
WELCOME!
October 10, 2017
Milano, TX

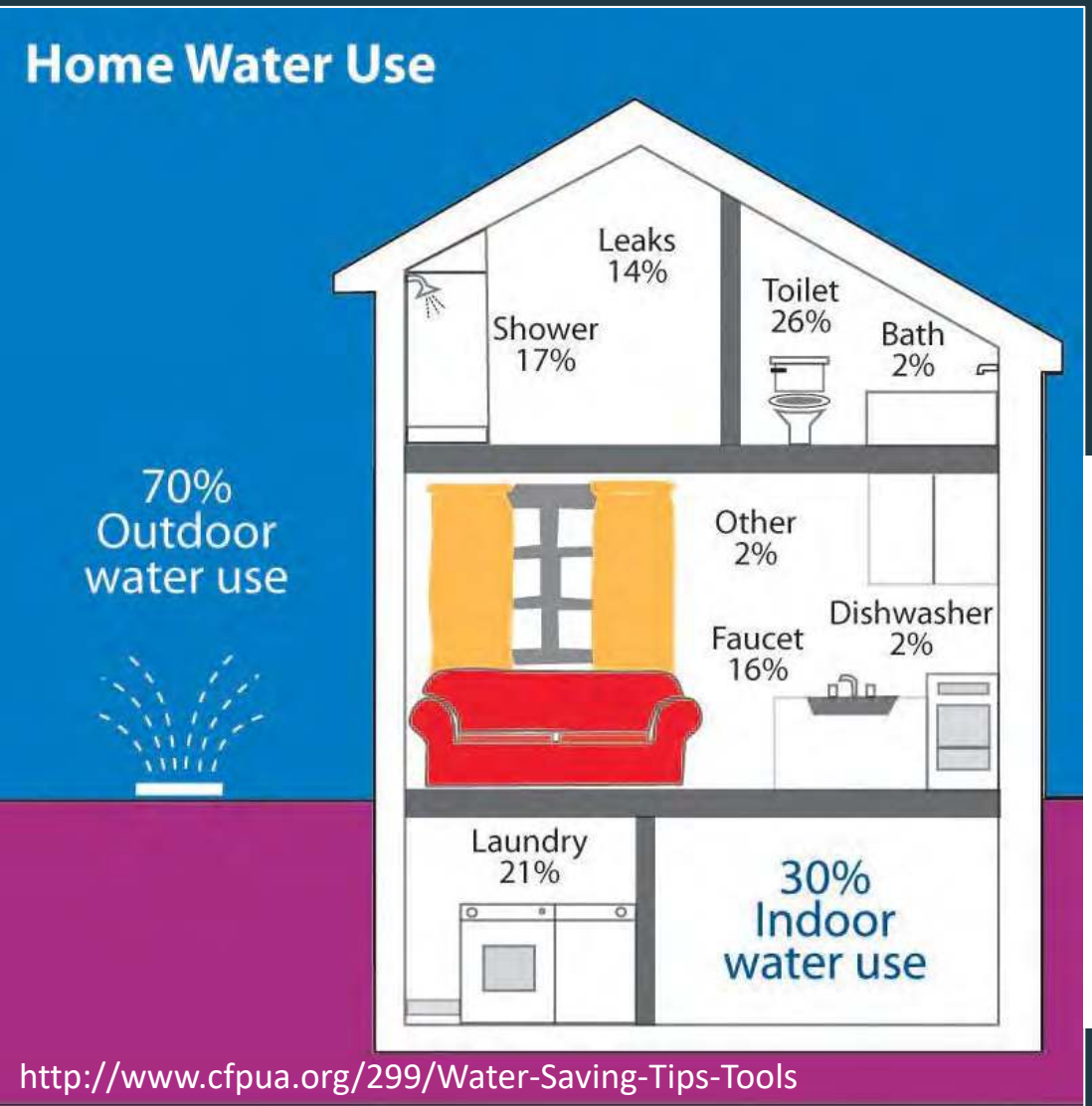
Session Outline

- Conservation
- Collection Capacity
- Components
- Gutters and Filters
- Aesthetics

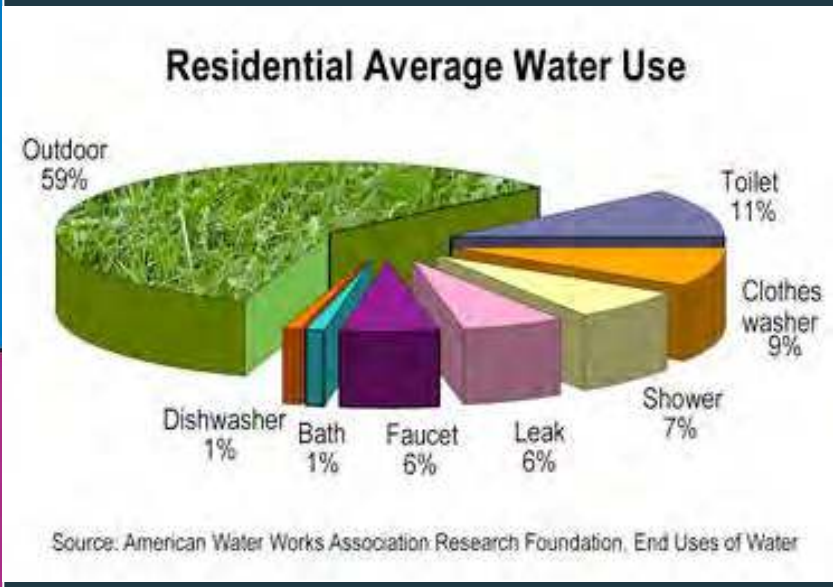
Conserving a Precious Resource

Rainwater harvesting is the capture, diversion, and storage of rainwater for use in landscaping, rangeland, and other purposes

How Do We Use Water?



Outdoor use is about 60 – 70% (estimates vary slightly)!



http://www.cfpua.org/299/Water-Saving-Tips-Tools

Not a New Idea!

Source: www.monticello.org

Advantages of Rainwater Harvesting

- Is a conservation practice
- Can reduce storm water runoff, and so reduces pollutants entering water bodies
- Rainwater is of superior quality: zero hardness, sodium-free, and nearly neutral pH (neither acidic nor basic)
- When properly managed, rainwater harvesting eliminates the need for costly treatment and distribution systems
- Apart from costs to collect, store, treat, and convey the water into the facility, rainwater harvesting is free

Disadvantages of Rainwater Harvesting

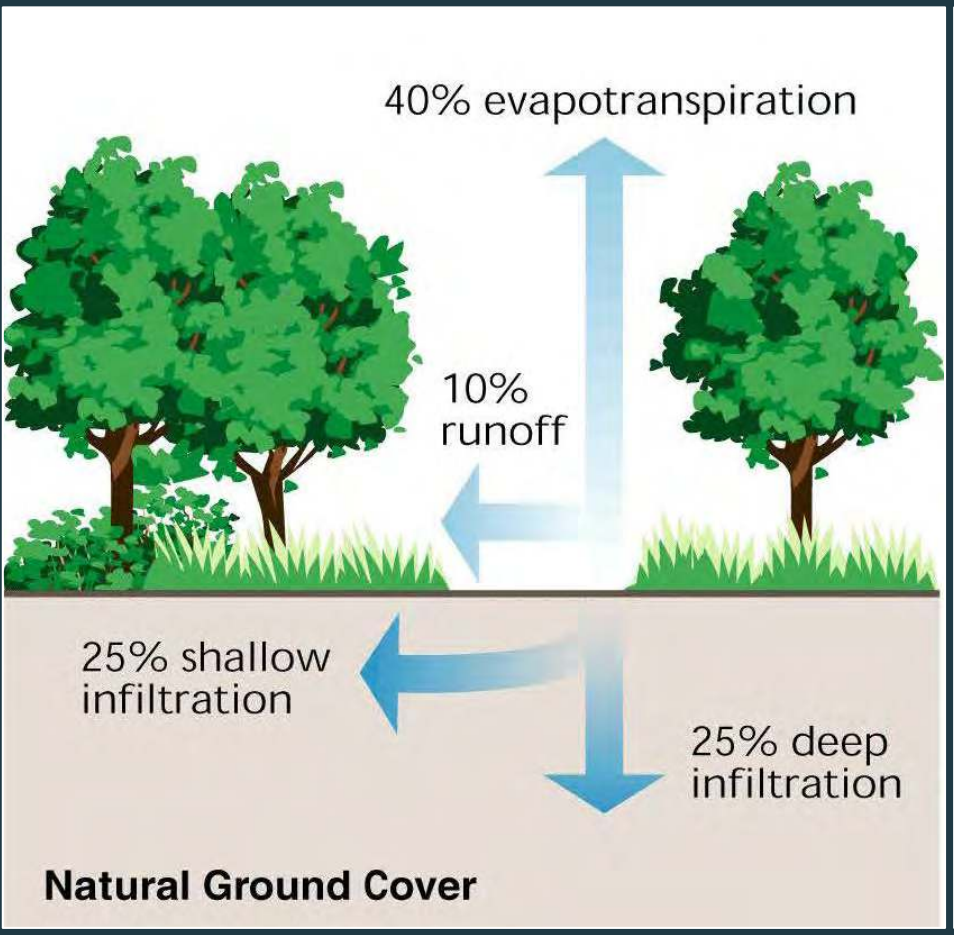
- Rainwater harvesting may need to be supplemented with water from other sources, especially during extended dry periods or droughts
- Systems require regular maintenance after installation
- Storage systems can take up space around the house
- Standardized construction guidelines for systems are lacking

