments have already implemented and/or are encouraging water conservation measures, including water rationing and water reuse. The largest percentage of water consumption (77%) in California is attributed to agriculture (Figure 1) with an estimated 13% for urban residential use (both single- and multi-family). In Southern California (the South Coast Hydrologic Region), however, about 54% of the water consumption (Figure 2) is attributed to urban residential use, which accounts for the largest usage of potable water by the municipal and industrial (M&I) sector (i.e., the urban sector). Although use of water by the M&I sector in the South Coast Hydrologic Region represents a small fraction of California's total water use (~6%), the loss of even a small percentage of this potable water apportionment can have significant impact on the quality of life in urban areas. For example, in order to cope with water shortages, the Los Angeles Department of Water and Power (LADWP) has implemented a program that includes restrictions on urban irrigation, guidelines for residential water conservation, and shortage-year water price increases.

The largest percentage of water consumption in California is attributed to agriculture

but in Southern California about 54% of the water consumption is attributed to urban residential use.

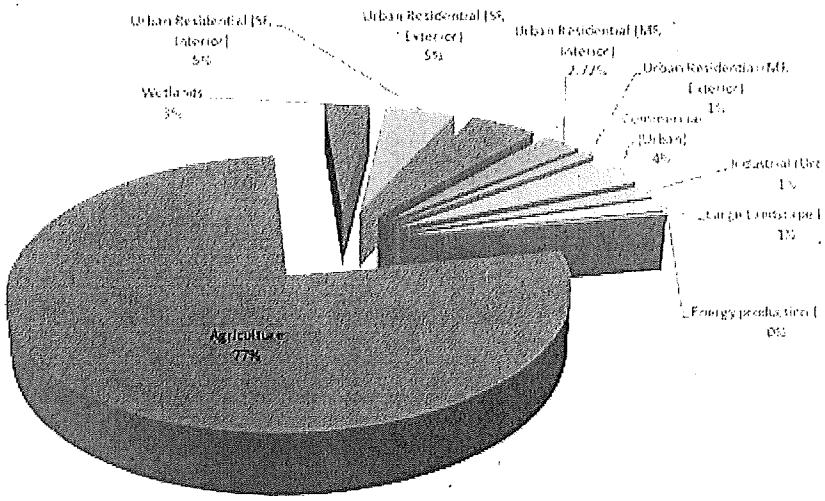


Figure 1. Freshwater use in California (Source: [3]). Note: MF - Multifa
Single Family.

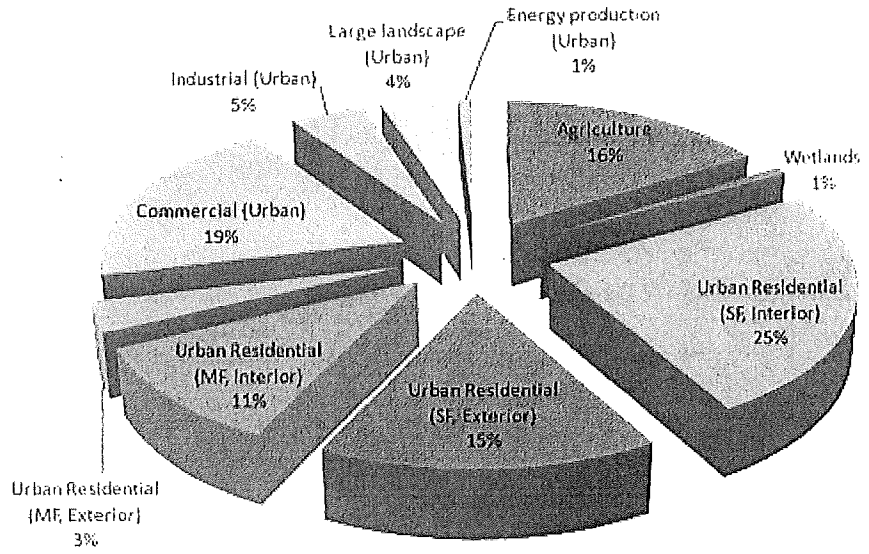


Figure 2. Water use distribution in California's South Coast Hydrologic (Source: [3]).

In order to meet California's future water supply needs, it is clear water conservation must be implemented as a component of the State's overall water plan. Domestic measures of water conservation, which are of great importance to the M&I sector, include expanding the use of ultra low-flow toilets and low-flow shower heads, as well as efficient washers for laundry and the kitchen. In addition, water recycling, particularly of graywater, which has been gaining popularity in various countries, is now being advanced as a potential water source that could alleviate some of the water shortage pressure in Southern California.

GRAYWATER: LIGHT AND HEAVY

Graywater, as defined in Chapter 16A Part I of the 2007 California Plumbing Code [4], is untreated wastewater that has not been contaminated by any toilet discharge, has not been affected by unhealthy bodily wastes, and does not present a threat from contamination by unhealthful processing, manufacturing, or operating wastes. Under this definition, toilet wastewater (also known as blackwater) is not considered graywater and would require significant treatment in centralized wastewater plants. The importance of graywater recycling and reuse has been recognized recently by California's Department of Housing and

Community Development which proposed the adoption of emergency graywater regulations into the 2007 California Plumbing Code. Approved by the California Building Standards Commission in August 2009, the revised plumbing code now presents clearer and less restrictive regulations for graywater reuse.

Water recycling, particularly of graywater, is now being advanced as a potential water source that could alleviate some of the water shortage

Graywater is typically wastewater low in turbidity, clear in color, and found from the drainage of bathtubs, showers, bathroom washbasins, clothes washing machines, and laundry tubs. Graywater quality is highly variable because it is source dependent given the variability in household water use. For example, water from clothes washers is high in phosphate content, whereas water from the shower has high turbidity and suspended solids. Residential graywater can be categorized as light graywater or heavy graywater.

Light graywater is wastewater from the shower, bath, bathroom washbasin, and clothes washing machine. Heavy graywater is wastewater from the kitchen sink and dishwasher. According to the revised 2007 California Plumbing Code, heavy graywater is not considered graywater in California. Commercial technologies already exist for processing both light and heavy graywater on-site for non-potable usage. However, the recycling and reuse of graywater requires careful considerations of potential health and environmental risks that can arise due to improper use.

Health risk concerns include potential exposure to pathogenic bacteria and viruses, which may occur through direct contact with graywater as well as through exposure to graywater contaminated irrigated areas, crops, or groundwater. For this reason, it is important that human contact with untreated graywater or its areas of exposure are minimized. Under the revised 2007 California Plumbing Code, for example, protective regulations limit direct reuse of untreated graywater to landscape irrigation. Furthermore, the revised Code specifies untreated graywater cannot be used for spray irrigation, but must only be conveyed and distributed underground (e.g., drip irrigation) or below at least two inches deep of mulch, rock, soil, or under a solid shield.

