Innovation Incubator Spring 2020

Greater Los Angeles Greywater Program

Perkins&Will

In Los Angeles County, “greywater” is defined as.....

Untreated waste water which has not come into contact with toilet waste. **Includes waste water from bathtubs, showers, bathroom wash basins, clothes washing machine, laundry tubs,** or an equivalent discharge as defined by the Department of Public Health. [2]

It **does not include wastewater from kitchen sinks, photo lab sinks, dishwashers, or laundry water from soiled diapers.** [2]

Rainwater harvested from roofs is an **alternate water source** that may be combined with graywater.

2. http://www.publichealth.lacounty.gov/eh/EP/lu/lu_graywater.htm

Getting to Greywater

Greywater for use on single family residential yards in LA County is a great untapped local and sustainable water resource. If implemented more widely with the use of strategic incentives and marketing, residential greywater could yield a higher quality and quantity of shade and fruit trees for homeowners across a wide range of neighborhoods in the county. The program would reduce the share and quantity of potable water used for landscape irrigation and divert it from sewage treatment. As a piece of a greater roadmap towards a resilient water future for the region, these simple greywater systems that require no permit, implemented by individual homeowners could divert a volume of water comparable to the annual flow of the LA River. This consumer-led effort could start our county on a path to resilience today, with no red tape (well, maybe some plumbers tape).

The project is comprised of three parts. It includes an analysis of the state of greywater implementation practices in the area with an examination of permitting requirements, existing incentives and county-wide planning goals. Also included is a GIS soils/infiltration vs. zoning analysis and a survey of the composition of greywater. With a few exceptions, greywater implementation could go ahead without causing damage to the soil substrate due to the soils types found throughout LA County. Finally, marketing materials are provided that address the how, what, and why of greywater implementation in LA County, punctuating its social, economic and environmental benefits with a call to action.

Changing the Greywater Cycle

1 Sierra Nevada's snowpack, watershed of 5 states

2 DWP controls majority of the aqueducts to Los Angeles

3 Only laundry (and shower and bathroom sink water) is "greywater"

4 All other household uses of water

5 To sewage treatment, then Pacific Ocean

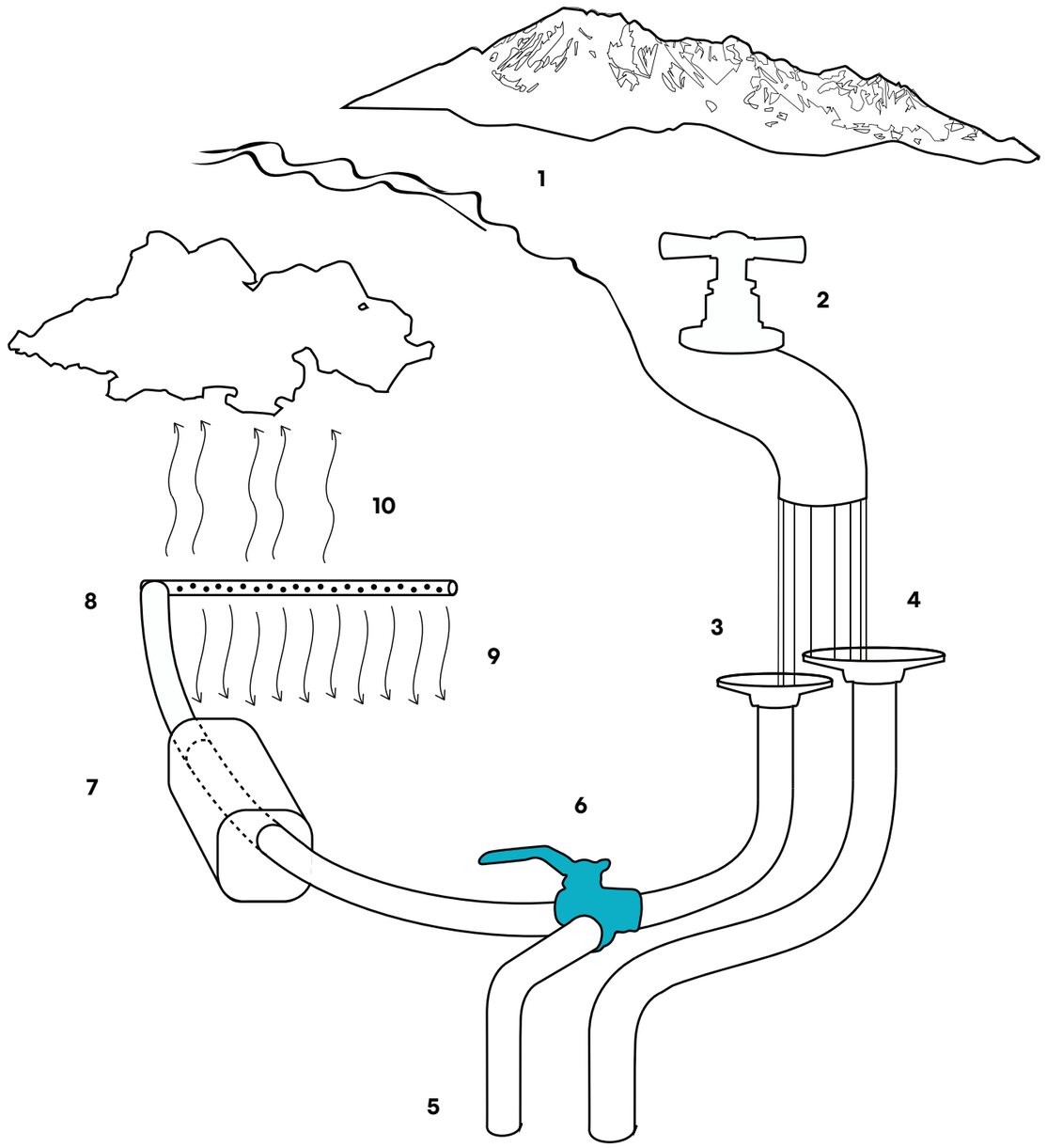
6 Manual diverter valve can direct laundry-to-landscape when no bleach or several other chemicals are used.