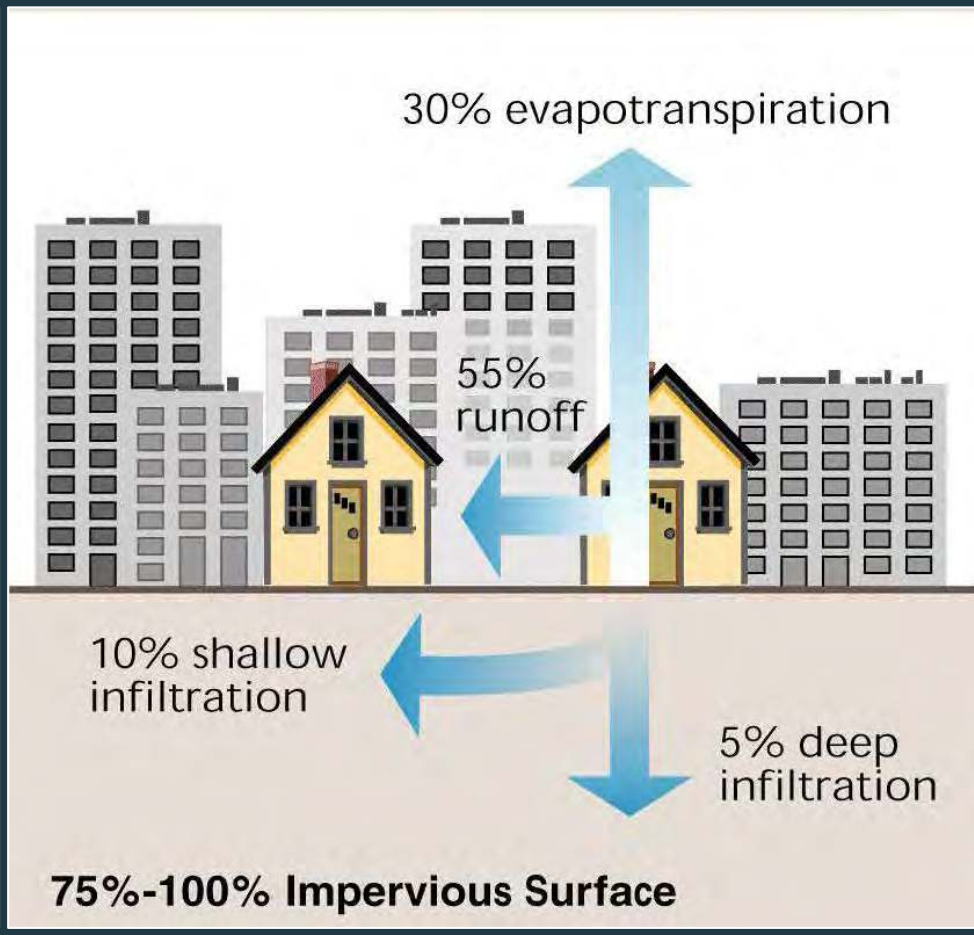
Texas Senate Bill 198, 2013-2014

Senate Bill 198: Illegal for a homeowners association to prohibit:

- Installing rain barrels or a rainwater harvesting system
    - Can require screening or shielding to obscure view of tanks
- Using drought-resistant landscaping or water-conserving natural turf
- Composting of vegetation
- Installing underground drip irrigation

Impervious Surface Causes Increased Runoff





Potential Rainfall Collection Volume

For every 1” of rain:

- Each square foot of a collection surface footprint generates about 0.6 gallons of water:

Total Gallons H_2O = Square Feet of Footprint X 0.6 Gallons/ft^2

~In other words~

- Each 2,000 square feet of collection surface generates 1,200 gallons of water

77 Year Average of Monthly Rainfall in Milano

	Ave. Monthly Rainfall (in)
January	2.8
February	2.9
March	2.9
April	3.3
May	4.1
June	3.5
July	2.3
August	2.5
September	3.5
October	3.5
November	3.2
December	3.2

Average annual total rainfall in Milano is 39.8 inches

Texas Water Development Board

Monthly Rainfall Collected/2,000 ft² in Milano (39.8 in)

	Ave. Monthly Rainfall (in)	Catchment (ft^2)	Gal/ft^2	Collection (gal/month)	Amount in tank (gal)
January	2.8	2,000	0.6	3,360	
February	2.9	2,000	0.6	3,480	
March	3.3	2,000	0.6	3,960	18,840
April	4.1	2,000	0.6	4,920	
May	4.1	2,000	0.6	4,920	
June	3.5	2,000	0.6	4,200	
July	2.3	2,000	0.6	2,760	
August	2.5	2,000	0.6	3,000	
September	3.5	2,000	0.6	4,200	
October	3.5	2,000	0.6	4,200	
November	3.5	2,000	0.6	4,200	
December	3.2	2,000	0.6	3,840	

77 Year Average of Monthly Rainfall in Milano (gal/ft²)

	Ave. Monthly Rainfall (gal/ ft²)
January	1.7
February	1.8
March	1.7
April	2.0
May	2.5
June	2.1
July	1.4
August	1.5
September	2.1
October	2.1
November	2.1
December	1.9

Average annual total rainfall in Milano in gal/ft² is 22.8 gallons

Texas Water Development Board

Monthly Rainfall Collected/1,500 ft^2 in Milano

	Rainfall (gal/month)	Catchment (ft^2)	Collection (gal/month)	Amount in Tank (gal)
January	1.7	1,500	2,550	
February	1.8	1,500	2,700	
March	1.7	1,500	2,550	13,800
April	2.0	1,500	3,000	
May	2.5	1,500	3,750	
June	2.1	1,500	3,150	
July	1.4	1,500	2,100	
August	1.5	1,500	2,250	
September	2.1	1,500	3,150	
October	2.1	1,500	3,150	
November	2.1	1,500	3,150	
December	1.9	1,500	2,850	

Rainwater Harvesting Calculators

Texas Water Development Board Rainwater Harvesting System Sizing Calculator available through the American Rainwater Catchment Association
https://arcsa.site-ym.com/?page=268

Texas A&M AgriLife Extension Rainwater Harvesting Calculator:
http://rainwaterharvesting.tamu.edu/2011/05/31/calculator/

What Can Fall on Your Roof?

Protect water quality from the beginning to avoid clean-up later

RWH Questions to Consider

- Subdivision restrictions?
- How much water can I catch from my roof?
- Estimated cost of tank/s?
- Can I afford a tank I will be proud of, or do I need to hide a less expensive tank?
- Is storage available under a porch, patio or in a basement?

Components

Functional considerations only, or are aesthetics also important?

