

Water is Life!

It's that simple.

If we can become conscious consumers and passionate advocates for water...

We can start restoring our ecology: improving the livelihood of ourselves, our community, and all life in our area.





Introductions

Hello!

Name

City/town you reside in

What passions bring you to consider water more within your life?

One question you would really like to get the answer for in this class.

Gary's Grey(t)Water Systems

Greywater Systems &
Rainwater Harvesting

Simple changes for permanent benefits

Gary Michael Foresman

Founder of
[G-Force Gaia Services, LLC](#)



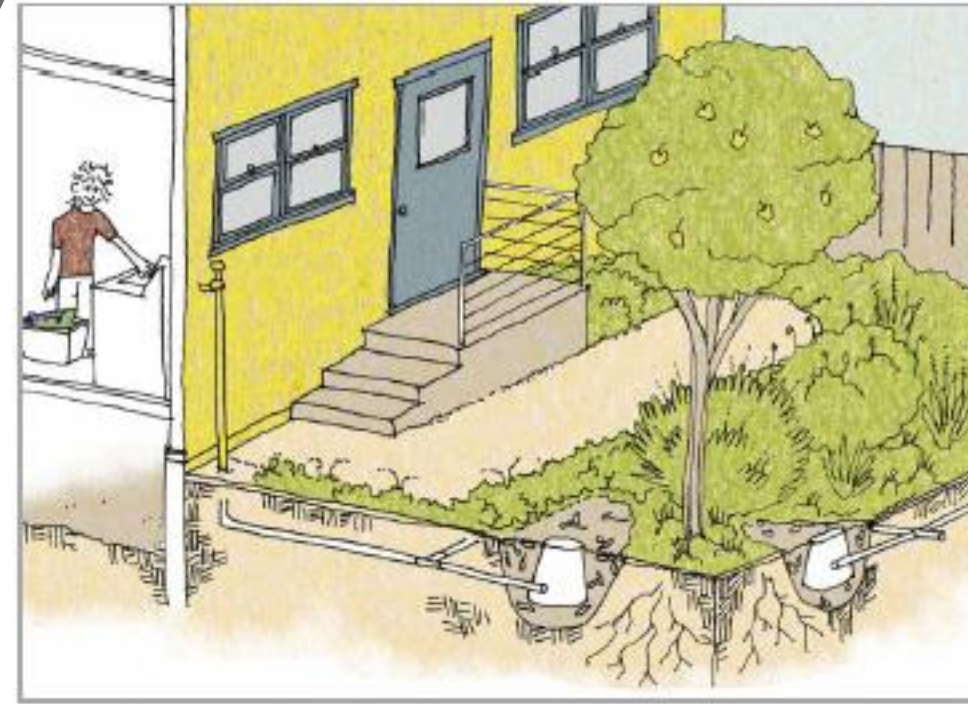
What is Greywater?

Greywater is most household water that has been used once & does not contain dangerous chemicals for reuse.

Therefore, any water from your laundry machine, bath/shower, and bathroom sink is “thrown away” greywater that is in great quality to be diverted towards your landscape.

Indoor water -> Outside landscape

**Same, everyday tasks ->
Incredible benefit to your landscape
& watershed**



What is greywater?



Clean Water

*Springs, wells,
purified water,
city water, rain water*



Greywater

*Used water without
toxic chemicals
and/or excrement*



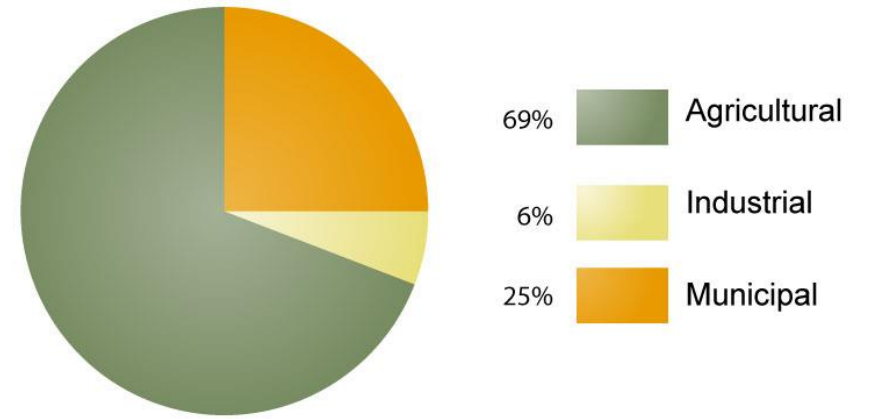
Blackwater

*Contaminated water
with toxic chemicals
and/or excrement*

Arizona Water

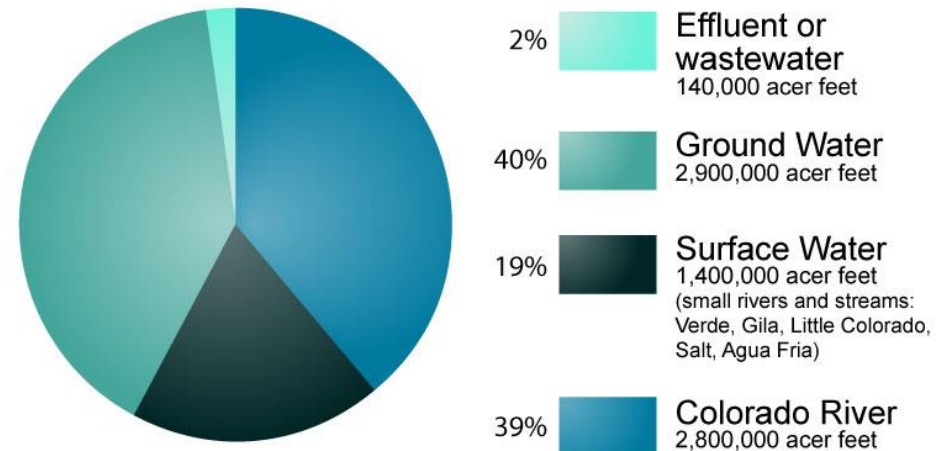
- Arizona uses an average of 2.4–2.5 trillion gallons per year
 - Average between University of Arizona and Arizona Department of Water Resources studies
- Total annual rainfall in Arizona: 8” average, 9.28 million acres 2 trillion gallons per year
- “The average American family uses more than 300 gallons of water per day at home. Roughly 70 percent of this use occurs indoors.”
 - EPA
- “Estimates vary, but each person uses about 80-100 gallons of water per day.”
 - USGS
- Well measurements in the Verde Valley have averaged a 15’ drop each year totaling 150’ in the past 10 years

How do we use water?



Values based on Arizona Department of Water Resources
<http://www.azwater.gov/AzDWR/PublicInformationOfficer/documents/supplydemand.pdf>

Arizona Water Sources



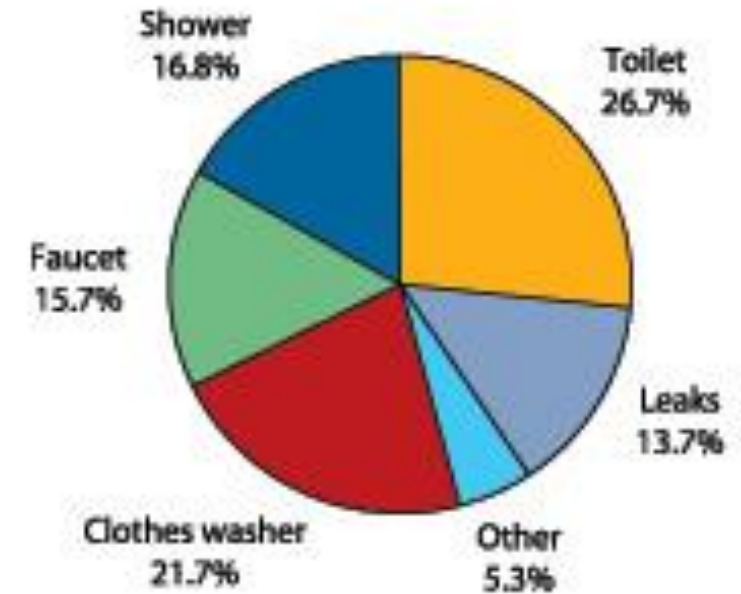
Values based on Arizona Department of Water Resources ABC's of Water
<http://www.azwater.gov/AzDWR/PublicInformationOfficer/ABCofWater.htm>

“A Drop in the Bucket”

City	Population	Citizen Daily Water Use
Clarkdale	4,000	400,000 gallons
Cottonwood	12,000	1.2 million gallons
Sedona	10,000	1 million gallons
Camp Verde	11,000	1.1 million gallons
Verde Valley	70,000 (in 2002)	7 million gallons

- Over a third of our indoor water-use is greywater
- Cottonwood alone has 100,000 gallons/day for greywater which could water over 10,000 fruit trees.