7 A filter may be installed but would require maintenance

8 Subsurface irrigation of trees and bushes

9 Recharge aquifer

10 Evapotranspiration



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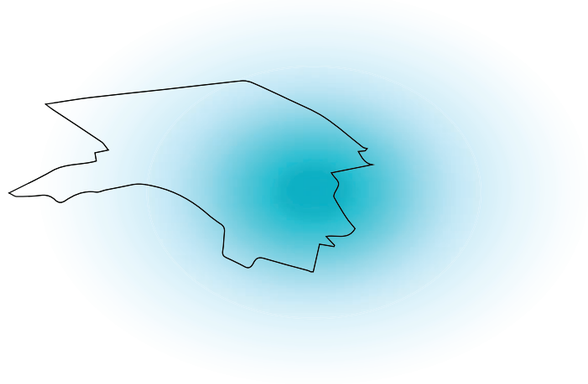
Greater Los Angeles Greywater Program
System Diagram



How do we take an environmentally-minded goal and make it realistic within the confines of the current market economy? By pushing for the greater adoption of existing simple greywater reuse strategies by the homeowners of Los Angeles. To reduce unsustainable reliance on water from out of state, to increase resilience, to water trees that would provide shade that would lead to a more walkable and liveable city.

Greater Los Angeles Greywater will market to consumers who are also the co-owners of the public utility that will charge them more in the future if they don't cut back on water usage now. Trees could die. Water will become more expensive. Looking ahead, the city, its residents and the utility companies must prepare the groundwork for a resilient water future.

Greywater Vision

Greywater Business Model Canvas

KEY PARTNERS

Outsource activities to:
Greywater plumbing installers,
Greywater filter maintenance companies,
Greywater landscape installers,
Designers

Marketing outsourced to:
Greywater educators,
Greywater companies.

Acquired parts:
System component hardware vendors,
Filter vendors

Rebates could be offered by
DWP, LA Sanitation,
Los Angeles City Planning Department,
LA County Planning

KEY ACTIVITIES

Problem-solving and production:
Assessing options, choosing system
Hooking up greywater system
Choosing which landscape area to irrigate on your property.
Choosing high/low-maintenance systems.
Filling out rebate applications.

KEY RESOURCES

Assets required to offer and deliver the elements:
Physical - ownership or management of home(s) with laundry and yard.
Intellectual - find and apply kit of parts to individual cases.
Human - greywater installers
Financial - $200 to $20,000 per system in materials, labor and permit fees.

VALUE PROPOSITION

What value do we deliver to the customer? Which of the customer's problems are we helping to solve? Which needs are we satisfying? What bundles of products and services are we offering to each customer segment?

Making an investment in the water infrastructure future of our city, one house at a time.
Cost reduction: smaller water bill.
Performance: use your water twice.
Customization: Greywater system to fit your scale, yard and habits. Accessible, distributed, new water source comparable to the LA River in volume.

"Save your water from going into the sewer while irrigating your shade trees and recharging aquifer"

CUSTOMER RELATIONSHIPS

Relationships established and maintained with each customer segment.
I. Self- service
II. Co-creation
III. Dedicated personal assistance

CHANNELS

Communication
Distribution
Sales
1. Awareness (marketing for city)
2. Evaluation (DWP cost brochure)
3. Purchase (web sale of parts)
4. Delivery (intaller partners)
5. After Sales (filter maintenance) (monitor the pH meter)

CUSTOMER SEGMENTS

A. Single-family owner-occupied residences that are not condos. (I, II, less III)

B. Duplex owners and House + ADU owners that live on the premises and can check on the system regularly. (I, II, less III)

C. Property managers of 2-unit or more residential properties. Especially properties where less than a certain number of gallons of laundry effluent produced, these properties might already be undergoing renovations. (II, III)

D. Developers, builders, real-estate professionals and owners of planned future residences. (II, III)

COST STRUCTURE

Cost-driven or value driven?
Cost driven issues: cost of tap water, cost of greywater system
Value driven issues: quality of life improvements, getting around the cap on water usage, freedom, stewardship of resources, civic pride.
Fixed costs - laundry will be required by residents, no matter what. Greywater simple hardware will have a fixed cost. Variable costs - installation/labor, filtration systems, permitting.
Economies of scale - permit for larger projects only.
Economies of scope - those wishing to save a lot of water with minimum investment would only do direct laundry to landscape.

REVENUE STREAMS

Revenue streams result from value propositions successfully offered to customers.
Water: currently, usage fee. Will be higher in the future. This is ofsetting future costs.
Greywater system: asset sale if direct laundry to landscape.
Greywater filter, if using: could have a monthly maintenance subscription fee.
Permitting is like a brokerage fee. This should be minimized within reason to prevent it being a barrier to adoption of greywater systems as long as they are safe. Advertising fees should be absorbed by the city and utility as it benefits both and they have the resources. Will water and sewage have fixed or dynamic pricing in the future Los Angeles?
What if revenue were measured in future gallons of water diverted from LA Sanitation or the number of trees ensured permanent watering?