Components

Site Selection

Roof and Collection Surface

Conveyance

Primary Filtration

Foundation for Tank

Tanks

Tank Parts

Secondary Filtration

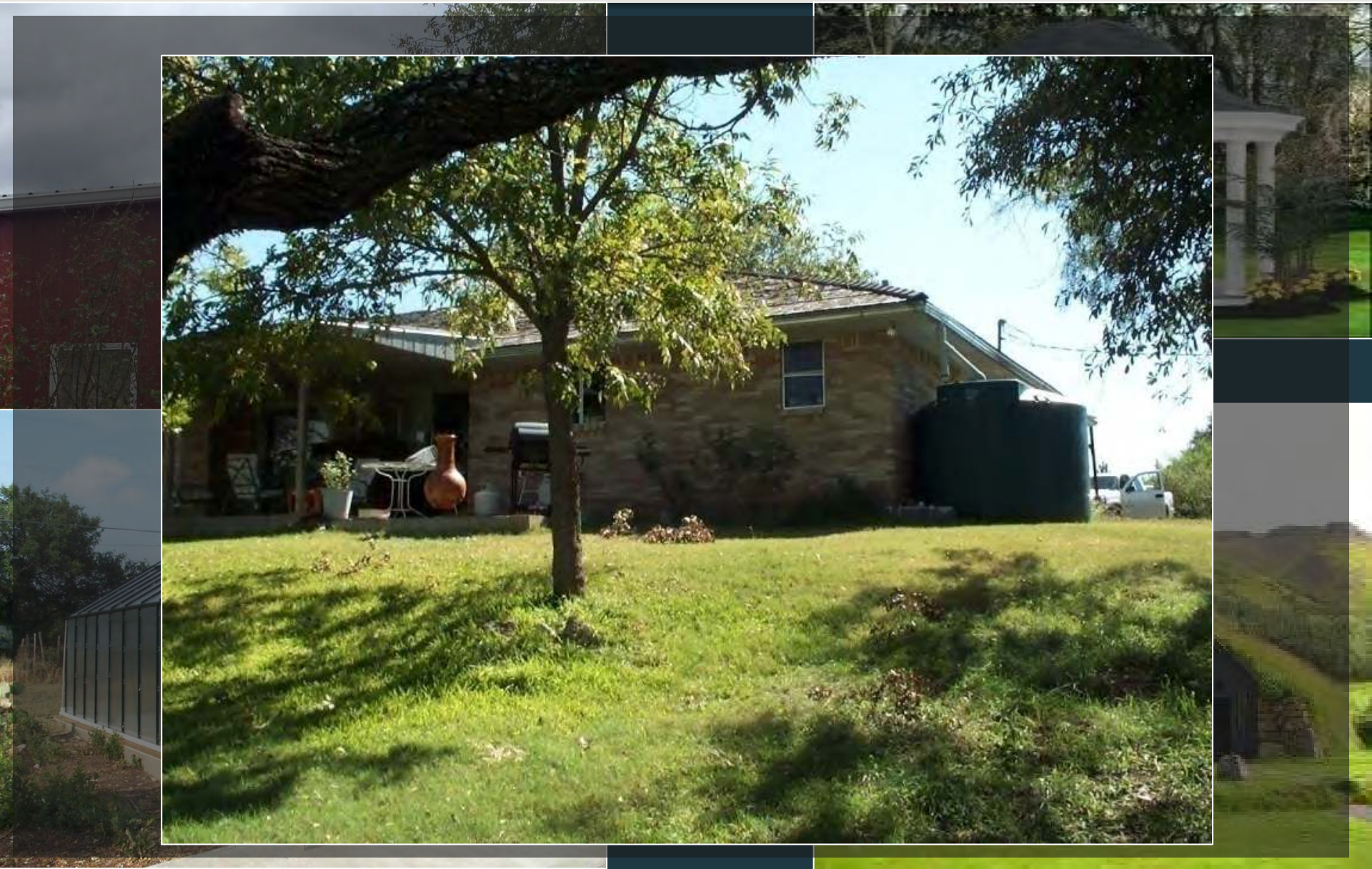
Pumps and Pressure Tanks

In Home Use

Site Selection For Tanks

- Soil type – trenching, leveling, digging
- Elevation – gravity flow or use pump to storage tank
- Distance tanks will be from the house
- Distance to electricity, filters, freeze protection
- Smaller size tanks I could install myself
- Type of foundation under the tank (consider size)
- Underground or larger, specially designed tanks may require excavation or a professional

Roofs and Collection Surfaces

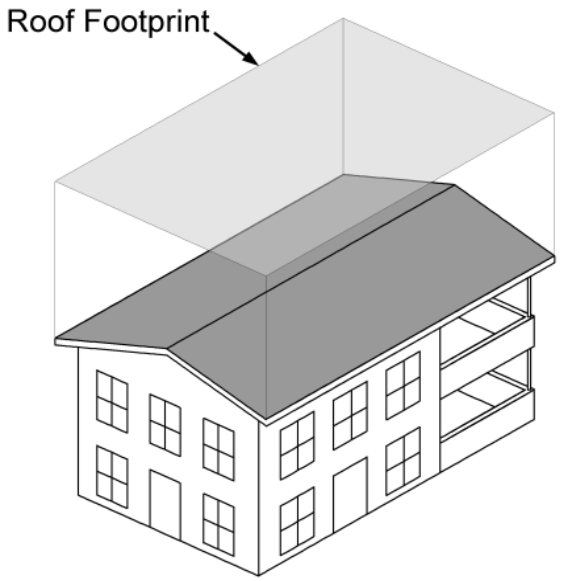


Some Roof Materials Are Not Recommended

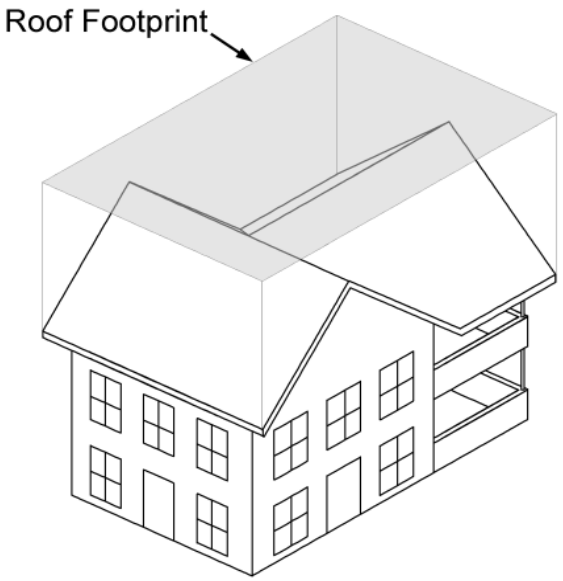
- **Not recommended:**
  - Chemically treated wood
  - Composite asphalt shingles
  - Asbestos
  - Some paints
- If painted, paints meeting NSF 61 should be used
- Particle filters should be installed if asphalt shingles are used