How Much Water Do We Use?



Source: American Water Works Association Research Foundation, "Residential End Uses of Water," 1999

Arizona Law: Type 1 General Permit's Best Management Practices



A Type 1 General Permit requires **no** formal notification to the department, **no** review or design approval, and **no** public notice, reporting or renewal.

You must follow the BMPs, summarized below:

- The general permit is meant for private residential use only.
- Under 400 gallons per day
- Non-spray irrigation, keep it on-site and avoid direct human contact or access to the public
- Only drip or flood irrigation with graywater is allowed.
- Do not surface irrigate any plants that produce food, except for citrus and nut trees and avoid surface accumulation.
- Avoid hazardous materials, grease, oil, & diaper/fecal matter.
- If you have a septic or other on-site wastewater disposal system, your gray water use does not change that system's design requirements for capacity and reserve areas.
- Groundwater must be at least 5' below grade
- Label pipes carrying gray water under pressure to eliminate confusion between gray water and drinking water pipes.

In general, **no** city, town or county may limit the use of gray water if the use is allowed by this general permit (ARS §49-204)

<http://www.yavapai.us/Portals/34/Reference%20Materials/GrayWaterNotice.pdf>

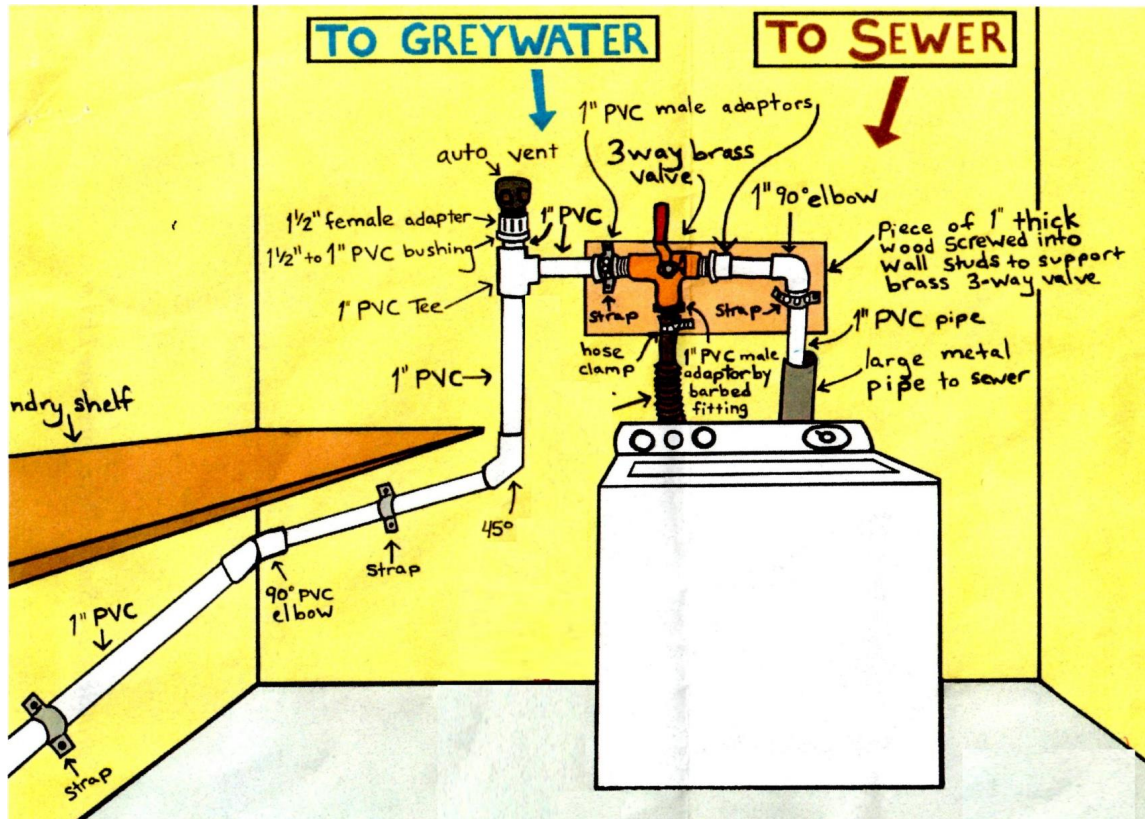


Why Laundry to Landscape?

15-50 gallons per load

- ✓ Easy Installation
- ✓ Affordable
- ✓ Already Pumped

- Plumbing is accessible
- Tools and parts for an install cost only \$150-300
- Laundry pumps can push water up to 6' up & 100' out and gravity feed even further
- Most laundry machines are close to an outside wall



Illustrations from The Urban Farmer Store

Laundry to Landscape Tools & Components

Tools for an Install

- 1-1/2" PVC Cutter
- Drill
- 1-3/8" hole drill bit & diamond hole bit
- Caulking gun
- Torpedo Level
- 1' to 4' Level
- Tape Measure
- Shovel

Good to Have:

- Wire cutters
- Stud Finder
- Pickaxe
- Wrench or Adjustable Pliers

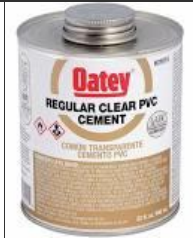
- Longer hole bits help make it through thicker walls



Components of an Install

- 3-Way Diverter
- Air Vent
- 1" PVC pipe, parts, & glue
- 1" Barbed adapters
- Check Valve (if necessary)
- Thread Tape
- Pipe Straps
- Hose Clamps
- Screws
- Caulking
- Pots
- Mulch

- **Three-Way Diverter:** Easy switch between diverting towards sewer/septic or garden
- **Air Vent:** Prevents vacuum to allow drainage
- **Barbed Adapter:** Connects to washer tubing
This is one of the most variable parts of installation.
- **Mulch & Pots:** Greywater ends in a mulch basin with an air gap around the outflow to prevent clogging



Mulch Basins

The mulch basin keeps the greywater subsurface per BMPs and also filters out salts in the water.

- Use wood chip mulch as thicker, organic material will take longer to biodegrade
- Vault Box or 5-gal pots for air gap
- Hole drill for piping
- 2" air gap before wood chip mulch inside box

Check in box annually:

- Mulch visible
 - You are good
- Mulch turned to soil*
 - Top dress around tree with soil and replace with fresh mulch

* This soil is rich in nutrients and ecology including mycorrhizal fungi





Mulch basins for existing trees





Installation



Couple months later





Perennial & Annual Veggies - Gardens love it!