Greywater Decision-Making Tree

which best describes your position?

homeowner

landlord /property manager

renter ⟹ consider talking to others in your building and to your landlord. Assess your options based on the property's criteria. Installation is ultimately the landlord's choice.

do you control the detergents used in the laundry on the premises? Would you be able to obtain agreement from the people doing laundry in your household to always flip a switch when their laundry loads contain bleach?

yes

no *

what volume of laundry water is being generated daily?

< X

> X ⟹ consider a larger-scale laundry-to-landscape system. Perhaps incorporating shower and bathroom sink water into the system. You will need a permit, so will need a plan, a filter, and a pump. It would be best to consult a design professional who will work with a greywater specialist to assess and propose the right-size system for you.

do you have some yard space that is not paved? landscape area that is not a lawn nor being used to grow root vegetables? Is there a tree in your yard?

yes

no ⟹ consider converting part of the hardscape on your property to a planter or converting a part of your lawn to planting bed.

is this area in your yard lower than your laundry room? The total recommended height difference between the top of your laundry machine and the perforated irrigation pipe buried 2"-30" below surface is 5 feet.

yes

no ⟹ consider adding a pump to your system. unfortunately, this triggers the need for a permit. consider an alternate greywater reuse method.

we recommend a direct laundry-to-landscape system with no filter. simply control the types of detergent you use and divert the flow whenever using a harsh one not compatible for the system.

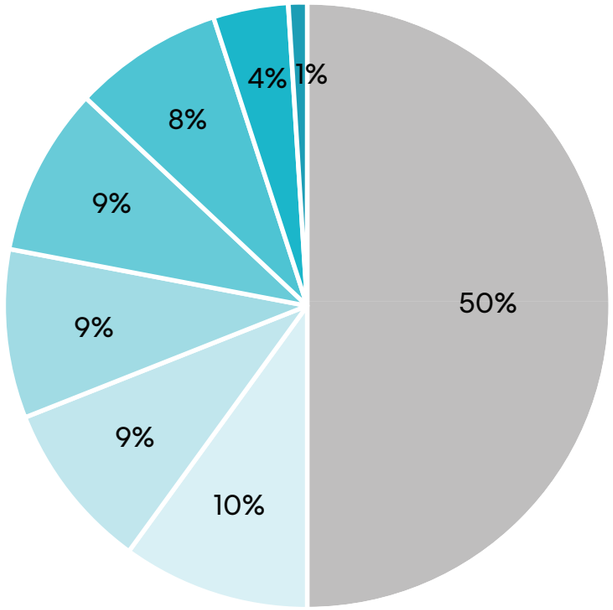
* we recommend a laundry-to-landscape system with the diverter switched to the "sewage" position until the content of the effluent is controlled. Alternatively, consider a filtered system that requires a permit.

X = 250 gallons$_{20}$, calculated with an estimated 15 gallons/ day for laundry per occupant

10,039,107 people live in LA County[3] in 3,328,398 households with an average household of 2.96 people.

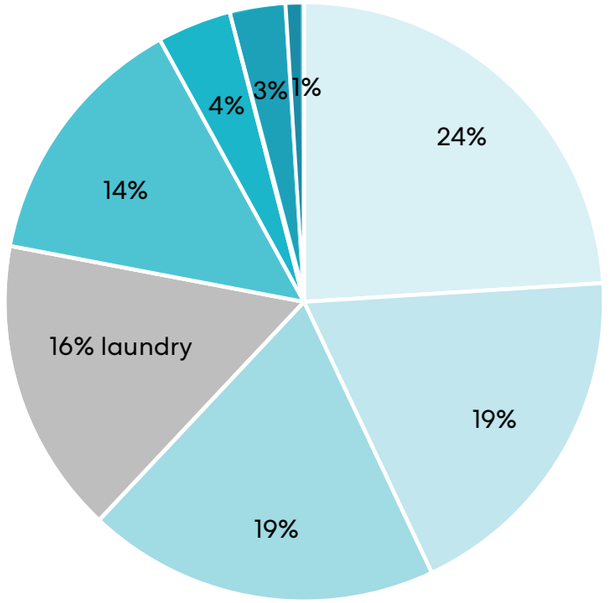
California Household Water Use[18]

- 50% outdoors
- 10% toilet
- 9% laundry
- 9% showers
- 9% faucet
- 8% leaks
- 4% baths
- 1% dishwashers



Residential Indoor Water Use[19]

24% toilet	14.2ga/day
19% shower	11.1ga/day
19% faucet	11.1 ga/day
16% laundry	9.6ga/day
14% leaks	7.9ga/day
4% other	2.5ga/day
3% bath	1.5ga/day
1% dishwasher	0.7ga/day