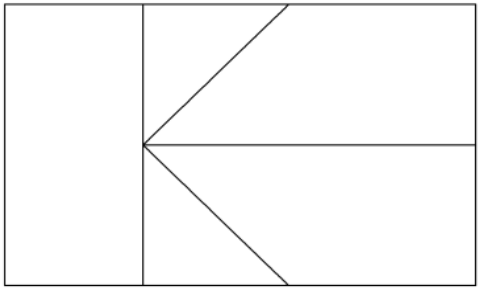
Unique Catchment Surfaces

Footprint of the Collection Surface

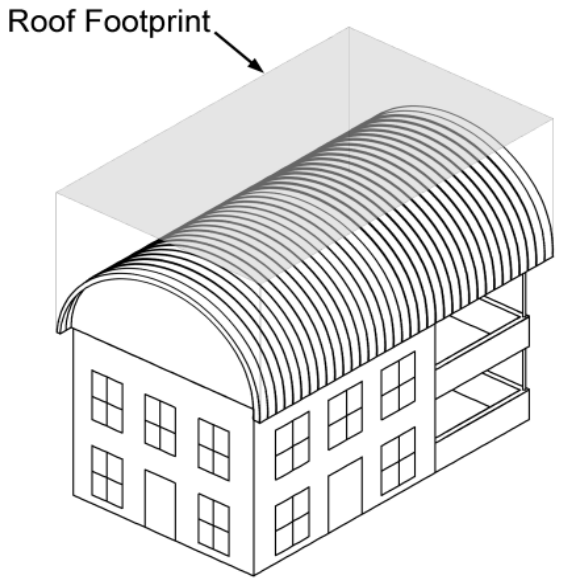


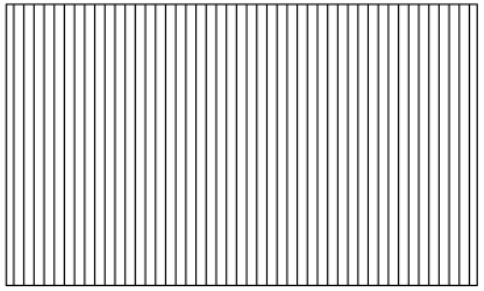
Roof Footprint





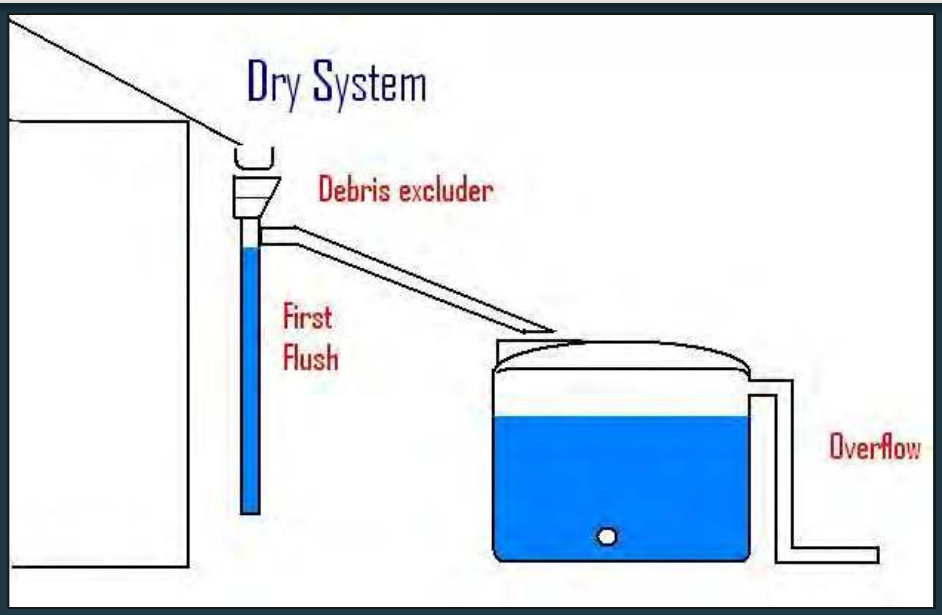
Roof Footprint

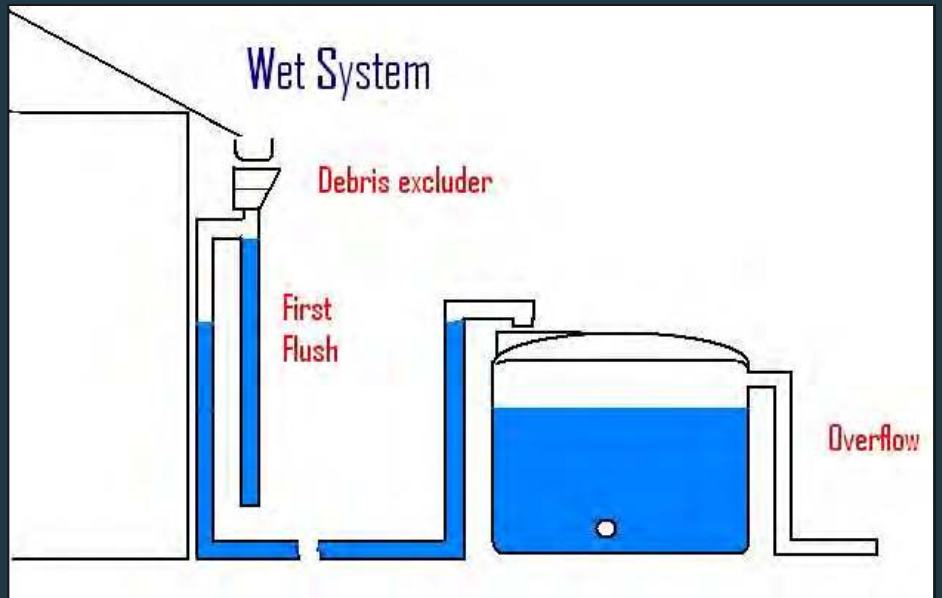


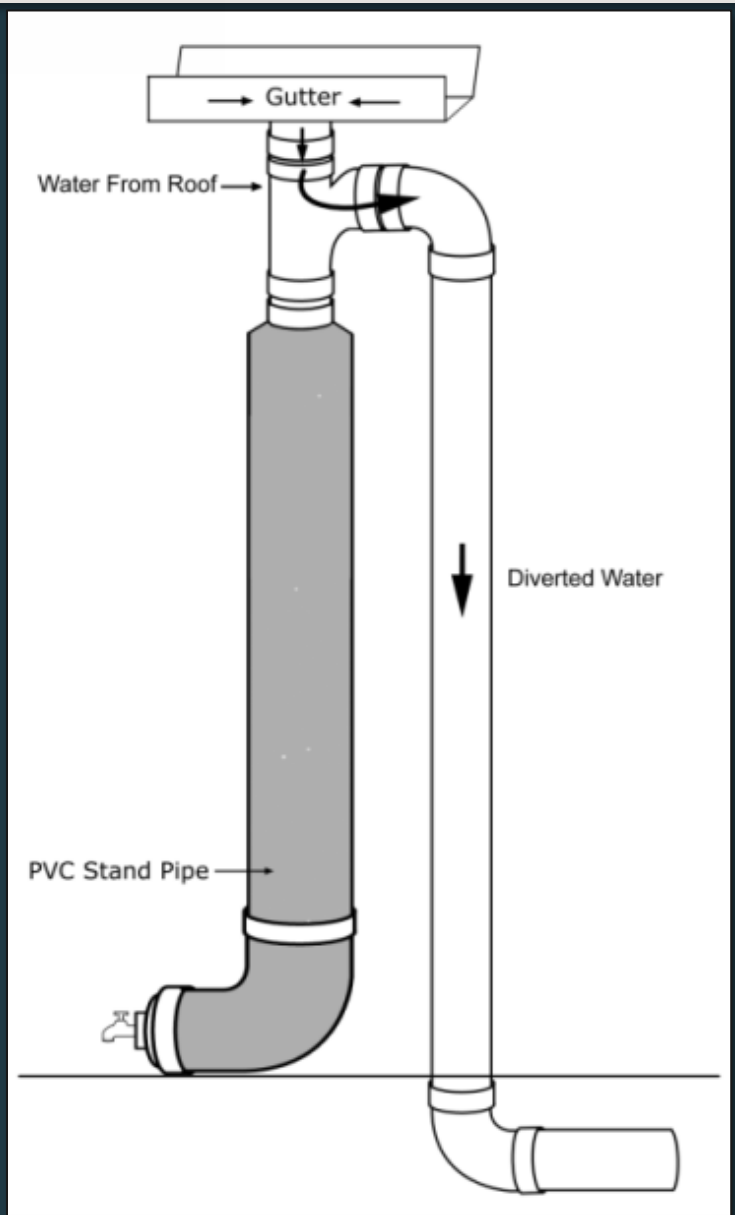


Roof Footprint

Conveyance


Dry System
Debris excluder
First
Flush
Overflow


Wet System
Debris excluder
First
Flush
Overflow


Gutter
Water From Roof
Diverted Water
PVC Stand Pipe

Gutters And Downspouts

Problems Do Occur!


joe

Non-traditional Downspouts

Non-traditional Downspouts

Government Canyon State Natural Area, San Antonio

Sizing Gutters

- Should be sized to adequately move rainwater runoff from a 100-year storm
- Generally, should be at least 5 inches wide

Downspouts

- Provide one square inch of downspout area for every 100 square feet of roof area
    - For example, a 2” x 3” downspout (6 square inches) can accommodate runoff from a 600 square foot roof
    - A 3” x 4” downspout (12 square inches) can accommodate runoff from a 1,200 square foot roof
- The same rule can be used for circular PVC piping

Gutters

- Materials: vinyl, seamless aluminum, galvanized steel, stainless steel, copper
- Slope toward the downspout 1/16”per 1’ to 1/16” per 10’
- Tilt out ½” to prevent water seeping into the walls
- Expansion joints for runs over 40’
- Hangers every 3’
- Use splash guards in valleys
- Number of downspouts varies with size and surface area – 1 per 1,000 square feet surface
- 1 square inch of outlet per 100 square foot of roof surface

Different Gutters and Downspouts

Secure the Gutters

Slope on Gutters

Gutters with a slope of ½” per foot can serve an area almost 2 times as large as a gutter with a slope of 1/8” per foot.

Catchment Surface

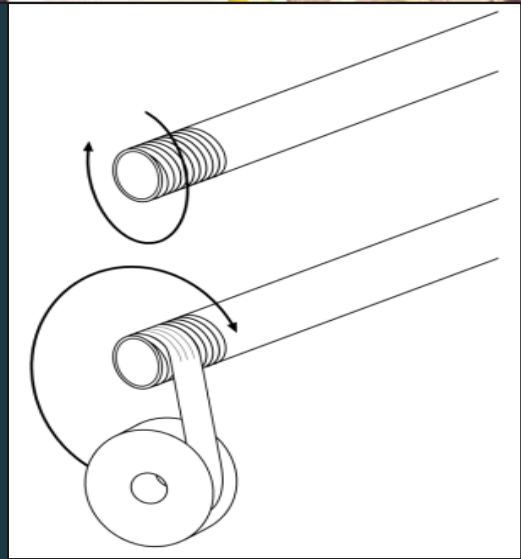
Imagination Never Hurts!

PVC Schedule 40 is for Socket Fittings Only

- Aluminum-plastic composite water piping
- Multipurpose pressure piping used for hot and cold water distribution indoors and outside
- Composite piping is approved by all national code authorities
- Copper is more likely to corrode with lower pH

Piping for RWH

- PVC to metal threaded – often leak
  - PVC – external threads - male
  - Metal – internal – female = best
  - Brass—preferred over steel
- Teflon tape – same direction as external threads (joint compounds not recommended)
- Never use gray pipe to carry water
- Never use white to carry electricity
- Always use purple pipe for nonpotable water

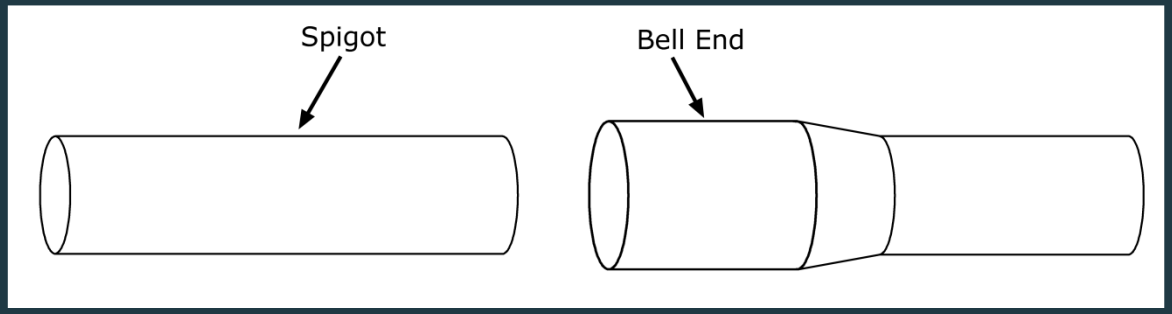


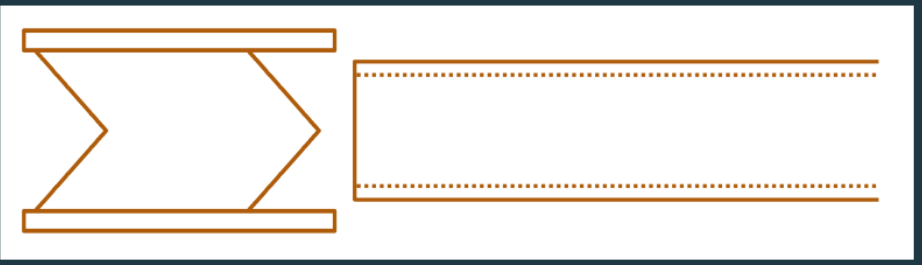
Pipe Inner Diameter

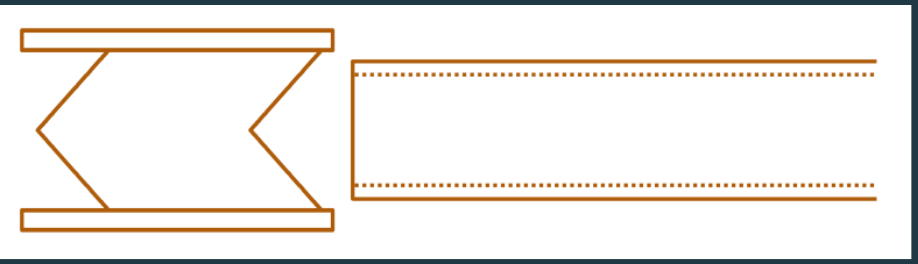
Nominal Diameter (in.)	Sch. 40	Sch. 80	(API) Flexible PVC
½	0.622	0.546	0.546
¾	0.824	0.742	0.740
1	1.049	0.957	0.960
2	2.067	1.939	-