Mulch Basin for a
climbing rose

~~~

Gardens love it!



# Getting Ready



# 3-Way Valve to the Sewer



Through  
the wall!



# Anti-Siphon





Dig out trench and places for basins and plants.

Mulch Basins for:

Pomegranate

Strawberry

Yarrow

Squash

Thyme

and more!

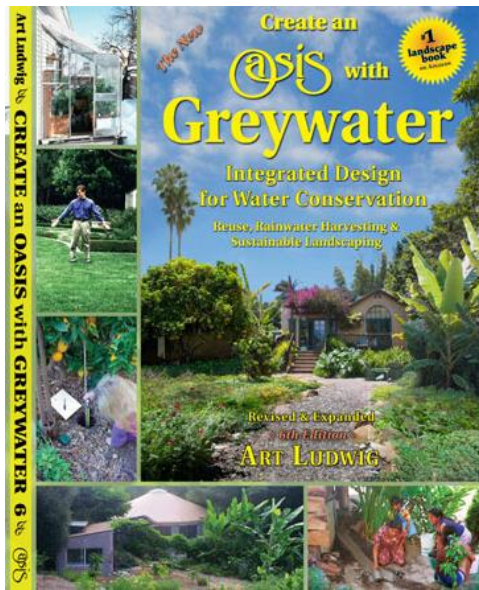
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Gardens love it!









Tips

- Use Biodegradable/Greywater Friendly Laundry Detergent with no Boron, Salt/sodium, nor Chlorine
Use the [Ecology Center reference sheet](#)
- **Rarely** use storage for greywater
- Send piping down-slope at least 2% (1/4" per foot)
- Refill mulch basins annually
- Clear PVC glue looks better
- Paint sun-exposed PVC
- Plants, plants, plants!



Detergent Options

Laundry Greywater Systems

Look for products that list their ingredients. You're more apt to find greywater-compatible products at natural foods grocery stores and ecologically-minded stores. Choose liquid soaps over powder as they tend to contain less sodium.

Best	Limit	Avoid
Oasis Laundry Liquid	Citra Suds (sodium chloride)	Tide (enzymes +?)
Bio Pac Laundry Liquid	Biokleen Laundry Liquid	All (perfume, brightening agent, colorant, +?)
ECOS liquid detergents	Planet (salt, sodium carbonate/washing soda)	Arm & Hammer (water softener, brightener, +?)
Hydrogen Peroxide bleach	Ecover Laundry Wash (some salt)	Woolite (?)
Vaska Herbatergent	Mountain Green Laundry Detergent	Ivory Snow (enzymes +?)
	LifeTree Laundry Liquid	Clorox (chlorine bleach)
	Lullwater Soap Nuts Seventh Generation (enzymes)	Borax
	Biokleen Bac Out (sodium percarbonate, enzymes)	
	Biokleen Oxygen Bleach Plus (sodium sulfate)	

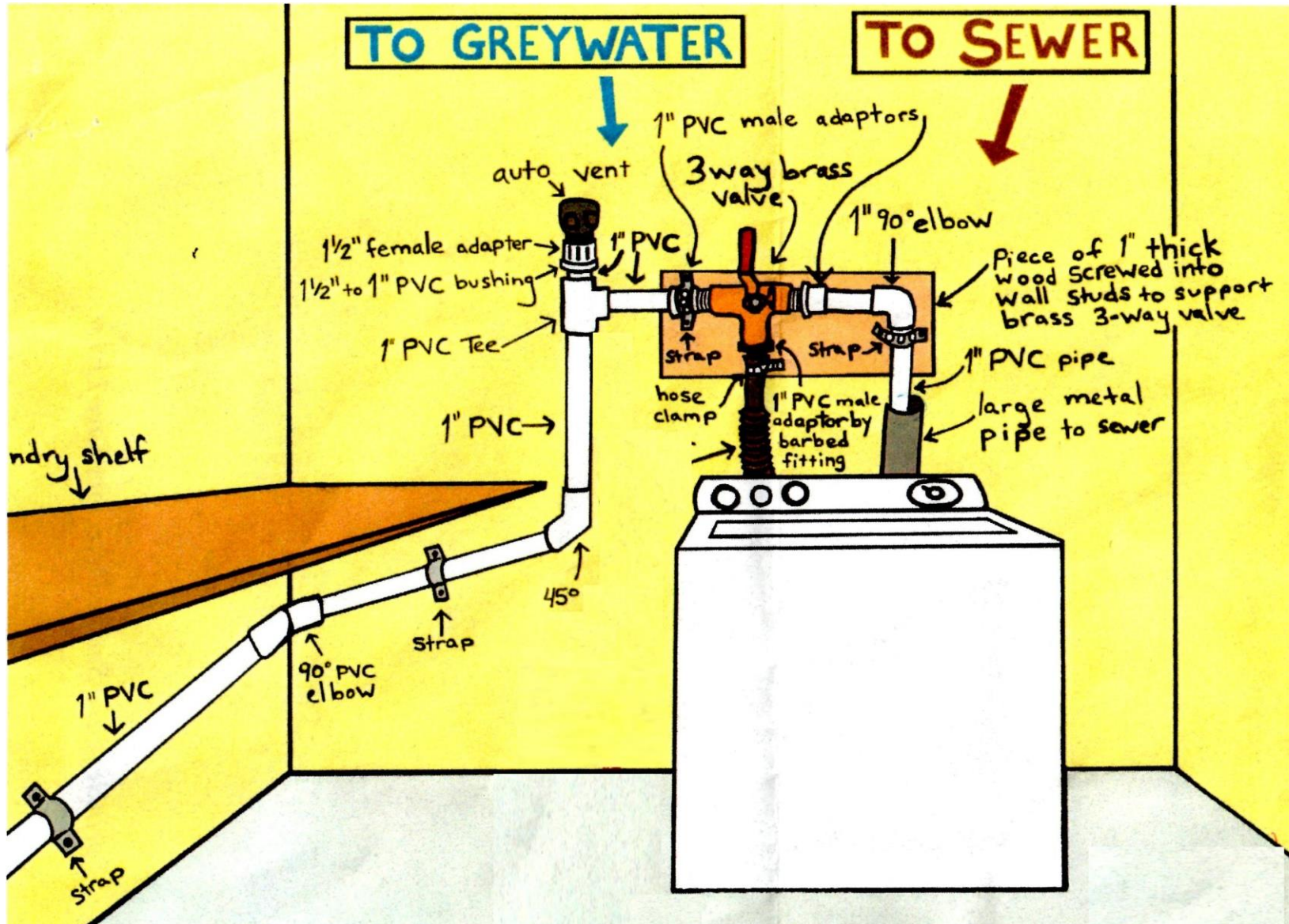
? The question marks in the table above indicate that these products do not list all of their ingredients on their labels. This is a common practice with many conventional brands. It is safe to assume that many of these products contain artificial colors and scents among their ingredients.

Home Greywater System Design Activity

Group up, each group with at least one person who has a site picture/plan of their property

Mark locations of greywater appliances, indicate elevation either with contour lines or arrows pointing in the way the water falls down your property, and where rain falls off of your roof.

