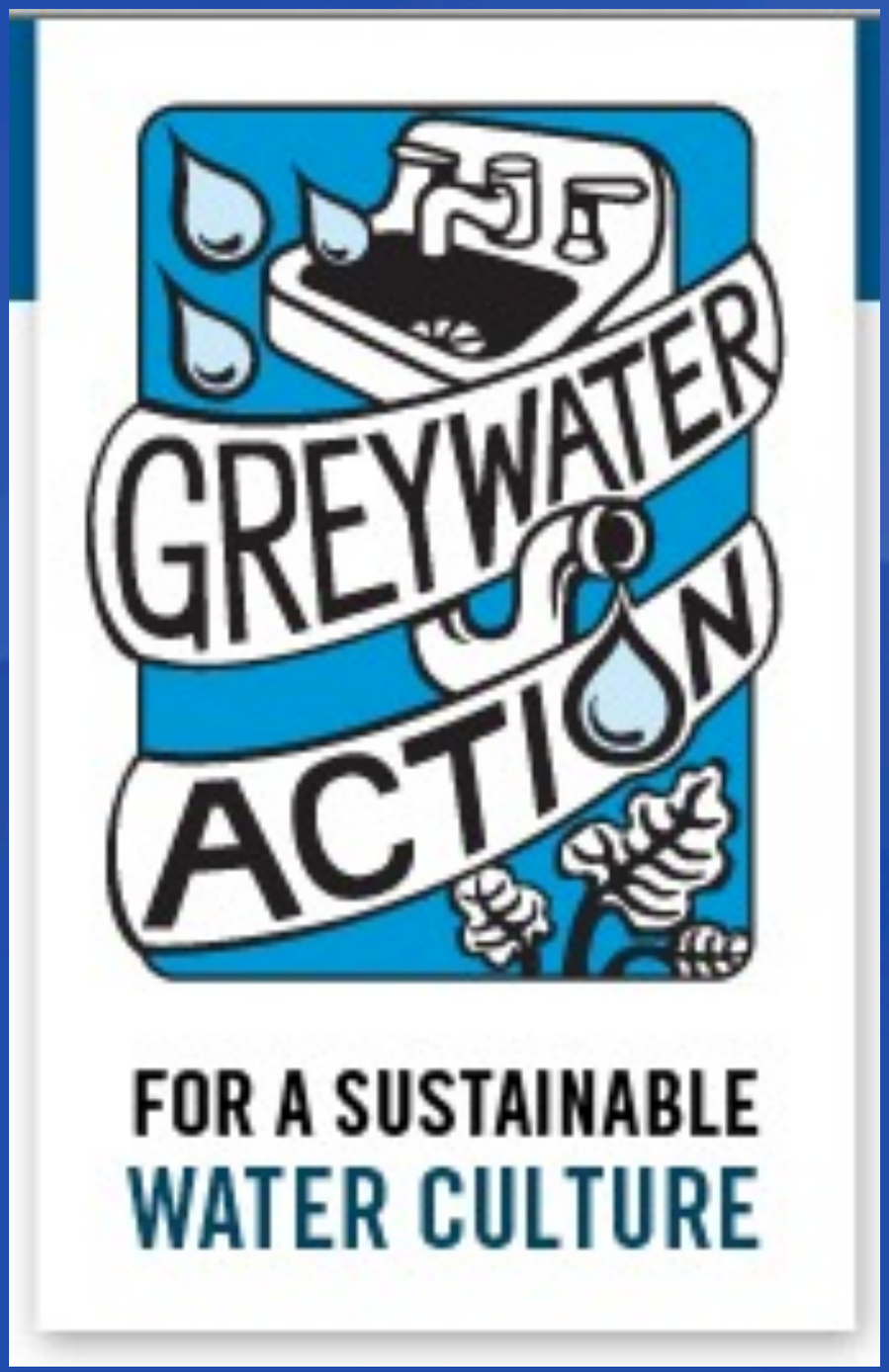


greywater clarified!

with
christina bertea
greywater action

january 26, 2019

your instructor:

christina bertea

greywater action instructor 10 years

http://greywateraction.org

eco-artist

http://weadartists.org/artist/christina-bertea

natural builder

union trained journeywoman

plumbing contractor

greywater

why?

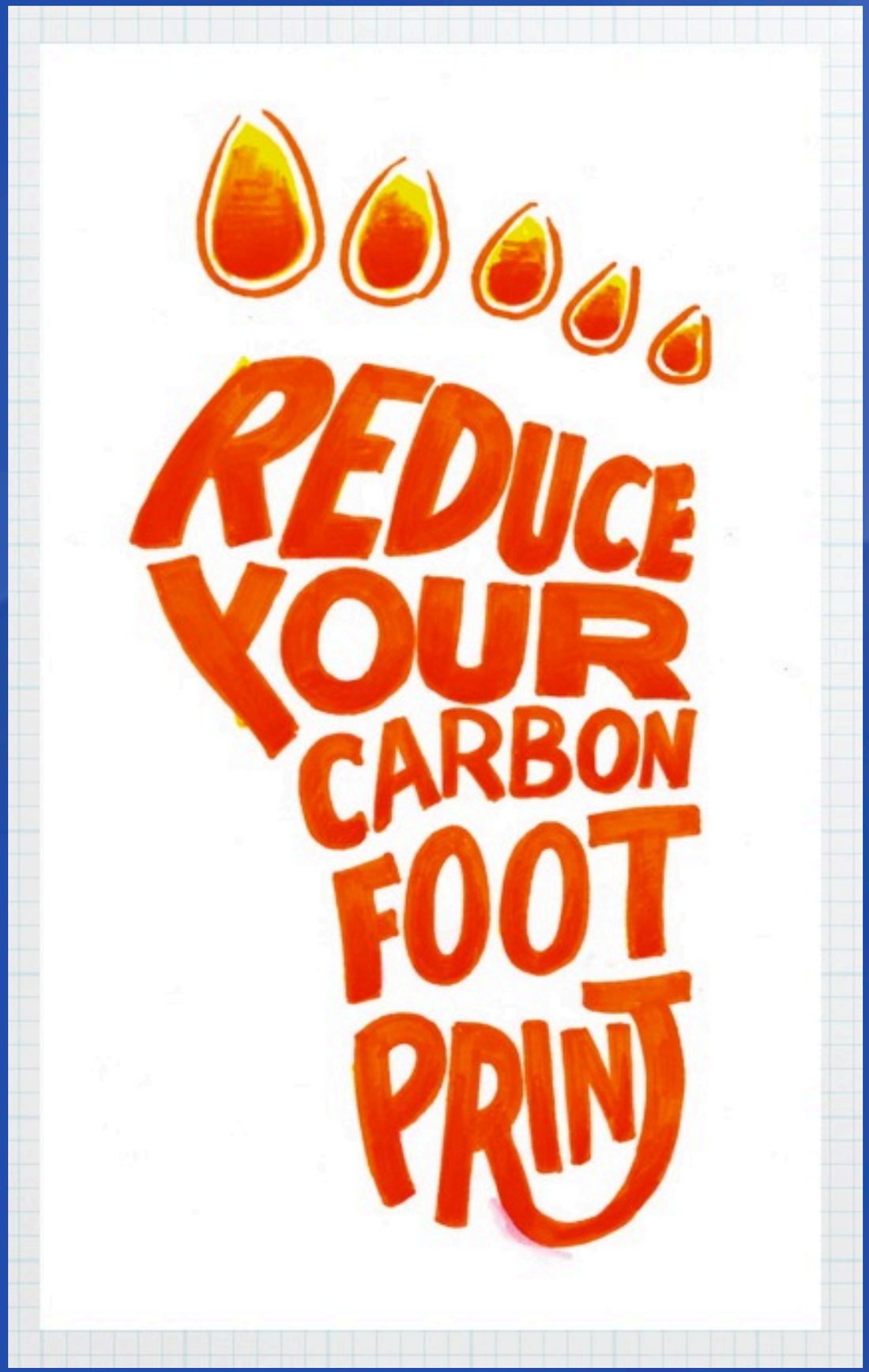
no sewage treatment plant to avoid?
no failing septic?

septic leach fields infiltrate but don't
necessarily support plant growth

year round
production of greywater
for
year round
production of plants

benefits both
soil
&
climate

soil



household water:
pumped so it
has embodied energy

from

footprint

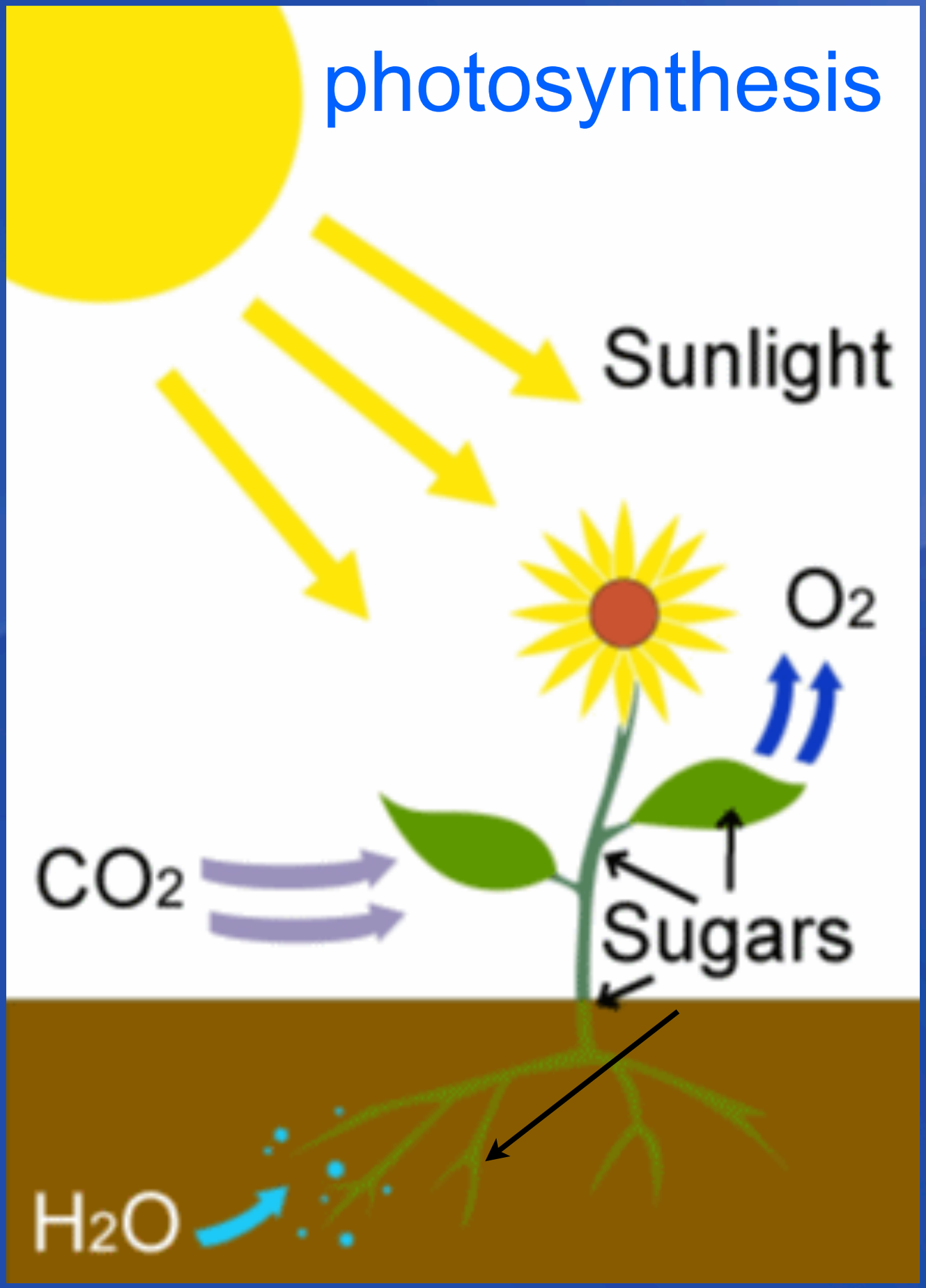
to

beneficial carbon impact

much talk of
no till
mulches &
cover crops

keeping the soil undisturbed
and covered with plants
supports the
microbial life in the soil

photosynthesis



carbon dioxide
+
water
+
solar energy creates
=
oxygen
+
glucose (sugars)

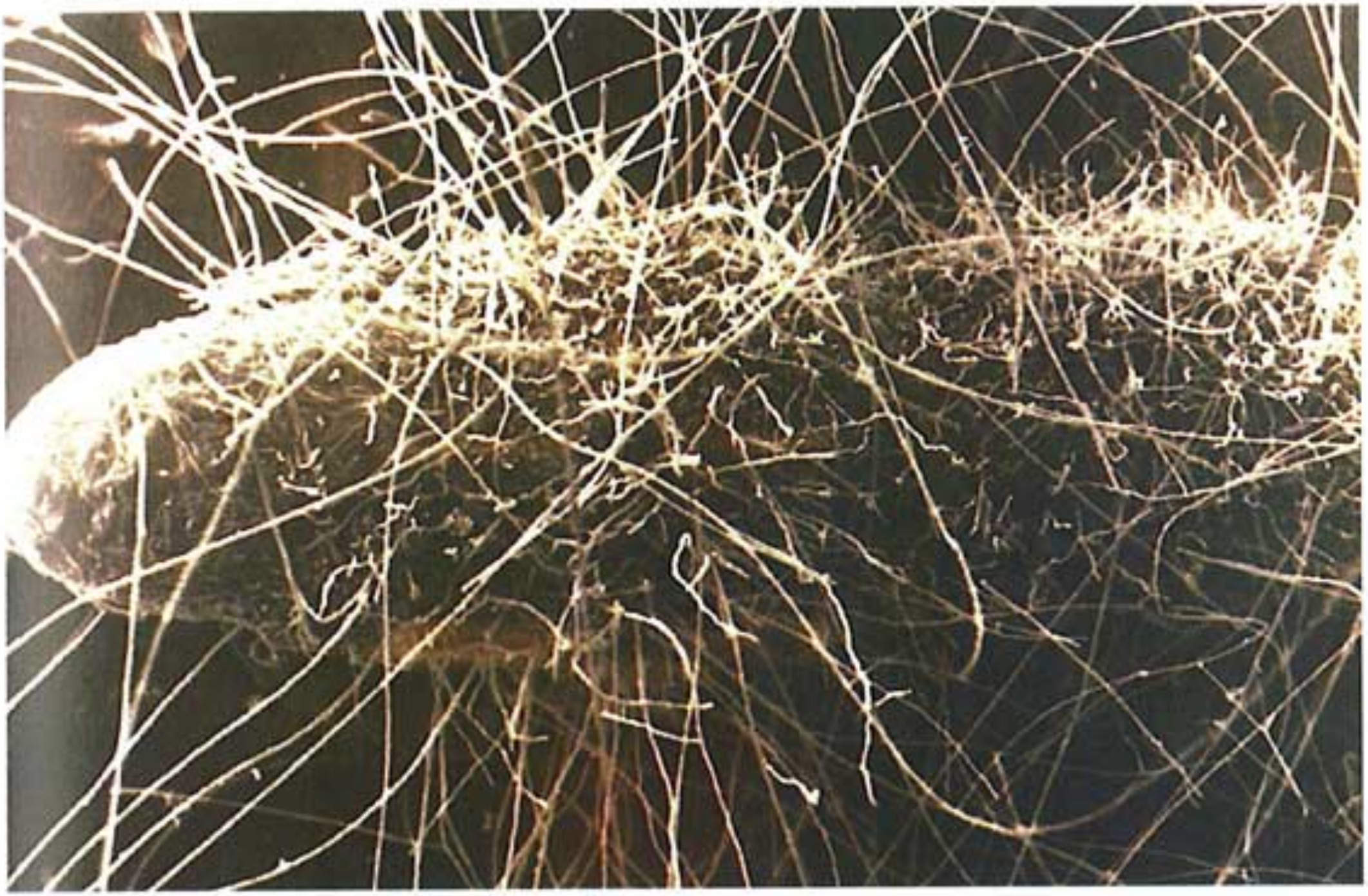
$C_6H_{12}O_6$

for plant growth

and

to trade with soil microorganisms

root exudates feed mycorrhizal fungi who feed the roots



Mycorrhizal fungi, extending from a root—and increasing the plant's ability to obtain nutrients and water. Courtesy Mycorrhizal Applications, www.mycorrhizae.com.

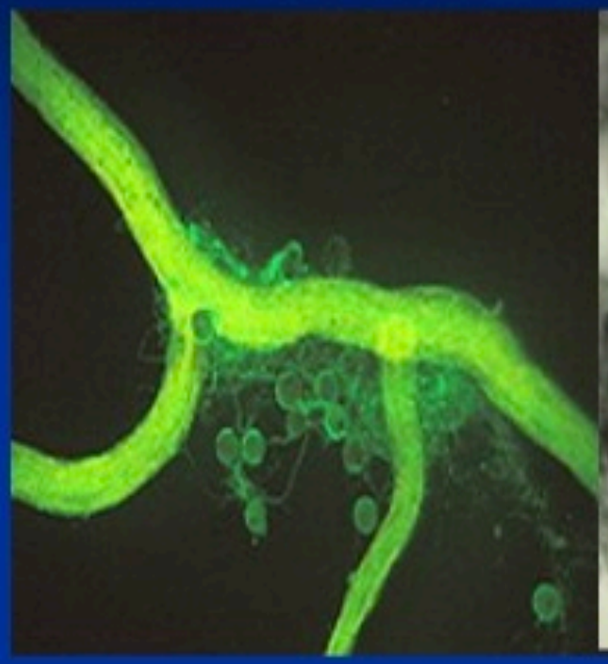
mycorrhizal fungi: the plant's secondary root system

Photo by Scivit on Wikimedia Commons

a symbiotic relationship:
benefits both
plant
and
fungi

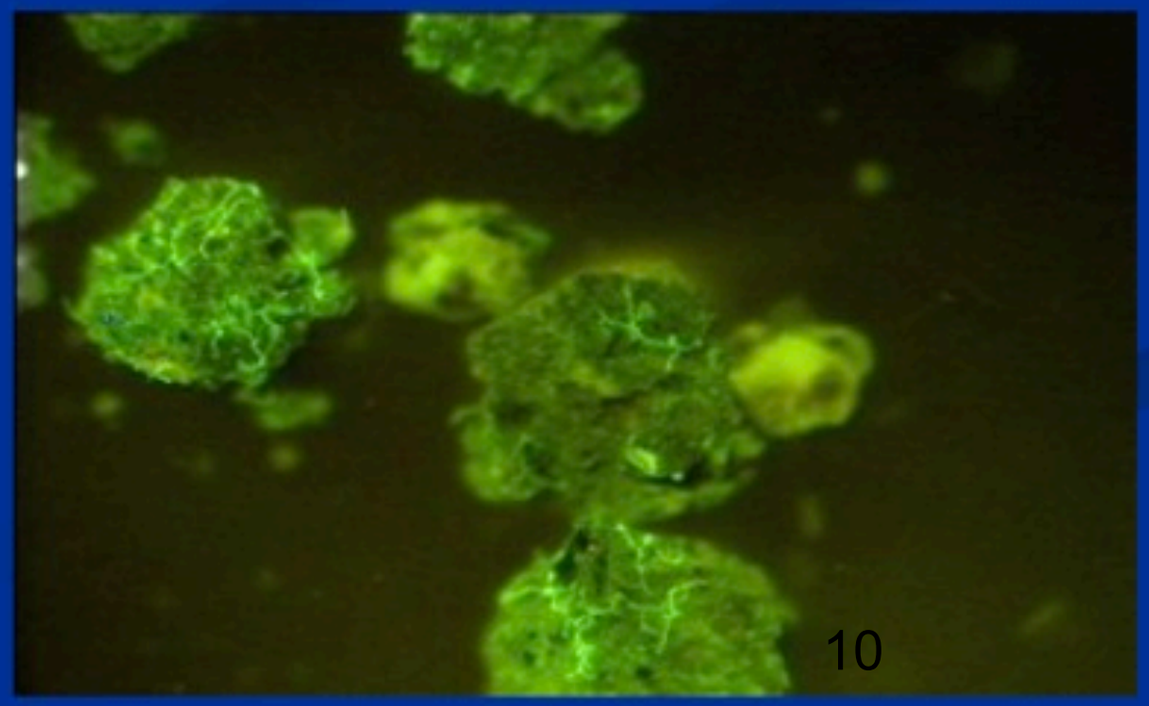
(AMF: arbuscular mycorrhizal fungi)

What are AMF and Glomalin?



AMF invade root cells and transfer nutrients to the plant in exchange for the plant's carbon.

AMF use a portion of the carbon to produce a tough, sticky glycoprotein called glomalin.

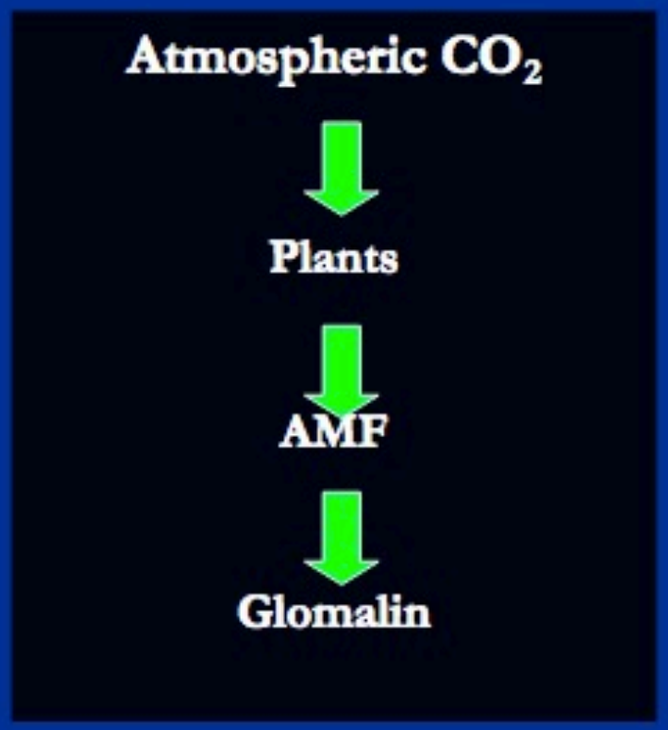


from a presentation by Sherry Darabi

fungi can sequester carbon in a stable form in the soil!

Mitigation of Climate Change

- Global warming is a current concern.
- Atmospheric CO_2 contributes to global warming.