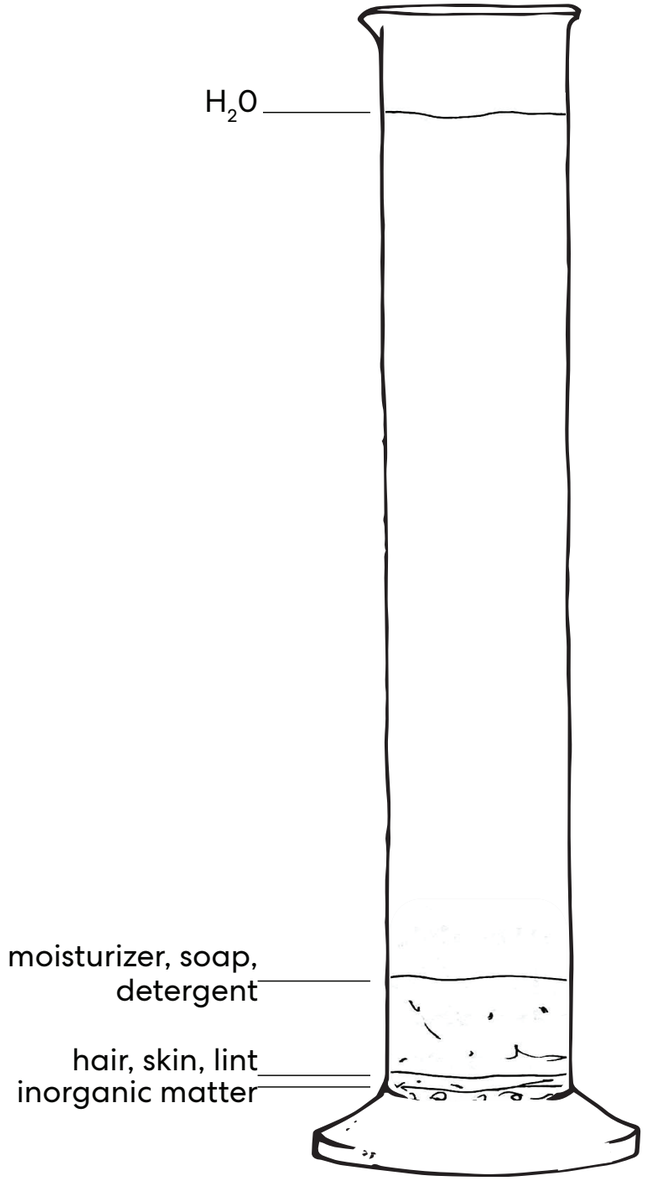
18 2015 Pacific Institute "Average California Household Water Use" https://pacinst.org/wp-content/uploads/2020/06/PI_Water_Use_Trends_June_2020.pdf
19 Residential End Uses of Water, Version 2 (REUS 2016) Executive Report https://www.circleofblue.org/wp-content/uploads/2016/04/WRF_REU2016.pdf

When controlling the composition of the direct-to-landscape greywater produced by laundry or showers, care must be taken to divert the flow if it contains salts, boron, bleach or other harsh chemicals. Soaps, shampoos, hydrogen peroxide, a variety of safe detergents listed below and vinegar may be used.

Oasis, Vaska, Puretergent, FIT Organic, ECOS, Bio Pac are all brands of laundry detergent that is safe for greywater use on landscape. Liquid detergents tend not to contain contain boron and salts whereas powdered ones often do.

To summarize: boron and salts are not acceptable ingredients to flush down the system. Bleach is to be avoided as well as water softeners and fabric softeners.

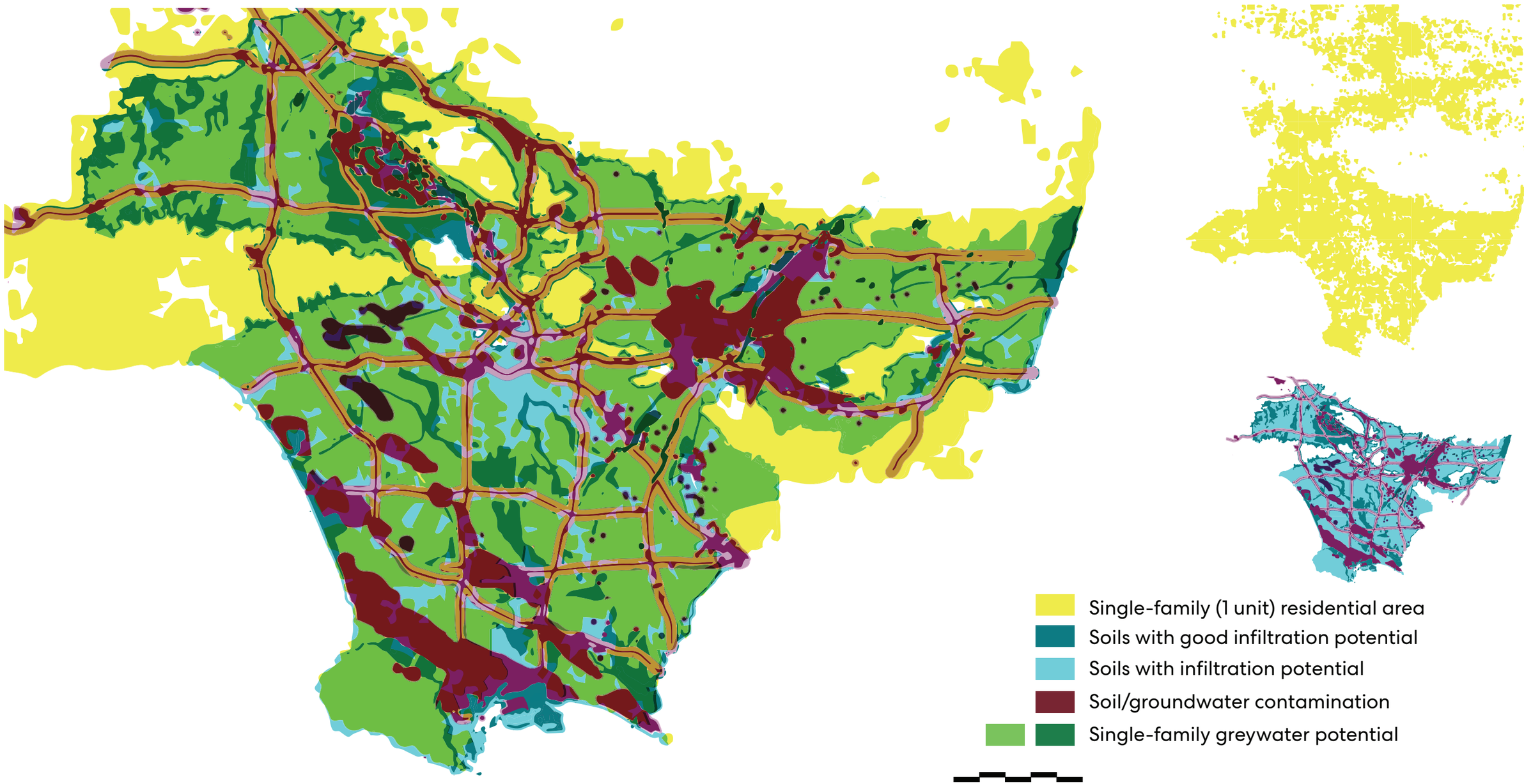
A list of recommended products should be posted for users who are new to such a system.