The revised 2007 California Plumbing Code has now eased previous permit requirements for certain untreated graywater delivery and distribution systems. Permit requirements are now based on daily discharge volume, number of household

pressure in Southern California.

sources, and number of graywater system fixtures. According to the Draft 2010 California Plumbing Code proposed by the California Department of Water Resources [5]; expanded indoor and outdoor uses of graywater (e.g., toilet flushing, spray irrigation, etc.) are also possible if the source graywater is treated to meet the California Department of Public Heath statewide uniform criteria for disinfected tertiary recycled water. This implies that, for expanded use graywater (i.e., besides in underground irrigation systems), water quality of treated graywater from small-scale, on-site residential treatment systems would be held to the same regulatory standards as large-scale, centralized municipal water treatment plants.

TREATMENT AND REUSE

The recycling and reuse of graywater requires careful considerations of potential health and environmental risks that can arise

At present, given the revised 2007 California Plumbing Code definition of graywater, both heavy graywater and blackwater must be conveyed to and treated by centralized wastewater treatment plants. Only light graywater can be treated on-site for non-potable usage. Clearly, in order to evaluate the potential significance of graywater to the water portfolio in Southern California, it is instructive to first assess the volume of domestically produced graywater that can be treated and reused relative to the volume of municipal and industrial water usage by California's 37 million residents. California's municipal and industrial water use currently is about 7,600 million gallons of water per day (MGD) of which the South Coast Hydrologic Region uses about 3,650 MGD (nearly 50%). The LADWP service area (~3.8 million people) and the Metropolitan Water District of Southern California service area (~16.8 million people) use about 600 MGD and 3,200 MGD which represent about 8% and 42%, respectively, of California's total M&I water use. It is interesting to note the combined municipal and industrial per capita water consumption in Southern California is nearly twice that of Sydney, Australia – an urban region of similar climate and severe water shortage. The lower residential water consumption in Sydney is due to a multi-faceted approach to water conservation, and a positive change in public attitude.

Single-family and multi-family homes use about 50% (or about 1,800 MGD) and 17% (600 MGD), respectively, of the M&I water used in the South Coast Hydrologic Region, with commercial, industrial and large landscape comprising

due to improper use.

the bulk of the remaining M&I water use in that region (Figure 3). Water usage in a typical home includes water used for showering, clothes washing, toilet, dishwashing, sinks, and irrigation (Figure 4). In the LADWP service area, the 2010 projection is that indoor water use in single-family homes will be about 127 MGD with outdoor use being about 85 MGD, resulting in an average annual water bill of about $900 for a single-family home. It is interesting to note single-family residents use a greater percentage of water outdoors (62%) relative to multifamily residents (20%) who have limited access to private landscapes (Figure 5).

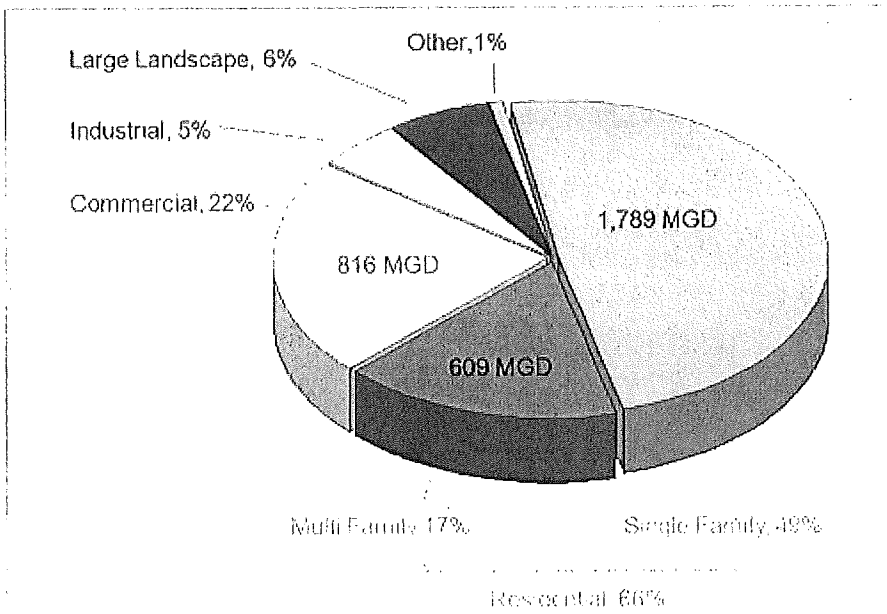


Figure 3. Municipal and industrial water use in the California's South C
Hydrologic Region (Source: [3]).

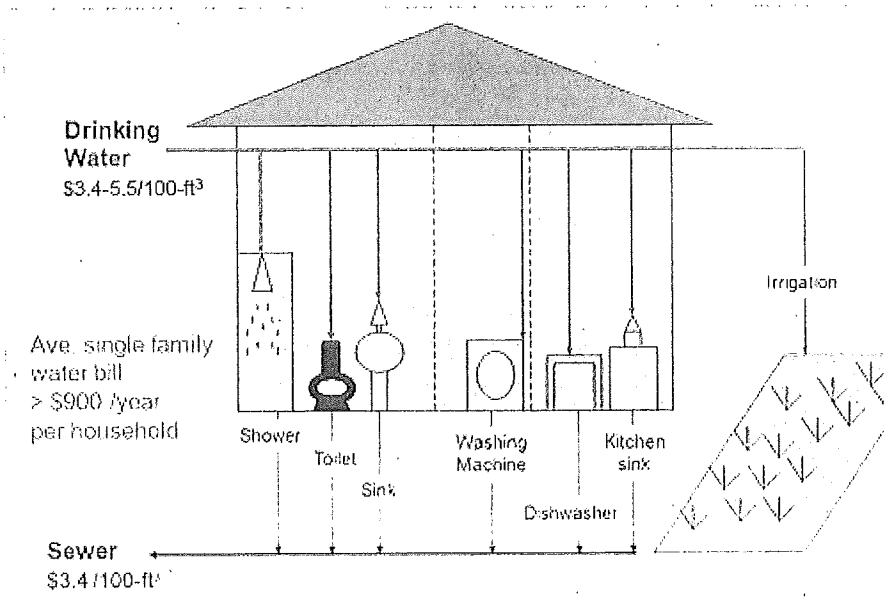


Figure 4. Water use in a single-family home (drinking water and sewer are for LADWP rates).