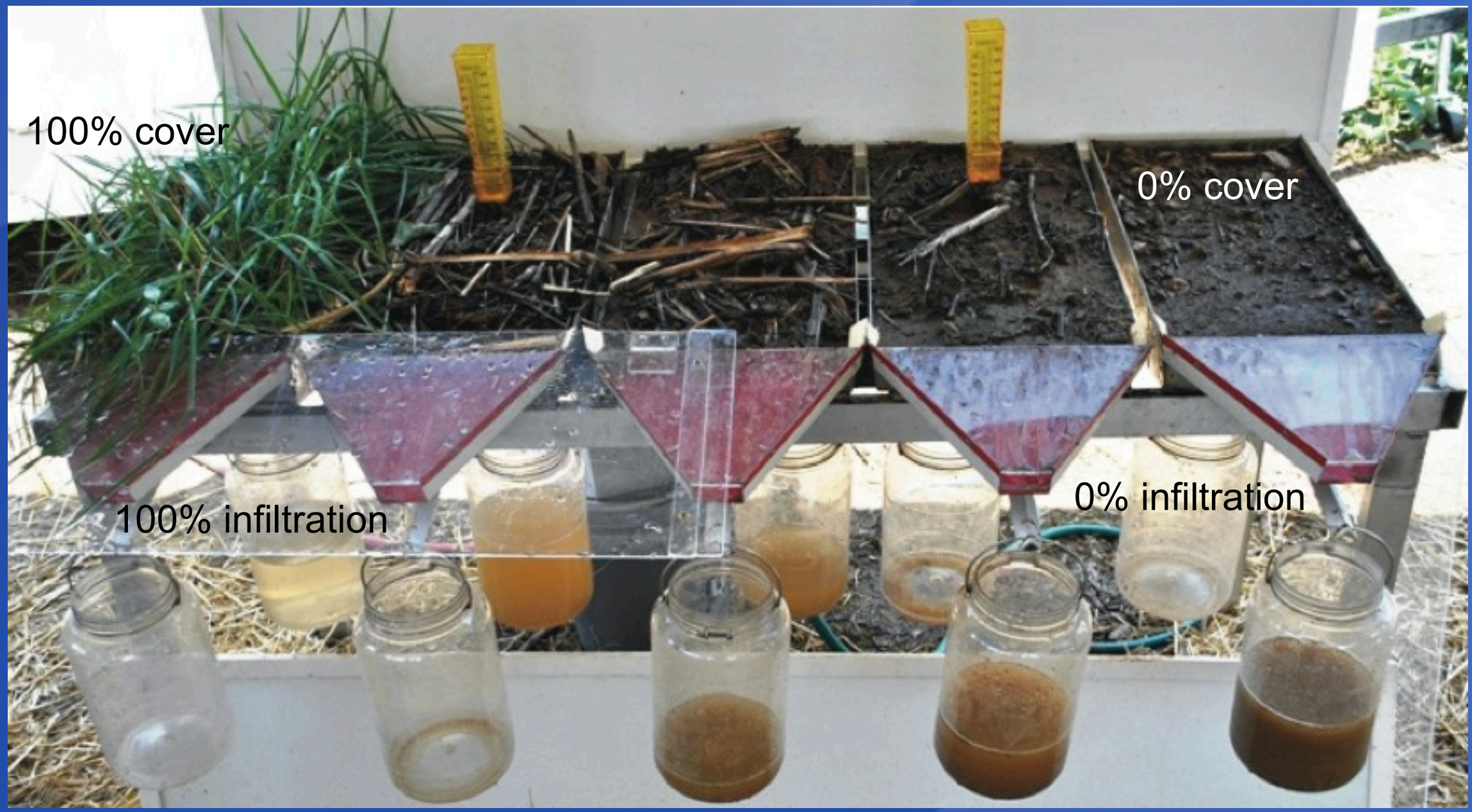
AMF may ameliorate climate change by producing glomalin with the carbon in CO_2.

from a presentation by Sherry Darabi

glomalin aids in soil aggregation: restoring the soil carbon sponge

improved soil structure allows more water to infiltrate into the soil, eventually recharging aquifers

NRCS rainfall simulator



surface run-off with erosion

using greywater
to grow plants year round:

maintains fungal life that

~sequesters carbon

~increases the water holding capacity of the soil

and now~

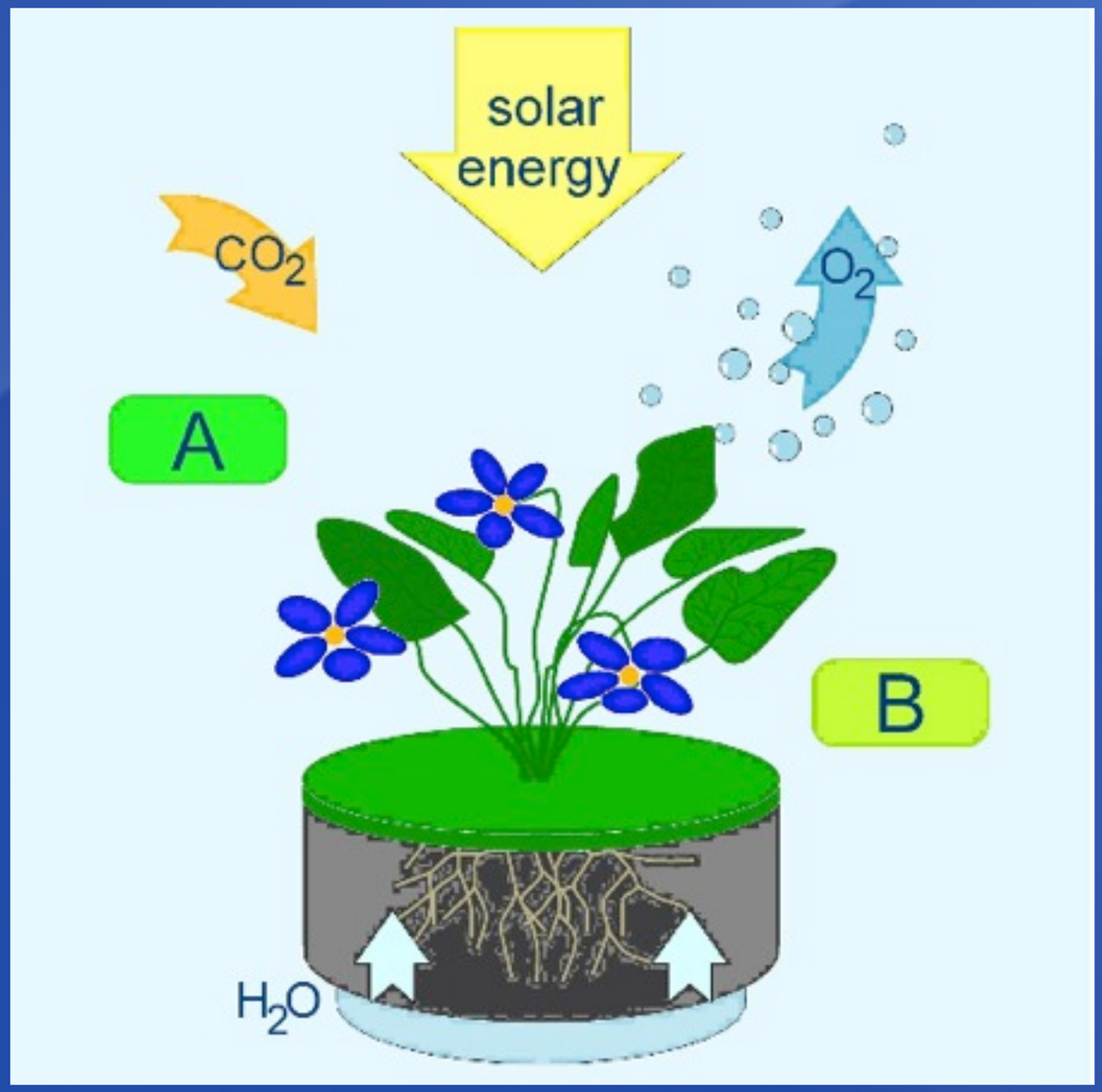
climate reasons

why
continuous plant cover
and soil moisture

(from greywater)
are important

solar energy blasts the earth but
plant cover and soil moisture keep the
surface cool...

solar energy is
consumed
during
photosynthesis



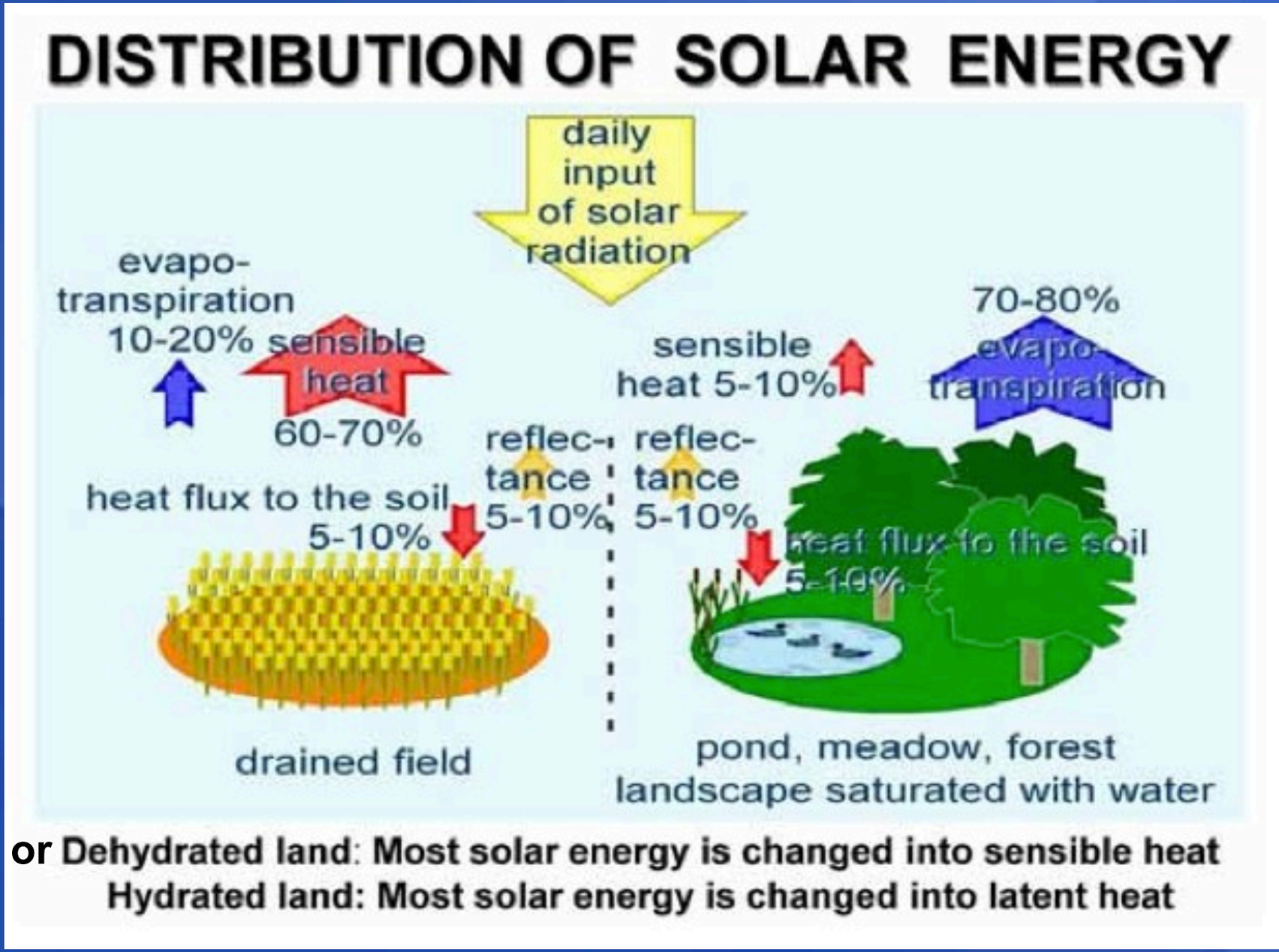
solar energy is
consumed
in the
phase change
of water from
liquid
to vapor
during transpiration
from leaves
and evaporation
from soil

Water for the Recovery of Climate - A New Water Paradigm

(thus far) maintaining a temperature range habitable by us

earth’s vegetative “fur” serves as a natural air conditioner, stabilizing the climate

where there is no vegetation or surface moisture solar energy radiates back into the atmosphere as “sensible” heat

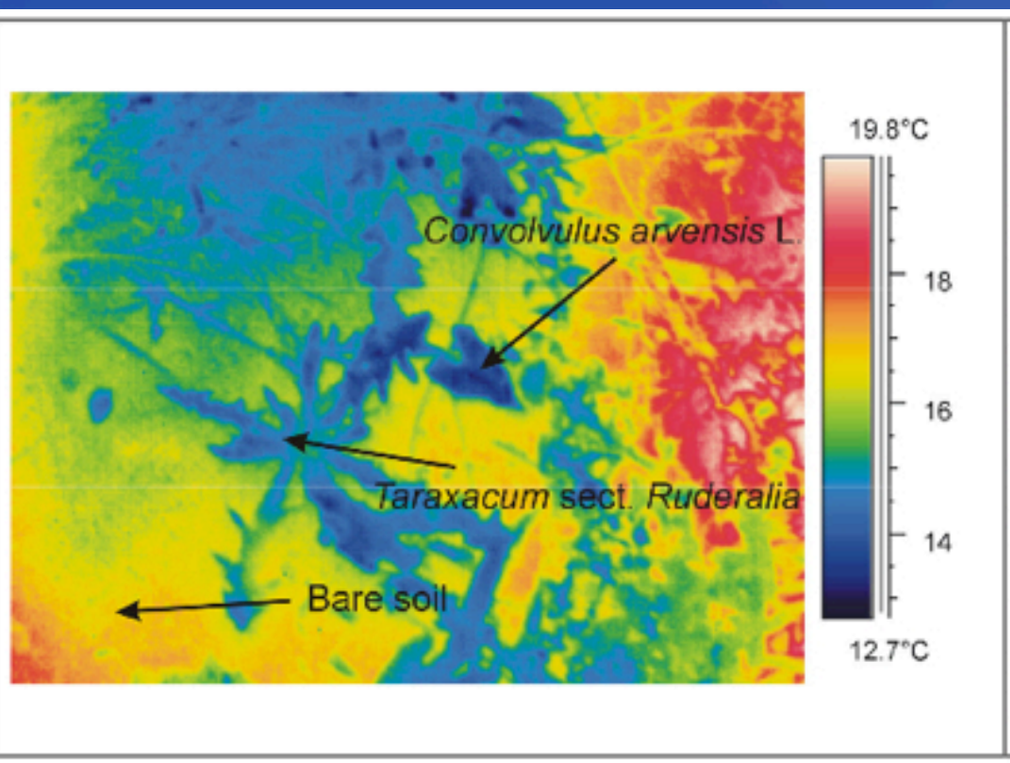


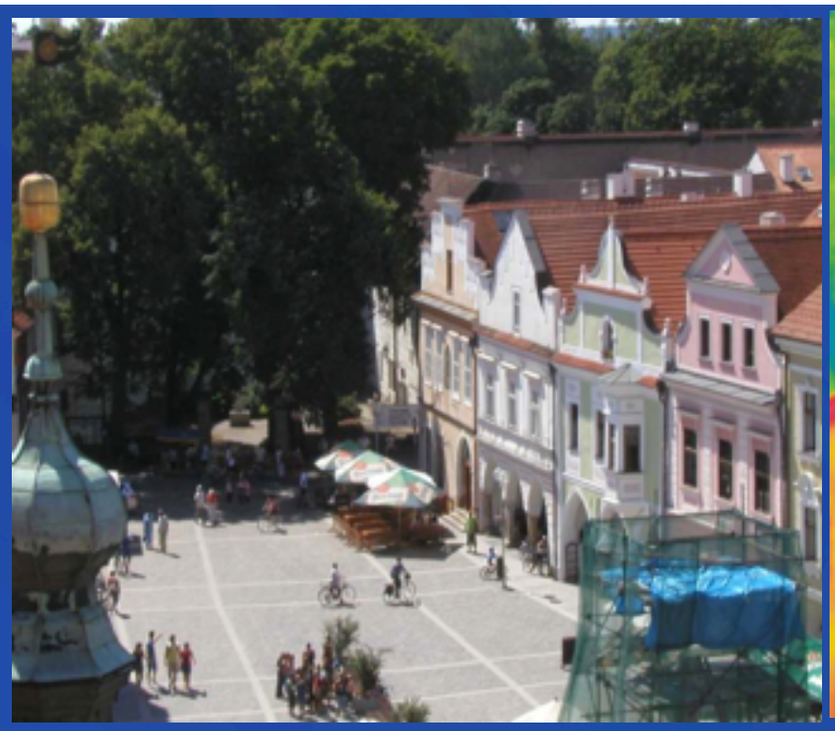
Water for the Recovery of Climate - A New Water Paradigm

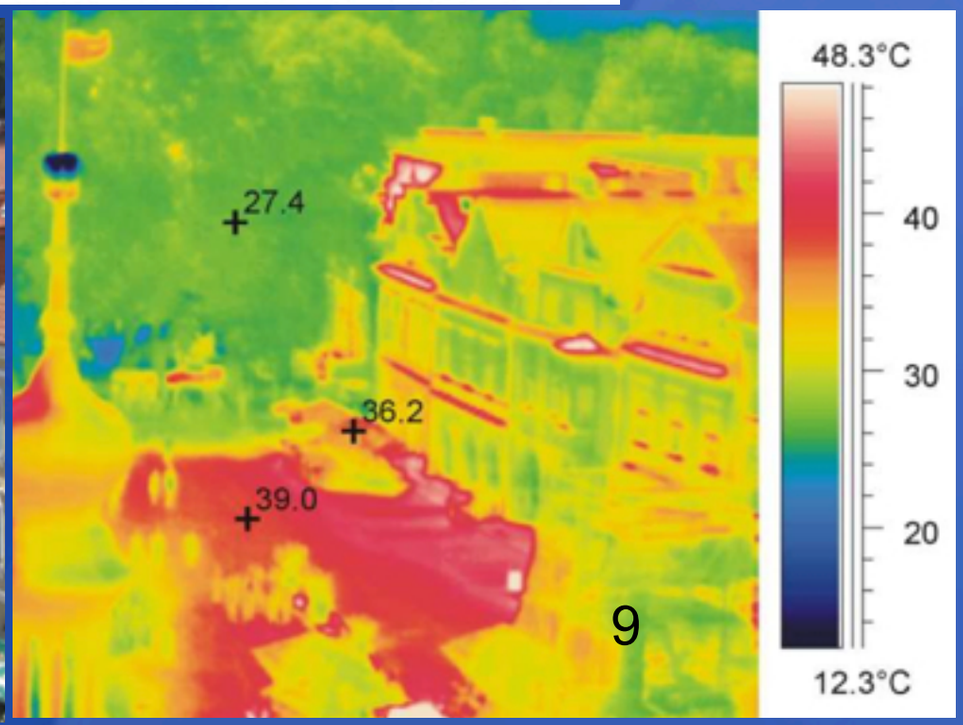
sensible heat rises and creates “heat islands” that contribute to climate chaos

infrared photos on a sunny day:

~low surface temperature on vegetation (due to transpiration)
~high surface temperatures on bare ground, roofs, pavement (sensible heat)








KISS the GROUND
PLANTS
ARE COOL
BARE SOIL
IS NOT

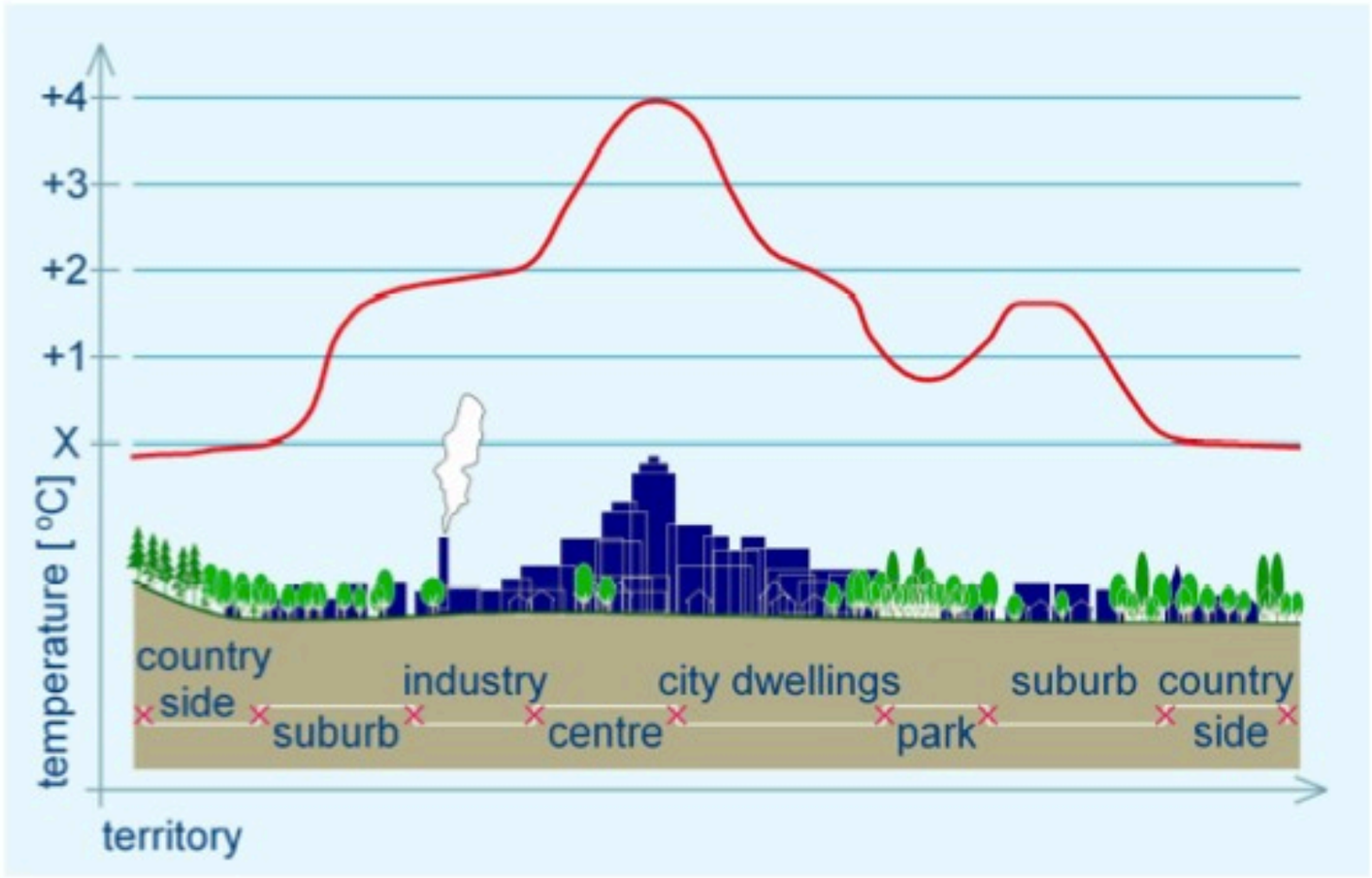
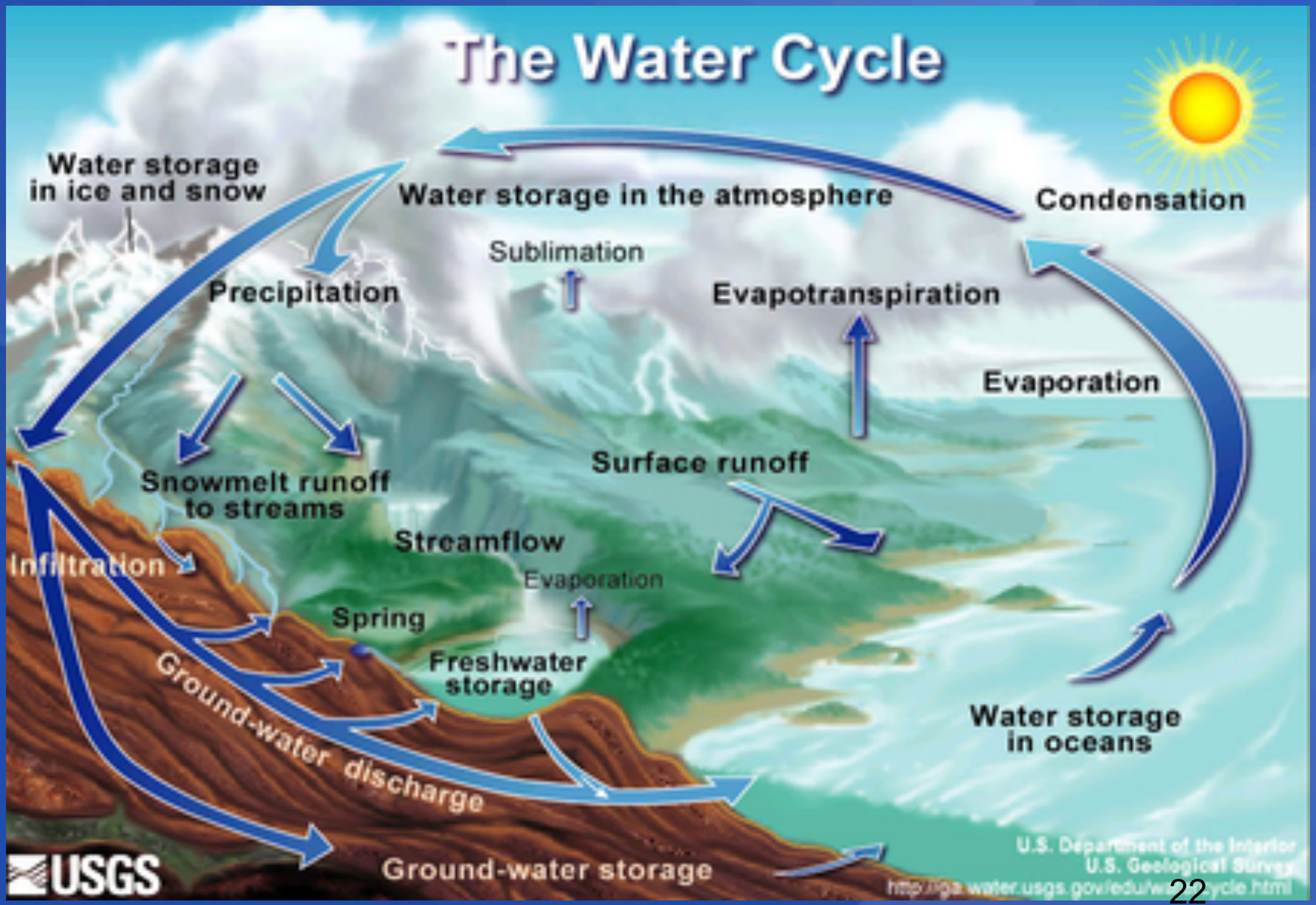


***Fig. 16* The hot climatic umbrella of an urban space**
Temperature depends on the relation between a built up area and area covered by vegetation.

