

A map of the state of Texas is shown in a dark red color. A white grid pattern is overlaid on the map, primarily covering the northern and central regions. The grid consists of small squares, with some lines curving to follow the state's irregular borders.

## **Rainscapes / Green Stormwater Infrastructure**

**Holistic Home Design for  
Water Harvesting and  
Conservation**

TEXAS A&M  
**AGRILIFE**  
EXTENSION



# Earth Ship – Taos, New Mexico









# Roof-Reliant Landscaping™

Rainwater Harvesting with Cistern Systems in New Mexico

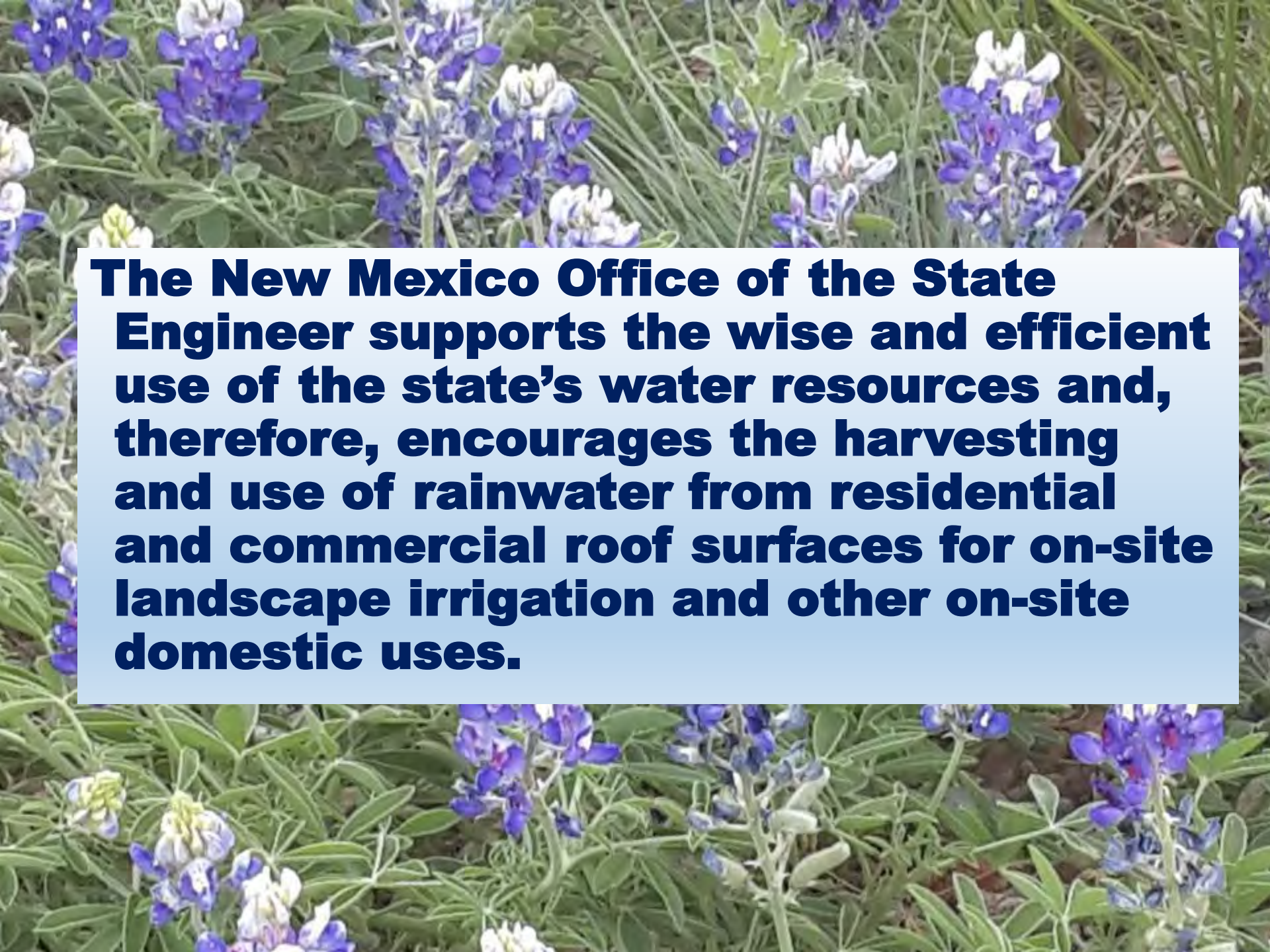


**New Mexico Office of the State Engineer**

1-800-WATER-NM • [www.ose.state.nm.us](http://www.ose.state.nm.us)

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A close-up photograph of a field of lupine flowers. The flowers are in various stages of bloom, with some showing vibrant purple petals and others being mostly white. The green leaves are visible between the flower stalks. The background is slightly blurred, emphasizing the foreground flowers.

**The New Mexico Office of the State Engineer supports the wise and efficient use of the state's water resources and, therefore, encourages the harvesting and use of rainwater from residential and commercial roof surfaces for on-site landscape irrigation and other on-site domestic uses.**









- Plan your landscape
- Do The Extra –  
**“Earth Matters”**

# Peeling back the pavement

**A Blueprint for Reinventing Rainwater Management  
in Canada's Communities**

**POLIS Project**

**Ecological Governance**

University of Victoria

Law Centre Environmental UNIVERSITY OF VICTORIA



## Three design principles are crucial for moving from a stormwater paradigm to a rainwater paradigm in our urban communities:

- **1. Reduce the amount of impermeable surfaces** by changing the way we build and retrofit our communities
- **2. Use rain as a resource** and as a viable decentralized source of water for non-potable needs
- **3. Integrate decision making on a watershed scale** – We all live in a watershed

**“The nation behaves well if it treats the natural resources as assets which it must turn over to the next generation increased and not impaired in value.” *Teddy Roosevelt***



# Thomas Jefferson's RWH at Monticello 4- 3,830 gallon cisterns



Because of periodic shortages of water, Mr. Jefferson installed four cisterns. They were placed at strategic points to collect rainwater from the roof and walkways. Each held 3,830 gallons.

The Bullitt Foundation's Bullitt Center  
.... including **net zero energy, waste and water**  
..... a - 56,000-gallon basement cistern.





- "There is not going to be enough water in the future,"
- The solution? Build thousands of reservoirs in the basements (incorporated in the design) of buildings, sufficient to hold water to meet the needs of the current and future residents of a city

# Abilene Christian University McDaniel Lab Landscaping in February 2015



# Traditional vs ACU Ag & Environmental Science Dept. Landscaping





# Rainwater Harvesting





# No Gutters – No Problems



# Keyhole Garden

















***“That land is a community is the basic concept of ecology, but that land is to be loved and respected is an extension of ethics.” – Aldo Leopold***



The Cheapest Water  
You Will Ever Have Is  
The Water You  
Already Have!



I oppose  
the  
San Antone  
hose!

Extension Service cooperation with Texas Parks and Wildlife will co-sponsor a Chronic Wasting Disease Program on Monday, October 26th at the St. James Lutheran Church-Scholarship Hall, located at 1401 First St. in Llano. Registration is at 5:30 p.m. with the program starting promptly at 6:00 p.m.

"Chronic Wasting Disease is a condition that affects the nervous system of deer, elk, and moose," said Dr. John Tomczak, Texas A&M AgriLife Extension Service Wildlife Specialist at San Angelo and one of the evening presenters. "It is critical to diseases such as scrapie in sheep and goats and bovine spongiform encephalitis in sheep, goats, cattle or humans."

The disease was first detected in 1967 in a captive study deer herd in Colorado. Since then, it has been detected in 22 U.S. states and 2 Canadian provinces. The disease was detected in the west Texas in 2012, which was the first instance in the state, until the Mason County confirmation earlier this summer.

Attendees will learn all about Chronic Wasting Disease from the history to clinical signs to prevention techniques. Whether you are a landowner, hunter or deer enthusiast, this program is one to speak conversation.

Speakers include Dr. John

Wildlife Disease Director from the Texas Parks and Wildlife Department.