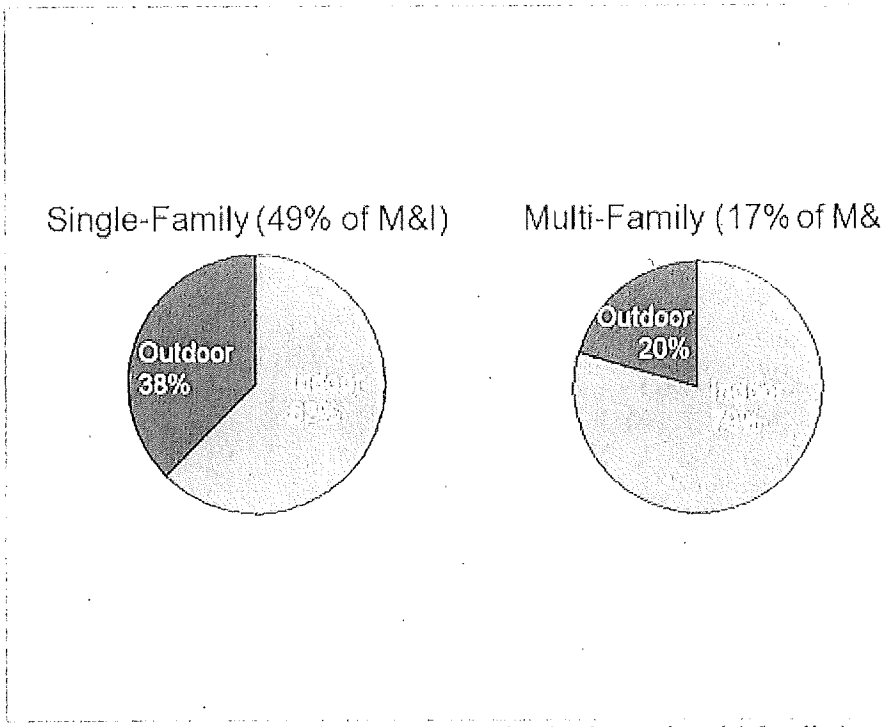


Figure 5. Indoor and outdoor water use in single- and multi-family hom California's South Coast Hydrologic Region. Source: [3].

Graywater that can be used directly or with a reasonable level of local treatment (i.e., at the point of use) includes clothes washer, shower/bath and faucet (non-kitchen) water constituting about 60% of the total indoor water use in single-family homes (Figure 6). Only 1.3% of the total indoor water in a single-family home is used for washing

dishes. This relatively small wastewater stream, from dishwashing or the kitchen sink, is typically not included as graywater because it has a high level of suspended solids and also a high organic content, thus requiring a significant level of treatment to allow even non-potable reuse. Given the above, it is estimated the capacity for graywater recycling and reuse for single- and multi-family homes in the South Coast Hydrologic Region is about 650 MGD and 285 MGD, respectively, or about 25% of the total M&I water used in that region. It is estimated that the residential graywater reuse capacity in the LADWP service area could range from a low of 50 MGD to a high of 165 MGD (or about 8-27% of the total M&I for LADWP service area).

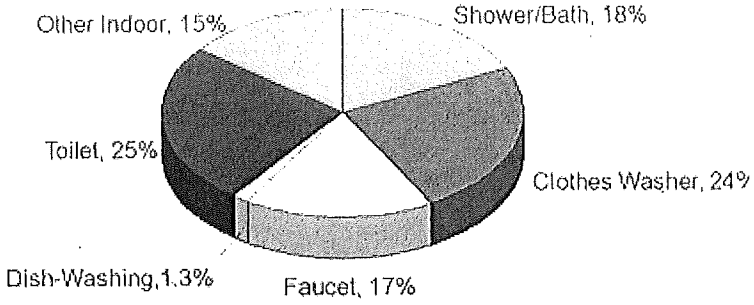


Figure 6. Indoor distribution of water use in a single-family home, base average per capita indoor consumption data for four cities in Southern California (Source: [6]).

POTENTIAL WATER SAVINGS

With only 10% of Southern

In order to assess the potential for potable water savings in the residential sector, it is useful to consider three tiers of graywater reuse and how these can be matched with water demand (Figure 7). Tier 1 includes laundry water, Tier 2 adds shower water, and Tier 3 adds dishwasher and faucets water (including kitchen). As noted earlier, Tiers 1 and 2 are considered light graywater while Tier 3 is considered heavy graywater. It is clear that recycling all of Tier 1 and Tier 2

California homes participating, the volume of water saved would be equivalent to the capacity of a modern, large seawater desalination plant such as those proposed for California.

graywater would be sufficient to meet outdoor water use in Southern California. Adding heavy graywater would meet up to 41% of toilet water use provided this heavy graywater undergoes treatment before use. The estimated residential per capita potable water savings range from 16% - 40% for Tiers 1-3 (Table 1).

Total savings for the 2,400 MGD of residential water use in the South Coast Hydrologic Region would depend on the level of public participation in adopting graywater recycling and reuse practices at the single-residential and community-levels. For example, for a participation of only 10% for Tiers 1-3, the potable water savings for the South Coast Hydrologic Region would range from about 40 to 100 MGD (1.6% - 4%). Although the percent saving may seem small, it is worth noting the volume of water saved is equivalent to, or larger than, the capacity of a modern, large seawater desalination plant such as those proposed for California. Also, the reuse of graywater at the point-of-use has the potential advantage of a lower cost than would be expected for centralized graywater treatment and distribution systems.

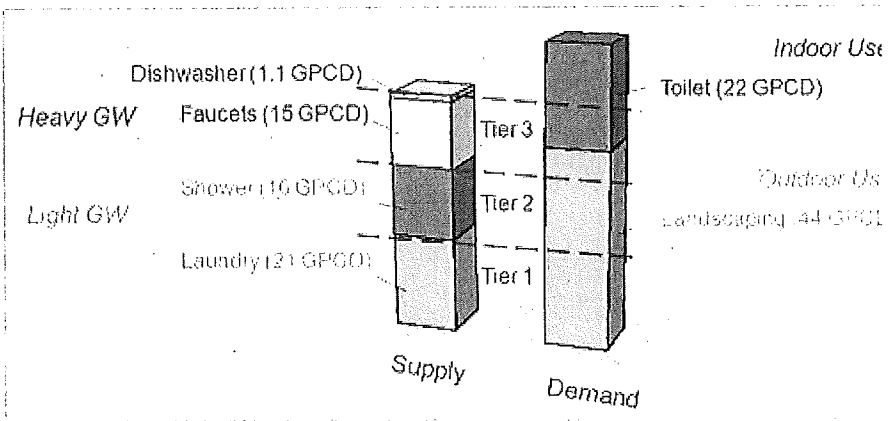


Figure 7. Estimated daily residential (single- and multi-family dwelling: graywater generation (supply) and demand per capita (GPCD = Gallons capita per day) in Southern California (based on data from Figs. 3, 5, a

Table 1. Estimated potable water savings for residential homes in Southern California

	Daily Potable Water Savings per Capita (gallons)	Daily South Coa Region Total Sa gallons)
		Particip
		100% 1
Tier 1	21 (16% savings)	383 3
Tier 2	37 (28% savings)	672 6
Tier 3	53 (40% savings)	964 9

Note: Tiers 1-3 are defined consistent with Fig. 7.