“heat islands” disrupt climate patterns

what we learned in school: the “large” water cycle



“small” water cycles inland effect local climate

water evaporated on land falls locally in the form of gentle rain

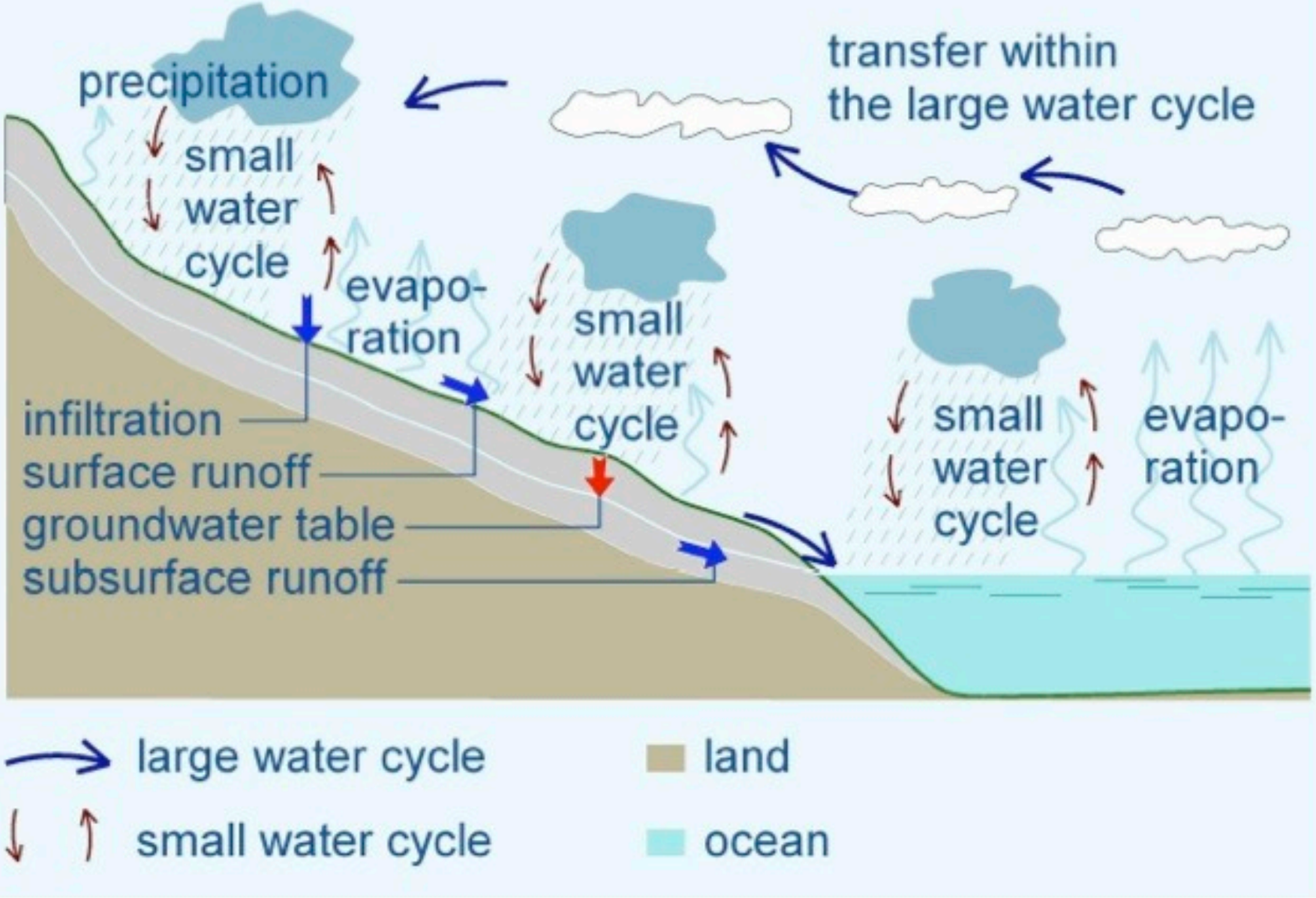


***Fig. 1* The large and small water cycles on land**

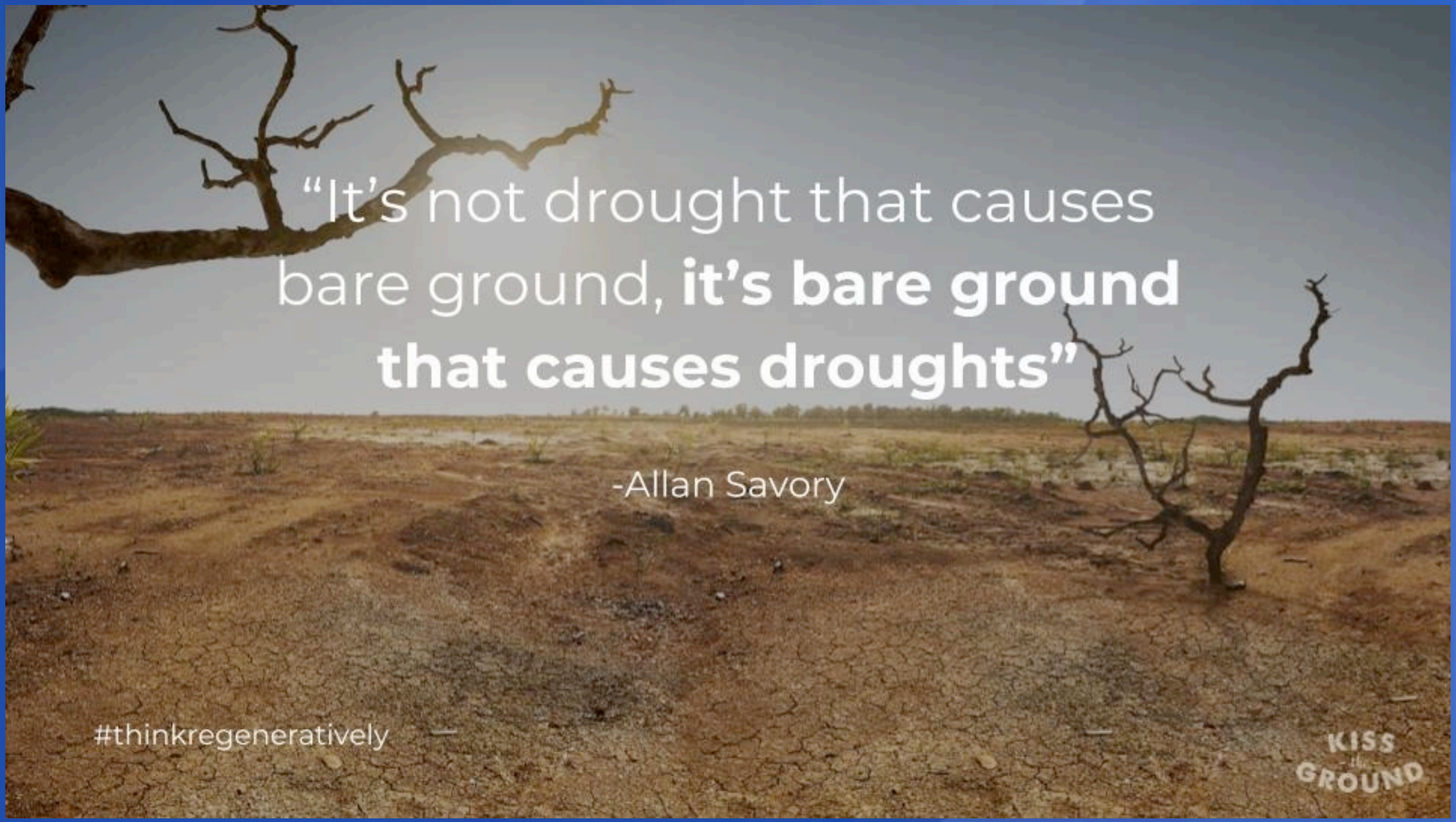
Water for the Recovery of the Climate - A New Water Paradigm

up to two thirds of precipitation on land comes from the small water cycle

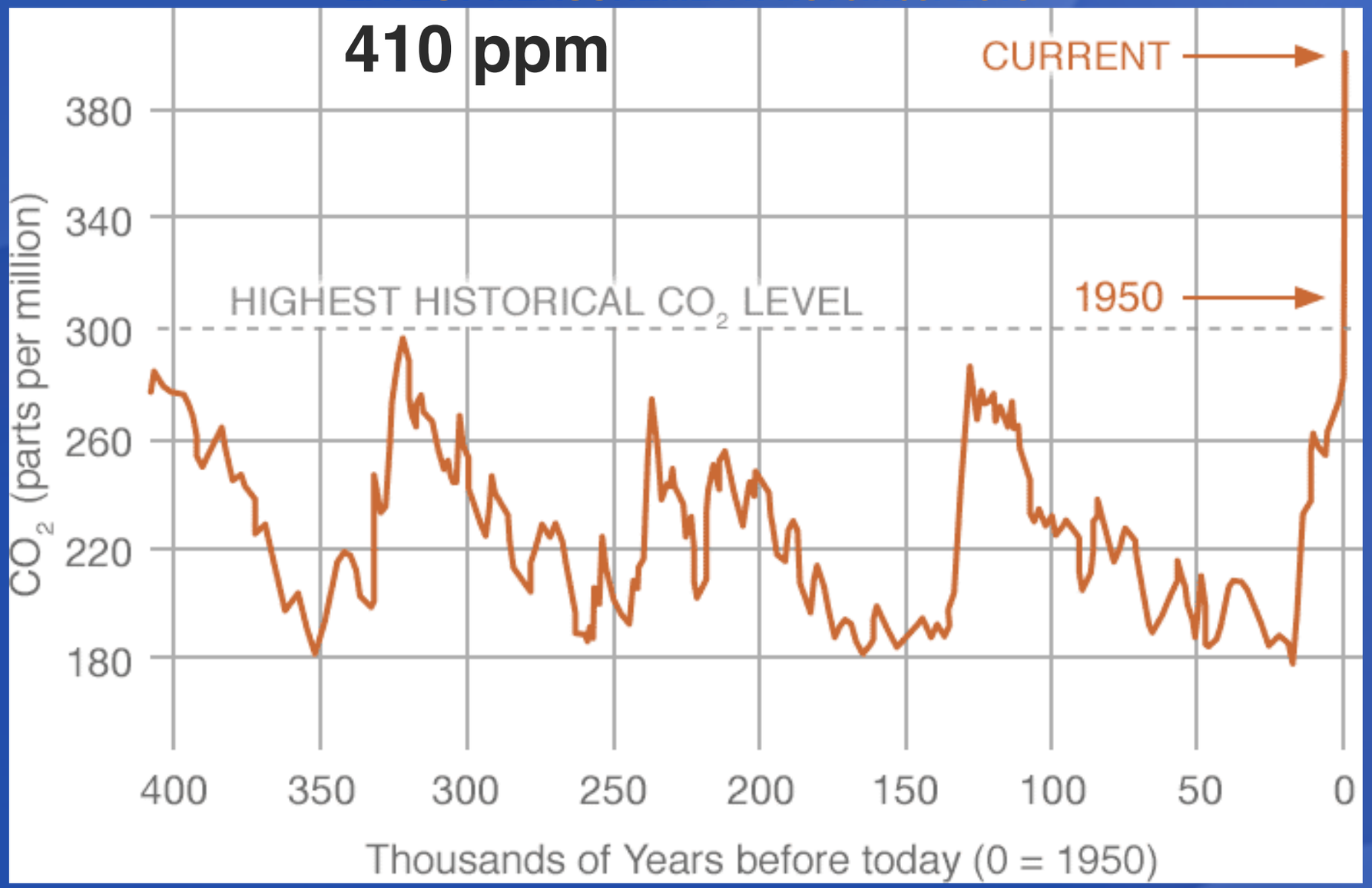
clouds that are formed cool the earth’s surface too

the small water cycle is interrupted

where there is no moisture to evaporate!


"It's not drought that causes
bare ground, it's bare ground
that causes droughts"
-Allan Savory
#thinkregeneratively
KISS the GROUND

some scientists are saying that water vapor is as important a greenhouse gas as CO2



with CO2 we've been a little slow to act

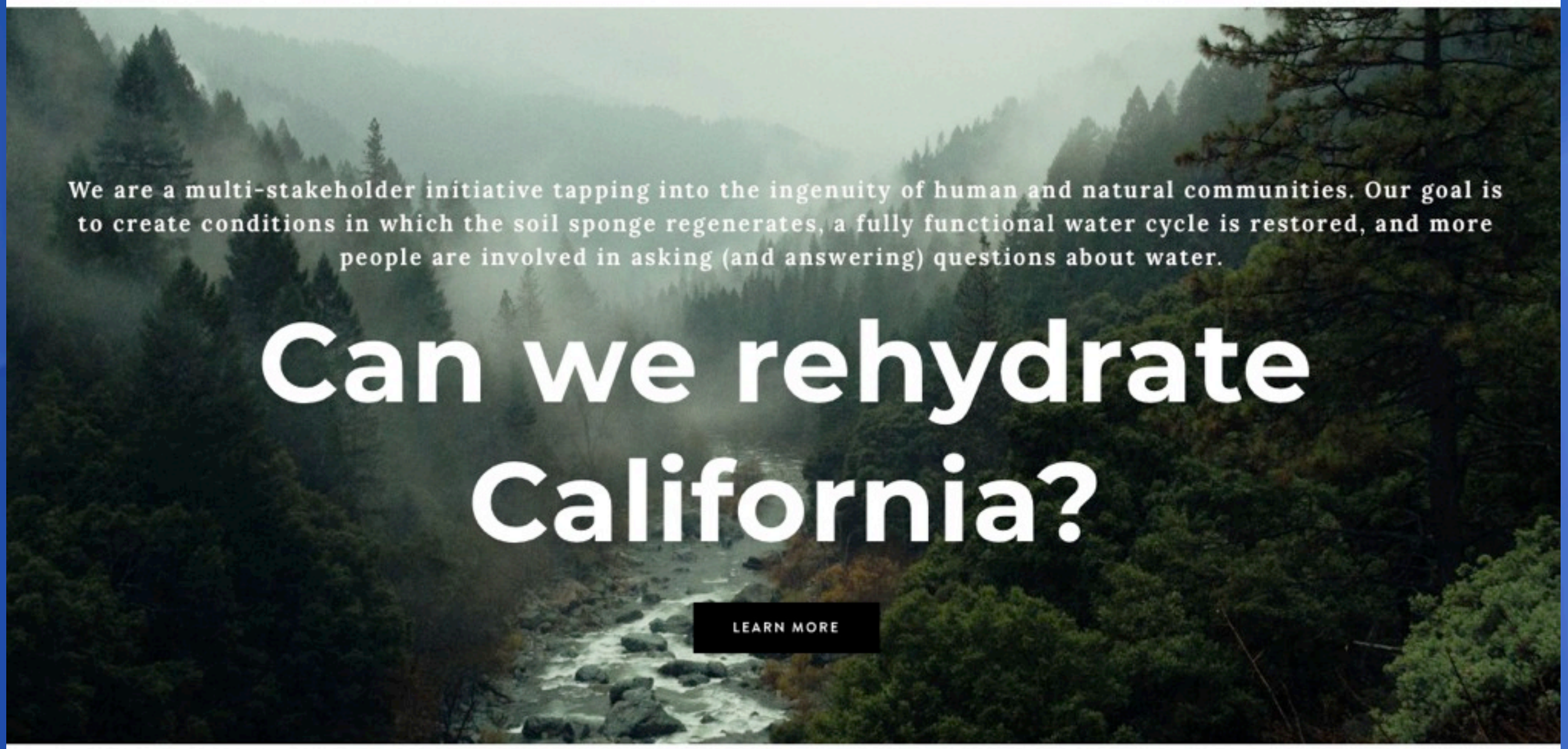
https://climate.nasa.gov/vital-signs/carbon-dioxide/

they say that now
re-hydrating land masses
may be our best leverage point in counteracting climate chaos

human activities have contributed to the drying of the world’s land masses

By understanding the water cycle and regenerating landscapes we can rehydrate and naturally cool our climate

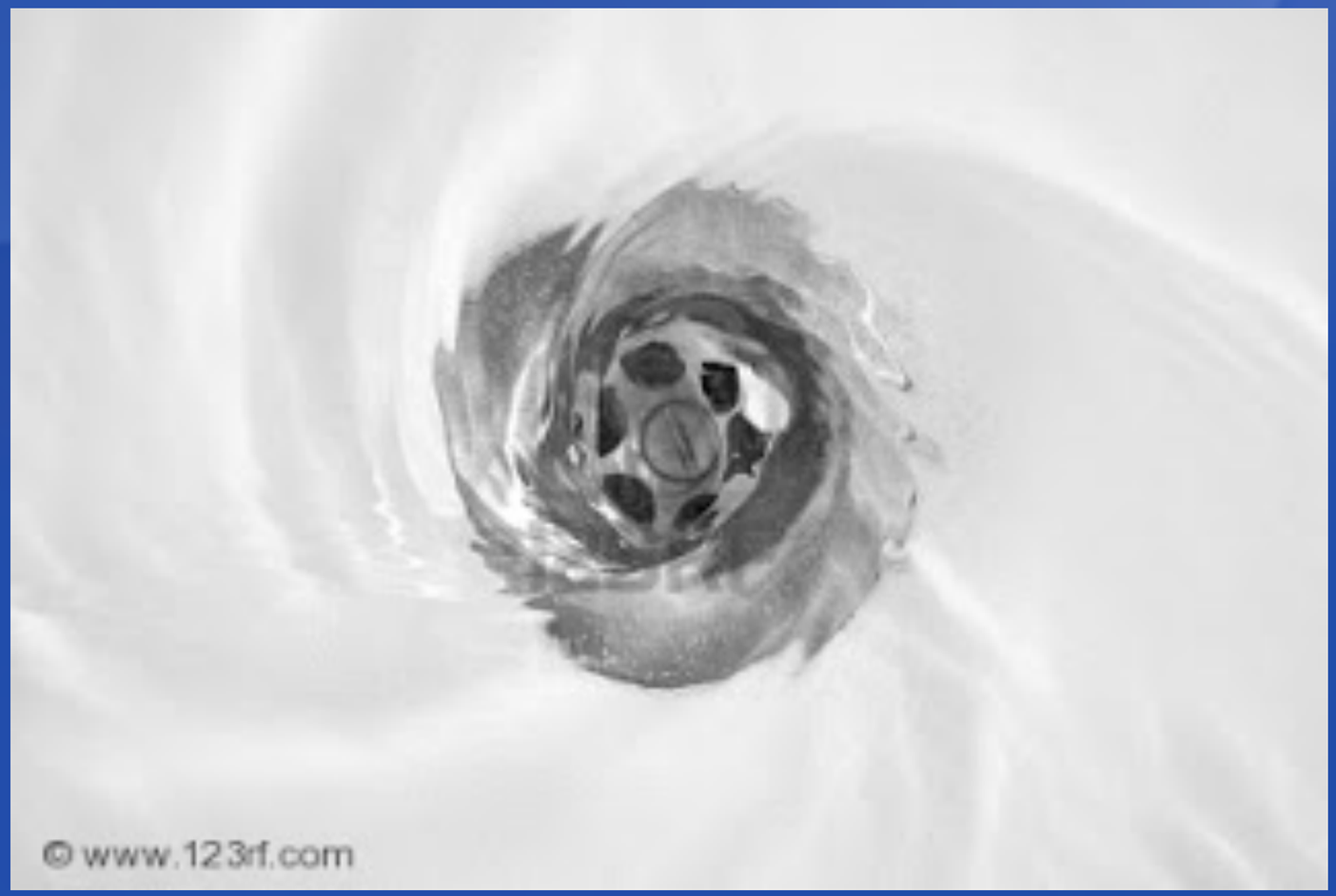
http://www.rehydratecalifornia.org



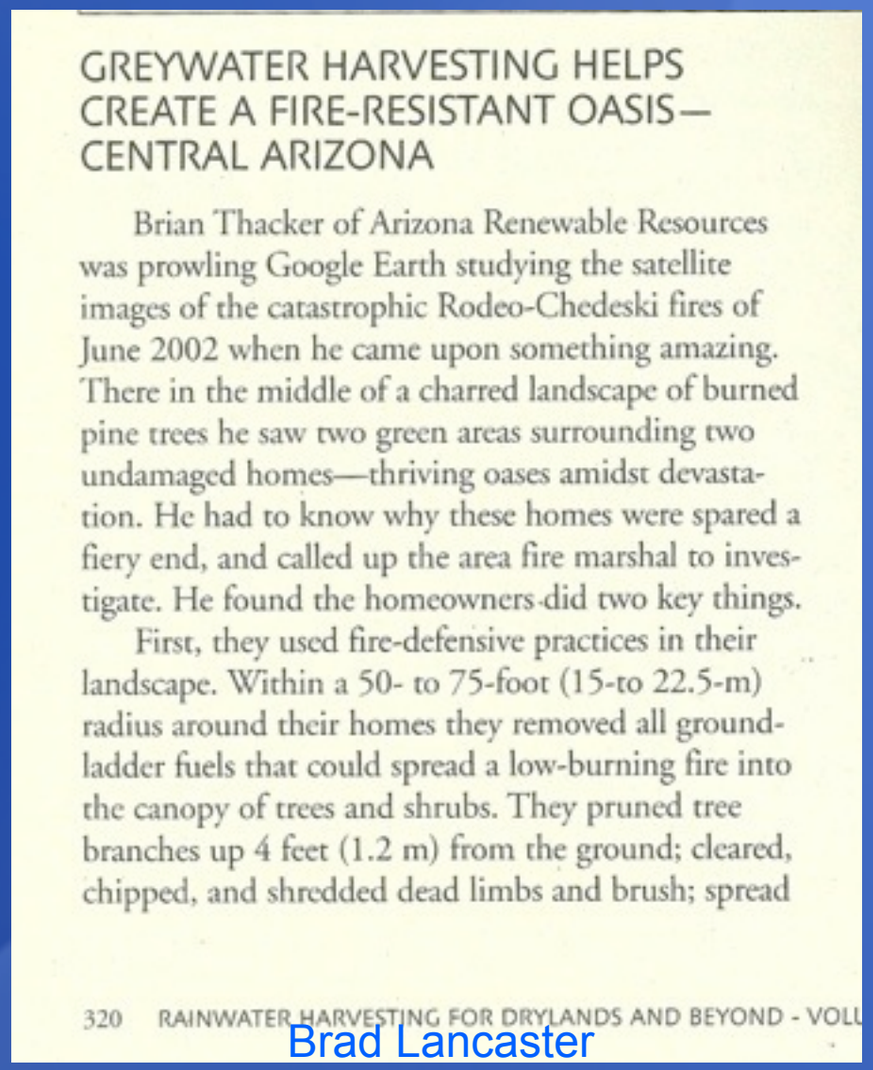
What could rehydrating California do?

takeaway:
get that greywater into the soil
growing plants year round

contributing transpiration and soil evaporation to the small water cycle--
helping to rehydrate the land



and just possibly
protecting your residence from fire:



GREYWATER HARVESTING HELPS CREATE A FIRE-RESISTANT OASIS—CENTRAL ARIZONA

Brian Thacker of Arizona Renewable Resources was prowling Google Earth studying the satellite images of the catastrophic Rodeo-Chedeski fires of June 2002 when he came upon something amazing. There in the middle of a charred landscape of burned pine trees he saw two green areas surrounding two undamaged homes—thriving oases amidst devastation. He had to know why these homes were spared a fiery end, and called up the area fire marshal to investigate. He found the homeowners did two key things.

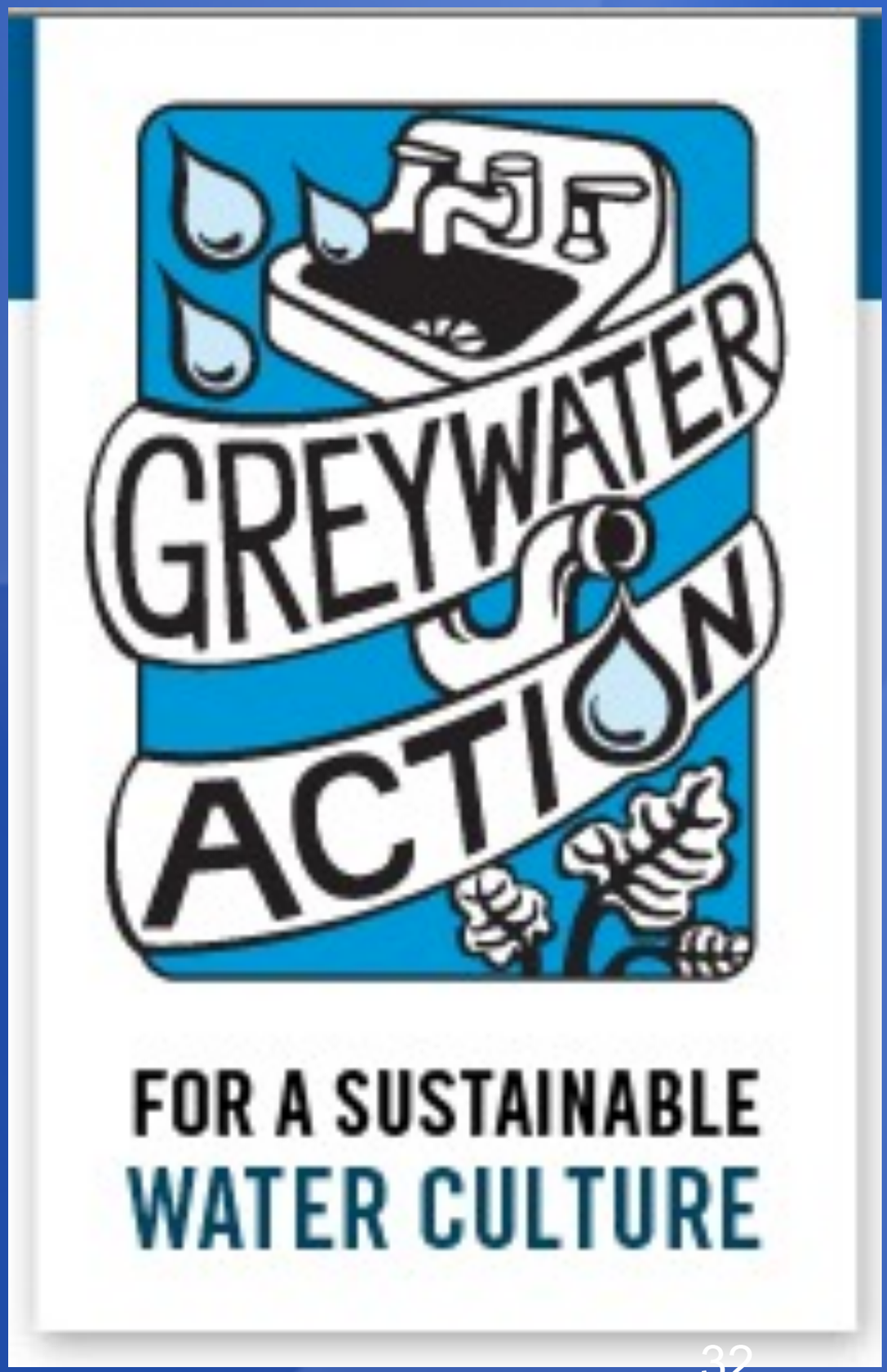
First, they used fire-defensive practices in their landscape. Within a 50- to 75-foot (15-to 22.5-m) radius around their homes they removed all ground-ladder fuels that could spread a low-burning fire into the canopy of trees and shrubs. They pruned tree branches up 4 feet (1.2 m) from the ground; cleared, chipped, and shredded dead limbs and brush; spread

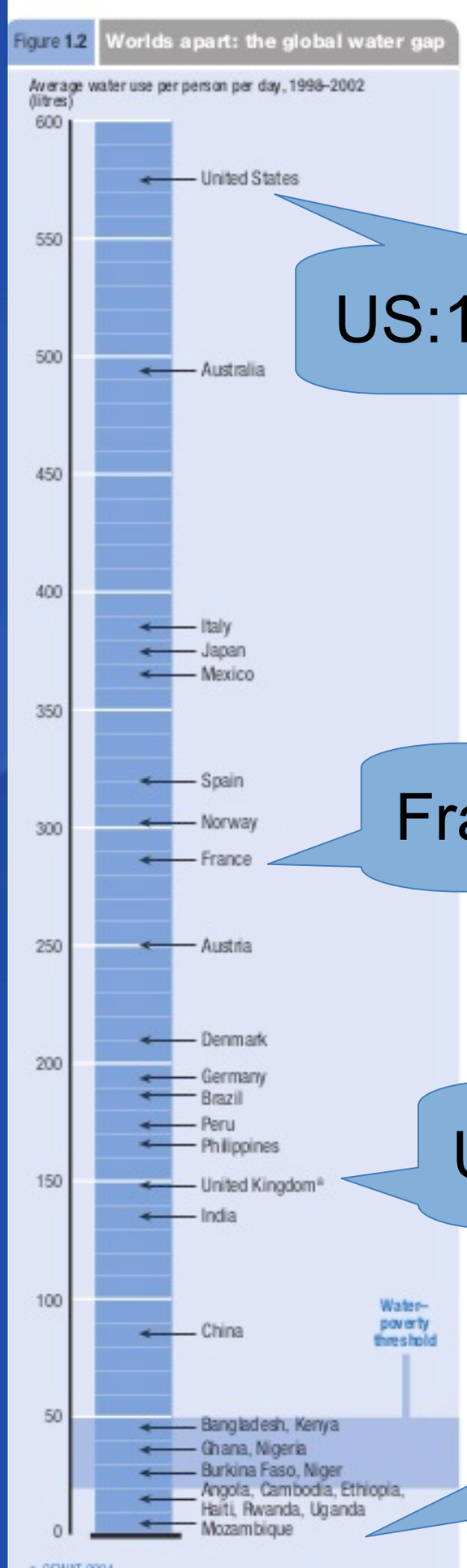
320 RAINWATER HARVESTING FOR DRYLANDS AND BEYOND - VOLU

Brad Lancaster

twice is nice!

re-use that barely used water that goes down the drain!