Physicochemical characteristics of greywater	
Parameter	USA
pH	6.4
Turbidity (NTU)	31.1
EC (µS/m)	23
TSS (mg/L)	17
TDS (mg/L)	171
BOD5 (mg/L)	86
COD (mg/L)	–
Cl (mg/L)	–
Oil and grease (mg/L)	–
Nitrate (mg/L)	–
T. Nitrate (mg/L)	13.5
T. Phosp (mg/L)	4
FC (CFU)	–
E. coli (CFU)	5.4×10^5

Table 2 from Oteng-Peprah, Michael et al. “Greywater Characteristics, Treatment Systems, Reuse Strategies and User Perception-a Review.” Water, air, and soil pollution vol. 229,8 (2018): 255. doi:10.1007/s11270-018-3909-8

Greywater Composition



Greywater Zones

Permitting and Implementation

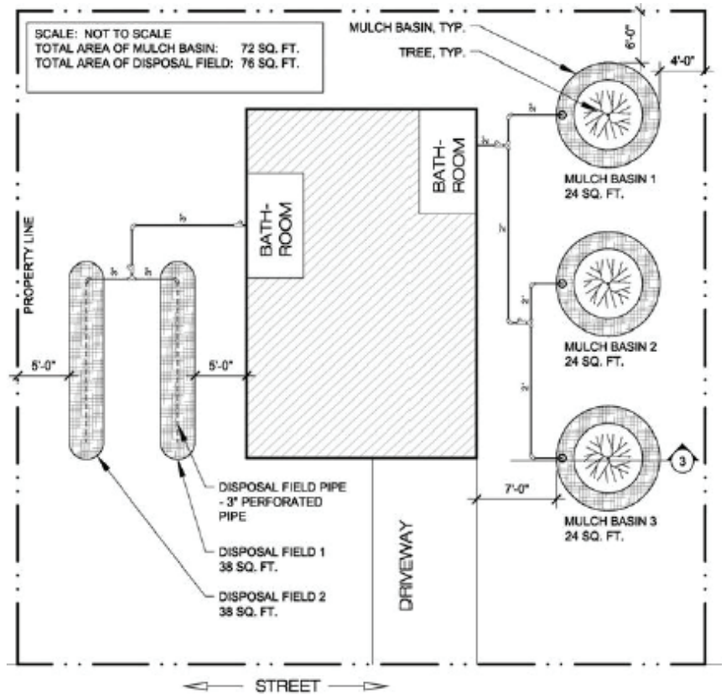


Image from LADBS IB-P-PC2014-012

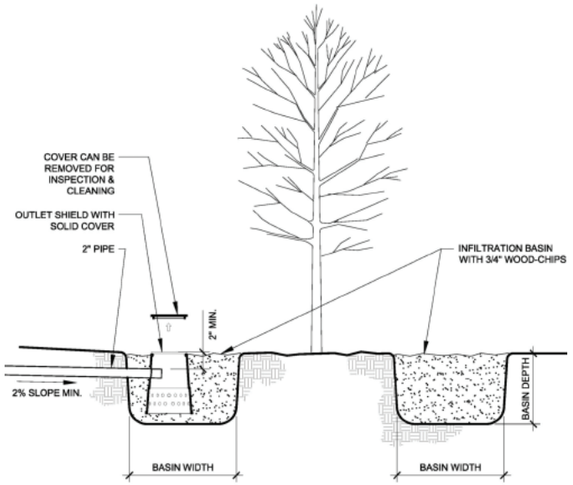


Image from LADBS IB-P-PC2014-012

There are two simple systems. One requires a permit while the other is required to meet 13 conditions, and have a site plan and a manual, but needs no permit.

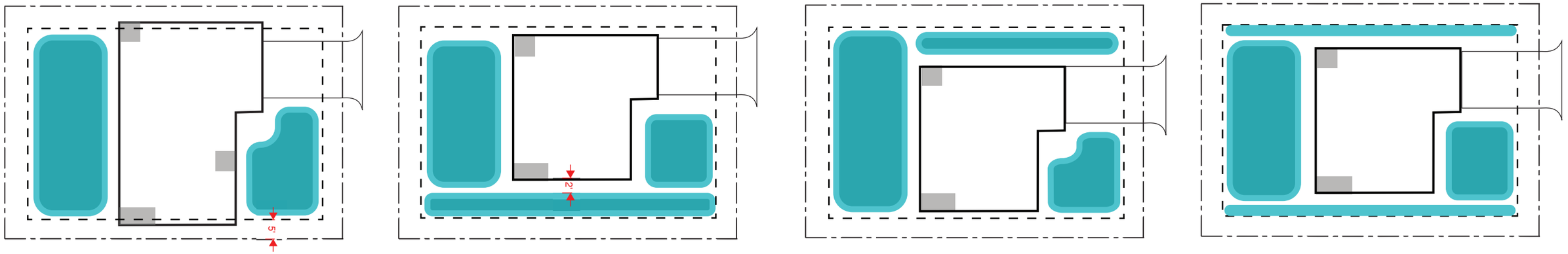
Setbacks - 5' from property line and 2' from building are required to be maintained for both systems. The water outlet must be at least 2" below the soil surface in section and outside of the setback in plan.