TREATMENT LEVEL

Under the revised 2007 California Plumbing Code, Tiers 1 and 2 untreated graywater recycling can be used for subsurface or covered irrigation provided it is not for root crops or food crops with edible parts that contact the soil. According to the Draft 2010 California Plumbing Code, indoor use of Tiers 1-3 for toilet flushing would require water treatment to meet disinfected tertiary recycled water criteria as regulated by the California Department of Public Health. This proposed code implies treated graywater (from small and large volume generators) could be used for unrestricted

non-potable use (outdoor and indoor) with the requirement of online water quality monitoring and regulatory oversight that seems to be approaching the level of large-scale centralized water treatment plants.

Three levels of graywater treatment steps are required in order to meet the level of recycled graywater quality for the above stated unrestricted non-potable use: a primary treatment for removal of suspended matter (e.g., sedimentation or filtration), a secondary step for stabilizing organic matter (e.g., biological treatment), and a third step that includes finishing filtration (using membranes or media filters) and disinfection (e.g., UV irradiation). Upgrading the quality of graywater to unrestricted non-potable use may require a significant investment and technical know-how to ensure an effective treatment that will provide adequate public health protection. Therefore, it could be argued the level of sophistication and expense of treating graywater may not be justified, relative to the demand (Figure 7), given that all light graywater (Tiers 1 and 2) can be used to meet about 84% of outdoor residential water use without the need for treatment under current California regulations.

It is undeniable that graywater treatment would provide a protective measure that could garner greater public and regulatory support for the acceptability of graywater as an indispensible part of California's water portfolio. At the same time, the significant added expense and the high level of treatment and monitoring required for upgrading graywater quality to a level allowed for unrestricted non-potable reuse may be an impediment for the deployment of distributed small-scale residential systems for graywater recycling and reuse.

GOVERNMENT INCENTIVES AND PUBLIC INVOLVEMENT

Coordinated government assistance

The state of California's recognition of the potential benefit of graywater recycling and its importance in the State's overall water plan is a key step forward. In implementing this approach, California could benefit from the experience other countries have had with graywater recycling. In Australia, for example, government-provided information and certification regarding commercial graywater systems is clear and posted on government web sites. In addition, detailed information is provided to the public sector on

for the selection, installation and deployment of distributed graywater systems is needed to accelerate the development of graywater recycling, and to alleviate the pressure on

available and acceptable graywater recycling technologies and approaches. Moreover, the Australian government has established a National Rainwater and Greywater Initiative with funding and rebates to promote efficient and safe graywater recycling and rainwater storage. Like Australia, Southern California can develop a more sustainable water program by increasing graywater recycling to a level at which it becomes a measurable part of the State's water portfolio. However, an effective graywater recycling program will have to include broad public education and participation, certified and properly managed distributed graywater recycling systems, centralized recycling plants where applicable, and incentives for graywater recycling programs.

CONCLUSION

The volume of residential graywater in Southern California appears sufficient to meet a significant portion of outdoor residential water demand. Coordinated government assistance for the selection, installation and deployment of distributed graywater systems is needed to accelerate the development of graywater recycling, and to alleviate the pressure on already dwindling potable water resources.

GRADE

The State of California earns an **overall Grade B+.** First, for

already dwindling potable water resources.

moving forward to address the need to increase California's water portfolio and for recognizing the potential of graywater recycling and reuse; and second, for easing graywater permitting requirements, allowing the use of a variety of technologies. But the State receives a **Grade B-** for providing insufficient public information and guidance regarding graywater recycling technologies and regulations.

ACKNOWLEDGEMENTS

Dr. Anditya Rahardianto and Rose Eng contributed importantly to the development of quantitative data and other information in the preparation of this article. Their efforts are greatly appreciated.

SOURCES

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2. Association of California Water Agencies; California Department of Water Resources California Ends Third Dry Year - Public Called On to Continue Conserving Water. http://www.saveourh2o.org/ (September 30, 2009).
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5. California Department of Water Resources Draft 2010 California Plumbing Code: Chapter 16 – Part II, Recycled Water Systems.
6. Mayer, P.W., W.B. DeOreo, E. Opitz, J. Kiefer, B. Dziegielewski, W. Davis, J.O. Nelson, American Water Works Association (AWWA), *Residential End Uses of Water Study (REUWS), Denver, CO*, 1999.

AUTHOR BIO

Dr. Yoram Cohen received his B.A.Sc., M.A.Sc., in 1975 and 1977, respectively, both in Chemical Engineering, from the University of Toronto, and his Ph.D. from the University of Delaware in 1981. He has been on the Faculty of Chemical and Biomolecular Engineering at the University of

Yoram Cohen, Ph.D.

California, Los Angeles (UCLA) since 1981. He is the founder and Director of the Water Technology Research Center and the Center for Environmental Risk Reduction, and a member of the UCLA/National Science Foundation Center for the Environmental Implications of Nanotechnology. Dr. Cohen is an Adjunct Professor at Ben-Gurion University and a member of the International Advisory Committee to the Stephen and Nancy Grand Water Research Institute at the Technion.

Dr. Cohen is a UCLA Luskin Scholar and a recipient of the 2008 Ann C. Rosenfield Community Partnership Prize in recognition of his environmental research. He received the 2003 Lawrence K. Cecil award in Environmental Chemical Engineering from the American Institute of Chemical Engineers (AIChE), as well as the AIChE Separations Division Outstanding Paper Award (1997). In 2008 he received a County of Los Angeles Commendation, a State of California Senate Certificate of Recognition, and a Certificate of Special Congressional Recognition (U.S.) for contributing to legislation to protect public health and dedicated service to the Los Angeles community. Dr. Cohen has published over one hundred and fifty research papers and book chapters in water technology, separations processes, transport phenomena, polymer science, surface nano-structuring and environmental engineering. Dr. Cohen developed patented technologies in membrane synthesis, reverse osmosis desalination, surface nanostructuring and chemical sensors.

Credits

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PREFACE

INTRODUCTION

Chapter 16A establishes minimum requirements for the installation of graywater systems in occupancies regulated by the Department of Housing and Community Development (HCD). It is intended to provide guidance to code users while providing flexibility that will encourage the use of graywater. This chapter contains provisions which allow the installation of limited types of graywater systems to be installed without a construction permit. It is not the intent of HCD that the exemption from a construction permit be construed by code users as an exemption from the provisions of this chapter or other lawfully enacted requirements imposed by a city, county, or city and county, nor does it eliminate the need for persons considering the installation of a graywater system from contacting local authorities to ensure they are adequately informed about any local requirements or prohibitions.

DEVELOPMENT

This chapter was developed through input from stakeholders representing a wide variety of interests during several public meetings. These meetings resulted in several drafts, which were distributed to stakeholders for comment. HCD considered these comments and did extensive research on graywater use. Toward the end of the development stage, HCD made a decision to propose these standards on an emergency basis in order to allow the regulations to become effective approximately 18 months sooner than the standard adoption process.

ADOPTION

The emergency graywater regulations, which added Chapter 16A "Nonpotable Water Reuse Systems" into the 2007 California Plumbing Code, were approved by the California Building Standards Commission (CBSC) on July 30, 2009. The emergency regulations were subsequently filed with the Secretary of State on August 4, 2009, effective immediately upon filing.