US:150 gal/person

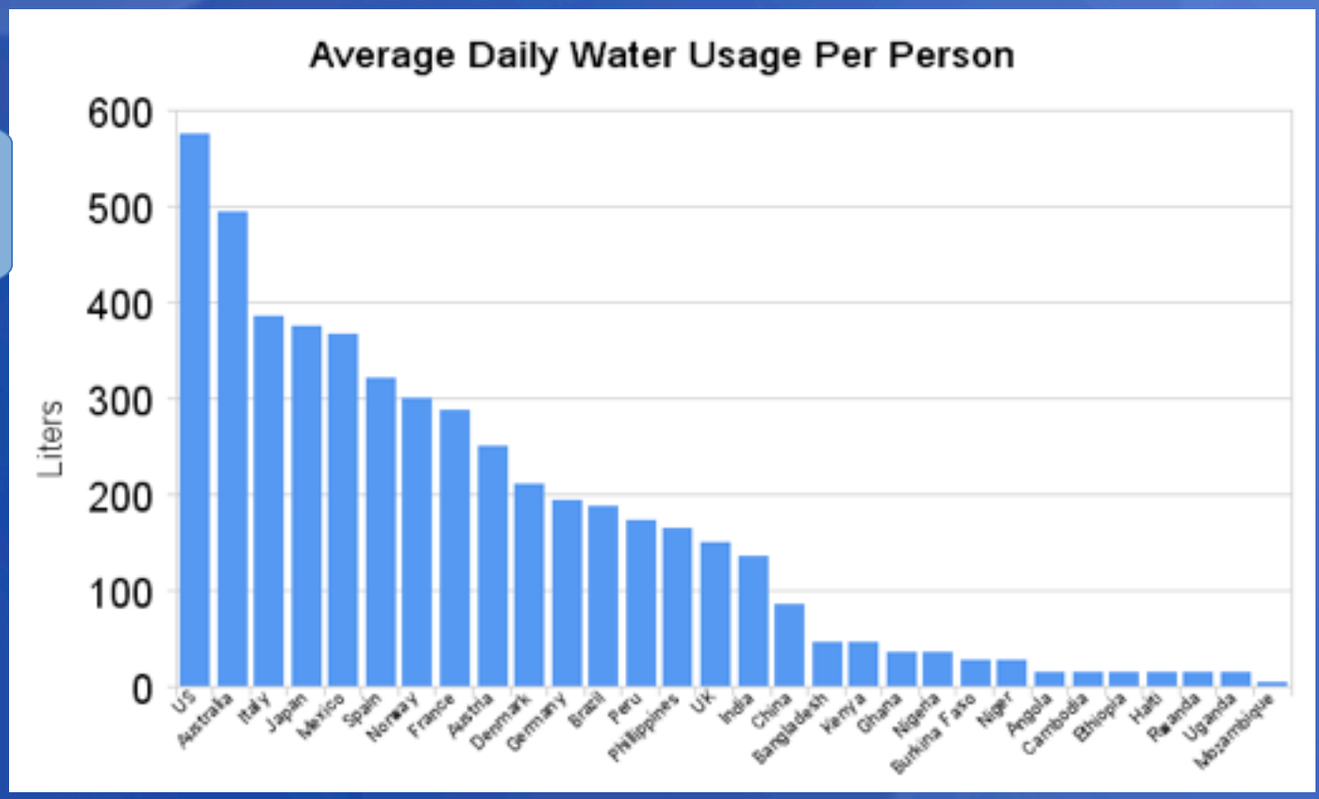
France:76 gal/person

UK: 40 gal/person

Mozambique
1 gal/person

we use an extravagant amount of water so

start with conservation!



Source: UNDP Human Dev. Report 2006

greywater is~

water flowing down the drain

from:

* washing machines
* bathtubs and showers
* sinks
* kitchen sinks (in other states)

blackwater is~ (yucky)

wastewater containing fecal matter or toxins from:

* toilets
* laundry (when washing diapers, greasy rags or fabric with chemicals or when using bleach)
* kitchen sinks or dishwashers (in CA)

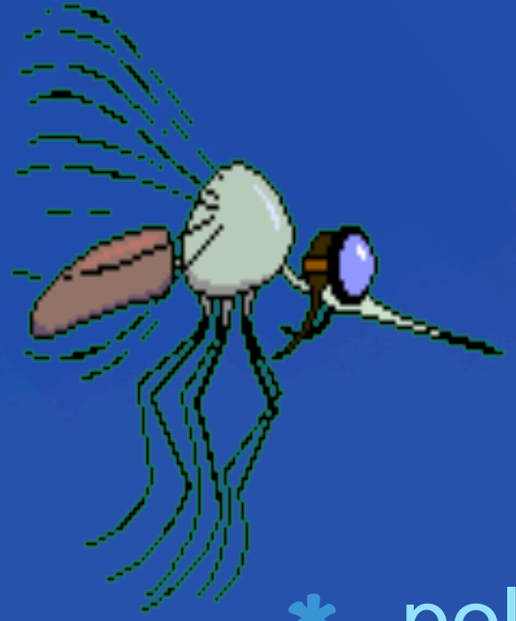
soaps and products

avoid:

- salt (sodium compounds)
- Boron (borate)
- Chlorine bleach (hydrogen peroxide bleach okay)

recommended products:

- liquid laundry detergent: Oasis, ECOS, Biopac, more
- soap alternatives: Soap nuts, “wonder balls”, ozone
- read ingredients: “biodegradable” is not necessarily garden friendly!
- sodium is common in fabric softeners/water softeners



valid concerns

* pollution of creeks, bodies of water, groundwater
* contamination of soil with toxins or salts
* runoff into storm drains or to neighboring property
* exposure to humans by pooling on surface
* mosquitos
* cross connection and contamination of potable water supply

groundrules for greywater re-use

* no contact with people or domestic animals

  ~no spraying or sprinkling
  ~no surfacing or daylighting
  ~no ponding or runoff

* discharge point covered with 2” of mulch, gravel, soil or a solid shield

* no storing for more than 24 hours

* no touching the edible part of a plant

more groundrules

* valve to allow diversion back to sewer or septic
* valve clearly labeled
* operating/maintenance manual that stays with house
* irrigation or disposal field may be a mulch basin
* no toxins down the drain--choosing products carefully

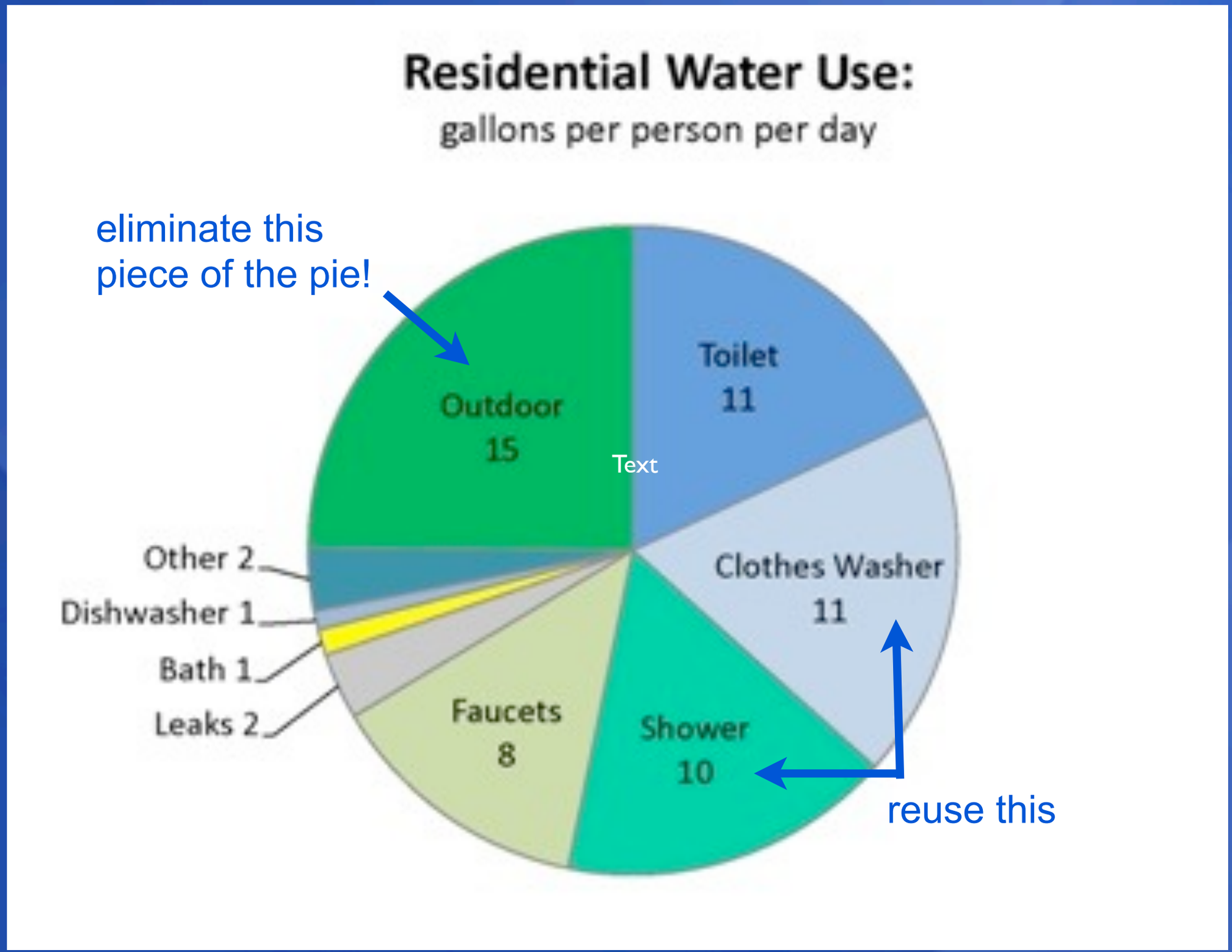
some benefits of using greywater:

- offsets potable water use
- conserves energy (used to pump, transport, clean and treat water)
- encourages healthy product choices
- facilitates home-grown food production
- reduces demand on septic systems and wastewater treatment plants

the EPA says
860 billion gallons of untreated sewage
overflow into US water ways each year.

so even if you have one...
treatment plants don't
always do their job

in santa cruz:

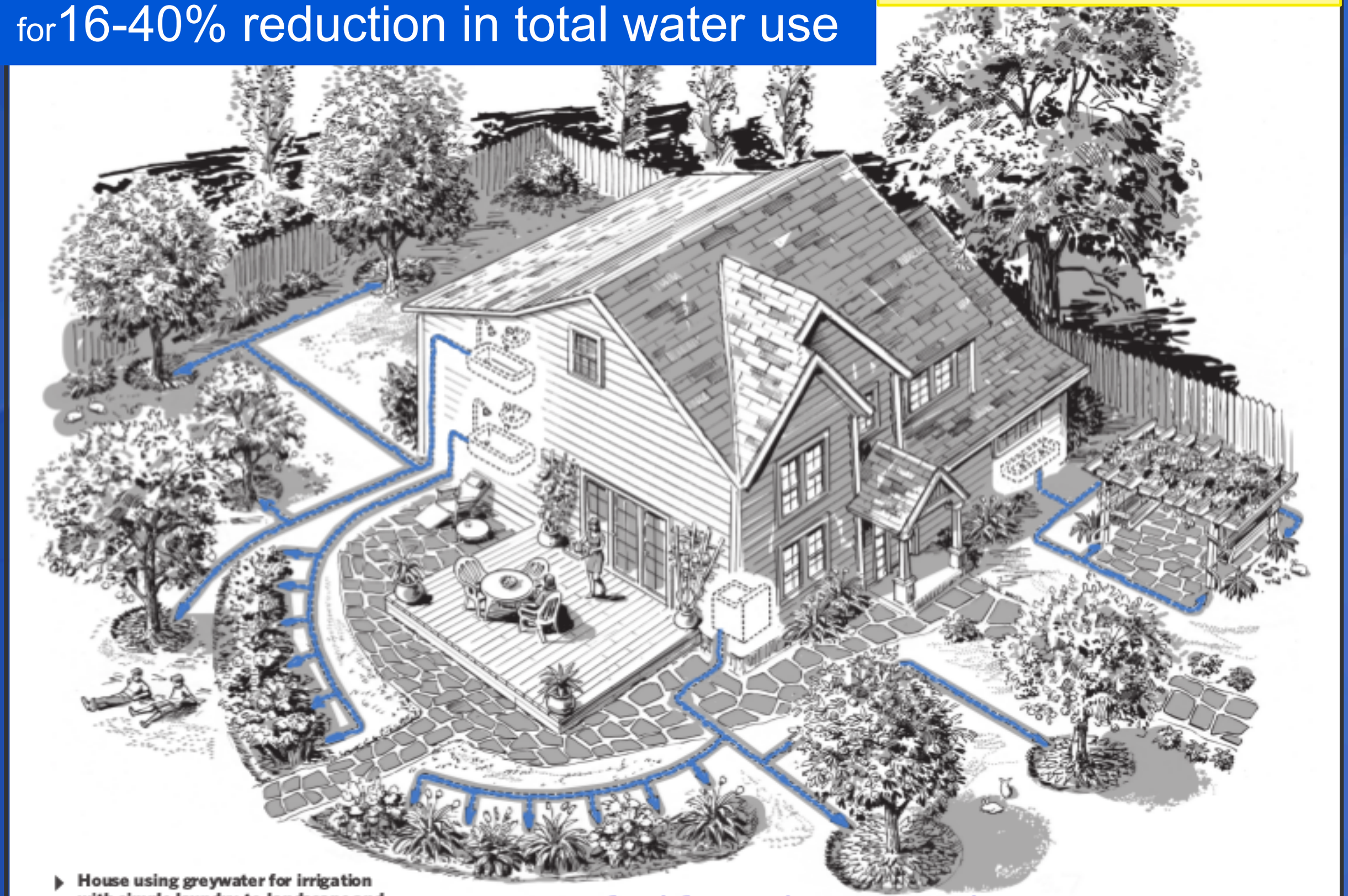


Text

reuse greywater

for 16-40% reduction in total water use

a system for every fixture!



House using greywater for irrigation with simple laundry-to-landscape and gravity-fed systems

diy informal greywater use
lowest tech: the humble bucket

- collect cold water until shower heats up-- pour into toilet bowl to flush
-
- use a dishpan in sink to collect wash water--
- carry outside to water the garden

bathroom sinks:
~disconnect the trap
~use greywater
to flush the toilet

tank lid sinks:

tank refill water becomes greywater as hands are rinsed

greywater is then “reused” to flush the toilet

As seen in Work Bench Magazine (2/08) Top Ten Innovations of ‘08

homeowner creativity:

utility pump pushes tubwater to garden

renter's laundry drum system
(not to code)

Laundry hose put out window

30-50 gallon food grade drum
"surge tank"...
does not store greywater

Greywater gravity flows out garden hose (no shut off)

outdoor washer + standpipe for every tree!

dual drain washing machine box--one to septic/sewer,
one to garden

ways to use greywater

* outdoors for irrigation:

  ~landscape direct to mulch basins
  no added pumps or filters

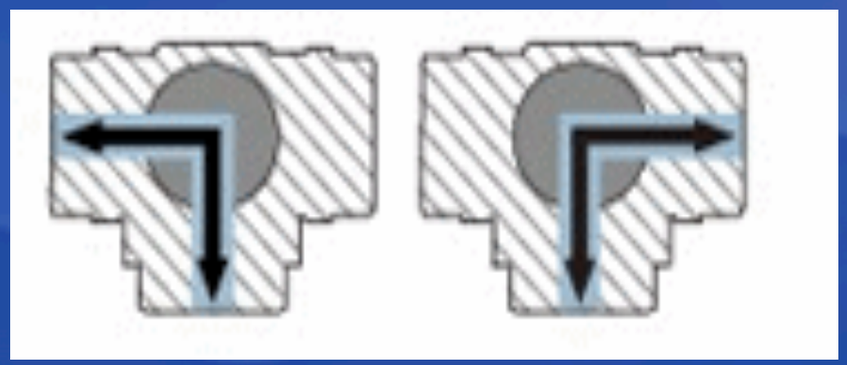
  ~pumped to mulch basins

  ~pumped and filtered to drip irrigation
  tanks, pumps, filters, automatic backflushing,
  potable water connectin

* indoors for toilet flushing
  tanks, filters, disinfection, pumps

“three way” diverter valves

control the flow of greywater either
to the landscape or
to the sewer/septic system
installed downstream from vent (not in trap arm)



1” for laundry to landscape

1-1/2” or 2” for tub/shower/sinks
Pentair or Jandy pool valves

mulch basins

distribute the greywater
preventing ponding or
runoff

adding coarse mulch

best for:
trees
shrubs / vines
large plants

too bulky for:
lawns
groundcovers
beds with many small plants

mulch irrigation basins

serve as a bio-filter that captures particles
large coarse material (woodchips) are best
basins must be large enough so greywater
spreads and soaks into ground~

- in clay soil,
  trench 1 sq. ft.
  per gallon
  of greywater
  produced daily

- in sandy loam
  1/2 sq. ft.
  per gallon

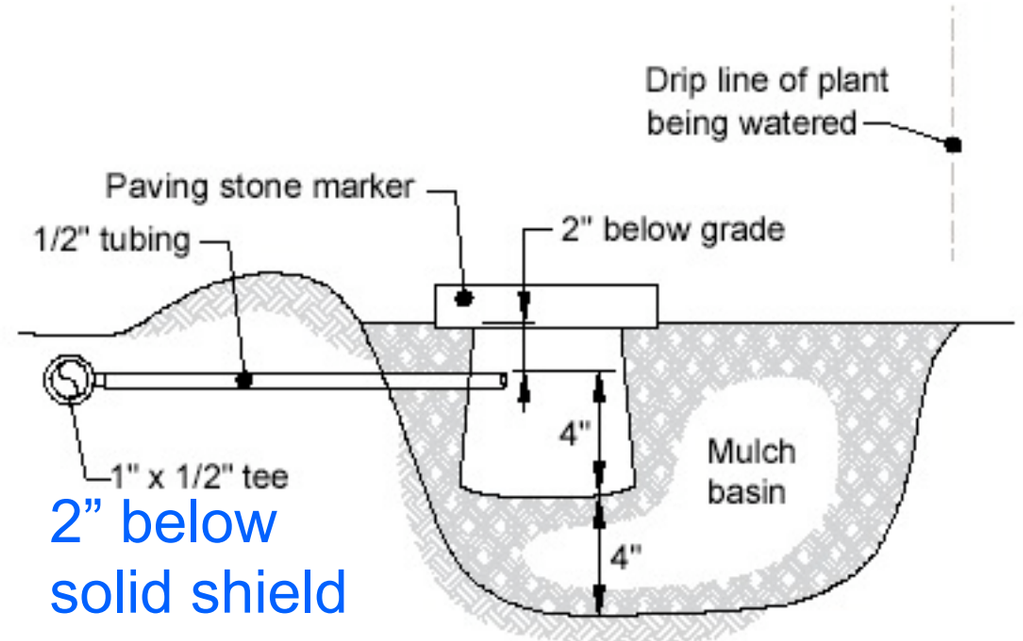
(flat nosed shovel width)

Size of basin
will vary based on
amount of greywater
produced,
number of distribution
points,
and soil type.

photos by Greywater Action

greywater enters mulch basins through a mulch shield

"mulch shield"



2" below solid shield

Figure 4. Mulch shield placement.