→ **LADBS Greywater Setback Requirements**

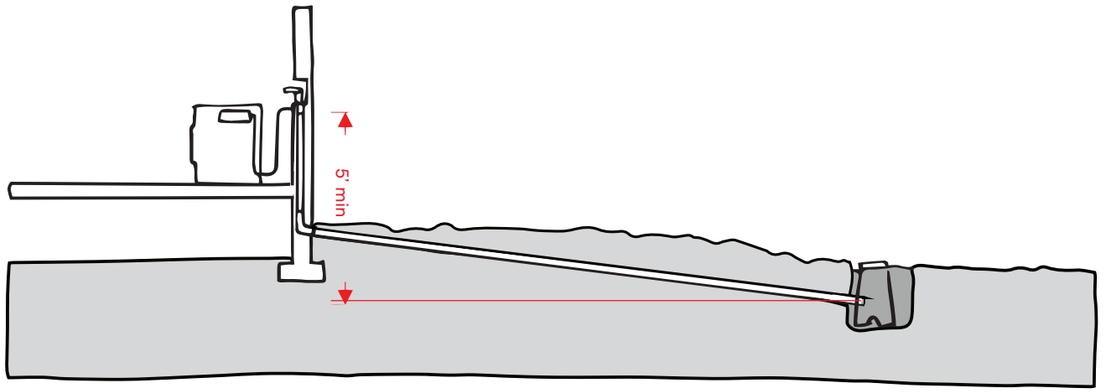
TABLE 1502.4
LOCATION OF GRAY WATER SYSTEM

MINIMUM HORIZONTAL DISTANCE IN CLEAR REQUIRED FROM	SURGE TANK (feet)	SUBSURFACE AND SUBSOIL IRRIGATION FIELD AND MULCH BASIN (feet)	DISPOSAL FIELD
Building structures[1]	5[2,3,9]	2[5,6]	5
Property line adjoining private property	5	5[5]	5
Water supply wells[4]	50	100	100
Streams and lakes[4]	50	100[5,10]	100[5]
Sewage pits or cesspools	5	5	5
Sewage disposal field[10]	5	4[5]	4[5]
Septic tank	0	5	5
On-site domestic water service line	5	0	0
Pressurized public water main[7]	10	10	10[7]

For SI units: 1 foot = 304.8 mm

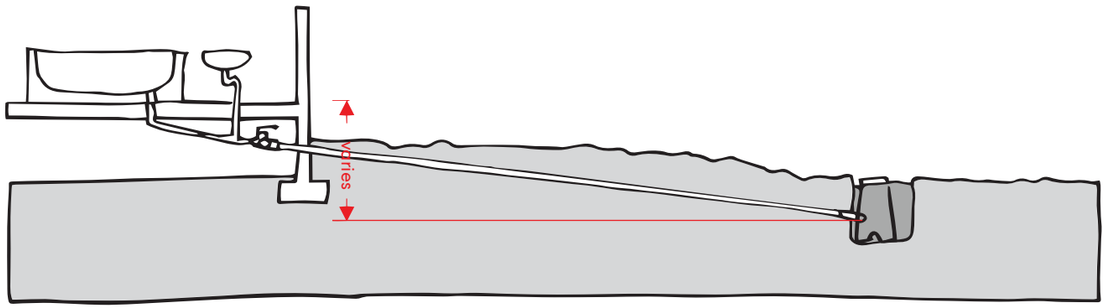


Setback requirements can limit the zones available to disperse the greywater; a rule of thumb is that the diverted laundry water can water about 5 trees. Plantsshould be grouped by similar watering needs into one of several “hydrozones”.



Simple Laundry to Landscape System

The pump integral to the laundry machine pumps the used water out. A diverter valve is installed to toggle between sewer and landscape.



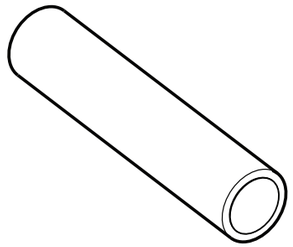
Simple Bath /Shower to Landscape System

This system requires a permit.

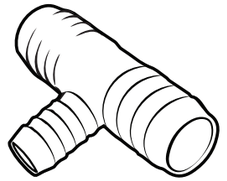
Kit of Parts

Auto-vent

1” inner HDPE tubing

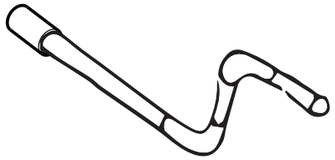


1”to 1/2” PVC tee

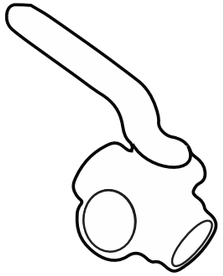


1/2” PVC outlet

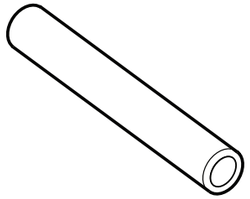
At least 2’ of horizontal 1” PVC pipe for diverter valve