Sketch a possible way for you to pipe any accessible greywater systems. Use gravity, consider existing and new plantings. What obstacles might you have to get around?



Time to Practice!

Identify the parts & tools

Use cutters on PVC
(measuring can be challenging with fittings)

Use glue
(have cloth to keep surfaces clean)

*Notice how fast it dries

Tape threaded pieces
*Learn best strategy

Put adapters on 3-way

Put pipe strap on washer tube and barbed adapter



Other Greywater Installations

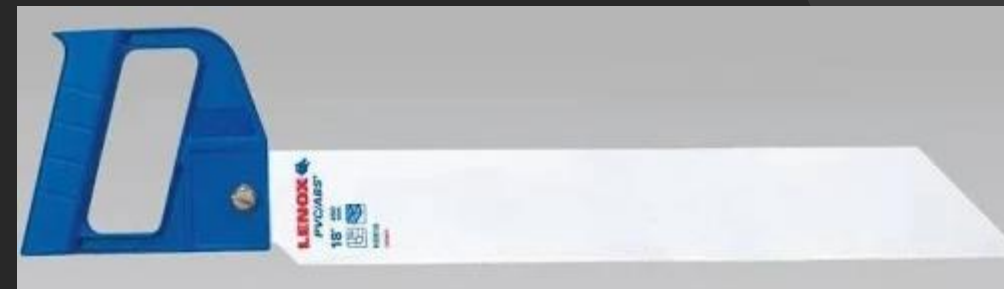
- All other greywater installations will typically work best with ABS piping:
 - Shower
 - Bath
 - Bathroom Sink
- Gravity-fed only

Additionally need:

- ABS Saw
- ABS Glue
- Larger Hole Bit(s)
- 3-Way Valve (Pentair)

May Need:

- Fernco Rubber Coupler
- Unknown



Other Greywater Installations

Considerations

- Install after the P-trap
- Clean-out

ABS:

- Sani-tees
- Sweeping Elbows
- Size: 1 1/2" – 2" typically
 - Try not to reduce sizing



Shower & Bath

- Home crawl space for access
- Piping available above outside grade

Sink

- Can do in sink cabinet, if easy to drill holes to the outside





Greywater Installation & Planting Workshop

Saturday, October 6th ~ 8:30AM-Noon
426 W. Gila St., Cottonwood, AZ 86326

Get hands-on experience on how to do a laundry to landscape greywater installation. We will be installing an ABS system along with a complete greywater planting, beautifying an otherwise bare gravel side lot and growing edible and medicinal plants that will be accessible to the founder of H.E.A.L., her family, and the neighbors of Gila St.

This is in collaboration with and celebration of the H.E.A.L. Verde Valley Community! The Health & Environmental Action Leaders are spearheading various activist and restorative changes for the betterment of the Verde Valley and are sponsoring this otherwise free workshop.

Arizona Greywater Rebate Example



CITY OF
TUCSON

- Tucson Water's Single Family Residential Gray Water Rebate Program: Receive reimbursement of up to \$1,000 when a permanent graywater irrigation system is installed in your home, given that you also attend a 2-hour workshop.