In compliance with the Administrative Procedure Act, HCD prepared a "Certificate of Compliance" confirming the completion of the rulemaking process, which included a 45-day public comment period, a subsequent 15-day comment period, a Final Statement of Reasons and the Final Express Terms.

The "Certificate of Compliance", along with the Final Express Terms, was unanimously approved by the CBSC and filed with the Secretary of State on January 27, 2010. With the rulemaking action complete, Title 24, Part 5, Chapter 16A, Part I emergency regulations of the 2007 California Plumbing Code were made permanent.

CERTIFICATE OF COMPLIANCE

DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT

The Department of Housing and Community Development (HCD) hereby certifies that it has, within 180 days of the effective date of the emergency building standards attached hereto, which were filed with the Secretary of State on August 4, 2009, given notice of the adoption thereof and afforded interested persons the opportunity to present statements, arguments, or contentions in a manner substantially similar to that provided by Government Code Sections 11346.2 – 11347.3.

Kim Strange, Deputy Director — Date 12/21/09

CHAPTER 16A

NONPOTABLE WATER REUSE SYSTEMS

Part I

Intent

This part is applicable to occupancies under the authority of the Department of Housing and Community Development as specified in Section 108.2.1.1 and is intended to:

1. Conserve water by facilitating greater reuse of laundry, shower, lavatory and similar sources of discharge for irrigation and/or indoor use.

2. Reduce the number of non-compliant graywater systems by making legal compliance easily achievable.

3. Provide guidance for avoiding potentially unhealthful conditions.

4. Provide an alternative way to relieve stress on a private sewage disposal system by diverting the graywater.

1601*A*.0 Graywater Systems – General.

(A) Except as otherwise provided for in this chapter, the provisions of this code shall be applicable to gray water installation. *The provisions of this part shall apply to the construction, alteration, discharge, use, and repair of graywater systems. The graywater system shall not be connected to any potable water system without an air gap or other physical device which prevents backflow and shall not cause the ponding or runoff of graywater. A city, county, or city and county or other local government may, after a public hearing and enactment of an ordinance or resolution, further restrict or prohibit the use of graywater systems. For additional information, see Health and Safety Code Section 18941.7.*

(B) *The type of system shall be determined by the location, discharge capacity, soil type, and ground water level. The system shall be designed to handle graywater discharged from the building and may include tank(s) and other appurtenances necessary to ensure proper function of the system.*

> ***Note:*** *It is not the intent of this section to require that all graywater must be handled by an irrigation field or disposal field. It is acceptable for excess graywater to be diverted to the building sewer through the overflow required pursuant to Section 1609A.O (E).*

(C) No graywater system or part thereof shall be located on any lot other than the lot that is the site of the building or structure that discharges the graywater, nor shall any graywater system or part thereof be located at any point having less than the minimum distances indicated in Table 16*A*-1.

> ***Exception:*** *When there exists a lawfully recorded perpetual and exclusive covenant to an easement appurtenant and right-of-way between adjoining land-owners of two or more contiguous lots to discharge graywater from one lot to an adjoining lot.*

(D) No *construction* permit for any graywater system shall be issued until a plot plan with appropriate data satisfactory to the *Enforcing Agency* has been submitted and approved. When there is insufficient lot area or inappropriate soil conditions to *prevent the ponding or runoff* of the graywater, as determined by the *Enforcing Agency*, no graywater system shall be *allowed.*

> ***Exception:*** *A construction permit shall not be required for a clothes washer system which does not require cutting of the existing plumbing piping provided it is in compliance with Section 1603A.1.1.*

(E) All graywater systems shall be designed to allow the user to direct the flow to either the irrigation or disposal field or the building sewer. The means of changing the direction of the graywater shall be clearly labeled and readily accessible to the user.

(F) Water used to wash diapers or similarly soiled or infectious garments or other prohibited contents shall be diverted by the user to the building sewer.

(G) Graywater shall not be used in spray irrigation, allowed to pond or runoff and shall not be discharged directly into or reach any storm sewer system or any surface body of water.

(H) Human contact with graywater or the soil irrigated by graywater shall be minimized and avoided, except as required to maintain the graywater system. The discharge point of any graywater irrigation or disposal field shall be covered by at least (2) inches (51 mm) of mulch, rock, or soil, or a solid shield to minimize the possibility of human contact.

(I) Graywater shall not be used to irrigate root crops or edible parts of food crops that touch the soil.

1602A.0 Definitions.

Clothes Washer System. *A graywater system utilizing only a single domestic clothes washing machine in a one- or two-family dwelling.*

Complex System. *Graywater systems that discharge over 250 gallons (947 L) per day.*

Disposal Field. *An intended destination for graywater including but not limited to a mulch basin or receiving landscape feature, graywater leach field, or other approved method of disposal.*

Graywater. *Pursuant to Health and Safety Code Section 17922.12, "graywater" means untreated wastewater that has not been contaminated by any toilet discharge, has not been affected by infectious, contaminated, or unhealthy bodily wastes, and does not present a threat from contamination by unhealthful processing, manufacturing, or operating wastes. "Graywater" includes but is not limited to wastewater from bathtubs, showers, bathroom washbasins, clothes washing machines, and laundry tubs, but does not include wastewater from kitchen sinks or dishwashers.*

Graywater System. *A system designed to collect graywater and transport it out of the structure for distribution in an Irrigation or Disposal Field. A graywater system may include tanks, valves, filters, pumps or other appurtenances along with piping and receiving landscape.*

Irrigation Field. *An intended destination for graywater in the receiving landscape including but not limited to a drip irrigation system, mulch basin, or other approved method of dispersal for irrigation purposes.*

Mulch. *Organic waste material including but not limited to leaves, prunings, straw, pulled weeds and wood chips. Mulch shall be permeable enough to allow rapid infiltration of graywater.*

Mulch Basin. *A type of irrigation or disposal field filled with mulch or other approved permeable material of sufficient depth, length and width to prevent ponding or runoff. A mulch basin may include a basin around a tree, a trough along a row of plants or other shapes necessary for irrigation or disposal.*

Receiving Landscape. *Includes features such as soil, basins, swales, mulch, and plants.*

Simple System. *A graywater system serving a one- or two-family dwelling with a discharge of 250 gallons (947 L) per day or less. Simple systems exceed a clothes washer system.*

Treated Graywater. *Nonpotable water collected and treated on-site suitable for direct beneficial use.*

1603A.0 Permit.
A written construction permit shall be obtained from the Enforcing Agency prior to the erection, construction, reconstruction, installation, relocation or alteration of any graywater system that requires a permit.

***Exception:** A construction permit shall not be required for a clothes washer system which does not require cutting of the existing plumbing piping provided it is in compliance with Section 1603A.1.1.*

1603A.1 System Requirements.