To plan accordingly, please

Texas A&M AgriLife Extension Service are open to all people without regard to race, color, religion, sex, national origin, age,

Keep Up With Friends & Family In The  
Mason County News

Wildlife Disease Director from the Texas Parks and Wildlife Department.

To plan accordingly, please

Texas A&M AgriLife Extension Service are open to all people without regard to race, color, religion, sex, national origin, age,

Keep Up With Friends & Family In The  
Mason County News

**Monster wind towers  
and transmission  
towers are horrible.  
They stab at our  
souls and stab our  
beautiful land.**

Concerned Mason County Ranchers and Naturalists



**I THINK I'LL STOP  
EATING PECANS!!**

*Jamie Smith Jackson*  
A Good Friend of the San Saba River



# Water is life

- Two methods to sustain water supply:
  - Increase Supply
  - Reduce Demand



# Nature's First Rain Catchers



Perennial  
Native  
Grasses

Annual  
Grasses





Big Bluestem,  
Indian grass and  
Compass Plant



# Compass Plant and Missouri Goldenrod



# Indian grass roots Switchgrass



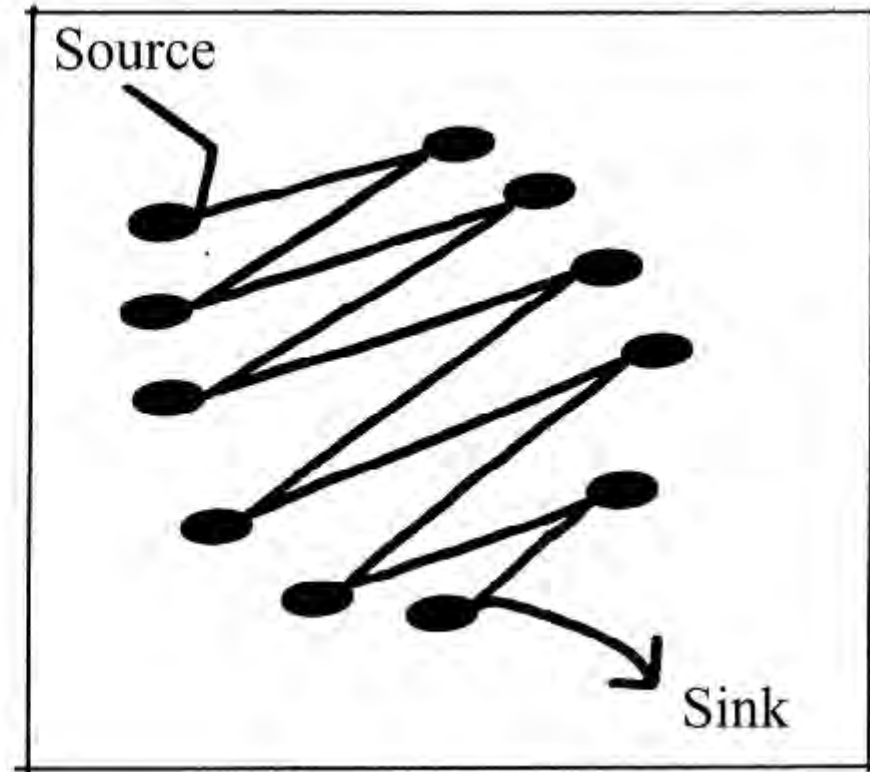
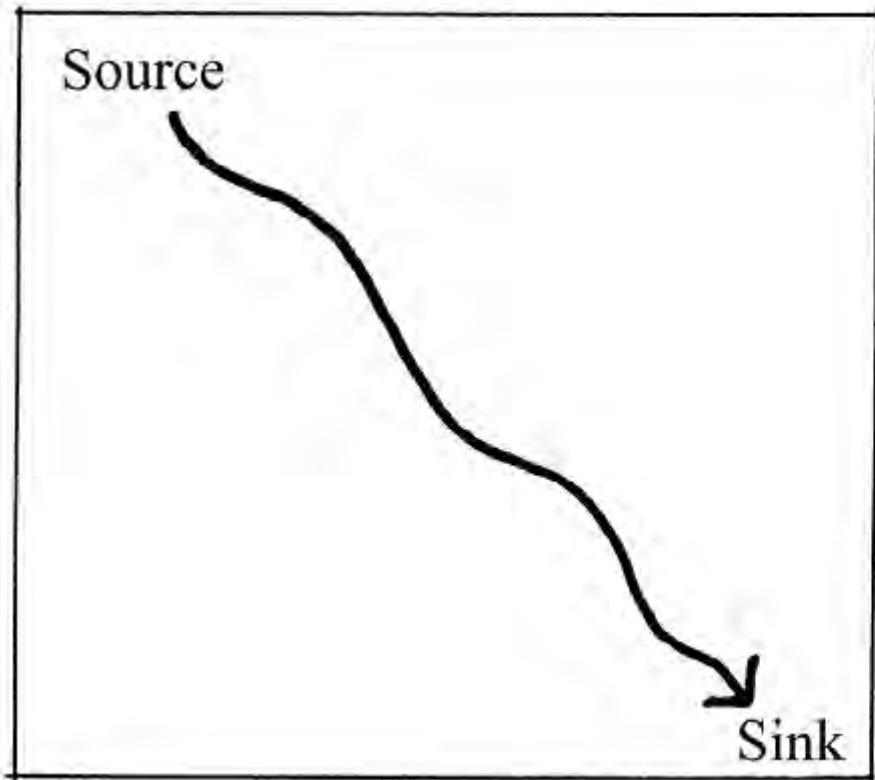
# Forbs - **Antelopehorn**

(Trailing Milkweed)





Make water take the Long Way to the river



Make water take the L o n g W a y to the river



# Tucson Like You Expect



# Tucson ten years later



# Rain Gardens and Pocket Prairies





# Soil Storage Infiltration Systems: Vegetated Infiltration Strip



# Soil Storage Infiltration Systems:

## Vegetated Infiltration Strip







JUNCTION MIDDLE SCHOOL

**JUNCTION  
MIDDLE SCHOOL**  
WE LOVE OUR EAGLES  
GO BLACK  
NOV 26-28 HOLIDAY

66C-NW4

Three students walking on the stone-paved area in front of the building.