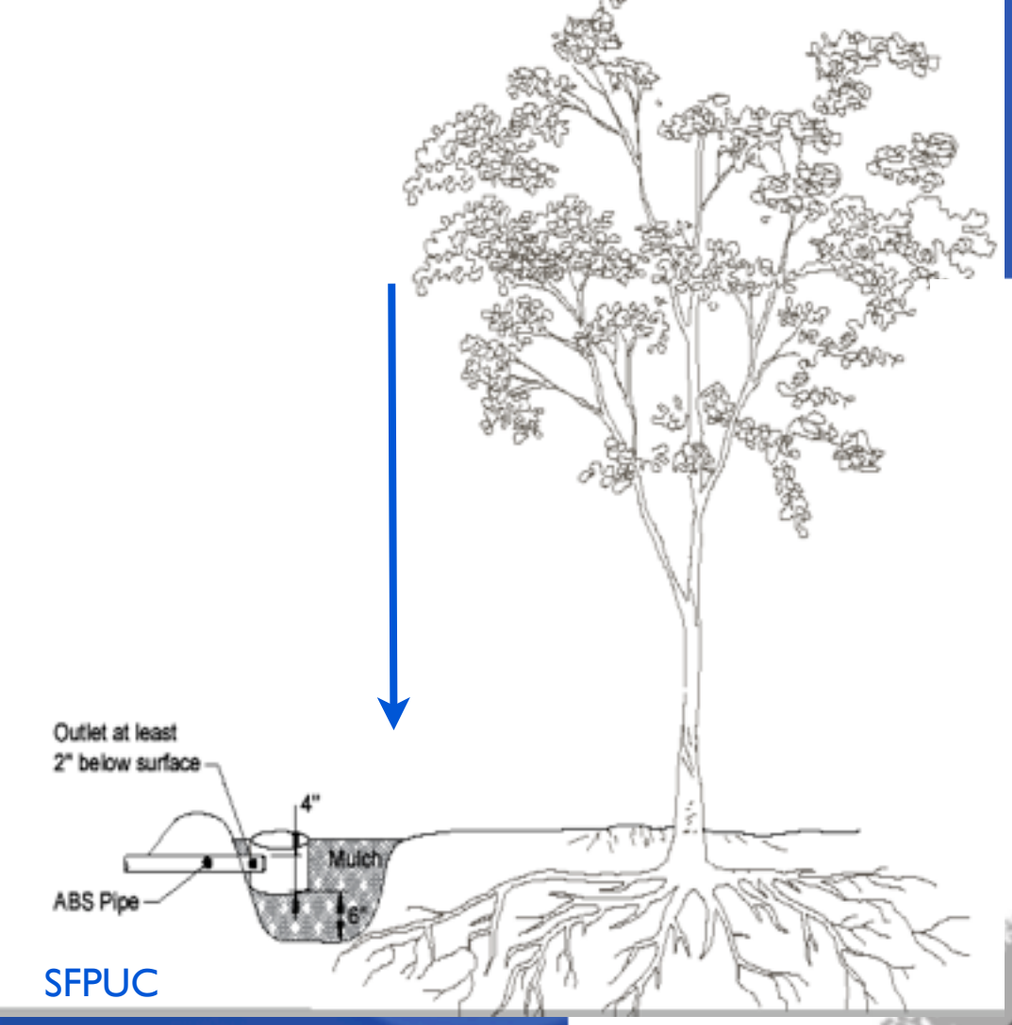
Image from SFPUC manual on greywater

greywater freefalls through air onto mulch placed under shield

spreads and soaks into basin

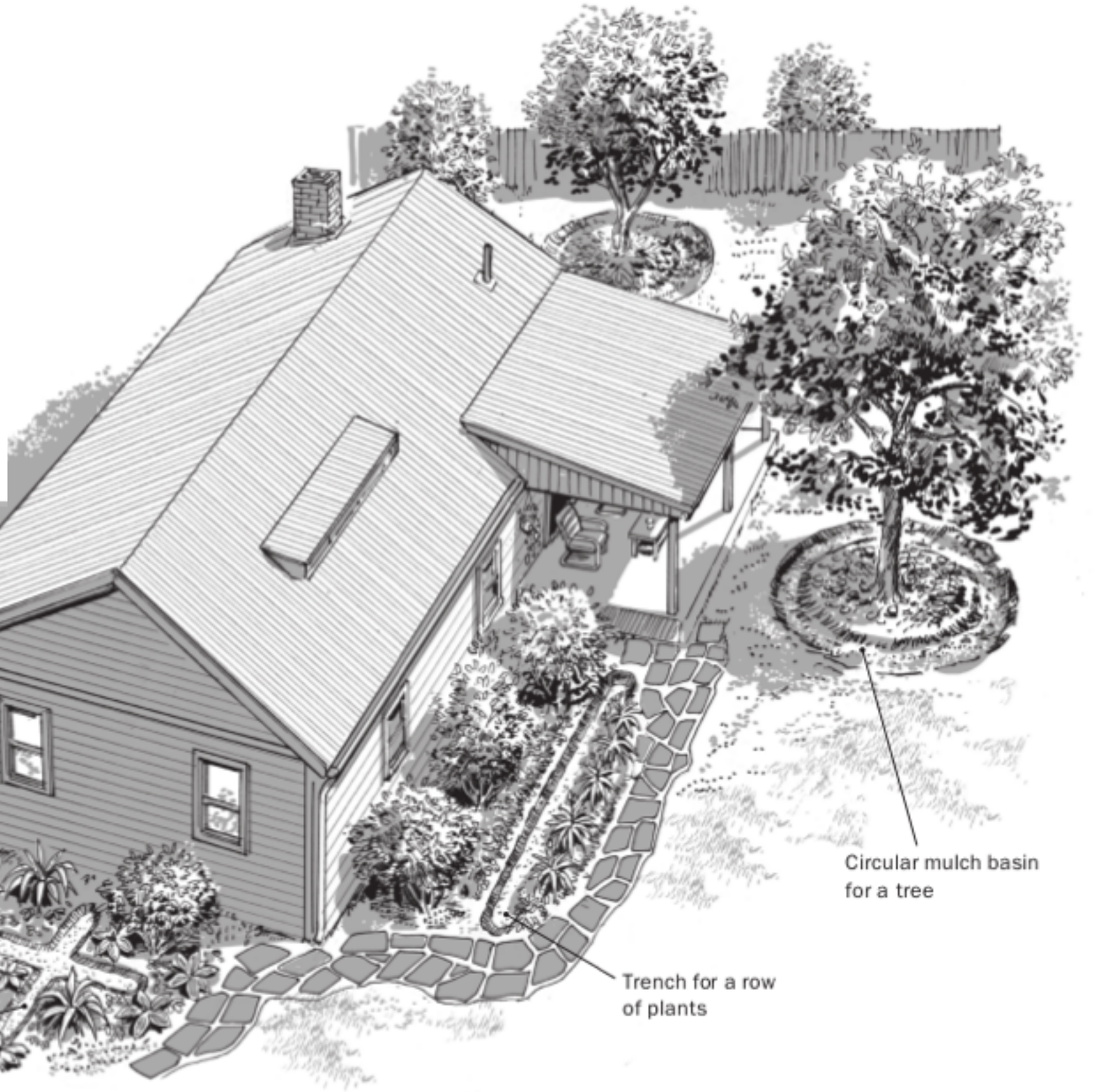
shield prevents roots from clogging outlet, marks location

dig mulch basins at drip line of plants



SFPUC

basins can be different shapes



setbacks for mulch basin irrigation fields

2 ft from buildings

1.5 ft from property lines

100 ft from wells or creeks

5 ft from septic tank

4 ft from leach field

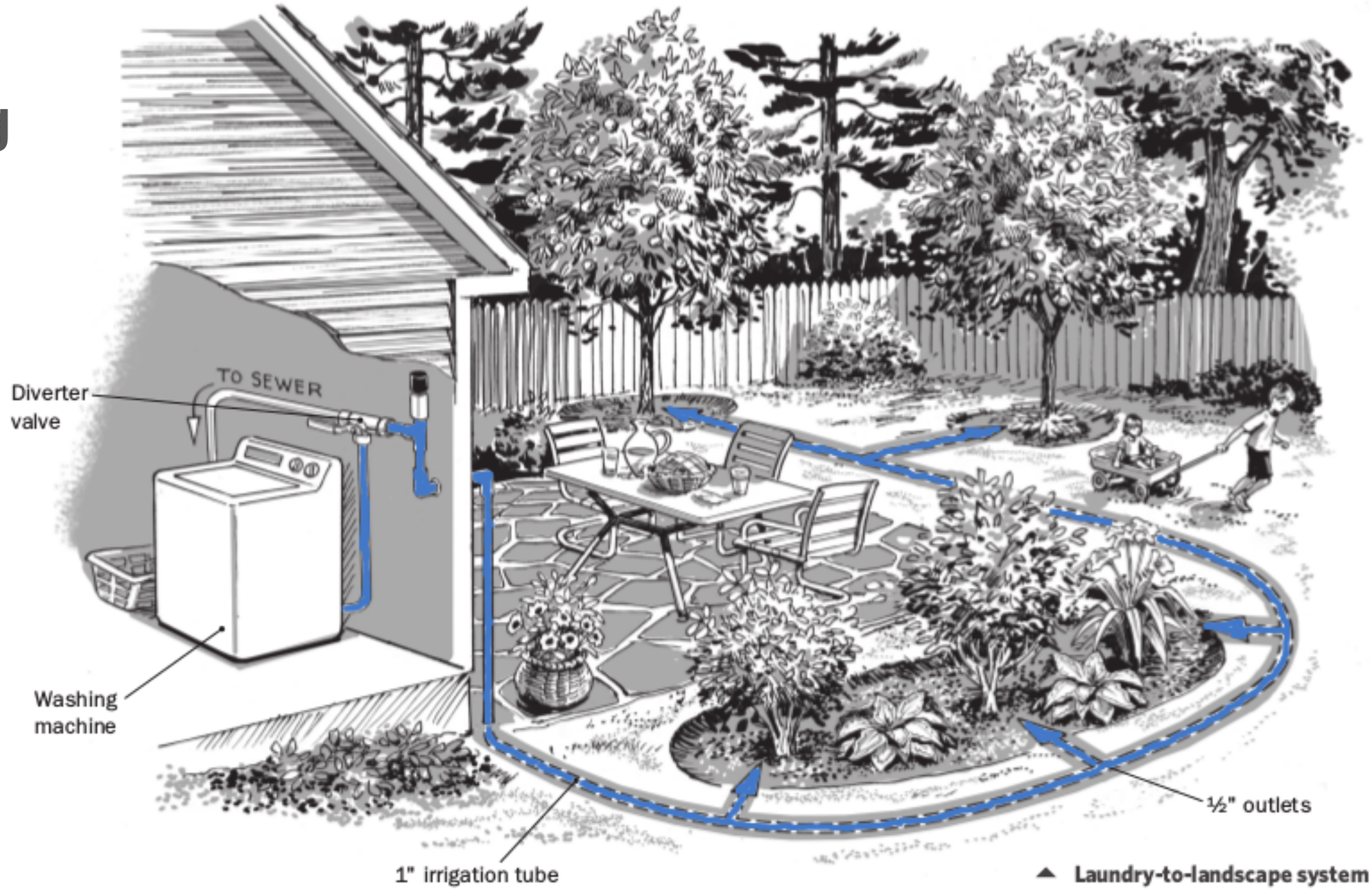
3 ft above groundwater table

easiest!

laundry-to-landscape system (L2L)

= a washing machine system

that doesn't alter the plumbing and doesn’t require a permit (if basic guidelines are followed).



▲ Laundry-to-landscape system

the **pump in the washing machine** pushes the greywater to the garden

laundry to landscape “L2L”:
no alteration to plumbing
no permit required

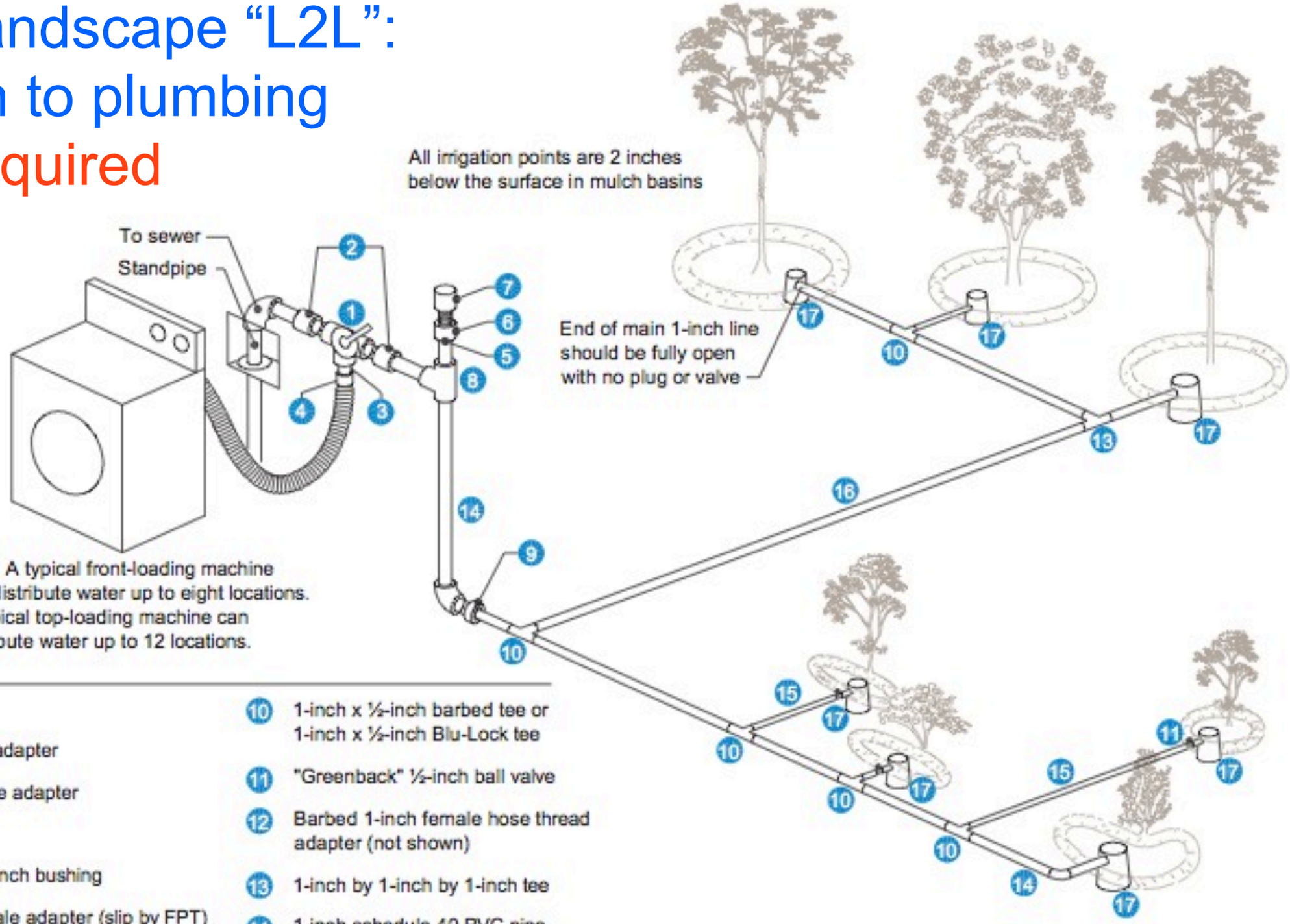


Figure 3. Laundry-to-landscape overview. Source: Clean Water Components.

image by cleanwatercomponents.org

inside the laundry room...

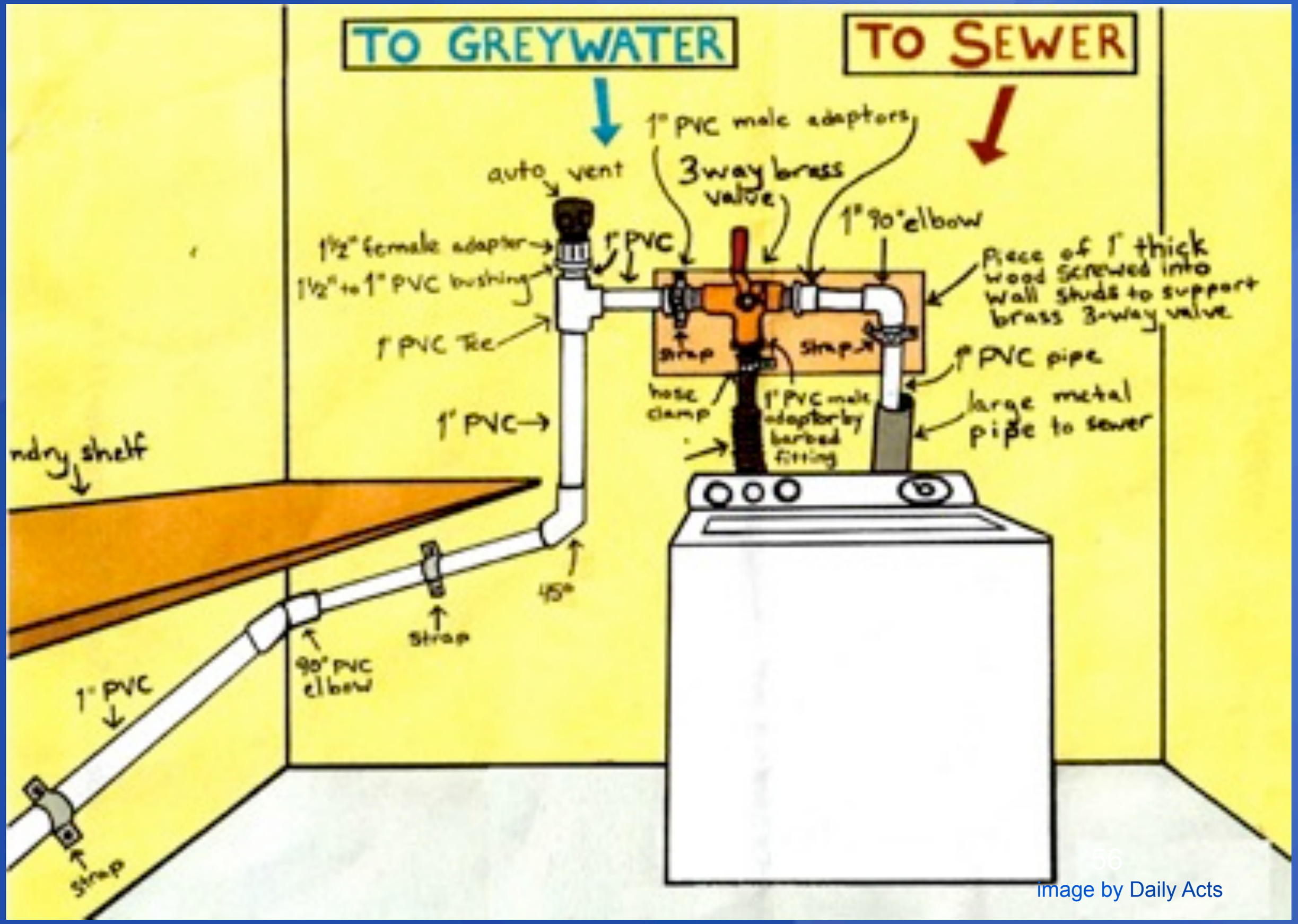
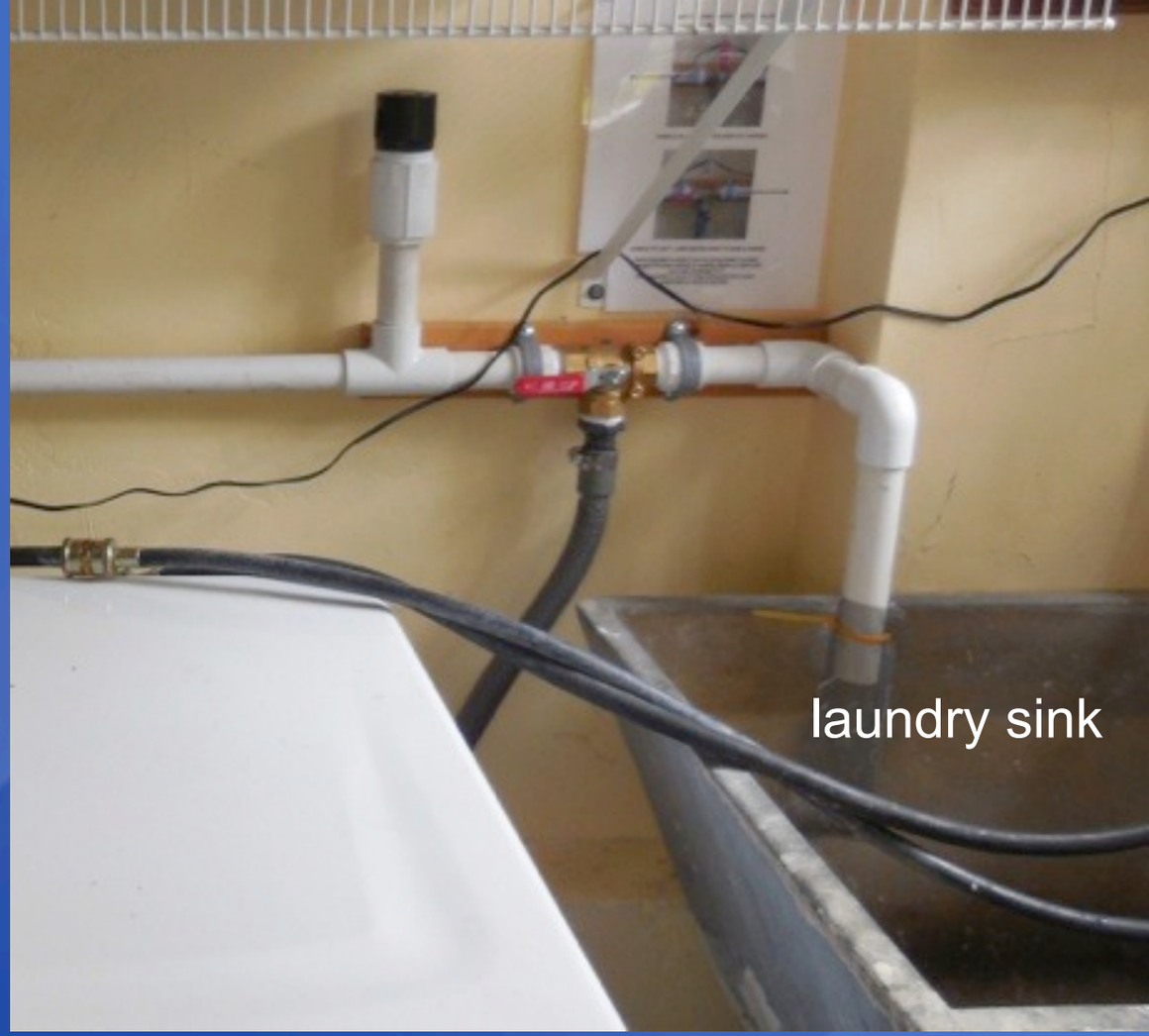


image by Daily Acts

washing machine box



laundry sink

standpipe

1” three-way valve:

(note labeling)

placed higher than top of machine

directs greywater to sewer or to garden

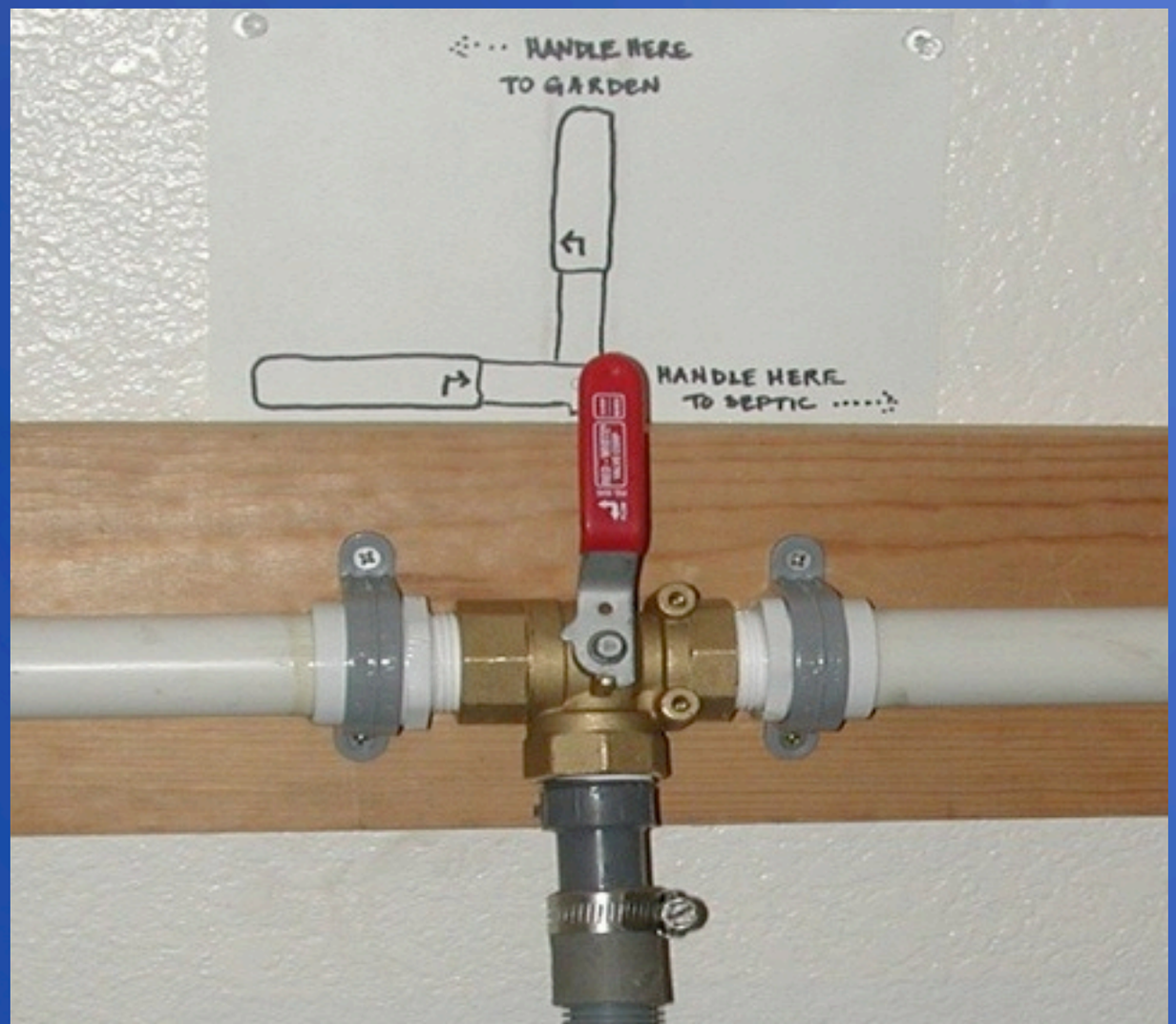
valve must be accessible

even in a tight closet with stacking washer/dryer!

