napa rainbarrel workshop

June 6, 2015

with Christina Bertea and Brian Munson
Greywater Action

harvesting rainwater

why?

~to offset municipal water use

19% of all electricity used in CA is related to

~water~

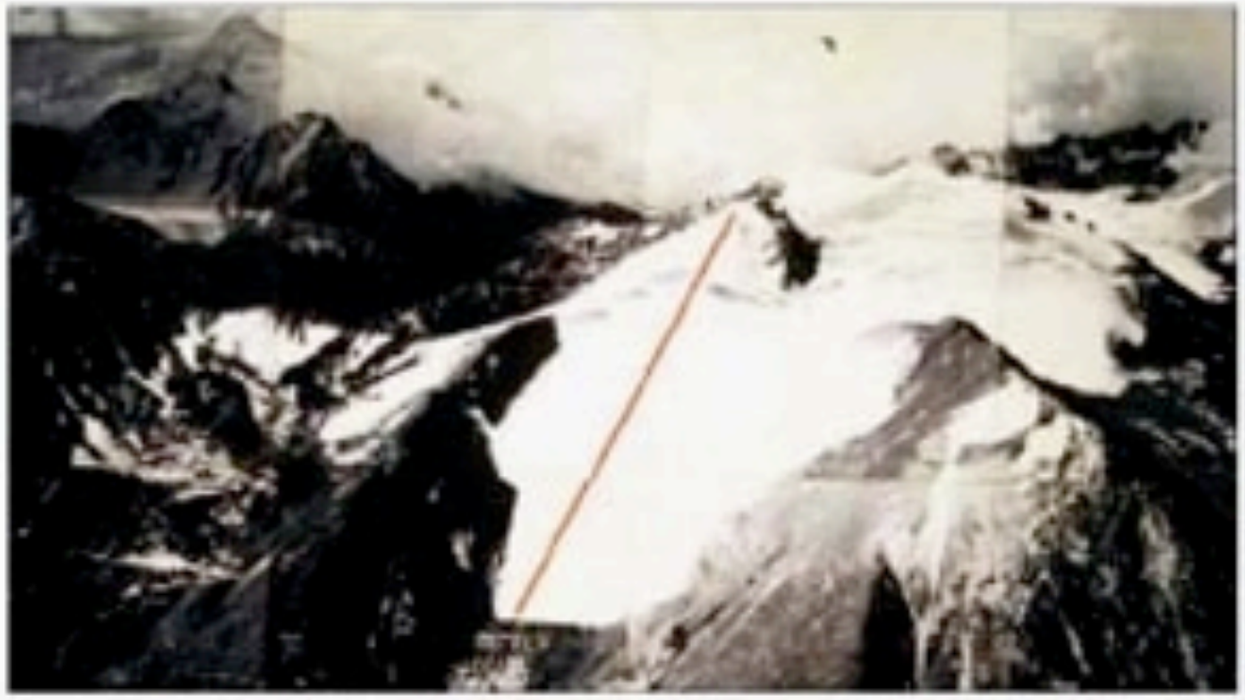
~to be prepared for

California's uncertain water future:

* population pressures

* climate change risks
  - ~unpredictable precipitation
  - ~decreasing snow pack

* natural disaster risks
  - ~earthquake/ vulnerable delta
  - ~sea level rise



1940 0.22 km²

1982 0.14 km²

1996 0.08 km²

2005 0.01 km²

melting glaciers in the Andes, uncertain Sierra snowpack

Precipitation Data for bay area cities

http://weather.sfgate.com/auto/sfgate/geo/precip/index.html

for Napa

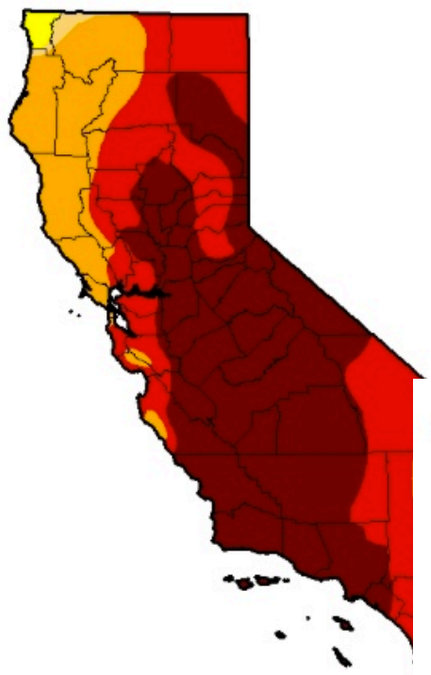
July 1 2014 to June 5 2015: 16.66 inches=60% of norm

July 1 2013 to June 5 2014: 10 inches= 36% of norm

July 1 to June 5 norm: 27.73 inches

Total Season norm: 27.88 inches

U.S. Drought Monitor
California



February 17, 2015
(Released Thursday, Feb. 19, 2015)
Valid 7 a.m. EST

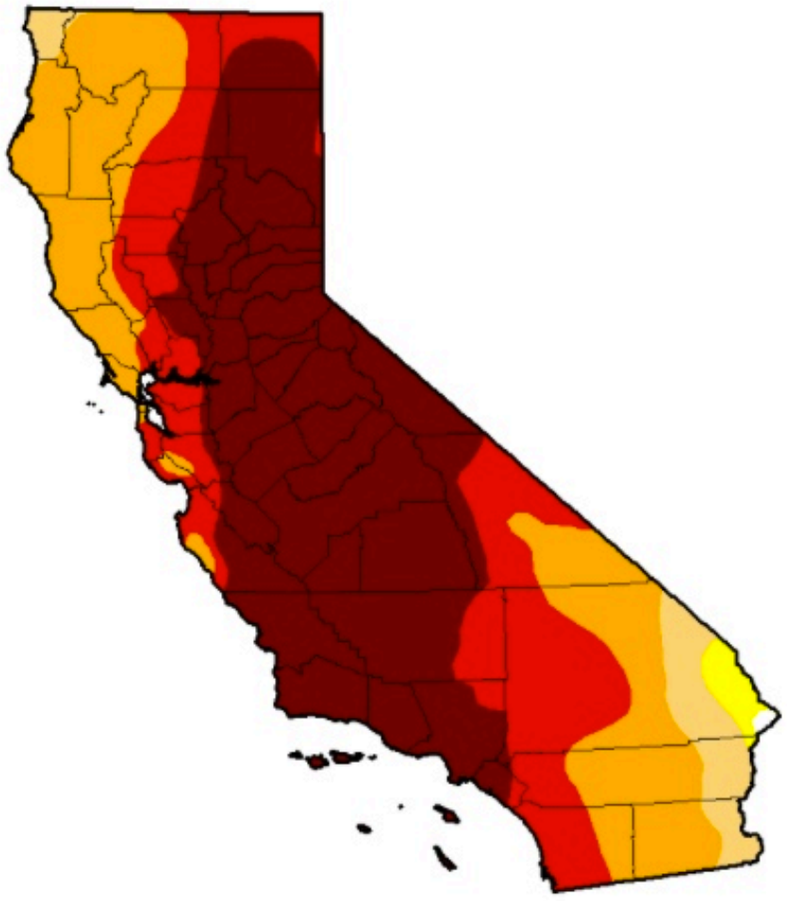
Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.16	99.84	98.10	93.44	67.46	41.20
Last Week 2/10/2015	0.16	99.84	98.10	93.44	67.46	39.99
3 Months Ago 11/18/2014	0.00	100.00	99.72	94.42	79.69	55.08
Start of Calendar Year 12/30/2014	0.00	100.00	98.12	94.34	77.94	32.21
Start of Water Year 9/30/2014	0.00	100.00	100.00	95.04	81.92	58.41
One Year Ago 2/18/2014	0.00	100.00	94.54	90.82	68.30	14.62

Intensity:
D0 Abnormally Dry — D3 Extreme Drought

Home › State Drought Monitor

U.S. Drought Monitor
California



Download: PNG PDF JPG

June 2, 2015
(Released Thursday June 4, 2015)
Valid 8 a.m. EDT

Statistics type: (•) Traditional (D0-D4, D1-D4, etc.) ( ) Categorical (D0, D1, etc.)

Drought Condition (Percent Area):

Week	Date	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	2015-06-02	0.14	99.86	98.71	93.91	69.61	46.73
Last Week	2015-05-26	0.14	99.86	98.71	93.91	66.60	46.73
3 Months Ago	2015-03-03	0.16	99.84	98.10	93.44	67.46	39.92
Start of Calendar Year	2014-12-30	0.00	100.00	98.12	94.34	77.94	32.21
Start of Water Year	2014-09-30	0.00	100.00	100.00	95.04	81.92	58.41
One Year Ago	2014-06-03	0.00	100.00	100.00	100.00	76.68	24.77

Population Affected by Drought: **37,034,027** View More Statistics

Intensity:
- D0 - Abnormally Dry
- D1 - Moderate Drought
- D2 - Severe Drought
- D3 - Extreme Drought
- D4 - Exceptional Drought

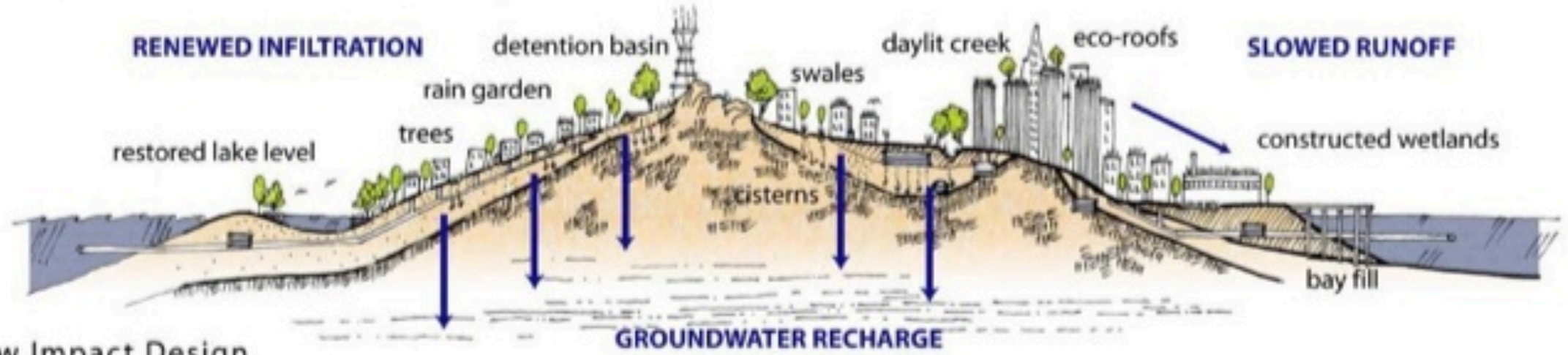
*The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying **text summary** for forecast statements.*

Author(s):

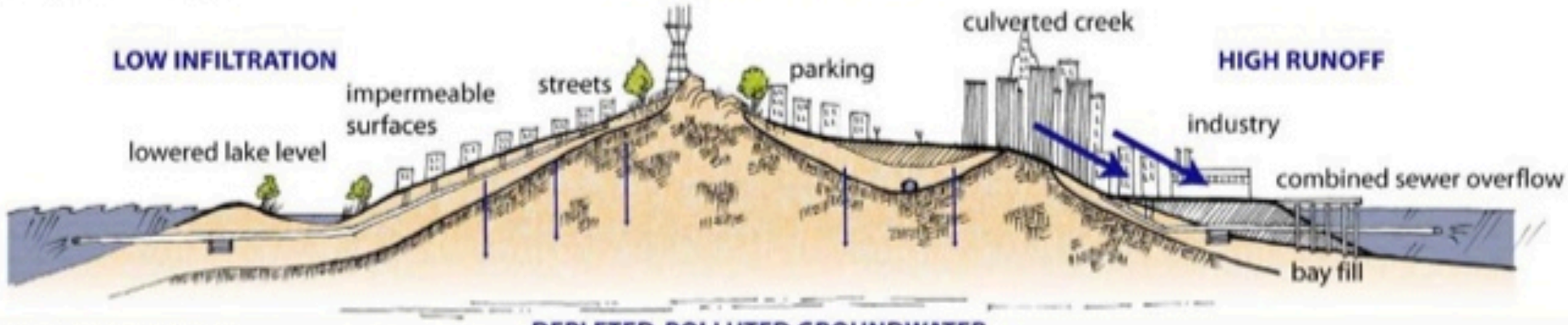
~to mitigate storm surge pollution: preventing run off to streams, rivers and bay

Urban Hydrology

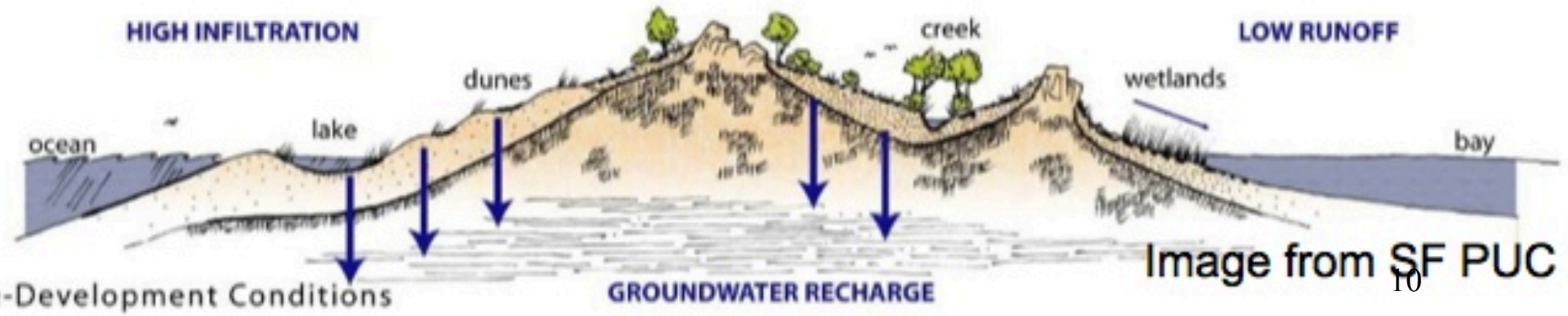
Urbanization dramatically changes the natural hydrologic cycle. Low Impact Design (LID), applied across the watershed, can partially repair the cities hydrologic cycle while beautifying the city. LID uses stormwater as a resource and reduces combined sewer overflows.