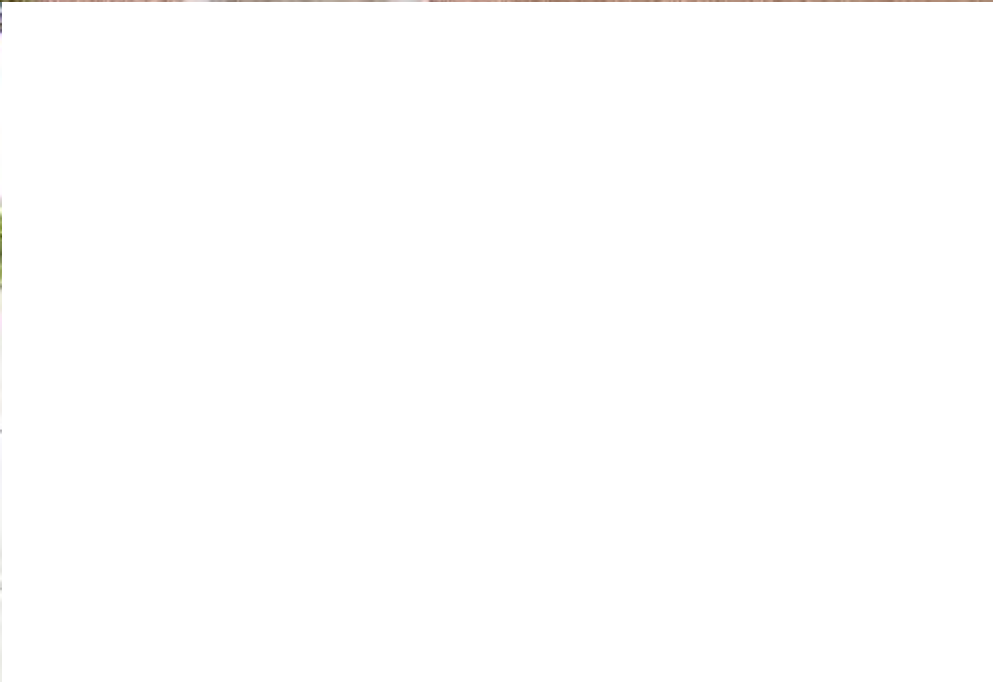
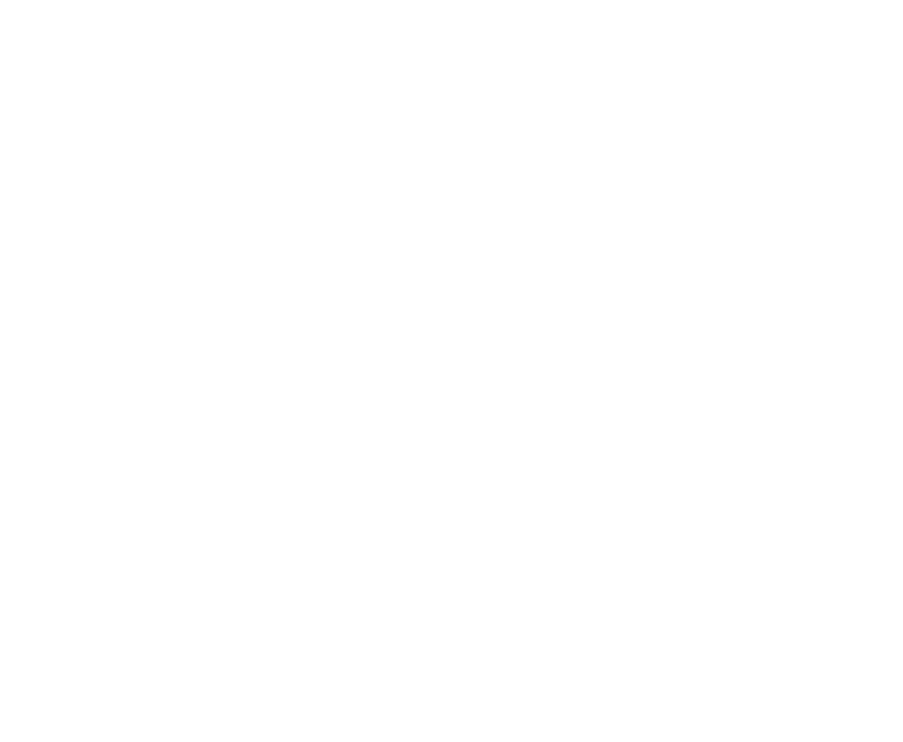
OPAL B. ROBERTS

LANDSCAPE  
OF  
HOPES AND DREAMS

FOR  
CONSERVATION  
AWARENESS









MARJORIE RUSSELL EDUCATIONAL GARDEN



IN MEMORY OF MARJORIE MAE RUSSELL, THE EDUCATIONAL GARDEN WAS DESIGNED WITH MANY OF HER INTERESTS IN MIND. SHE BELIEVED IN IMPROVING EDUCATIONAL OPPORTUNITIES FOR PEOPLE OF ALL AGES. SHE WAS A RANCHER, EDUCATOR AND AN IMPORTANT PART OF THE METARD LIBRARY CLUB. THOUGH SHE LOVED TO TRAVEL EXTENSIVELY, HER FAVORITE PLACE WAS METARD. IT IS HER FAMILY'S HOPE THAT THIS GARDEN IS ENJOYED BY THE COMMUNITY THAT MARJORIE LOVED SO MUCH. THE RUSSELL FAMILY IS GRATEFUL FOR ALL OF THE VOLUNTEERS AND CONTRIBUTORS BUT ESPECIALLY GRATEFUL TO THE LIBRARY CLUB, THE COUNTY OF METARD, "METARD MORNING GLORES" (JUNIOR MASTER GARDENERS), BILLY AND MARY KNIFLEN.

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Kevin Menard  
10/20/21  
10/20/21



