Photo by: Greywater Action

valve must be labeled
explaining
when & how to use it

handle position
is easiest way
to indicate direction of flow



also post instructions
that bleach, diaper water,
or washwater with chemicals
must go to sewer

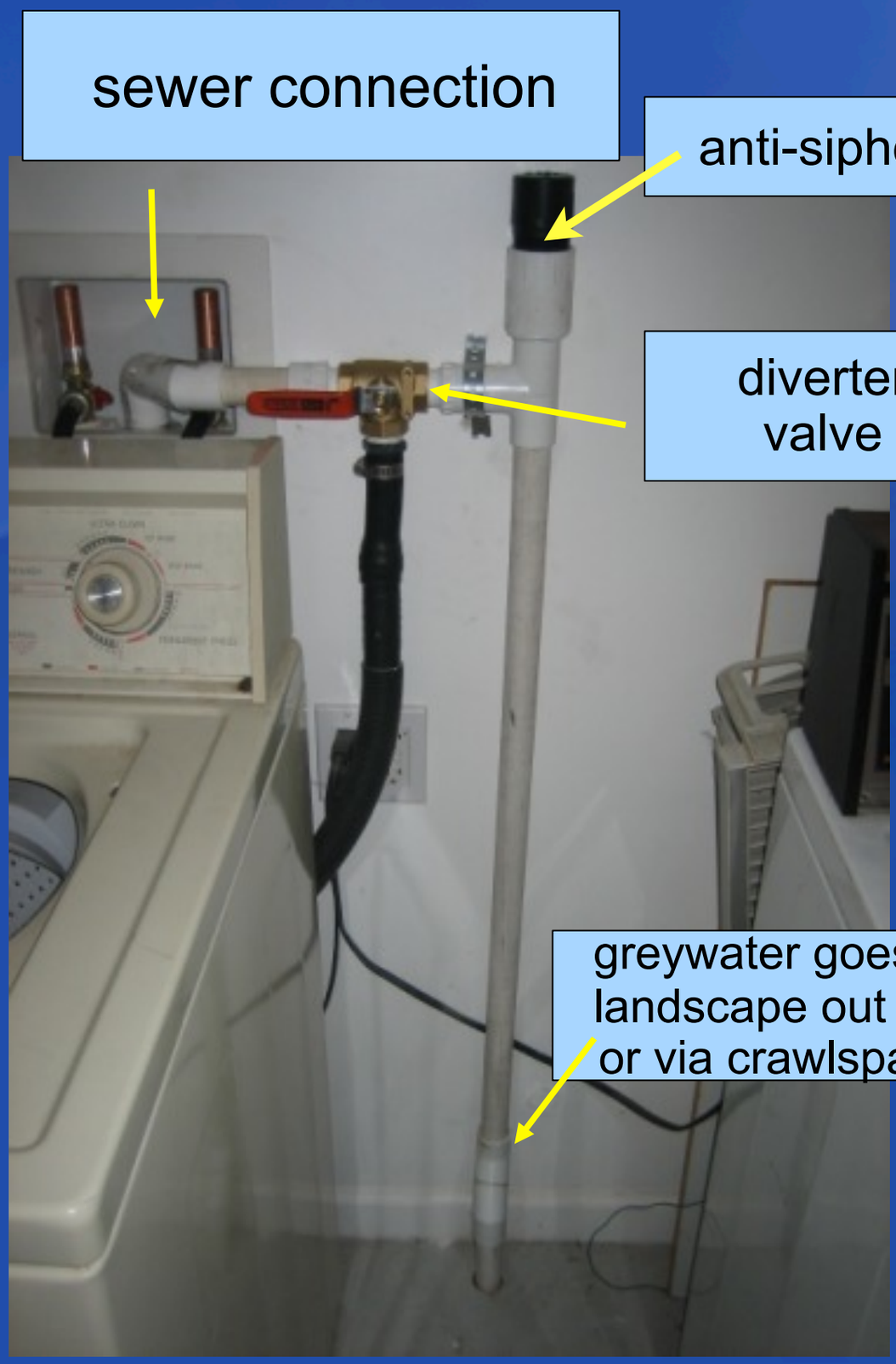
“auto vent” siphon protection

“studor vent”
“air admittance valve”
“inline vent”

~installed at high point
~visible and accessible
~indoors or outdoors

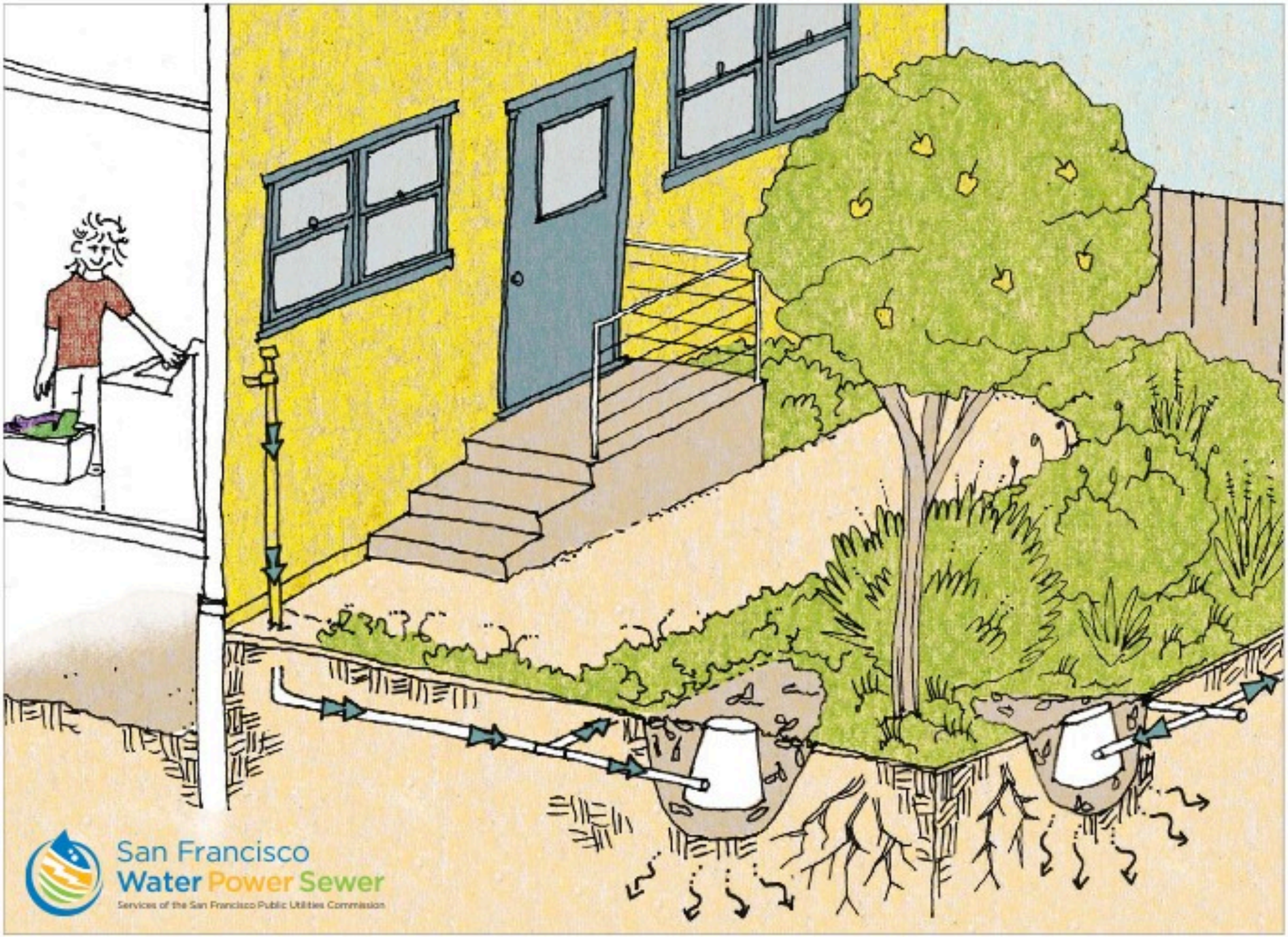
prevents a siphon from forming and draining the machine as it tries to refill

laundry to landscape system



top loading machine: 35-50 gals
can distribute water up to 20 places

front loading: 12-25 gals
can distribute water up to
8 places



SAN FRANCISCO graywaterdesignmanual for OUTDOOR IRRIGATION

L2L outside in the garden:

1” HDPE main

1/2” poly branches to mulch shields... set in mulch basins

uh oh, hardscape!

- go under it
- around it
- cut a strip out of it
- remove it

Photo by: Greywater Action

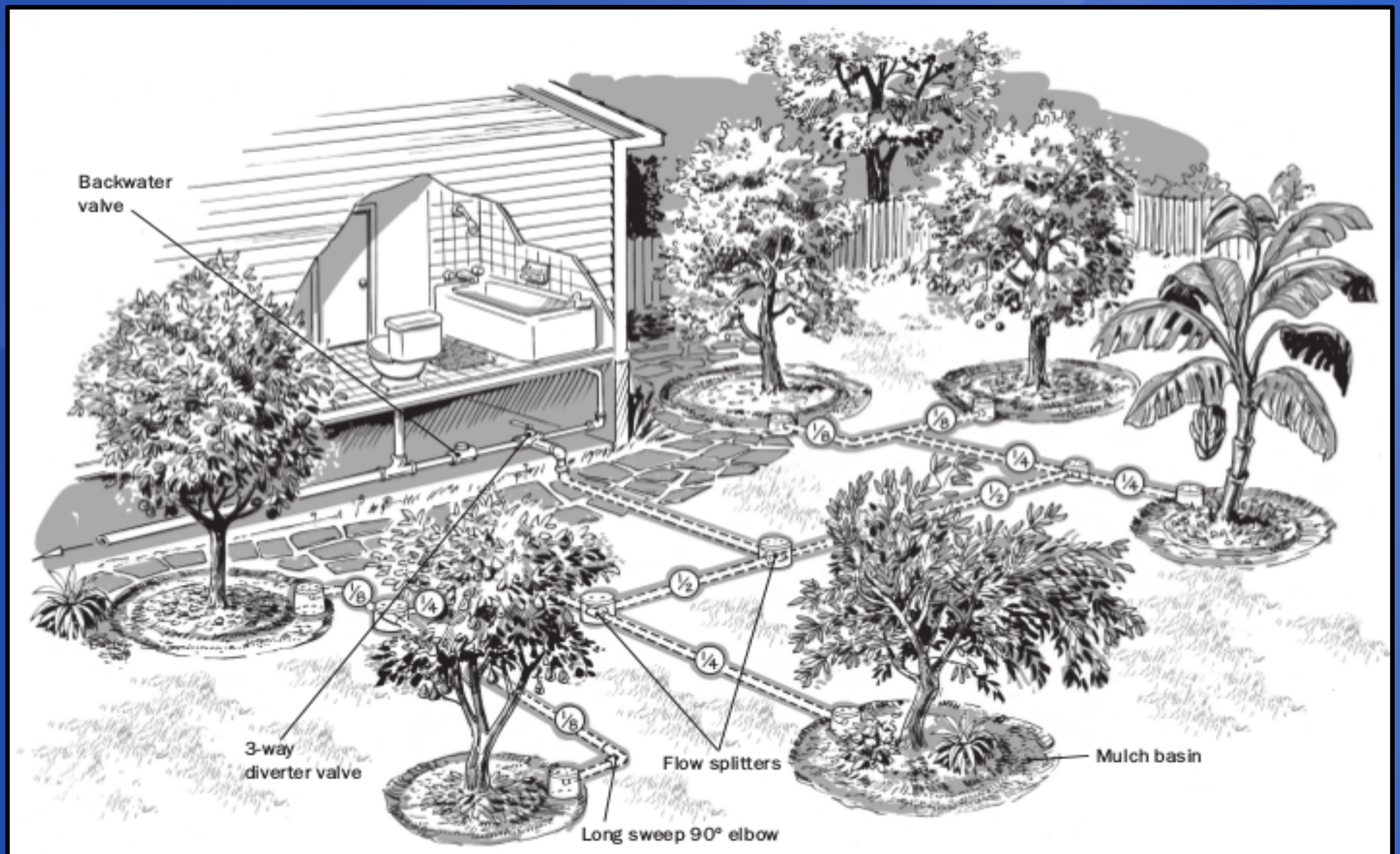
DISTRIBUTING WATER WITH AN L2L SYSTEM

serpentining the tubing
down a slope
before burying it

a while later...

for tubs showers or sinks:

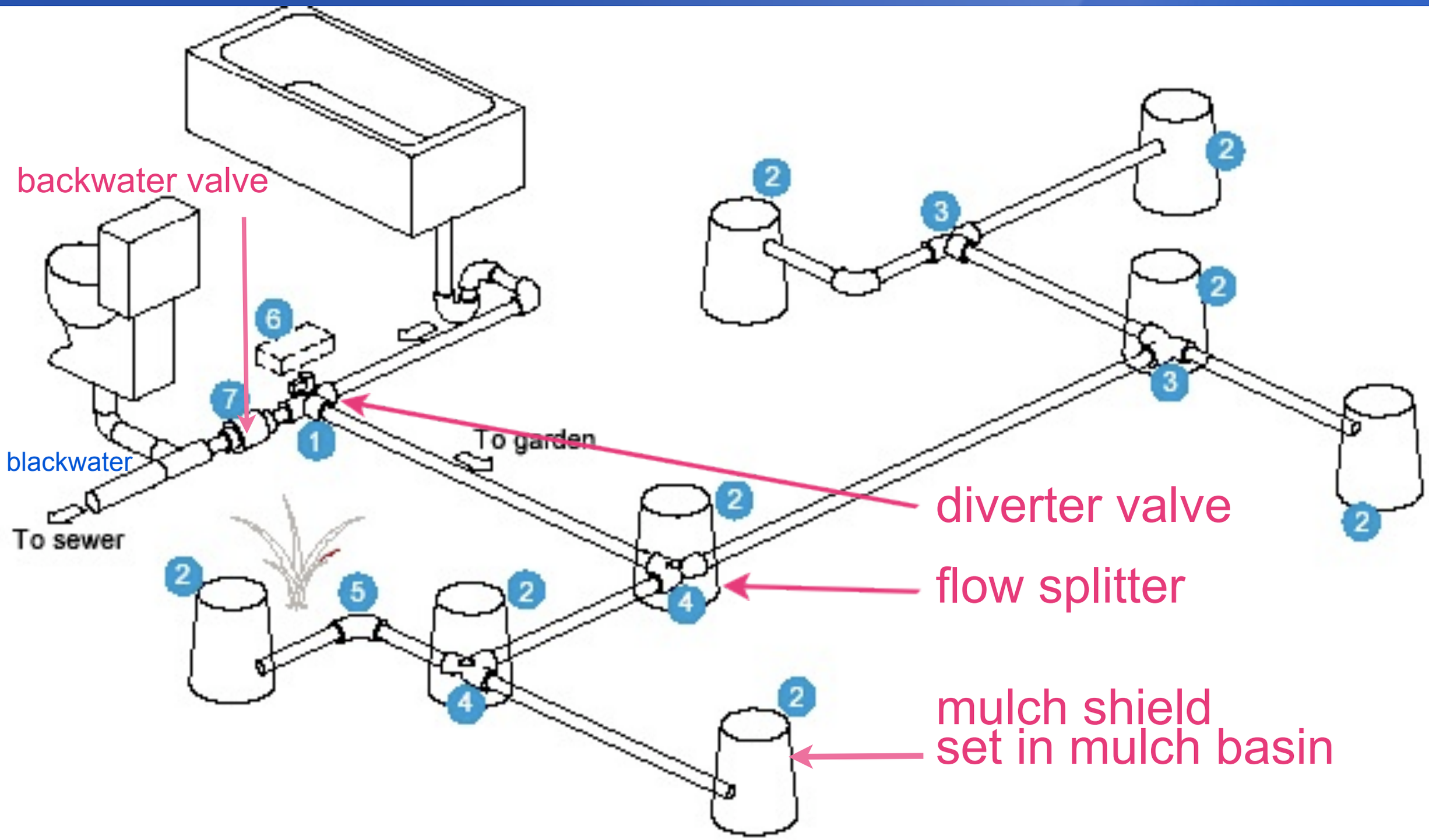
branched drain gravity system



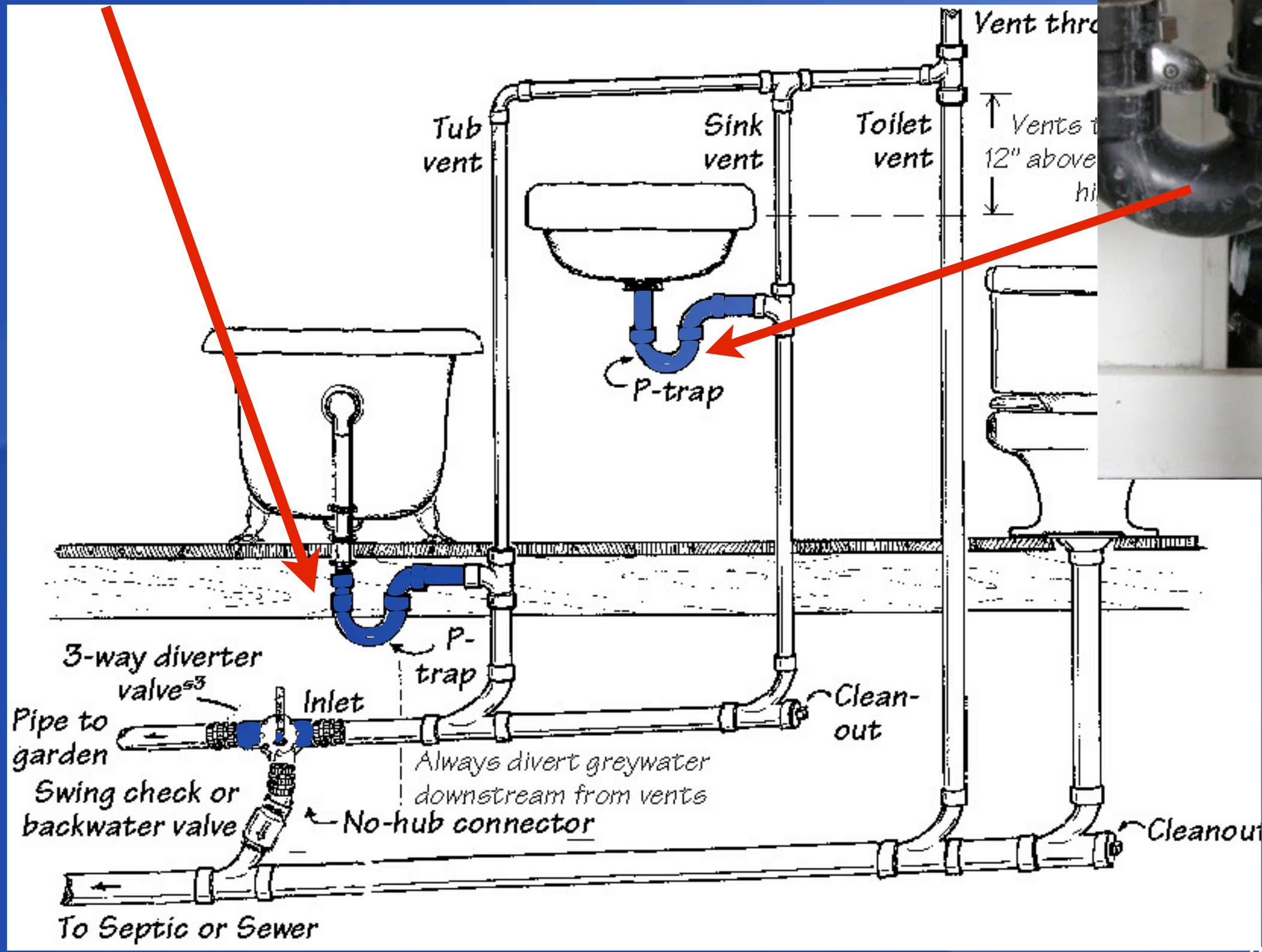
▲ **Branched drain system. Shower water here irrigates six fruit trees. Fractions show how the flow splitters divide greywater flow into halves, quarters, and eighths.**

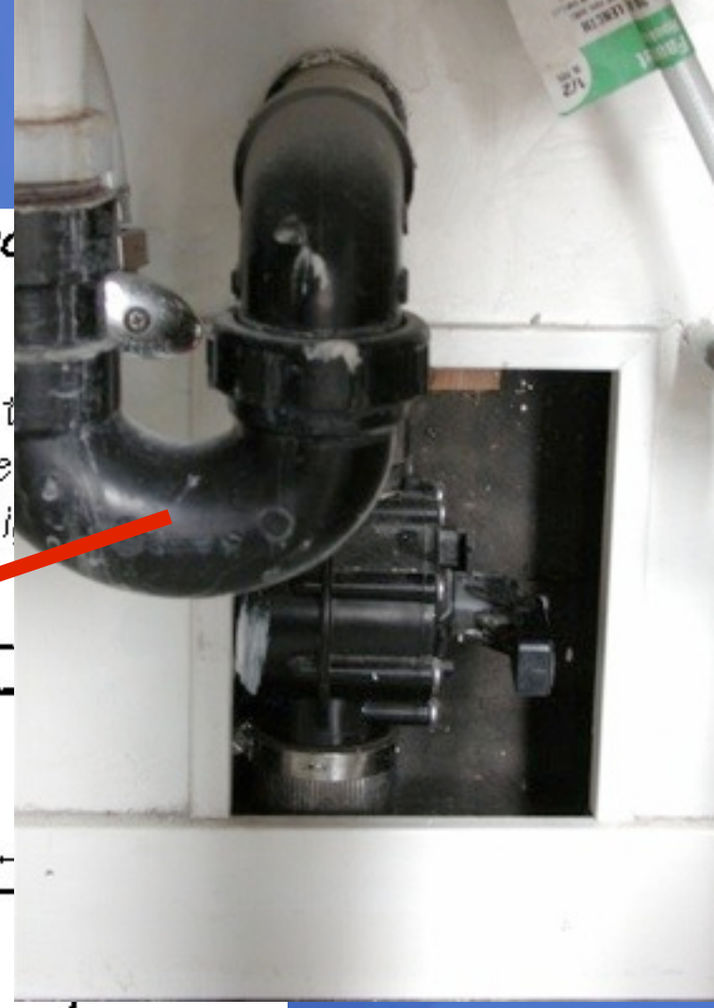
branched drain gravity system

components



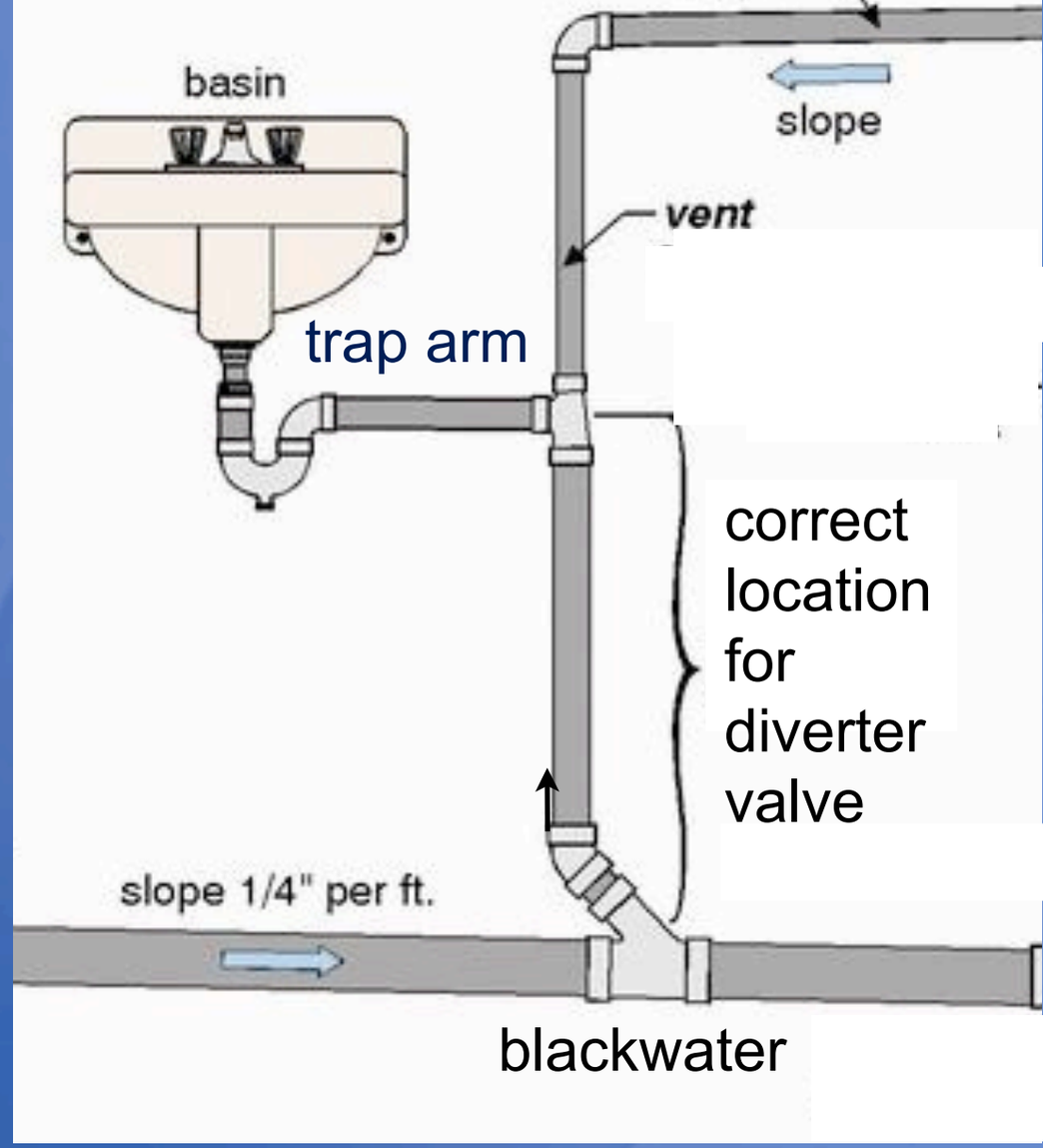
tub/shower traps are below the floor, sink traps above