Low Impact Design



Current Conditions

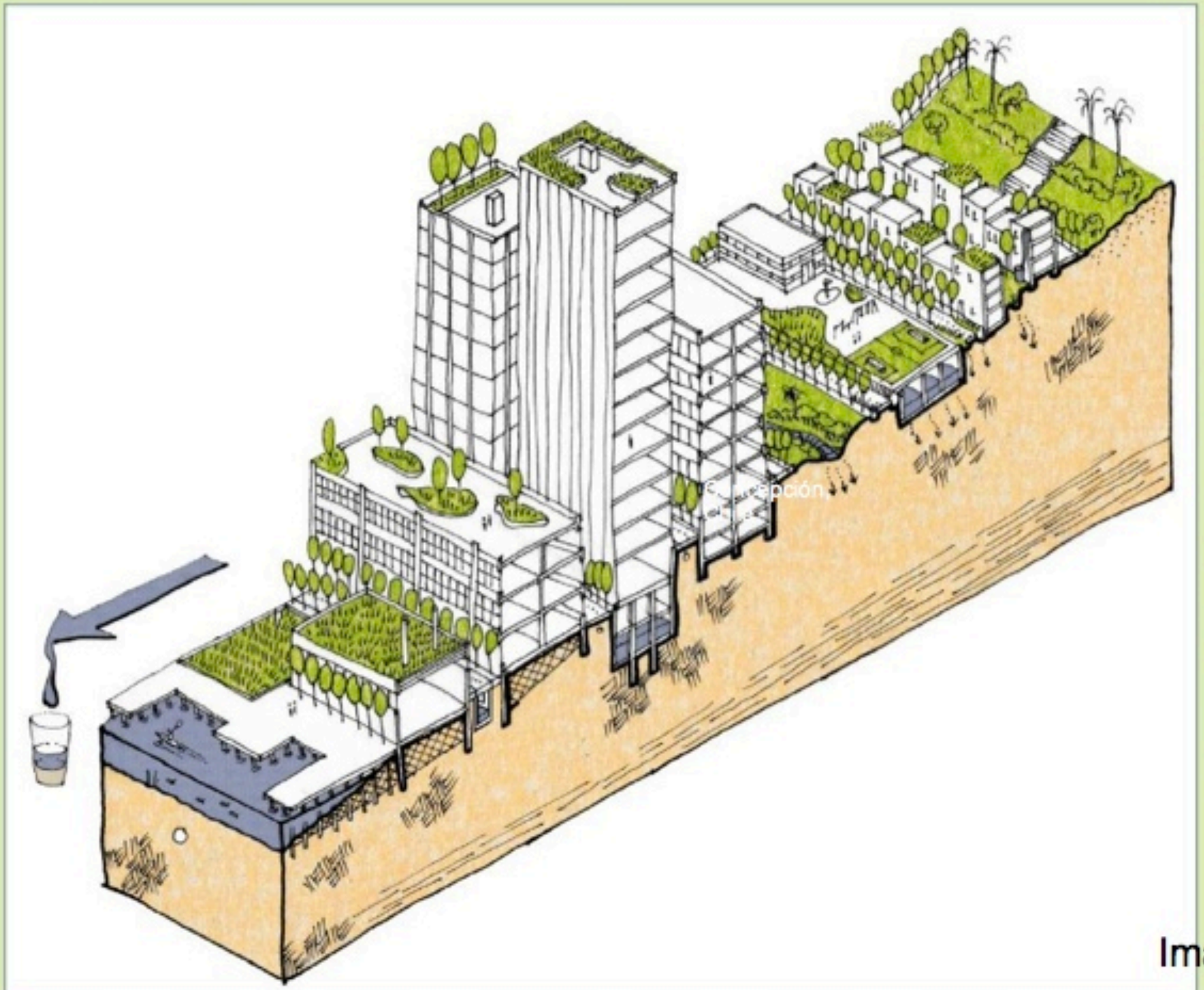


Pre-Development Conditions

Image from SF PUC

Low Impact Design (LID)

keeping stormwater onsite



Intensive eco-roof

Rain screen

Permeable paving

Rainwater harvesting

In-street planter

Image from SF PUC

but how much rain can you harvest from your catchment surface?

-house
-garage
-carport/shed
-barn
-sculptural form

Raincatchment Potential

Roof size in square feet	Gallons per inch of rain	Gallons per 20 inch annual rainfall
1000	550 (600 gallons/inch is also used)	11,000
1500	825	16,500
2000	1100	22,000

formula for harvestable rain:

length x width
of catchment footprint =
sq. feet

Image from
Rainwater Harvesting
for Drylands and Beyond

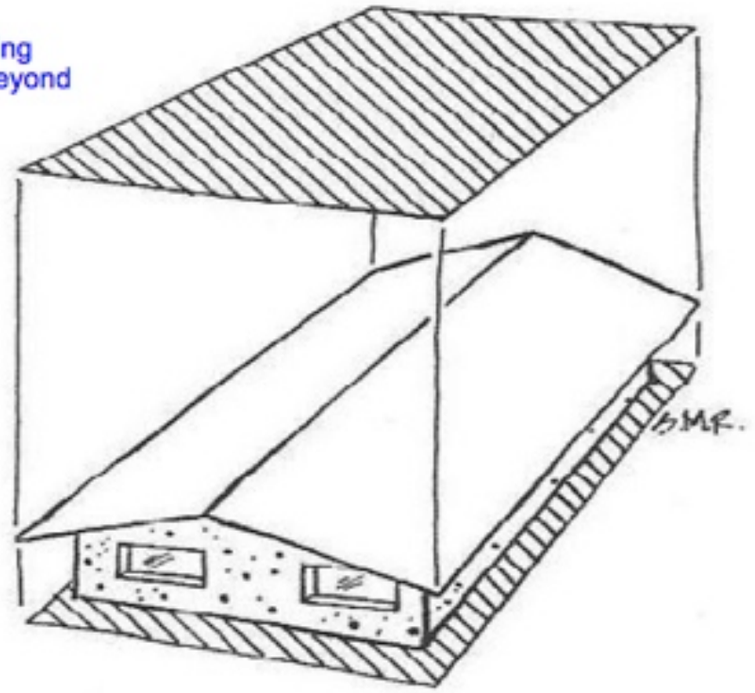


Fig. 2.5. Size of a roof catchment: measuring only the outside dimensions—or "footprint"—the roof's edge. Ignore the roof slope; no more rain falls on a peaked roof than falls on a flat roof with the same footprint.

x .6 gallons per 1" of rain

x average inches per year

= total yearly catchment potential

1000 sq. ft x .6 =600 gals/inch x 20"= 12,000 gallons

how much saved rain will your garden need?

general rule:

- assume ½ gallon per week for each square foot of a plant's footprint

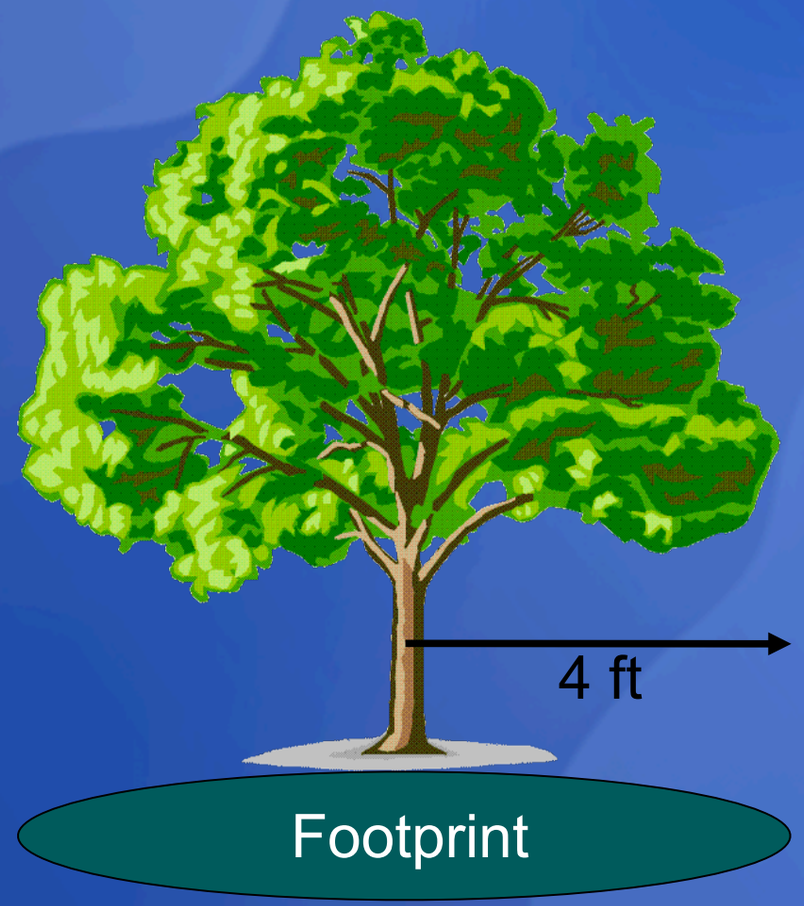
Plant water requirements
are affected by microclimates,
sun/wind exposure, type of plant,
ground water depth, etc.

This rule of thumb number
is for peak irrigation time.

The footprint is the area beneath the canopy

finding plant water requirements

how many gallons/week would a fruit tree with a 4 foot radius need during the peak irrigation season?



(at 1/2 gallon per sq. ft.:)

using πr^2:

3 x 4 x 4 =48 square feet

48/2 = 24 gallons per week during peak months

if a drought tolerant plant, divide by 2 again= 12 gallons/week

basic components of a system

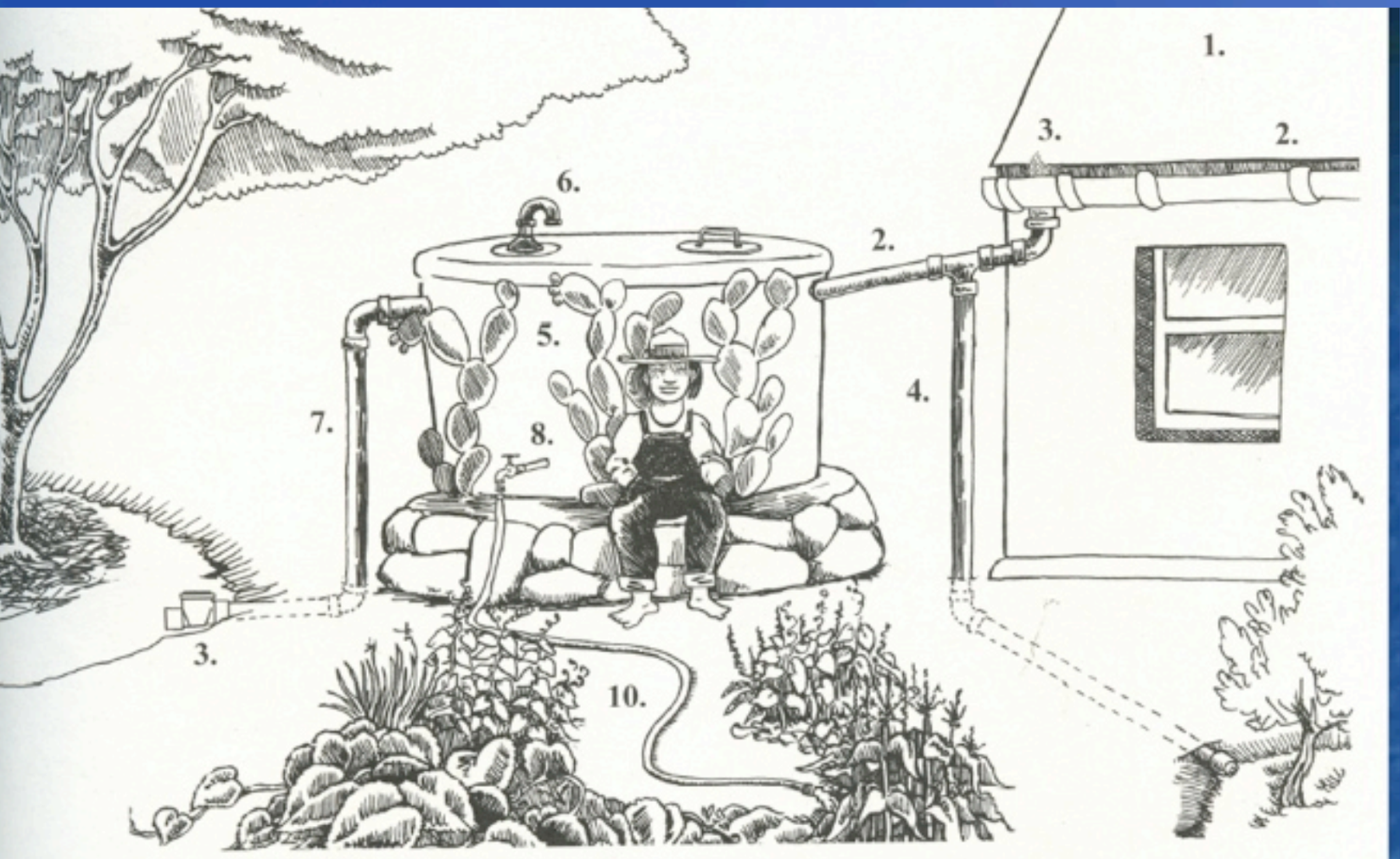


Fig. 3.28. Basic components of a cistern system

KEY:

from Brad Lancaster's
Rainwater Harvesting for Drylands

*catchment surface

*gutters + downspouts

*first flush

*inlet to storage

*storage

*air vent

*outlet to garden

*overflow to ???

the
mantra:

inlet
outlet
overflow

inlet

overflow

outlet

2” inlet to screened top of barrel

2” overflow to infiltration basin

goal:
keep debris out of the tank!