**Pocket Prairie**













**1000 gallon tank**







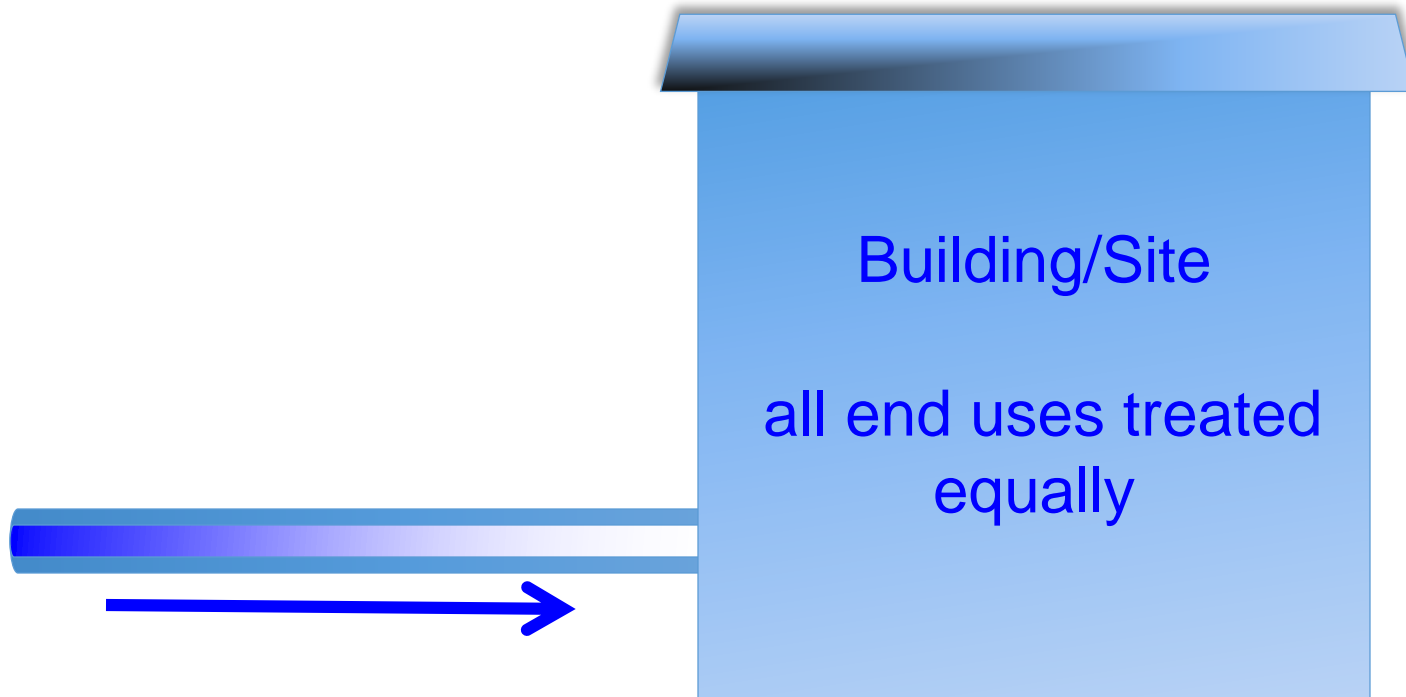








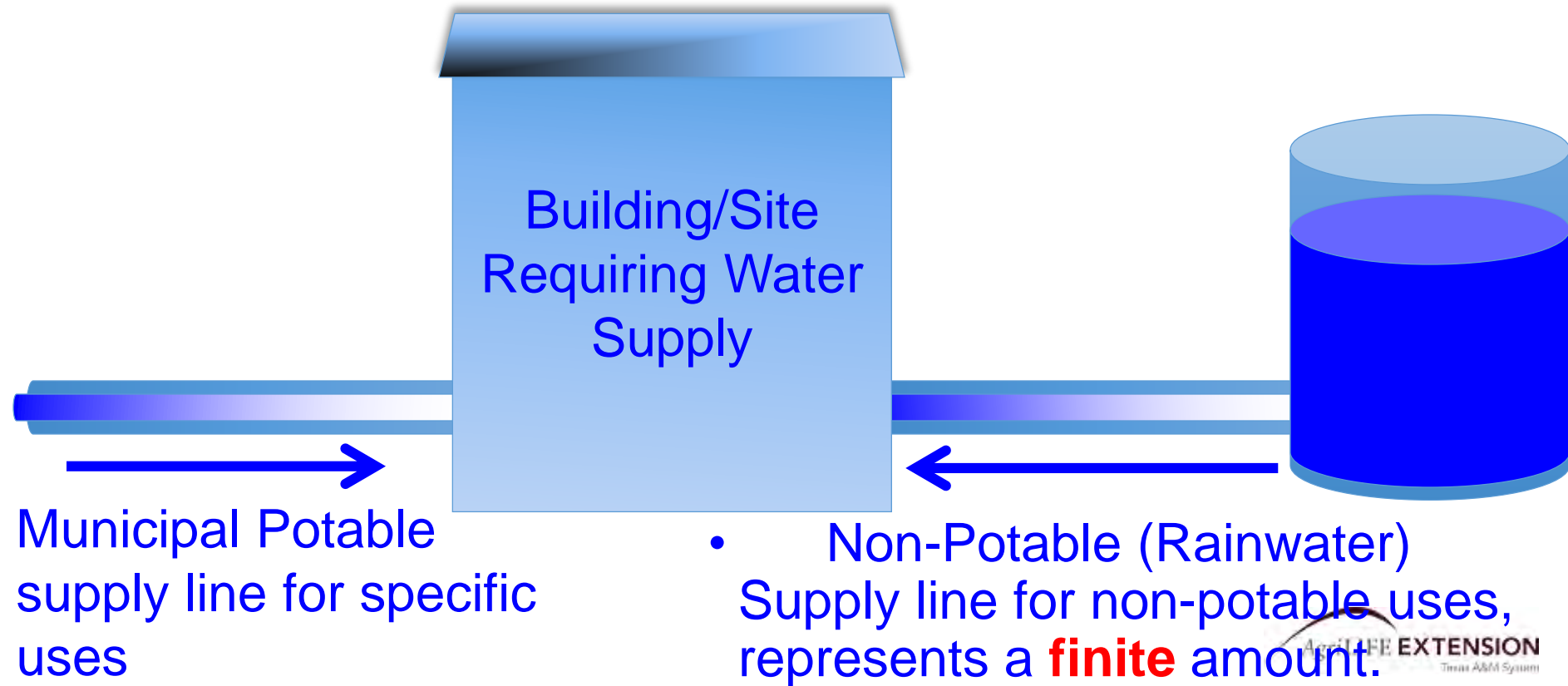
# Current Water Supply Paradigm



Municipal, Well or Other Supply Line represents an **unlimited** supply of Potable water for all end uses.

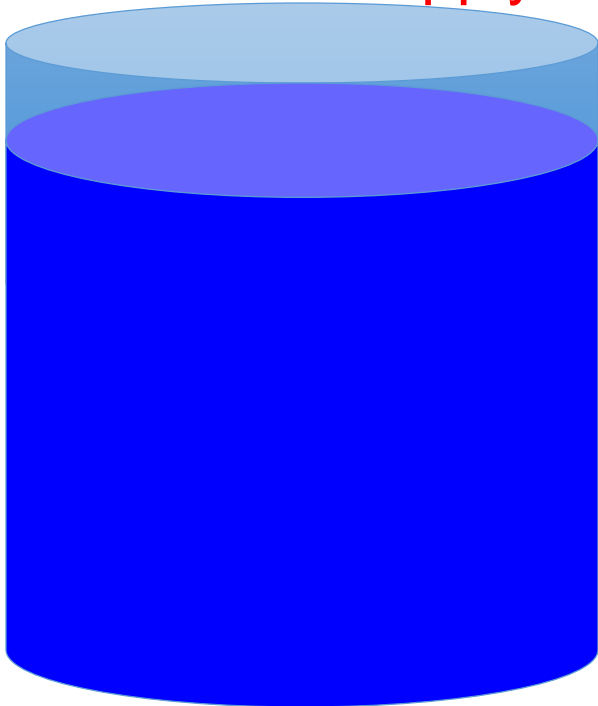


# New Water Supply Paradigm.



# Three approaches to rainwater/stormwater management

Cistern managed for water supply



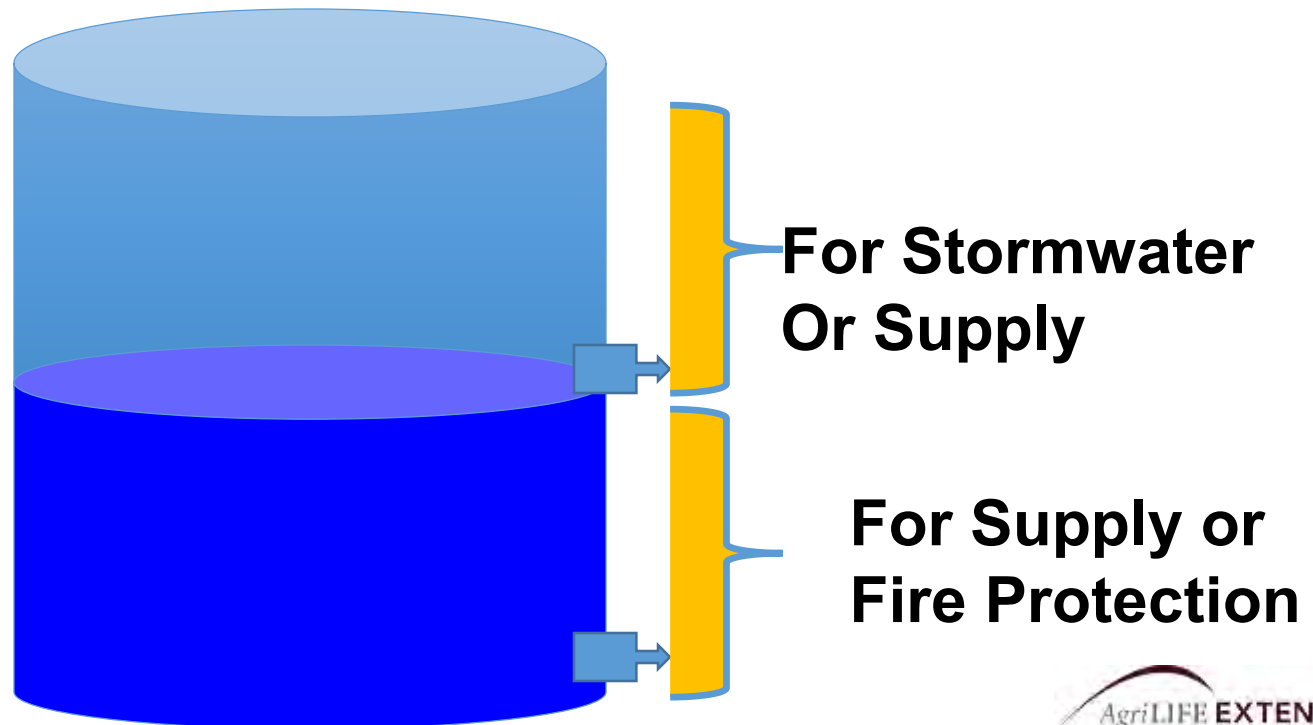
Cistern managed for stormwater control



**AND**



Cistern managed for BOTH water supply  
and managed for stormwater control or fire protection

























# How Big Does The Roof Need To Be?



**5' diameter**

**Pi times radius squared**

**$3.14 \times 2.5 \times 2.5 = 20$  square feet**

**$20 \times .6 = 12$  gallons per 1" rain**

**4" = Full Tank**

**20 inches = Filled 5 times/yr**



**Filled 10 Times!**



15 Times - Rain Saucers



To use the calculator fill in all highlighted input values.