- Schedule 80 has same outside diameter as Schedule 40
  - Thicker wall for above ground use
  - Recommended to be used with centrifugal pumps and pressure tanks
- Standard Diameter Ratio (SDR)
  - The ratio of pipe diameter to wall thickness

Bevel Edges And Prime Pipe







Connecting Slip Socket PVC

- Cut square – de-bur/remove debris
- Clean – no oil and dry
- Dry fit
- Primer penetrates and softens
  - Vary in color and viscosity
- Apply cement to both inside and outside
- Assemble quickly while cement is still wet
- Push together until fully seated
- Turn ¼ turn
- Hold tightly to prevent joint pushing apart
- Wipe off excess – prevent from continuing to dissolve pipe

Connecting PVC Pipe

A suitable primer penetrates and softens PVC surfaces more quickly than cement alone

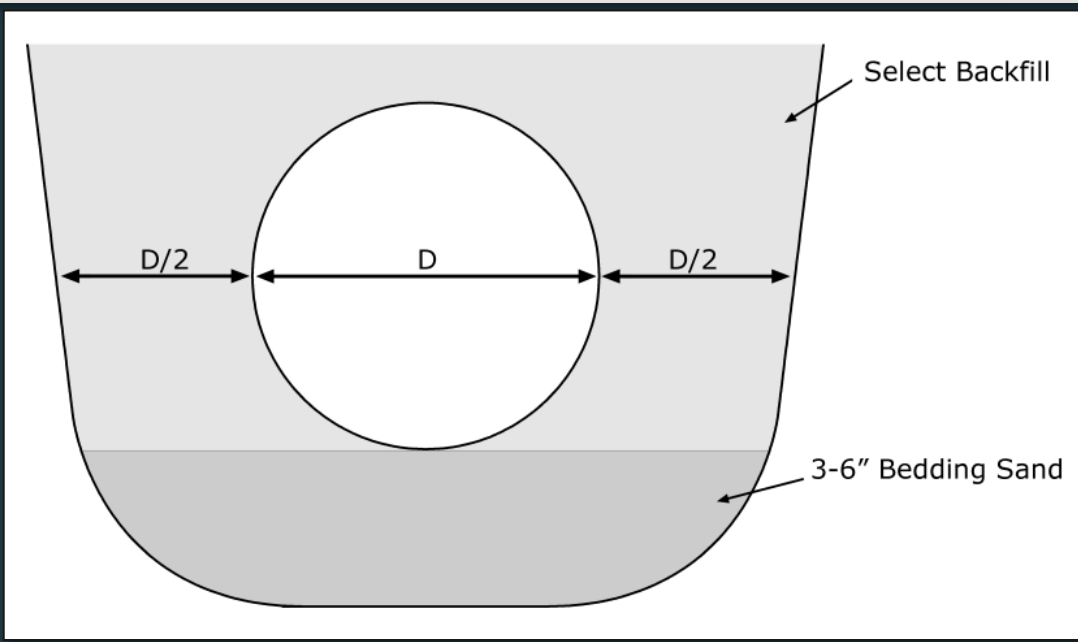
Apply more cement to the male end reducing excess from running into pipe

Connecting PVC

- Slip the pipe into the fitting while rotating ¼ turn to distribute cement evenly
- Keep pressure on connection or it may back out.
- Wipe off excess

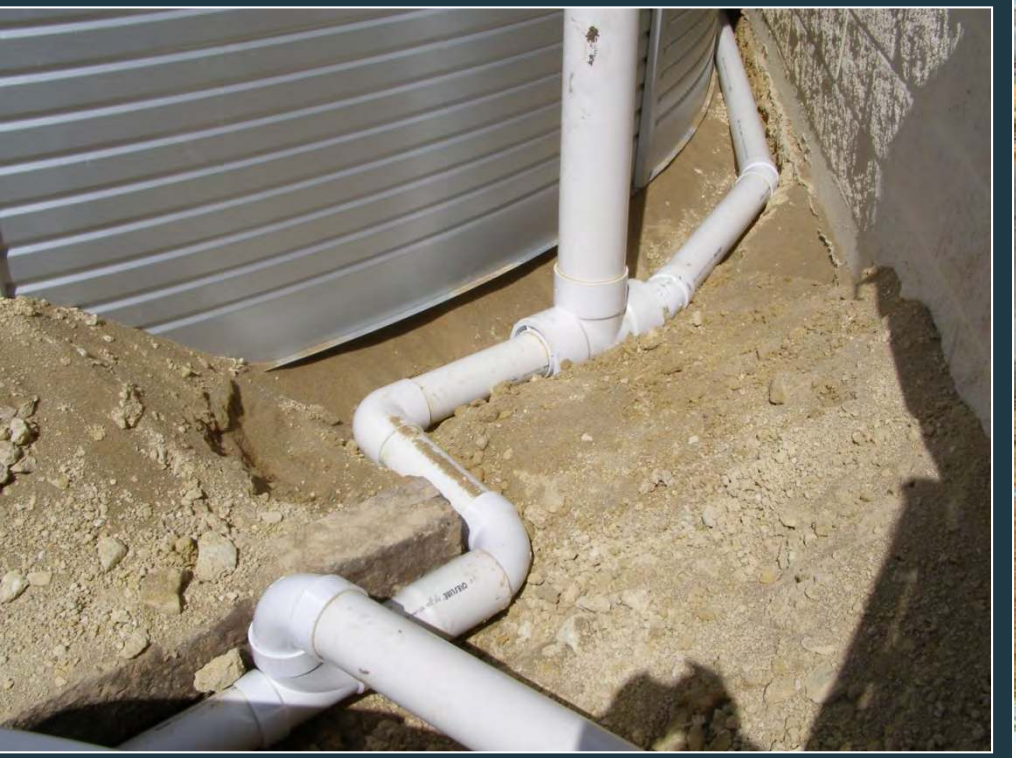
PVC Expands/Contracts 3.36” per 100 Feet at 100°F

- Snake the pipe in the trench
- Backfill in cool part of the day
- Trench should be twice the width of the pipe



- Pipe should be below the freeze line
- Do not have rocks or debris in backfill or exposed in bottom of trench – use sand if possible