***1603A.1.1 Clothes Washer System.** A clothes washer system in compliance with all of the following is exempt from the construction permit specified in Section 108.4.1 and may be installed or altered without a construction permit:*

1. *If required, notification has been provided to the Enforcing Agency regarding the proposed location and installation of a graywater irrigation or disposal system.*

   ***Note:** A city, county, or city and county or other local government may, after a public hearing and enactment of an ordinance or resolution, further restrict or prohibit the use of graywater systems. For additional information, see Health and Safety Code Section 18941.7.*

2. *The design shall allow the user to direct the flow to the irrigation or disposal field or the building sewer. The direction control of the graywater shall be clearly labeled and readily accessible to the user.*

3. *The installation, change, alteration or repair of the system does not include a potable water connection or a pump and does not affect other building, plumbing, electrical or mechanical components including structural features, egress, fire-life safety, sanitation, potable water supply piping or accessibility.*

   ***Note:** The pump in a clothes washer shall not be considered part of the graywater system.*

4. *The graywater shall be contained on the site where it is generated.*

5. *Graywater shall be directed to and contained within an irrigation or disposal field.*

6. *Ponding or runoff is prohibited and shall be considered a nuisance.*

7. *Graywater may be released above the ground surface provided at least two (2) inches (51 mm) of mulch, rock, or soil, or a solid shield covers the release point. Other methods which provide equivalent separation are also acceptable.*

8. *Graywater systems shall be designed to minimize contact with humans and domestic pets.*

9. *Water used to wash diapers or similarly soiled or infectious garments shall not be used and shall be diverted to the building sewer.*

10. *Graywater shall not contain hazardous chemicals derived from activities such as cleaning car parts, washing greasy or oily rags, or disposing of waste solutions from home photo labs or similar hobbyist or home occupational activities.*

11. *Exemption from construction permit requirements of this code shall not be deemed to grant authorization for any graywater system to be installed in a manner that violates other provisions of this code or any other laws or ordinances of the Enforcing Agency.*

12. *An operation and maintenance manual shall be provided. Directions shall indicate the manual is to remain with the building throughout the life of the system and indicate that upon change of ownership or occupancy, the new owner or tenant shall be notified the structure contains a graywater system.*

1603A.1.2 Simple System. *Simple systems exceed a clothes washer system and shall comply with the following:*

1. The discharge capacity of a graywater system shall be determined by Section 1606A.0. Simple systems have a discharge capacity of 250 gallons (947 L) per day or less.

2. Simple systems shall require a construction permit, unless exempted from a construction permit by the Enforcing Agency. The Enforcing Agency shall consult with any public water system (as defined in Health and Safety Code, Section 116275) providing drinking water to the dwelling before allowing and exemption from a construction permit.

3. The design of simple systems shall be acceptable to the Enforcing Agency and shall meet generally accepted graywater system design criteria.

1603A.1.3 Complex System. *Any graywater system that is not a clothes washer system or simple system shall comply with the following:*

1. The discharge capacity of a graywater system shall be determined by Section 1606A.0. Complex systems have a discharge capacity over 250 gallons (947 L) per day.

2. Complex systems shall require a construction permit, unless exempted from a construction permit by the Enforcing Agency. The Enforcing Agency shall consult with any public water system (as defined in Health and Safety Code, Section 116275) providing drinking water to the dwelling before allowing and exemption from a construction permit.

3. A complex system shall be designed by a person who can demonstrate competence to the satisfaction of the Enforcing Agency.

Table 1603A.1.4 – Construction Permit Requirements

Type of System	*Permit Requirements*
Clothes Washer System	*No construction permit required if conditions in Section 1603A.1.1 are met.*
Simple System	*Permit and plans required unless exempted by Enforcing Agency.*
Complex System	*Permit and plans required unless exempted by Enforcing Agency.*
Treated Graywater	*Permit and plans required unless exempted by Enforcing Agency.*

1604A.0 Drawings and Specifications.
Graywater systems for which a construction permit is required may be subject to submittal of plans and details of the proposed graywater system necessary to ensure compliance with the requirements of this chapter. Identification of the groundwater level and soil absorption qualities at the site shall be included in the plans or provided to the Enforcing Agency.

Exception: *The Enforcing Agency may waive the requirement for identification of groundwater level and/or soil absorption qualities based on knowledge of local conditions.*

1604A.1 Groundwater Depth. *Verification of ground water levels which exceed three (3) vertical feet (915 mm) from the deepest irrigation or disposal point of the proposed graywater system shall not be required.*

Note: *The absence of groundwater in a test hole three (3) vertical feet (915 mm) below the deepest irrigation or disposal point shall be sufficient to satisfy this section unless seasonal high groundwater levels have been documented to rise to within this area.*

1605A.0 Inspection and Testing.

(A) Inspection. *A graywater system for which a construction permit is required shall be subject to inspection by the Enforcing Agency and such construction or work shall remain accessible and exposed for inspection purposes until approved.*

At the time of final inspection, an operation and maintenance manual shall be provided. Directions shall indicate the manual is to remain with the building throughout the life of the system and upon change of ownership, the new owner shall be notified the structure contains a graywater system

(B) Testing.

(1) Tanks shall be filled with water to the overflow line prior to and during inspection. Seams and joints shall be left exposed, and the tank shall remain watertight.

(2) A flow test shall be performed through the system to the point of graywater *irrigation or disposal.* Lines and components shall be watertight.

1606A.0 Procedure for Estimating Graywater Discharge.

(A) Single Family Dwellings and Multi-Family Dwellings. The graywater discharge for single family and multi-family dwellings shall be calculated by *estimates of graywater use based on* water use records, calculations of local daily per person interior water use, or the following procedure:

1. The number of occupants of each dwelling unit shall be calculated as follows:

First Bedroom	2 occupants
Each additional bedroom	1 occupant

2. The estimated graywater flows of each occupant shall be calculated as follows:

Showers, bathtubs and wash basins	25 GPD (95 LPD)/occupant
Laundry	15 GPD (57 LPD)/occupant

3. The total number of occupants shall be multiplied by the applicable estimated graywater discharge as provided above and the type of fixtures connected to the graywater system.

(B) Daily Discharge – Graywater systems *using tanks* shall be designed to *minimize the amount of time graywater is held in the tank and shall be sized to* distribute the total amount of estimated graywater on a daily basis.

Exception: *Treated graywater systems when approved by the Enforcing Agency.*

1607A.0 Required Area of Irrigation or Disposal Fields. *Irrigation or disposal fields may have one or more valved zones. Each zone must be of adequate size to receive the graywater anticipated in that zone. No irrigation or disposal field shall extend within three (3) vertical feet (915 mm) of the highest known seasonal groundwater, or to a depth where graywater contaminates the groundwater, ocean water or surface water. The applicant shall supply evidence of groundwater depth to the satisfaction of the Enforcing Agency.*

Note: *The absence of groundwater in a test hole three (3) vertical feet (915 mm) below the deepest irrigation or disposal point shall be sufficient to satisfy this section unless seasonal high groundwater levels have been documented to rise to within this area.*

1608*A*.0 Determination of Maximum Absorption Capacity.