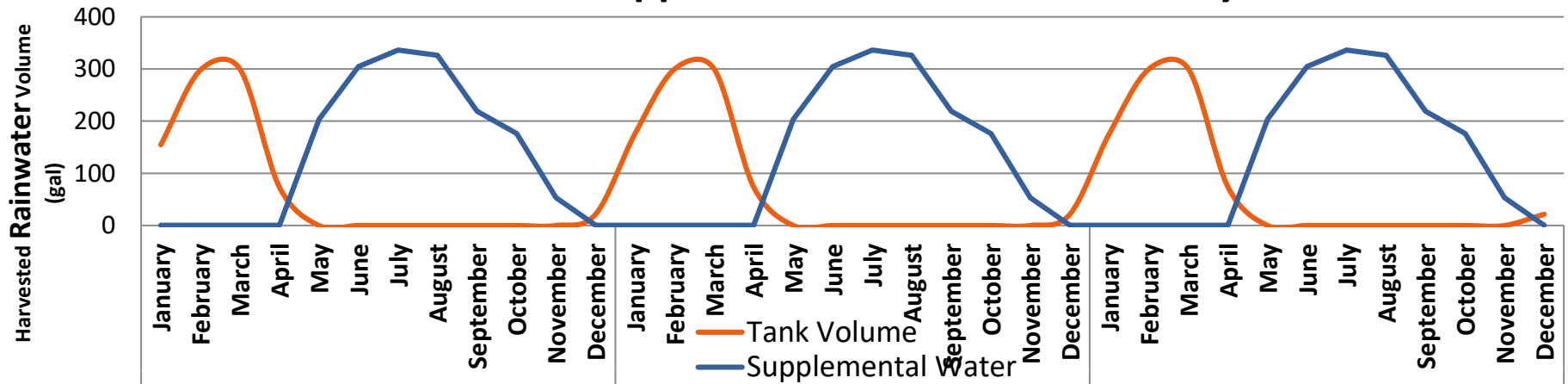
<http://rainwaterharvesting.tamu.edu>

Input Values	
Catchment area (ft <sup>2</sup> )	150
Collection efficiency (%)	95
Initial tank volume (gal)	0
Tank size (gal)	300
Plant water use coeff.	1
Irrigated area (ft <sup>2</sup> )	100
Monthly indoor demand (gal)	0

	Avg. monthly rainfall (in)	Avg. PET (in)	AC Condensate (gal)
January	3	1.79	0
February	3.1	2.12	0
March	2.4	3.3	0
April	0.6	4.49	0
May	0.2	4.73	0
June	0.1	5.03	0
July	0	5.4	0
August	0.1	5.38	0
September	0.3	3.94	0
October	0.4	3.4	0
November	1.1	2.45	0
December	1.9	2.23	0
Total	13.1	44.22	0

Yearly Percent Average Rainfall (%)	
Year 1	100%
Year 2	100%
Year 3	100%

### Tank Volume and Supplemental Water Needs for 3 years



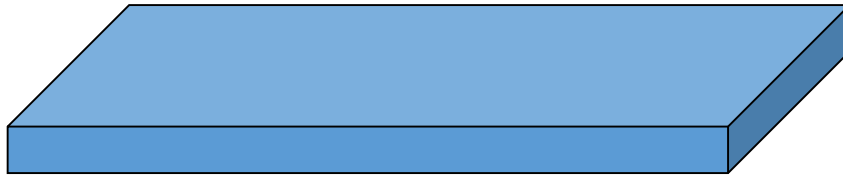
# Rain Intensity



- Plumbing Code on intensity
  - Affects gutter size
  - Affects downspout size
  - Affects conveyance size
- Quillayute Wa. – 101.7” annually // max - 1”/hr
- **New Orleans – 64”/yr 4.5”/hr or 0.047 g/m/ft<sup>2</sup>**
- **El Paso – 9”/yr 2.0”/hr or 0.021 g/m/ft<sup>2</sup>**

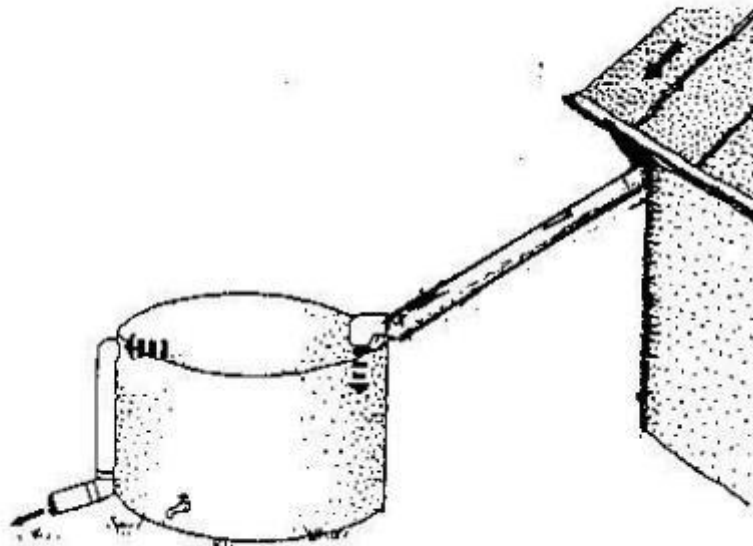
# Rain Intensity – Texas – 2-4.5”/Hour

- ▶ 4.2” per hour
- ▶ 0.044 Gallons per minute per square foot



- ▶ 2000 sq' x 0.044 = 88 gallons/minute
- ▶ Affects:
  - ▶ Gutter size,
  - ▶ Number and size of downspouts
  - ▶ Size of conveyance piping

- Rain intensity – 4.2”/hour or **0.044 g/m/sq’**
- Roof area – **2,000** square feet
- **2,000 x 0.044 = 88 g/m**



# Sizing Gutters

**1/16" slope/ft. and 4" per hour**

4" gutter – 360 sq'

5" gutter – 625 sq'

6" gutter – 960 sq'

For 1,000 square foot roof

Need 2 - 5"downspouts

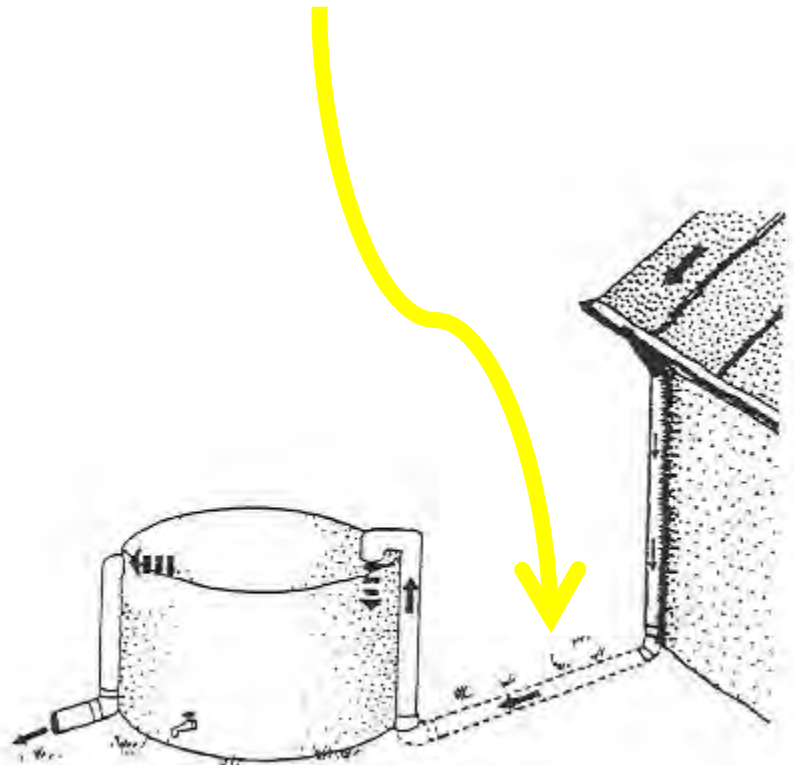
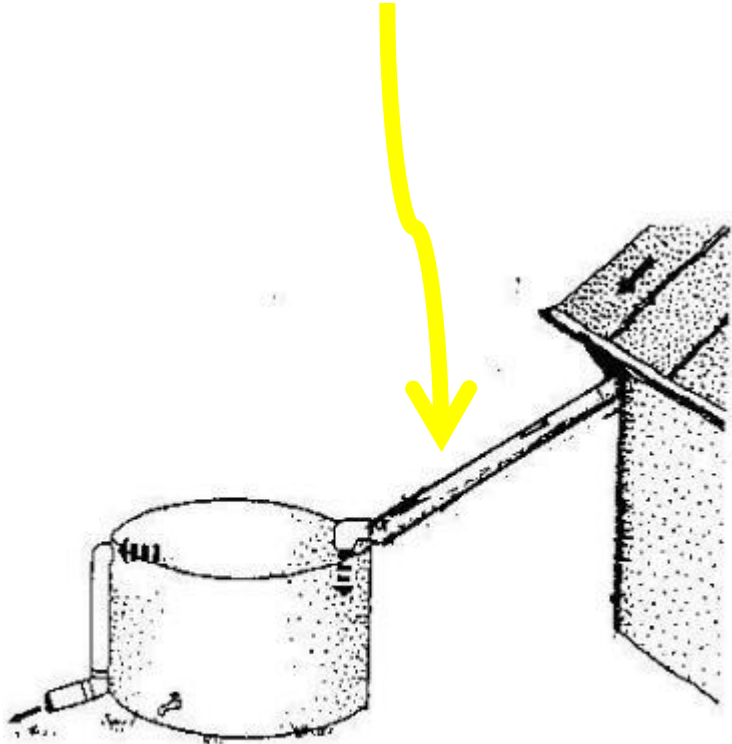
# Vertical Piping/Downspouts