- Covers half of qualifying residential graywater system costs.
- Rebate covers design costs, materials, storage tanks, filters, pumps, backflow prevention assembly, and installation.



*G-Force Gaia
Services, LLC*

Vision Statement

To empower the Verde Valley with locally-focused, ecologically regenerative, and economically accessible renovations to our community, homes, and land.



For More Information on Greywater

G-Force Gaia Services, LLC Website:

GForceGaiaServices.com
under Our Solutions/Greywater

Articles, Videos, Book Suggestions,
Forums, Brochures , and more!

Business:

L2L DIY Consult & Delivery

L2L Complete Installation

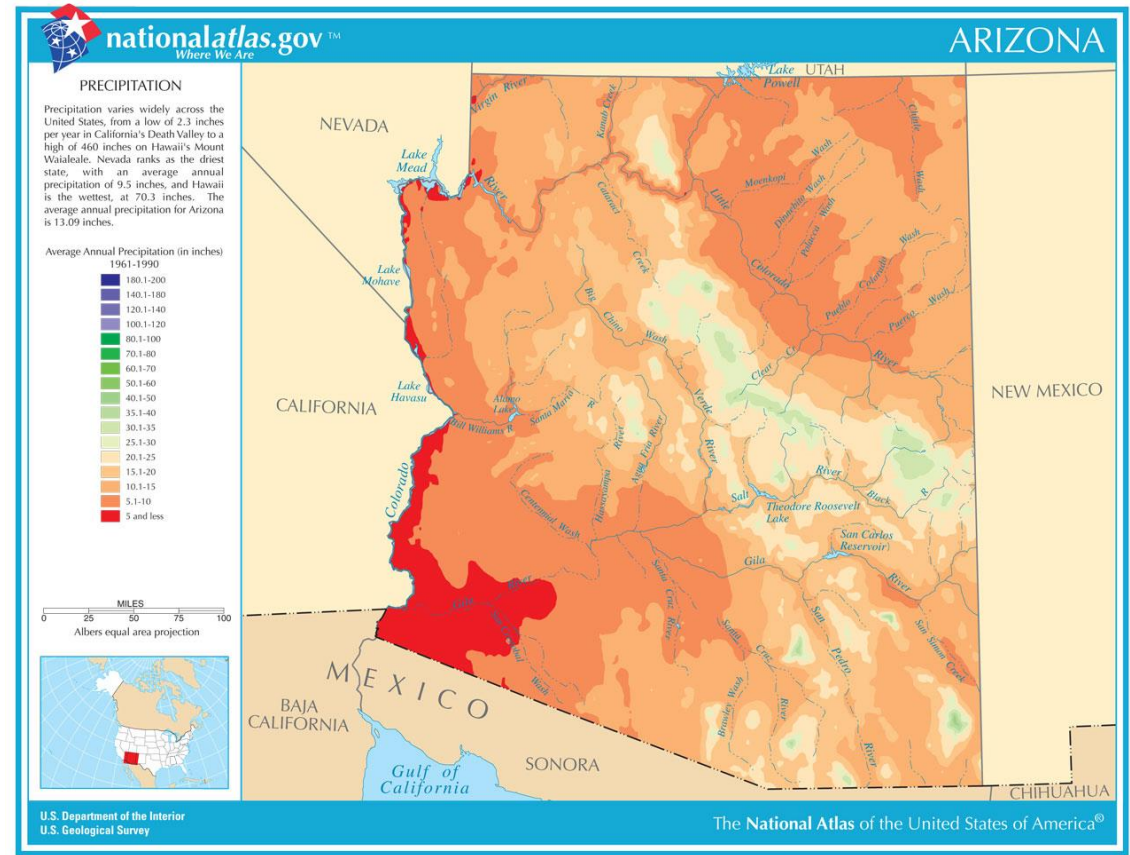
Rainwater Harvesting



Arizona Rainwater

- The highest annual rainfall is 28.46 inches at Junipine and the lowest is 10.55 inches at Cottonwood.
- One inch of rain falling on 1 acre of ground is equal to about 27,154 gallons

In the state of Arizona, it is legal to collect any rainwater that falls on your property for future use.



City	Square Miles	Acres	Gallons per inch of rain
Clarkdale	10.6	6,765	183 million
Cottonwood	16.6	10,624	288 million
Sedona	19	12,160	330 million
Camp Verde	43	27,520	747 million
Verde Valley	714	457,000	13 billion

Quick Rainwater Calculations — Roof & Property

Home Square Footage to Rainwater per inch:

Write down your home's square footage
Multiply by 0.6 =
Total estimated gallons per inch of rain

Additional numbers:

Estimate and split this number for each
roof division for general rainfall on each
section of roof or gutter downspout

Multiply these numbers by 10-20 for
annual gallons off your roof

Property Acreage to Rainwater per inch:

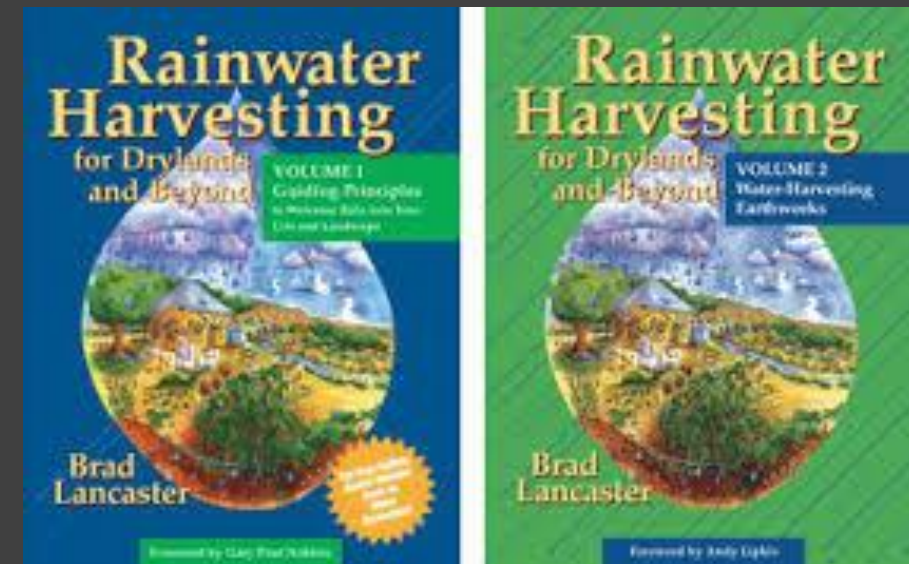
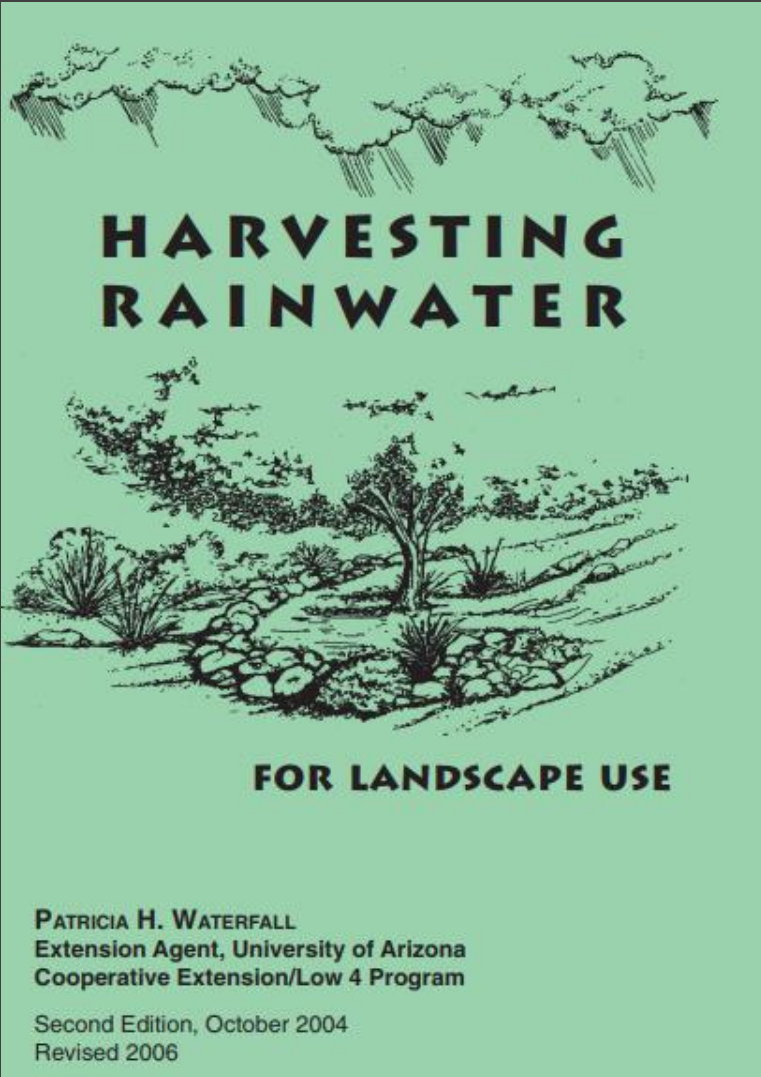
Write down your home's general acreage
Multiply by 27,000 =
Total estimated gallons per inch of rain

Multiply these numbers by 10-20 for
annual gallons on your whole property

Rainwater Harvesting Strategies



Rain Tanks
Earthworks
Rain Gardens
Mulch
French Drains



Follow Brad Lancaster in Tuscon

Rainwater Tanks



SAN FRANCISCO
rainwater  **harvesting manual**
for non-potable residential uses

Intro to Rain Tanks

Rules of Thumb:

1" of rainfall x 1,000 sqft =
~600 gallons

A tank itself can cost