(A) Wherever practicable, *irrigation or disposal* field size shall be computed from Table 16*A*-2.

(B) In order to determine the absorption quantities of questionable soils other than those listed in Table 16*A*-2, the proposed site may be subjected to percolation tests acceptable to the *Enforcing Agency*.

Exception: *Irrigation fields in compliance with Section 1611A.2, which only utilize drip type emitters.*

(C) When a percolation test is required, no graywater system shall be permitted if the test shows the absorption capacity of the soil is *unable to accommodate the intended discharge of the proposed graywater system.*
Exception: *The Enforcing Agency may waive the requirement for percolation tests based on knowledge of local conditions or accept other testing methods.*

1609*A*.0 Tank Construction.

(A) *When system design includes a tank, specifications for the tank shall be* submitted to the *Enforcing Agency* for approval. Such plans shall show all dimensions and other pertinent data.

(B) *Tanks* shall be constructed of solid, durable materials not subject to excessive corrosion or decay and shall be water-tight.

(C) Each tank shall be vented as required by Chapter 9 of this code, shall *be sealed against vermin and mosquitoes, and have an* access opening to allow for inspection and cleaning.

(D) Each tank shall have its rated capacity permanently marked on the unit. In addition, a sign stating "GRAYWATER IRRIGATION SYSTEM, *CAUTION* — UNSAFE WATER" shall be permanently marked on the holding tank.

(E) Each tank shall have an *overflow drain*. The overflow drain shall have a permanent connection to the building drain or building sewer, upstream of septic tanks, if any. The overflow drain shall not be equipped with a shutoff valve.

(F) The overflow *drain* shall not be less in size than the inlet pipe. The vent size shall be determined based on the total graywater fixture units as outlined in Table 7-5 of this code. Unions or equally effective fittings shall be provided for all piping connected to the holding tank.

(G) Each tank shall be structurally designed to withstand all anticipated earth or other loads. *Tank* covers shall be capable of supporting an earth load of not less than three hundred (300) pounds per square foot (1,464.7 kg/m^2) when the tank is *used* for underground installation.

(H) *The overflow* system must be designed so that the tank overflow will gravity drain to the existing sewer line or septic tank. The tank shall be protected against sewer line backflow by a backwater valve.

(I) An overflow drain and backwater valve is not required on a clothes washer system.

1610*A*.0 Graywater Systems.

Graywater systems shall comply with Sections 1610*A*.1 through *1610A.3.*

1610*A*.1 Pipe Materials. Graywater pipe, valves and fittings shall conform to the requirements of Sections 604.0, 605.0 and 606.0.

1610*A*.2 Identification. *Graywater distribution piping upstream of any connection to an irrigation or disposal field or a distribution valve shall be identified with the words "CAUTION: NONPOTABLE WATER, DO NOT DRINK." Marking shall be at intervals not to exceed five (5) feet (1,524 mm).*

1610*A*.3 Valves. All valves shall be accessible. A backwater valve installed pursuant to this code shall be provided on all tank drain connections to the sanitary drain or sewer piping.

1611*A*.0 Irrigation, Disposal Field *and Mulch Basin* Construction.
Irrigation fields, disposal fields and mulch basins used in graywater systems shall comply with this section. Graywater systems may contain either a irrigation field or a disposal field or a combination of both. This section is not intended to prevent the use of other methods of graywater irrigation or disposal approved by the Enforcing Agency.

1611A.1 Mulch Basin *A mulch basin may be used as an irrigation or disposal field. Mulch basins shall be sized in accordance with Table 16A-2 and of sufficient depth, length and width to prevent ponding or runoff during the graywater surge of a clothes washer, bathtub or shower. Mulch must be replenished as required due to decomposition of organic matter. Mulch basins will require periodic maintenance, reshaping or removal of dirt to maintain surge capacity and to accommodate plant growth and prevent ponding or runoff,*

1611A.2 Irrigation Field. *The provisions of this section are not intended to prevent the use of any appropriate material, appliance, installation, device, design or method of construction. If an alternate design is not available, the following provisions may be used as guidance in the design of a graywater irrigation field:*

(1)Filters used in graywater irrigation systems shall be as specified by the manufacturer's installation instructions for the design flow rate and intended use. The filter backwash and flush discharge shall be contained and disposed of into the building sewer system, septic tank or, with approval of the Enforcing Agency, a separate mini-leachfield sized to accept all the backwash and flush discharge water. Filter backwash water and flush water shall not be used for any purpose. Sanitary procedures shall be followed when handling filter backwash and flush discharge or graywater.

(2) Emitters shall be designed to resist root intrusion and shall be of a design recommended by the manufacturer for the intended graywater flow and use. For emitter ratings, refer to Irrigation Equipment Performance Report, Drip Emitters and Micro-Sprinklers, Center for Irrigation Technology, California State University, 5730 N. Chestnut Avenue, Fresno, California 93740-0018.

(3) Each irrigation zone shall be designed to include no less than the number of emitters specified in Table 16A-3, or through a procedure designated by the Enforcing Agency. Minimum spacing between emitters is in any direction shall be sufficient to prevent surfacing or runoff.

(4) The system design shall provide user controls, such as valves, switches, timers and other controllers, as appropriate, to rotate the distribution of graywater between irrigation zones.

(5) All drip irrigation supply lines shall be polyethylene tubing or PVC Class 200 pipe or better and Schedule 40 fittings. All joints shall be properly solvent-cemented, inspected and pressure tested at 40 psi (276 kPa), and shown to be drip tight for five minutes, before burial. All supply piping shall be covered to a minimum depth of two (2) inches (51 mm) of mulch or soil. Drip feeder lines can be poly or flexible PVC tubing and shall be covered to a minimum depth of two (2) inches (51 mm) of mulch or soil.

(6) Where pressure at the discharge side of the pump exceeds 20 psi (138 kPa), a pressure-reducing valve able to maintain downstream pressure no greater than 20 psi (138 kPa) shall be installed downstream from the pump and before any emission device.

(7) Each irrigation zone shall include a flush valve/antisiphon valve to prevent back siphonage of water and soil.

1611A.3 Disposal Field. *The provisions of this section are not intended to prevent the use of any appropriate material, appliance, installation, device, design or method of construction. If an alternate design is not available the following provisions may be used as guidance in the design of a graywater disposal field:*

(A) *Disposal systems* shall be not less than three (3) inches (80 mm) in *cross sectional dimension* and shall be constructed of perforated high-density polyethylene pipe, perforated ABS pipe, perforated PVC pipe, *leaching chambers* or other approved materials, provided that sufficient openings are available for distribution of the graywater into the trench area. Material, construction, and perforation shall be in compliance with the appropriate absorption fields drainage standards and shall be approved by the *Enforcing Agency*.