three way valve is installed before the greywater joins the blackwater

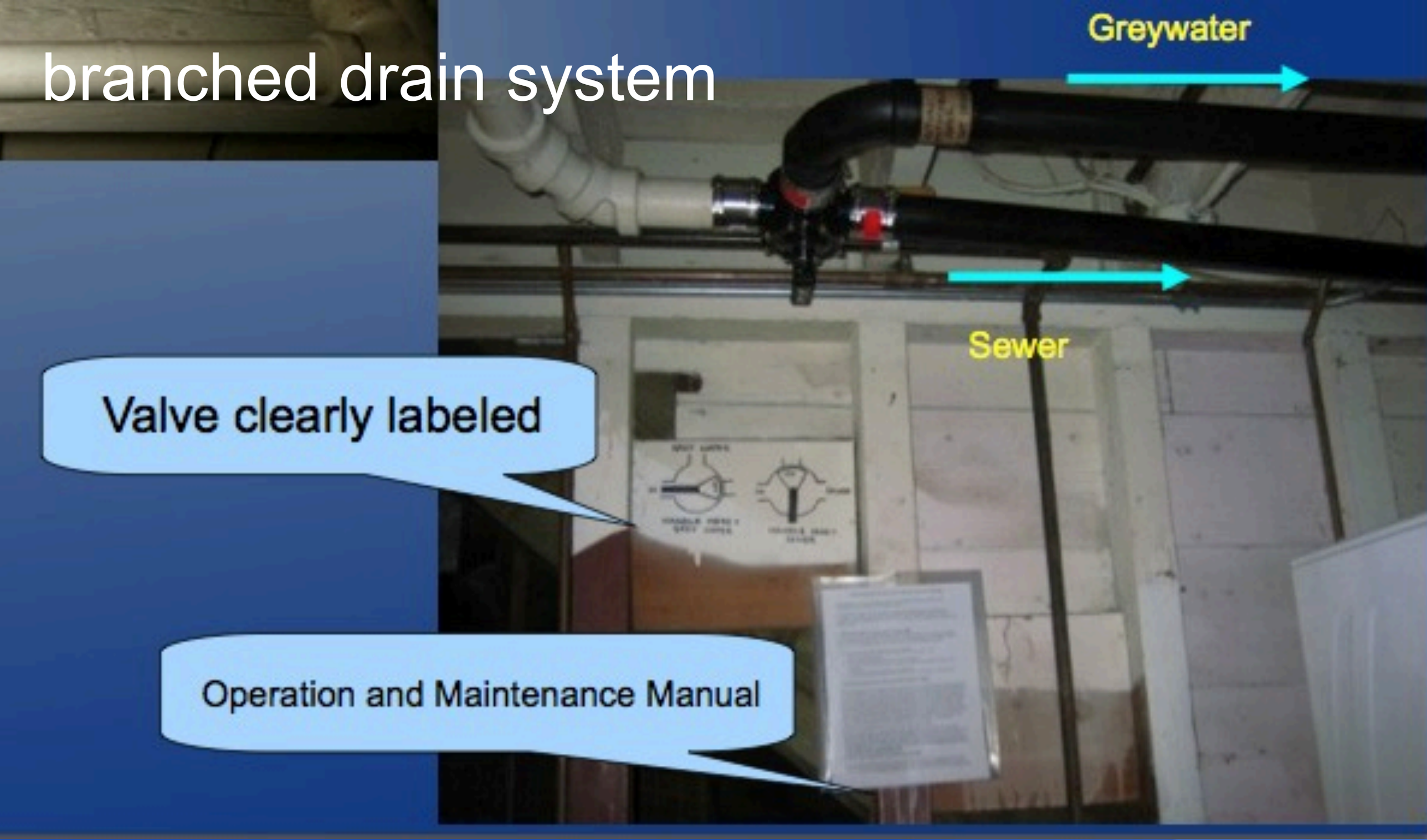
three way valve under sink



correctly installed
in the greywater drain line
“downstream”
from the vent

not in the trap arm

branched drain system



~drain pipes must be accessible (slab won’t work)
~greywater piping to garden must have continuous 1/4” slope
~be able to pass over or go through perimeter foundation

branched drain systems often need

electronic “actuators”
for inaccessible valves:

switch is mounted
in more convenient location

require electricity
must be labeled

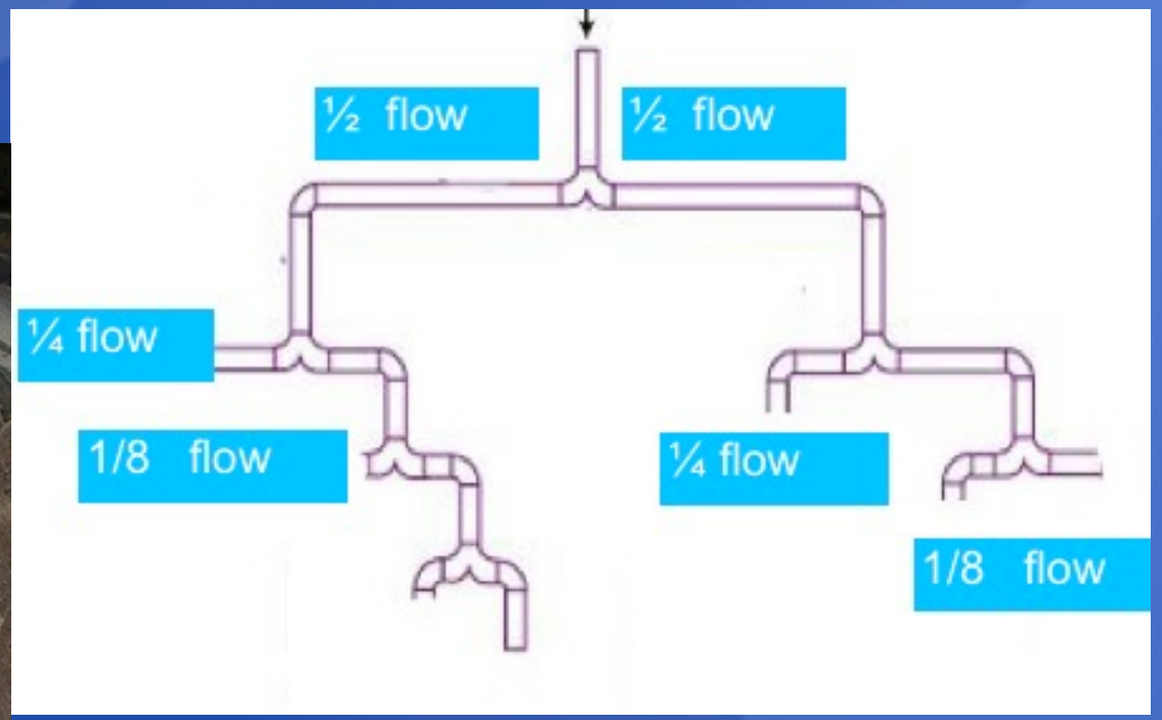
even in the crawlspace images of the valve handle in “to garden” or “to sewer” positions should be laminated and posted

cleanout plug drilled into fitting

“flow splitters” or
“double ells”

if perfectly level

with 2’ run of straight pipe leading into them



will split the flow evenly

shower greywater branched drain in San Francisco:

Setbacks from buildings
and property lines

Greywater outlet is under a solid shield
and flows into a mulch basin.
Size of basin depends on
soil type and amount of water.

Images: Josh Lowe

SF branched drain
one year later

SF project completed

images: Josh Lowe

constructed wetlands:

~can be a lovely landscape feature
IF the greywater is not needed for irrigation
(transpiration will deplete much of the water)

~can relieve stress on failing septic systems

~ gravel or rock substrate provides habitat for organisms that “clean” the water

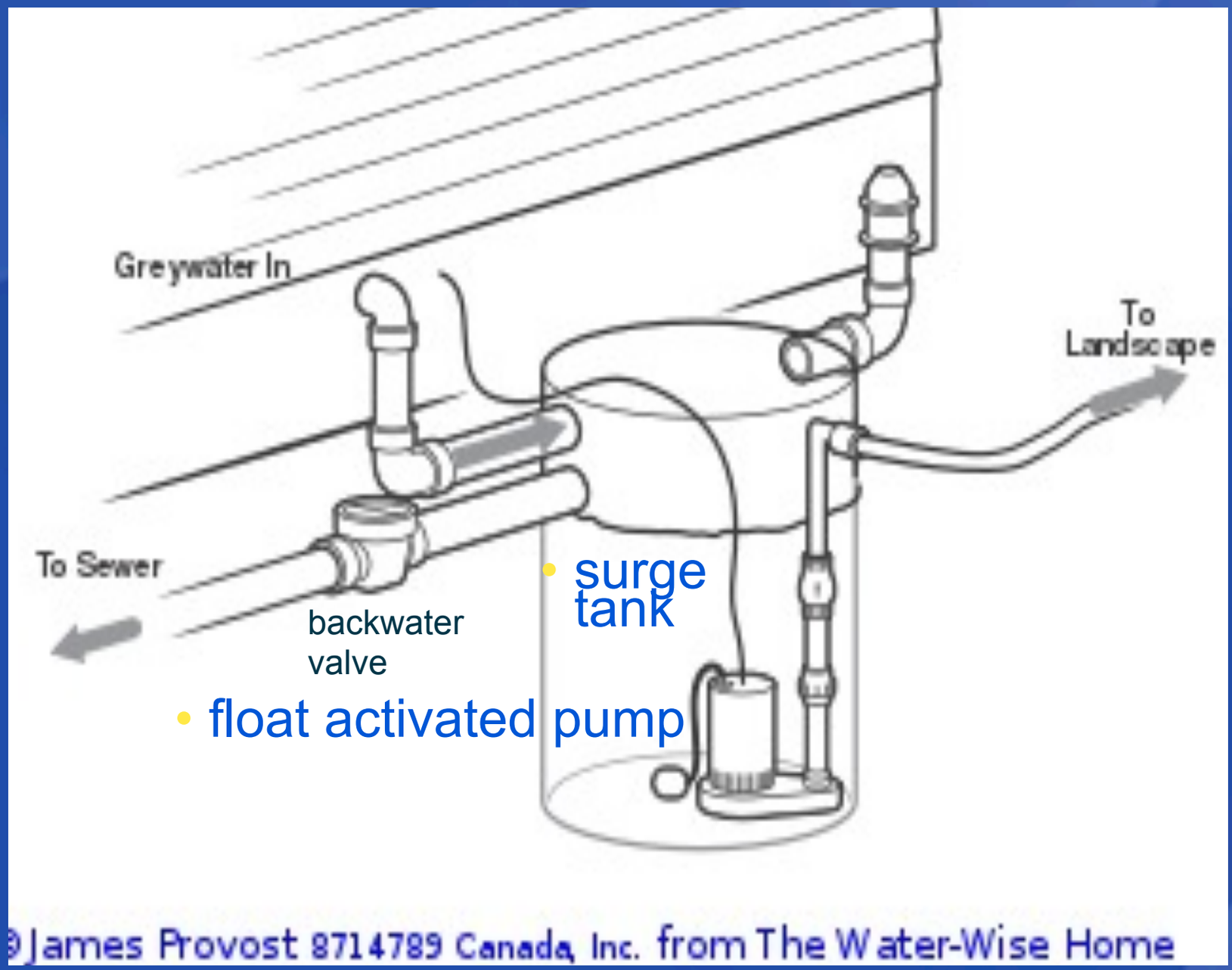
~water level is 2” below surface of gravel so no mosquitos

~ overflow water is used elsewhere in garden

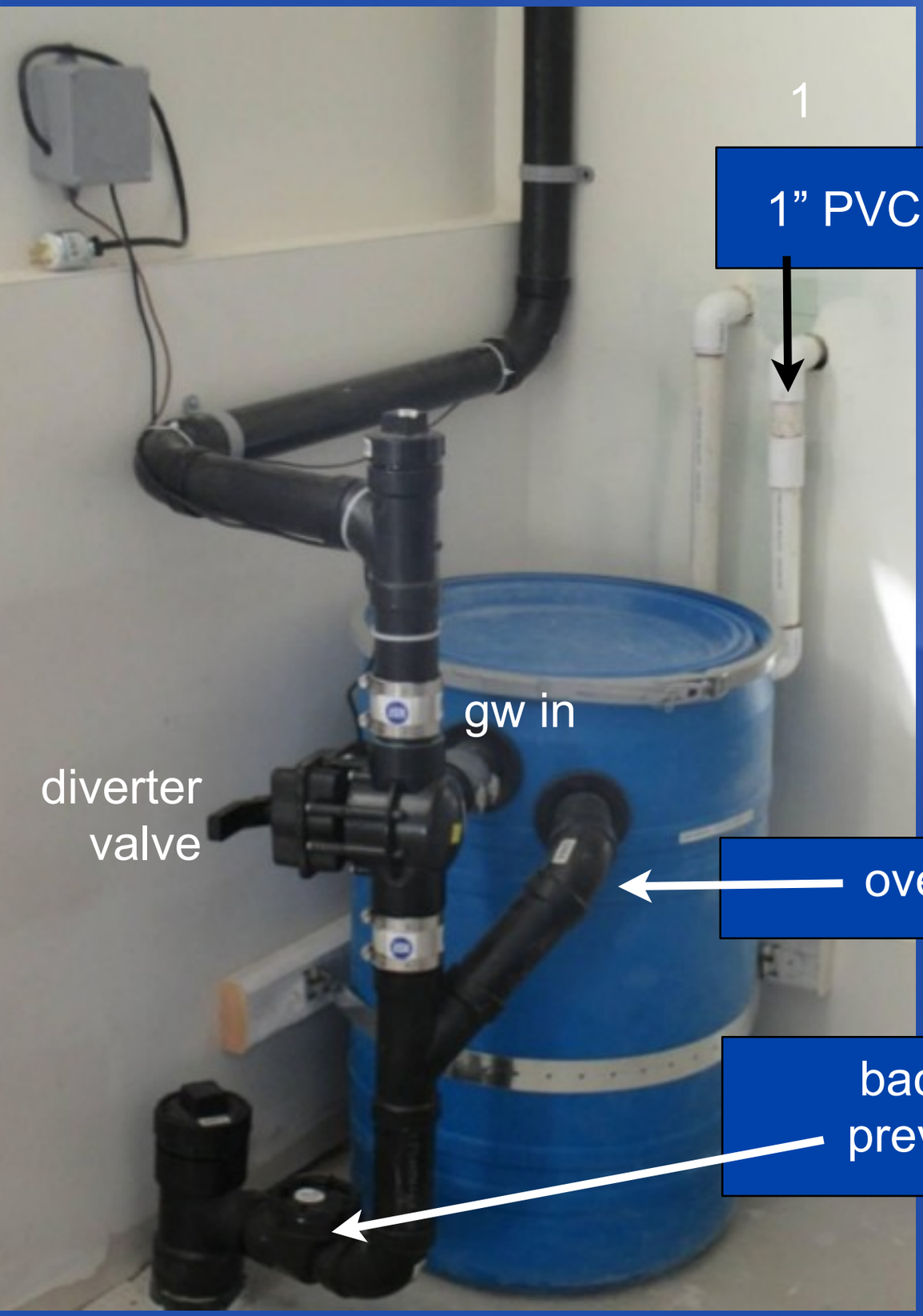
when area to be irrigated is uphill

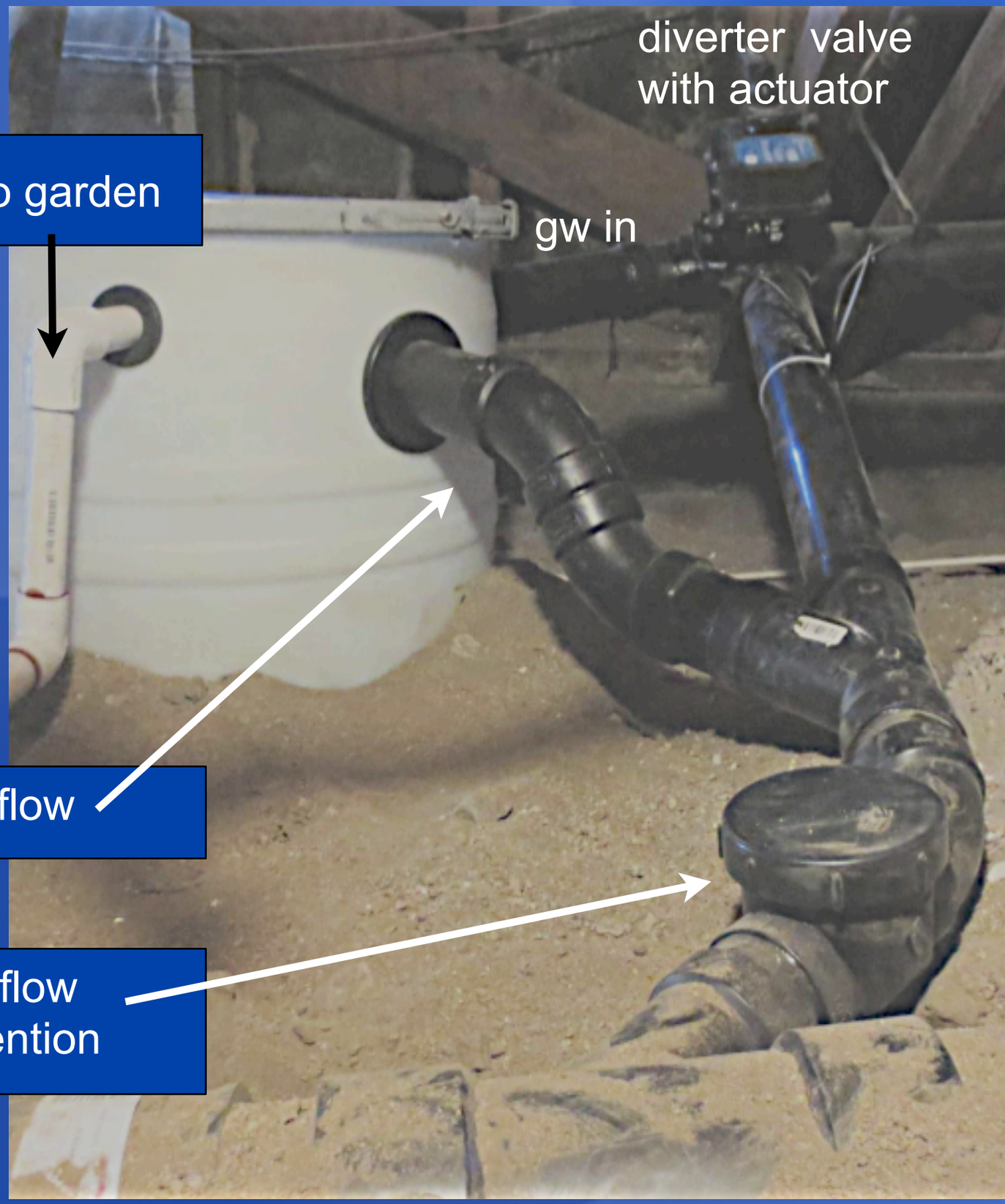
pumped system to mulch basins

(no filters)



- diverter valve directs greywater to surge tank
- float activated pump pushes unfiltered greywater to the landscape through 1” tubing and ½” outlets
- greywater is delivered to mulch basins
- overflow has backwater valve before joining sewer





1” PVC to garden

overflow

backflow
prevention

Photo: Leigh Jerrard

pumped system to mulch basins

for simple drip irrigation:

aqua2use system

matalla filters: clean 2x year

~surge tank with filters and pump

~overflow

~added strainer

~to IrriGRAY drip line

Aqua2use®
"The Answer for Greywater Reuse"

http://www.aqua2use.com

Note: Filtered GW requires special drip tubing and is not compatible with most standard drip systems.

IrriGRAY drip line

* low filtration (40 mesh or 400 micron)

* specifically designed for greywater as each emitter has a built in filter

* pressure range 2 - 45 psi

* on soil surface:
must be covered with
2” of mulch

(other brands suitable for gw are also available)

will you really clean those filters?

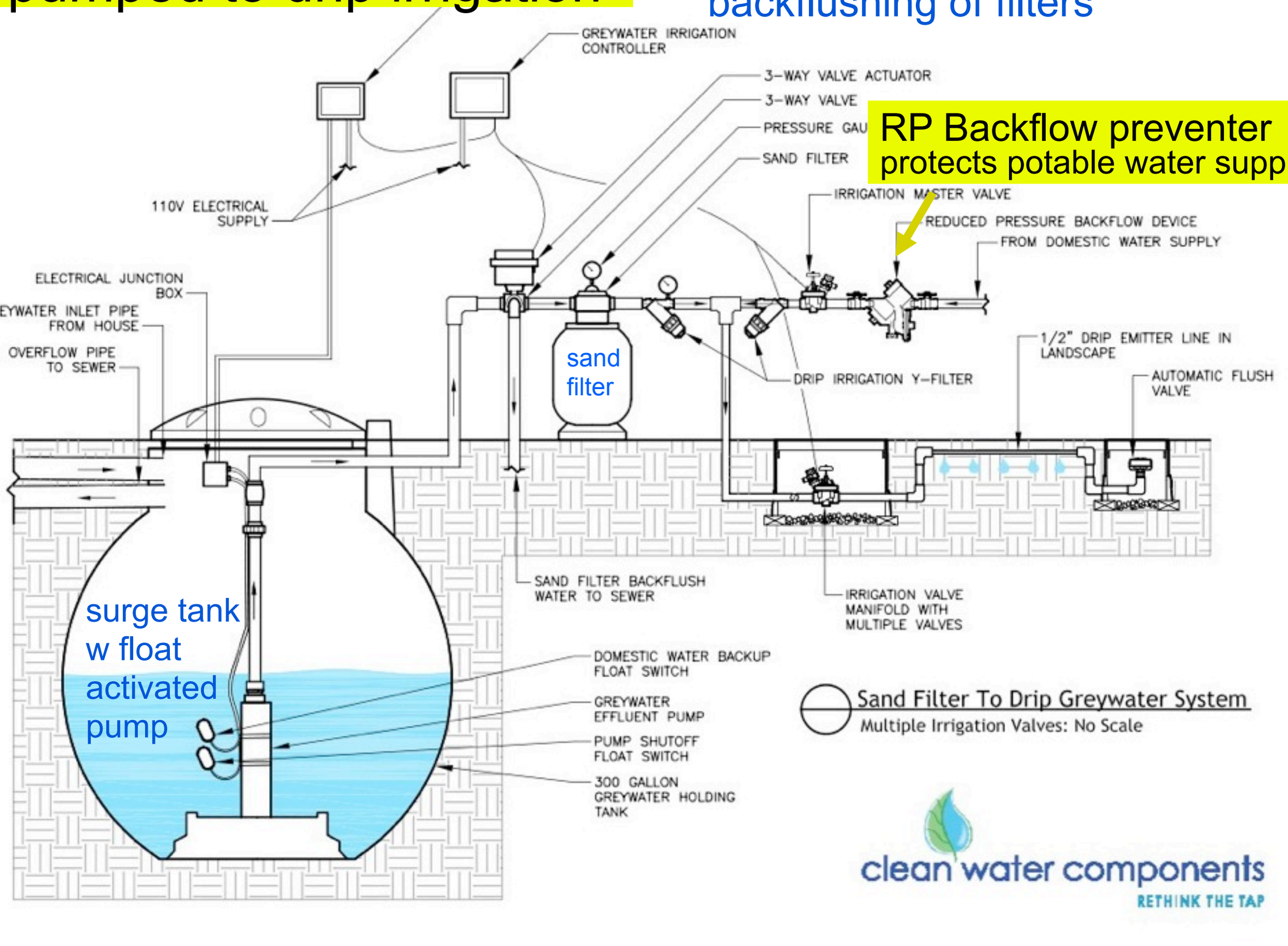
Image: Leigh Jerrard

many packaged systems include some form of automatic filter cleaning with water or air

pumped to drip irrigation

with automatic potable water backflushing of filters

RP Backflow preventer
protects potable water supply

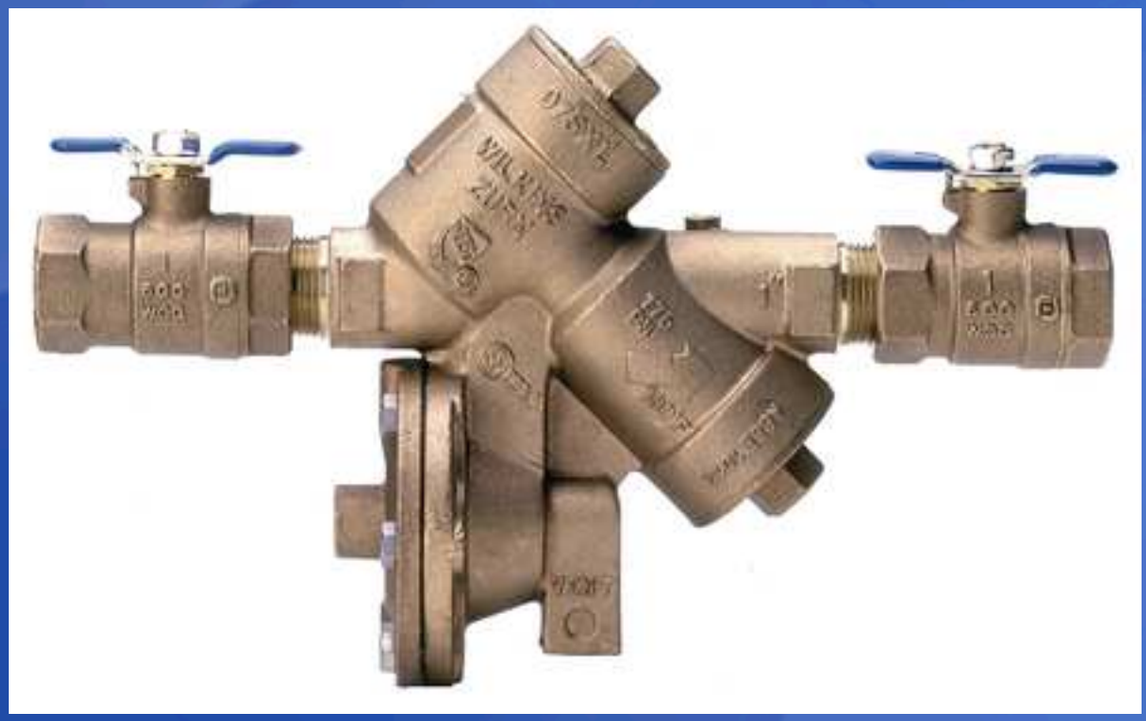


Sand Filter To Drip Greywater System
Multiple Irrigation Valves: No Scale

clean water components
RETHINK THE TAP

reduced pressure zone backflow preventers

protect the potable water supply from cross contamination



may require annual inspection

http://www.greyflow.net.au

using air for filter backflushing so no RP needed!