--leaves
--grit from shingles
--bird/rat/squirrel poop
--particulate matter from traffic

methods:

screen the gutter
shed leaves with a “leaf eater”
first flush system to catch dirtiest rain

prevent debris from entering the gutter

with a
Gutter Glove
(the cadillac)

amount of screening depends on

~how dirty the roof gets
~how the water will be used

3" Rain Head Debris Separator

BMDS.....$34.95

Mount this rain head just below where you cut off the downspout. Follow directions for spacing downspout from wall. Self-cleaning design sheds leaves, twigs, and other debris keeping it out of the rain tank. Use 3" drain pipe for plumbing to first flush diverter or directly to tank.

"leaf eaters"
shed leaves,

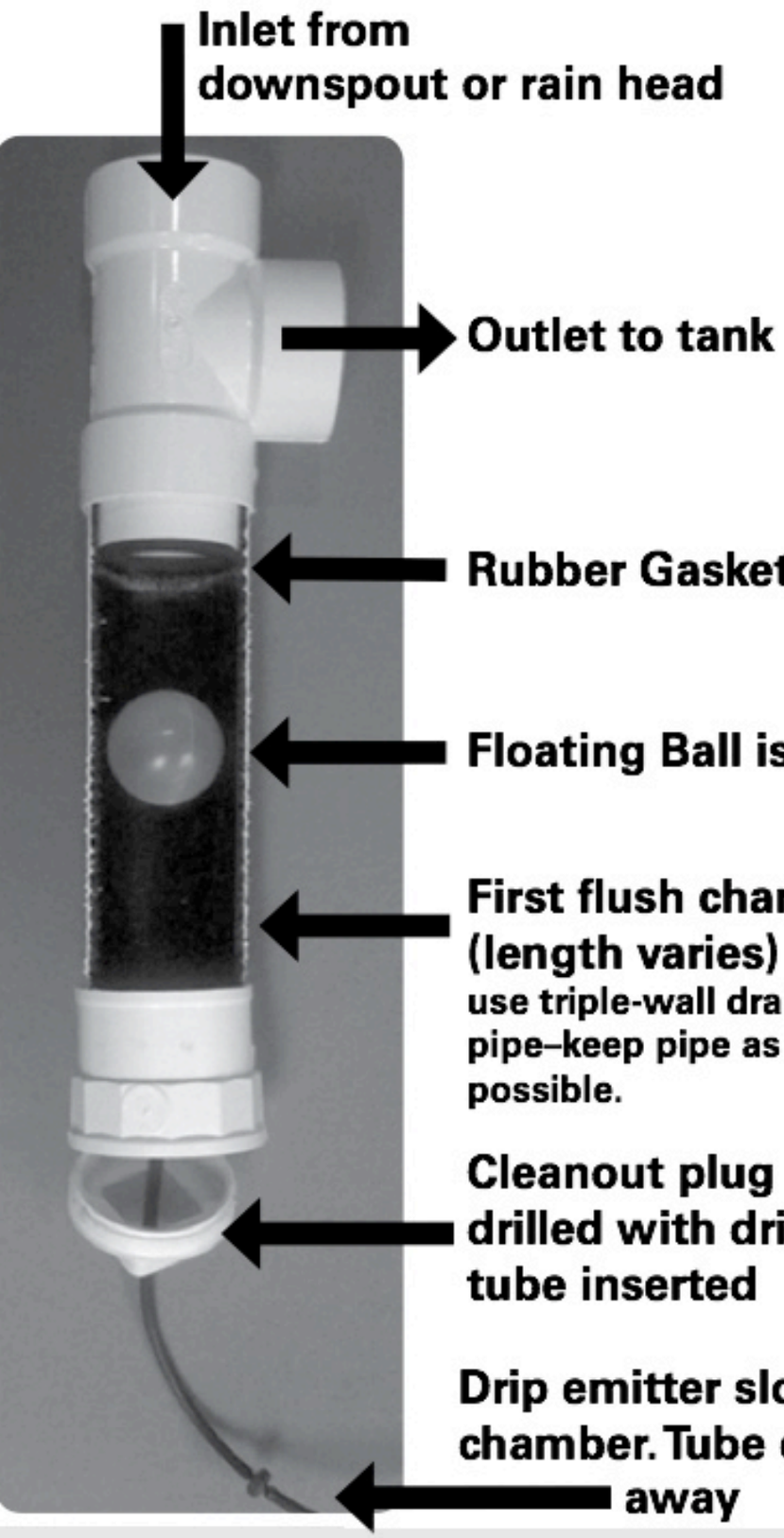
keep debris out
of the tank

first flush diverters:

dirtiest initial roof-rinse water
gets diverted and released slowly--

then first flush standpipe is empty and ready for next rain event

formula: divert 1 to 10 gallons per 1000 square feet



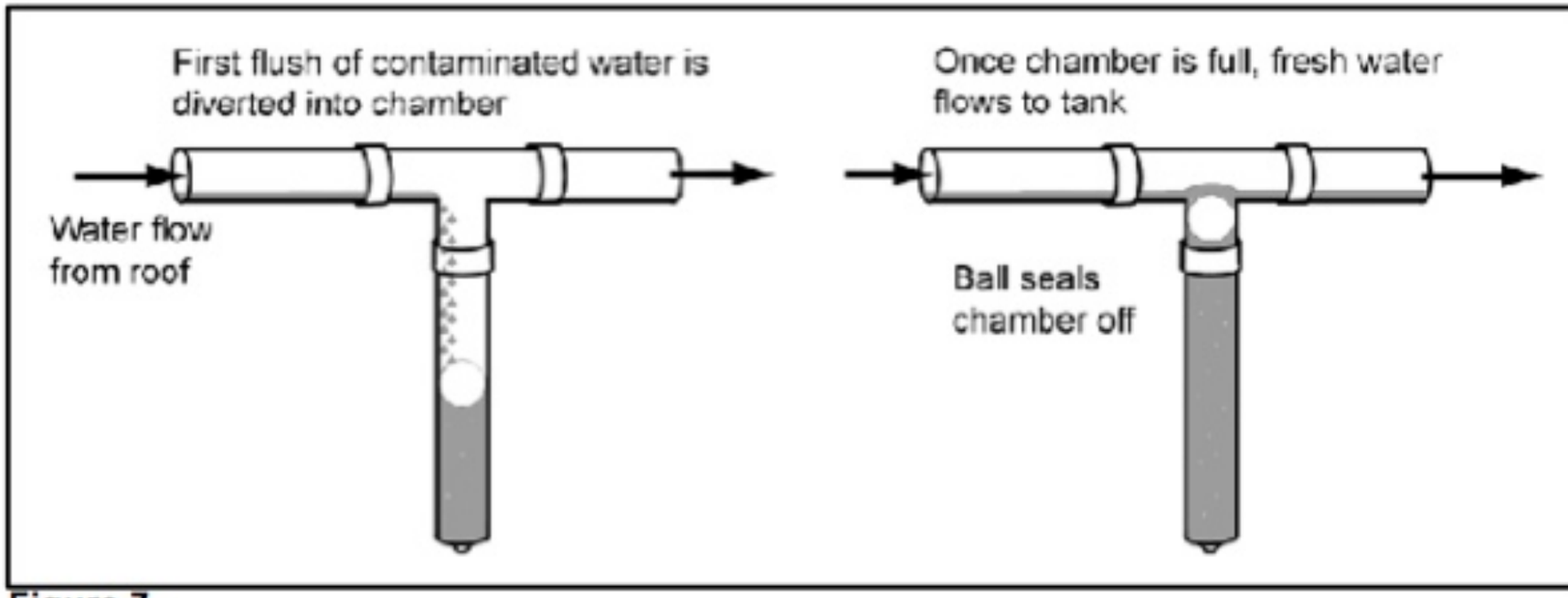


Figure 7.

“first flush”

The best way to keep your water clear is to capture the first flush of a storm and isolate its dust and debris. As the chamber fills, the ball floats up and seals on the seat gasket, trapping first-flush water and routing the balance of the water to the tank. The floating ball isolates the first flush water and its debris from the storage tank. Drip emitter slowly empties chamber. Unscrew clean-out plug occasionally to remove built-up silt and debris. Kit includes everything but the pipe.

5.1 ROOF WASHER

Roof Washers are commonly used to waste the initial water coming off the collection surface before being allowed to fill the cistern. Commonly used roof wash amounts are indicated below, but may be varied to reflect actual site and seasonal conditions.

Estimated Roof Contamination Potential

High Contamination [1]	Medium Contamination	Low Contamination [2]
.03" / 8mm	.01" / 2 mm	.002" / .5mm

Notes:

(1) High Contamination is considered to have high content of organic debris from animal waste, adjacent trees, and / or airborne contamination.

(2) Low Contamination is considered to either have frequent rainfall to keep collection surface clean, and / or minimal non toxic contamination.

(3) Sample Calculation: 1000 square foot collection surface, medium contamination:

Gallons = .01" rain x 1000 Square Feet x .623 gallons / square foot - inch:
= 6.23 gallons

Figure 5.

from ARCSA publication

The volume of pre-wash for a nominal 4" (4.046 inch actual) diameter PVC pipe can be determined as follows in Figure 8a.

4" PVC Pipe Storage Volume

Length : feet (meters)	Volume: gallons (liters)
1 (.3)	.7 (2.6)
3 (.9)	2.0 (7.6)
5 (4.6)	3.3 (12.5)
10 (3.0)	6.7 (25.4)
15 (4.6)	15.0 (56.8)

Figure 8a.

The volume of pre-wash for a nominal 6" (6.065 inch actual) diameter PVC pipe can be seen in Figure 8b.

6" PVC Pipe Storage Volume

Length : feet (meters)	Volume: gallons (liters)
1 (.3)	1.5 (5.7)
3 (.9)	4.5 (17.0)
5 (4.6)	7.5 (28.4)
10 (3.0)	15.0 (56.8)
15 (4.6)	22.5 (85.2)

Figure 8b.

from ARCSA publication

inlet to pillow tank

inlet

first flush

overflow

first flush diverters

homemade first flush diverters

large capacity--

--running amok!

innovative “U” first flush for increased capacity

dirty water still drips out at the bottom

cleanout for removing debris

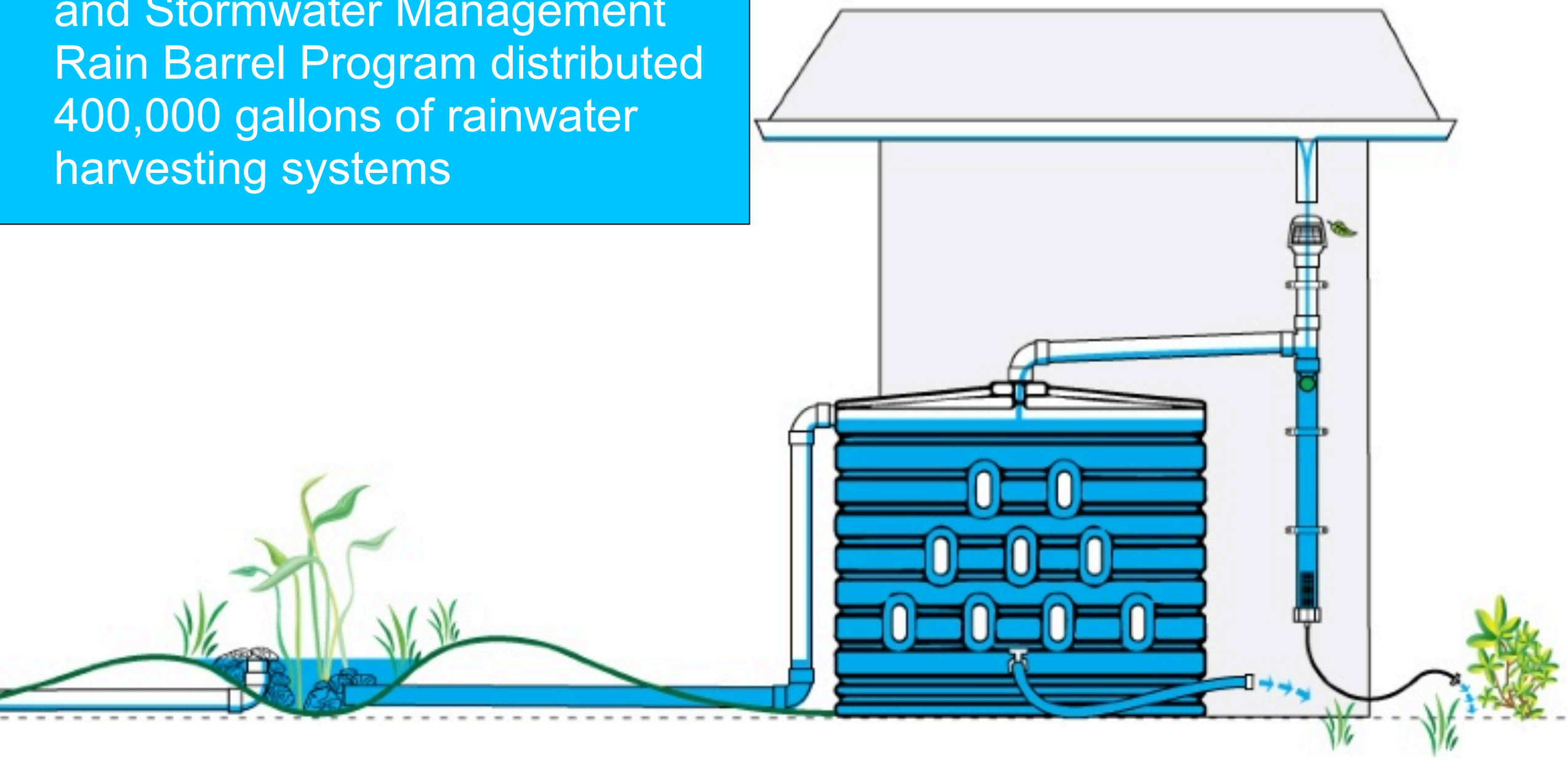
dirty first flush water drips out of the stack between rain events

prevent mosquitos from entering the tank

mosquito netting placed at barrel opening

top inlet and side overflow of large tanks come screened

the city of Oakland's Watershed and Stormwater Management Rain Barrel Program distributed 400,000 gallons of rainwater harvesting systems



name the parts: downspout, leaf eater, first flush, inlet, outlet, overflow to rain garden

what type of storage?