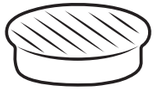
3-way diverter valve



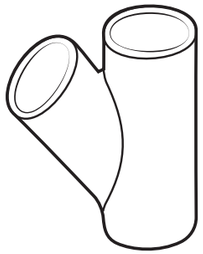
1/2” tubing



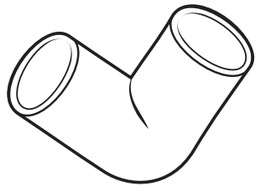
Wood chip mulch



Cleanout

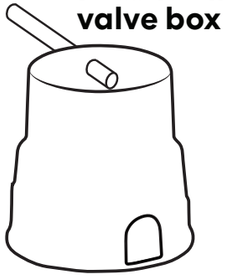


1” inner diameter PVC elbows



1/2” PVC barbed tee

7” to 10” irrigation valve box



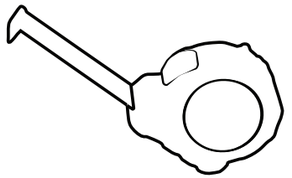
Simple Laundry to Landscape System | No Permit Required | Checklist, Manual with Site Plan Required

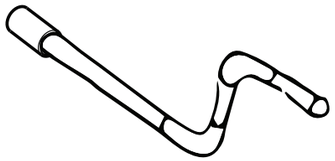
Manual

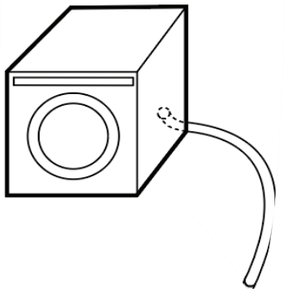
A manual should include a plumbing diagram , site plan and information on the parts used to build the greywater system. It is best practice to include construction photos of the system before it was covered.

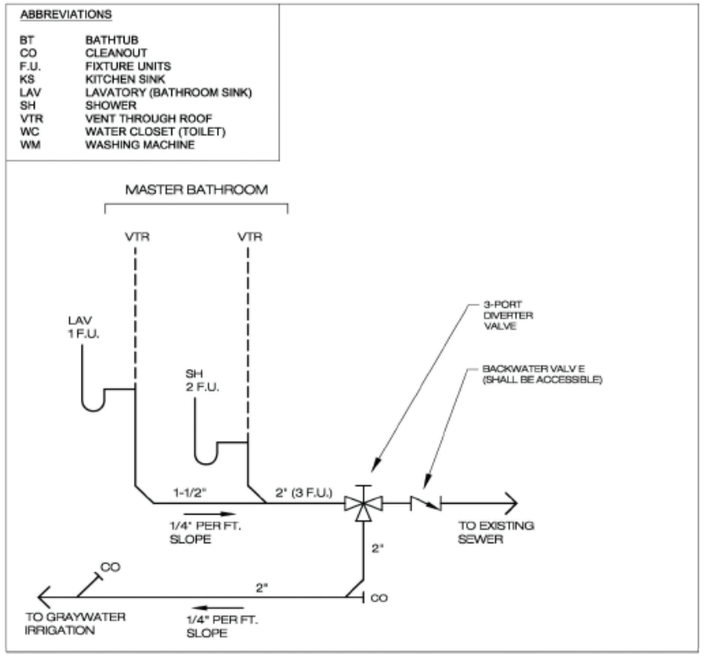
Each manual is unique.

A great guide for compiling a system and manual, with step by step instructions, is contained in a book by Laura Allen titled “Greywater Green Landscape”.









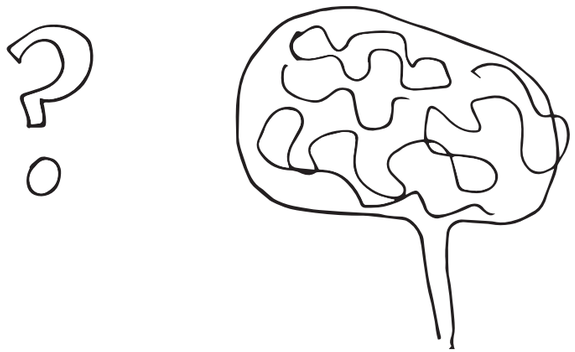
from LADBS Information bulletin → P-PC2014-012

Simple Laundry to Landscape System | No Permit Required | Checklist, Manual with Site Plan Required

"Quite a few people believe you can store greywater and thus exert a high degree of control on the irrigation end of things. We
do not structure our systems to store the water due to the high biological load in the water, so we have to convey to clients that the water is used in the landscape more or less as it's produced.

• Cost - our systems are not particularly cheap. However, we maintain that our systems are robust and worthwhile for the right
client. We try to steer people away from the notion that a greywater system can be viewed as a high-ROI item in terms of saving on their water bills. In most municipalities, water is provided so cheaply it would take a considerable amount of time for a system to pay for itself. In a new construction, or a spot with very high water cost, or on homes that rely on septic systems - this equation may work out a little differently and a greywater system may provide more or a monetary benefit. Nonetheless we really try to emphasize how much of an environmental benefit greywater offers in offsetting both consumer water demand and dow stream impacts from sending so much water into the sewer system.
• Some people have a concern about the safety of the water and the potential smell. We design our systems to be safe and
smell-free by providing adequate infiltration space for the water, and avoid irrigating food plants where the water may contact any edible portions of plants. Aside from that, it's the material in the greywater that is simultaneously the "hazard" and the perk - the nutrients and biological material act like a continuous low supply of nutrients for the plants irrigated by greywater.[4]"