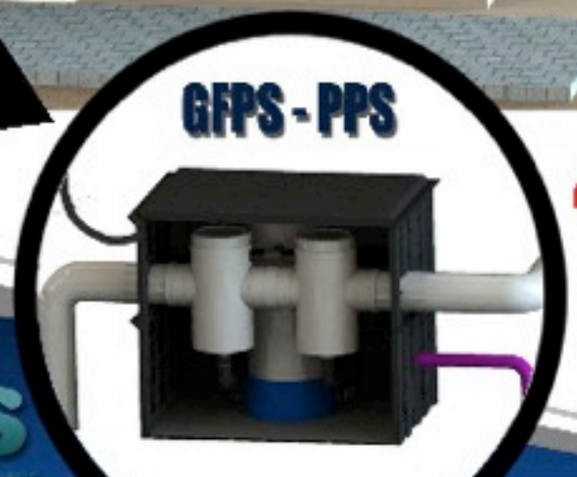
GREY FLOW PS PLUG & PLAY SELF-CLEAN GREY WATER DIVERTER

Features & Advantages:

- State of the art Self-Cleaning Mechanism
- Auto de-sludge configuration
- Extra low maintenance (2 years filter clean)
- Simple & robust design
- For above ground or partially buried applications
- Plumb, Plug & Play
- 100mm inlet and outlet

Divert Grey Water from:

1. Showers
2. Washing Machine
3. Basins
4. Air Conditioner



"Save up to 200,000 litres per year"

AWWS
Advanced Waste Water Systems

www.greyflow.net.au

Gray-It
Graywater Systems

http://www.gray-it.com

- volume based irrigation method:
  set volume and frequency of irrigation water for each zone so precise watering

- freshwater backup:
  at the end of each day controller completes the daily irrigation program with freshwater

- excellent programming support

EBMUD used this system at a new construction project at one of their reservoirs

IrriGRAY System Schematic

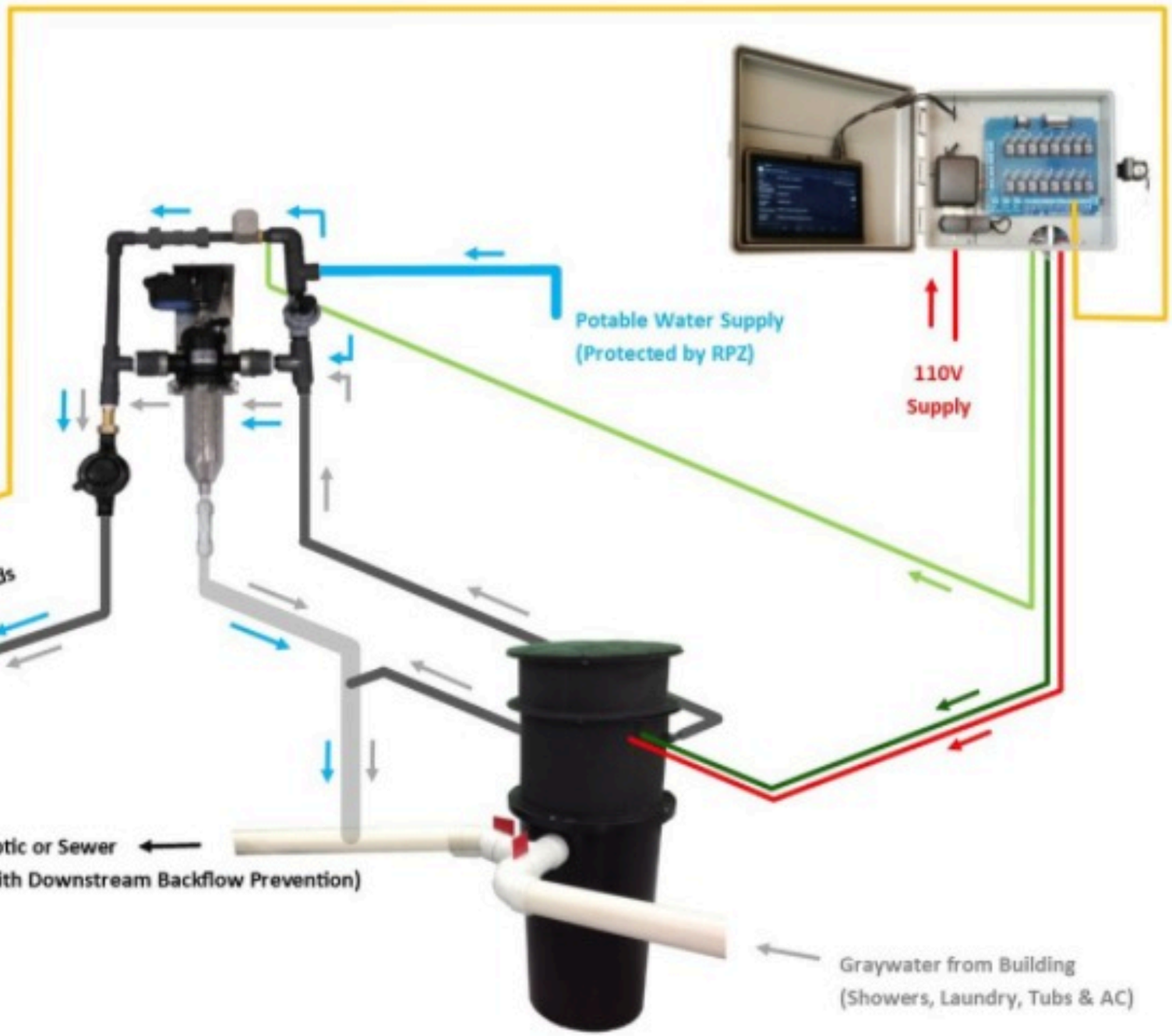
http://www.waterrenu.com

Electrical

- 110 V
- Pumping Direction Control
- Filter & Potable Control
- Irrigation Zone Control

Plumbing

- Graywater
- Potable Water
- Black Water Connection



Note:

The filter assembly may be located up to 20' from the pumping basin, either on an exterior wall or inside a garage.

The Controller must be located within 4' cable run of the filter assembly.

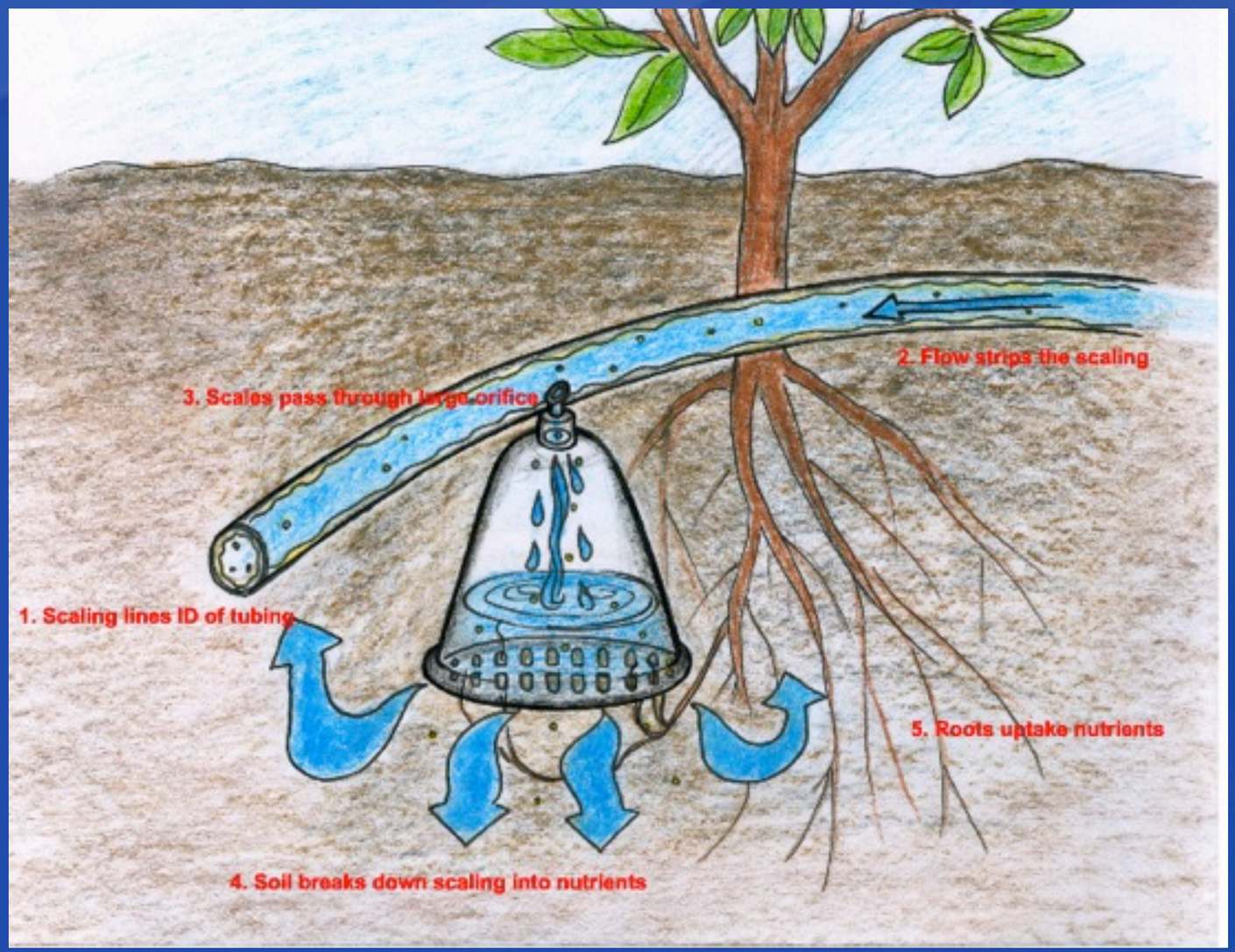
www.WaterReNu.com

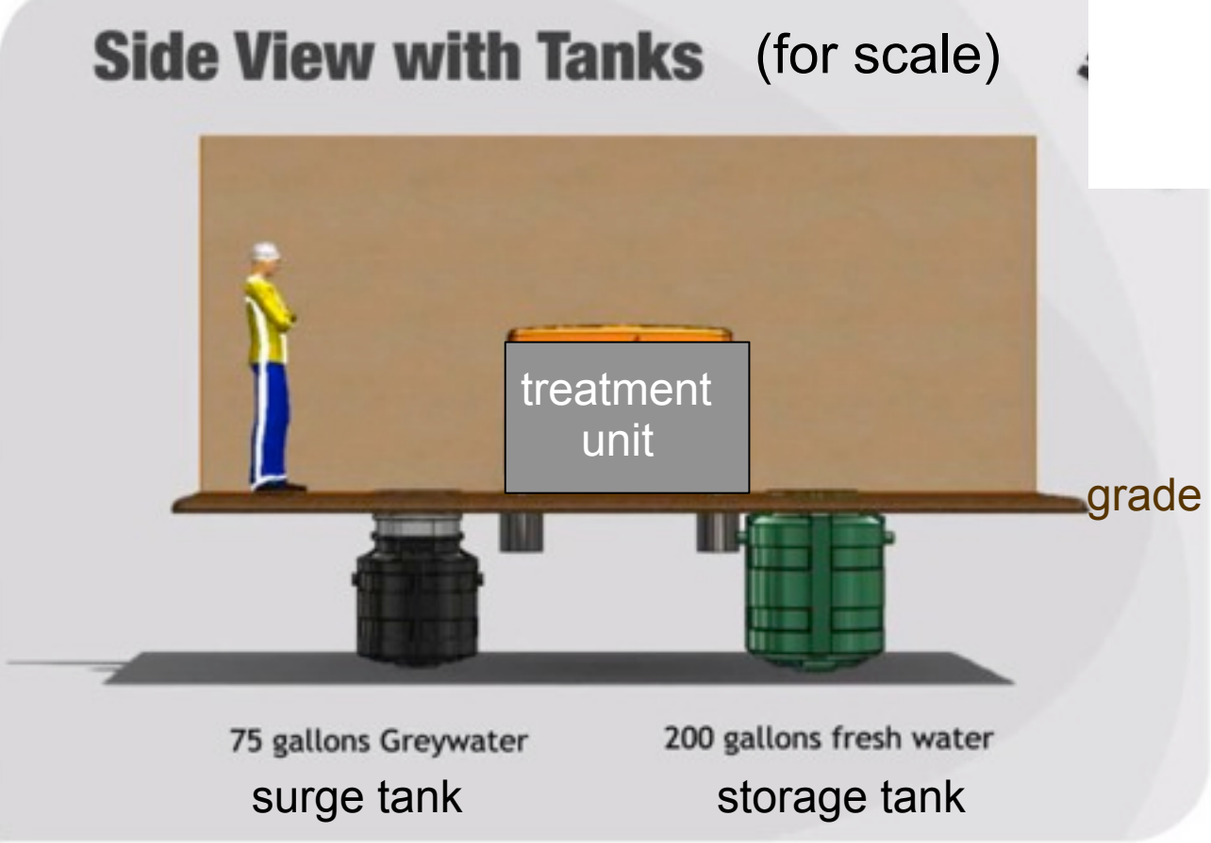
REWATER SYSTEMS

The Future of Water. Since 1990

http://rewater.com

* underground drip system
  perfected for lawns
* sand filter, automatic backwash
* many kits available





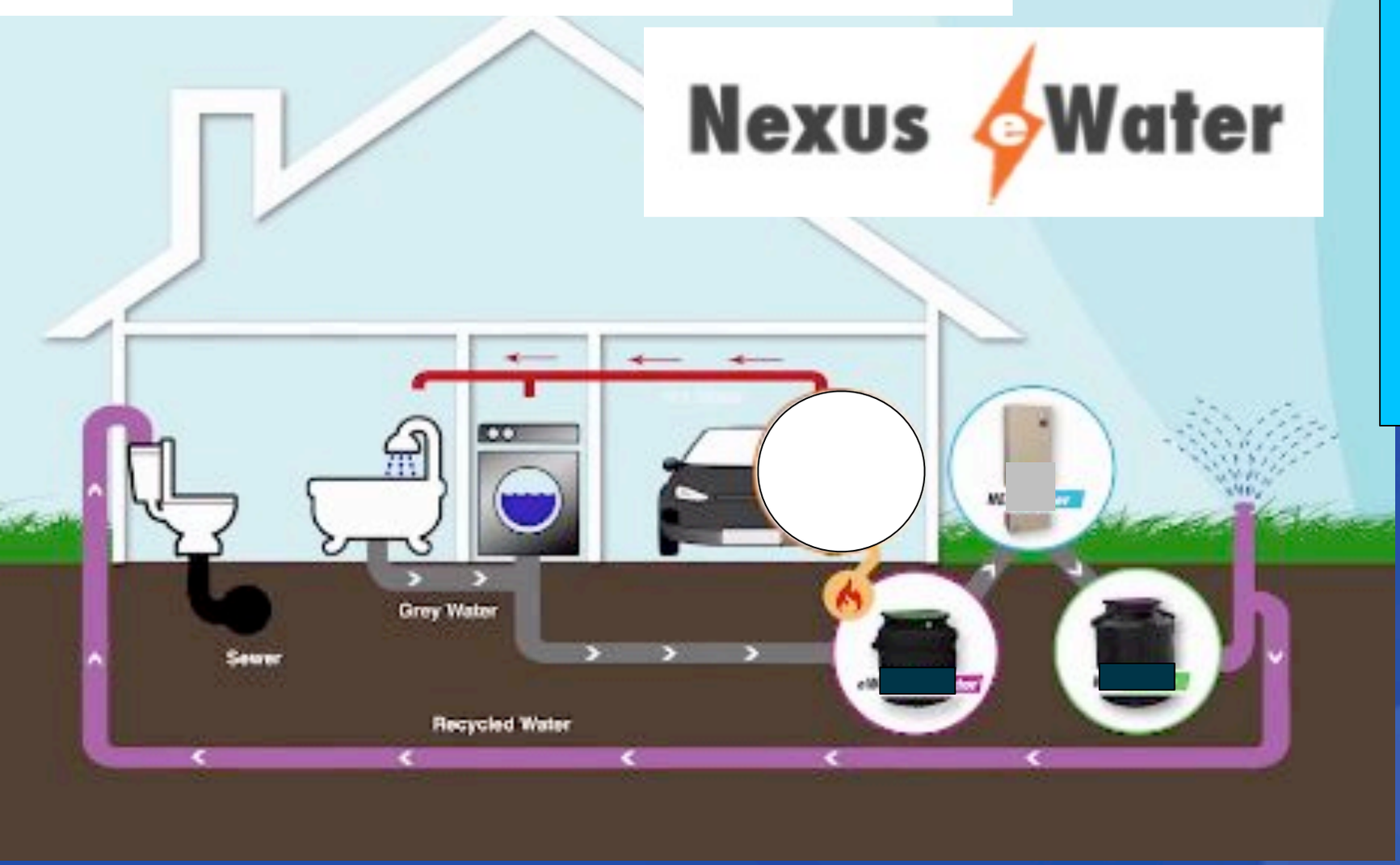
some whole house systems
treat graywater onsite

~a home scale solution to recover greywater from your drain
for storage and re-use
for toilet flushing
and irrigation

~200 gallon per day capacity

~no chemicals, additives or messy biological culture

Nexus eWater



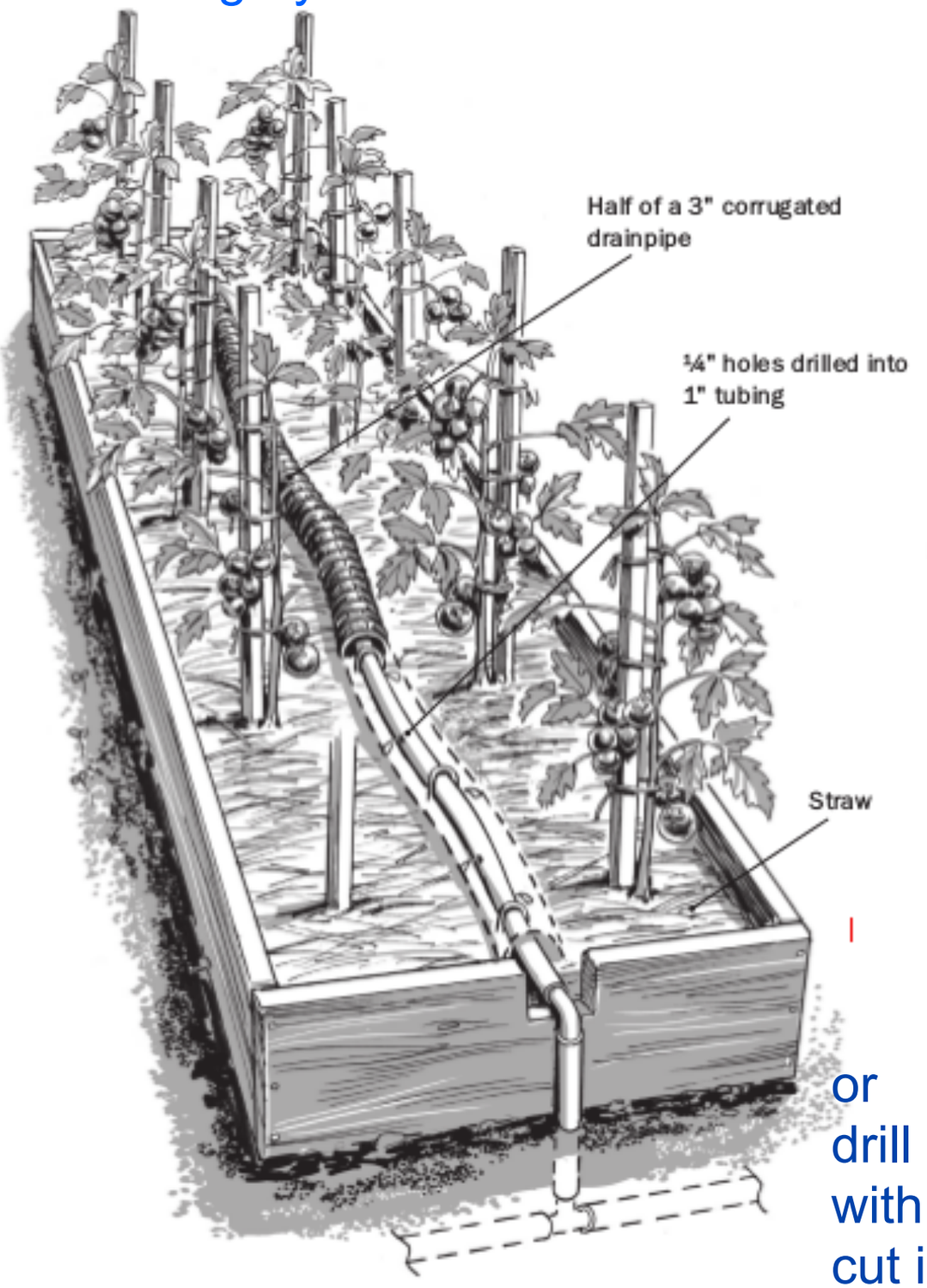
sounded good but gone now

WaterSprout design | build | maintain

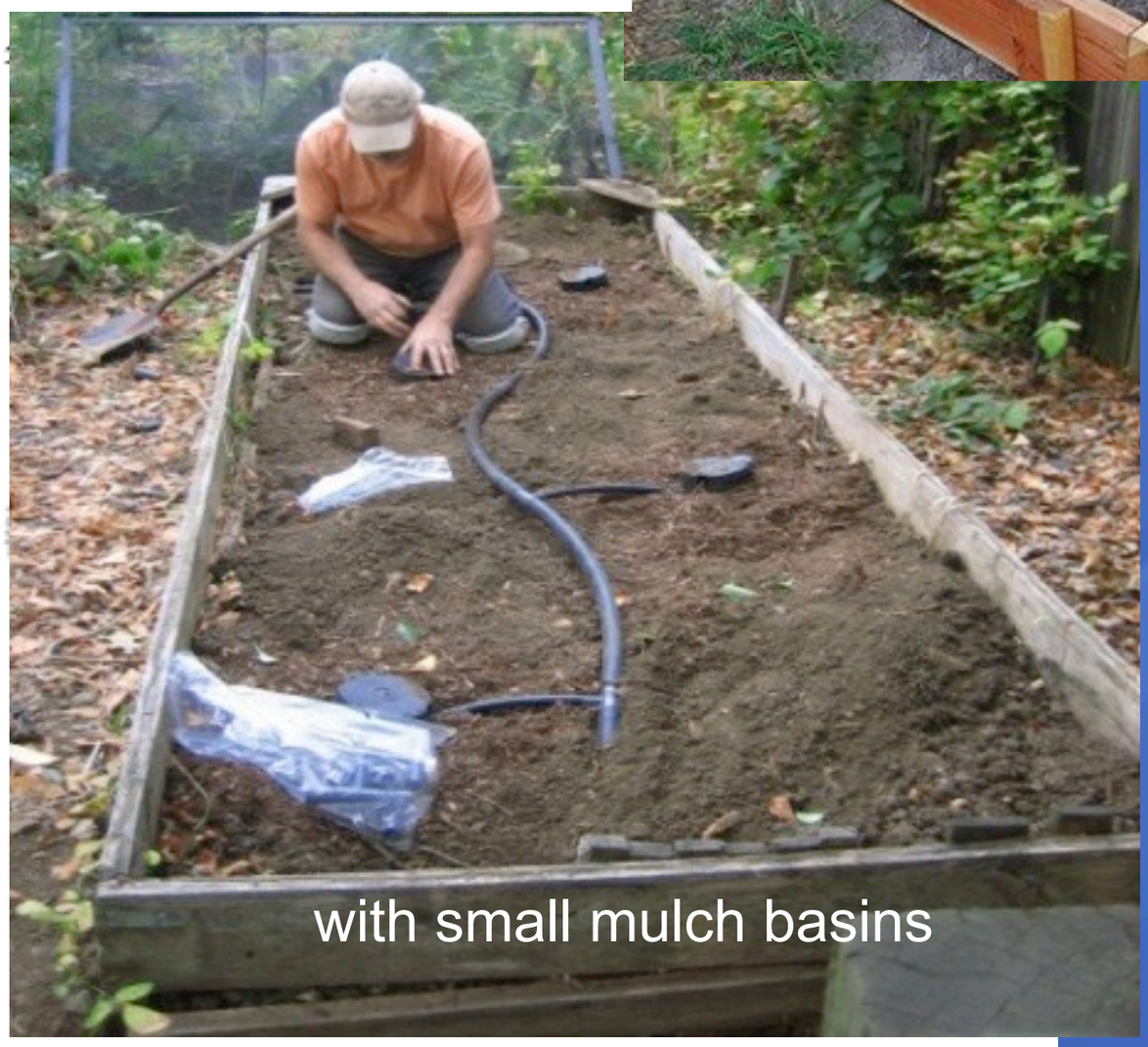
high end bay area systems

raised beds

remember, no root veggies!
edible part of plant must not
touch greywatered soil



with drip tubing covered
with 2” of mulch



or
drill holes in 1” tubing, cover
with 3” or 4” corrugated pipe
cut in half as “shield”

leaving enough water in our rivers so these guys can thrive

resources:

ask this old house episode
“graywater, small engines”
greywateraction.org
http://oasisdesign.net/greywater/

materials:

cleanwatercomponents.com
http://www.urbanfarmerstore.com

books:

Greywater Green Landscape by Laura Allen
The WaterWise Home by Laura Allen
Create an Oasis with Greywater by Art Ludwig
http://www.sfwater.org/ greywater design manual