&

where to put it?

seen around town

banks of tanks

narrow tanks

oak
barrels!

architectural tanks


just plain cool tanks

don’t like what you’ll see?
paint it!

tanks can sparkle!

take this
add fun for the whole family

= this

tanks can delight!

tanks can be covered

recycled convention banners morphed into tank covers

“pillow tanks”

tanks for underneath:

water hogs

2000 gallon potable pillow tank under a deck

pillow tank kit

tanks for
really
underneath--

in the ground

where to put it--another option

a “wet system”
allows storage
far from the catchment surface

gutter must be higher than tank inlet

“wet system”:

piping from downspout runs underground then up to tank inlet~~ uses physics!
no pumping

careful not to breed mosquitos in trapped water: provide drain at lowest point

a wet system allows storage
at upper end of yard
far from the roof--
then rainwater
can gravity feed to garden

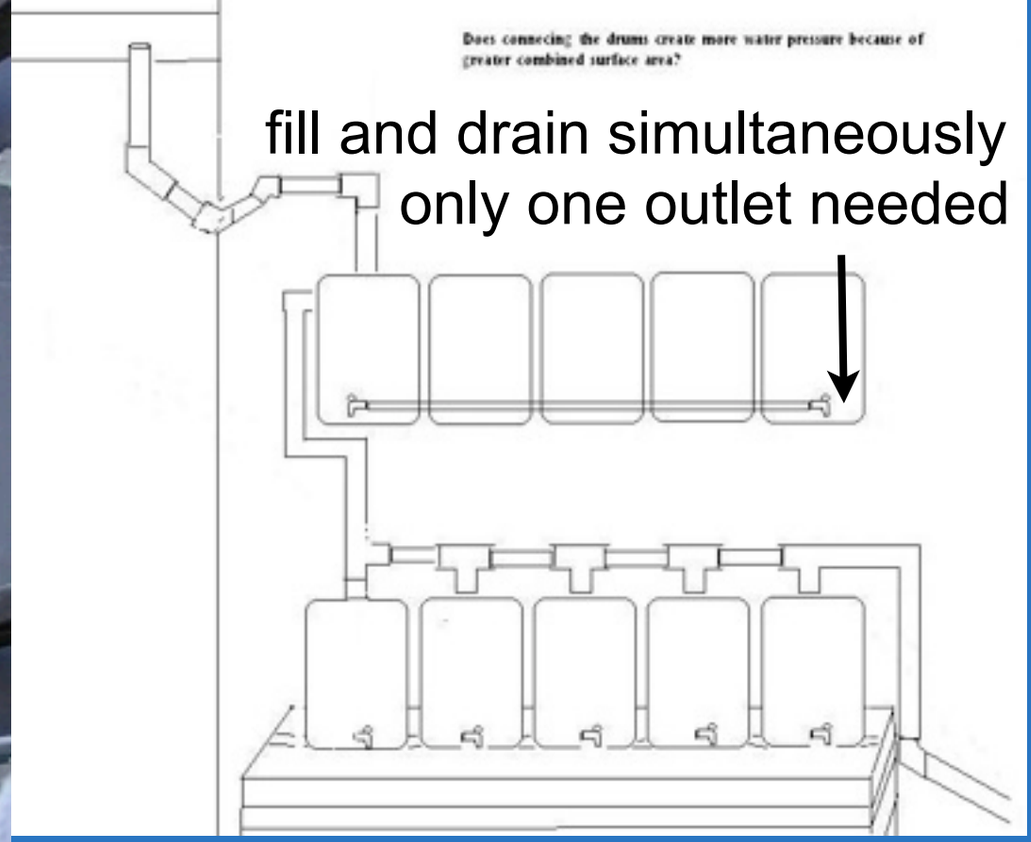
water trapped
in the wet system supply pipe
can be drained
at the low point

could have been a wet system, piped underground,
since inlets to tanks are lower than gutter

a large tank or multiple small tanks?

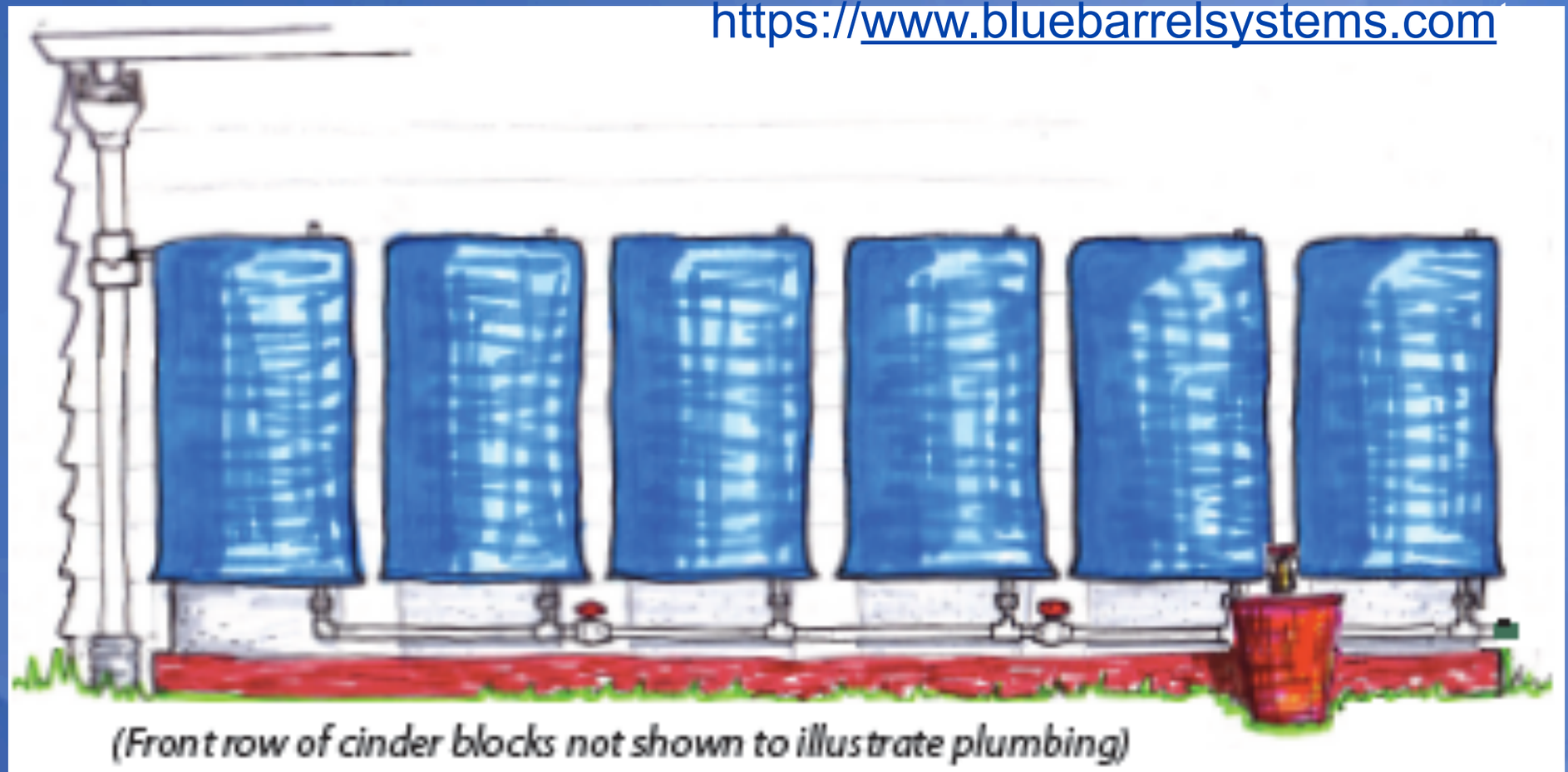
linking the barrels
at the bottom

or at the top



linking blue barrels...many options

https://www.bluebarrelsystems.com



(Front row of cinder blocks not shown to illustrate plumbing)

outlet:
at bottom of tank
for accessing stored rainwater--

to use

outdoors?

or even, indoors?

low tech--

attach a hose
or use directly

slightly higher tech--

a gravity drip system!

the rainwater code does not require a permit for tanks under 5000 gallons if there is no electrical connection

from JustWaterSavers:

IrriGRAY Greywater-Rainwater Dripperline -150' Coil **$99.50**

IrriGRAY is the only dripperline made specifically for use with greywater and gravity pressure rainwater drip systems.

Now manufactured in the US, in standard US 16mm irrigation tube size.

Advantages of IrriGRAY over typical dripperline or drip emitters

- A low 400 micron (40 mesh) filtration requirement
- Low pressure operation down to 1 foot of head pressure allows use of gravity feed from rainwater tanks.
- Dripper flow rate of 2 GPH

Specifications:

- Pressure range .5 - 45 PSI

wow!

each foot of elevation =
.433 PSI
so
for 0.5 psi you only need
about 1' height--

tank can be placed at a high point in the landscape
or on a raised surface
(as water level in the tank lowers, pressure in the tubing lowers)


elevated tank
battery timer
filter
irrigray drip

how much water is left in my tank?

shutoff, funky sight gauge, hosebibb

funky sight gauge

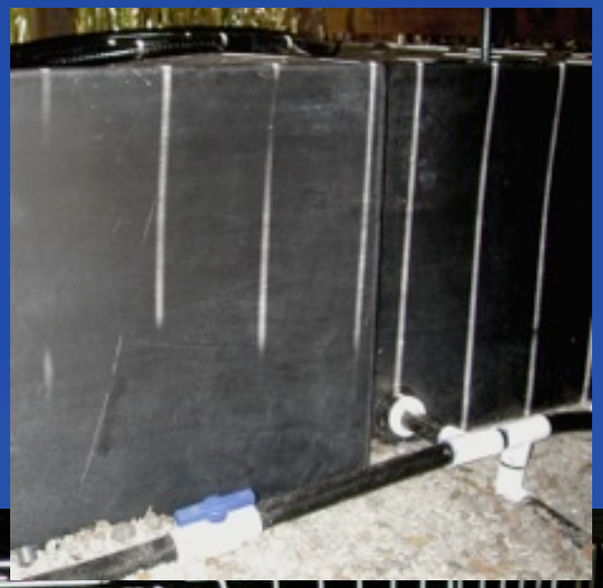
ball valve

hosebibb

elegant sight gauge

indoor use:

sediment filter
carbon filter
uv filter
pump



rainwater for toilets and laundry

rectangular tanks under a deck

sediment and carbon filters:
pressure gauges before and after
indicate if filters need changing