(B) Filter material, clean stone, gravel, slag, or similar filter material acceptable to the *Enforcing Agency*, varying in size from three-quarter (3/4) inch (19.1 mm) to two and one-half (2-1/2) inches (64 mm) shall be placed in the trench to the depth and grade required by this section. The perforated section shall be laid on the filter material in an approved manner. The perforated section shall then be covered with filter material to the minimum depth required by this section. The filter material shall then be covered with untreated building paper, straw, or similar porous material to prevent closure of voids with earth backfill. No earth backfill shall be placed over the filter material cover until after inspection and acceptance.

Exception. *Manufactured leaching chambers shall be installed in compliance with the manufacturer's installation instructions.*

(C) *Disposal* fields shall be constructed as follows:

(See chart below)

	Minimum	Maximum
Number of drain lines per valved zone[1]	1	—
Length of each perforated line[1]	—	100 ft. (30,840 mm)
Bottom width of trench[1]	12 in. (305 mm)	*24 in. (610 mm)*
Spacing of lines, center to center[1]	4 ft. (1219 mm)	—
Depth of earth cover of lines	*2 in. (51 mm)*	—
Depth of filter material cover of lines	2 in. (51 mm)	—
Depth of filter material beneath lines[1]	3 in. (76 mm)	—
Grade of perforated lines	level	3 in./100 ft. (2 mm/m)

[1] *Manufactured leaching chambers shall be installed in compliance with the manufacturer's installation instructions.*

(D) When necessary on sloping ground to prevent excessive line slopes, disposal lines shall be stepped *or installed on the contour lines of the slope.* The lines between each horizontal leaching section shall be made with approved water-tight joints and installed on natural or unfilled ground.

1612*A*.0 Special Provisions

(A) Other collection and distribution systems shall be permitted by the local *Enforcing Agency*, as allowed by Section *108.7* of this code.

(B) Nothing contained in this chapter shall be construed to prevent *a city, county, or city and county or other local government from, after a public hearing and enactment of an ordinance or resolution, further restricting or prohibiting the use of graywater systems. For additional information, see Health and Safety Code Section 18941.7.*

(C) Graywater stub-out plumbing may be allowed for future connection prior to the installation of irrigation lines and landscaping. Stub-out shall be permanently marked "GRAYWATER STUB-OUT, CAUTION --- UNSAFE WATER".

Table 16A -1 Location of Graywater System

Minimum Horizontal Distance Required From:	Tank	Irrigation Field	Disposal Field
	Feet/mm	Feet/mm	Feet/mm
Building structures[1]	5 (1,524 mm)[2]	2 (610 mm)	5 (1,524 mm)
Property line adjoining private property	5 (1,524 mm)	1.5 feet (458 mm)	5 (1,524 mm)
Water supply wells[3]	50 (15,240 mm)	100 (30,480 mm)	100 (30,480 mm)
Streams and lakes[3]	50 (15,240 mm)	100 (30,480 mm)[4,5]	100 (30,480 mm)[4]
Sewage pits or cesspools	5 (1,524 mm)	5 (1,524 mm)	5 (1,524 mm)
Sewage disposal field	5 (1,524 mm)	4 (1,219 mm)[6]	4 (1,219 mm)[6]
Septic tank	0 (0)	5 (1,524 mm)	5 (1,524 mm)
Onsite domestic water service line	5 (1,524 mm)	0 (0 mm)	0 (0 mm)
Pressurized public water main	10 (3,048 mm)	10 (3,048 mm)[7]	10 (3,048 mm)[7]

[1] Building structures does not include porches and steps, whether covered or uncovered, breezeways, roofed porte cocheres, roofed patios, carports, covered walks, covered driveways, and similar structures or appurtenances.
[2] Underground tanks shall not be located within a 45 degree angle from the bottom of the foundation, or they shall be designed to address the surcharge imposed by the structure. The distance may be reduced to six (6) inches (153 mm) for aboveground tanks when first approved by the Enforcing Agency.
[3] Where special hazards are involved, the distance required shall be increased as directed by the Enforcing Agency.
[4] These minimum clear horizontal distances shall also apply between the irrigation or disposal field and the ocean mean higher hightide line.
[5] The minimum horizontal distance may be reduced to 50 feet (15,240 mm) for irrigation fields utilizing graywater which has been filtered prior to entering the distribution piping.
[6] Plus two (2) feet (610 mm) for each additional foot of depth in excess of one (1) foot (305 mm) below the bottom of the drain line.
[7] For parallel construction or crossings, approval by the Enforcing Agency shall be required.

Table 16A-2 Design Criteria of Six Typical Soils

Type of Soil	Square Feet	Gallons	Square Meters	Liters
	Minimum square feet of irrigation/leaching area per 100 gallons of estimated graywater discharge per day	Maximum absorption capacity in gallons per square foot of irrigation/leaching area for a 24-hour period	Minimum square meters of irrigation/leaching area per liter of estimated graywater discharge per day	Maximum absorption capacity in liters per square meter of irrigation/leaching area for a 24-hour period
Coarse sand or gravel	20	5.0	0.005	203.7
Fine sand	25	4.0	0.006	162.9
Sandy loam	40	2.5	0.010	101.8
Sandy clay	60	1.7	0.015	69.2
Clay with considerable sand or gravel	90	1.1	0.022	44.8
Clay with small amounts of sand or gravel	120	0.8	0.030	32.6

Table 16A-3 Subsurface Drip Design Criteria of Six Typical Soils

Type of Soil	*Maximum emitter discharge (gal/day)*	*Minimum number of emitters per gpd of graywater production*
1.Sand	*1.8*	*0.6*
2.Sandy loam	*1.4*	*0.7*
3.Loam	*1.2*	*0.9*
4.Clay loam	*0.9*	*1.1*
5.Silty clay	*0.6*	*1.6*
6.Clay	*0.5*	*2.0*

Use the daily graywater flow calculated in Section 1606A.0 to determine the number of emitters per line.

1612A.1 Indoor Use of Treated Graywater.
Graywater shall not be allowed for indoor use, such as flushing toilets and urinals, unless treated by an on-site water treatment system approved by the Enforcing Agency. For the purposes of this section, graywater treated by an on-site water treatment system shall be considered "Treated Graywater". Treated graywater and treated graywater systems shall comply with the provisions of this code except as otherwise provided in this chapter and all of the following:

(1) The treated graywater shall have a separate tank sized to minimize the length of time it is retained.

(2) A maintenance and operation manual for the treatment system shall be kept at the location of the system.

(3) Treated graywater intended for use indoors shall meet the California Department of Public Health statewide uniform criteria for disinfected tertiary recycled water as provided in California Code of Regulations, Title 22 Section 60301.230.

(4) The treated graywater system shall be installed, inspected and tested as specified for reclaimed water systems in Sections 1618.0 and 1620.0.

NOTE:

Authority Cited: Health and Safety Code Sections 17040, 17921, 17922 and 19990.

Reference: Health and Safety Code Sections 17922.12 and 18941.7.