around \$0.50/gal.
and an install to upwards
of \$1-\$3/gal.

Gary's Rule of Thumb:

No matter the size of tank,
it will fill up easily
and quicker than you
would think!



Rain Tank Notes:

<- First Flush <-

Catches the first amount of rain that is the dirtiest & filters it before tanks start filling.

Overflow

Direct your tank overflow to other tanks and then to a raingarden or dry creek

-> Gravel Pad ->

Best practices say 6"-2' beyond the edge of the tank, it all depends on the size and weight of your tank when full



Rain Tanks

-> 1,100 Gallon Short Tank ->
7' dia. x 4'8" High



^530 Gallon Narrow Tank^
7' L x 2' W x 6.5' High



Rain Tanks

**2,650 Gallon Tank
8'6" dia x 6'8" high**

Connecting one full side of the house for a gravity-fed hose bib.

Note: Post with a red indicator for tank level



Rain Tanks

**5,000 Gallon Tanks
10'9" dia x 8' high**

Catching half of the greenhouse's roof into large tanks with a pump for a hose bib inside the greenhouse.



Rain Tank Use:

Gravity Feed:

It is easiest and cheapest to have the water gravity-fed from your tank, usually with a hose bib and hose.

Or

Pumping:

When you can't gravity feed or want more pressure for approaches like drip irrigation or pumping to a higher tank, you can install a pump as well that's appropriate for what you want to do.

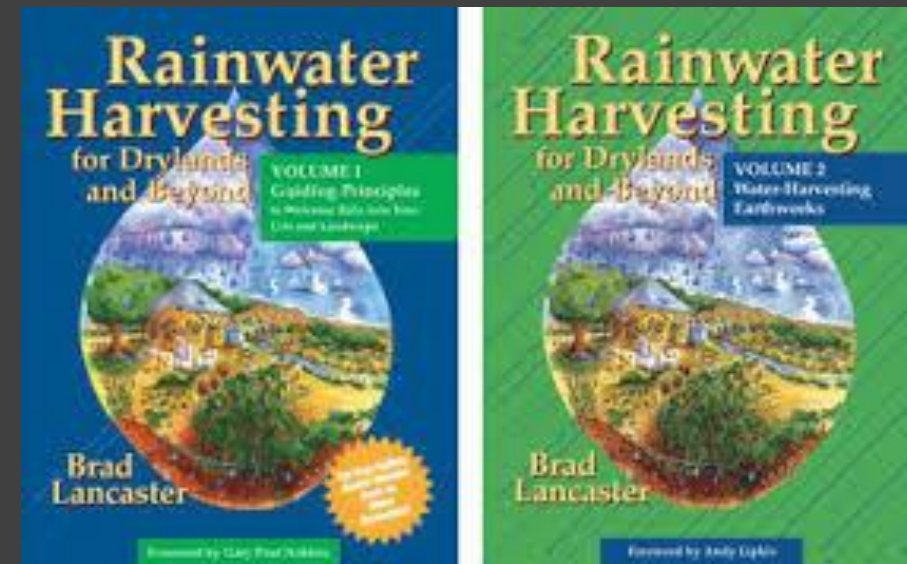
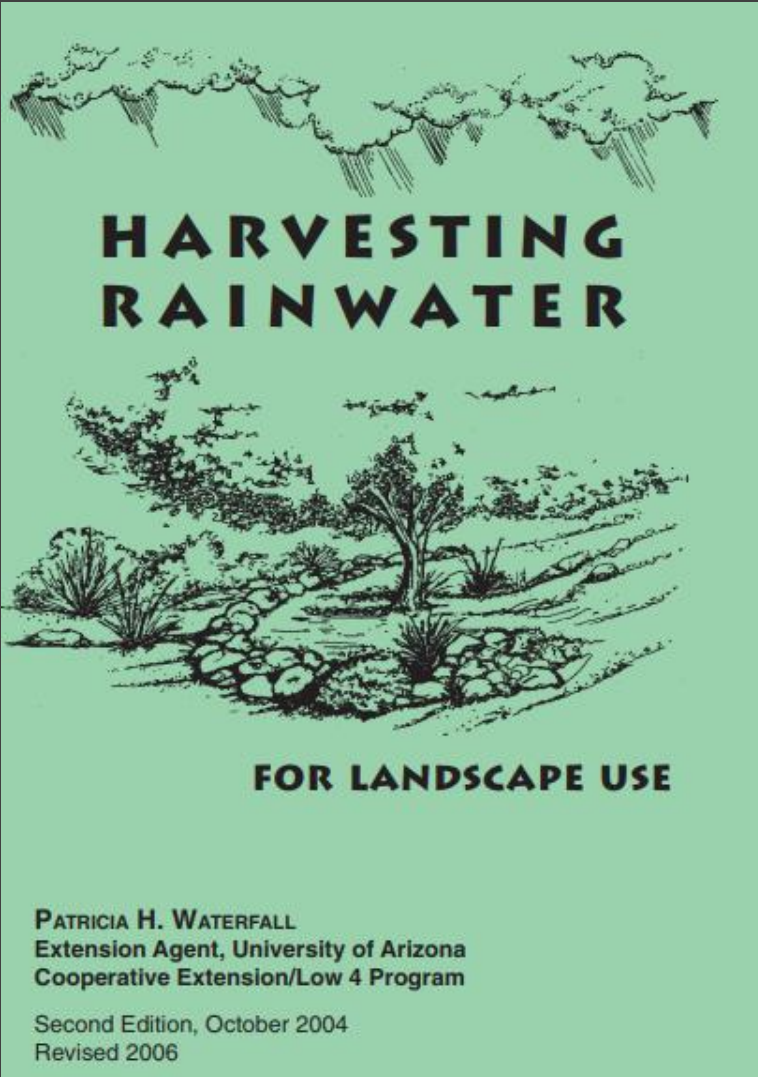
-> *Grundfos* 1 Horse Power Pump ->



Rainwater Harvesting Strategies



Rain Tanks
Earthworks
Rain Gardens
Mulch
French Drains



Follow Brad Lancaster in Tuscon

Earthworks & Rain Gardens



Slow It
Spread It
Sink It

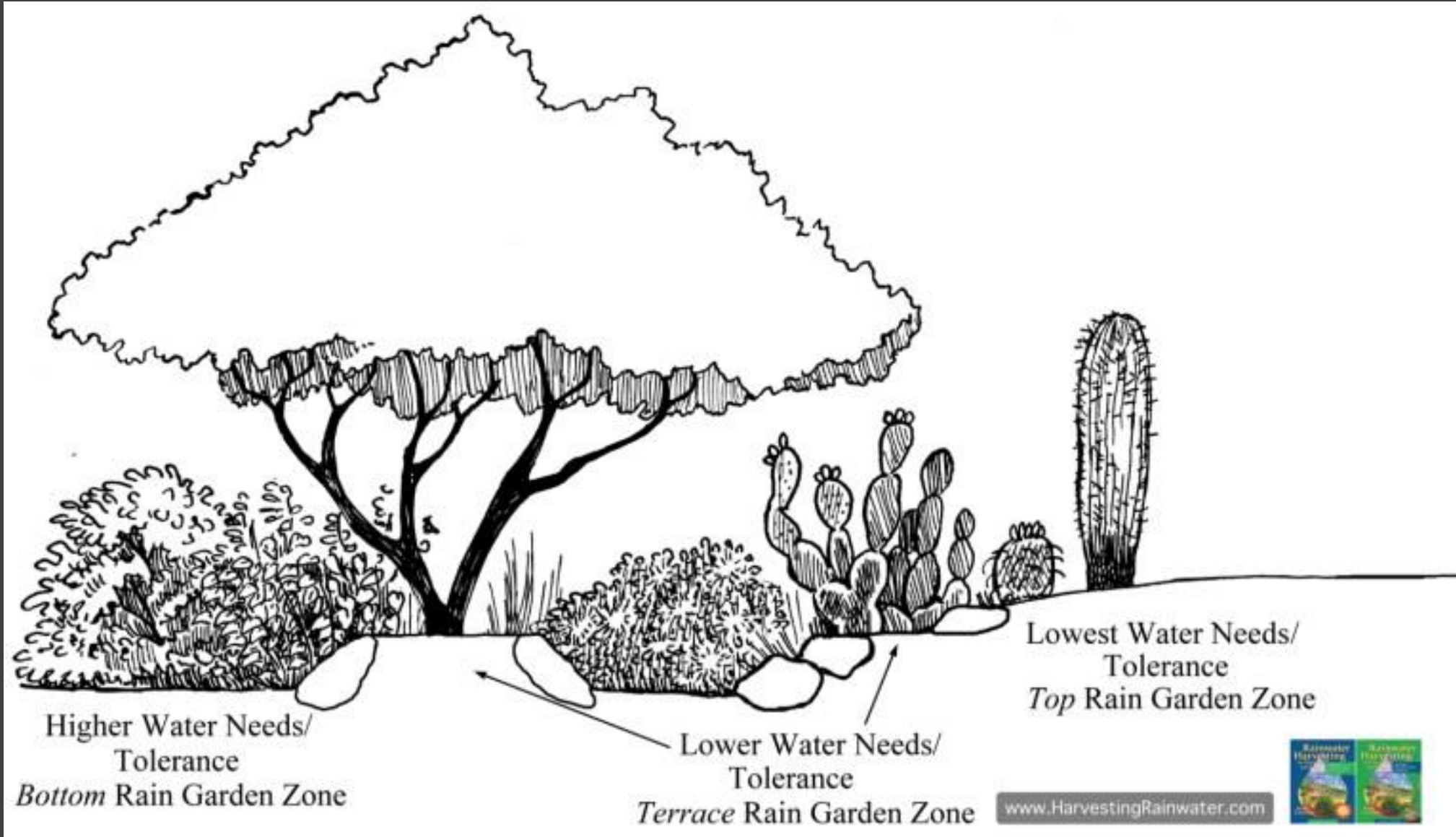
Earthworks



Earthworks



Rain Gardens



Rain Gardens

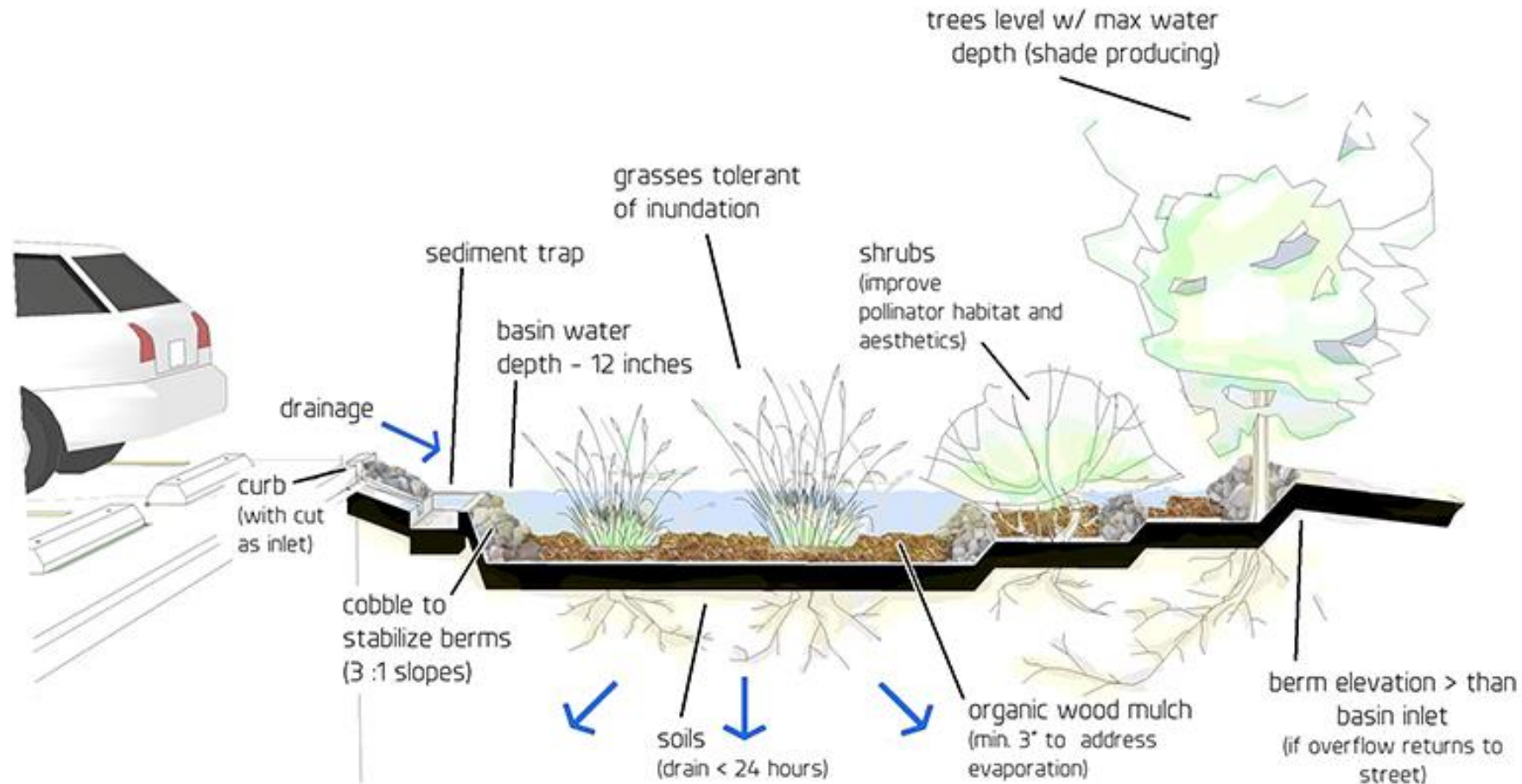


Rain Gardens – Cohousing Design Milagro, Tucson



Community View Looking East

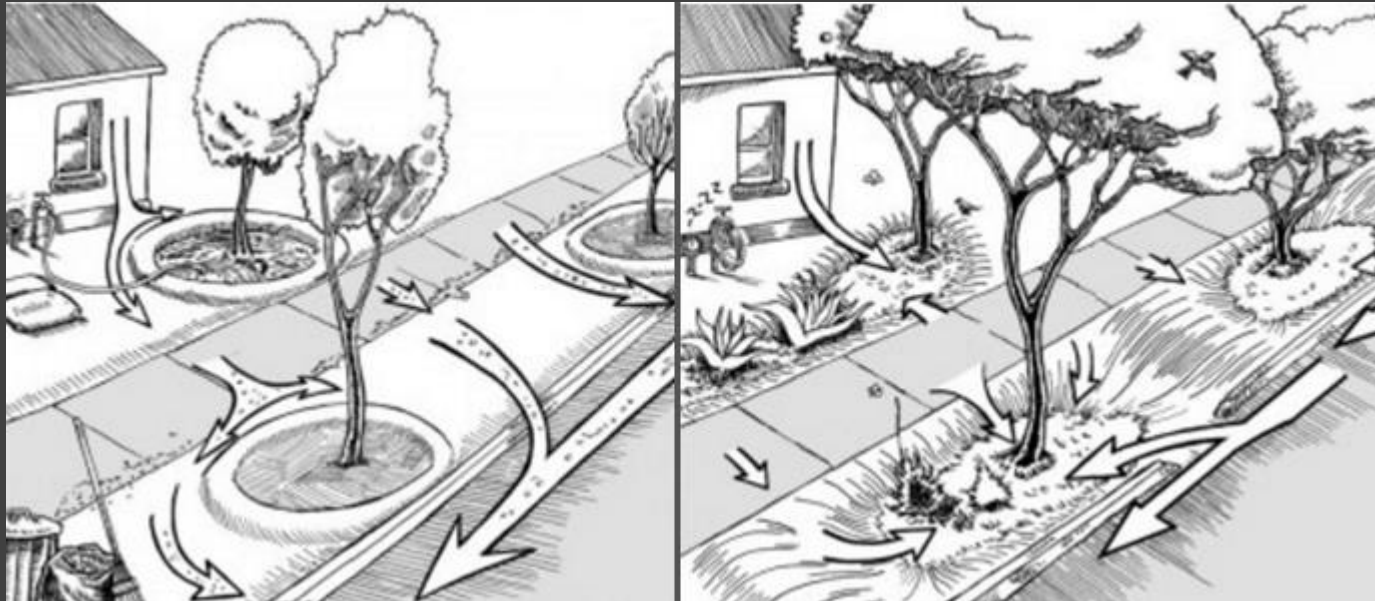
Rain Gardens & Curb Cuts



Basic Basin Design Considerations

diagram by
Paul Navrot
for SUH

Rain Gardens & Curb Cuts



Rain Gardens & Curb Cuts



Rain Gardens & Curb Cuts



Rain Gardens & Curb Cuts



Rain Gardens & Curb Cuts



Rain Gardens & Curb Cuts



www.HarvestingRainwater.com

Rain Gardens & Curb Cuts



HarvestingRainwater.com ©2009 Brad Lancaster