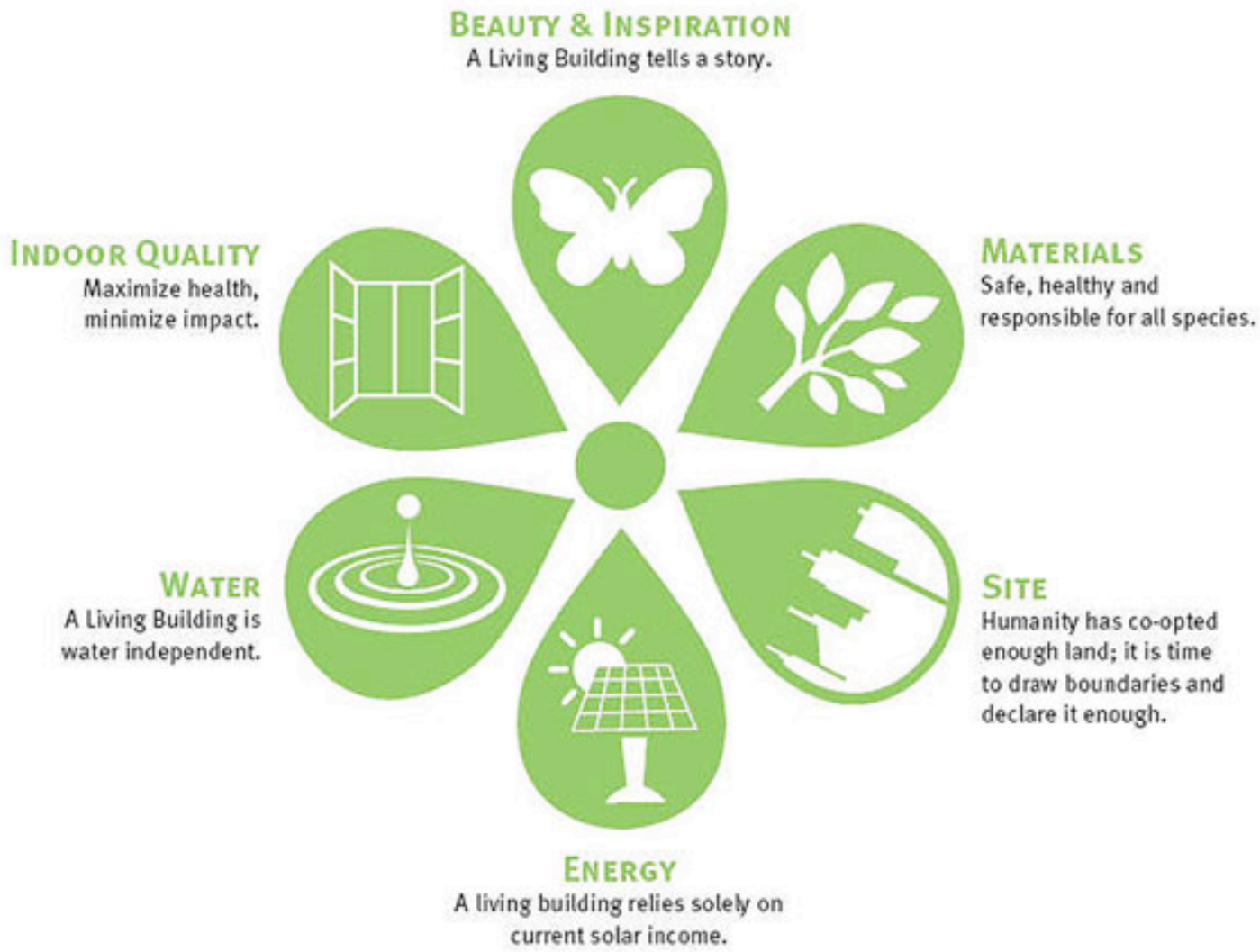
laundry water is UV treated here, toilet water is not

flex supply connects toilets and washer either to rainwater or to city water--

no cross connection possible

a naturopathic doctor in Portland used rainwater for all his family’s drinking water needs

LIVING BUILDING CHALLENGE™ 2.0



NET ZERO WATER

One hundred percent of the project's water needs must be supplied by captured precipitation or other natural closed loop water systems ... or by re-cycling used project water. Water must be appropriately purified without the use of chemicals.

the Bullitt Center, Seattle:
the greenest commercial building in the world

Crissy field rainwater catchment

Indoor Rainwater Use, SF

Rainwater used for toilet flushing.

Estimated savings of 29,000 gallons/year

Designed/Installed by WaterSprout

image by watersprout

Sonoma Community Center 7,900 gallons

We're watering with rain

The Maloney Family Garden and Waterwise Demonstration Project

CISTERN
Over the course of a year, this 7900-gallon tank will store tens of thousands of gallons of rainwater—a lot of what we need for our 4000-square-foot front garden.

(A foot of water in the tank is 375 gallons. The water-level indicator moves down as the tank fills.)

ROOF
We're catching the rain from 2000 square feet of our roof. That's about 1200 gallons for every inch of rain.

(A good rule of thumb is 600 gallons per 1000 square feet of catchment per inch of rain.)

ET CONTROLLER
Our smart irrigation system monitors evapotranspiration (ET) and tracks the weather to figure out how much and when to water.

BERMS
Our berms serve as planting mounds, and they give the garden some topography, but berms can also direct water flows and help manage stormwater runoff.

MULCH
Applying a layer of mulch is easy and provides lots of benefits. Mulch cuts erosion, slows runoff, keeps weeds down, conserves soil moisture and moderates soil temperature.

WATERWISE IRRIGATION
Drip irrigation helps keep water use low by delivering just enough to just the right place.

RAIN GARDEN
(Coming soon)
Contoured to retain runoff and let it soak into the ground; planted with wet- and dry-adapted species that filter pollutants.

APPROPRIATE PLANTS
Native and drought-tolerant plants are adapted to local conditions and require less water. They also attract birds, bees and butterflies.

PERMEABLE WALKWAYS
Asphalt and concrete create runoff; permeable materials such as decomposed granite allow rain to soak into the ground instead.

Illustration by Tom Wisherd

a project of
The Center for Sustainable Living

Sonoma Community Center

Thanks to our project funders

Sonoma Valley Groundwater Management Program

COMMUNITY FOUNDATION SONOMA COUNTY
SONOMA VALLEY FUND

the overflow:

sets maximum water level in tank

creates opportunity for secondary use

when the tank is full
it can overflow to a...

raingarden
swale
or
the stormdrain (a waste!)

an opportunity for infiltration!

this large tank
overflows to 55 gallon
barrels --
arranged so more
barrels can be added

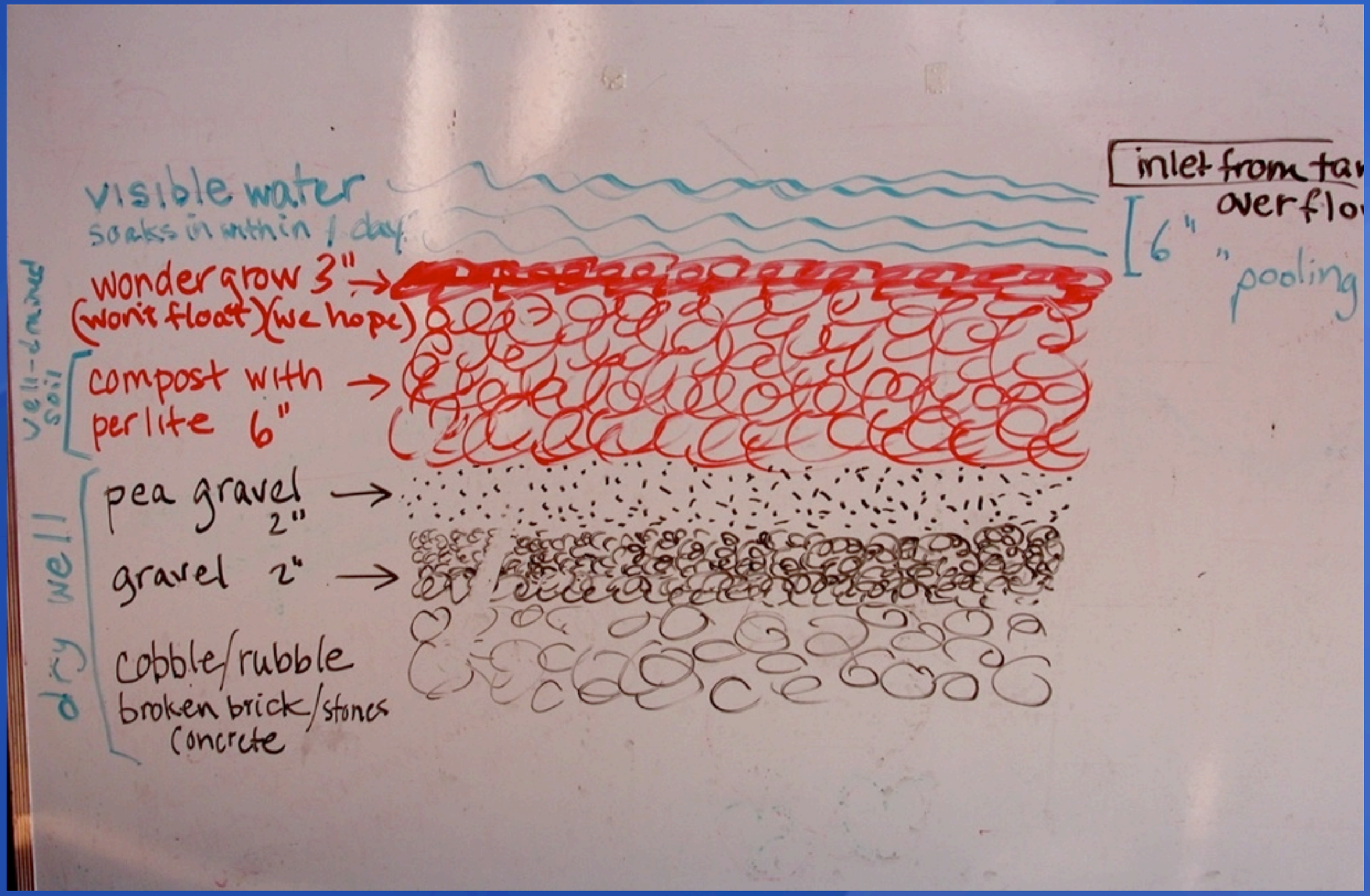
overflow from the
barrels goes to a sunken
area in the garden
(note overflow is on the
first barrel)

overflow is a secondary source of water--

to be delivered elsewhere in the garden

tank overflows
to a raingarden
which overflows
to
another bed
then the curbstrip

one raingarden recipe

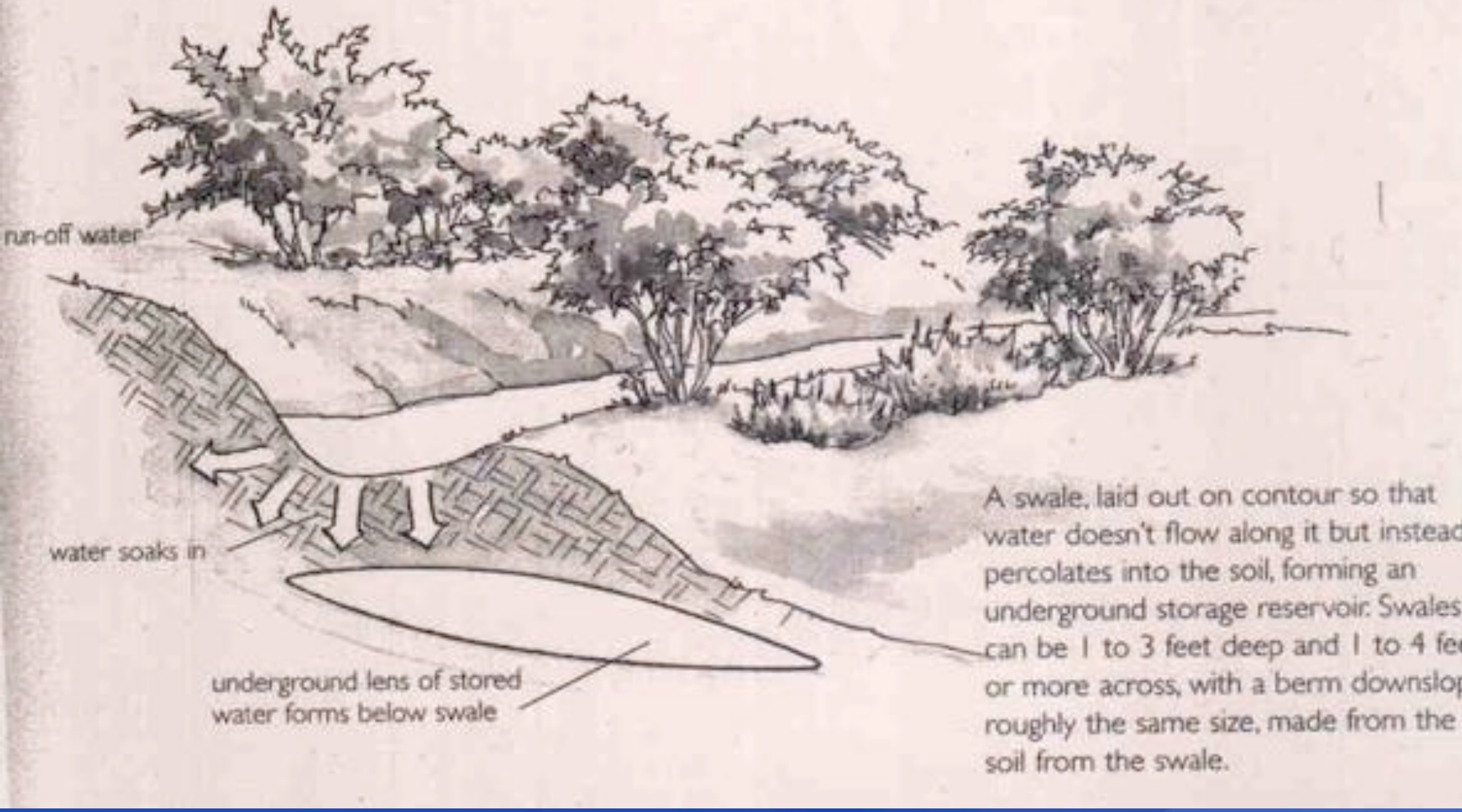



RAIN GARDEN
Rain gardens work like a native forest by capturing and infiltrating stormwater from rooftops, driveways, and other hard surfaces.
Rain gardens -- reduce flooding by absorbing water from impervious surfaces; filter oil, grease and toxic materials before they can pollute streams, lakes and bays; help to recharge the aquifer by increasing the quantity of water that soaks into the ground; provide beneficial wildlife habitat.

raingardens allow infiltration

the mantra:

slow it
spread it
sink it



A swale, laid out on contour so that water doesn't flow along it but instead percolates into the soil, forming an underground storage reservoir. Swales can be 1 to 3 feet deep and 1 to 4 fee or more across, with a berm downslop roughly the same size, made from the soil from the swale.