Curves Strengthen Conveyance in Soil



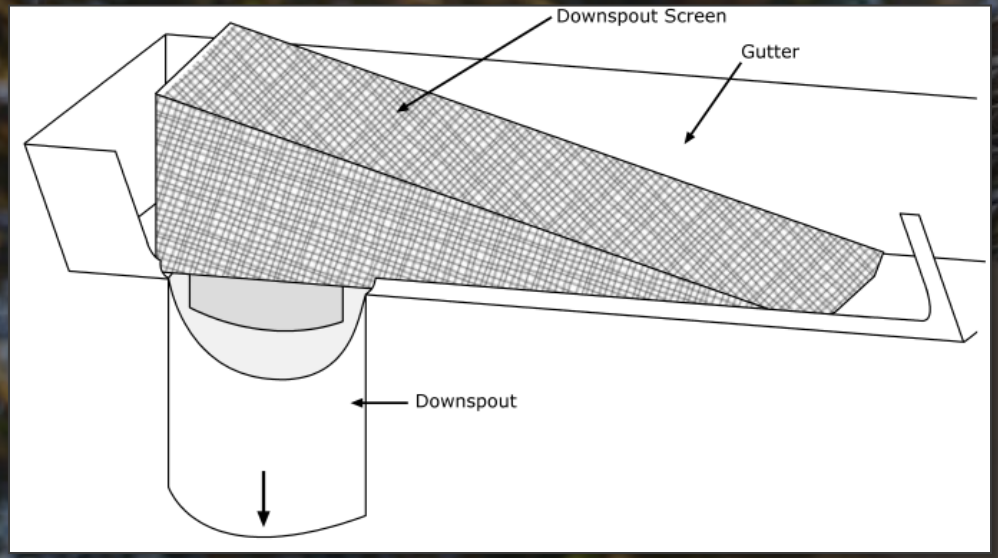
Preferred

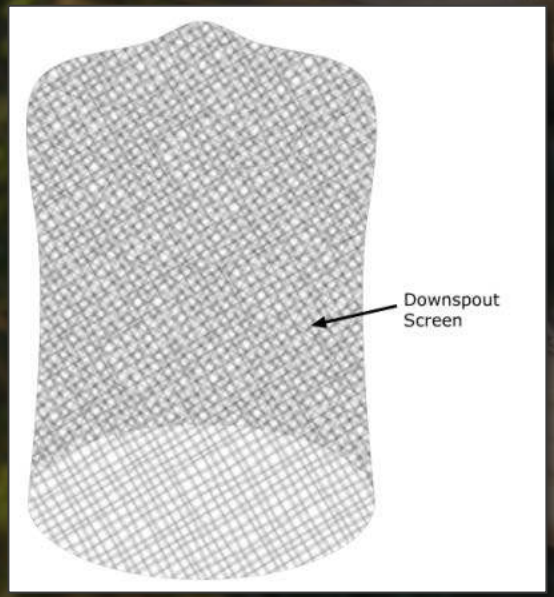
Not recommended

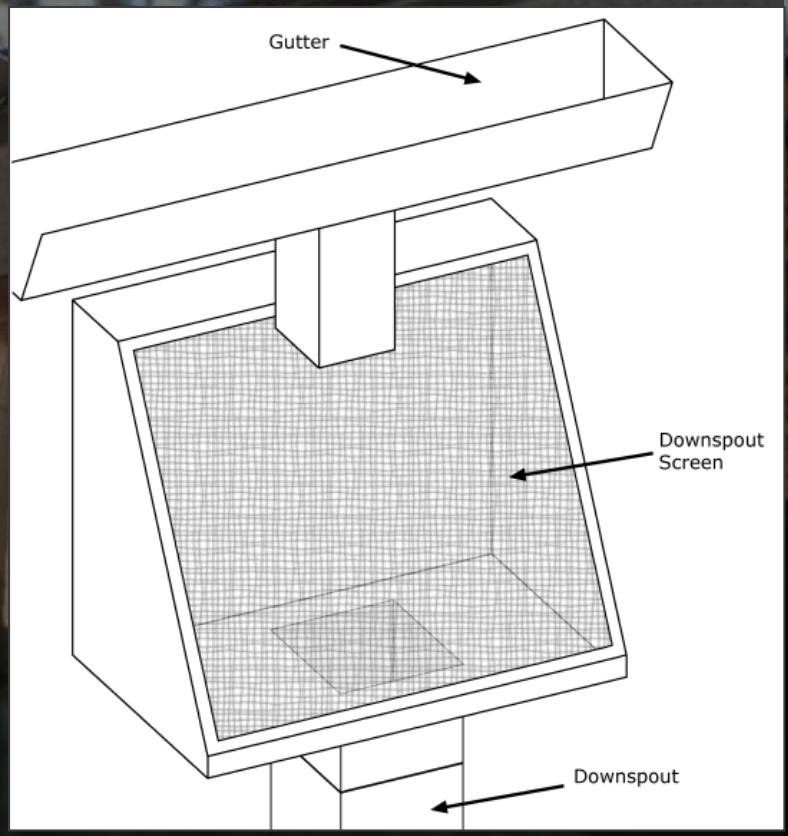
Primary Filtration

- Leaf screens
- Downspout filters
- Strainer baskets
- Self cleaning filters
- First flush diverters

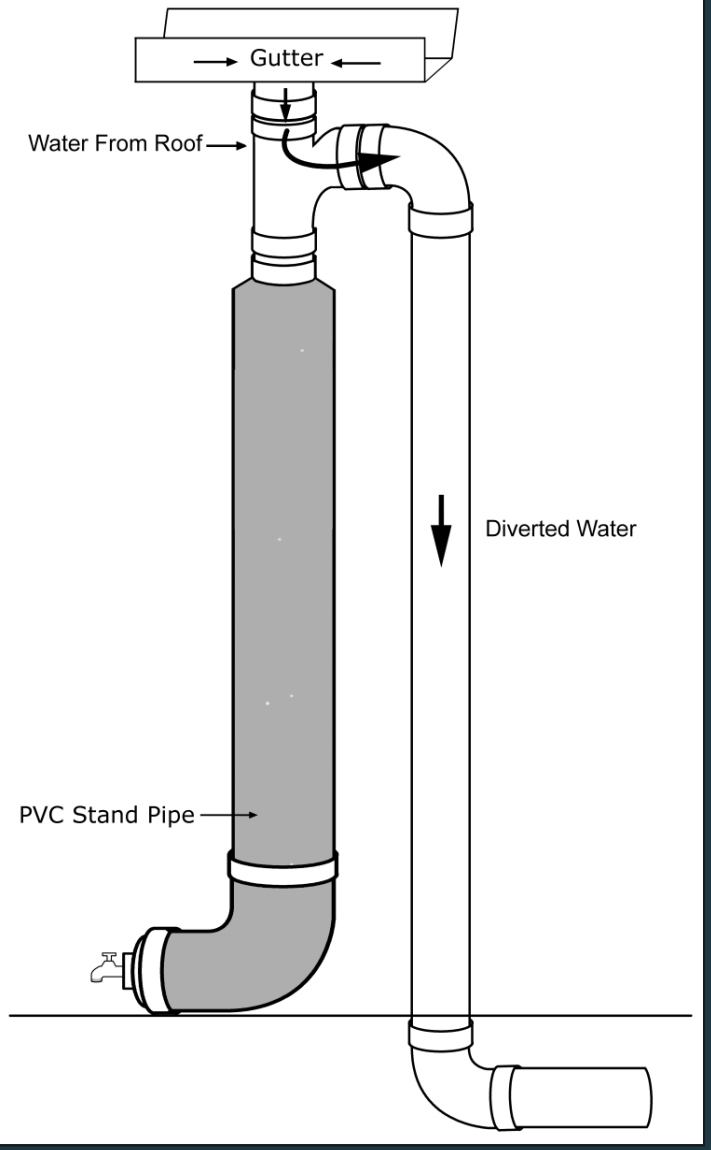
Screens and Gutter Guards

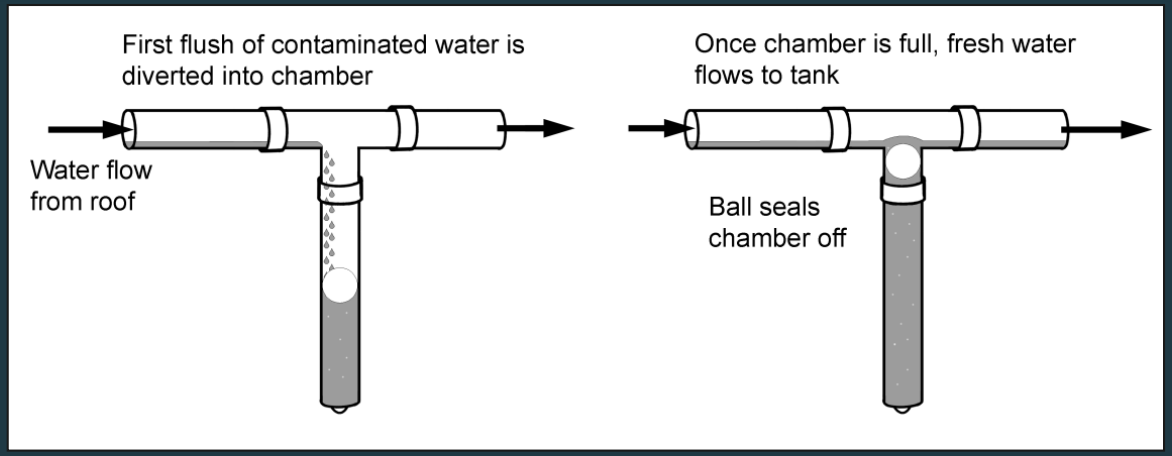






First Flush Diverters





How Much Rainfall to Divert in First Flush Diverter

1-2-3+ gallons per 100 square foot of roof

ARCSA Design Standard:

- High Contamination - .20”
- Medium Contamination - .08”
- Low Contamination - .02”

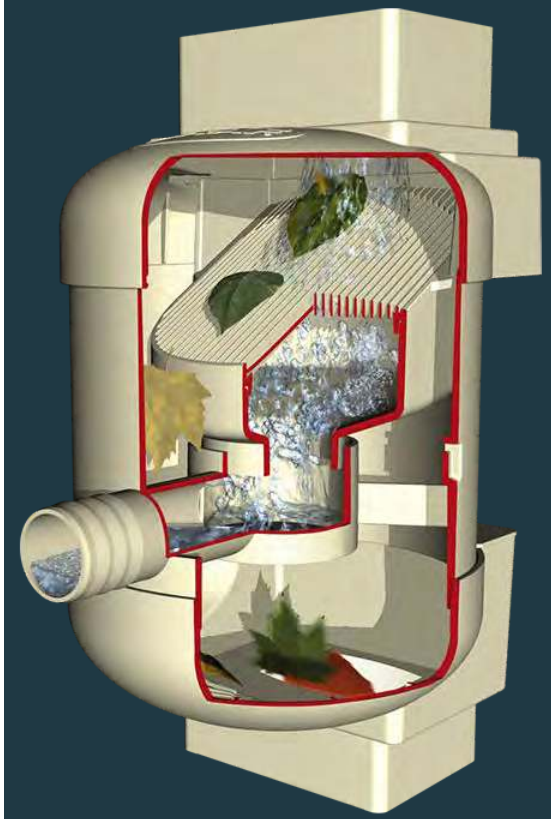
How Much Rainfall to Divert in First Flush Diverter