- 2" – 23 gpm 1,088 sq' roof
- 3" – 67 gpm 3,220 sq' roof
- **4" – 144 gpm 6,920 sq' roof**

# Conveyance Piping Sizing: Horizontal Pipe

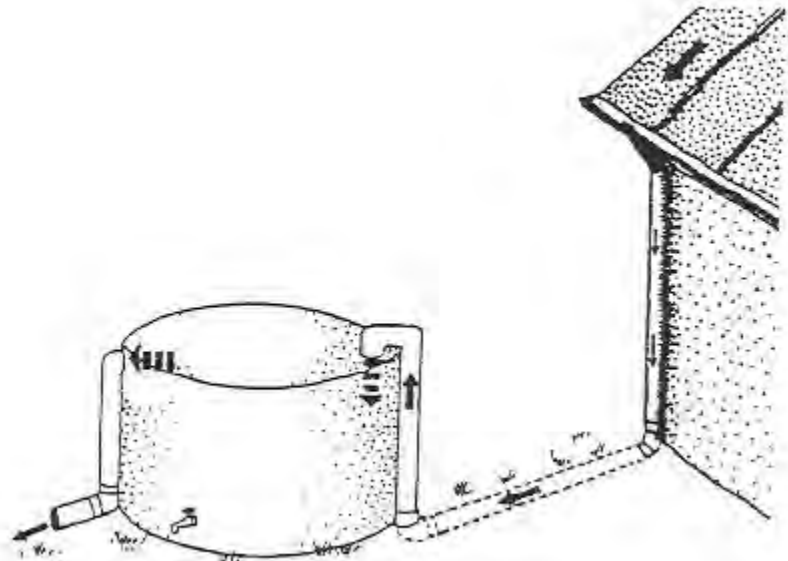
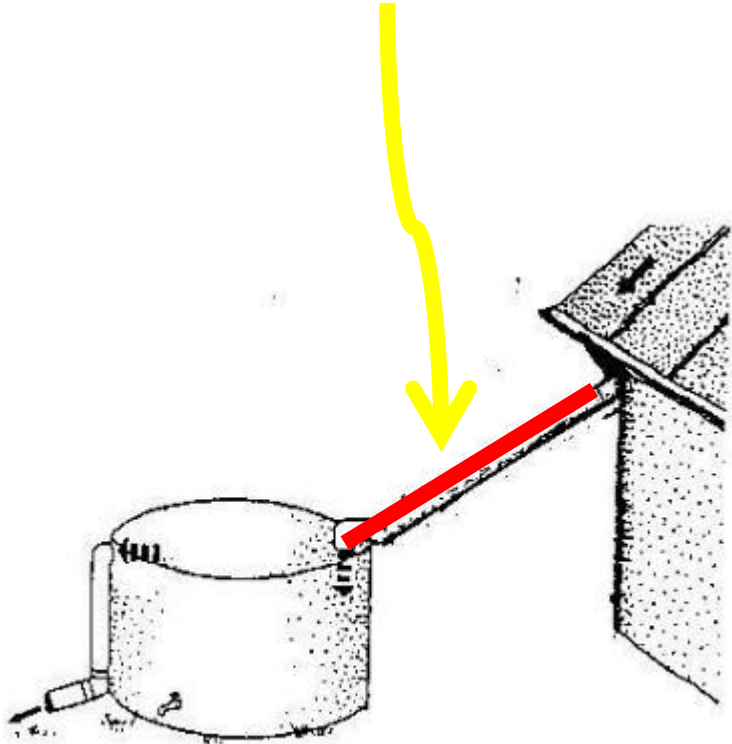
Size of Pipe	1/8"/ft. slope gpm	1"/hr	2"/hr	3"/hr	4"/hr	6"/hr
3"	<b>34</b>	3288	1644	1096	822	548
<b>4</b>	<b>78</b>	7520	3760	2506	<b>1880</b>	1253
5	<b>139</b>	13360	6680	4453	3340	2227
6	<b>222</b>	21400	10700	7133	5350	3566
8	<b>478</b>	46000	23000	15330	11500	7670

# Dry Line vs. Wet Line

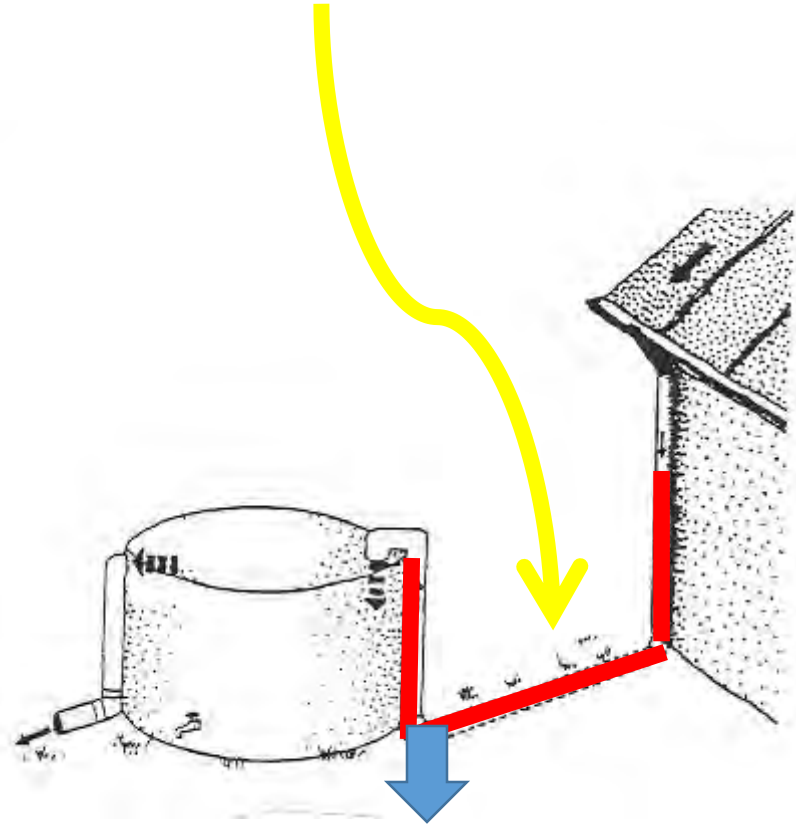
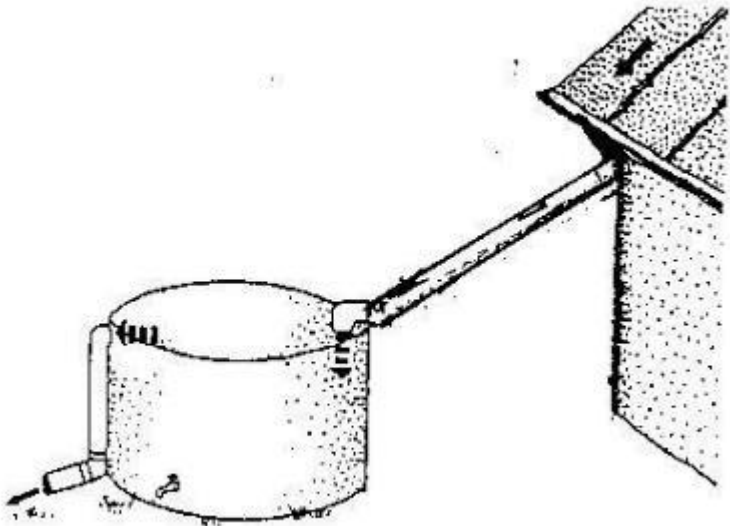