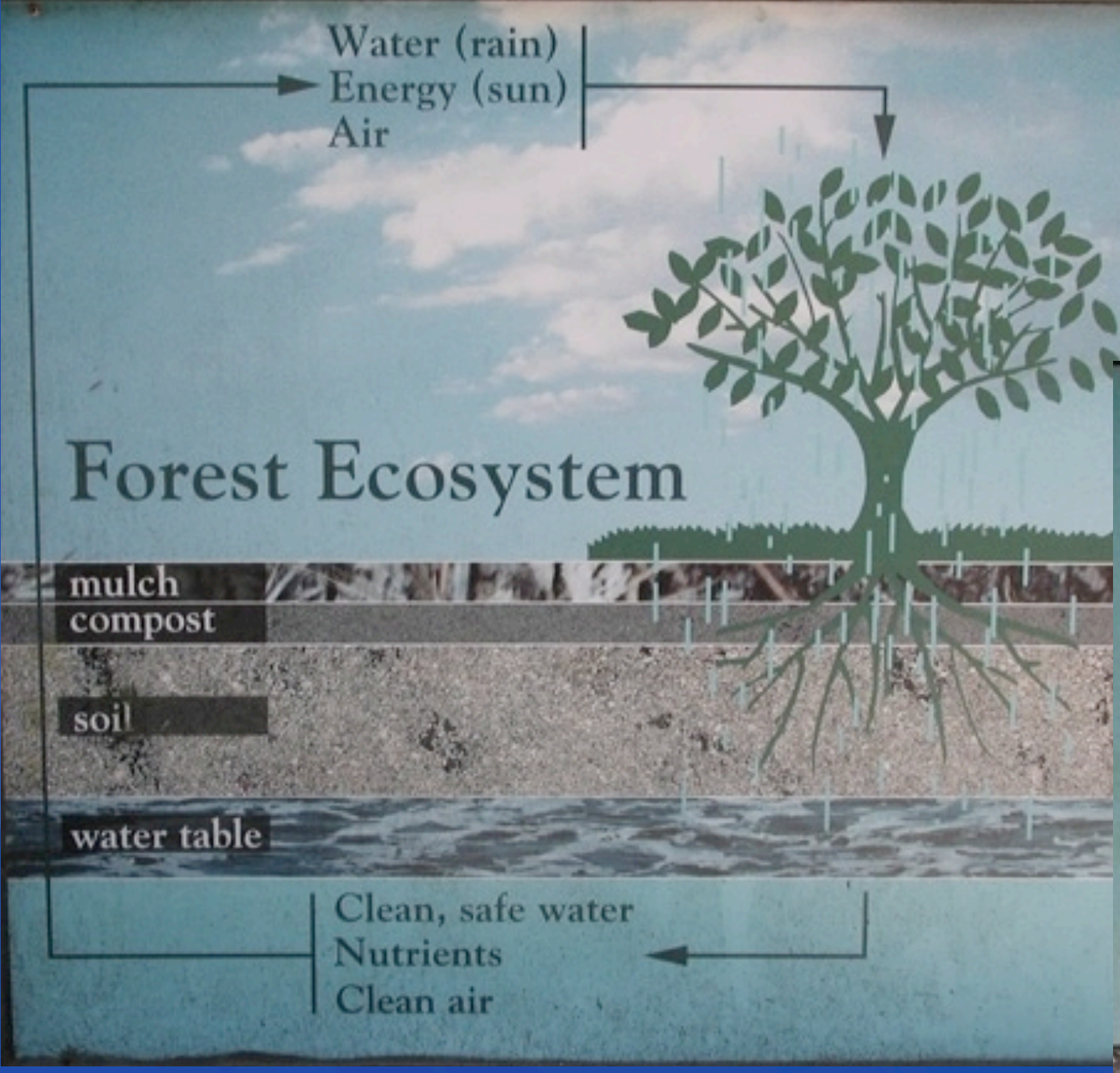
the classic swale: perfectly level, on contour