-Hayley Stansell, Office Manager at Greywater Corps in an email 10/5/2020



Resistance to Greywater

Planning for Greywater

Source 70% of L.A.'s water locally and capture 150,000 acre ft/yr of stormwater by 2035
Recycle 100% of all wastewater for beneficial reuse by 2035
Build at least 10 new multi-benefit stormwater capture projects by 2025; 100 by 2035; and 200 by 2050
Reduce potable water use per capita by 22.5% by 2025; and 25% by 2035; maintain or reduce 2035 use through 2050[24]
-L.A.'s Green New Deal Sustainability pLAn 2019

Los Angeles's mayor's Sustainability pLAn 2019 Local Water Targets

A 2017 report by the Alliance for Water Efficiency has the following to say about savings and payback of simple landscape greywater systems:

"This report assumes potable water irrigation savings equivalent to 75% of the average volume of greywater produced on a daily basis. The theoretical annual household potable water savings are therefore:

1. laundry-to-landscape systems = 33 Lcd (liters litres per capita per day) x 75% x number of persons/household (pph) x irrigation season (days/year)
2. branched drain systems = 40 Lcd x 75% x pph x irrigation season (days/year)
3. pumped systems = 73 Lcd x 75% x pph x irrigation season (days/year)

The annual net cost savings of a greywater system equals the annual volume of potable water savings multiplied by the marginal volumetric rate for water (or water & wastewater) minus any O&M costs for chemicals, electricity, replacement parts, etc. The simple payback period of a greywater system equals the total installed cost of the system divided by the annual net cost savings. Installed costs are estimated to range from as little as a couple hundred dollars for a do-it-yourself laundry-to-landscape system to more than $5,000 for a professionally installed pumped system. If the payback period exceeds the expected life span of the greywater system, the system will have a net cost to the customer. Landscape-based greywater systems are more likely to be cost-effective to the homeowner if:

A. Home has a high marginal volumetric water (or water/sewer) rate
B. Home has a high occupancy rate
C. Home is located in area with long irrigation season (e.g. >7 months for landscape-based greywater systems)
D. A low cost greywater system is installed
E. The greywater system has low operations and maintenance costs
F. A Do-It-Yourself greywater system is installed during home construction vs. retrofit

Greywater Financial Benefits to the Utility.

Reducing customer water demands can financially benefit a water utility, especially if the utility is operating at or near its system's peak production rate or if it is faced with a shortage of water supply. O&M costs associated with laundry-to-landscape and branched drain systems are minimal. Utilities can compare their unit cost (e.g., $ per L/day) of achieving water savings through a greywater reuse program (demand-side management) to the unit cost of expanding the system's water supply. If the unit cost of the demand-side option is lower, the program is cost-effective and provides a financial benefit to the utility." [22]

Support of local AHJ in the form of incentives to homeowners

Manual for adoption in LA County

Rebates/incentives available:

Rainwater barrel, cistern, irrigation upgrade, ADU, urban agriculture incentive, Pasadena greywater installation rebate.

Rebates that are available elsewhere that could benefit the greater adoption of greywater recycling by single family homeowners:

-3 way diverter valve rebate in San Francisco.

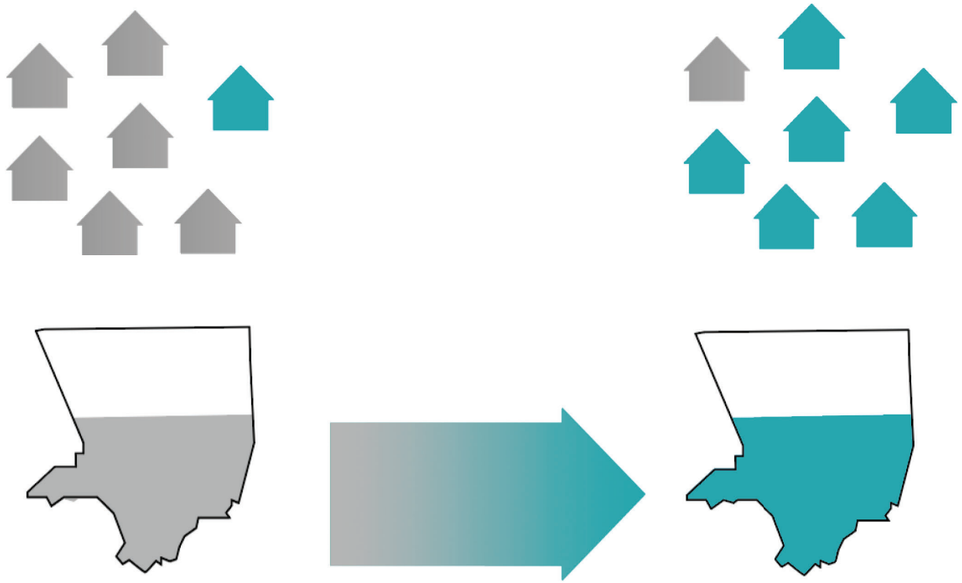
LEED (and LEED Homes) credits are available for simple greywater systems as well as complex permitted ones.

The utility companies in LA County, including DWP and LA Sanitation, are collaborating on a One Water LA Plan for 2040.

Greywater Future Benefits

Benefits of greywater-to-landscape systems beyond rebates and utility costs include:

-long term shade tree and landscpae planting resilience,
-energy and emissions savings,
-fewer chemicals used in water treatment,
-a greater awareness of the water cycle among its users.
-recharge the aquifer



A grassroots shift to simple greywater systems would be the least cost- and energy- intensive way to recycle wastewater for beneficial reuse in LA County.

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