# Dry Line vs. Wet Line

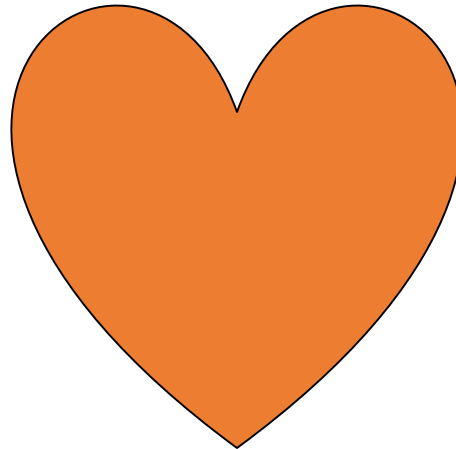


# Dry Line vs. Wet Line



# Heart of the System

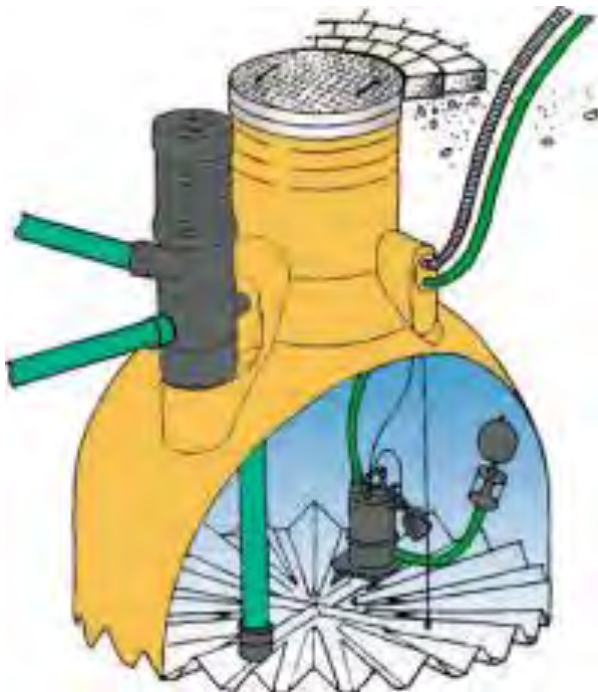
**Gutters and downspout systems leading to the cistern fitted with debris extruder or equivalent device.**









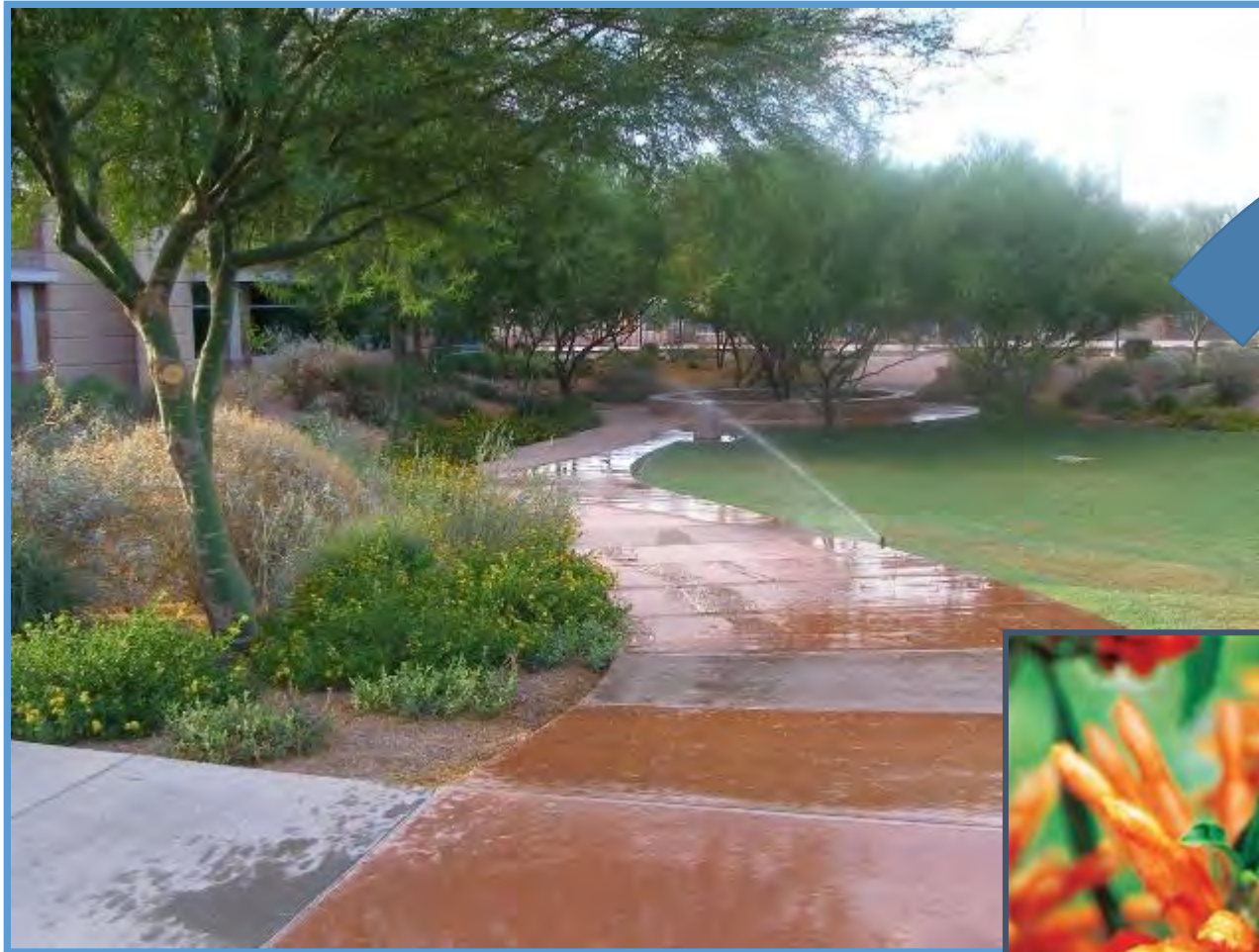


# Drip Irrigation





# This Will Not Work Sprinklers



# Types of Drip Irrigation







# Green Houses

## Water Features





















# Our Home and Barn

5000 sq. foot of roof (1700 square feet inside)

5000 x .6 gallons/foot =  
3,000 gallons of water per 1" rain





# Urban Pocket Garden?

















# Landscaping for Rainwater Capture





# Water Usage Inside and Outside

- 19 gallons per person inside the home
- 1,140 gallons per month
- $13,870 / 3,000 = 4.62''$  per year
- Use for May – September (5 months) 44 gallons/day  $44 \times 30 = 1320$  g./month
- $1320 \times 5 = 6,600$  gallons
- $6,600 + 13,870 = 20,470$
- $20,470 / 3,000 = 6.82$  inches per year