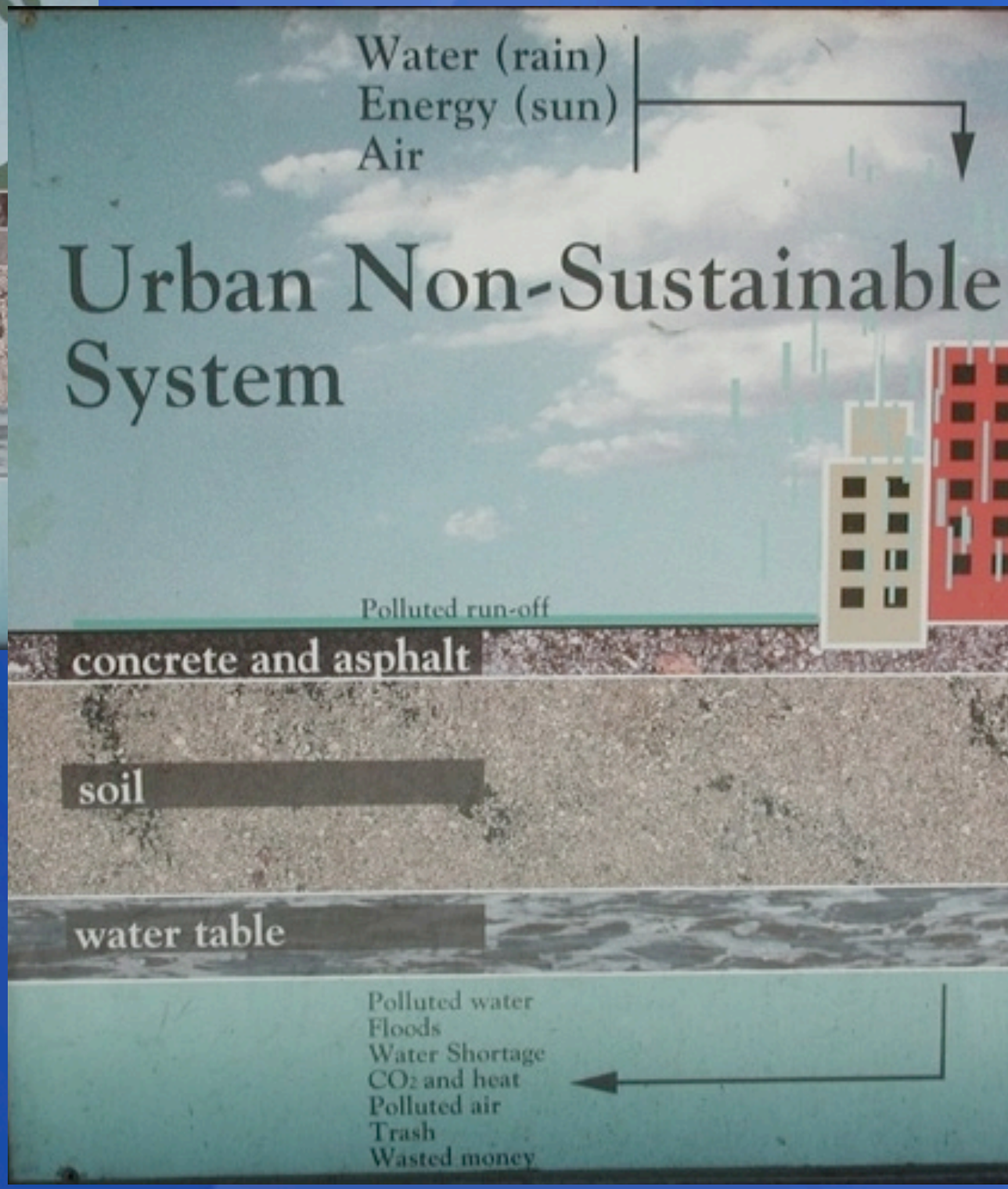
overflow into swales for infiltration

a “diversion swale” slopes slightly to storm drain

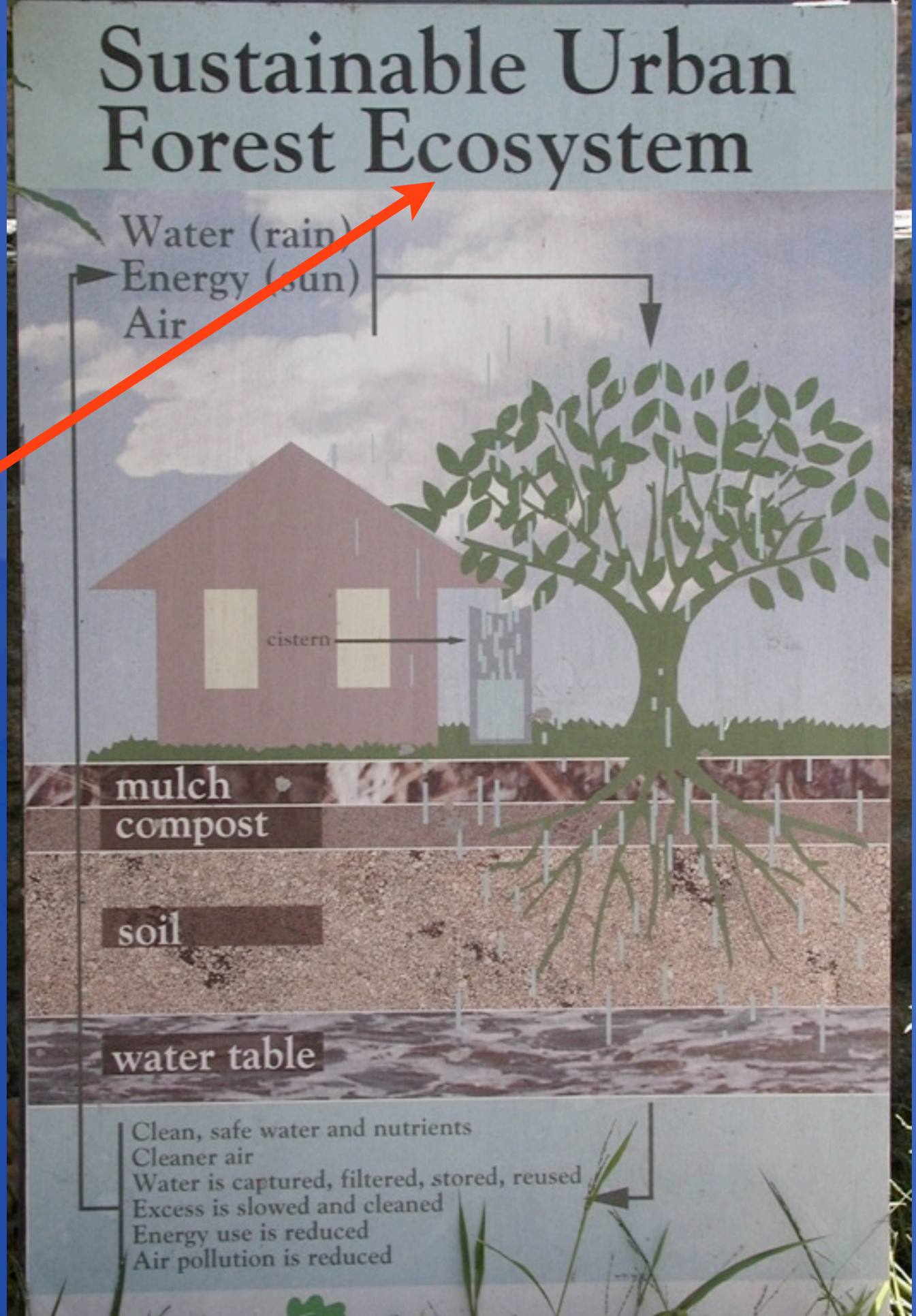
curb cuts and infiltration basins

treepeople in LA





treepeople:
re-dreaming
Los Angeles as a



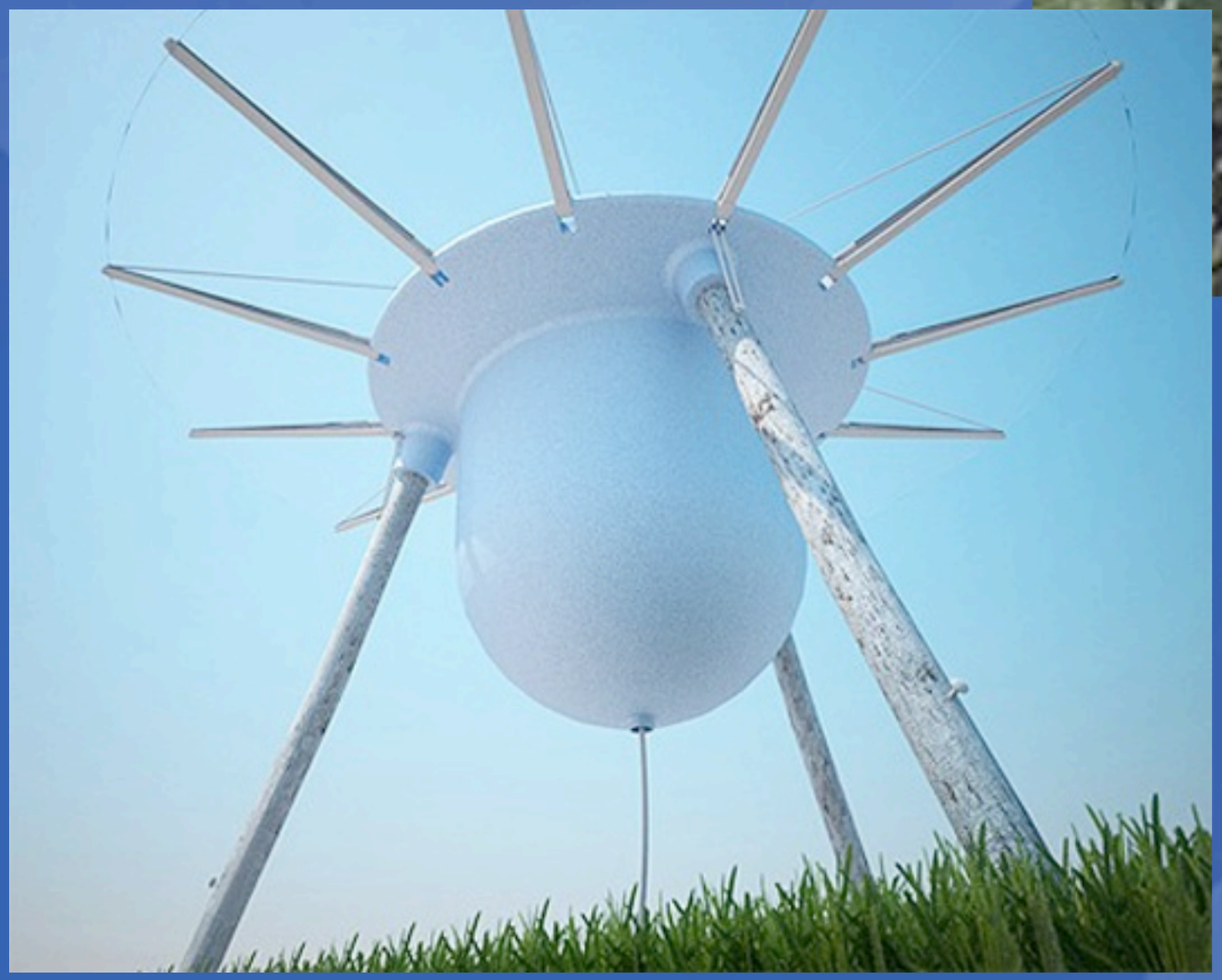
“catch and release”

moving the stormwater
away from the foundation

and now for fun: sculptural rain catchment

at Big Daddy's complete rejuvenatin' community garden, Emeryville

fun with form



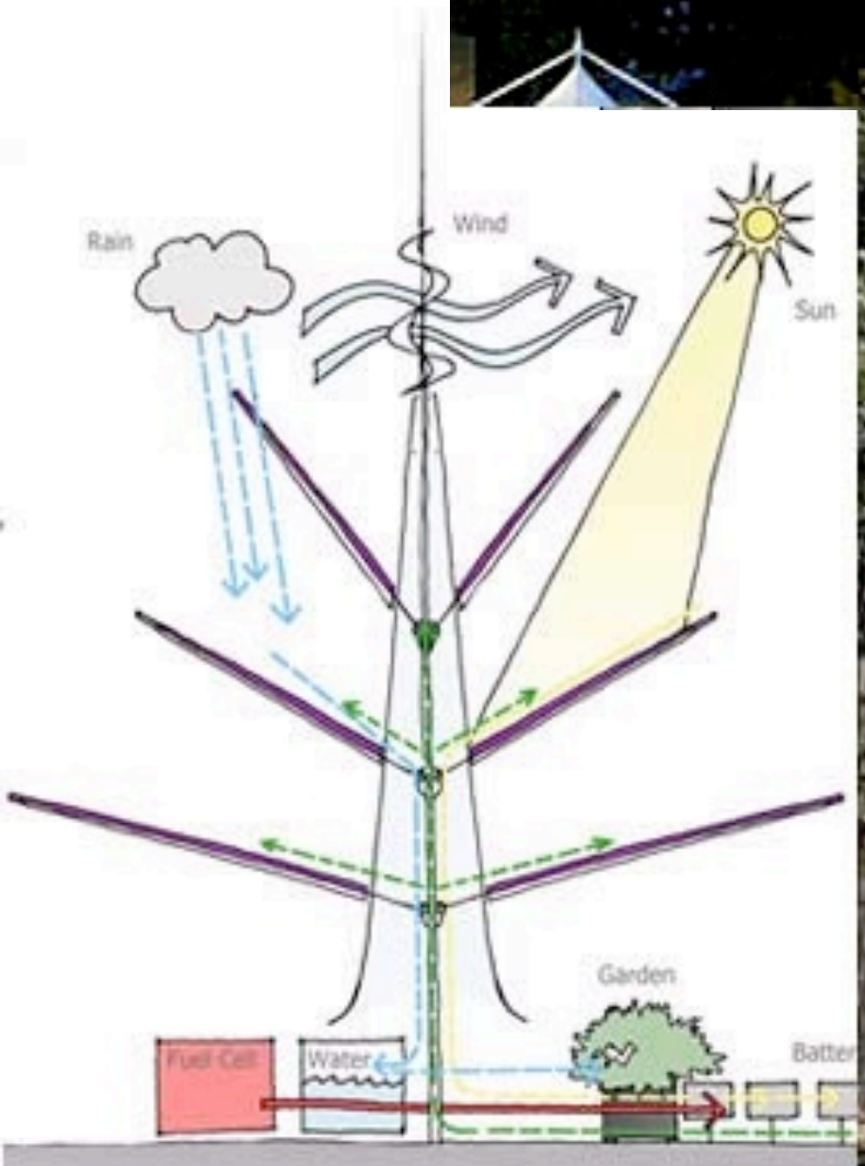
TomDavid Architecten for Cassablanca, Morocco

Mills College Science Building:
recycled stainless mayonaise vessel as storage for toilet flushing

“stacking functions”:
winter raincatcher /
summer clothesdryer

laurie chetwood's
Urban Oasis

catching
sun,
wind,
and
rain



making storage interesting

traditional forms

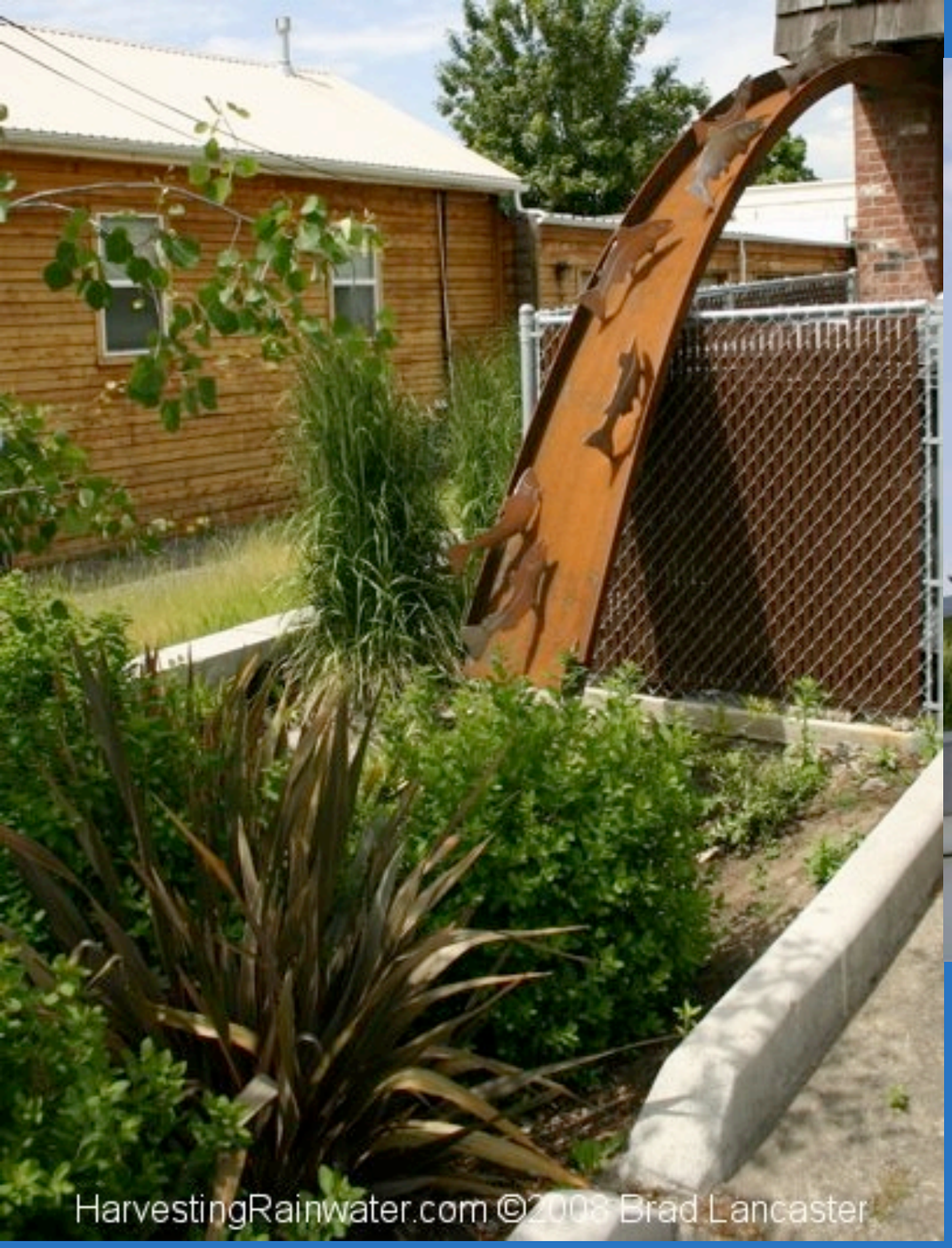
ferrocement

(great acoustics for summer concerts inside!)

concrete

wannabe stone

of PET bottles



fun with conveyance

even more
fun with conveyance

musical rain?

BusterSimpson's poetic utility

rain chains

prepping your barrel today inlet outlet overflow!!!

~outlet near bottom:

decision: how close to the bottom do you want it?
(water below that point will not be available)
pointing which way in relation to the overflow?

mark the spot and have us drill the hole
then:
~push the bulkhead fitting threads through the hole
~inside the barrel, tighten the nut in reverse direction (counterclockwise)
~put teflon tape clockwise onto hose bib threads
~very gently screw hose bib into bulkhead fitting
(carefull! metal threads can “cross” plastic threads)
~you may use channel locks to tighten fittings

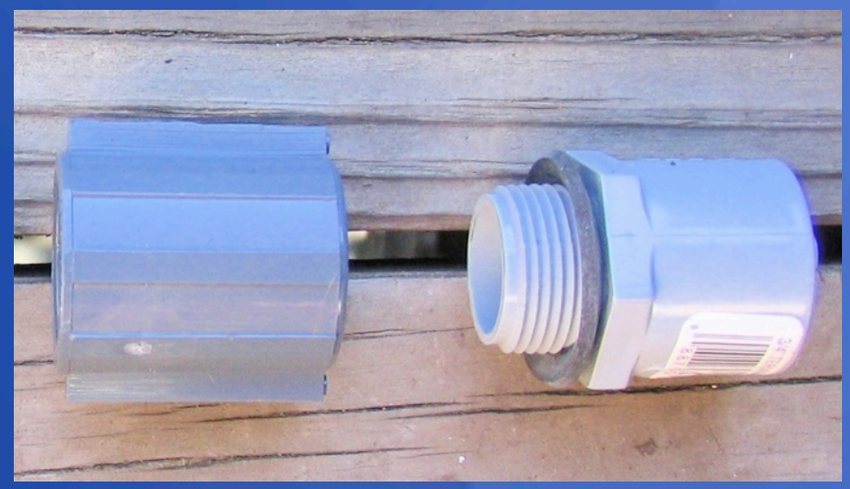
creating a new water-tight opening in a tank/barrel:

~ drill a hole with a holesaw

~ insert a uniseal
(from the outside only!)

or

~ electrical fittings with washer
(need to be able to hold one part inside barrel)



or

~ bulkhead fitting

~ overflow

remember it determines the height of water in the barrel

decision: what direction do you want it pointing

in relation to the outlet at the bottom?

where are you directing the overflow so it can infiltrate into the soil?

how will you convey the overflow water to that area?