Rain Gardens - Chicane



Mulch!

Wood Chip / Organic

Pros:

Improves Infiltration
Increases Water Retention
Builds Soil
Reduces Erosion

Cons:

Degrades Over Time

Rock / Gravel

Pros:

Strong Erosion Control

Cons:

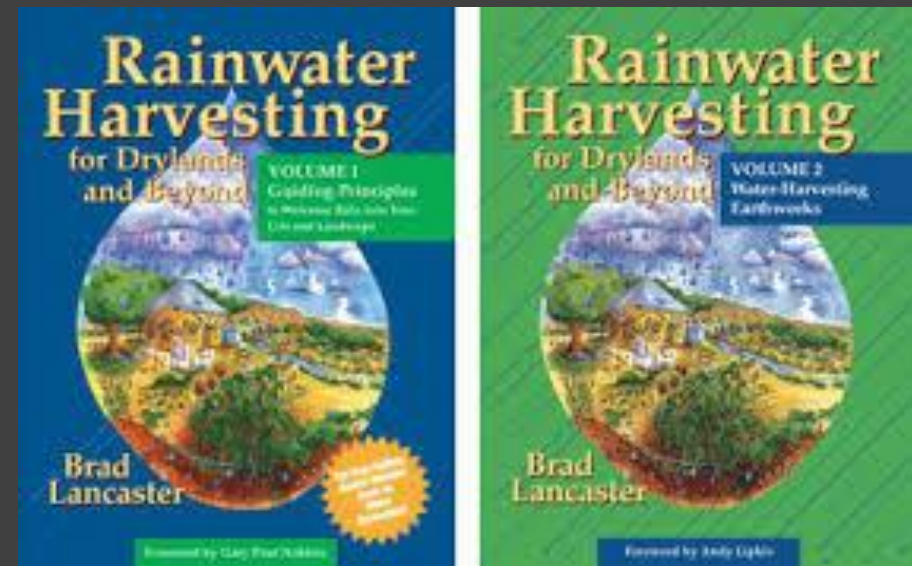
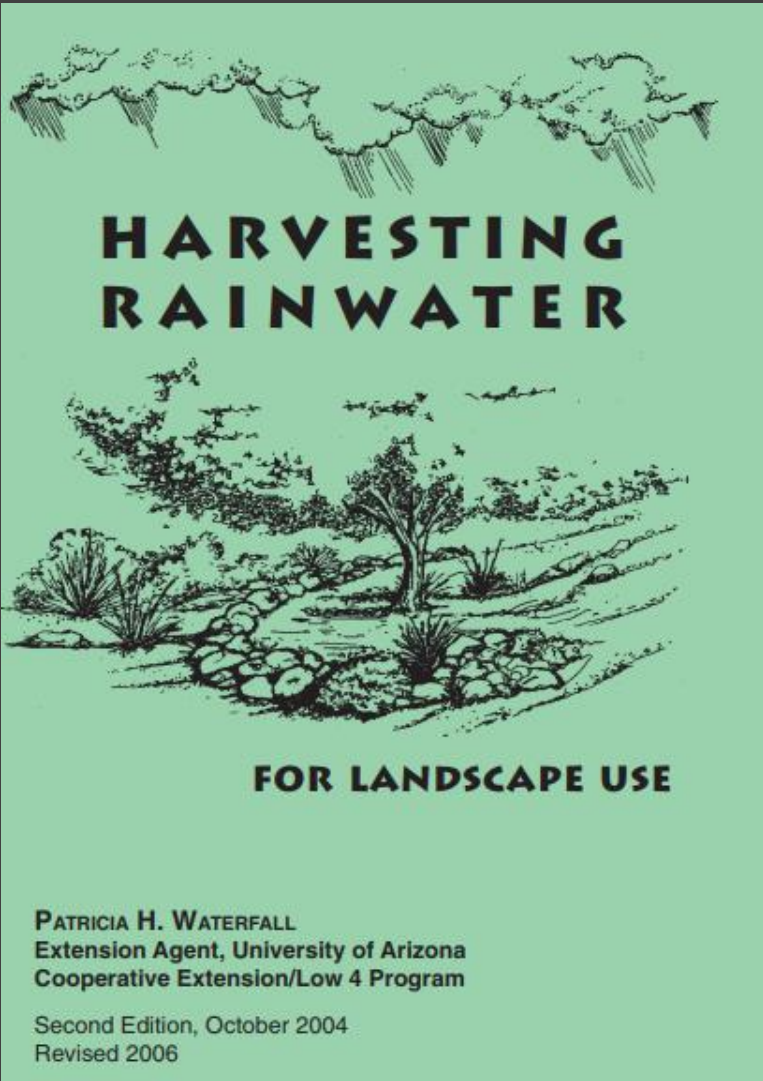
Accumulates Heat
Does Not Build Soil



Rainwater Harvesting Strategies

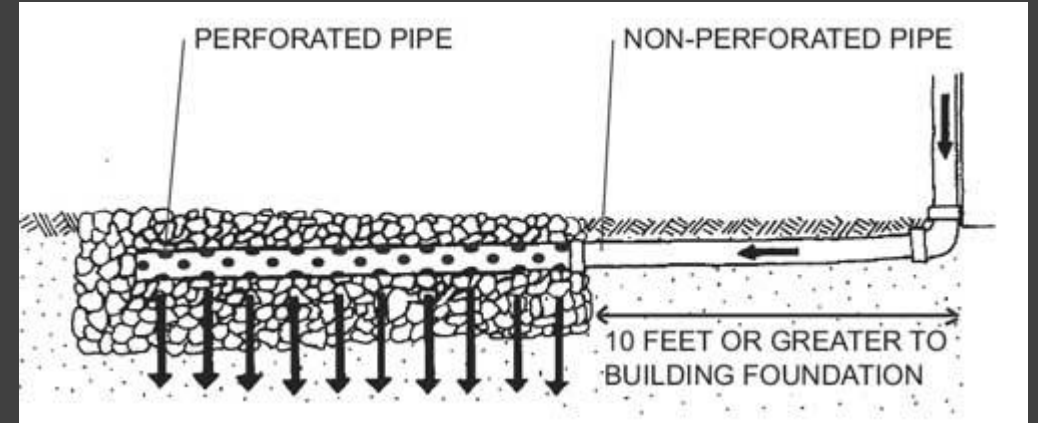
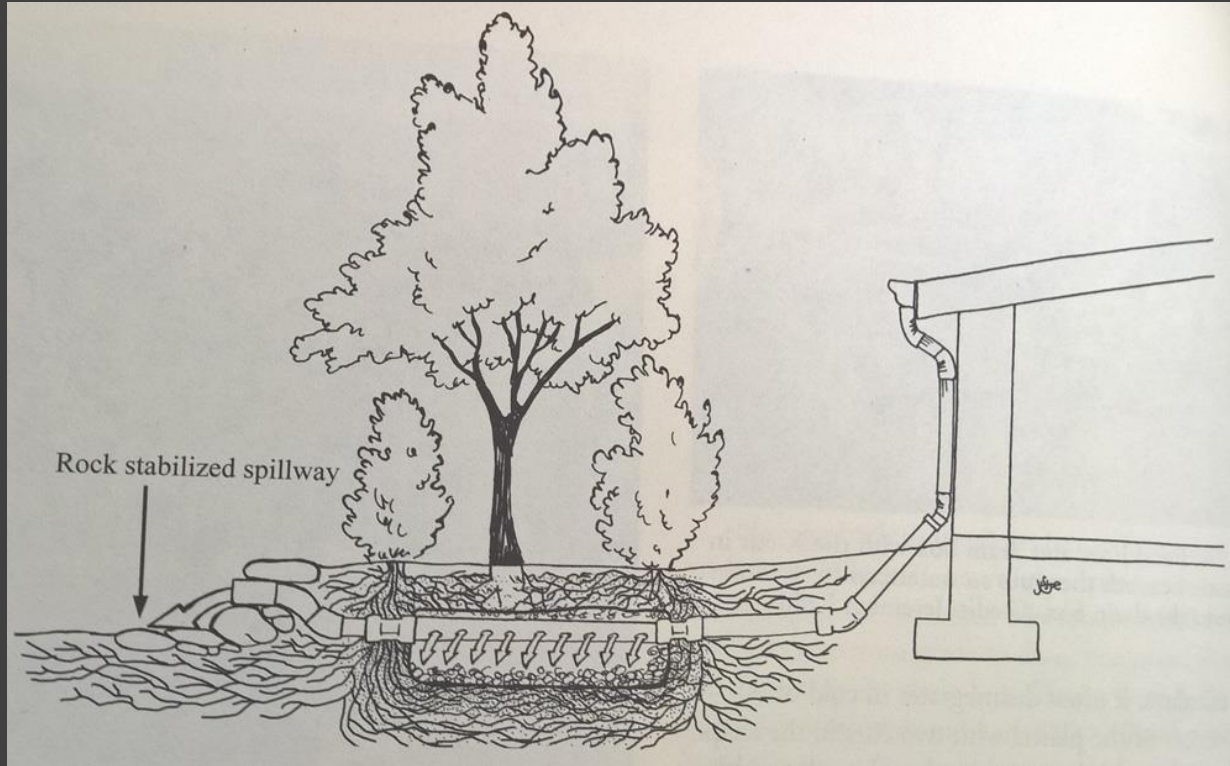


Rain Tanks
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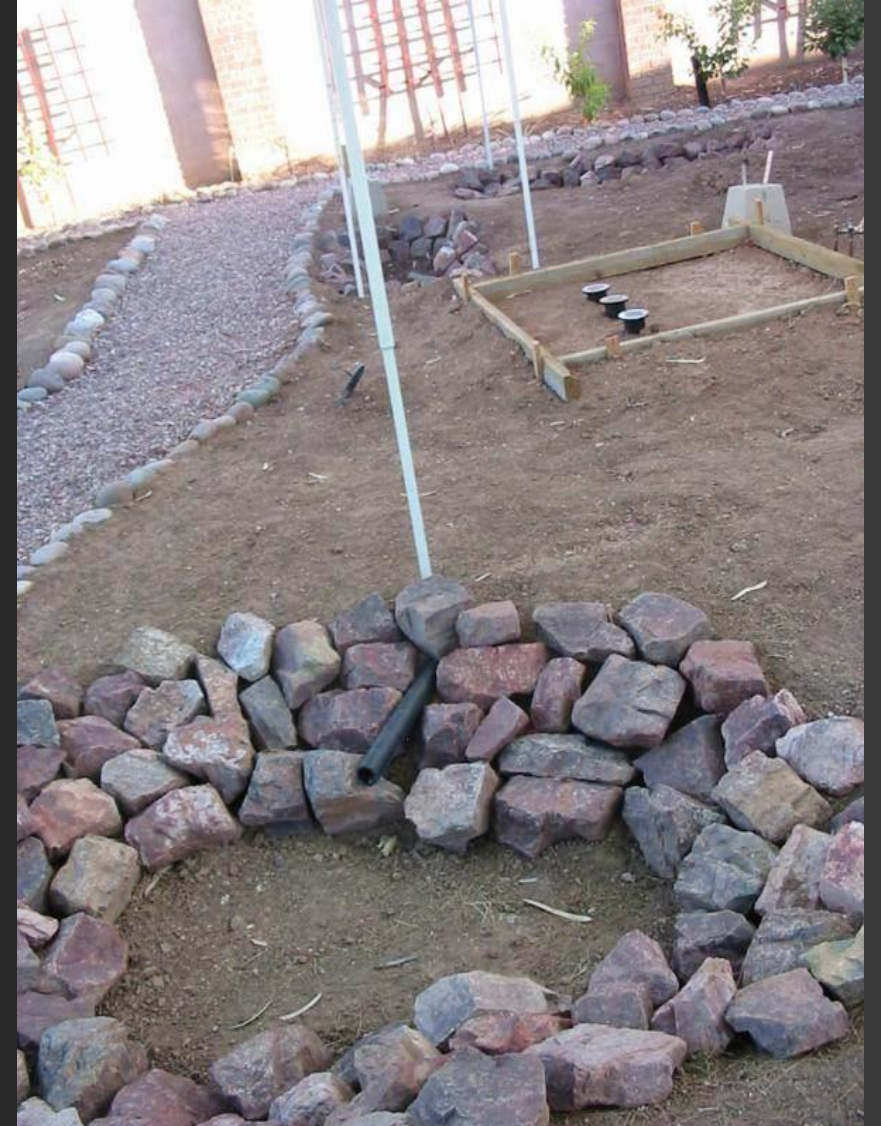
French Drains



French Drains



Outdoor Showers



Tucson, Arizona Rainwater



- Since 2012, Tucson Water has given homeowners up to \$2,000 to buy cisterns, gutters and downspouts for “active” water harvesting: capturing rainfall off the roof.
- The utility offers rebates of up to \$500 for “passive” harvesting that reshapes a yard to capture runoff.
- The utility has given nearly 2,000 homeowners rebates, costing nearly \$2 million. These and other rebate costs are paid by a fee in water bills of 9 cents per 748 gallons used — scheduled to hit 10 cents by fiscal year 2019-20.
- New roads are required to have rainwater harvesting for 1/2” of rainfall through infiltration basins.
- “The size of the impact on demand was way more than their engineering estimate had suggested,” Woodard said last week.
- “They’re redoing their whole landscaping, they are more conscious of the weather, the rain and how full or empty (their) tanks are.



Rebate Examples in Arizona

High Efficiency Toilet (HET) Rebate

Receive a \$75 rebate per toilet for replacing up to two high-efficiency toilets.

[Learn more and apply for rebate](#)

Limited-Income Toilet Replacement

Limited-income individuals and families can receive free replacement of older toilets.

[Learn more and apply for replacement](#)

Rainwater Harvesting Rebate

Receive a rebate up to \$2,000 per property for qualifying rainwater harvesting system costs.

- [Learn more](#)
- [How to Qualify](#)
- [Workshop and Project Plans](#)
- [Most Requested Information](#)
- [How to Apply](#)

Clothes Washer Rebate

Receive a \$200 rebate for purchasing a qualifying high-efficiency clothes washer.

[Learn more and apply for rebate](#)