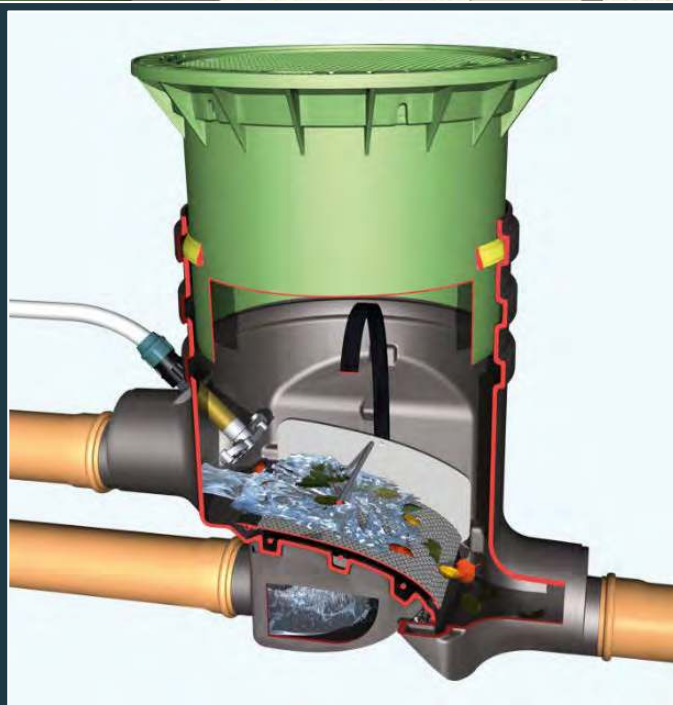
Standing pipes from 4”– 8” in diameter

Capacity at various SCH 40 PVC standpipe diverters

Length pipe (ft)	4” Capacity	6” Capacity	8” Capacity
1	0.7	1.5	2.6
3	2.0	4.5	7.8
5	3.3	7.5	13.0
10	6.7	15.0	26.0
15	10.0	22.5	39.0

More Filters





Foundation For Tank

Pad Preparation

- Tank pads – level, no rocks or roots
  - Sand, fine gravel, soil
  - Do not let the base underneath the tank wash or erode away due to overflow
- Gravity feed from the gutters, or
- Collect into smaller storage and pump into larger storage
- Longer distances – more resistance/friction; larger pipe needed
- Larger tanks may require cement foundation
- Jurisdiction of local ordinances

Tank Support

Foundation needs to be strong and safe

Water weighs 8.3 pounds/gal

3000 gallons = 24,900 pounds

Water Pressure= .4 pounds/column foot

Soil Bearing Capacity (lbs/ft²)

Soil Type	Load Bearing
Rock w/ Gravel	6,000 psf +
Gravel	5000 psf
Sandy Gravel	5000 psf
Sand	3000 psf
Silt Sand	3000 psf
Silt Gravel	3000 psf
Gravel w/ Clay	3000 psf
Clay	2000 psf
Sandy Clay	2000 psf
Silt Clay	2000 psf

- Ability of soil to support load applied to the ground
- Has a safety factor built in to prevent failure.
- The ultimate load bearing capacity is the point of failure with no safety factor.

Tanks

Tanks

- Well constructed and water tight
- Food grade plastic liner for potable water
- Size: how much do I need and how much can I collect?
- Cost: $ .35 (maybe) ➡ $2.25+ per gallon collected




Non-conventional Tanks

Where to Hide That Ugly Tank?

Two 1,440 gallon tanks under master bedroom deck

Tank Storage Options

The 3,000 gal black polyethylene tank is hidden behind the cedar picket fence. A pressure tank and pump are inside the building.

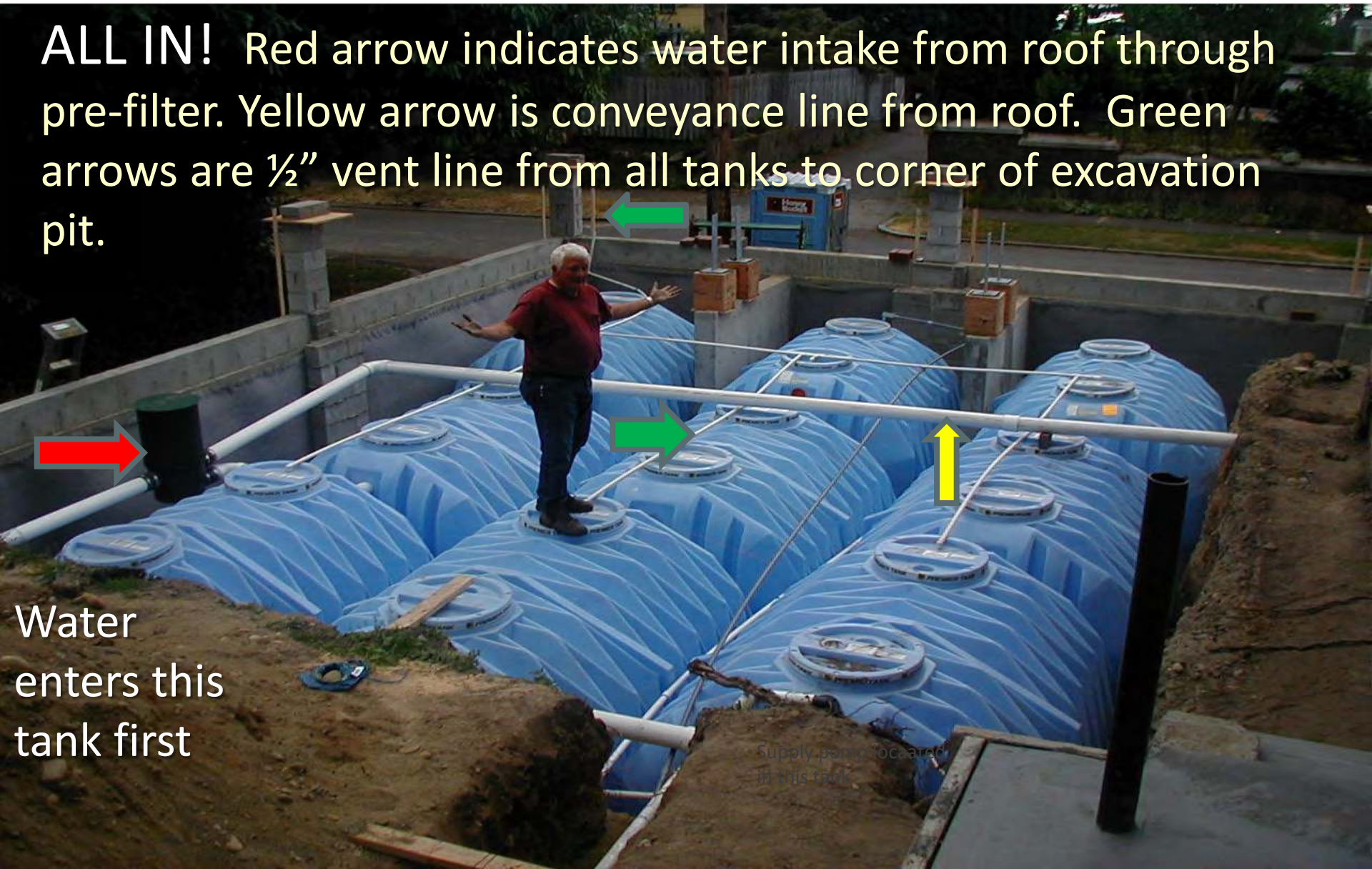
Above Ground Cable Prevented Movement by Hurricane Ike

Concrete Tank

Water storage in concrete while the top serves as a patio

Hiding the Tank

Hiding Those Tanks



Hiding Tanks - Same Location as Previous Slide

Finished installation under grass and patio is 14,400 gallons

Hiding the Tanks

Installation of Below Ground System

- Two 2,500 gallon Norwesco tanks
- WISY filter and Grunfos pump

Hiding Those Tanks

ARCSA
American Rainwater Catchment Systems Association

Rain Barrels

"Gateway Drug to Rainwater Harvesting"

Making a Rain Barrel

- Recycled food grade plastic containers, wine barrels, etc.
- Clean
- Supplies needed:
  - ¾” brass faucet with male threads
  - 1” paddle bit to drill hole
  - Silicone or Teflon tape to seal threads
  - If thin-walled barrel, add electric conduit nut on inside and tighten
- Drill hole about 4” from bottom, cover threads and screw in faucet and attach nut on inside if needed

Nicely painted barrel with small overflow but directed towards plants.

Other shapes and materials

Non-Traditional Tank Options

Watering trough substitute for rain barrel

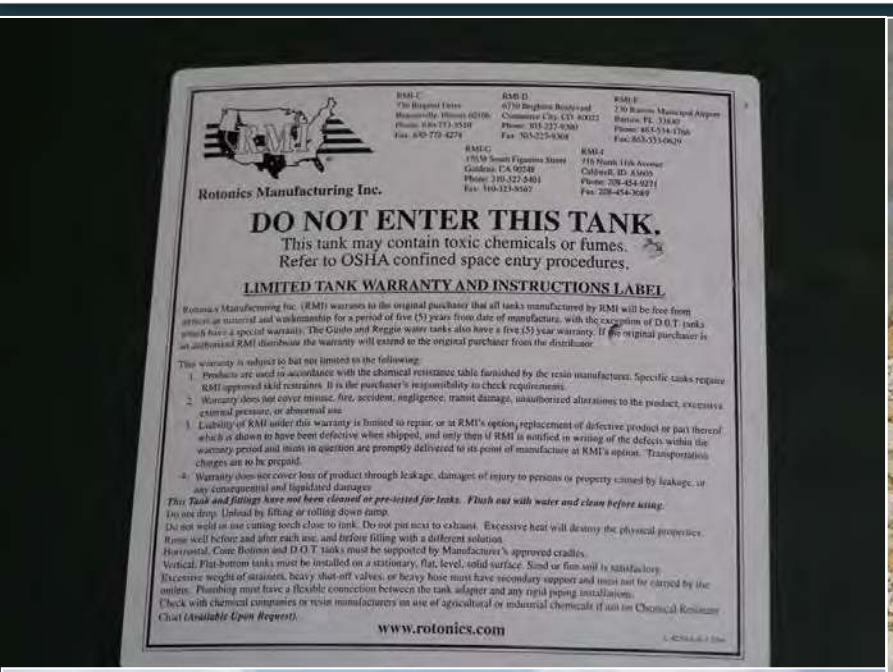
- Lower profile, yet more water

More Imagination!