mark the spot and have us drill the hole

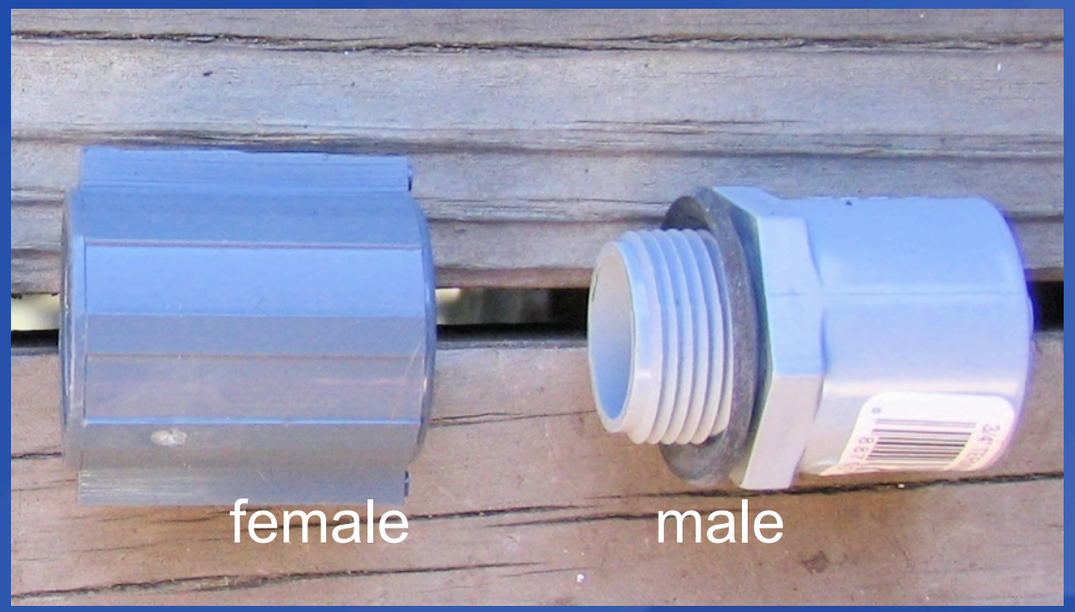
then

~push electrical male adapter threads into the hole

~screw the female adapter onto the male threads inside the barrel

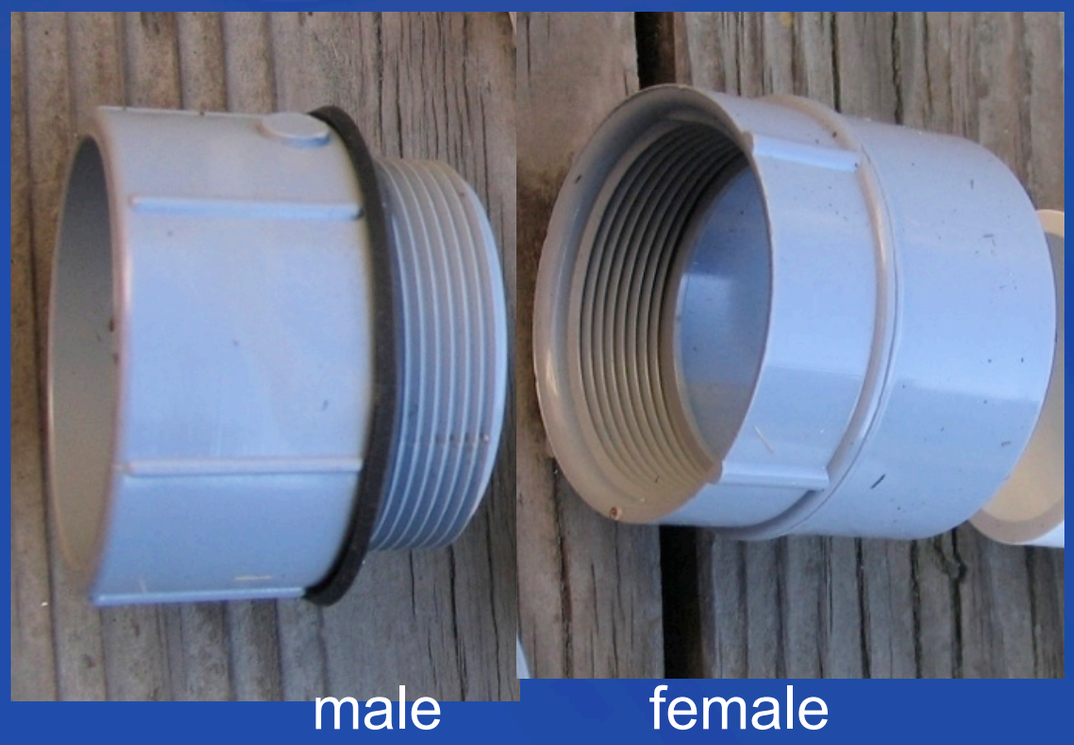
~tighten: no washer necessary since it is the overflow

why electrical fittings?



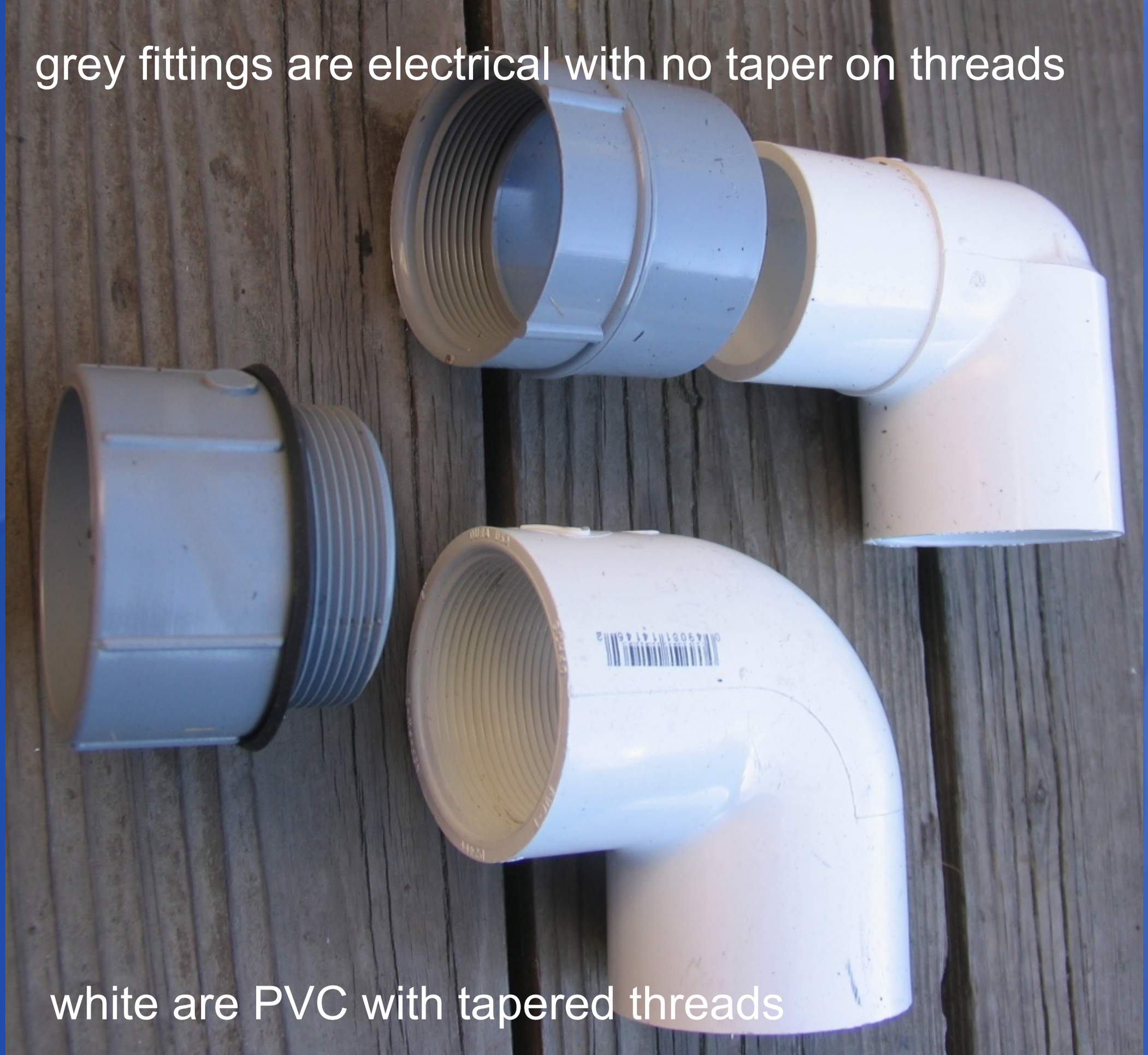
~cheaper than bulkheads
~easier to find than uniseals

“terminal adapters”:



threads are not tapered
so they tighten
all the way and can
compress a washer
against the side
of the barrel~~
creating a seal

grey fittings are electrical with no taper on threads



white are PVC with tapered threads

~ inlet

decision: how will you bring water from your downspout to the top of the barrel?
will the barrel be in a shady spot or sunny one?
will the entire top be open, (covered by the screen)
or will you have us drill several holes in the “lid” and then put that under/over the screen?

~cut screen 2’ x 2’ with scissors
(please use the template so there will be enough screen for everyone)
~screw on lid to hold screen in place

inlet

downspout has been cut

downspout adapter

with 3” street 45

3” triple wall pipe

and 3” 45

2” PVC overflow

to be connected

to green plastic tube

green downspout extender for inlet

mosquito netting

overflow to storm drain

outlet with ball valve

inlet

downspout has been cut

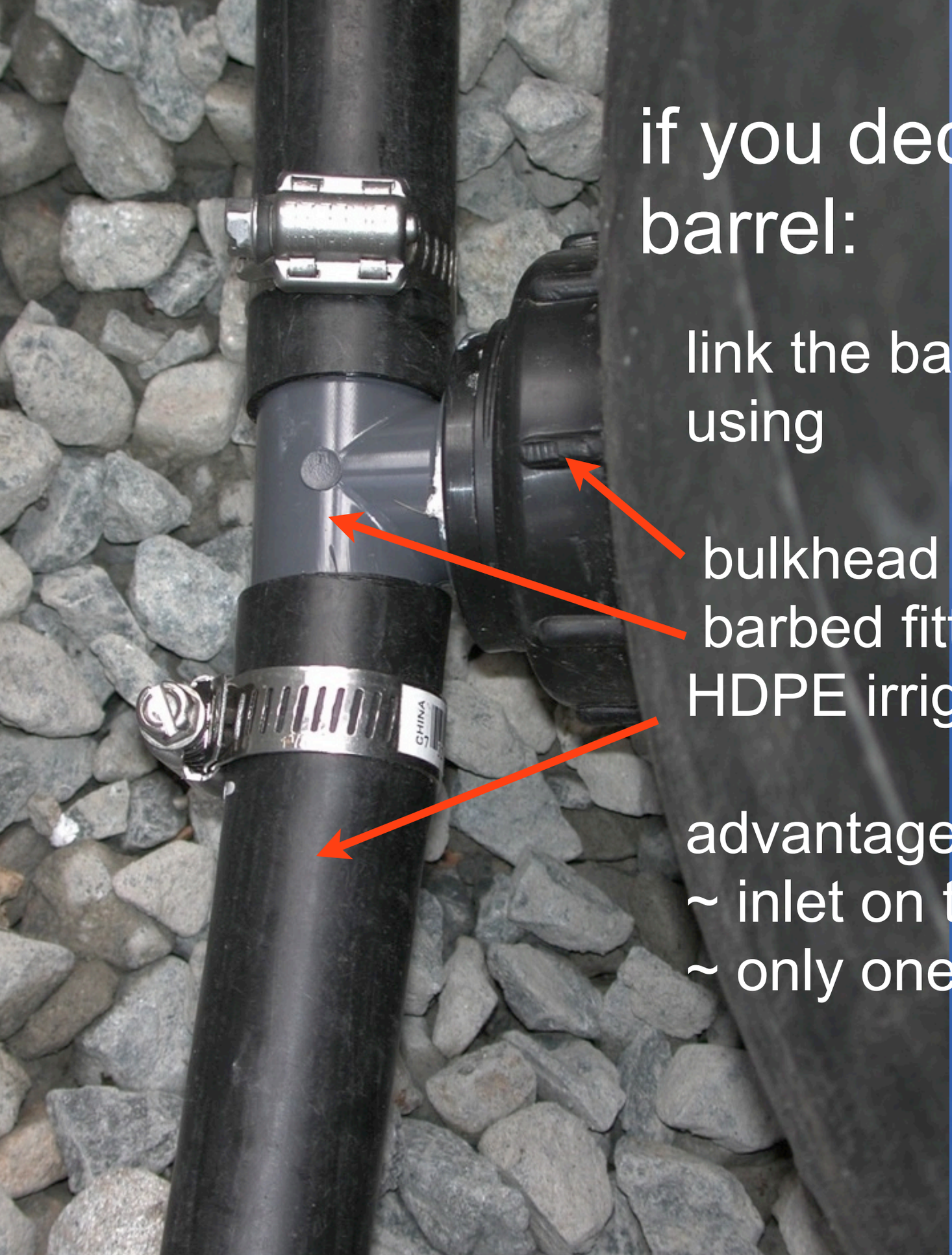
3” downspout adapter

3” pipe

3” SDR x 2” PVC reducer

2” PVC pipe to barrel

outlet hose bib



if you decide to add another barrel:

link the barrels at the bottom using

bulkhead fitting
barbed fittings with HDPE irrigation tubing

advantages:
~ inlet on top doesn't have to seal
~ only one overflow and outlet valve

linking barrels using bulkheads

FPT bulkhead fittings

male nipple

full port ball valve
is best
with hose thread
adapter

barb x male 90 / barb x female tee / barb x male adapter

linking barrels using electrical fittings instead of bulkheads

male terminal adapters inside tank have threads
pushed thru hole and washer on outside of barrel
then barb x female fittings on outside of tank


male terminal adapter inside with
threads pushed through hole,
washer on threads, then female
by barbed tee

blu-lock irrigation tubing linking
barb x female fittings
on pvc nipples
pushed into
uniseal gaskets in tank wall

please remember to

earthquake strap your barrel
paint PVC pipe with latex paint for UV protection
cover the overflow opening with screen as well

treasure that water!

resources:

greywateraction.org/rainwaterharvesting
arcsa.org
harvestingrainwater.com

materials:

cleanwatercomponents.com
urban farmer store: Mill Valley, Richmond, SF
wyatt irrigation, Napa, Santa Rosa, Petaluma
https://www.bluebarrelsystems.com

books:

The WaterWise Home by Laura Allen
Rainwater Harvesting for Drylands Vol 1 & 2 by Brad Lancaster
Water Storage by Art Ludwig

inspiring examples by bay area companies:

WaterSprout.com
Dig Cooperative http://www.dig.coop