Gray Water Rebate

Receive a rebate up to \$1,000 for installing a permanent gray water irrigation system.

[Learn more and apply for rebate](#)

Rainwater Harvesting Grant for Limited-Income Customers

Grants of up to \$400 and loans of up to \$2,000 are available to qualifying households.

[Learn more](#)

The city of Tucson posted a substantial decrease in residential water use, from a high of **121 gallons per capita per day in 1996, to only 82 GPCD in 2017. This is a reduction of 39 GPCD, or 32.2%, over 21 years.**

The city of Tucson has been proactive in encouraging water conservation by offering a wide range of rebates and incentive programs to residential and commercial customers. Arizona's residential water use has remained relatively constant between 1985 and 2015 with only slight fluctuations.

Water Breakoff #1

Design for your Home

- Group up and have your home design out, ready to be marked up on again
- Indicate gallons per inch of rain on each portion of your roof
- Consider and sketch out ways you can best use the rainfall on your property:
 - Gutter downspouts going into raingardens
 - Hardscape pouring into basins
 - Raintank options
 - Can you harvest from neighbors or the street?

Water Breakoff #2

Engage with your City

- Find others in your city and group up
- Find out when your City Council General Meeting is: Day and start time
- Draft an email you can send to your council and a request you can bring up during the public portion of the meeting.
- What do you want your city to do?
 - Request for rebates
 - Require or give guidelines for new homes to design for rain and greywater
 - Roads to include rainwater catchment
- Plan a general meeting to all go and support one another



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For More Information on Rainwater


G-Force Gaia Services, LLC Website:

GForceGaiaServices.com
under Our Solutions/Rainwater

Articles, Videos, Book Suggestions,
Forums, Brochures , and more!

Business:

Rainwater Consultations
Rainwater Harvesting Installations



Our trees, our land, and we love water.

It's that simple.

When we put our thoughts towards how we
worship our resources,
we can become healers.

Moving to worship ourselves
and all of those around us.