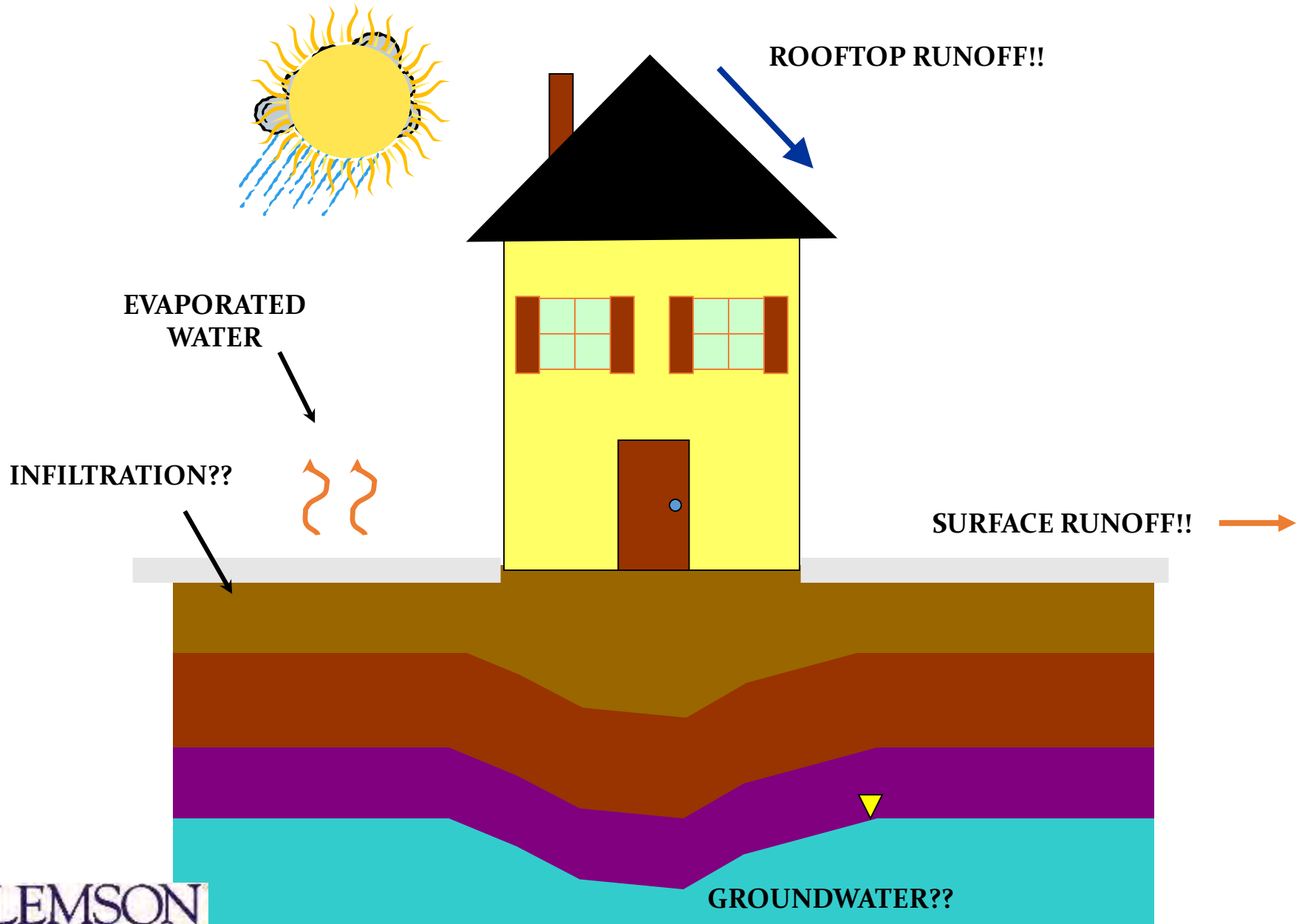


# Santa Fe County Ordinance

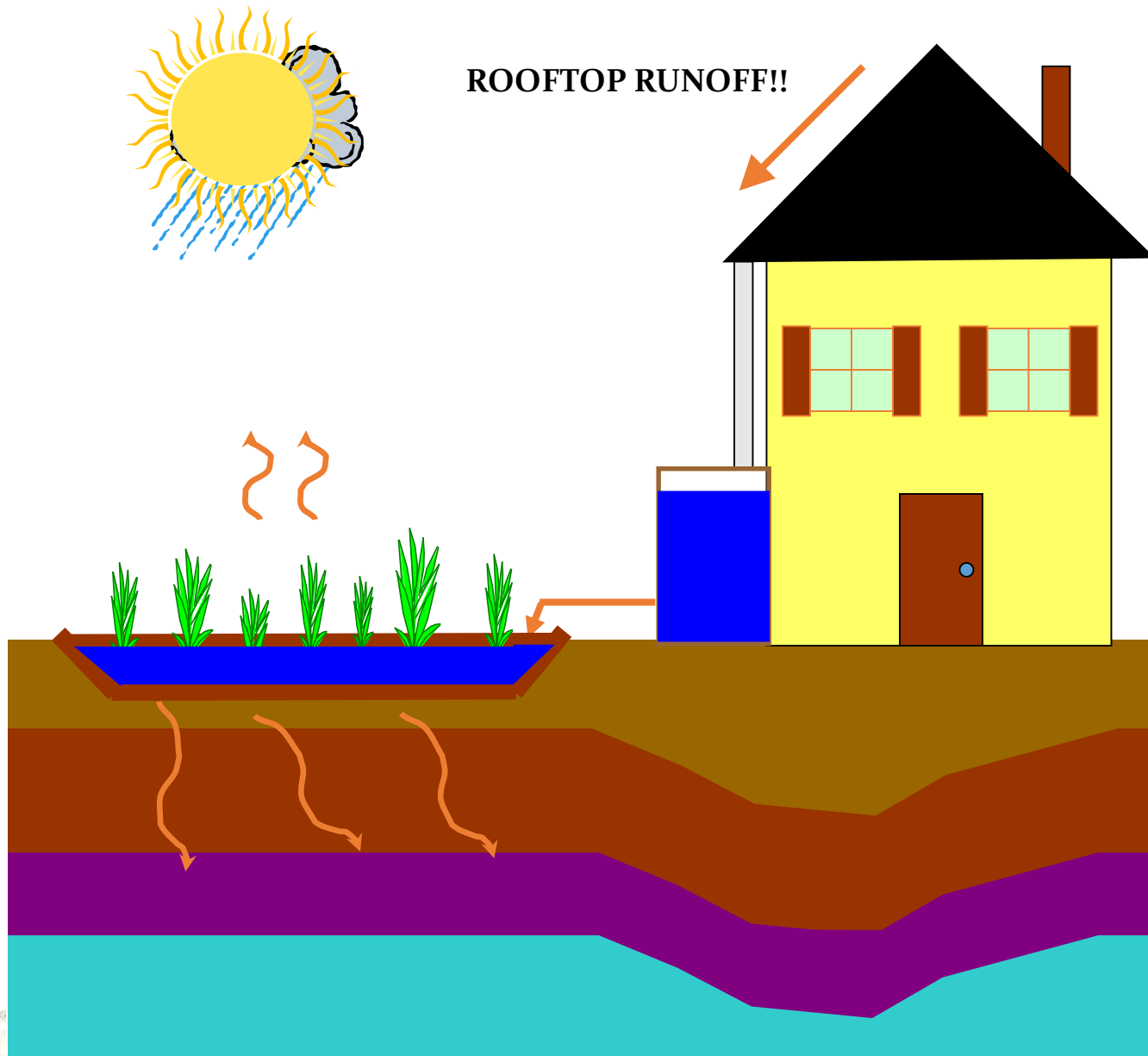
- Laws & Regulations

**Santa Fe County, New Mexico, was the first municipality in the United States to create an ordinance requiring any new structure, 2500 heated s.f. or more, to have a rain harvesting system.** This ordinance applies to both commercial and residential projects, with commercial projects requiring a higher percentage of total capture as well as larger storage reservoirs.

# Urban Water Budget – Pavement and Rooftop Scenario



# Urban Water Budget – Rainwater Harvesting Scenario



## Resources

- **ARCOSA website** [www.arcosa.org](http://www.arcosa.org)
- **Texas A&M University**  
<http://rainwaterharvesting.tamu.edu>



Thank You - Billy Kniffen