Making the Most of Your Tank

Color of the tank affects the temperature of the water and the amount of algal growth

Precautions



Non-Potable Water Warning

Underground Tanks are Upwardly Buoyant

Buoyant force (lbs) = Volume of underground tank (cubic feet) X 62.4 pounds per cubic foot

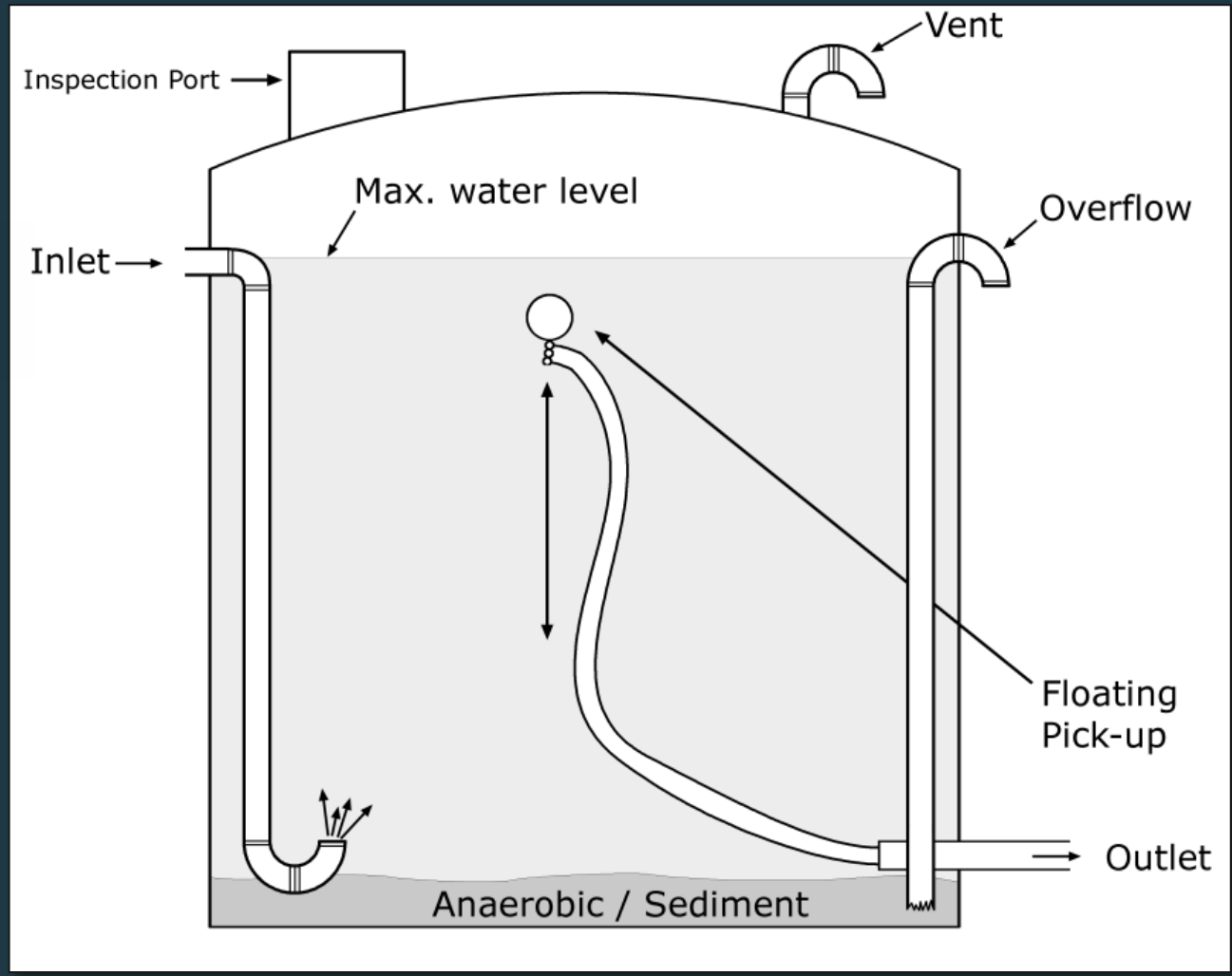
- 200 gallon tank divided by 7.5 gallons per cubic foot = 26.7 cubic feet
- 26.7 x 62.4 pounds/cubic feet = **1664.2 pounds of buoyant force**
- **Reinforced concrete weighs about 150 lbs/ft^3**

Additional Water Pressure

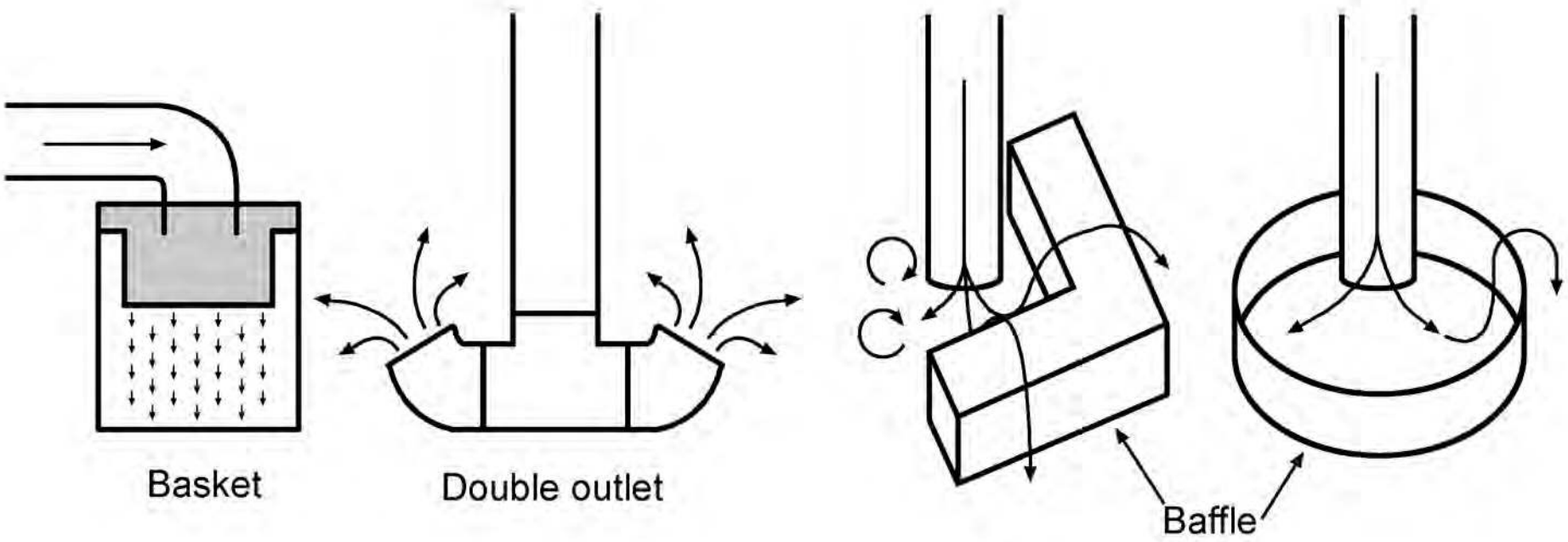
Water pressure = .434 pounds/column foot

Water Going In and Out of Tank

- Inlet – side or top or bottom
- Outlet - 4 inches from bottom
- Overflow - side near top
- Inspection port
- Vent



Types of Calming Inlets



Overflow Pipe

- Allows water out of the tank when full instead of backing up into the gutter
- Should be same size or larger coming out of tank than the inflow pipe
- Should be covered to prevent animals seeking water

Tank Water Level Gauges

Recommended Secondary Filtration, if Needed

1. Pass water through a 50 micron filter, and then through
2. Two 5 micron filters, and finally through a
3. UV (ultraviolet lamp) filter

Screen Out Mosquitoes and Trash

- Use window screening or other fine mesh to screen water
  - If open top, screen whole top
  - If with lid:
- Cut hole in the lid and screw down screen
- Cut 6” round hole in top, insert 1 gal planting pot with:
  - Screen glued into bottom
  - Rocks filling pot half way up
  - Insert thicker vent screen or something similar
  - Make sure overflow does no provide open water for mosquitoes
- Add mosquito dunks

Pumps and Pressure Tanks

Pumps

Centrifugal 230VAC

Submergible

Piston Pump 115 VAC

- May need intake screen
- May need to divert some water back to reservoir to cool pump (prevent deadhead)
- Consider pressure
  - Loose 1 psi for every 2.3 feet of head
  - Drip irrigation may require certain pressure (25 psi)

Resources

Healthy Lawns and Healthy Waters website: hlhw.tamu.edu

Texas A&M University website: http://rainwaterharvesting.tamu.edu

Texas Water Development Board website: https://www.twdb.texas.gov/innovativewater/rainwater

American Rainwater Catchment Systems Association website: www.arcsa.org

Be Sure To Use The Right Tools!

For additional information:
http://rainwaterharvesting.tamu.edu/